Dam Removal: To be Dammed or Not to be Dammed

Presented By:

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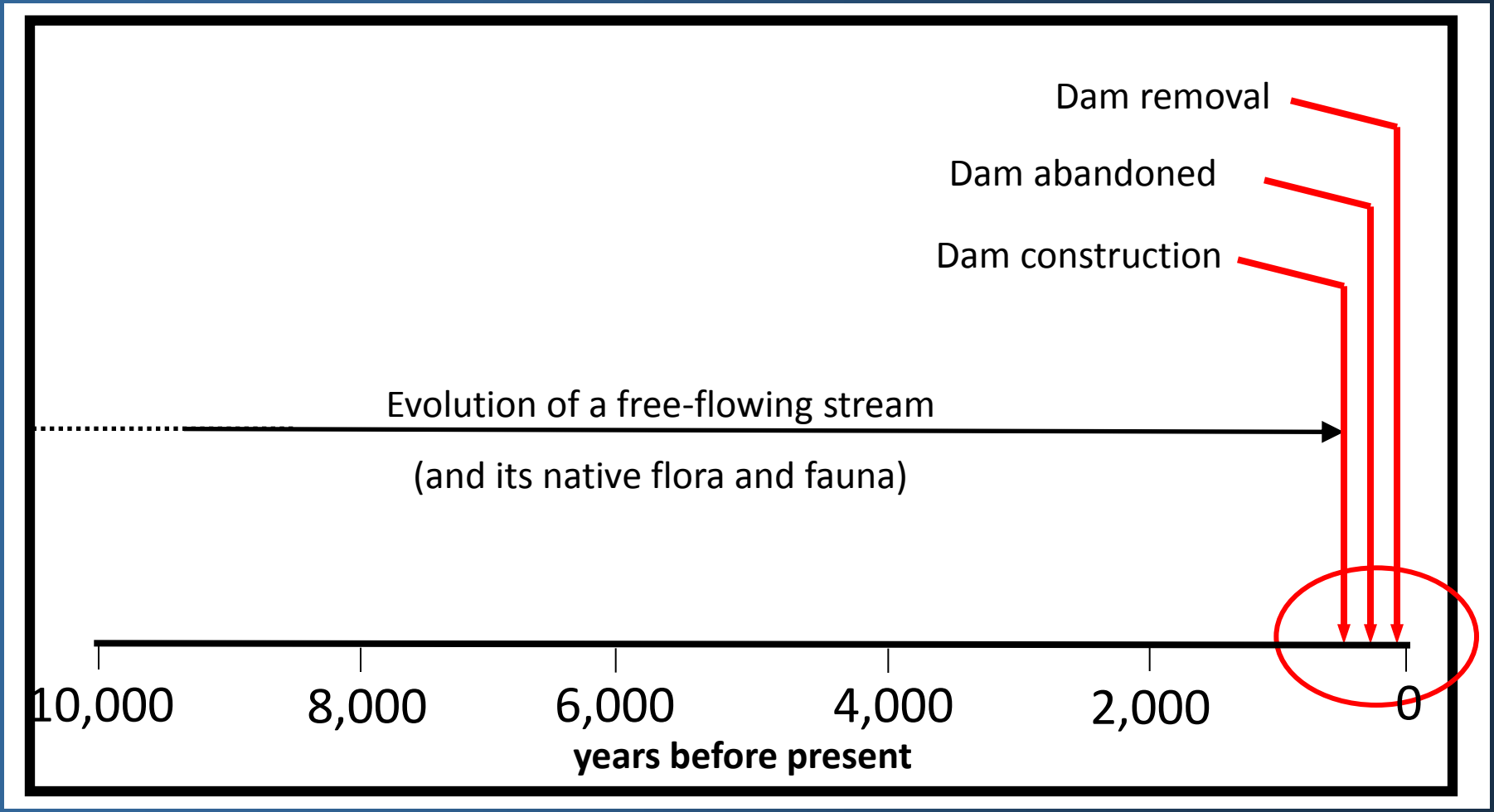
Talk Summary

- Building a dam is large scale disturbance of a river system
- The dam then requires active maintenance to maintain the impoundment or wetlands created (i.e. economic viability)
- The dam impoundment is constantly infilling and transitioning
- Removing a dam is also a disturbance
- But dam removal allows for partial or full restoration of natural processes
- And leads the system back to a self-sustaining system

A Long History

Evolution of the Free-flowing River vs. Evolution of the Impoundment



Source: Mark Carabetta

Early Dams, Dam Removals & Other Fixes

Elijah Boardman, future Senator, lead angry citizens to remove a dam in New Milford on the Housatonic River by force in 1799, convinced the dam was causing the repeated fever outbreaks in town. (*Gordon & Raber)*

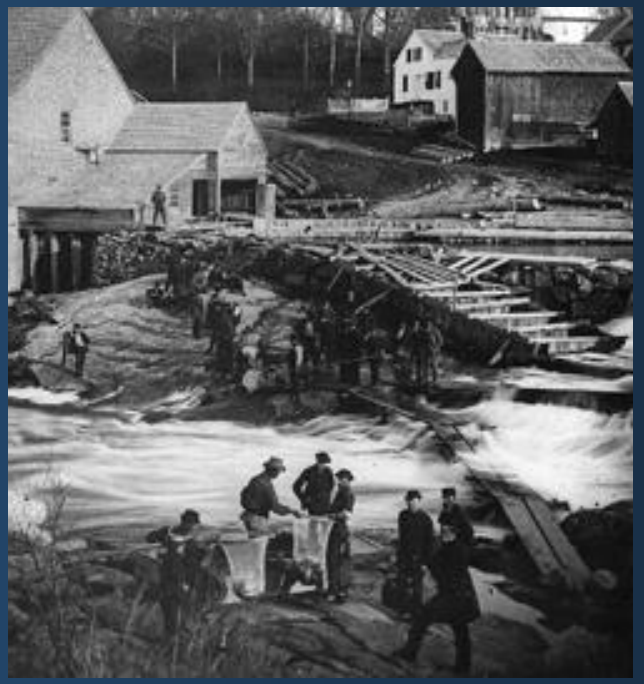
Seasonal Openings

Early Colonial Dams Used for Dams:

- Milling
- Farming
- Navigation

Some Reason Dams were Removed:

- Dam flooded property
- Dam blocked fish runs
- Make way for a new dam
- Eliminate liability & repair cost
- Because the dam no longer served a purpose



Medomak River in Waldoboro ME
1874 - fishway in center

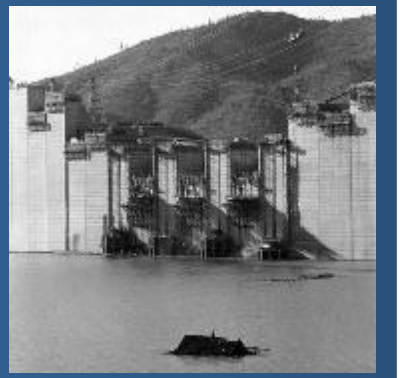
Photo: Courtesy Maine State Museum

The Conflict Between Dams and Rivers Begins When We First Build a Dam

In New England:

Farmers: public rights to fisheries and property rights relating to flooded land

Colonial fish weir

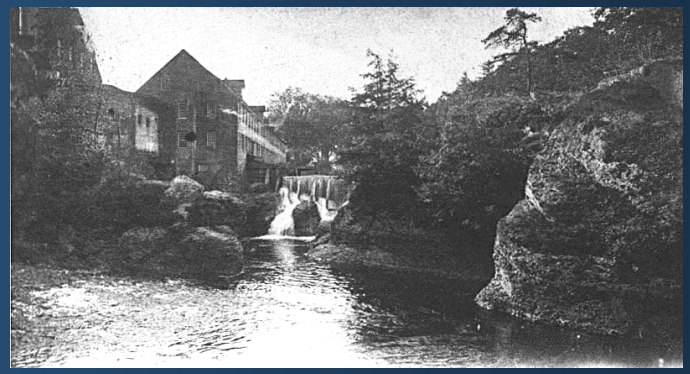


Shasta Dam rises; house submerged

"Herring Run" Artist: Robi Smith

Dam Owners: economic individualism and the start of the Industrial Revolution

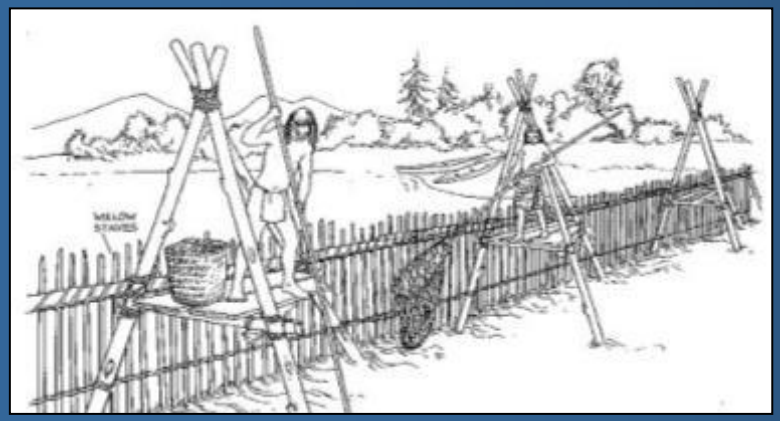
Mill dams in Lowell, MA on the Merrimack River

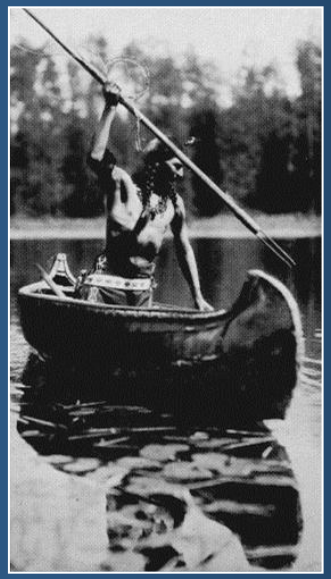


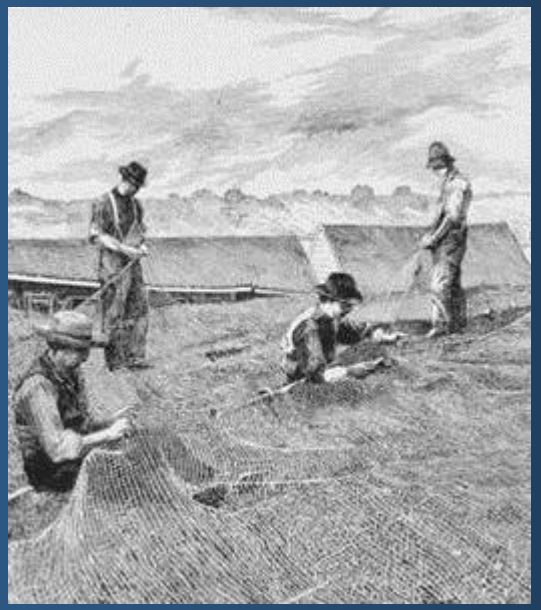
The Upper Falls - Charles River - Newton, MA
Algonquian tribe's "favorite fishing grounds" with fish weirs from bank to bank. Dam built in 1688

