The Science Behind Instream Flow Laws

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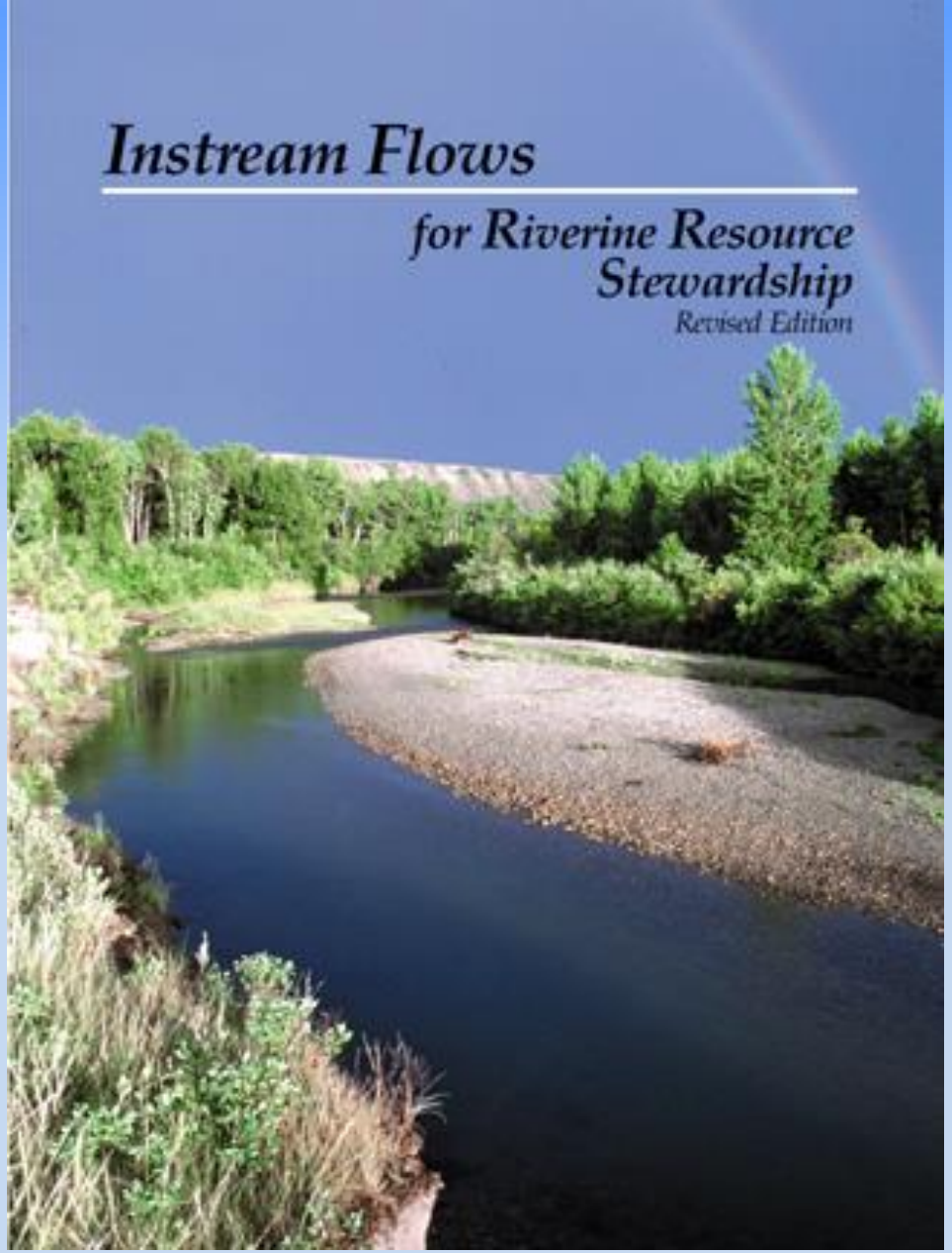
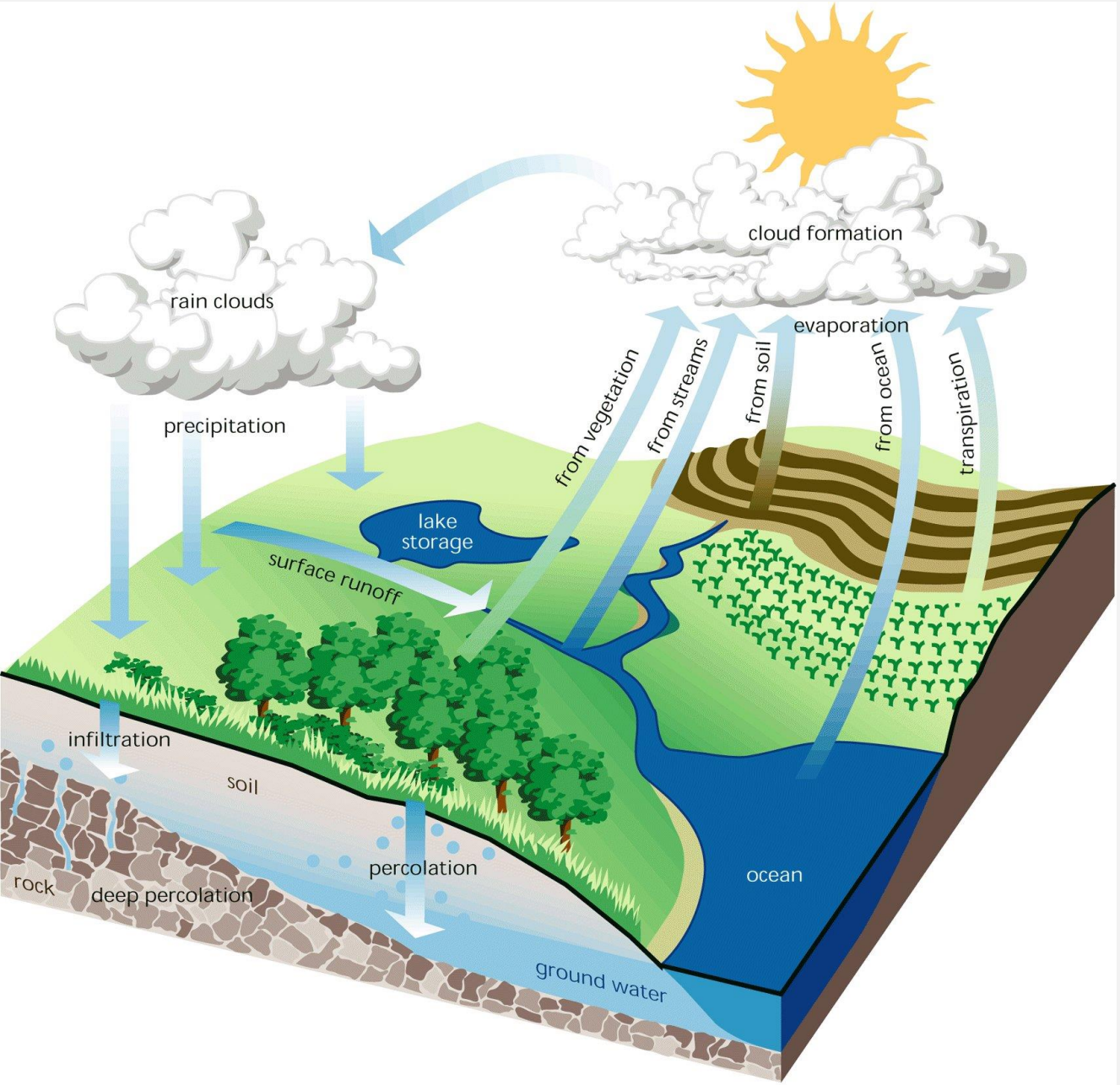


www.instreamflowcouncil.org

Session Format

- Elements of instream flow – context
- Riparian doctrine principles and considerations
- Appropriation doctrine principles and considerations



Water, land, and people are intimately connected

"When you pull on one string in nature, you find it is connected to everything else"

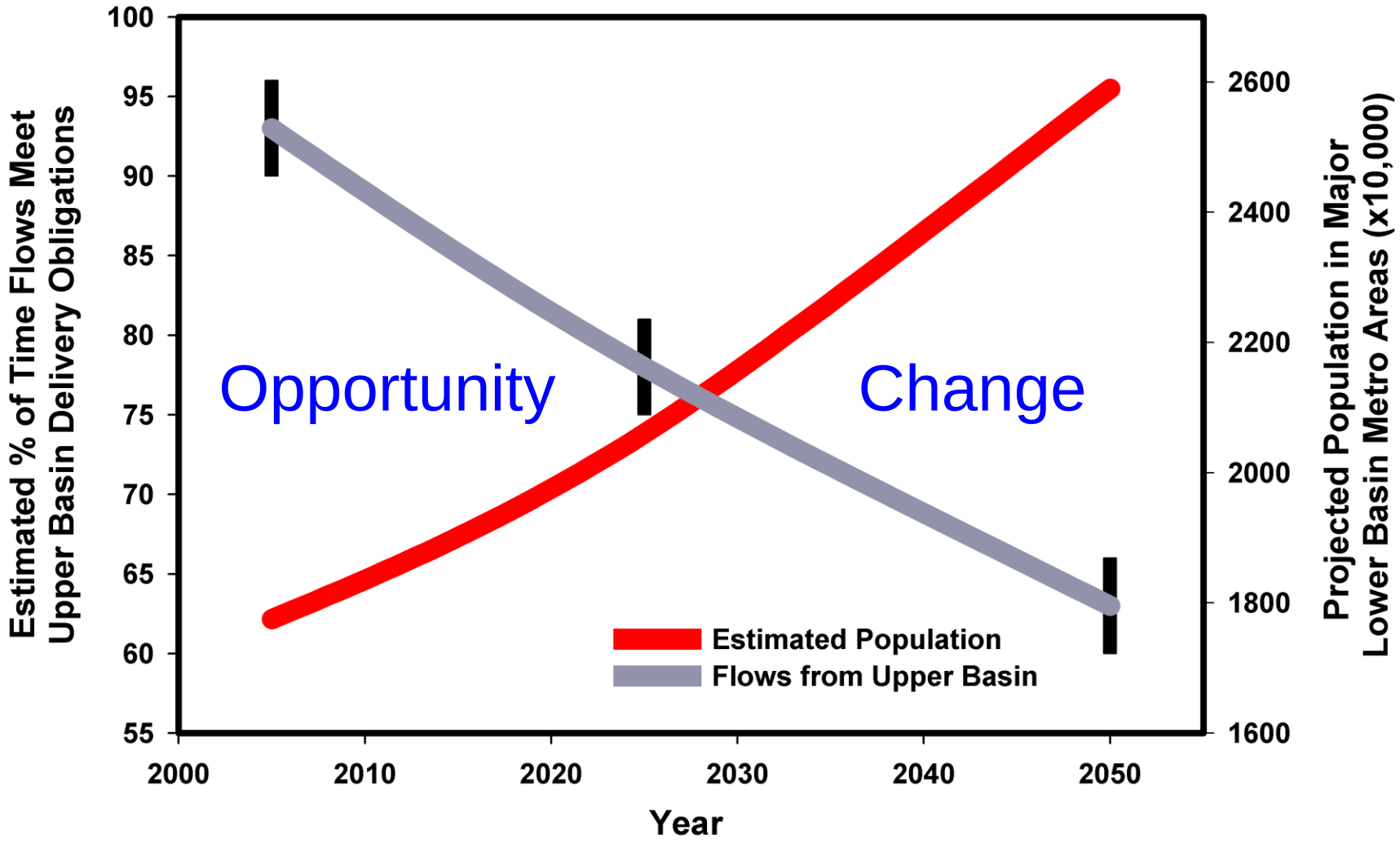
John Muir

All water users strive for certainty and control

Weather variability patterns, water availability and changing human values and needs complicate things

