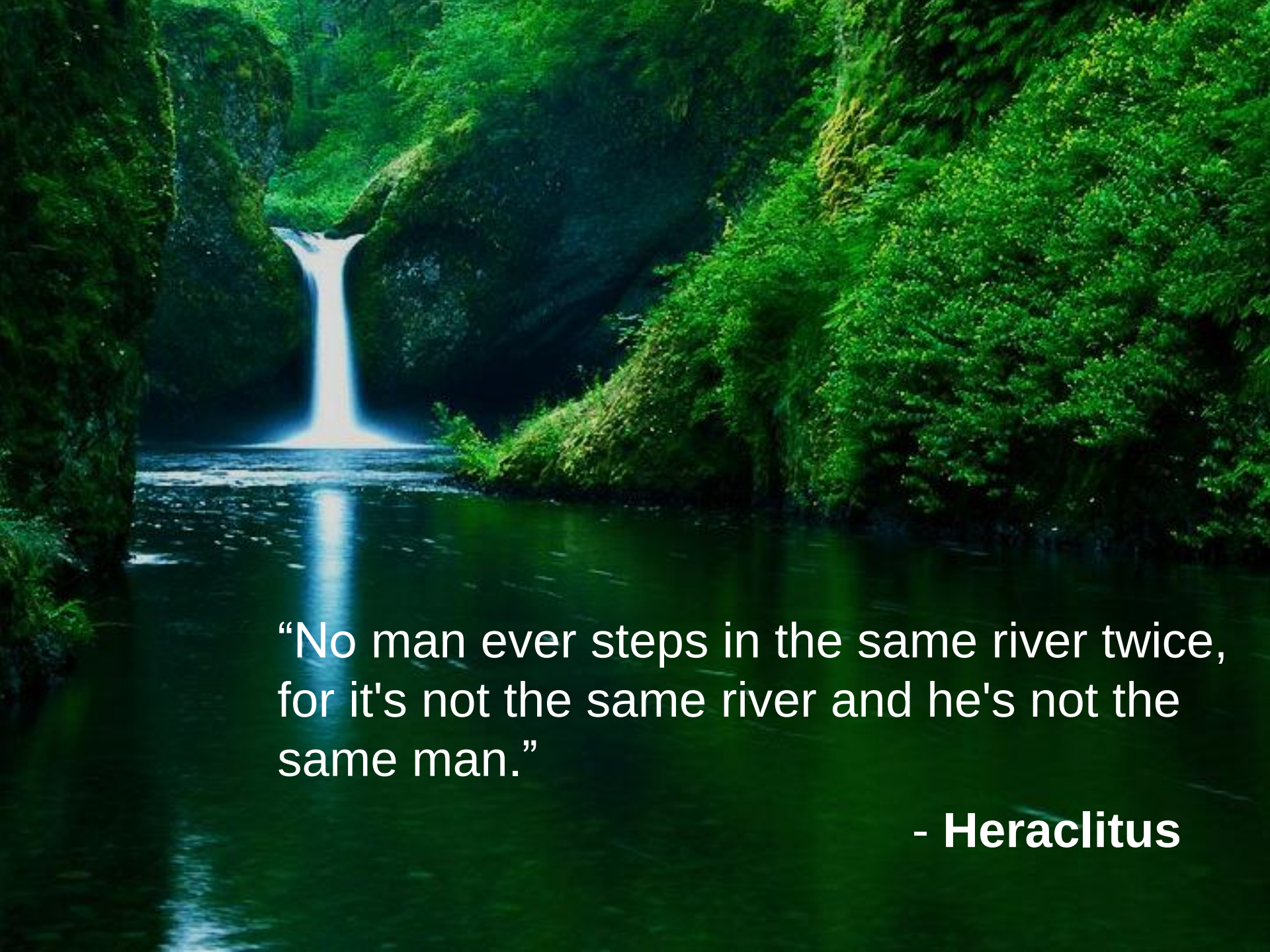

“No man ever steps in the same river twice, for it's not the same river and he's not the same man.”
- Heraclitus

The Changing Face of River Restoration

2015 Upper Midwest Stream Restoration Symposium

Keynote Address

Marty Melchior

interfluve

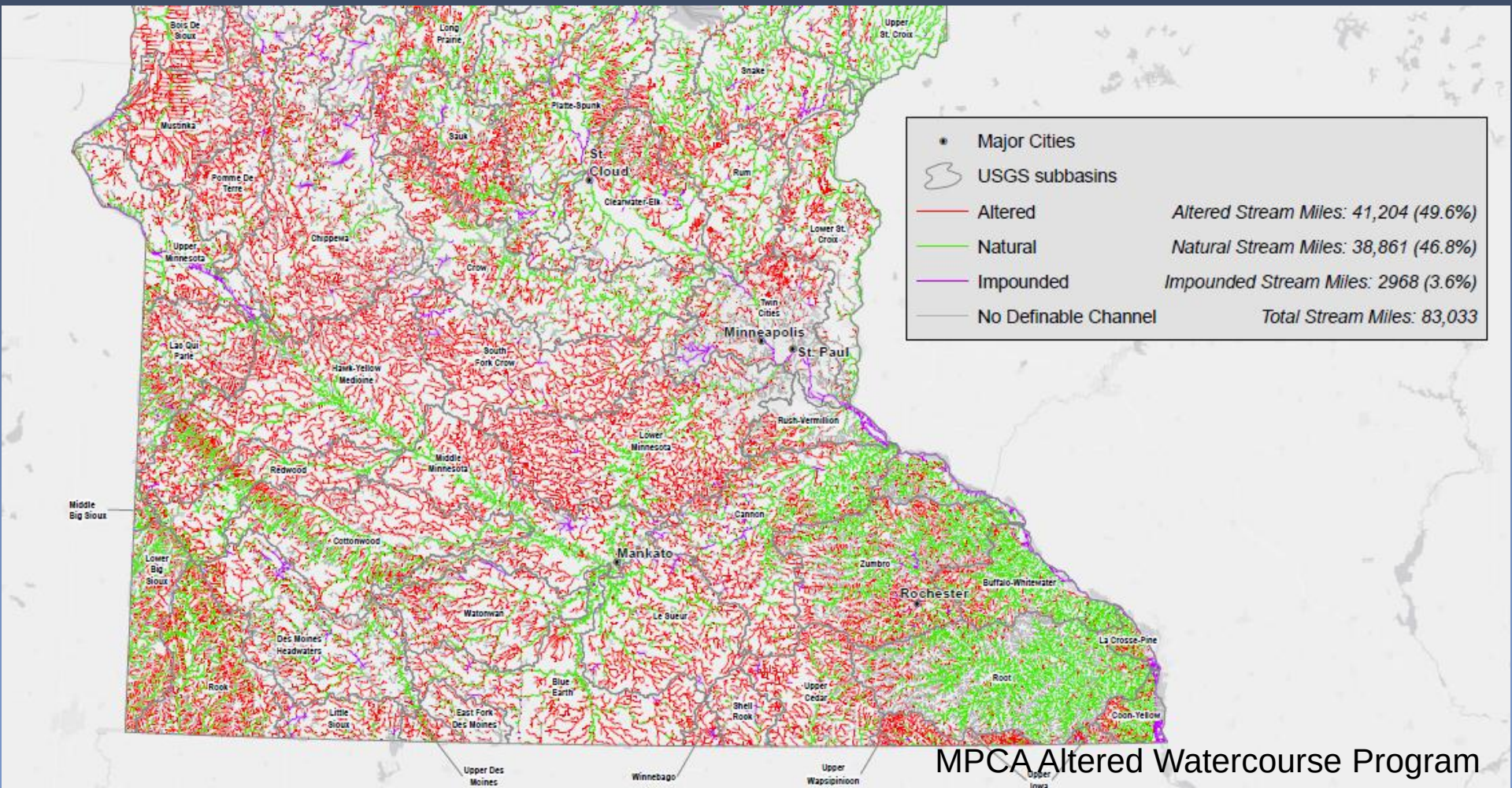
Presentation Outline

- River restoration. Why do it?
- Economics of river restoration
- River restoration examples/How have things changed

Why Do River Restoration?

Impacts To Rivers

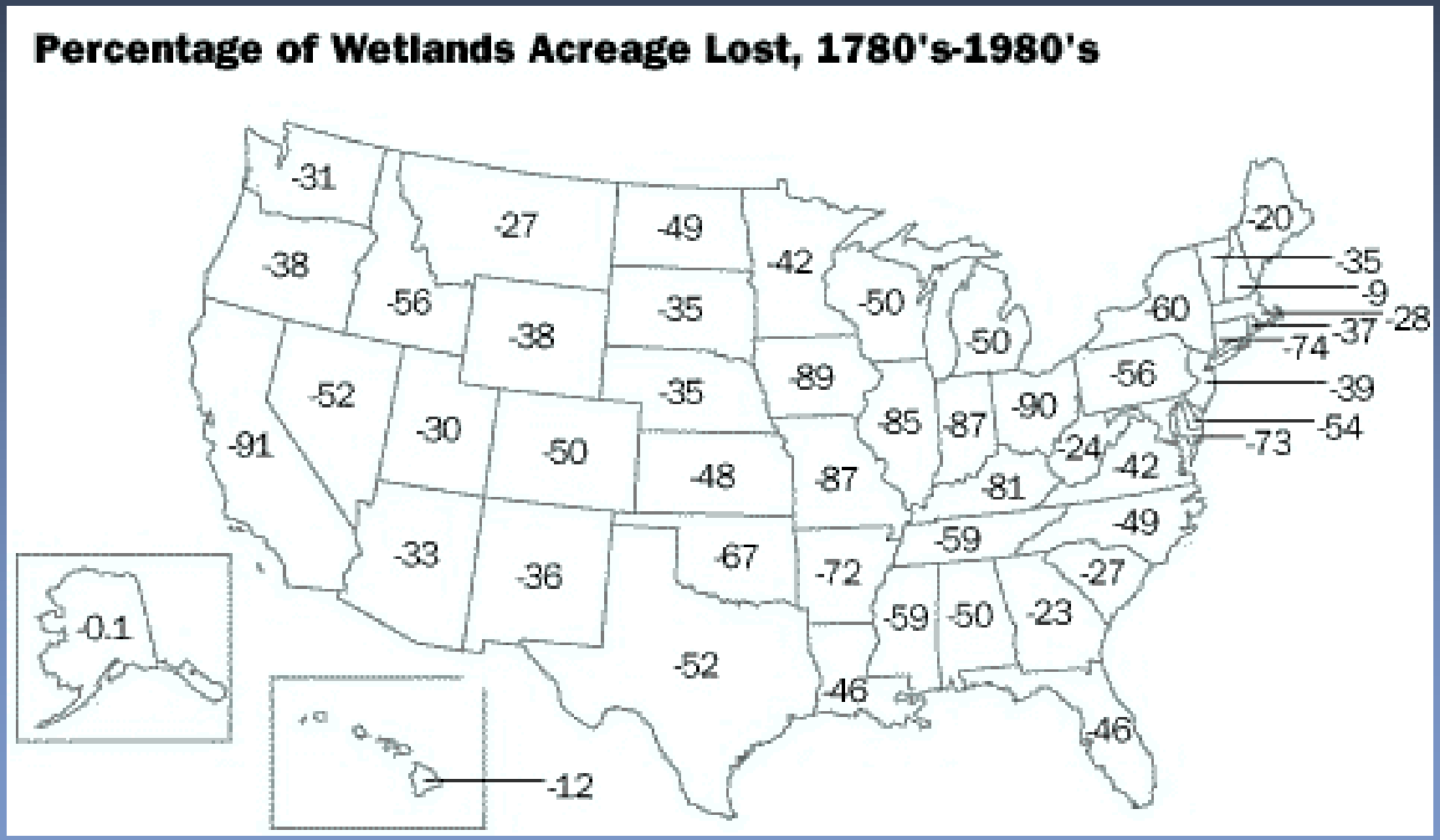
- What's wrong with our rivers that we should need to consider fixing them?