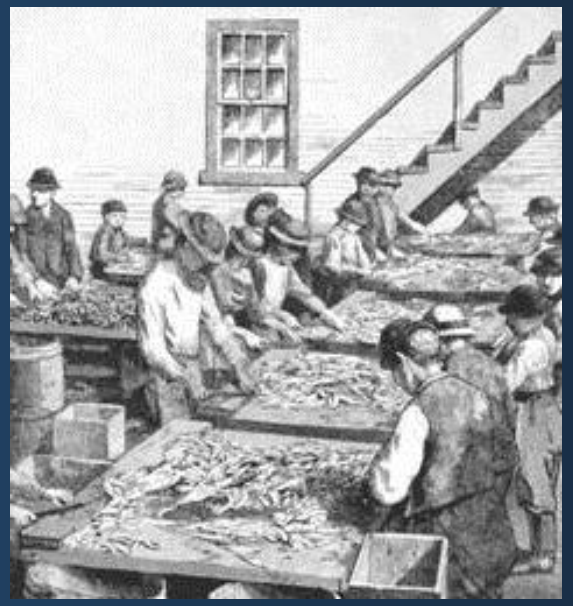
Rivers: A Public Trust

A resource preserved for public use



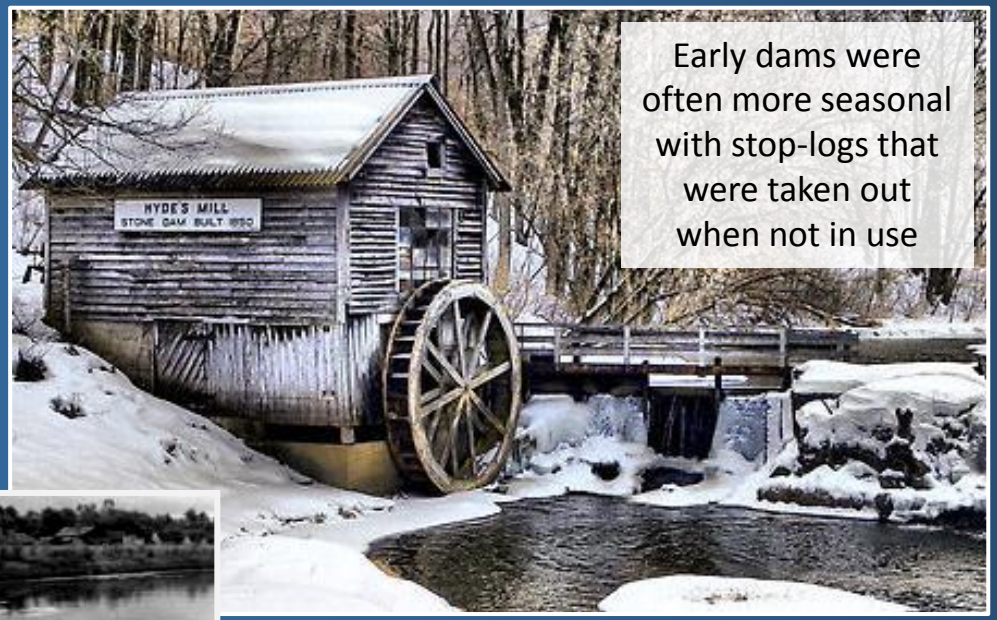






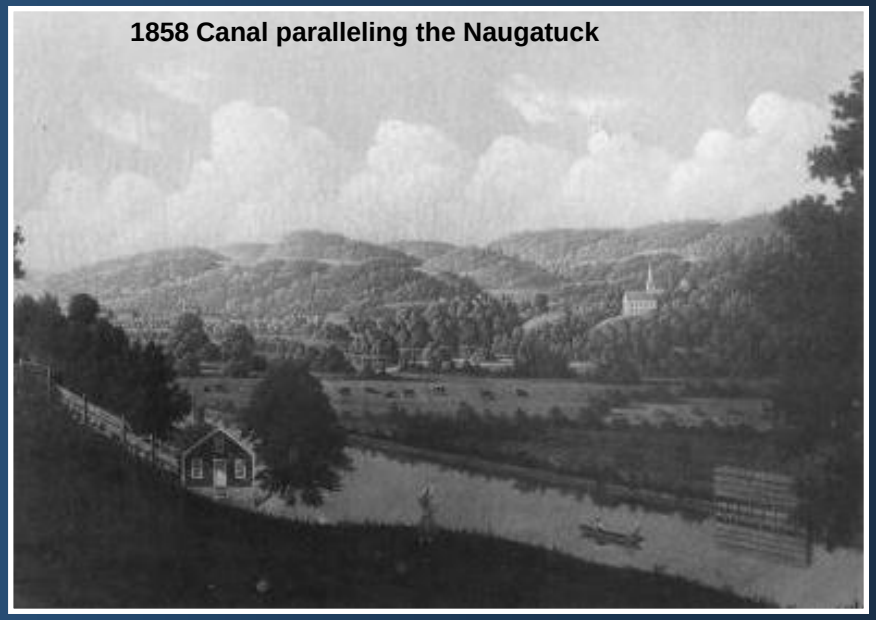
The Dam Building Era

Economic Individualism and the Industrial Revolution



Early dams were often more seasonal with stop-logs that were taken out when not in use

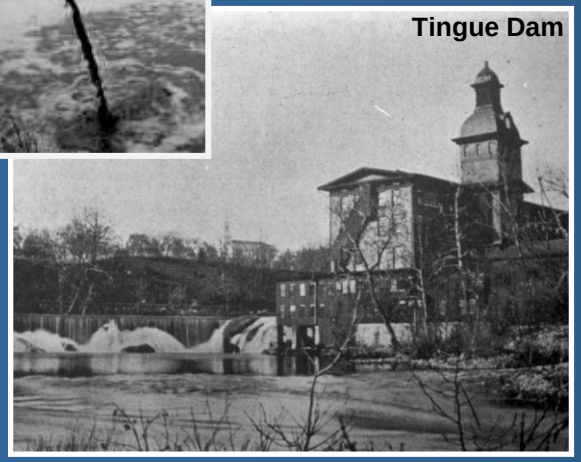
Mill – Mechanical Power



1858 Canal paralleling the Naugatuck

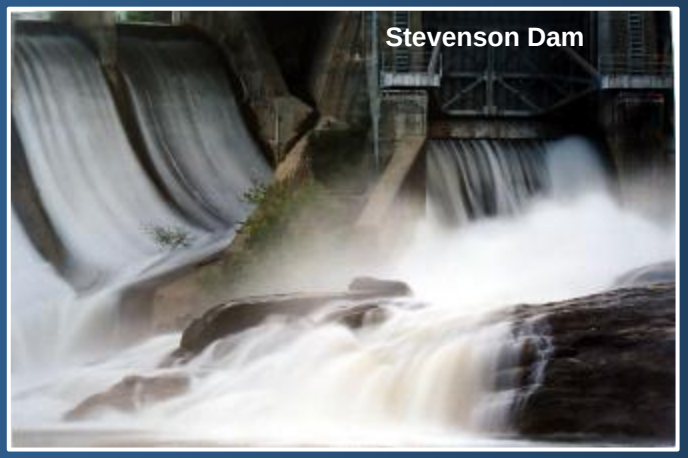
Diversion & Navigation Canals

Industrial Sewer



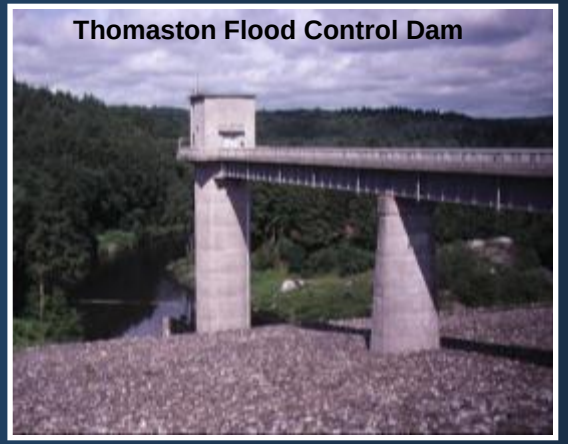
Tingue Dam

Industrial



Stevenson Dam

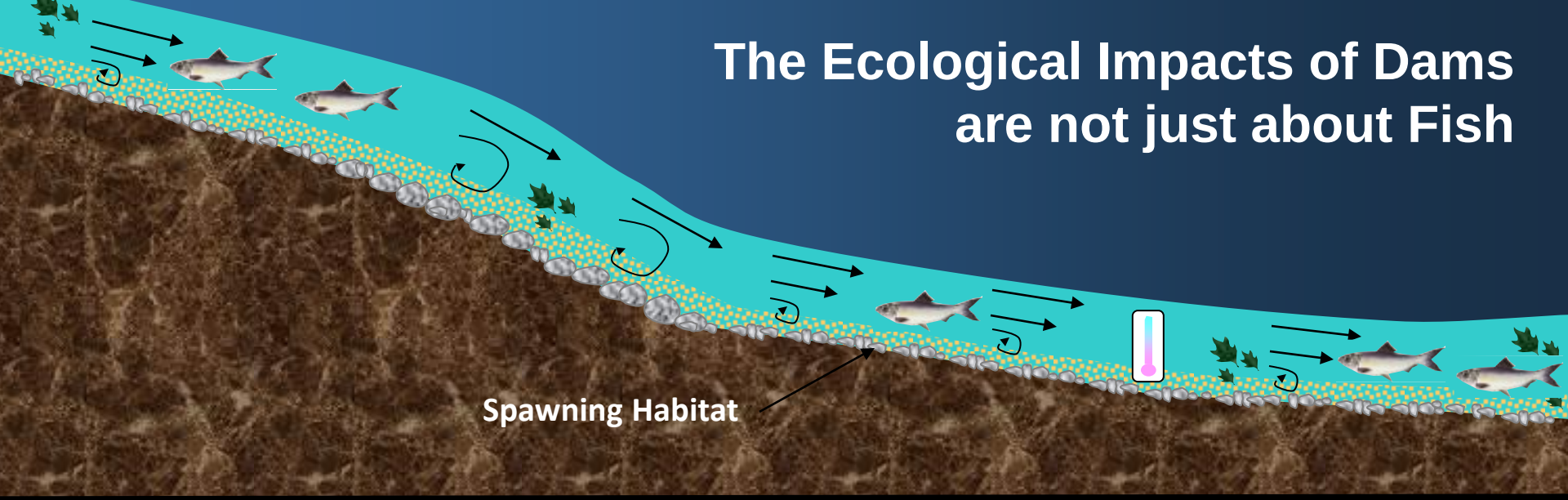
Hydroelectric



Thomaston Flood Control Dam

Flood Control

The Ecological Impacts of Dams are not just about Fish



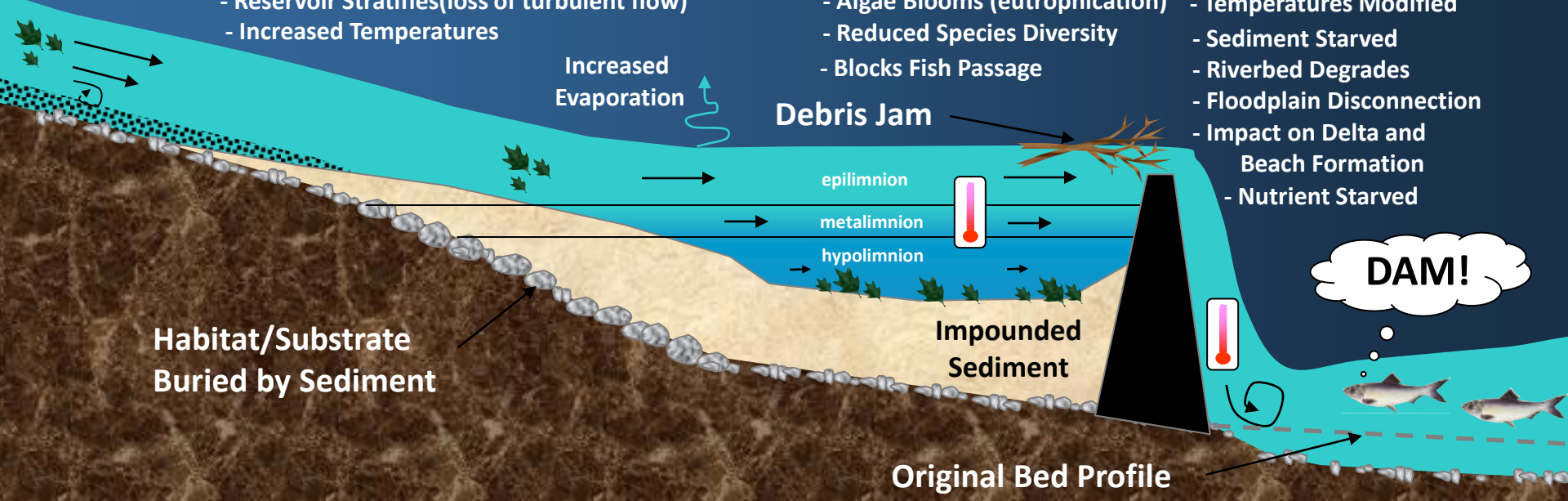
Reservoir

- Decreased Water Quality (decreased circulation)
- Pollutants Accumulate (concentrate)
- Oxygen Depletion (may become anoxic)
- Reservoir Stratifies(loss of turbulent flow)
- Increased Temperatures