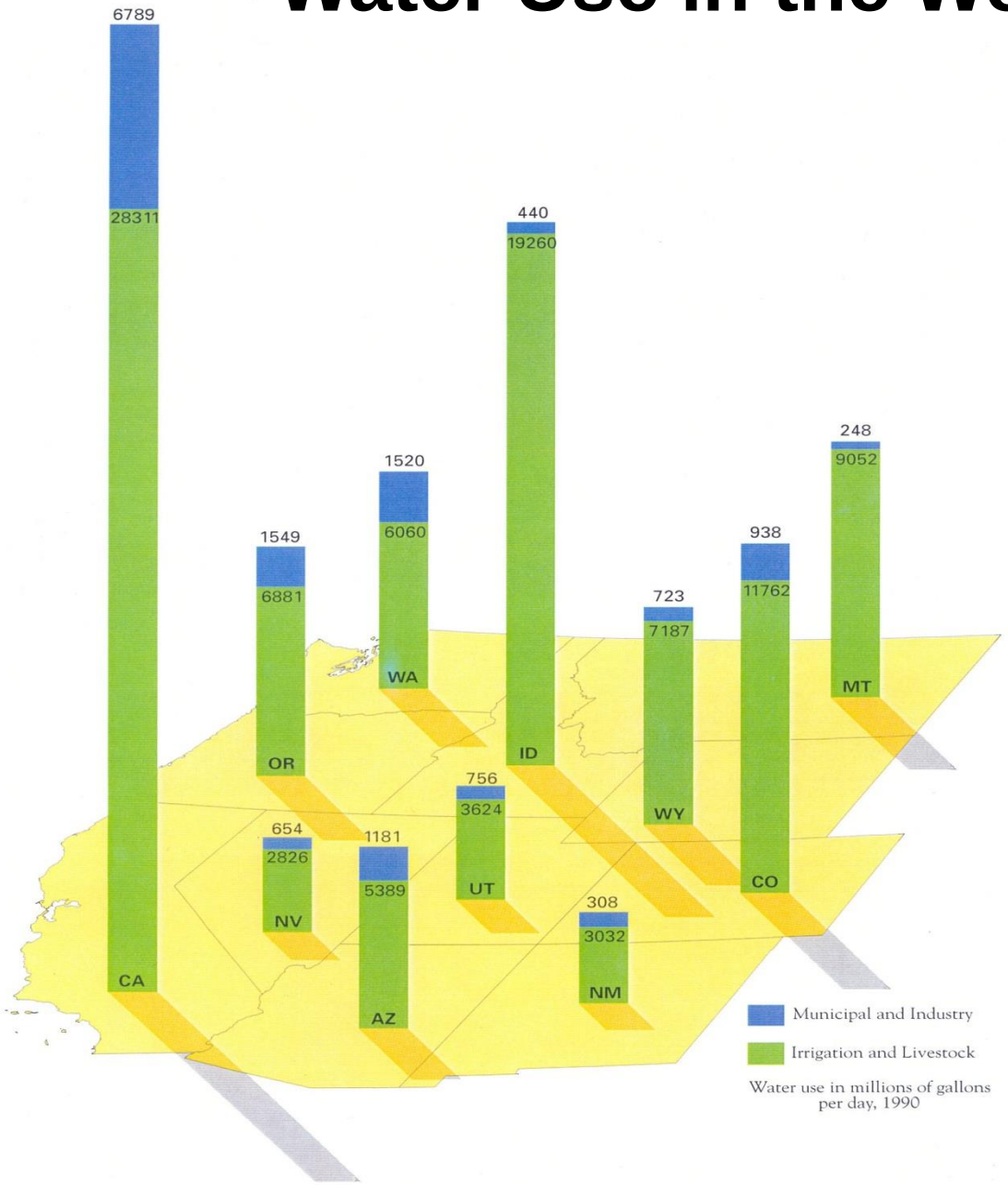
“Don’t worry. We’ll work with you!”

Projected Upper Colorado River Flows vs. Population Growth in Major Lower Basin Metropolitan Areas

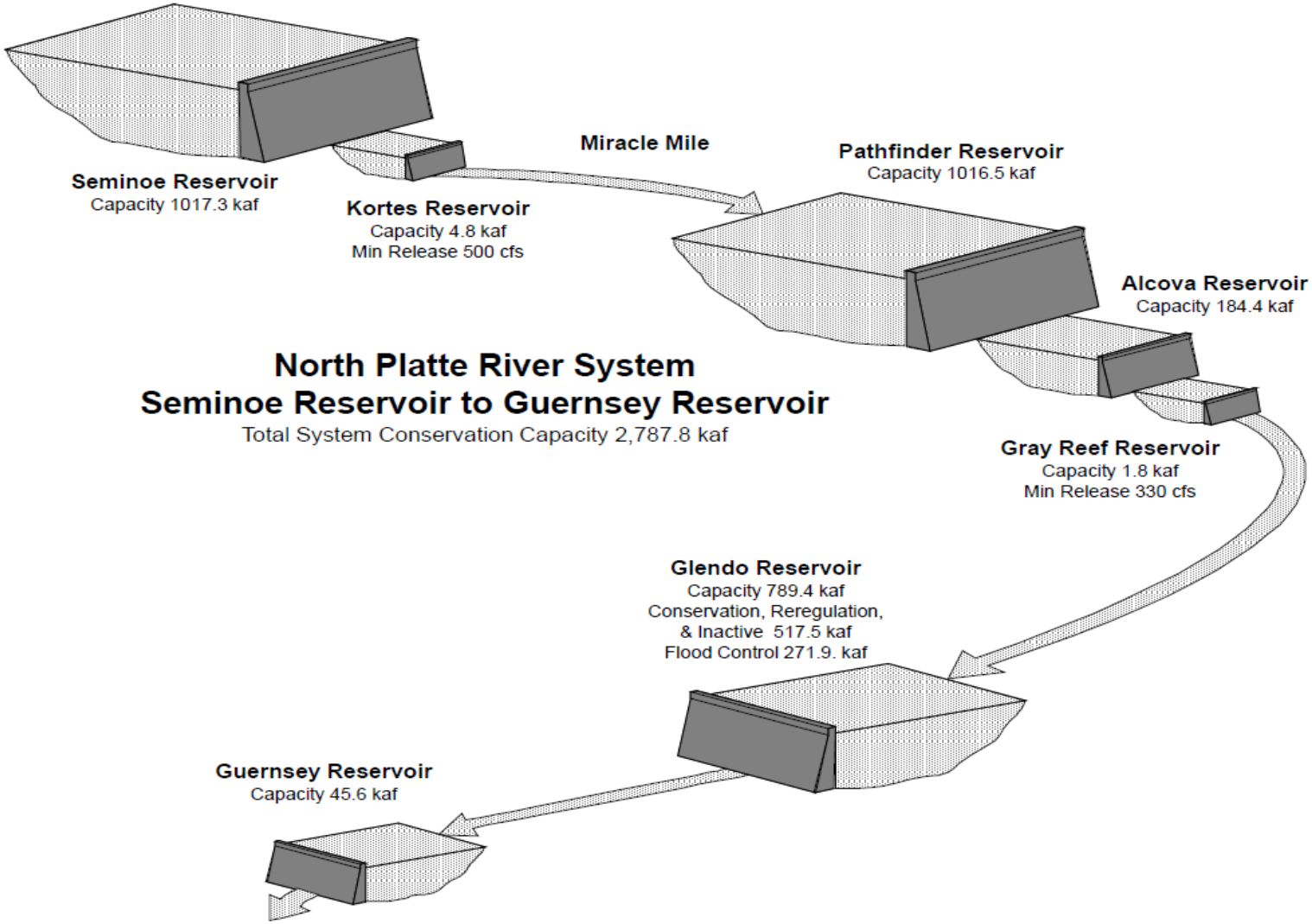


Source: McCabe and Wolock 2007

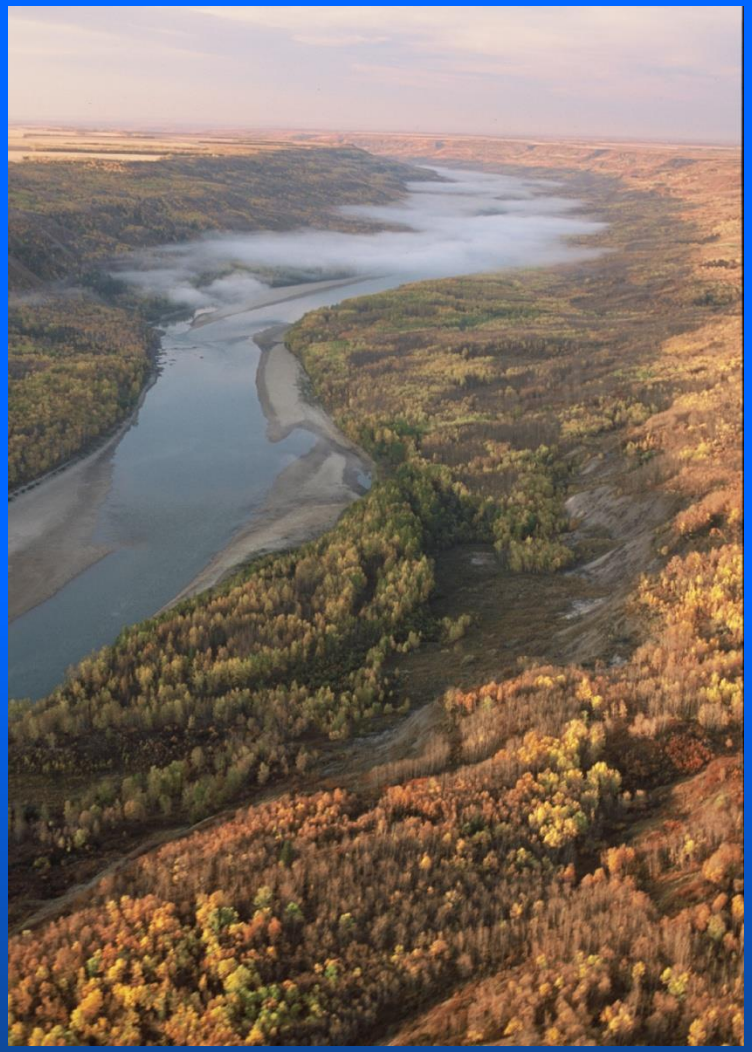
Water Use in the West



Effective water management is more than building “buckets and pipes”



Instream flow isn't an issue of JUST how many fish are in the river (or lake)



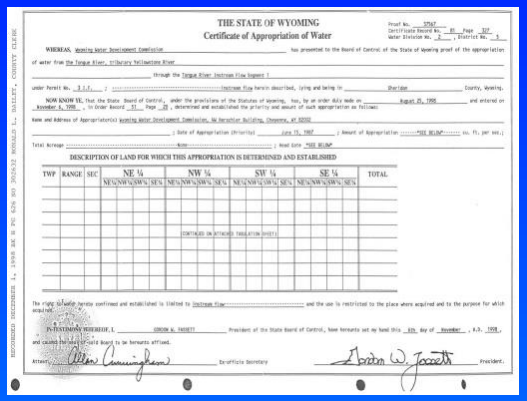
?

It’s an issue of world view and quality of life.

What is instream flow?