MPCA Altered Watercourse Program

Impacts To Rivers

- Its not just the streams, but the watersheds that need help.



Mitch and Gosselink, Wetlands, 2nd Edition, Van Norstrand Reinhold, 1993

Impacts To Rivers

- Common impacts to river systems (Midwest)
  - Ditching (straightening)
  - Dams
  - Urbanization (increased runoff/pollution)
  - Agriculture (increased runoff/pollution)
  - Forestry (increased runoff/pollution)
  - Artificial/hard armor bed and bank treatments
  - Floodplain encroachment (filling)
  - Cleaning/wood removal
  - Dredging

Impacts To Rivers

- These courses of action have resulted in:
  - Erosion – sediment load problems
  - Chemical pollution
  - Nutrient pollution
  - Habitat degradation
  - Extinction rates 5x that of terrestrial vertebrates
  - 1/3 of rivers listed as impaired or polluted
  - Withdrawals so extreme that rivers run dry
  - Increased flooding

Why Do River Restoration?

- The future of life on earth depends on the health of our natural systems
  - Rivers are a major part of the *water cycle*
  - Rivers transport whatever we put into them
  - We can reverse what we've done

From www.iowacorn.com

Why Do River Restoration?

- Natural recovery processes are slow following watershed restoration – we can speed it up

Whittlesey Creek (WI) – Logging and splash dams occurred 100 years ago. The system still has no habitat complexity or wood recruitment

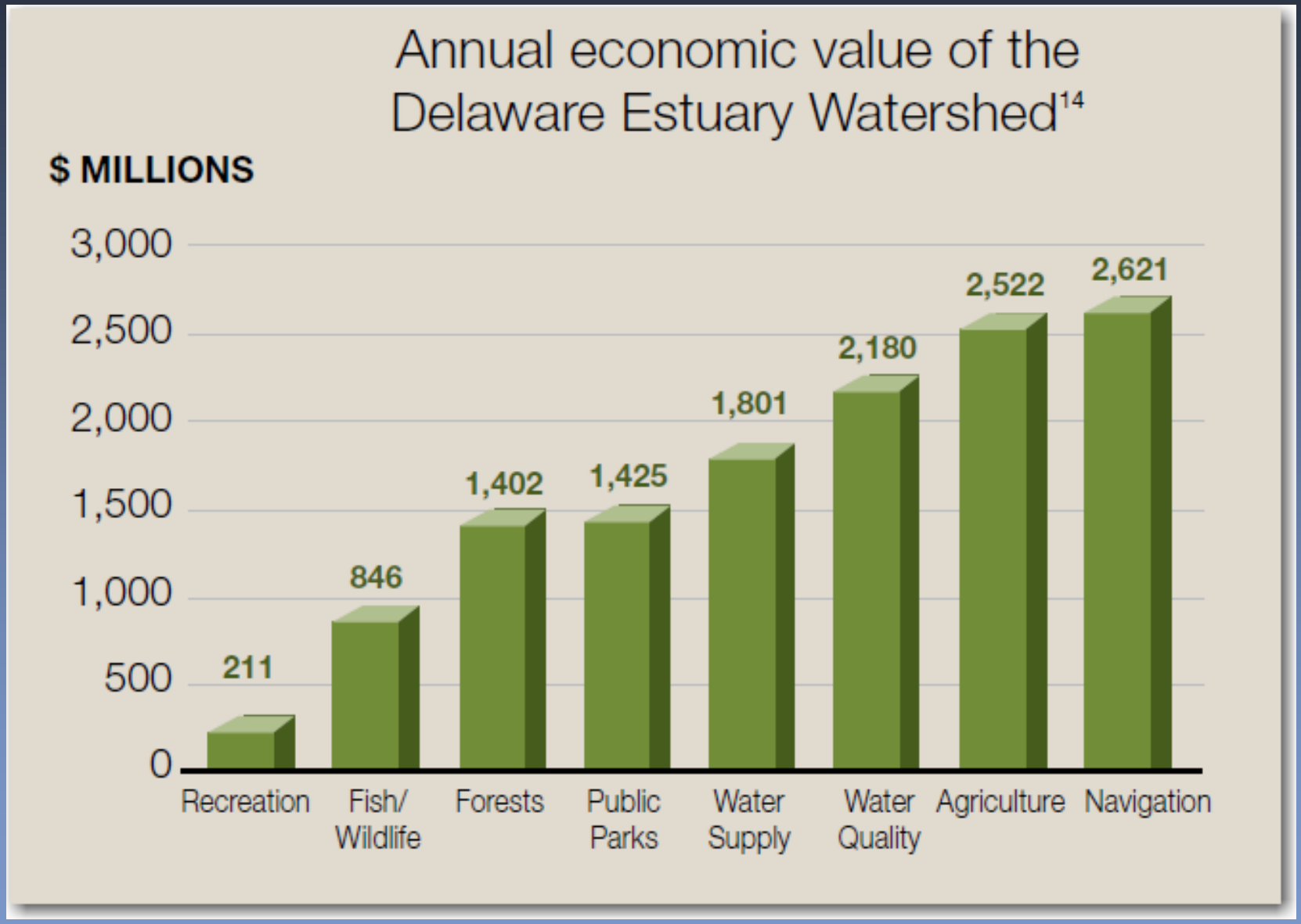
Great Dismal Swamp – 250 year old ditch remains unchanged

Why Do River Restoration?

- It's important to recognize what healthy versus degraded rivers tell us indirectly:

- If our rivers are degraded, they offer a mirror into our management of the land, air and water (canary in the coalmine)
  - Eg. 10% imperviousness/disturbance in Ag watersheds = extirpation of trout

The Economic Value of Rivers



The Economic Value of Rivers - Tourism

- Tourism is the 3rd largest industry in WI ($13 Billion/yr) behind agriculture and timber
- Tourism is largely associated directly with rivers and lakes
- WI has the 2nd highest number of Out-Of-State Angler Days (behind FL)


Great Iowa River Canoe and Kayak Race

The Economic Value of Rivers - Land

- Soil loss = lost $$
- Nutrient loss = lost $$
- Increase flooding = $$$$

The Economic Value of Rivers - Land

- Dam removal increases land values (UW study)
- *Example* – West Bend, WI Riverside Park

The Economic Value of Rivers

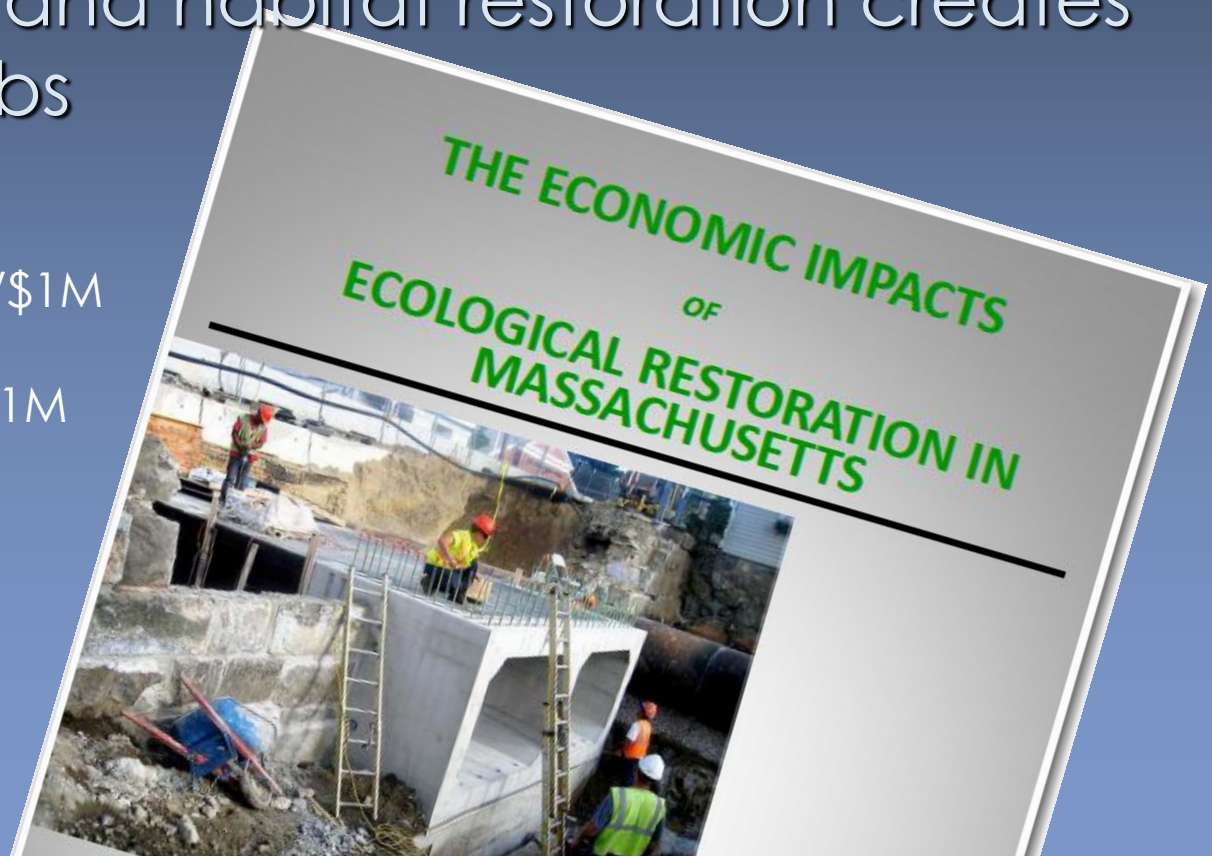
- A new era of accountability?
- Water quality costs
- Drinking water and public health

The Economic Value of Rivers - Jobs

- Restoration jobs provide a high ratio of jobs created versus money spent
- *Massachusetts* - $1 million of public investment in clean water and habitat restoration creates 12.5 full time jobs