- Traps Sediment
- Traps Debris
- Blocks Nutrient Transport
- Algae Blooms (eutrophication)
- Reduced Species Diversity
- Blocks Fish Passage

Downstream

- Water Quality is Reduced
- Altered Flow Regime (timing & flushing) & Diversion Impacts
- Temperatures Modified
- Sediment Starved
- Riverbed Degrades
- Floodplain Disconnection
- Impact on Delta and Beach Formation
- Nutrient Starved



National Inventory of Dams

- **85,000 Dams** >25 ft w/ 15ac-ft capacity or >6ft w/ 50ac-ft capacity

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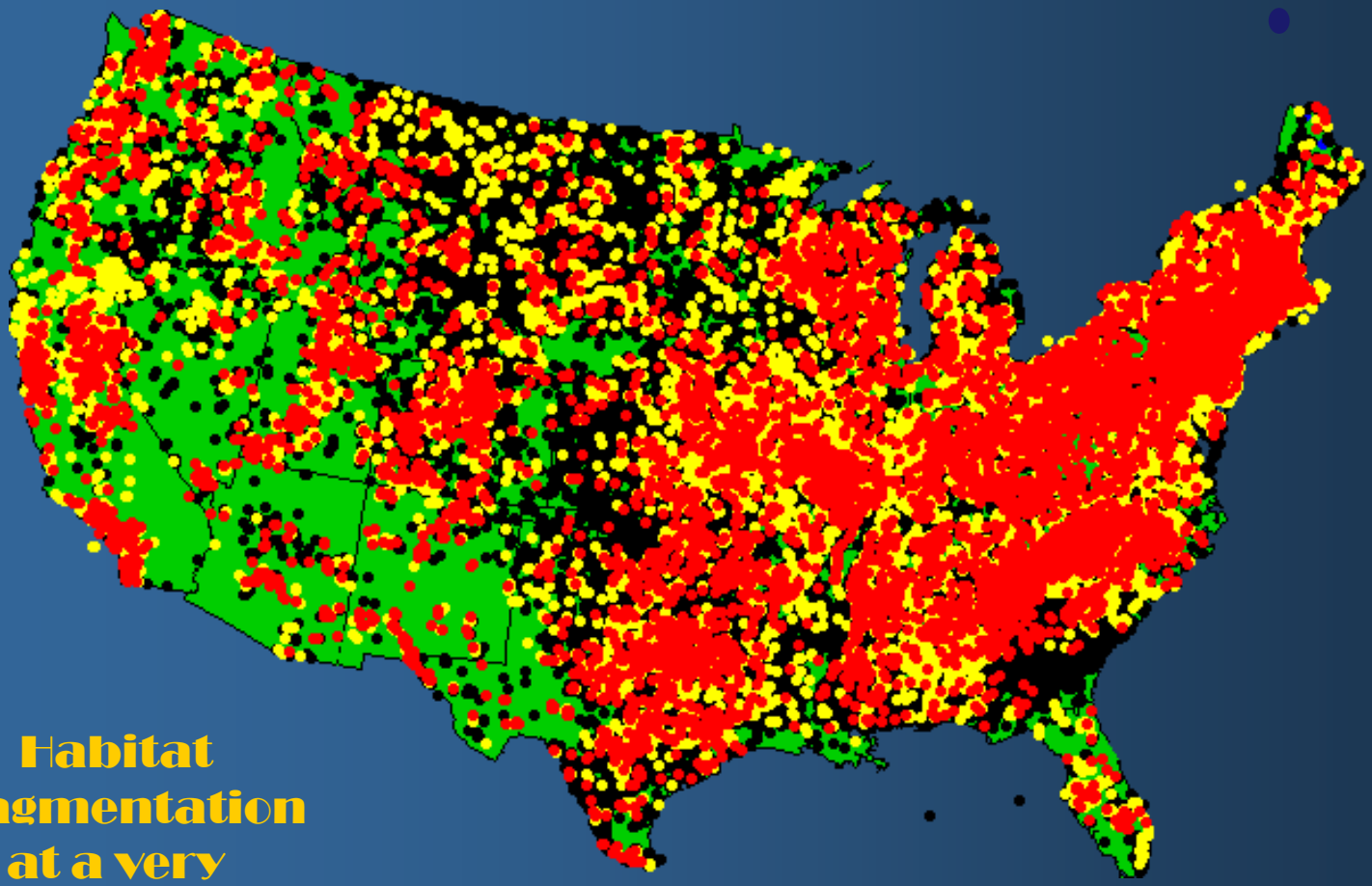
- **~99,000 Dams** regulated by states & in the USFWS Barrier Database
- **Several Million Dams** Status Report on the Nation's Floodplain Management Activity, 1989 (includes an estimated 2.5 million NRCS dams built as of 1977)



Habitat Fragmentation at a very large scale!

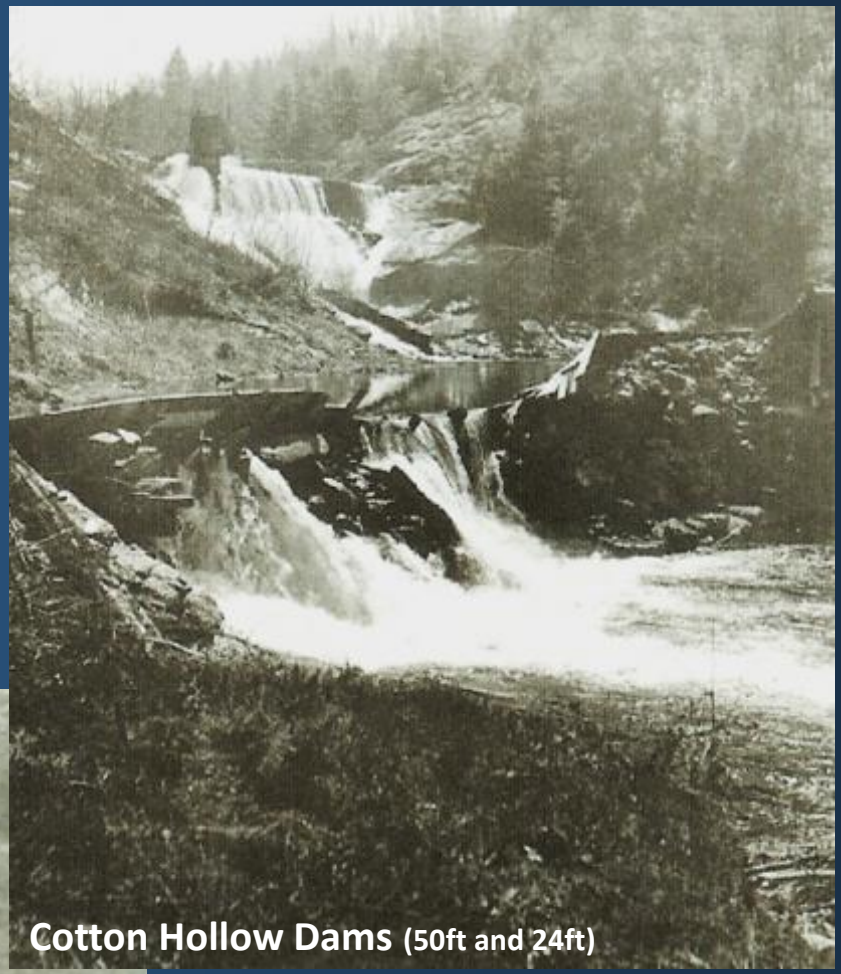
Hazard Classifications

- High Hazard
- Significant Hazard
- Low Hazard

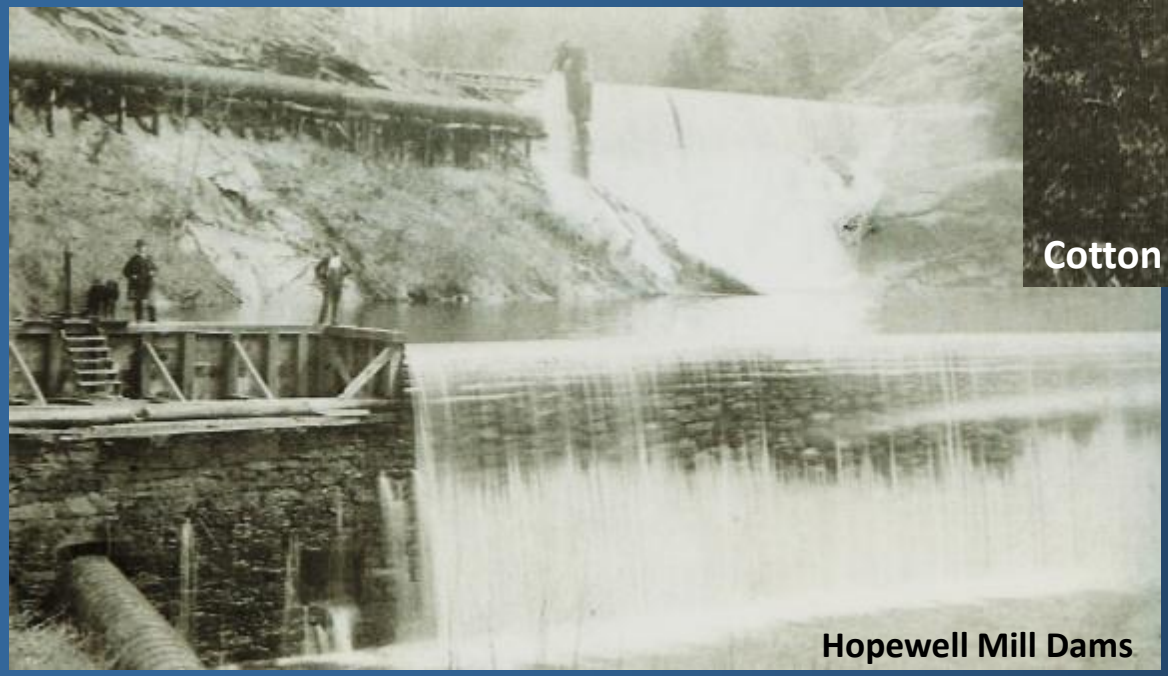
Cumulative Impacts of Multiple Dams

Roaring Brook, Glastonbury, CT

~27 Dams on Roaring Brook and it Tributaries (8 main stem dams)



Cotton Hollow Dams (50ft and 24ft)



Hopewell Mill Dams

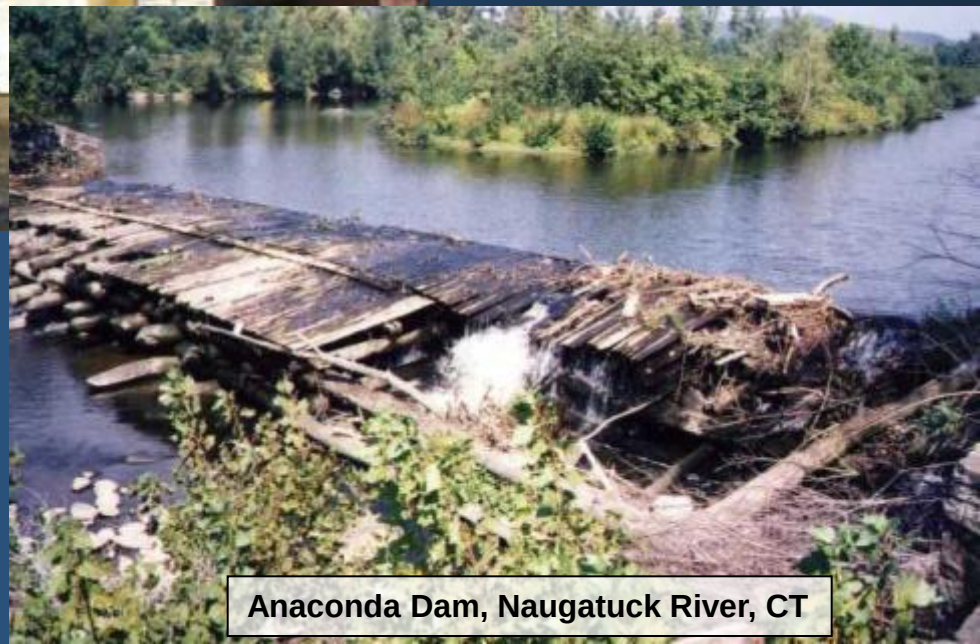
Spar Mill Bridge, Tryon St.