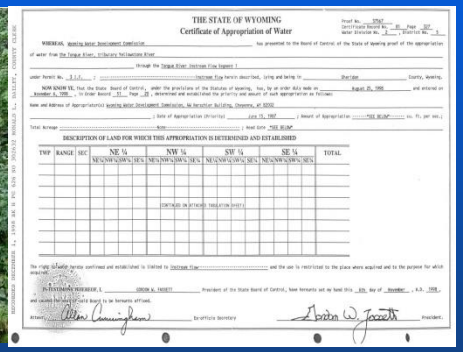
Instream Flow Can Mean:

Water in the creek but no regulatory mechanism



THE STATE OF WYOMING
Certificate of Appropriation of Water

Water permit or right but no water



THE STATE OF WYOMING
Certificate of Appropriation of Water

Water in the creek that's protected by an enforceable regulatory mechanism

River system or just a segment?

A little water, some of the time?

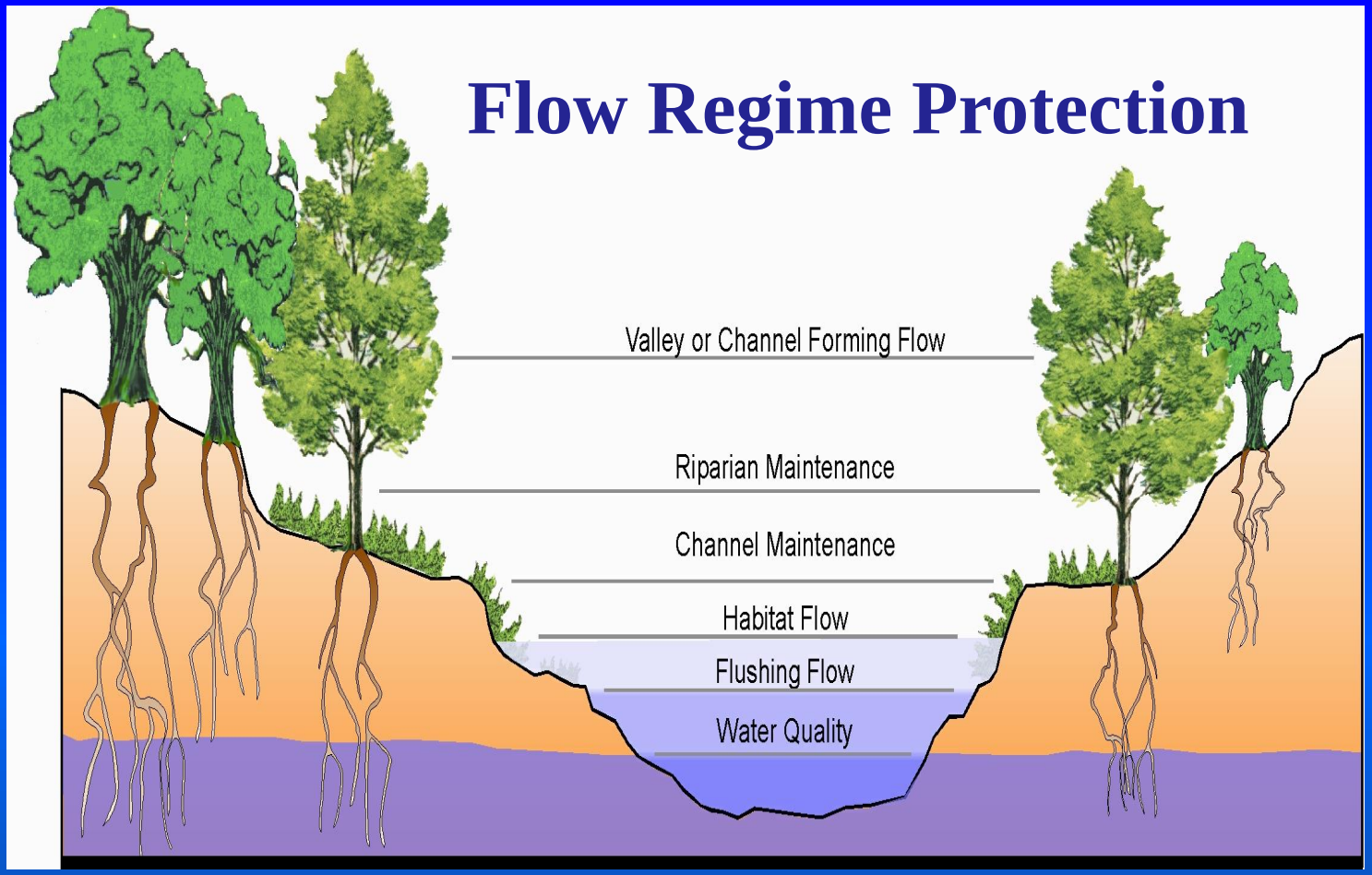
A seasonally adjusted flow regime?

Protection vs.

Restoration vs.

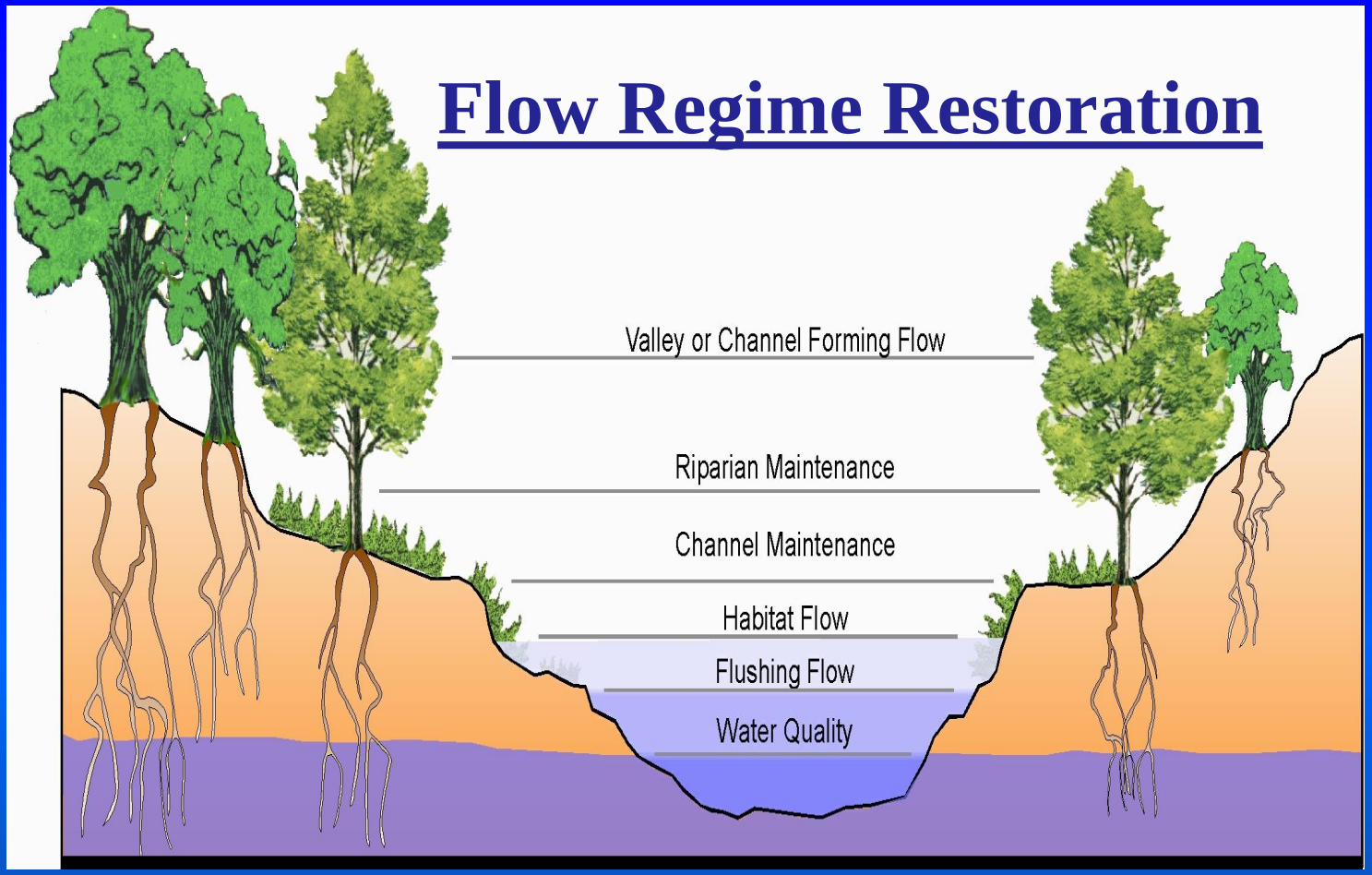
Mitigation

Flow Regime Protection



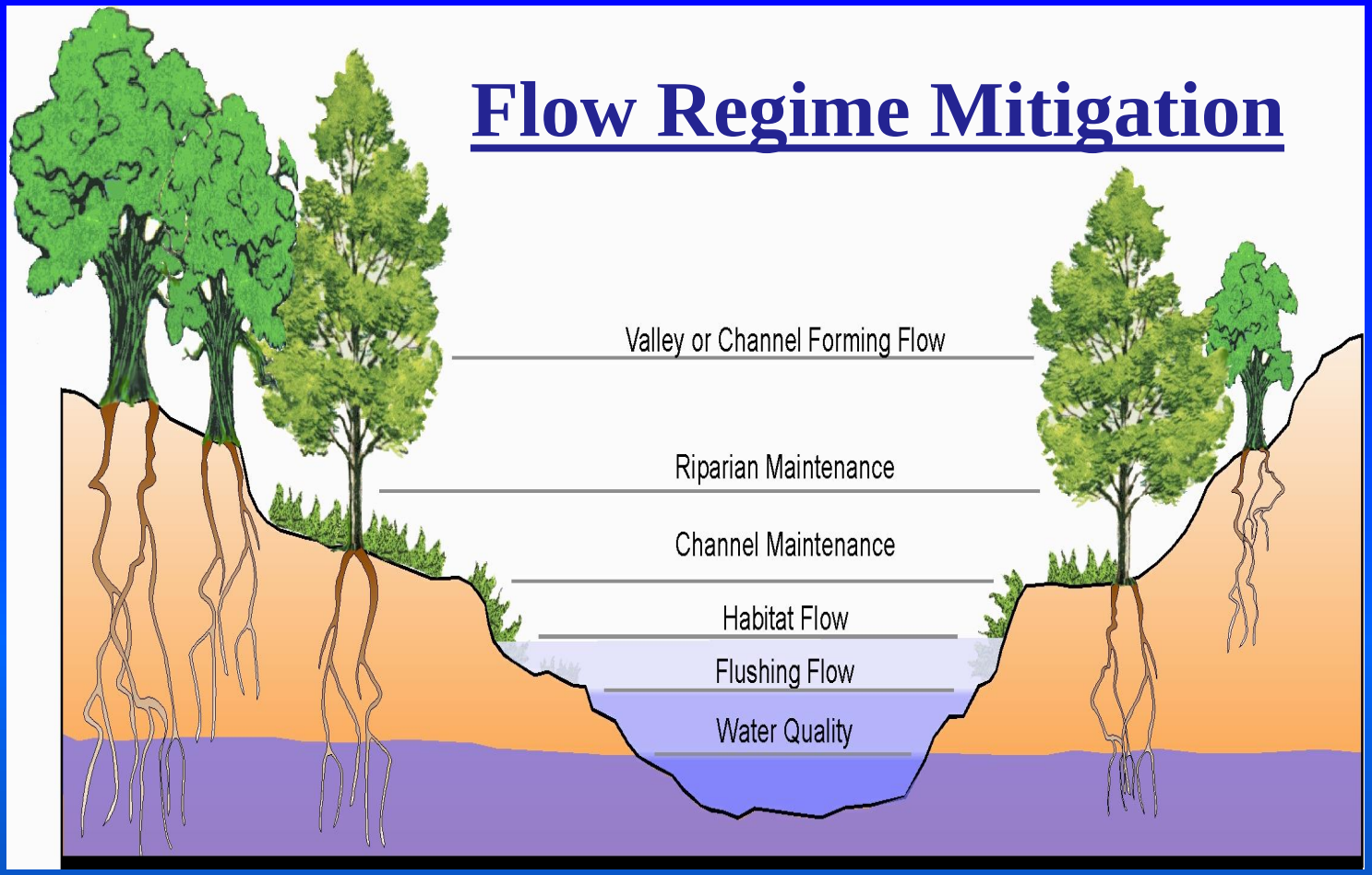
- *Upside Down Instream Flow*
- *Water is usually available*
- *Public land issue*