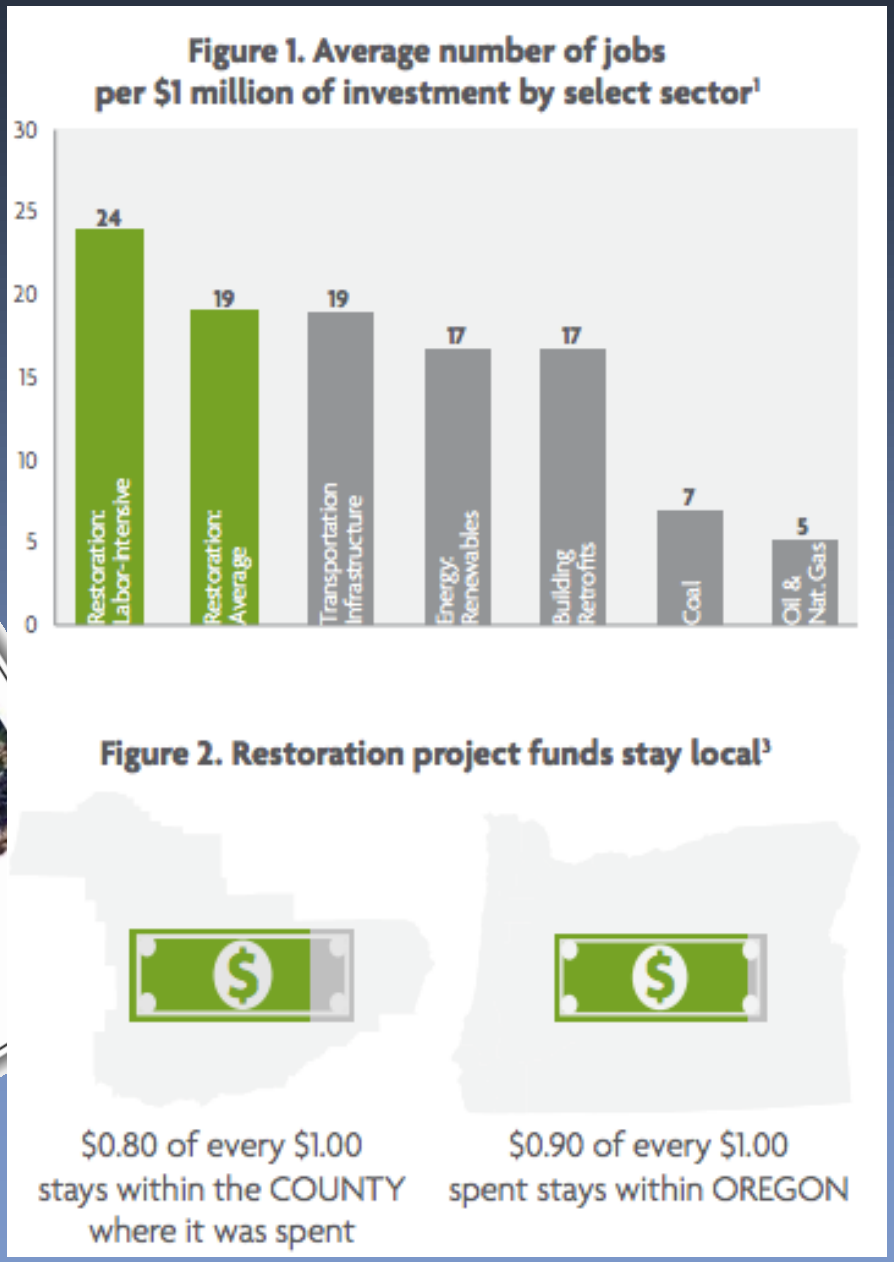
Road construction = 7 jobs/$1M

Military spending = 8 jobs/$1M

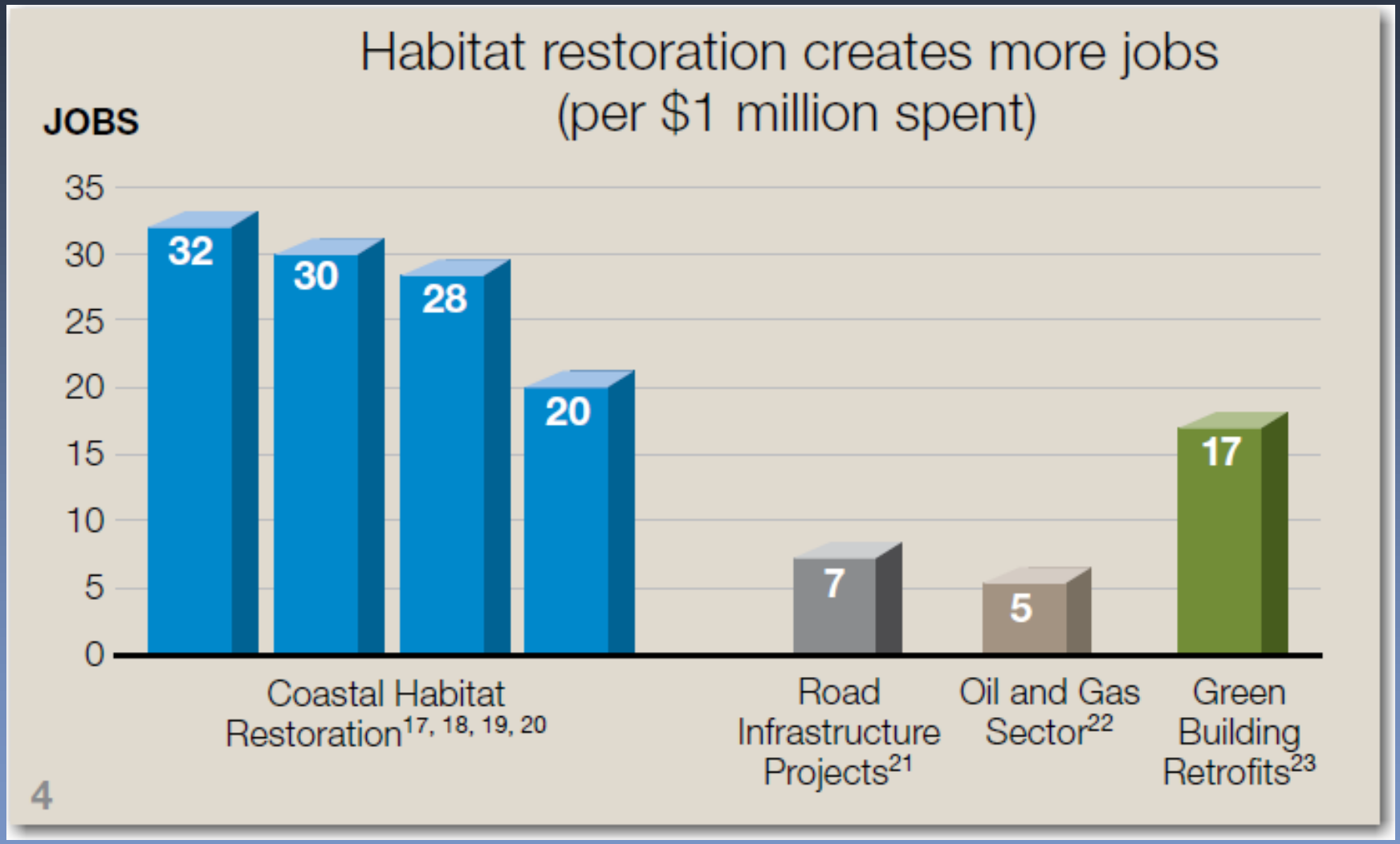


The Economic Value of Rivers - Jobs

- *Oregon* - $1 million of public investment creates 15-24 total jobs (Univ. of OR)
- Oregon projects from 2001 to 2010 and found the projects generated an estimated 6,483 jobs and nearly a billion dollars in economic output around the state.