Dams are manmade structures like buildings.

As dams age they require maintenance to remain standing.

When left abandoned they are often un-repairable and require replacement or removal.

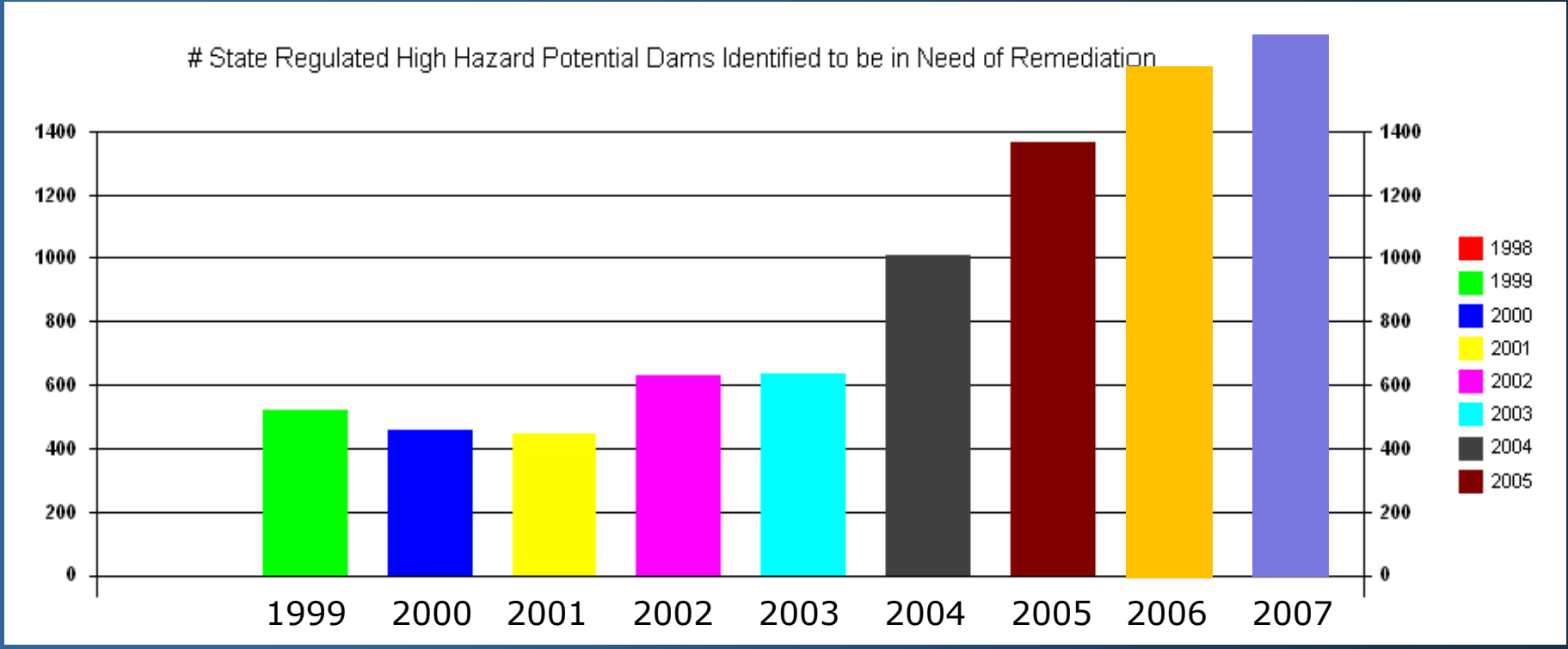
THE AGING PROCESS



Anaconda Dam, Naugatuck River, CT

As Our Dams Age Our Risk of Breach Increases

of state regulated high hazard dams identified in need of remediation has more than quadroupled since 2001

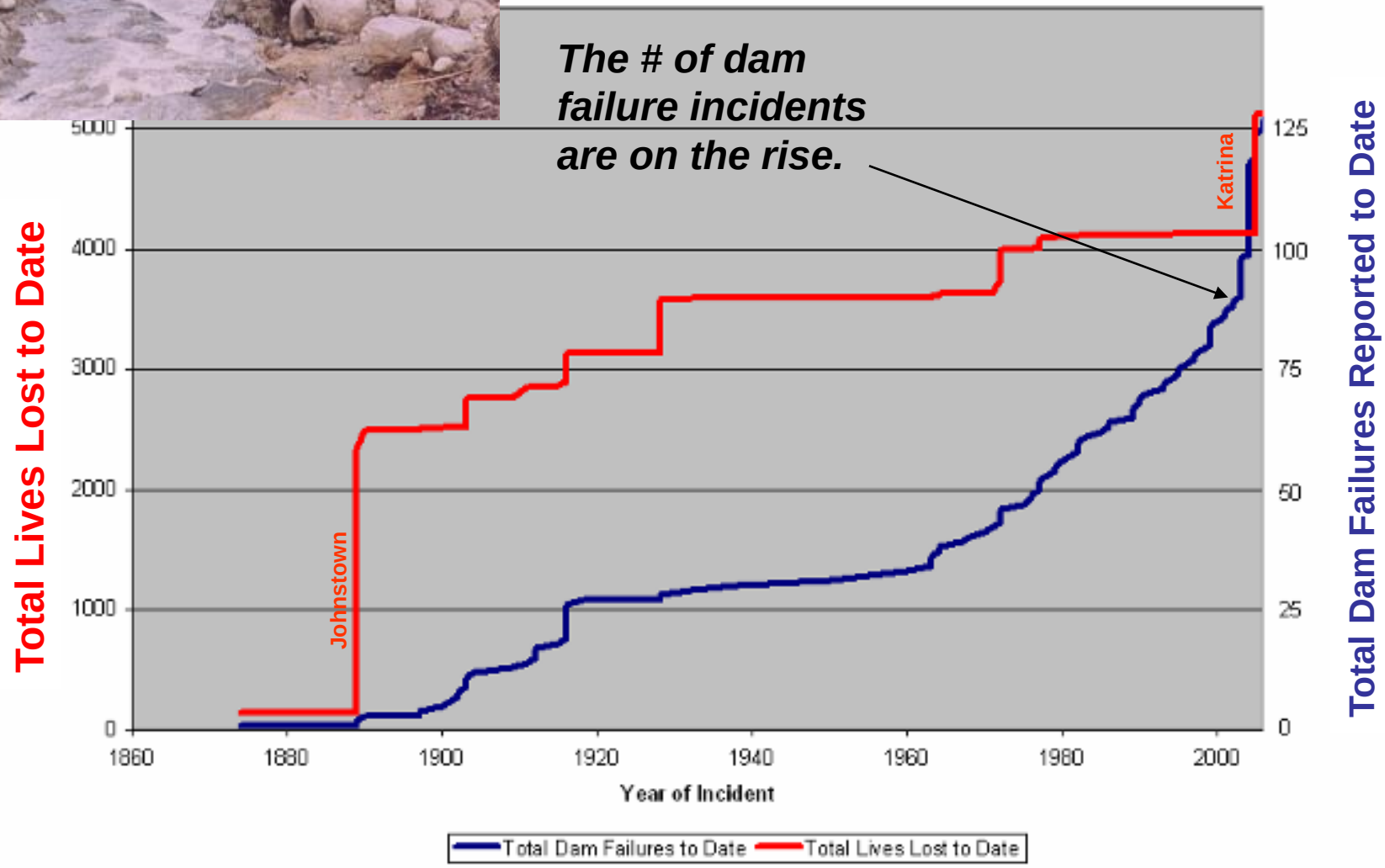


Slide source: modified from Michael Grounds ASDOS 2006 presentation on Dams Safety Performance Measures and NID

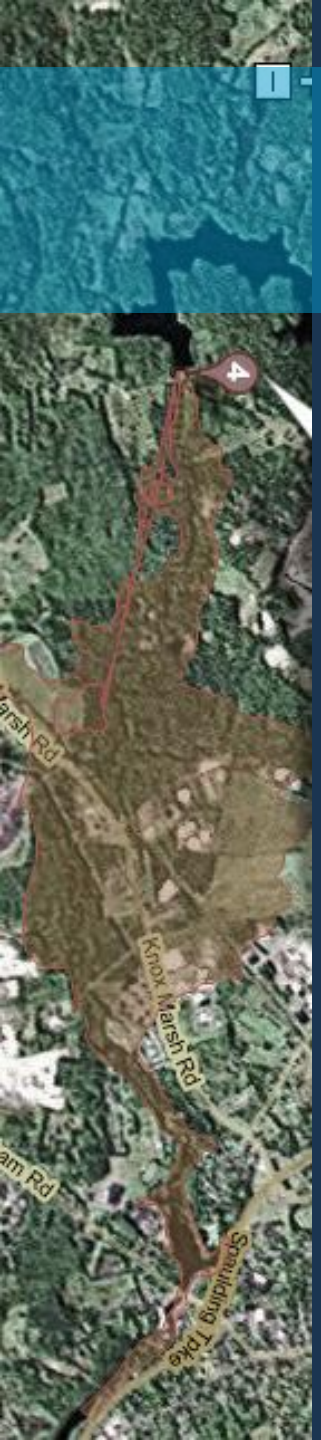
CT is switching over to dam owner responsibility for inspections – this will raise awareness