Flow Regime Restoration



- *Bottom up instream flow*
- *Need to find water*
- *Private land issue*

Flow Regime Mitigation

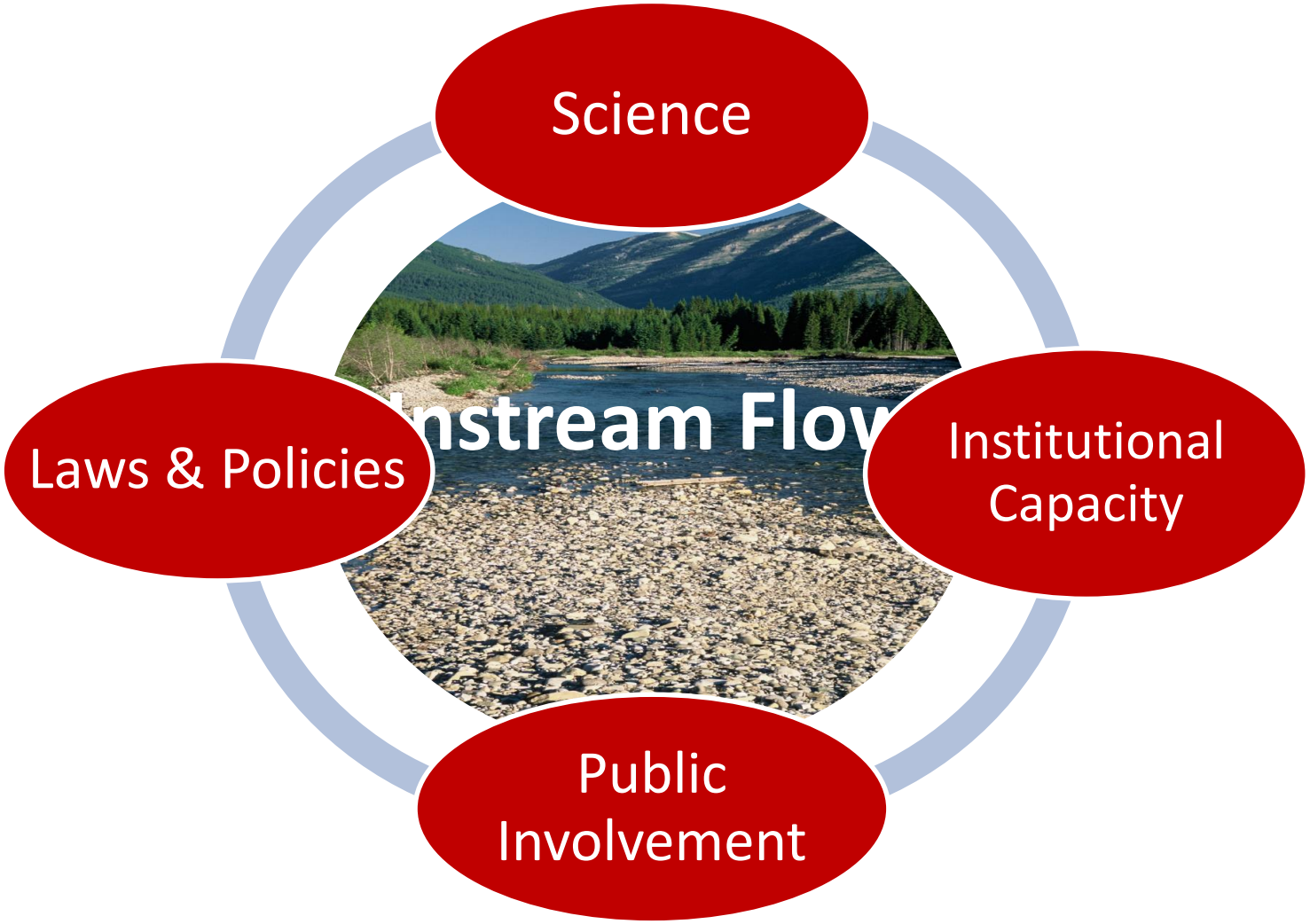


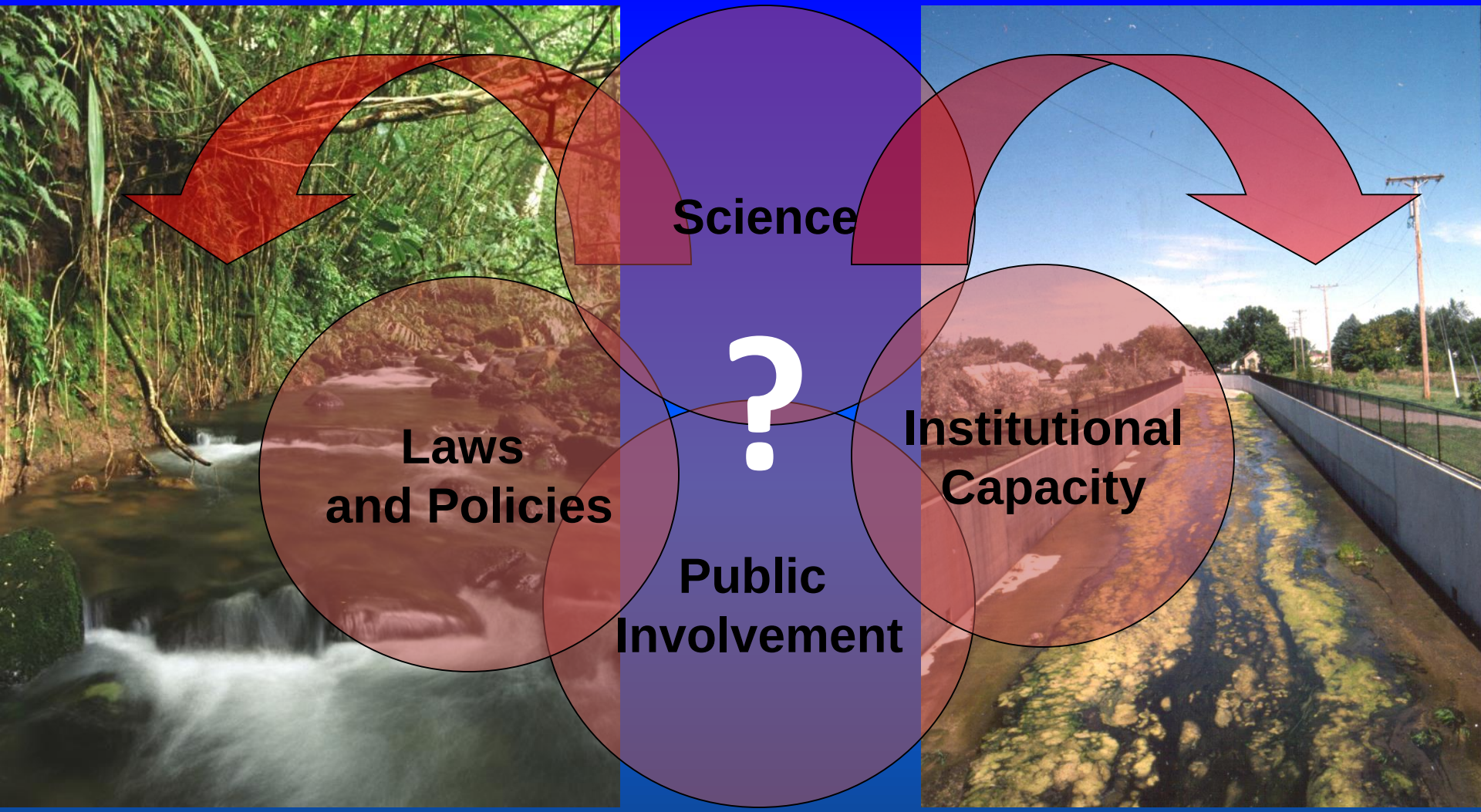
- *Avoid loss / maintain habitat quantity & quality if possible*
- *Improve / restore habitat quantity & quality when needed*
- *Reservoirs don't mitigate river losses*

Instream Flow?

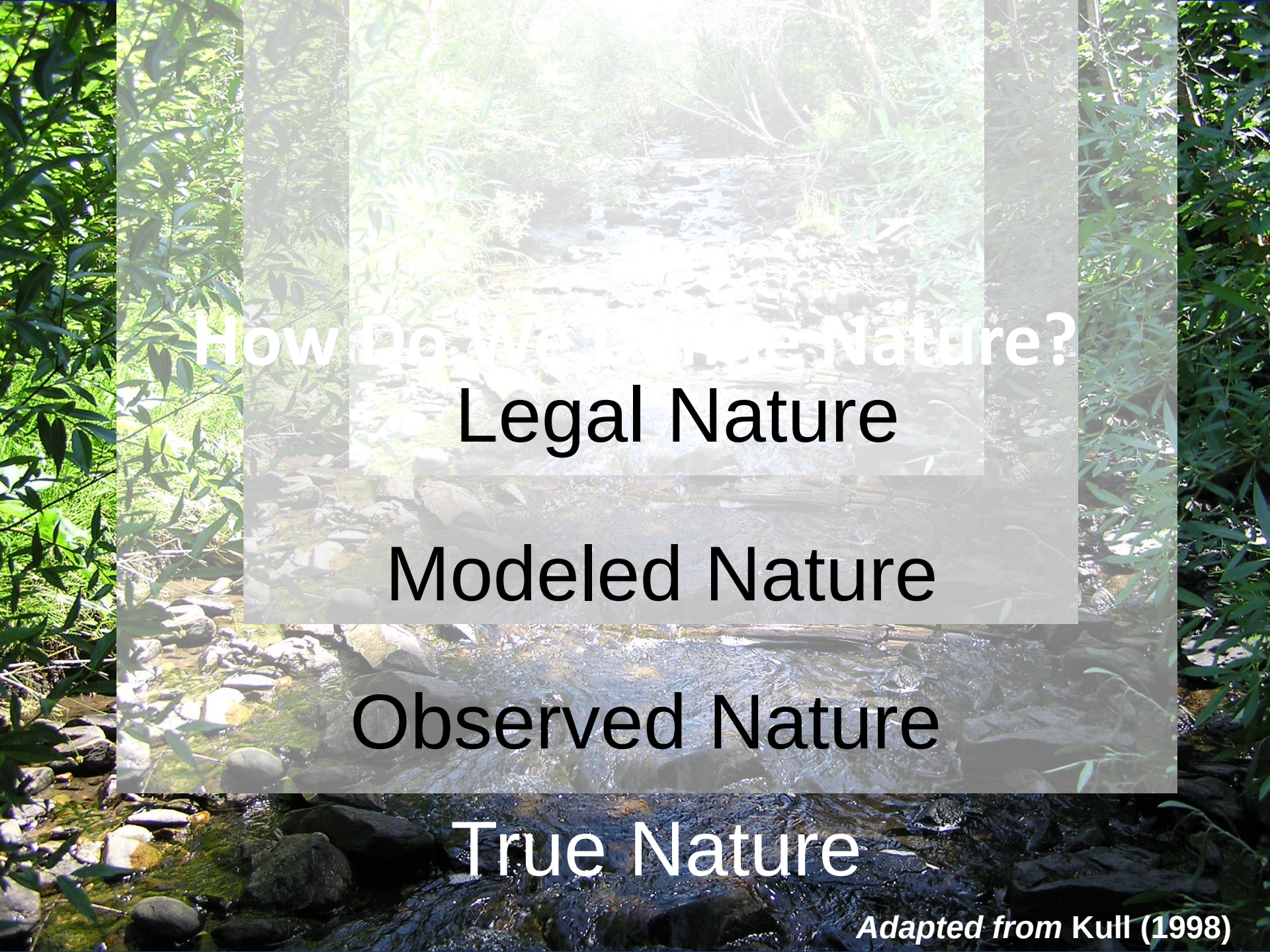
- A single, year-round flow?
- How about instream USE?
- How about instream flow REGIME?
- What about LAKES & RESERVOIRS?