The Economic Value of Rivers - Jobs



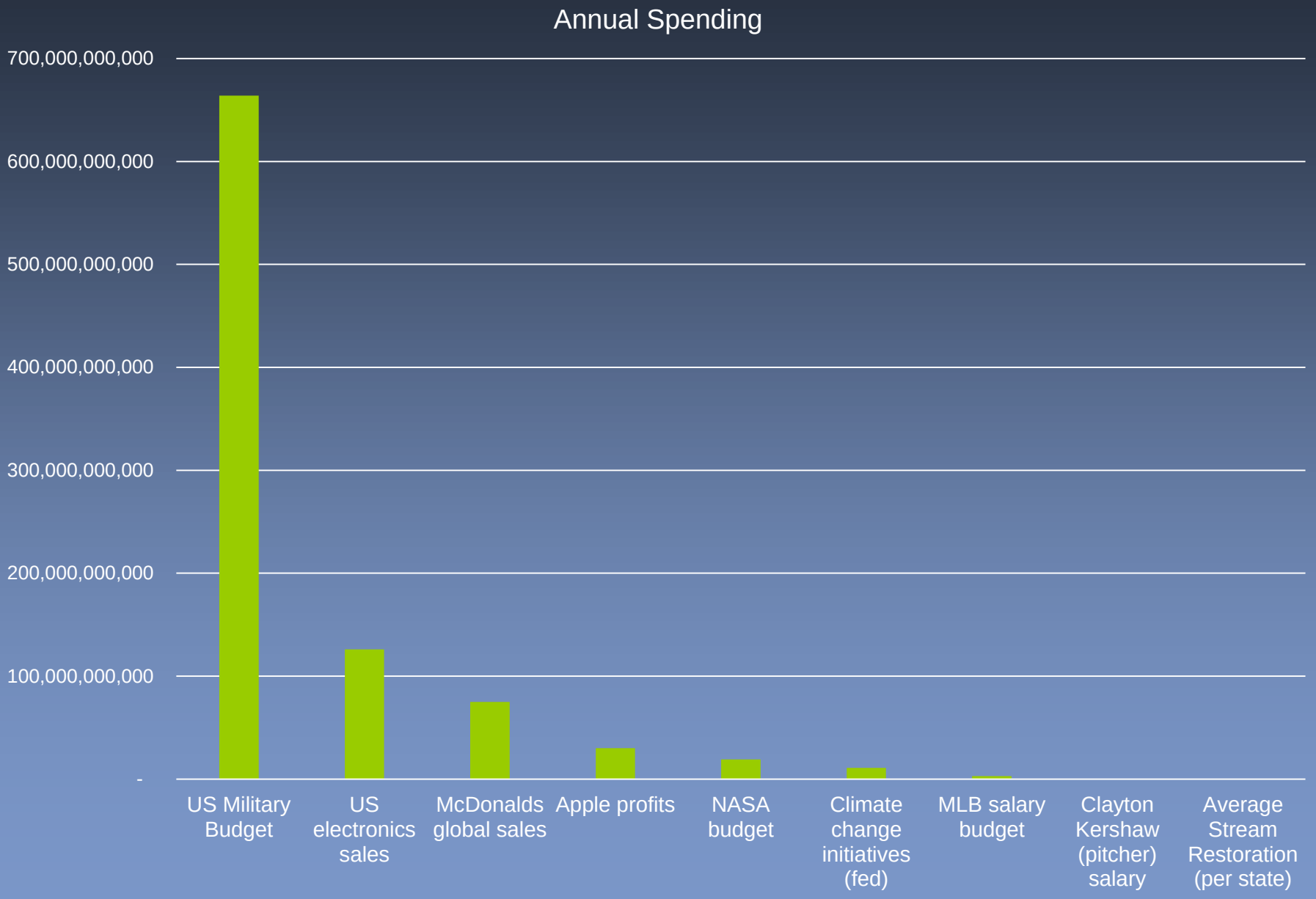
Courtesy NOAA 2013 – US Estuary Program

The Economic Value of Rivers - Municipal

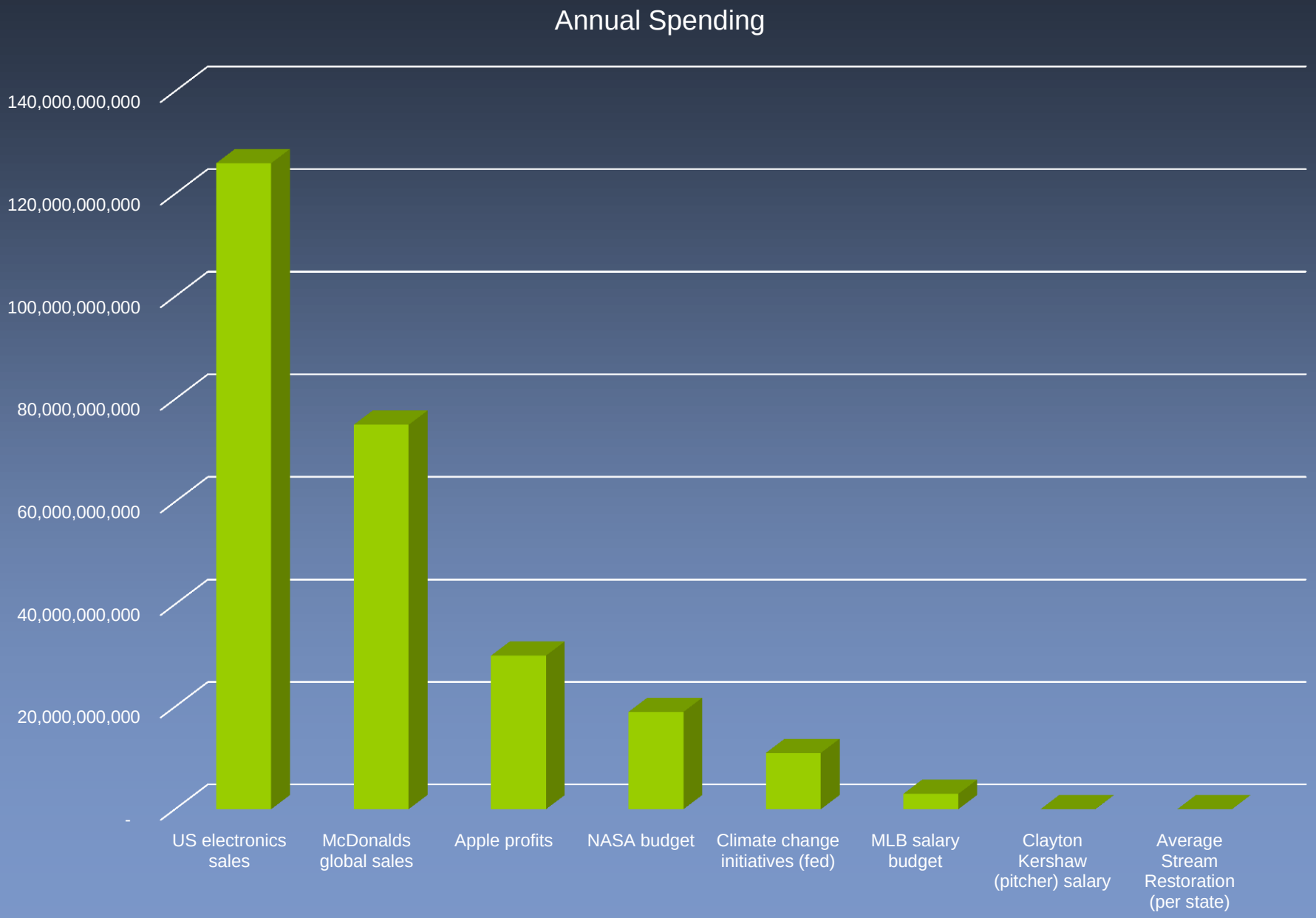
- Most US Cities originated on rivers and depended on river traffic for commerce, but that industry has waned

- We are learning now how to turn city attention toward the river again
  - E.g. Milwaukee parks, Downtown vitality
  - E.g. Racine – Once empty lake front beaches are now packed thanks to river and stormwater restoration *(90 days per year closed dropped to just 4 days in 5 years)*

How much do we spend on river restoration?



How much do we spend on river restoration?