ASDSO Reported Dam Failures & Fatalities

1874-2006



Source: ASDSO

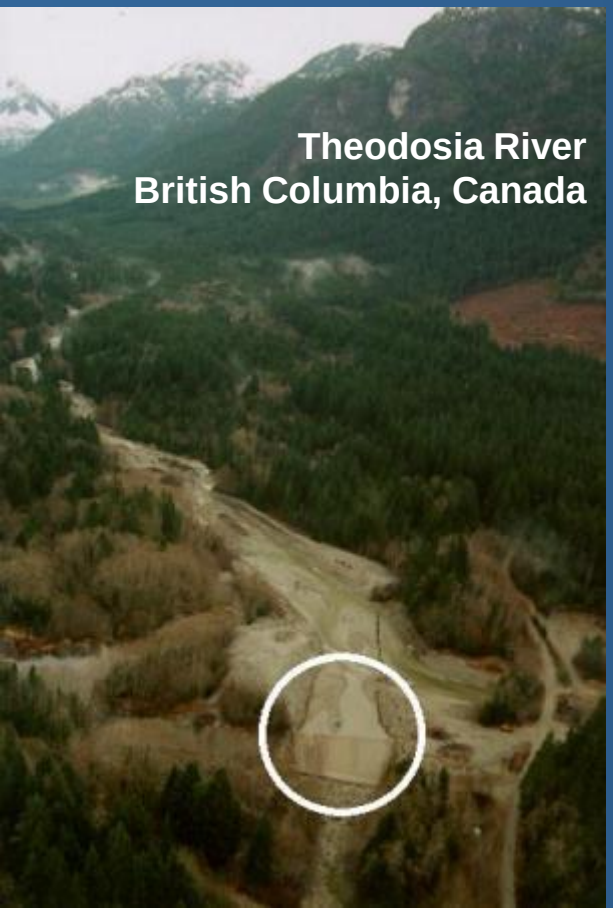


Reported Over-toppings, Breaches or Damaged Dams

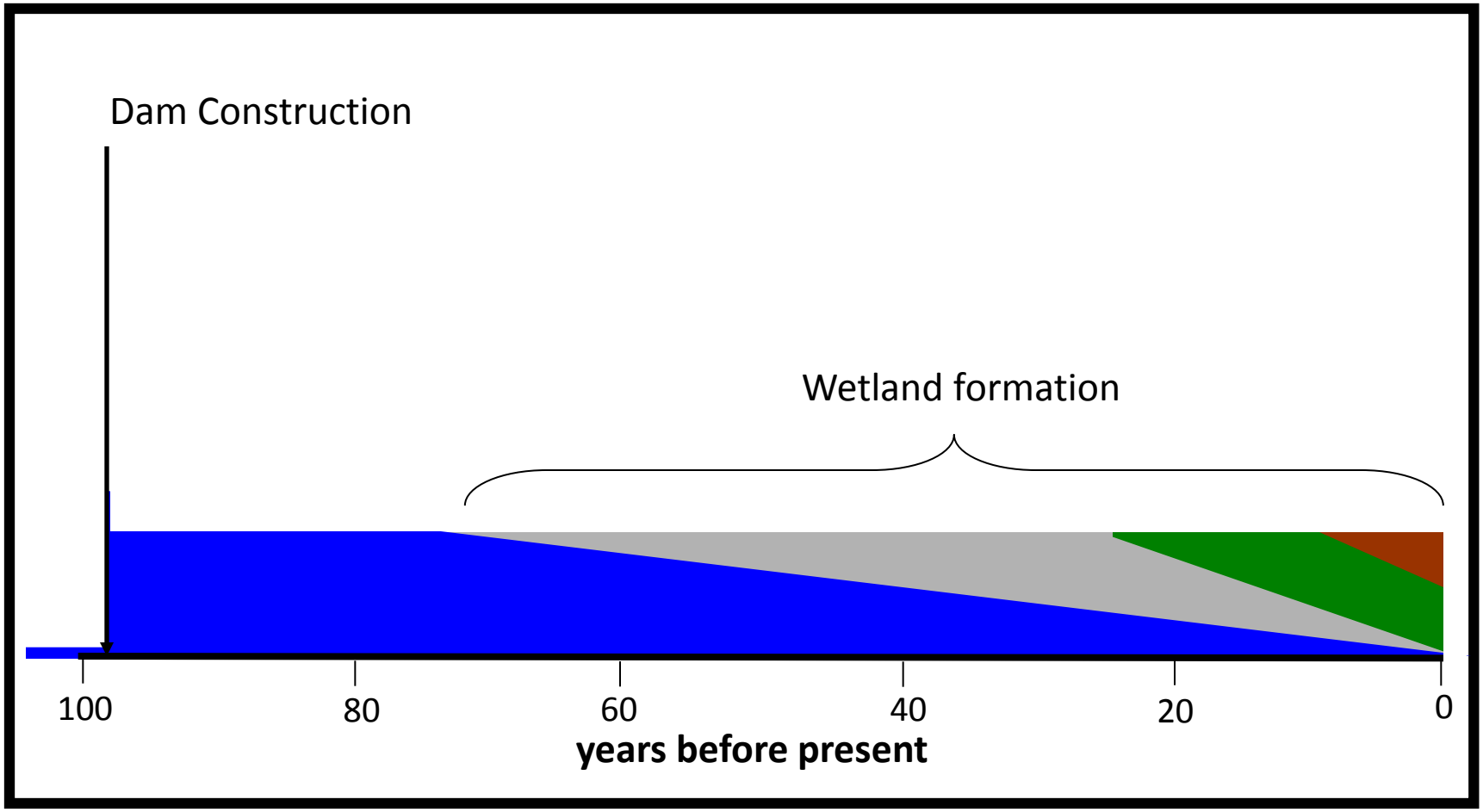
State	October 2005	May 2006
New Hampshire	13, plus 2 breaches	~100
Massachusetts	~40	~200
Connecticut	53 total =16 breached; 34 overtopped or damaged; 3 nearly overtopped	CT has data – just not logged into this table yet
Vermont	No record as of 6/06	No record as of 6/06
Rhode Island (staffed by 1)	No record	No record
Maine (staffed by 1)	No record	No record
Total* =	**108 recorded**	**300 recorded**

* Only includes incidents actually reported to state dam safety divisions

Impoundment Transitioning through Sediment Infill



Rindge Dam
Malibu Creek, CA



Source: Mark Carabetta

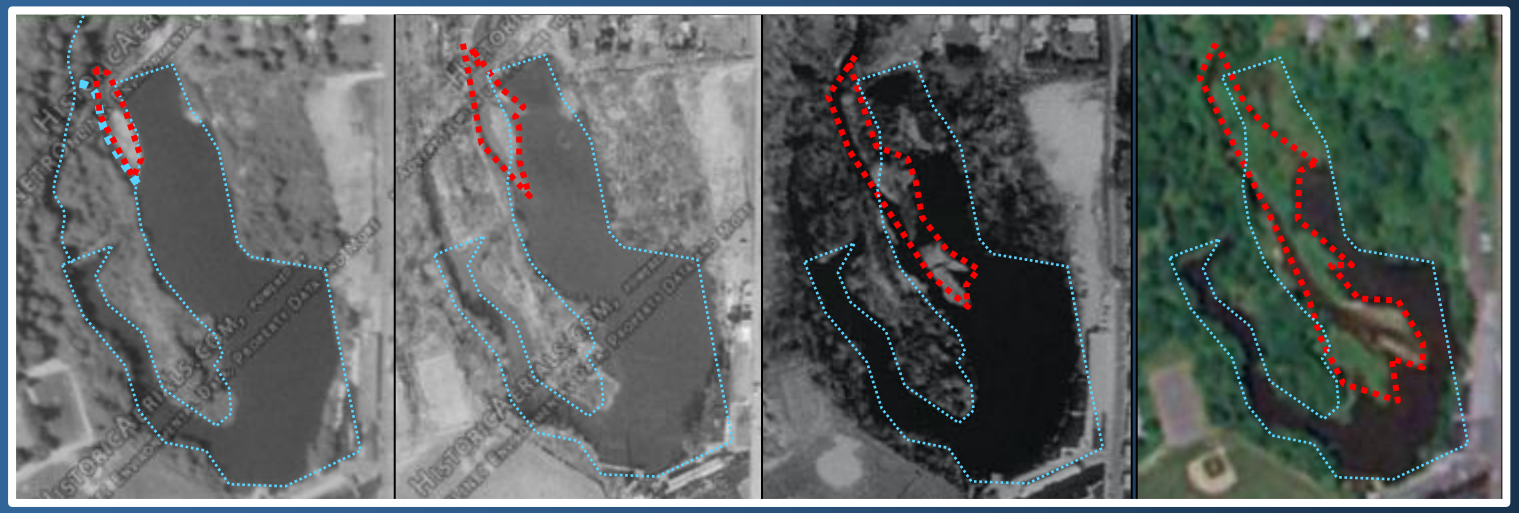
open water

emergent vegetation

floating-leaf vegetation

floodplain vegetation

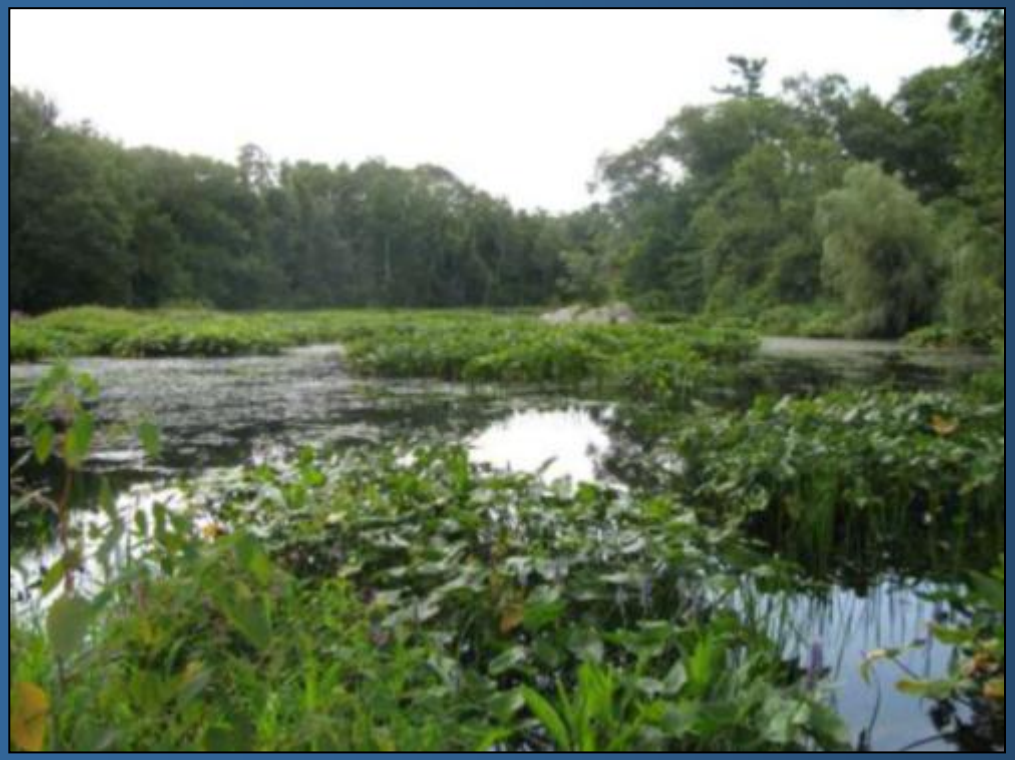
Example of a Mill Pond Infilling - Heminway Pond Transition From 1970 to 2011 Watertown, CT

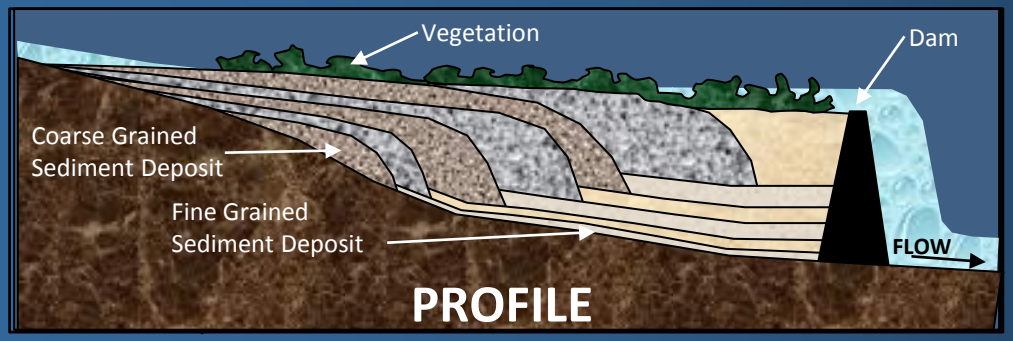


1970 1972 1990 2005

2004 2006 2008 2011

Impoundment Infilling





Why We Remove Dams

Aging

-dam structure

-reservoir sedimentation

Safety

-breaching

-drowning

-liability

Remnants of the Austin, Pennsylvania, dam after its failure on September 30, 1911.