Instream flow isn't just about the water



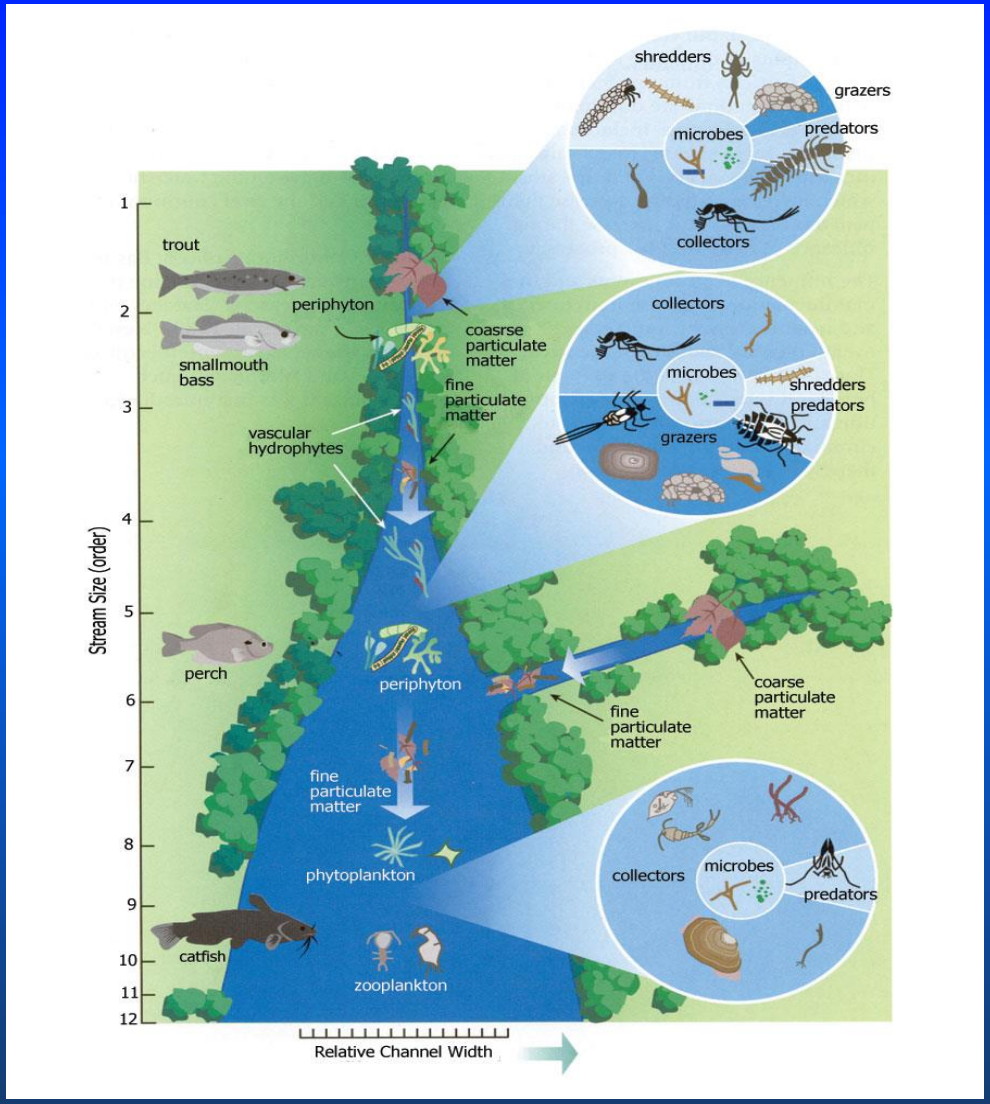


How well we integrate each element will affect how the world looks and our quality of life.


How Do We Define Nature?
Legal Nature
Modeled Nature
Observed Nature
True Nature
Adapted from Kull (1998)

Each Situation is Unique

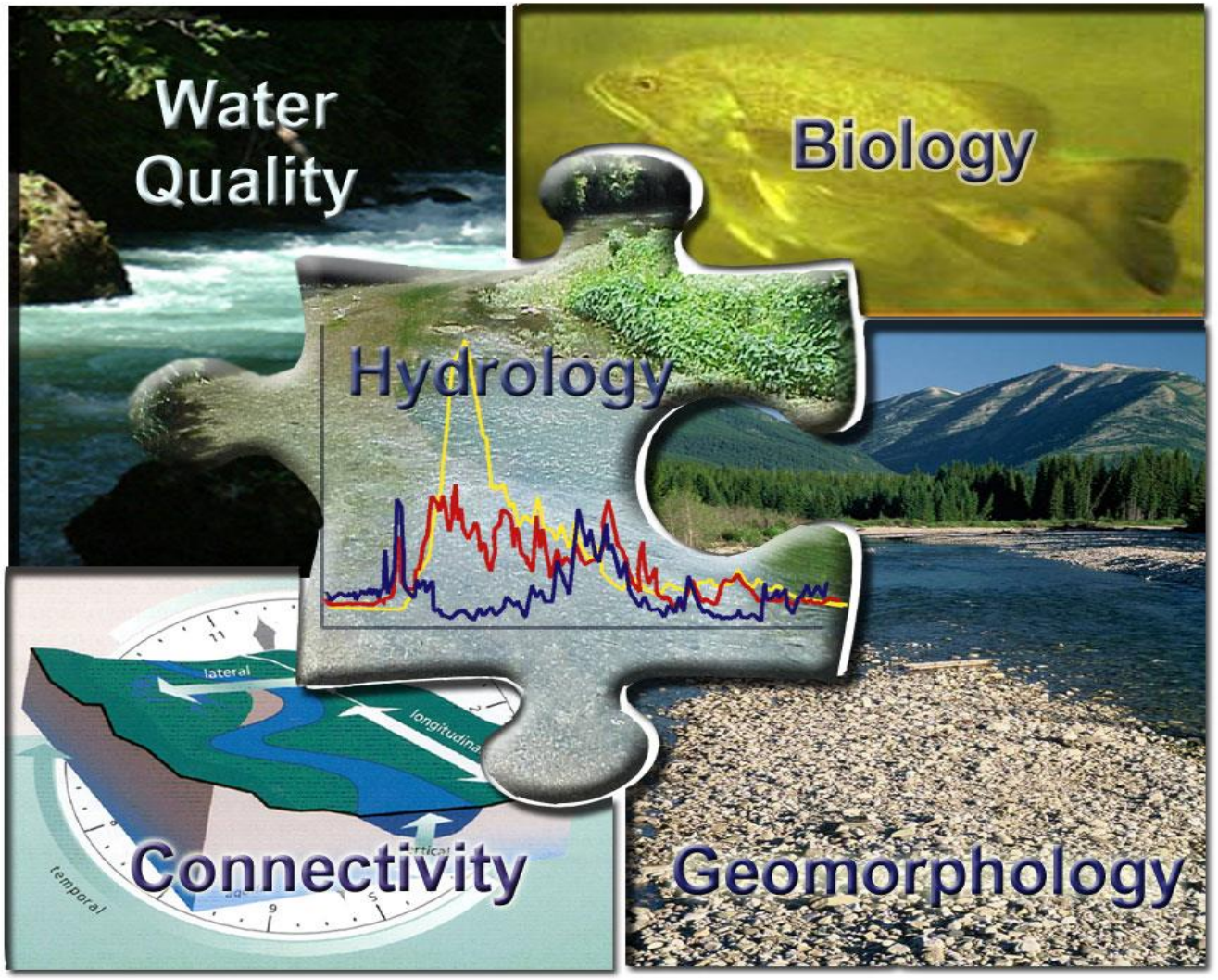
Rivers and the species that live there change in predictable ways over time and distance.



What about regional prescriptions?

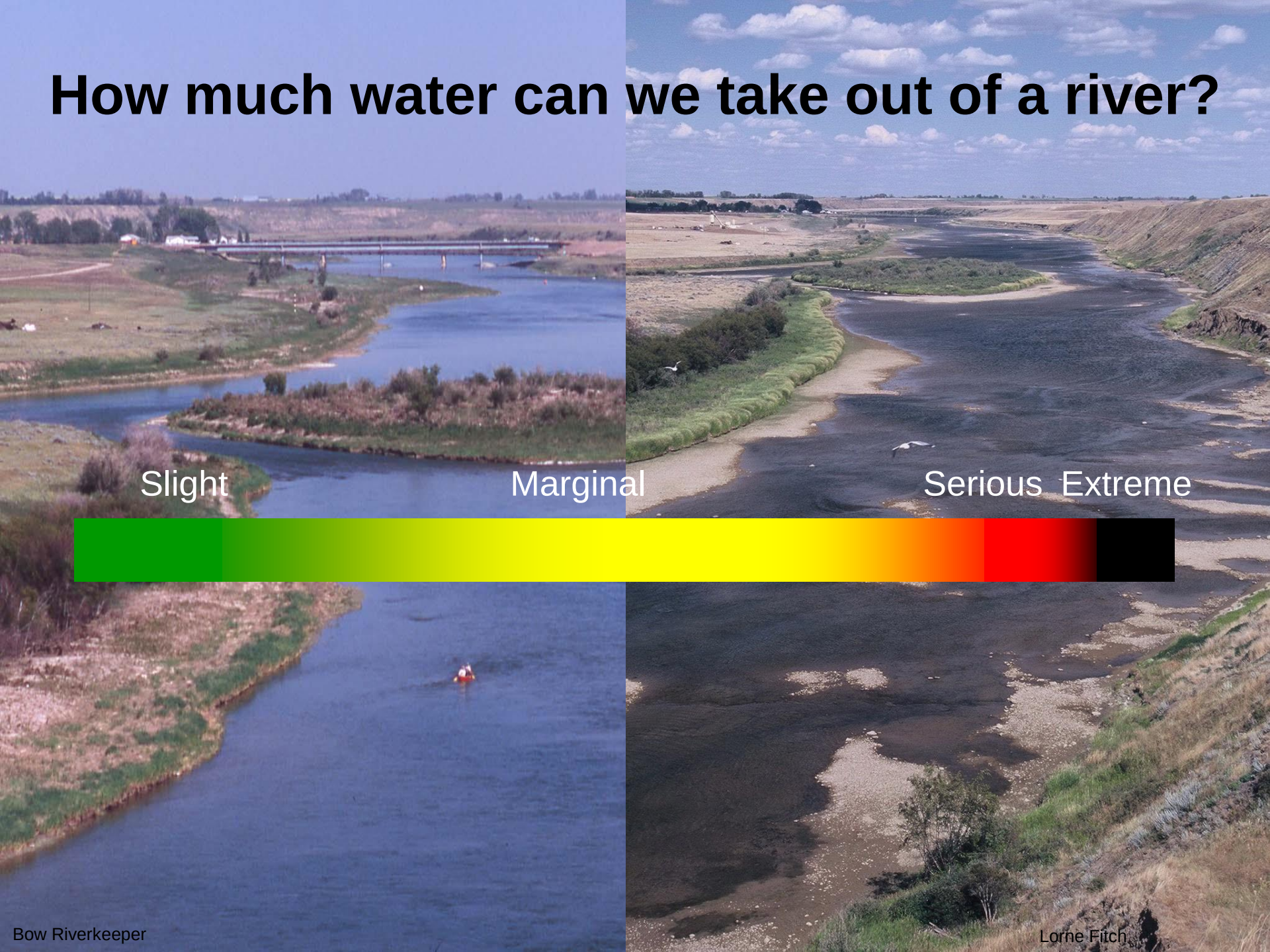
- Typically only work if they protect high levels
- Site-specific studies needed when significant depletions are involved

Rivers are defined by 5 elements



Understanding how the parts go together is crucial for managing rivers, making good laws, and informing the public

How much water can we take out of a river?