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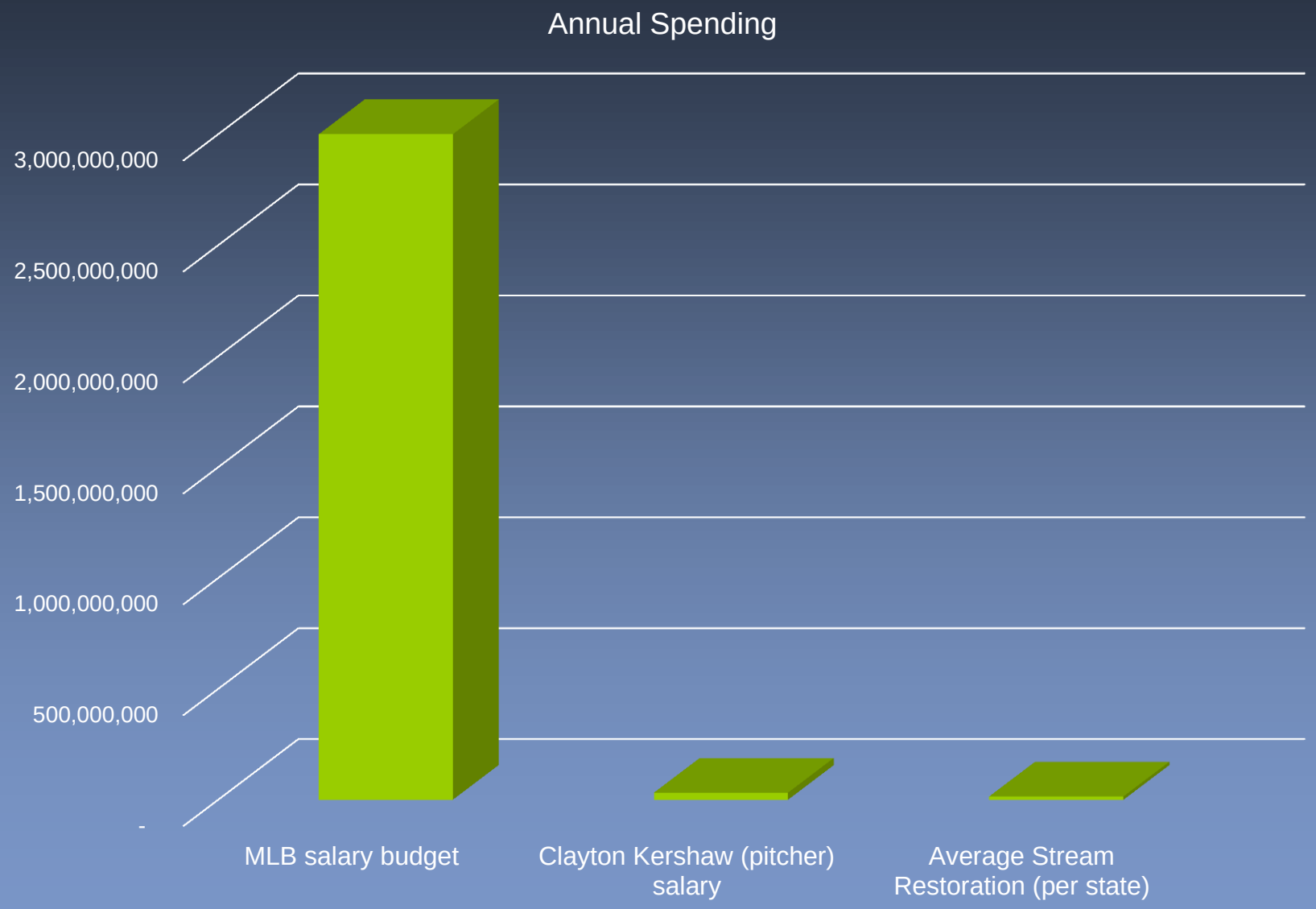
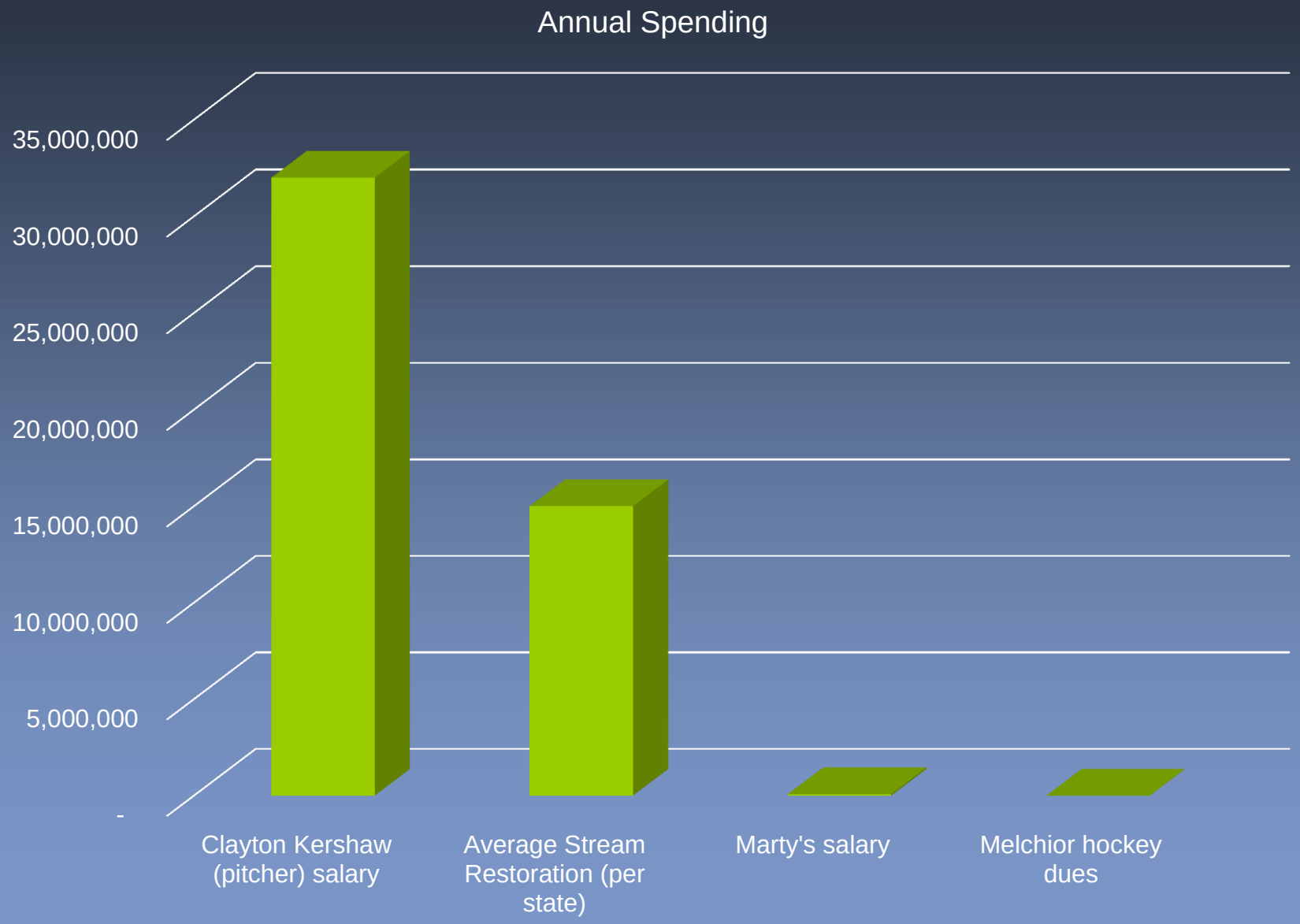
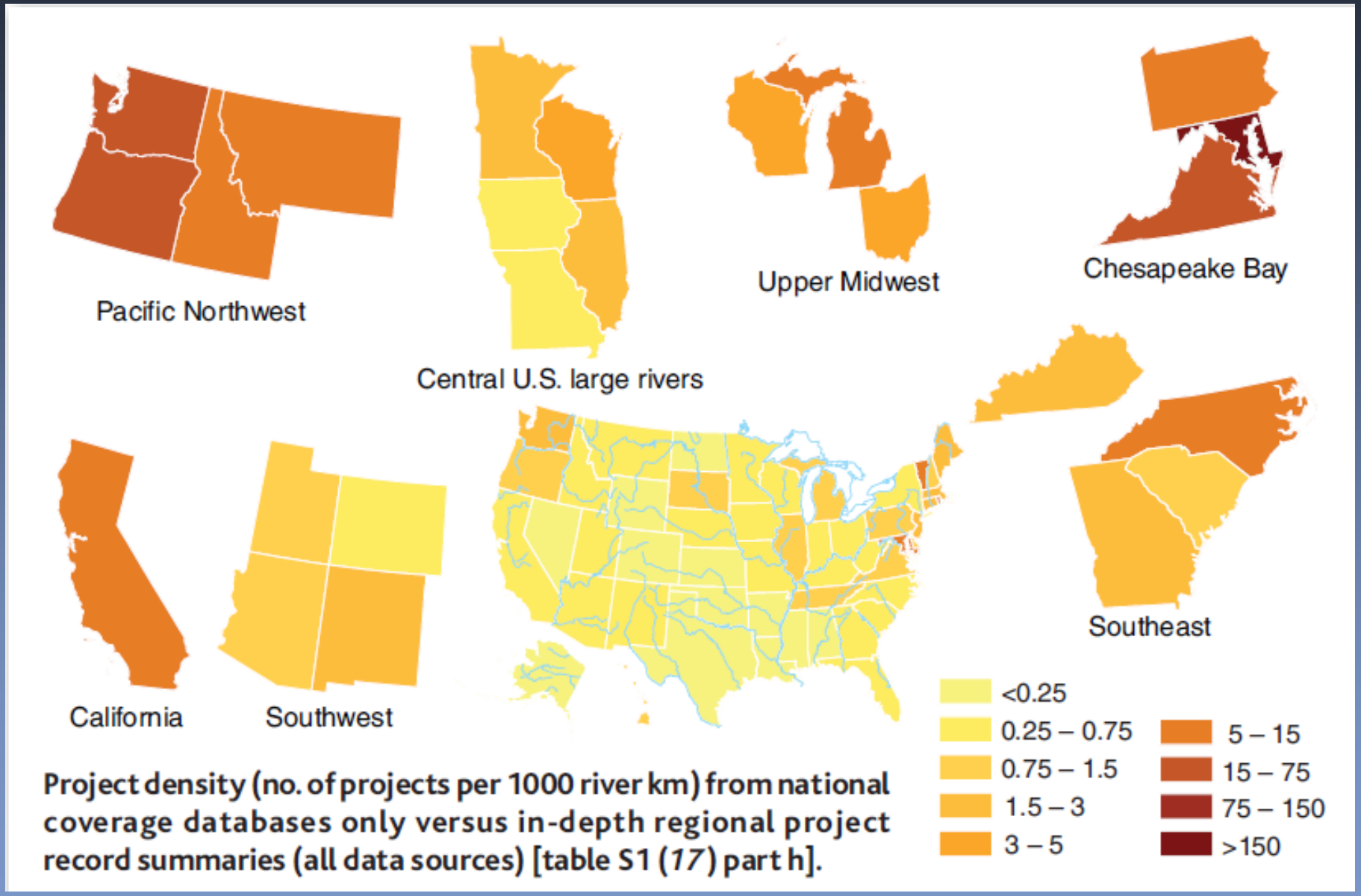


How much do we spend on river restoration?



Where is river restoration practiced?



Project density (no. of projects per 1000 river km) from national coverage databases only versus in-depth regional project record summaries (all data sources) [table S1 (*17*) part h].

From Bernhardt et al 2005 – Synthesizing US River Restoration Efforts – Science Vol 308

What Drives River Restoration?

- The most commonly stated goals or drivers in the NRRSS database:
  1. Enhance water quality
  2. Manage riparian zones
  3. Improve in-stream habitat
  4. Fish passage
  5. Bank stabilization

How long do projects take from assessment to completion?

- *Bank Stabilization*
  - *6 - 9 months with permitting*
- *Stream Restoration*
  - *1.5 - 3 years on average with permitting*
- *Dam Removal*
  - *3 - 7 years with permitting*

Best way to handcuff your own agency and ensure poor quality = Make grants that require construction in 1 year

How much do projects cost?

Inter-Fluve Ballpark Numbers

- Stream relocation ($50 - $500 per LF)
- Bank stabilization ($40 - $200 per LF)
- Small Dam Removal ($120K - $600K)
- Large Dam (>10ft) Removal > $1M

- *Inter-Fluve's average design contract over the past 100 projects is $60,000 but ranged up to $400K.*
- *Design costs were 20 – 40% of construction costs.*
- *Construction costs averaged $180,000 but ranged from $30K up to $5M.*

How much do projects cost?

NRRSS Database (roughly 20,000 projects with associated funding data)

Project Type	Average Cost
Land acquisition	$812,000
Floodplain reconnection	$207,000
Channel restoration	$120,000
Dam removal	$80,000
In stream habitat	$20,000
Riparian management	$15,000

Average of $1 billion per year spent over 27 states

Bernhardt et al 2005

What makes up a successful state river restoration program?

Essentials in a State River Restoration Program

Summary from staff at successful programs - Mass. DER, MDDNR, OR/WA, American Rivers

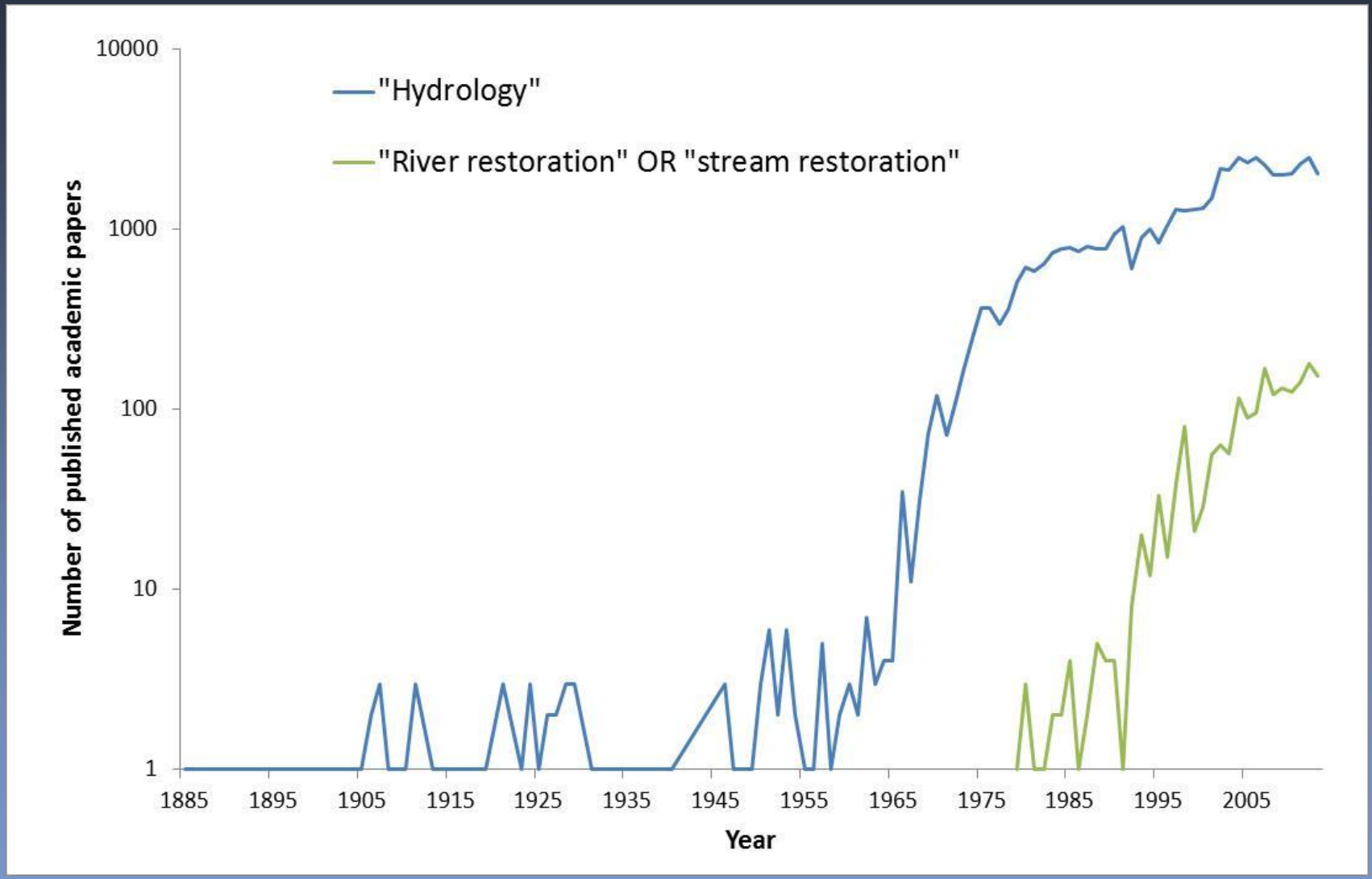
1. Dedicated management staff with goals
2. Adequate funding of the program
3. Adequate funding of projects
4. Watershed group initiation and assistance
5. Technical Guidance from the State
6. Enforceable Dam Safety Laws
   - Owners must inspect and either repair or remove dams
   - Owners are made aware of their personal liability
7. Qualified designers