Economics

-loss of original purpose or economic value

-maintenance

-no longer economically justifiable

Underestimating the power of a dam

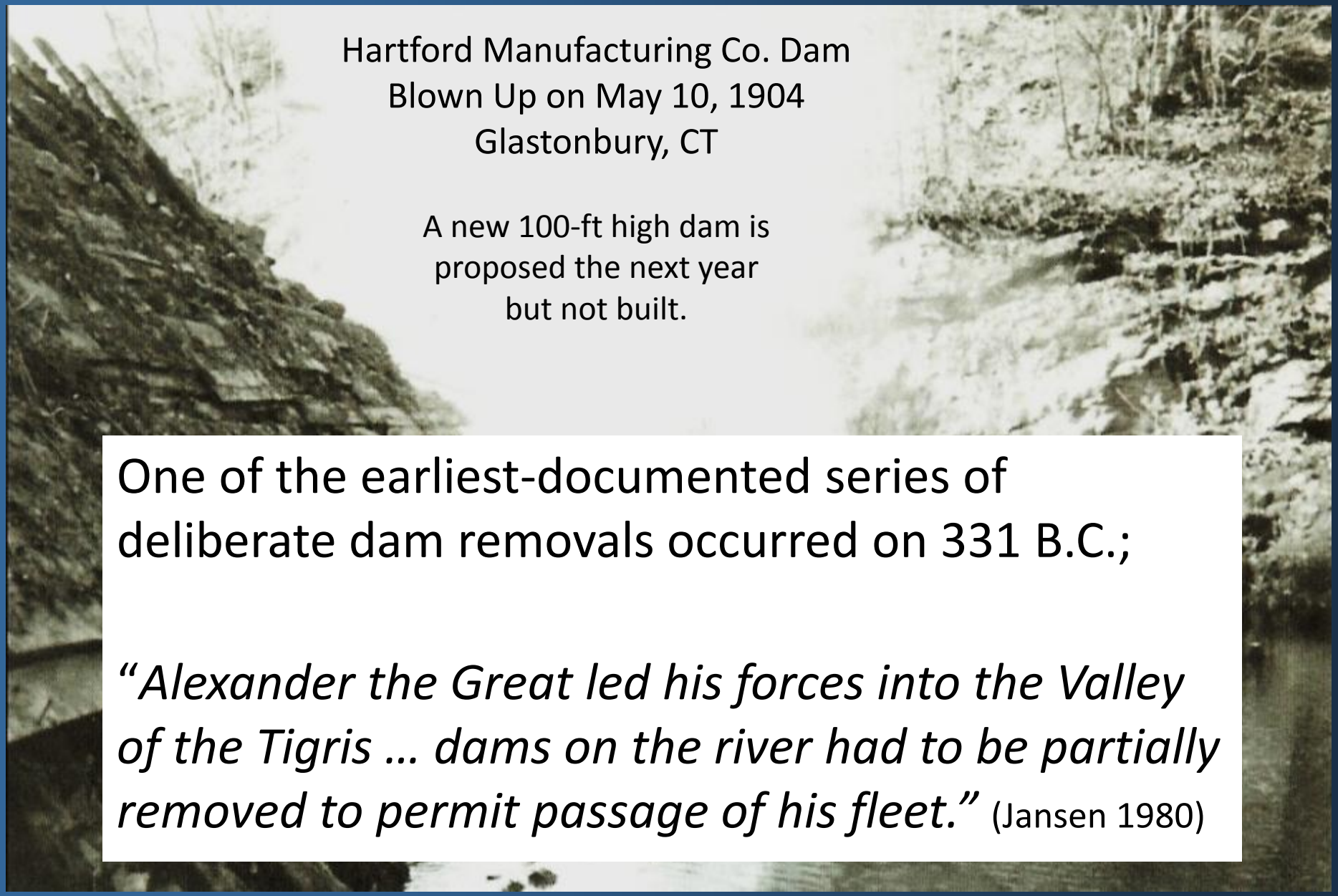
Environment

-environmental impact of dam is too great

-proactive restoration

Fish Passage

We Have Been Removing Dams for a Long Time



Hartford Manufacturing Co. Dam
Blown Up on May 10, 1904
Glastonbury, CT

A new 100-ft high dam is
proposed the next year
but not built.

One of the earliest-documented series of deliberate dam removals occurred on 331 B.C.;

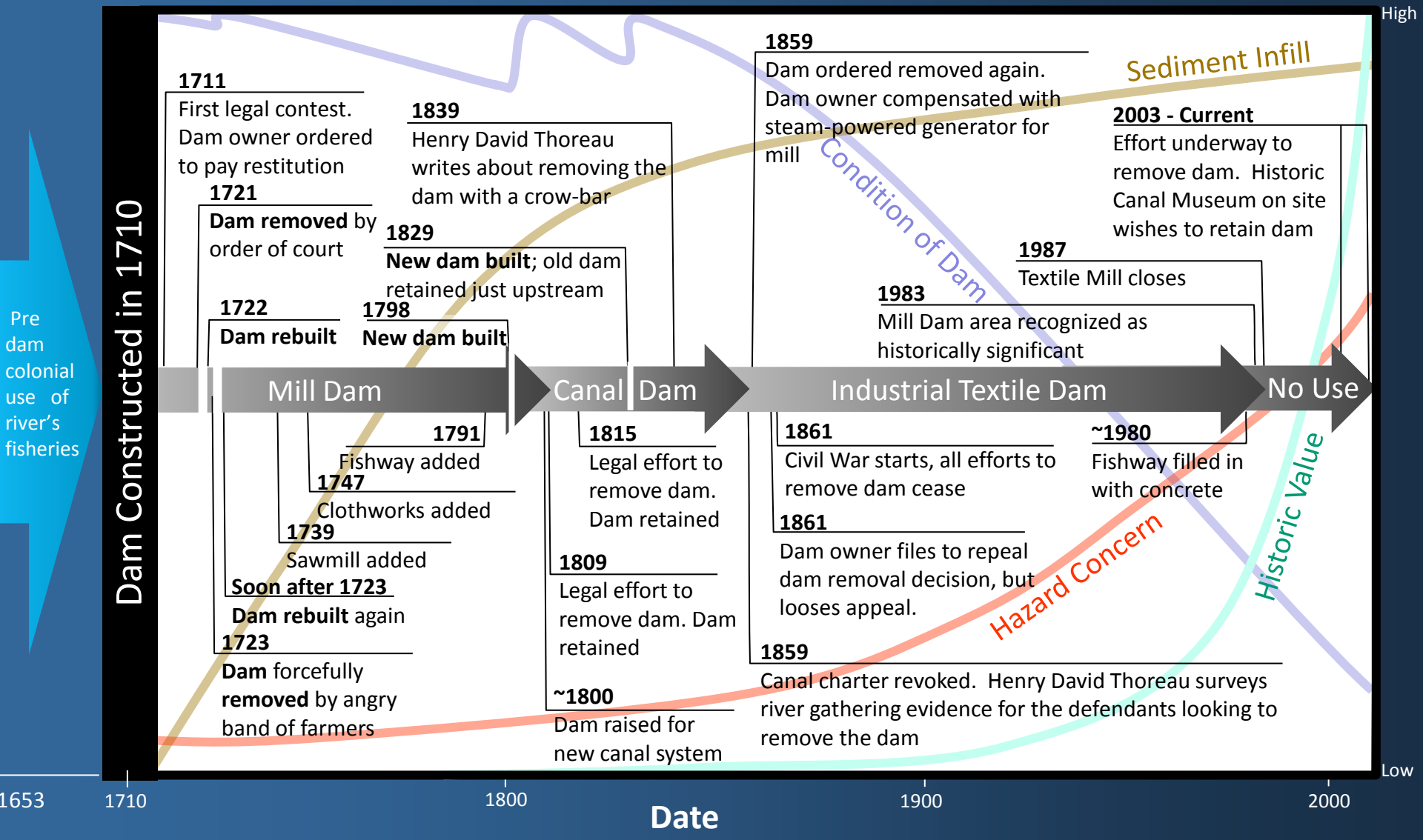
"Alexander the Great led his forces into the Valley of the Tigris … dams on the river had to be partially removed to permit passage of his fleet." (Jansen 1980)

The Billerica Dam

A Long History of Decision Points

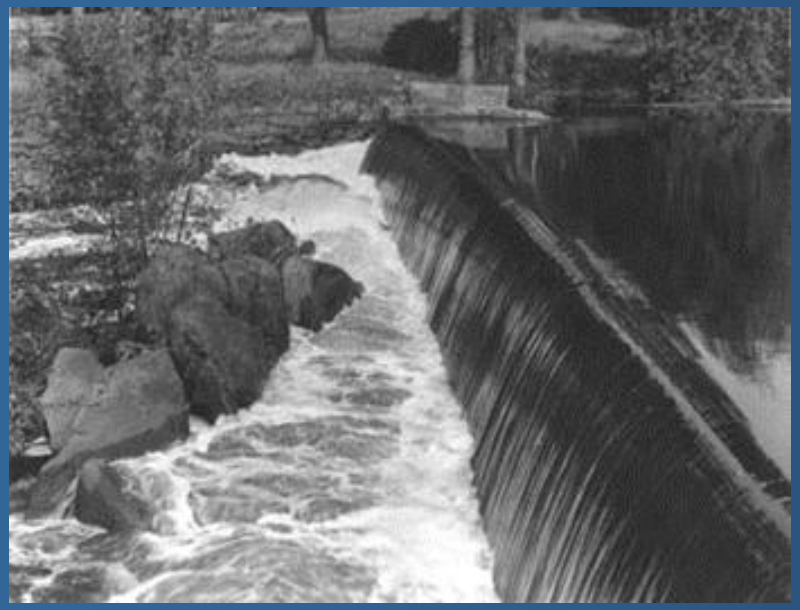
The Billerica Dam

A Long History of Decision Points



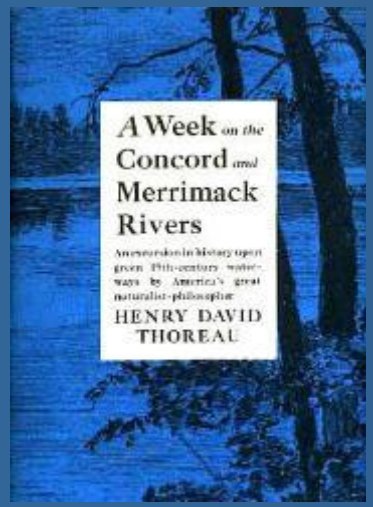
The Billerica Dam

Concord River, Billerica, MA



Henry French pleads with the Massachusetts Legislature, 1861:

"For generations, a painful and expensive controversy has existed in relation to [the Billerica Dam], and if [not removed now], the children and children's children of these parties will be cursed with strife and contention"



Henry David Thoreau in 1839 at the Billerica Dam:

"…mere Shad, armed only with innocence and a just cause … I for one am with thee, and who knows what may avail a crow-bar against that Billerica dam?"

Children's Children

Cursed with Strife and Contention

Winnemem Wintu Tribe war dance to protest Shasta Dam

Dam Removal is a Disturbance Too and has Impacts – including open water habitat and wetlands loss