Bow Riverkeeper

Lorne Fitch

Methods Evolution

1970's – Hydrologic statistics

1980's – Quantitative biology models

1990's – Ecosystem processes

2000's – Holistic methods

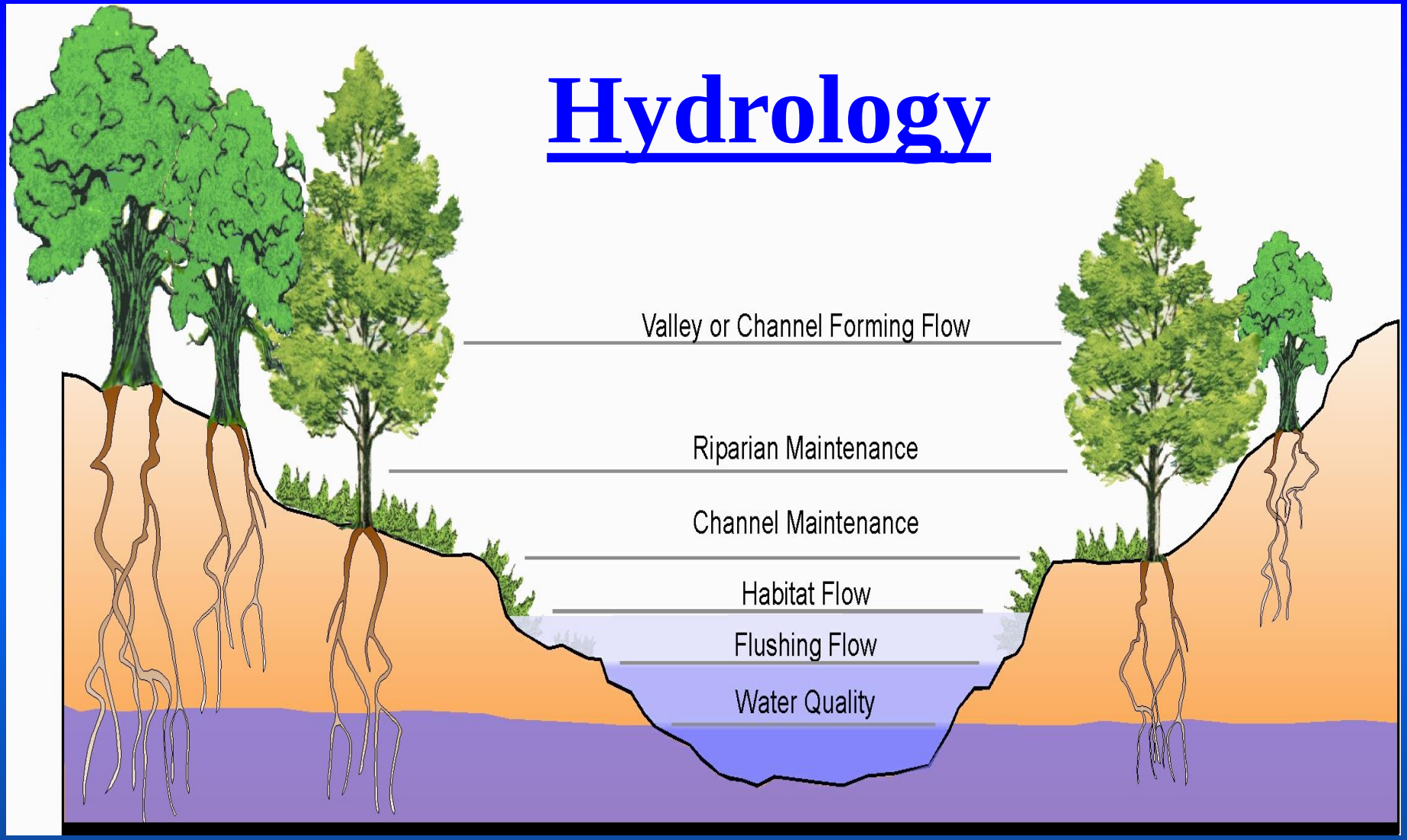
Types of Methods

- Standard-setting methods
  - Estimate single level or threshold of flow
- Incremental methods
  - Evaluate habitat value vs. flow relationship
- Multiple component methods
  - Integrated analyses / multiple outcomes

Habitat Modeling Caveats

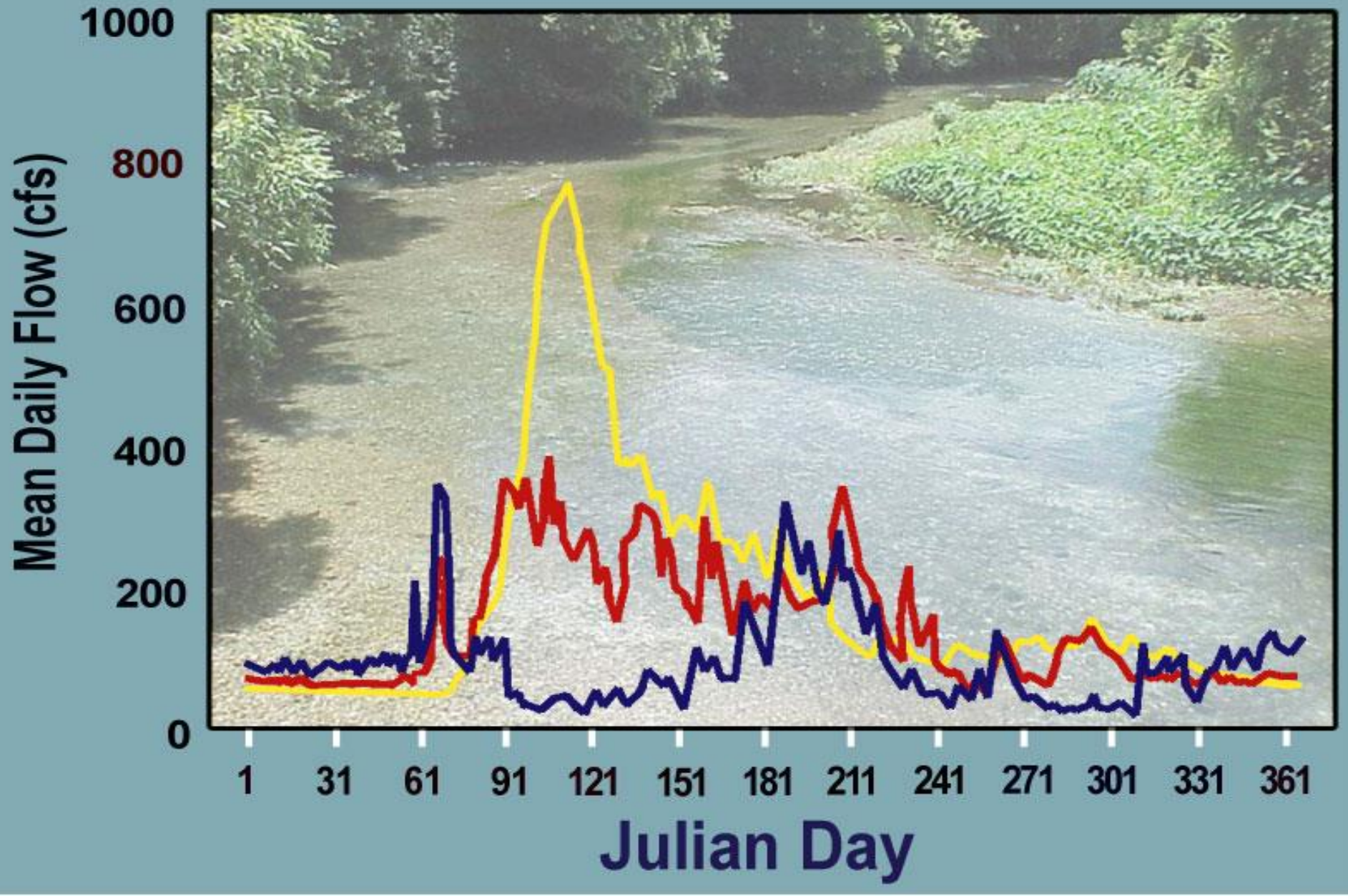
- Models manage uncertainty –don't eliminate it
- No straight-line relationship between flow and habitat.
- A flow that's good for one species may be detrimental to others.
- A flow that maximizes habitat in one stream segment may not provide much in another.
- There isn't a single "best" flow – think flow regimes.

Hydrology

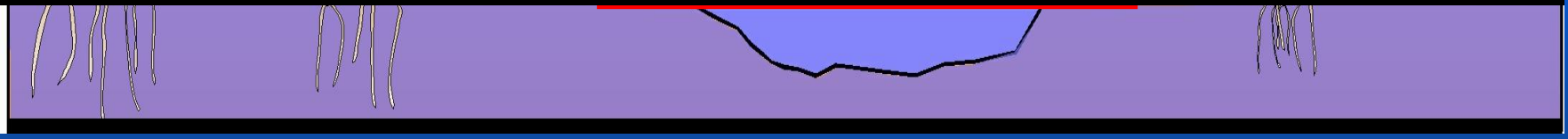


River systems were built and are maintained by different magnitudes of discharge occurring over time and space. (Hill et al. 1991)