Other elements identified:

- Combined watershed/stream approach
  - Start with uplands/wetlands in headwaters
  - Start upstream and work your way downstream
  - This embodies the combination of watershed restoration and stream restoration and tackles both simultaneously
  - Think big

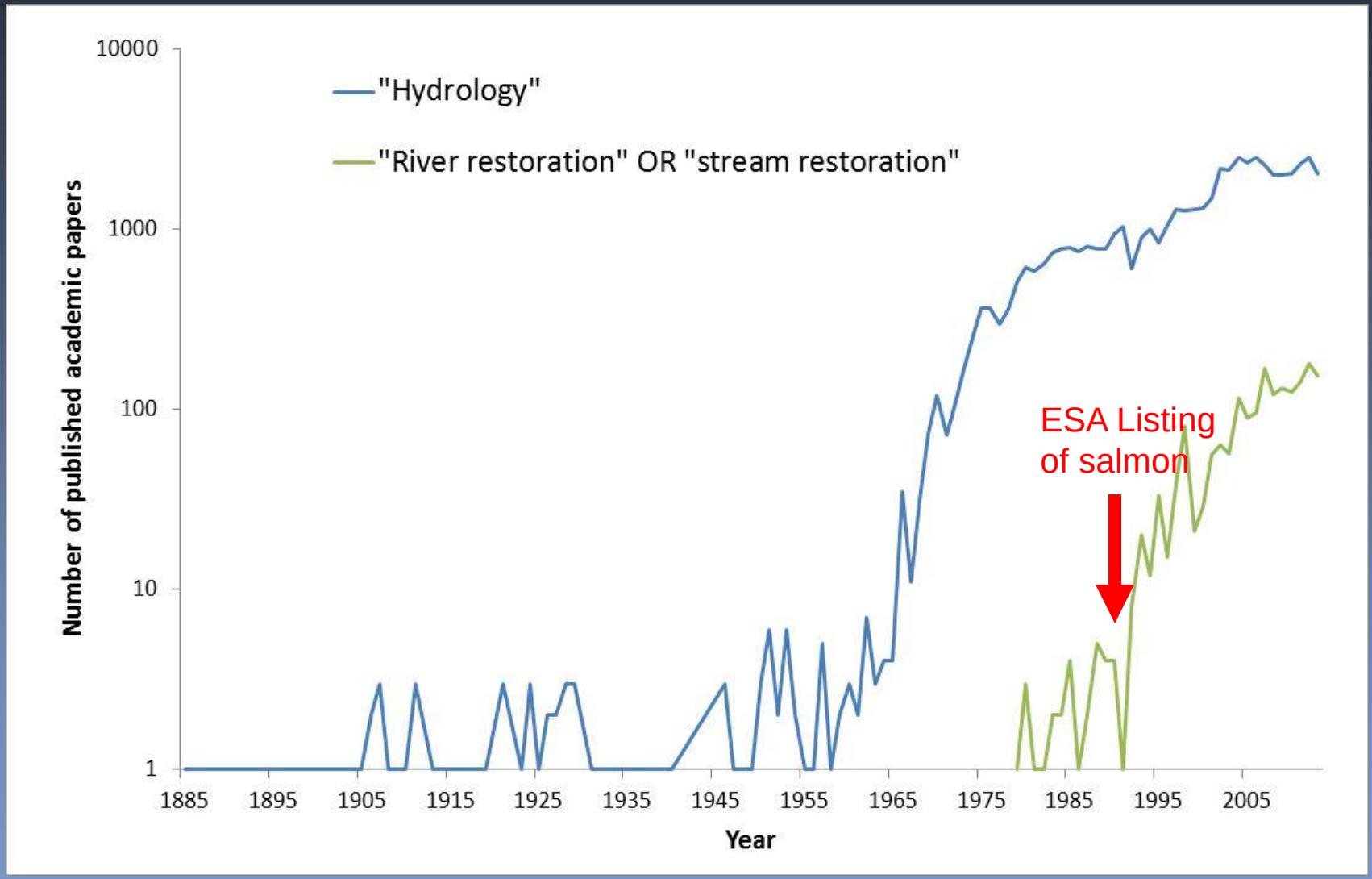
How has river restoration changed over time?

River restoration science is still young



- *Published literature*

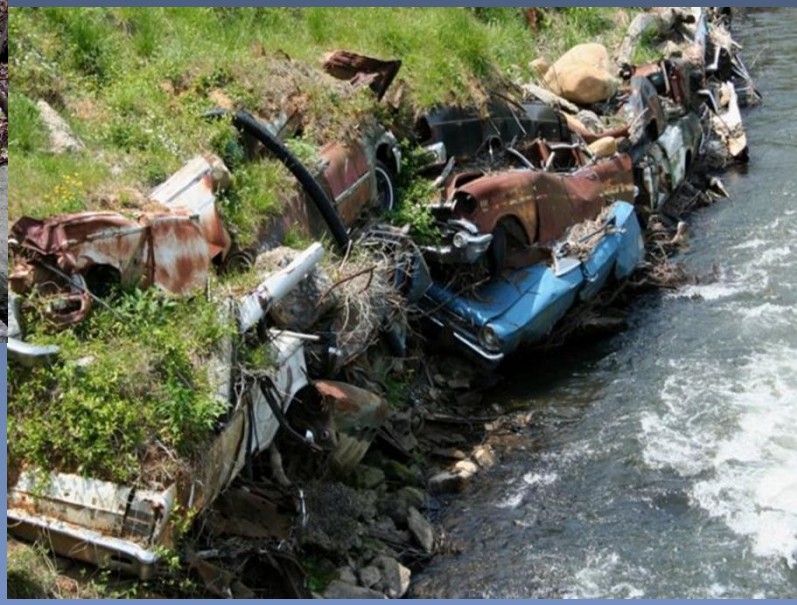
River restoration science is still young



- *Published literature*

Traditional approaches

- We've come a long way in our understanding of rivers, ecosystems and connectivity. Rivers were seen as simply conduits for floodwater. That's changing.



From the Rogues Gallery of Bank Stabilization

Structural approaches used elsewhere don't always make for good river applications

Restoration failures result from:

- Knowledge of biology, but lack of engineering
- Applying blanket fixes

Other kinds of failure

- Knowledge of engineering, but none of biology
- *Size of riprap is inversely proportional to info*

River restoration possibilities

Examples of river and stream restoration from other states

Balancing art and science

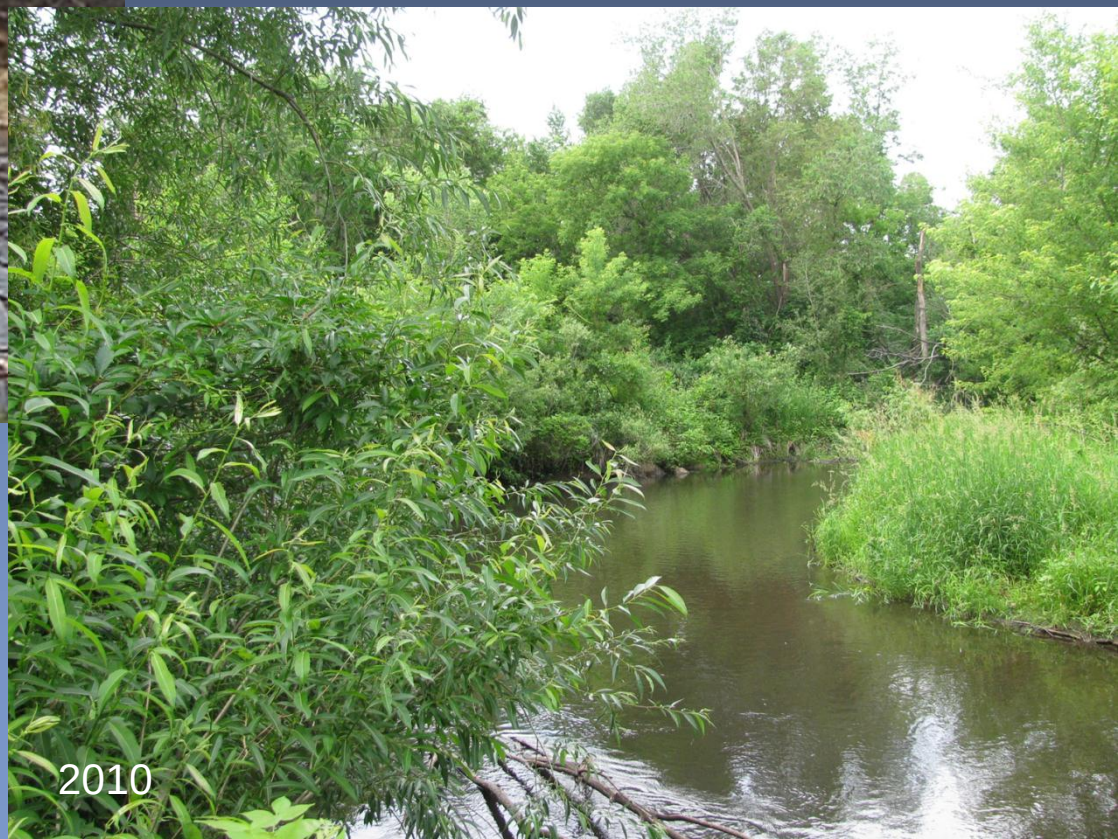
- Stream restoration involves many sciences
  - Each branch of science lends objectivity to an otherwise subjective process.
  - *Right brain (art)* – intuitive, creative and subjective
  - *Left brain (science)* – objective, logical and analytical
  - **Science provides geologic, hydraulic, ecological and other guidelines/constraints that keep us on the right track.**