1998 – Millport Dam Impoundment

1998 – Impoundment drawdown

Transition of Impoundment Post Dam Removal

1998 – Millport Dam Impoundment

1998 – Impoundment drawdown

1999 – Impoundment 1 growing season later

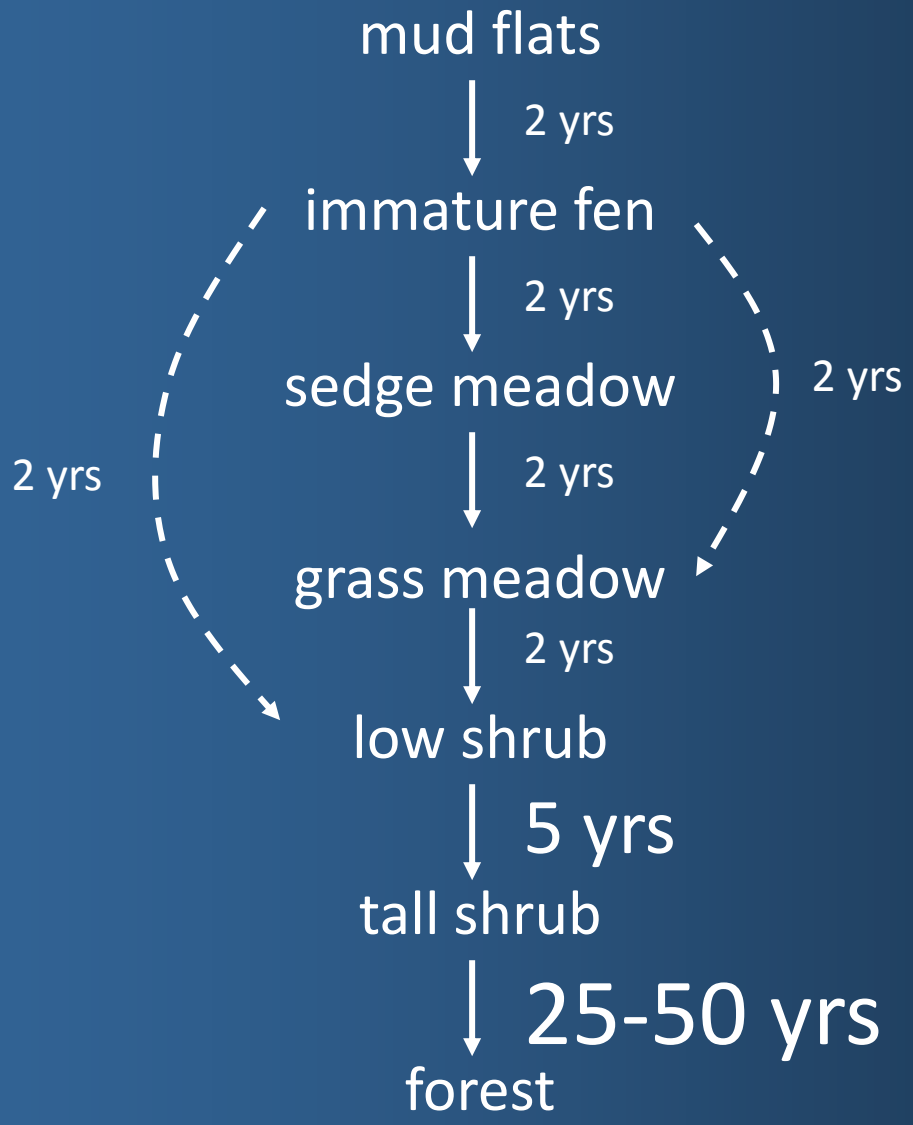
2008 – Impoundment 10 yrs later

Breached Dam in NH - Revegetation

Anaconda Dam, CT - Revegetation

3 ½ yrs after removal

Succession on Exposed Lake Bottom in Wood-Buffalo National Park



Slide Source:
Mark Carabetta

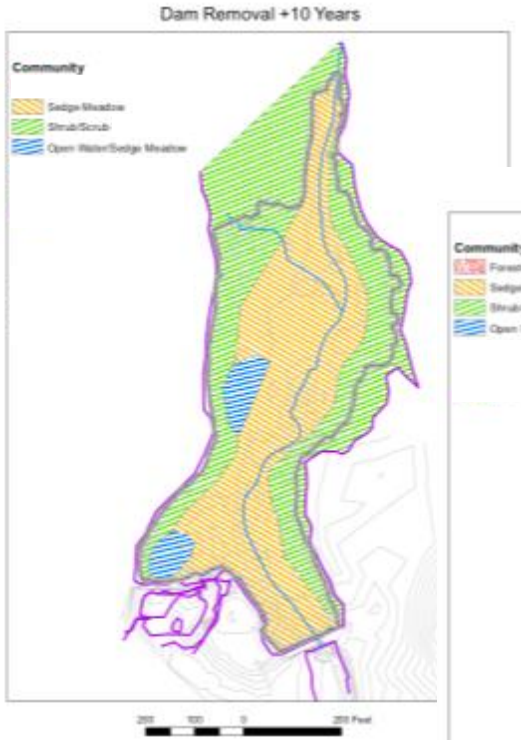
Adapted from
Keddy, 2000

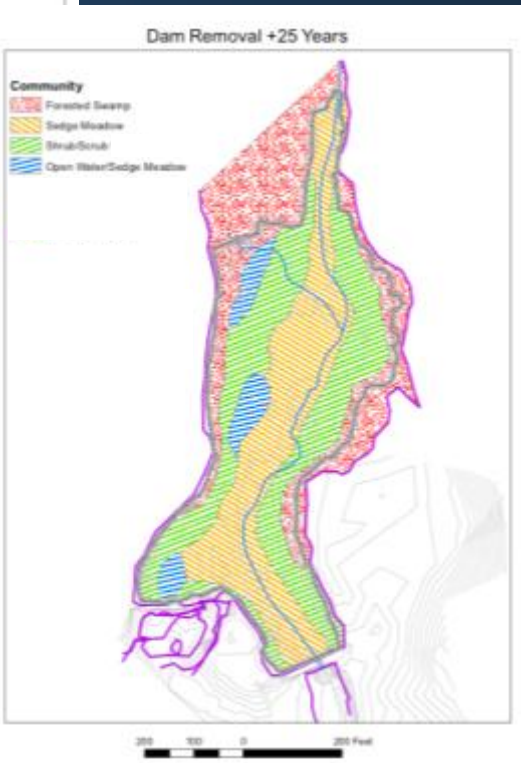
Zemko Dam, CT - Revegetation

During drawdown

Last day of dam removal

Open water to sedge meadow with increasing encroachment from shrub and then forested swamp





Source: Mark Carabetta

Prepared by Dr. Richard A. Orson for a TNC dam removal permit application

Ecological Factors Offsetting Open Water or Wetland Loss:

Restoration of…

- system connectivity - fish passage
- water quality
- temperature regimes/cold water fishery
- sediment regimes
- unregulated hydrology
- spawning habitat for fluvial specialists
- rarity: e.g., free-flowing streams are one of CT's "thirteen most imperiled ecosystems"
- a self-sustaining, ecologically viable system that is not dependent on a man-made structure

Source: Bukaty

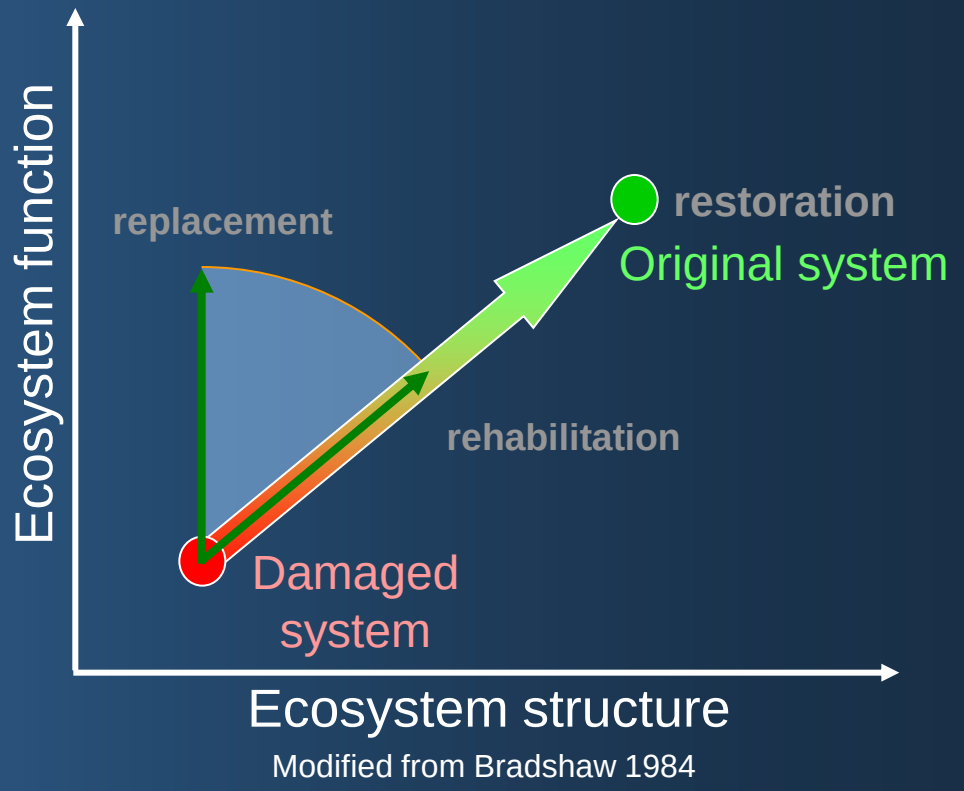
Source: Bukaty

Source: Southerland

Can We Really Restore A River By Removing A Dam?

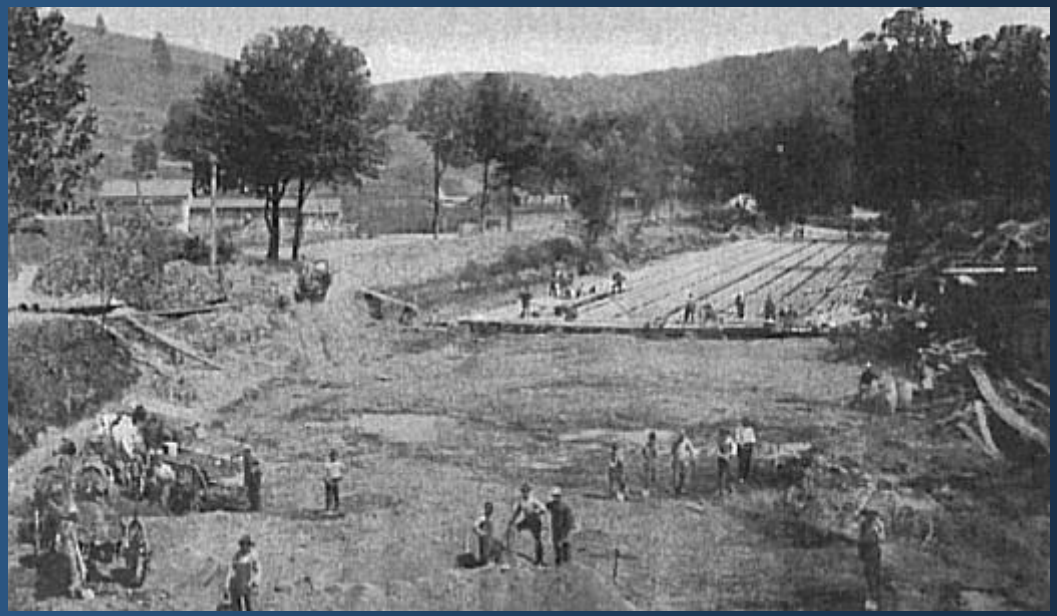
- Flows have Changed
- Sediment Regimes have Changed
- Species & Unique Genetic Strains have been Eradicated
- Infrastructure Remains In Way & Must be Accommodated for

- Restoring Toward an Ideal, but May Never Obtain It
- Restore as Much Natural Function as Possible
- Improved Ecological Condition
- Goal: Self Sustaining System
- Change the Way People Perceive & Utilize Rivers



Modified from Bradshaw 1984

Sometimes Restoring a Natural Self-sustaining System is a Challenge!