Inter- and intra annual flow variability matters

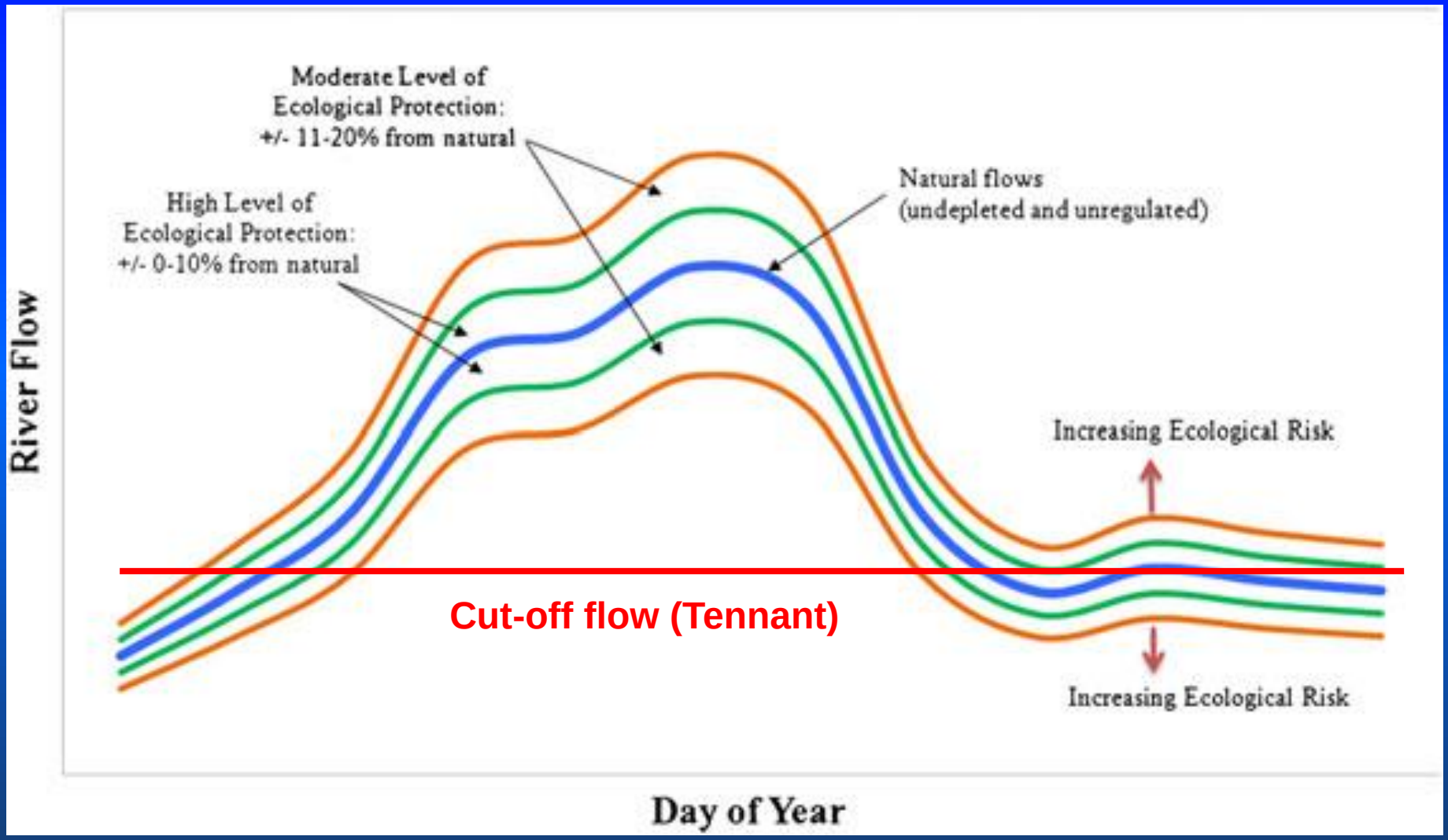


Maximum flow



The problem with minimum flows . . .

Minimum Flow REGIME



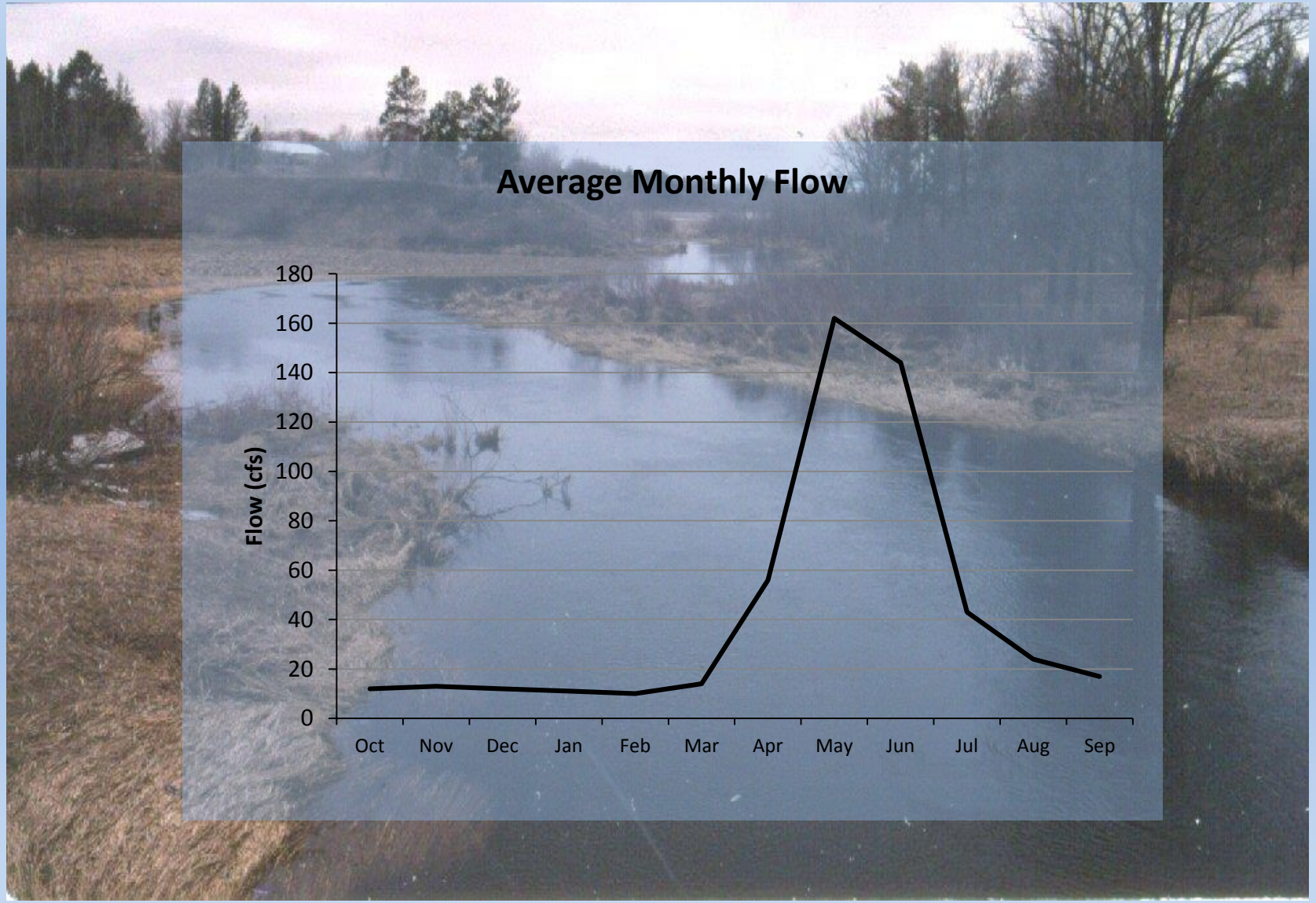
Richter et al. 2011


Minimum Flood Flow?

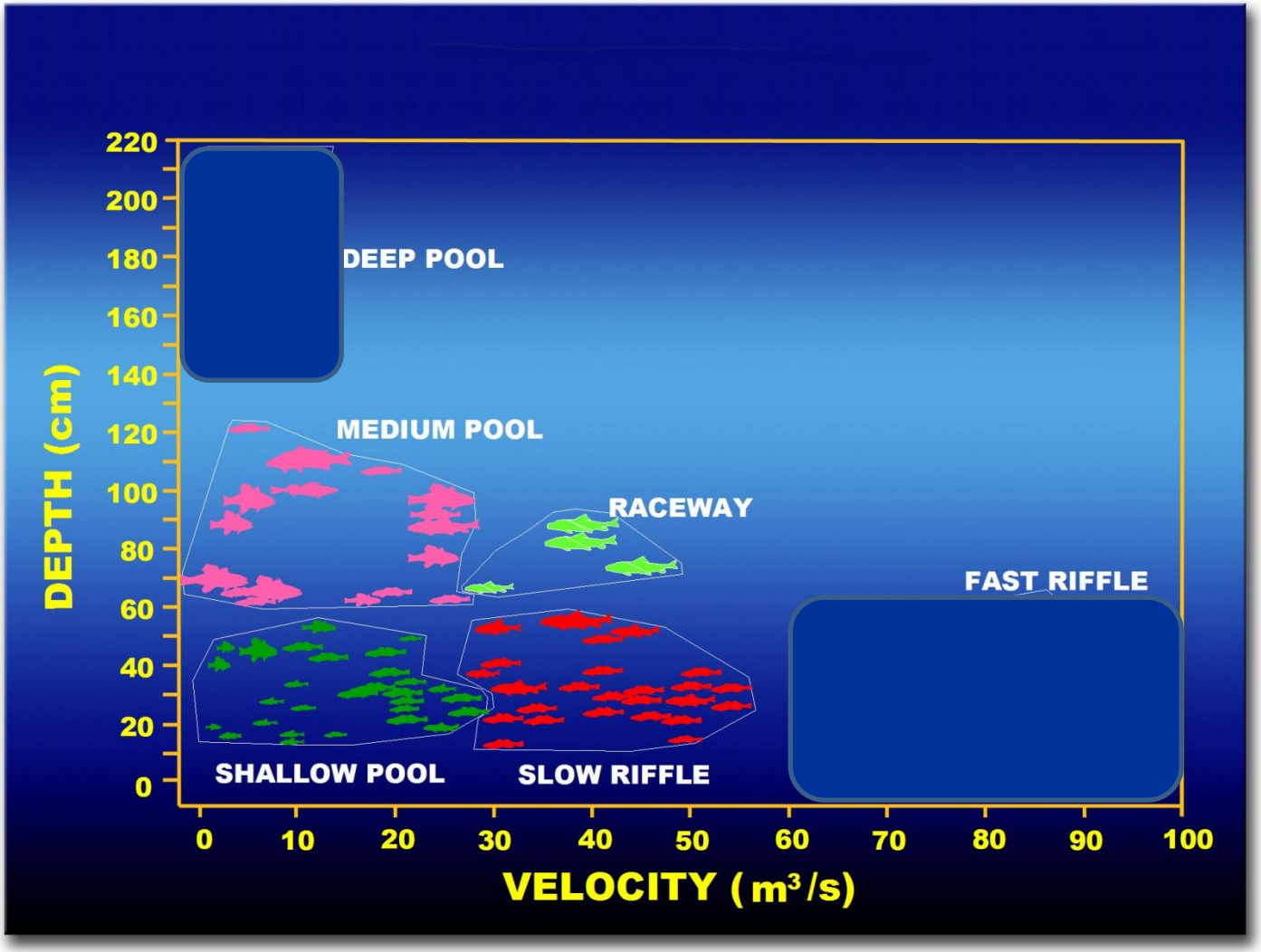
Minimum flow . . .

- for a river is a hydrologic term and derived from gage data. It is a very low flow that is typically derived from gage data.
- *needed* for a river is an ecological (biological) term that can be relatively large and seasonally variable.