$$T_b = \rho g h S$$

Bank stabilization

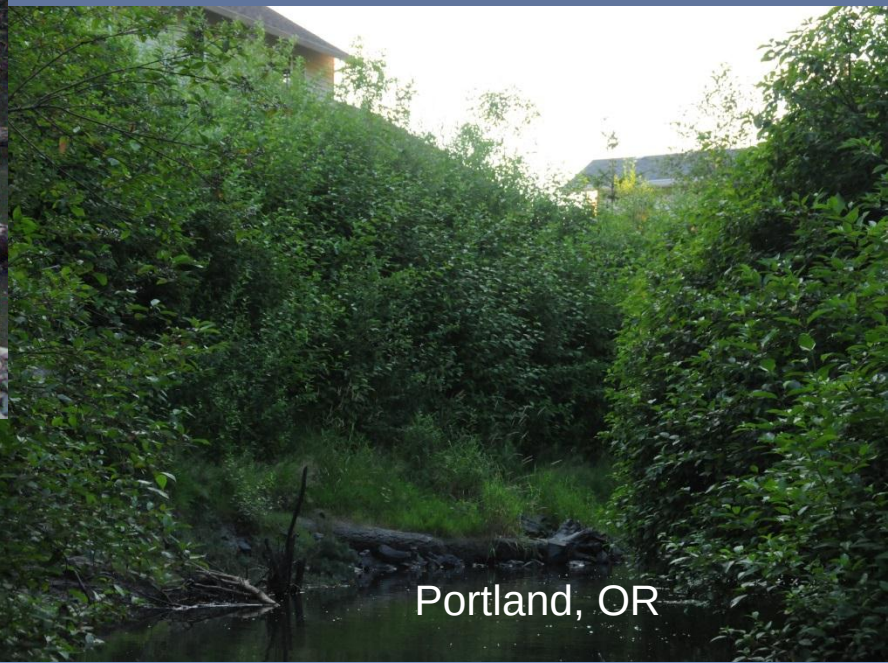
- *Example* – Bioengineering isn't new, but it has evolved slowly since the 1900s.

Farmington, MN

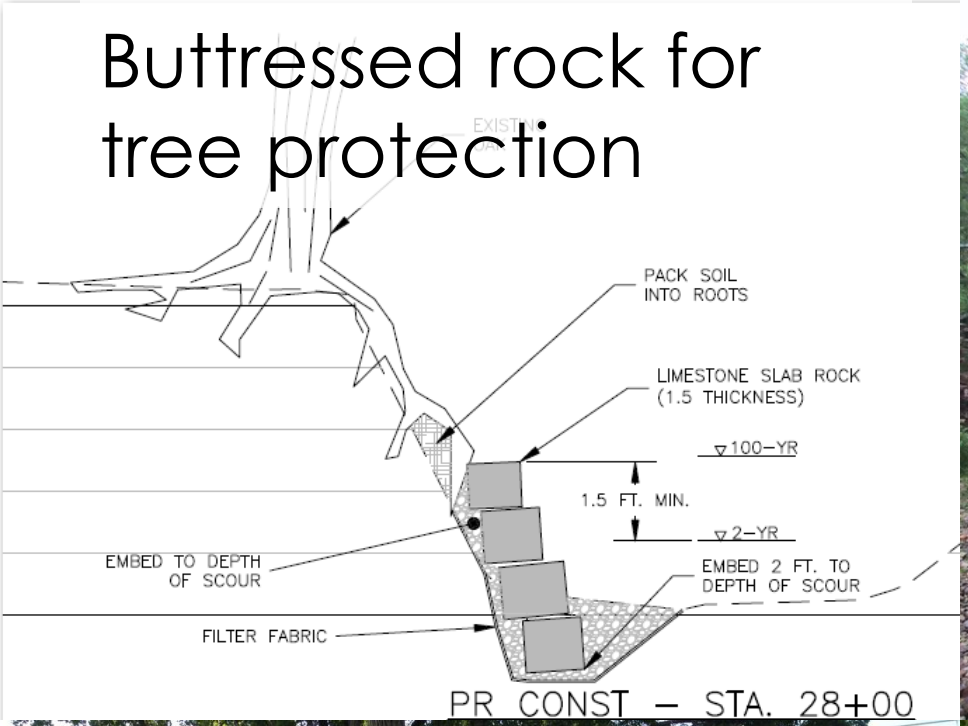


Bank Stabilization

- Example – There are many ways of stabilizing using bioengineering concepts. Here, stacked cells create an immobile bank for stabilizing in steep areas where no migration is allowed



Buttressed rock for tree protection



- Encapsulated toe
- Underwater life of fabric is substantially longer than wet/dry
- Can gain 5+ years of vegetation growth

Native vegetation

- *Example* – Riparian vegetation buffers are now seen as a way of transitioning from the built to the natural

Plymouth, MA

Modern Considerations

- *Plantings have become more diverse*
- *Community succession*
- *Invasive control*
- *Growth and stock size*
- *Browse control*

Habitat recovery

- *Example* – Creation of pools and riffles in a cattle damaged creek following exclusion of cattle from the stream banks and bed

Montana

Nursery Habitat Creation

- *Example* – Reconstruction of a headwater valley and stream system

Plymouth, Wisconsin

Nursery Habitat Creation

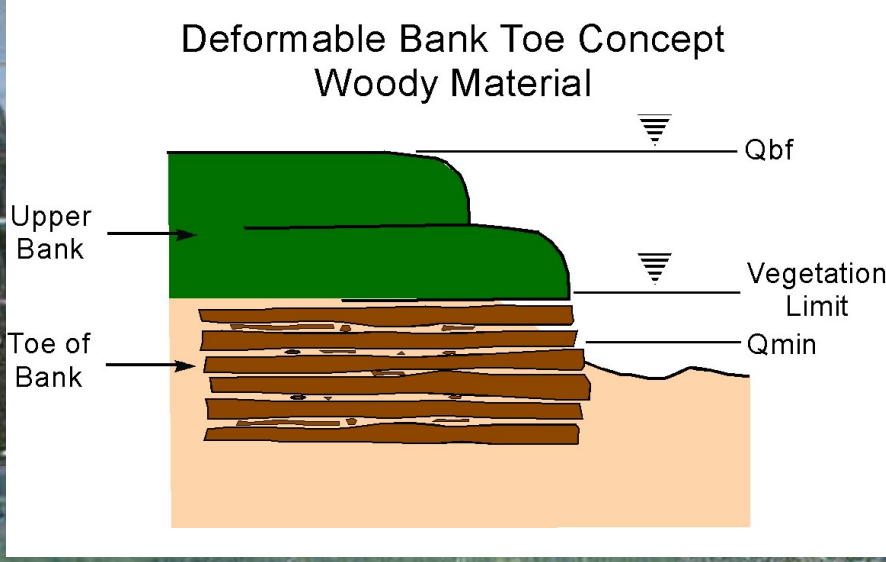
- ***Wisconsin - After 2 yrs***

Incorporating wood

- *Example – Dual purpose treatment* - Log placement for habitat and bank stabilization

Ashland, WI

Channel defining elements


Deformable Bank Toe Concept
Woody Material
Qbf
Upper Bank
Vegetation Limit
Toe of Bank
Qmin

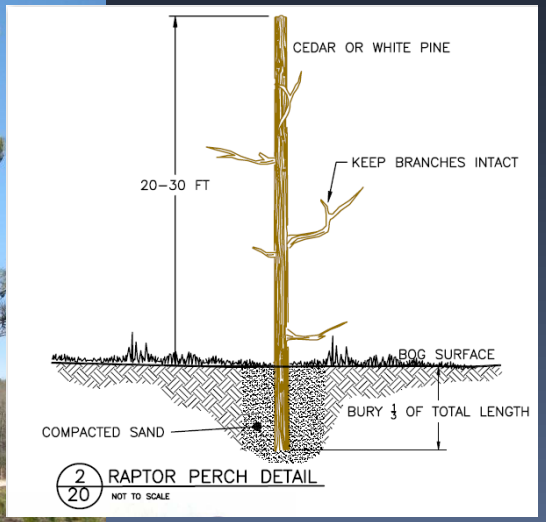
Bank reconstruction

- *Example* – Encapsulated soils used to build new banks

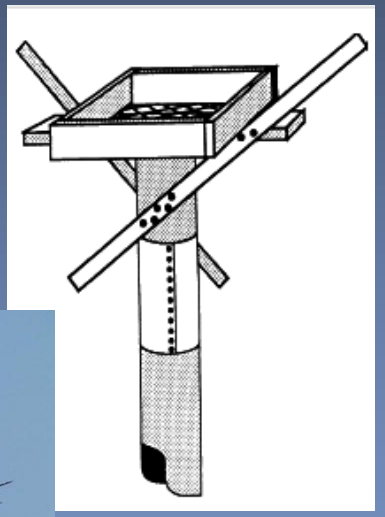
New Jersey

Natural channel restoration

- *Example* – We are moving toward synthesis of knowledge, and incorporating more complexity



Red Tailed Hawk



Osprey Platform

Incorporating wildlife features

DOT Channel Relocation

- *Example* – Channel relocation can now be used to mitigate for road construction, possibly improving

Rapid City, SD

Urban Channel Reclamation

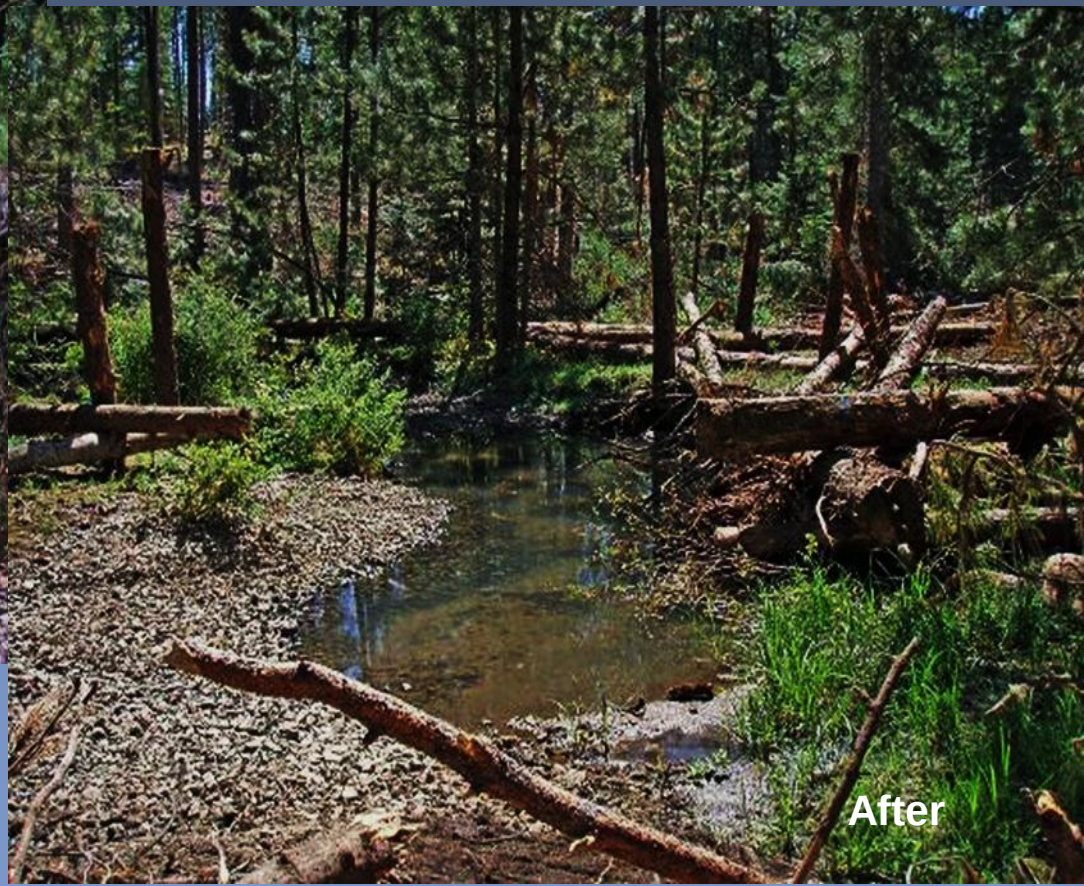
- *Example* – Removal of concrete and creation of a floodplain and stable, naturalized channel