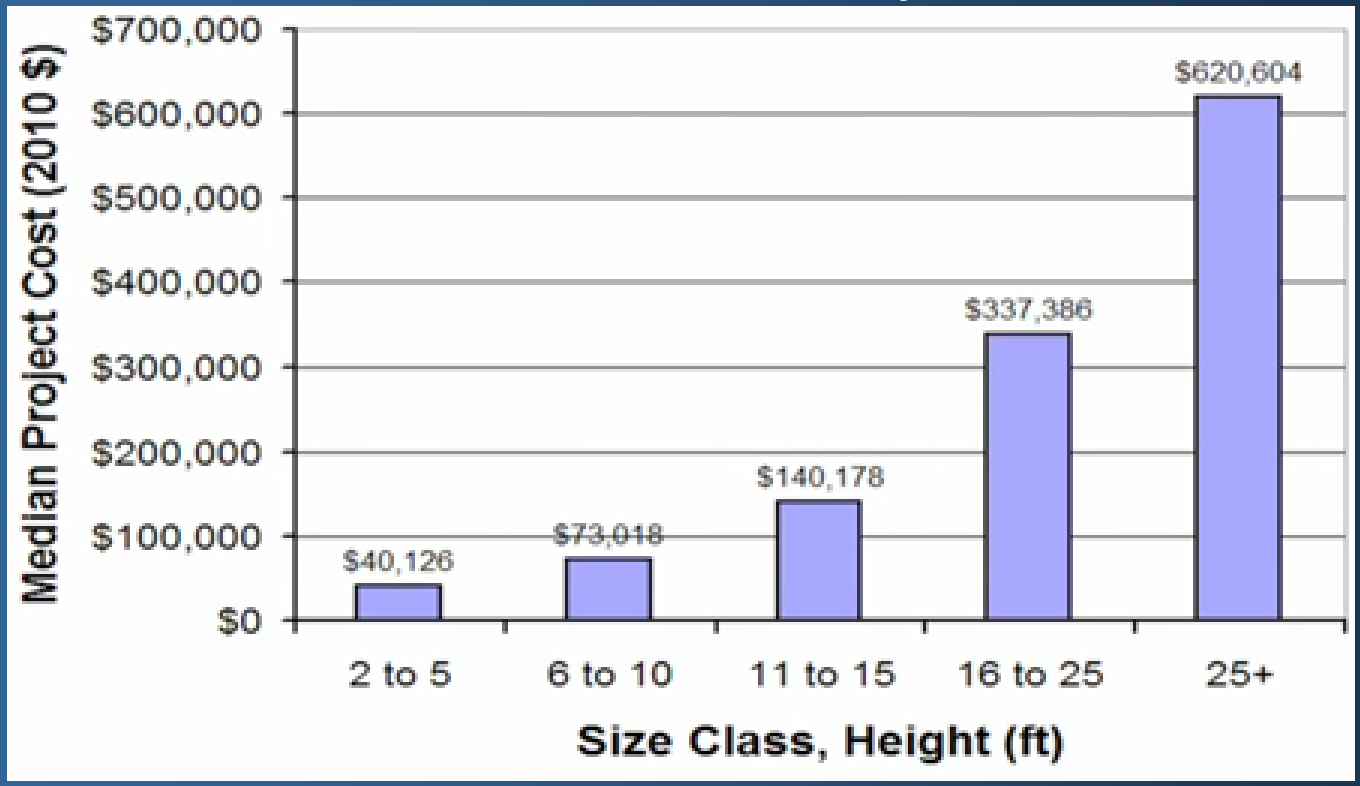
Brave Station Dam, PA –Cooling Pipes for Gas Pumping Station Under impoundment

Some Reasons Why a Dam Can't Be Removed May Include:

- Dam Serves a Valuable Purpose (flood control, water supply, hydro-electricity, navigation, recreation, etc.)
- Lack of Ownership Permission
- Contaminated Sediment (although leaving the sediment there is not a good option)
- Impacts to a Threatened or Endangered Species
- Community Attachment
- Significant Historic Value
- Cost Prohibitive

Cost: Dam Removal vs Dam Repair

Median Dam Removal Project Cost



Source: American Rivers – Median Project Cost Stats from 225 projects nationally in 2010 dollars (60 projects from PA)

- Cost of dam repair varies widely depending on condition and size of dam
- With dam repair you need to consider long term maintenance and eventual replacement of the dam
- There are more funding option (i.e. grants) available for dam removal because of the environmental benefits

What are our Alternatives?

If Dam Removal is not an Option

Aging

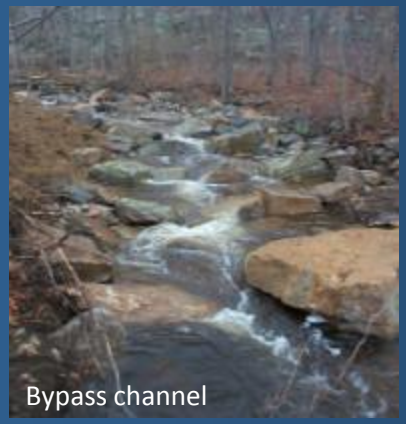
- *Replace* dam entirely
- *Dredge* pond


Rock ramp fishway


Dredge

Safety

- *Repair* dam
- *Lower* dam
- *Maintain* dam
- Get liability *insurance*


Bypass channel


Fish Ladder

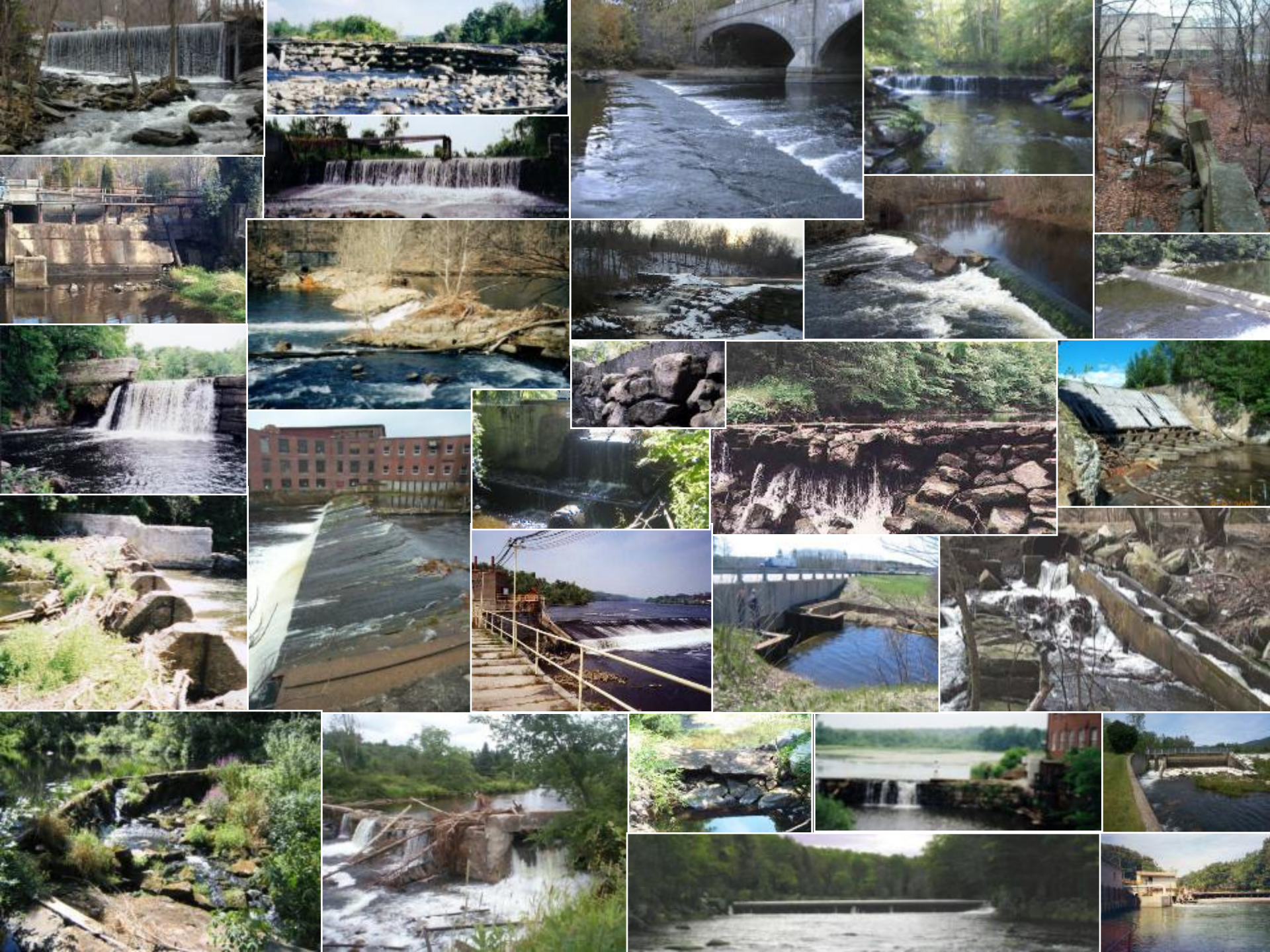
Environment

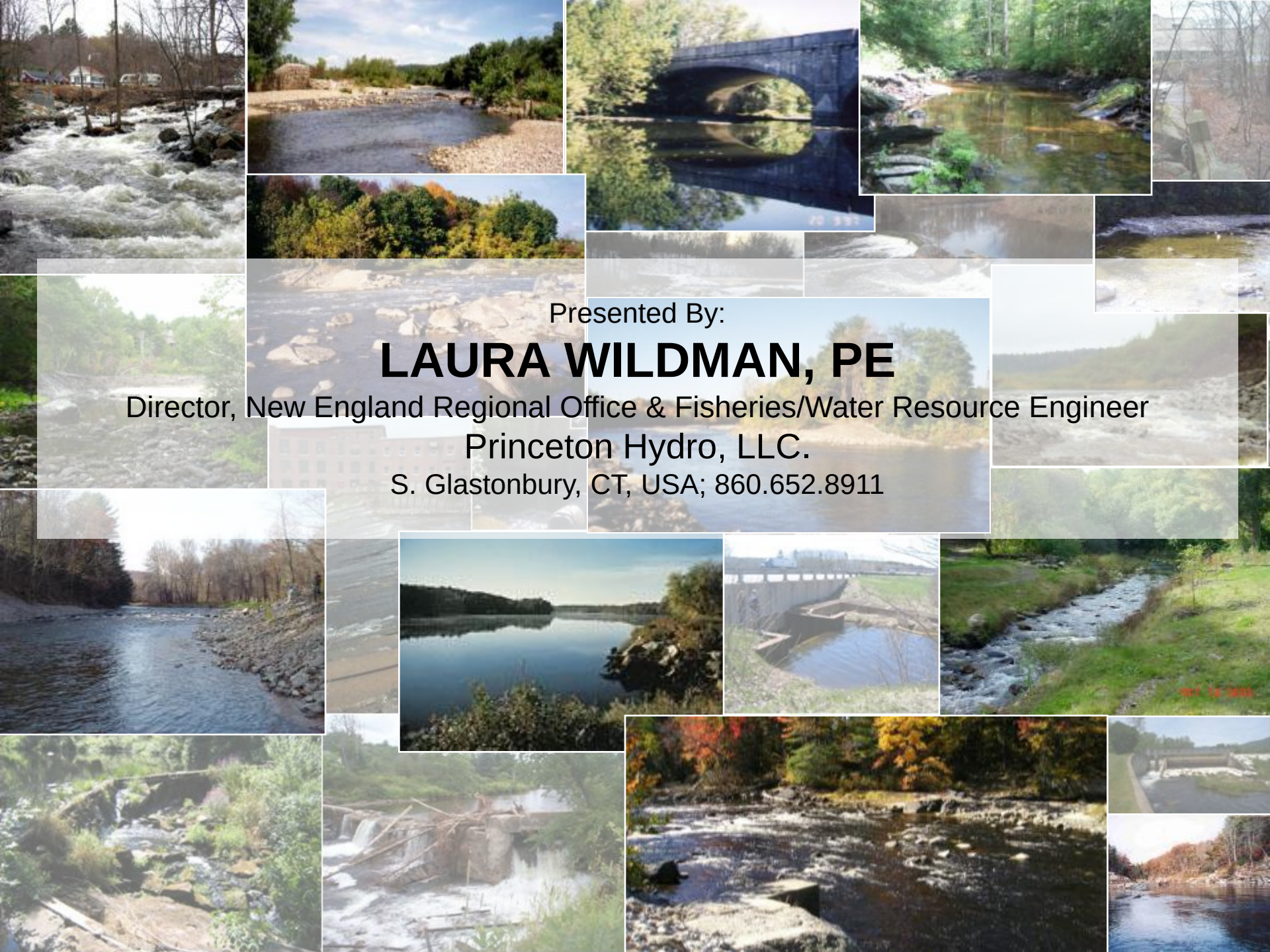
Partial fixes:

- *Fish passage* (ladder, ramp, bypass)
- *Naturalize flow* releases
- Alternate *low flow release* levels
- Sediment *flushing*
- *Seasonally operate* dam
- *Inflatable* hinged spillway

Economics

- Find an *alternate economic value* for dam that covers maintenance
- Find an *alternate owner* who is getting value from the dam (i.e. lake association)





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