Milwaukee, WI

Incised Channel Reclamation

- *Example* – Elevation of an incised channel to allow flood energy to dissipate on the former floodplain

Seattle, WA



Channel raised 3ft to reconnect the river with its floodplain

Incised Channel Reclamation

- *Example* – Channel elevation can include in-line infiltration underneath the stream

Shakopee, MN

After

Grade Control

- *Example* – Constructed immobile riffles combine a natural feature with infrastructure stabilization

Floodplain lowering

- As flood storage becomes more important, floodplain recovery grows in popularity
- Alternative when channel elevation is not feasible

Urban Wetland Stream Reclamation

- *Example* – Urban river corridors are increasingly being seen as connectors for both wildlife and people

St. Louis Park, MN

Wetland Channel Reclamation

- *Example* – Wetland stream restoration was historically limited by equipment available

Plymouth, MA

GOLF COURSE STREAM RELOCATION

Tahoe, CA

- *Example* – Golf courses can learn to use stream restoration as an amenity rather than viewing the stream as a conduit for water.
- Audubon certification

Fish passage

- *Example* – Fish bypass channels can be designed to function as natural channels for a wide variety of species.

Hood River, OR

Culvert Fish Passage

- *Example* – Aquatic Organism Passage or Stream Simulation requirements are improving connectivity

Western Massachusetts

Dam Removal

- *Example* – 75,000 small dams, getting older every day

Central WA

Bluff Erosion

- *Example* – Bluffs are now implicated as a major source of sediment inputs on Midwestern streams

Jordan, MN

Gully Erosion

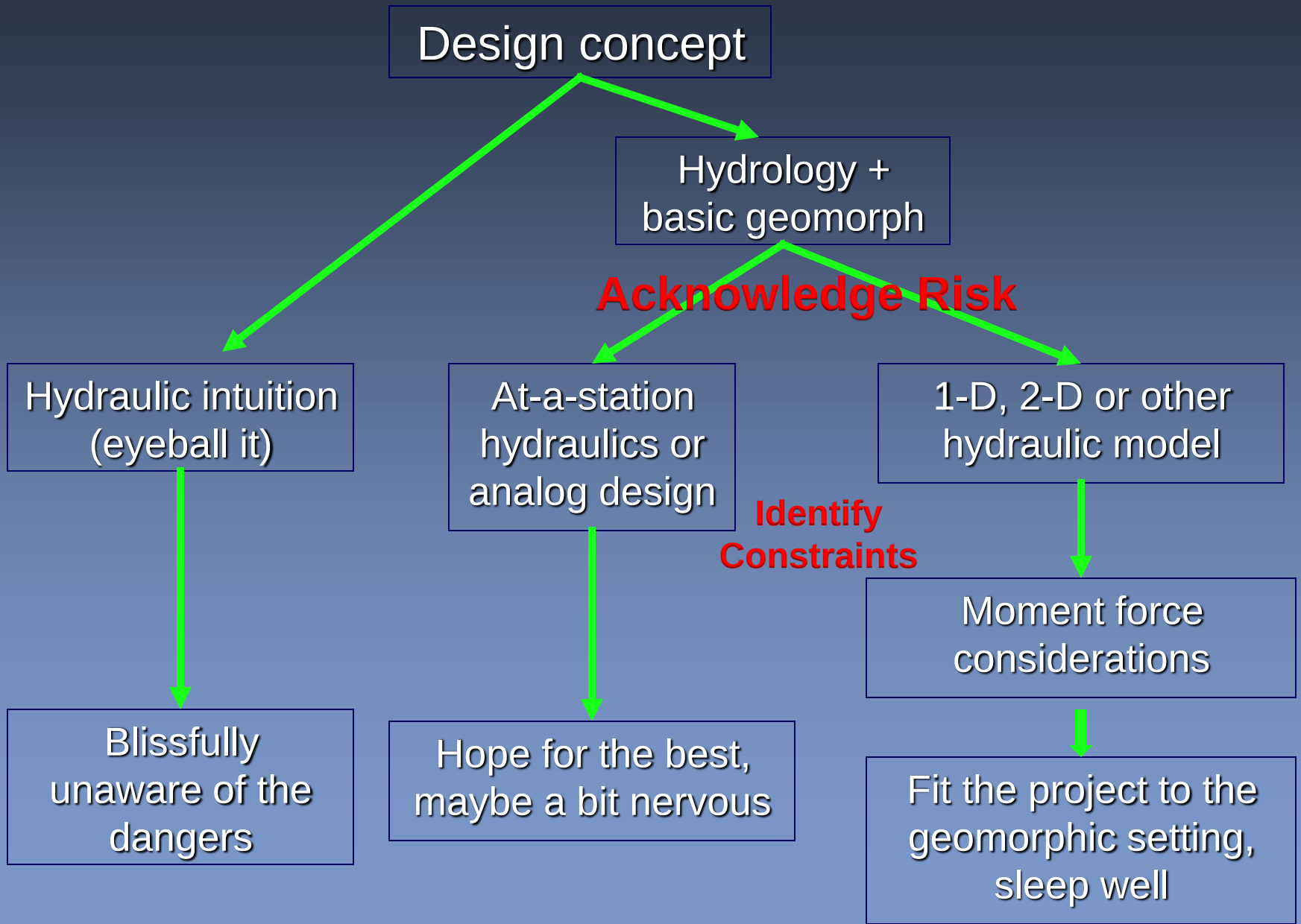
- *Example* – Gullies are right behind bluffs in terms of sediment inputs. Urbanization and Ag impact them.

Rochester, MN

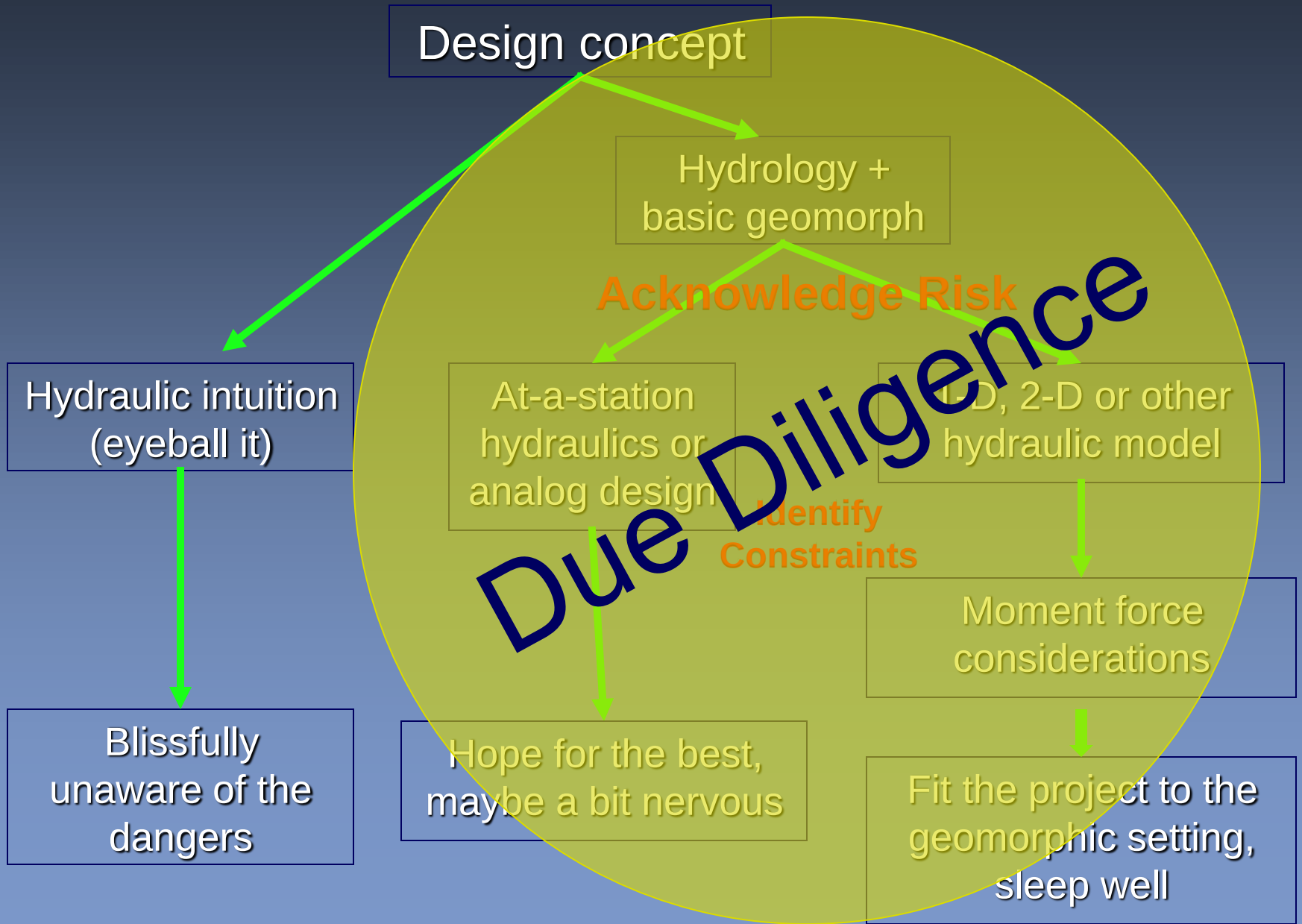
Balancing risk and other goals

- Positive changes are happening
- Healthy understanding of risk
  - Public safety
  - Infrastructure
  - Ecological damage
  - Money spent
  - Reputation/perception
  - Potential for future funding

Due diligence in design



The umbrella of due diligence



Building natural systems

- *A high level of proficiency can result in a fully functioning stream system in a short time*
- *Risk of failure is high from multiple directions*
- *Standards and due diligence reduce that risk*

Alaska, but could be Iowa!

Summary


Thank you
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