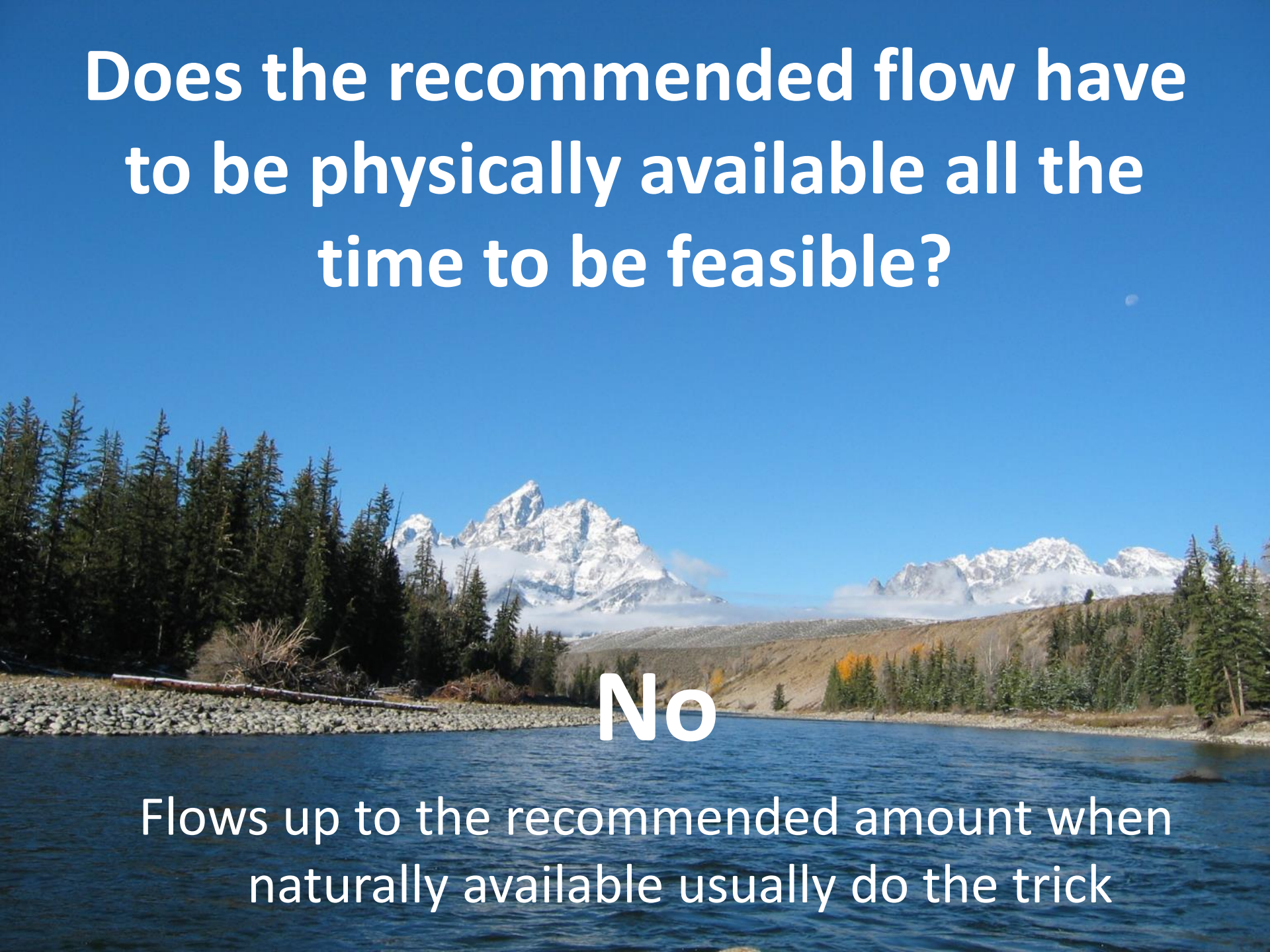
What about average monthly flow regimes?



Average flows = average habitat



Does the recommended flow have to be physically available all the time to be feasible?



No

Flows up to the recommended amount when naturally available usually do the trick

Hydrology Model Considerations

- Low to moderate effort
- Need long-term gage data
- Good for describing hydrology
- Relationship with biology is assumed
- Need other tools to assess needs for other flow elements

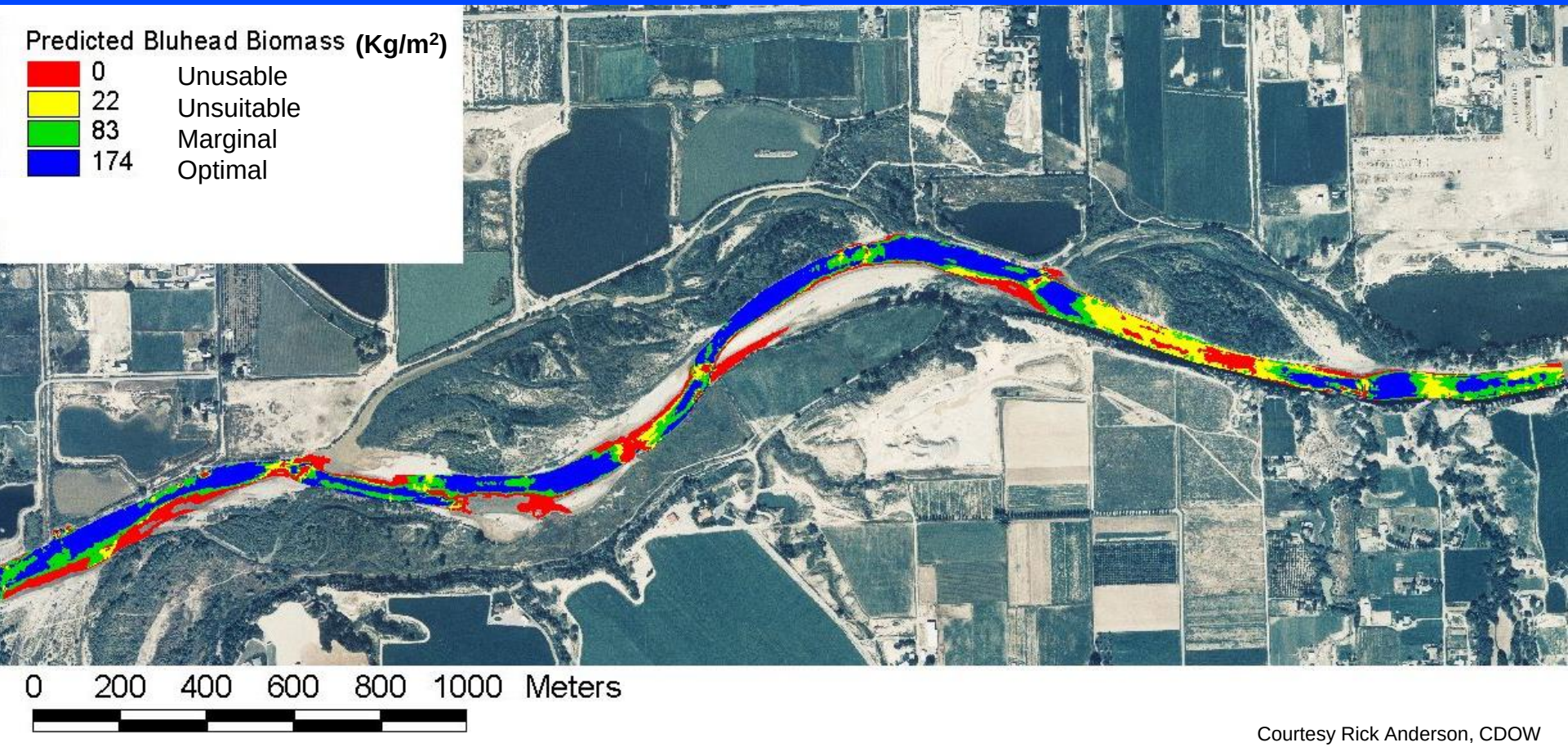
Biology

Biology

embraces all aquatic organisms in the stream . . .

and the riparian corridor

Overall Habitat Suitability

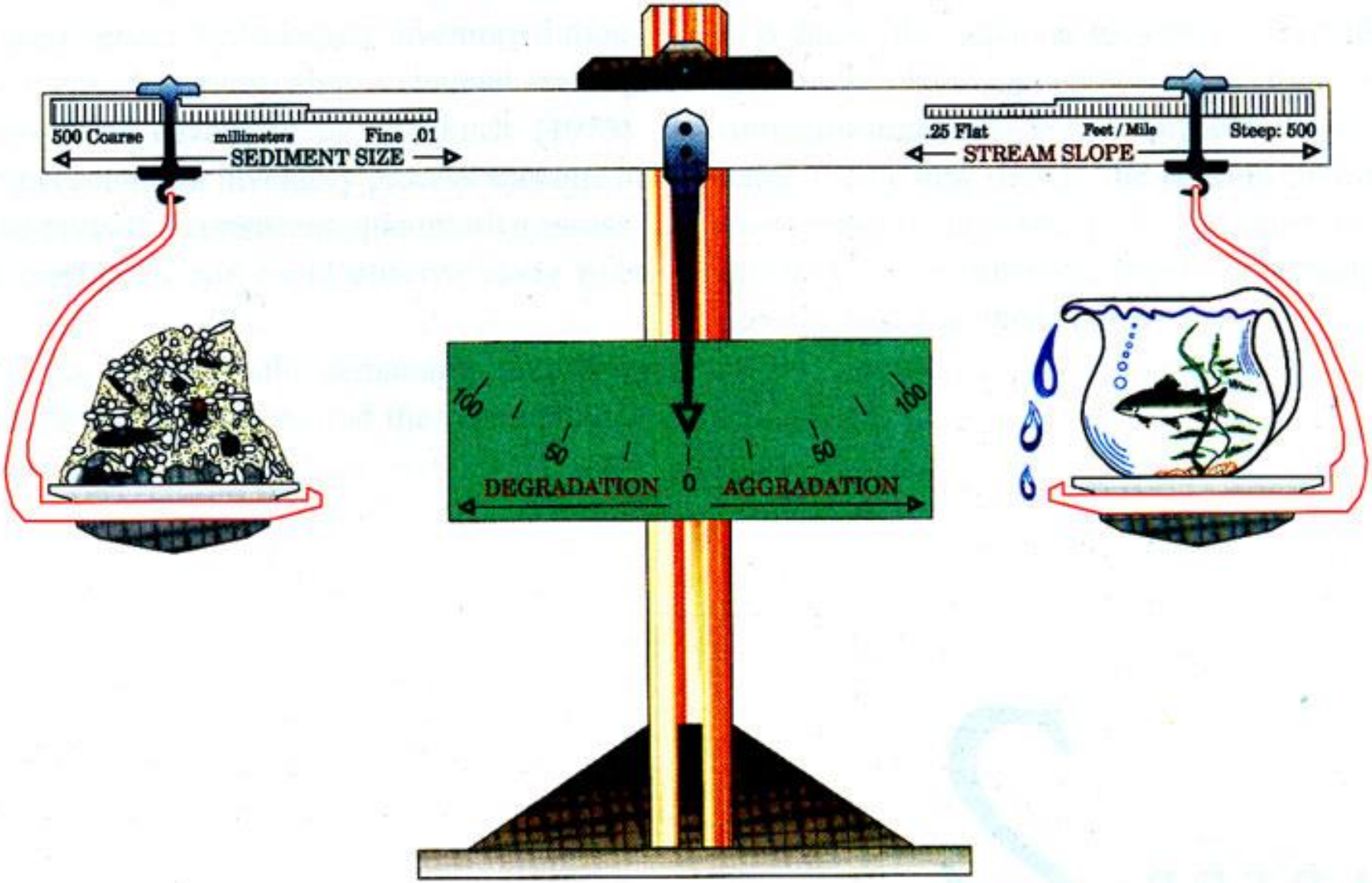


Courtesy Rick Anderson, CDOW

Biology Model Considerations

- Emphasis has been on fish vs. other organisms and riparian needs
- Focus on short-term survival or habitat suitability – fish numbers is elusive
- Need other tools to assess needs for other flow elements

Geomorphology



(Sediment LOAD) x (Sediment SIZE) $\propto$ (Stream SLOPE) x (Stream DISCHARGE)

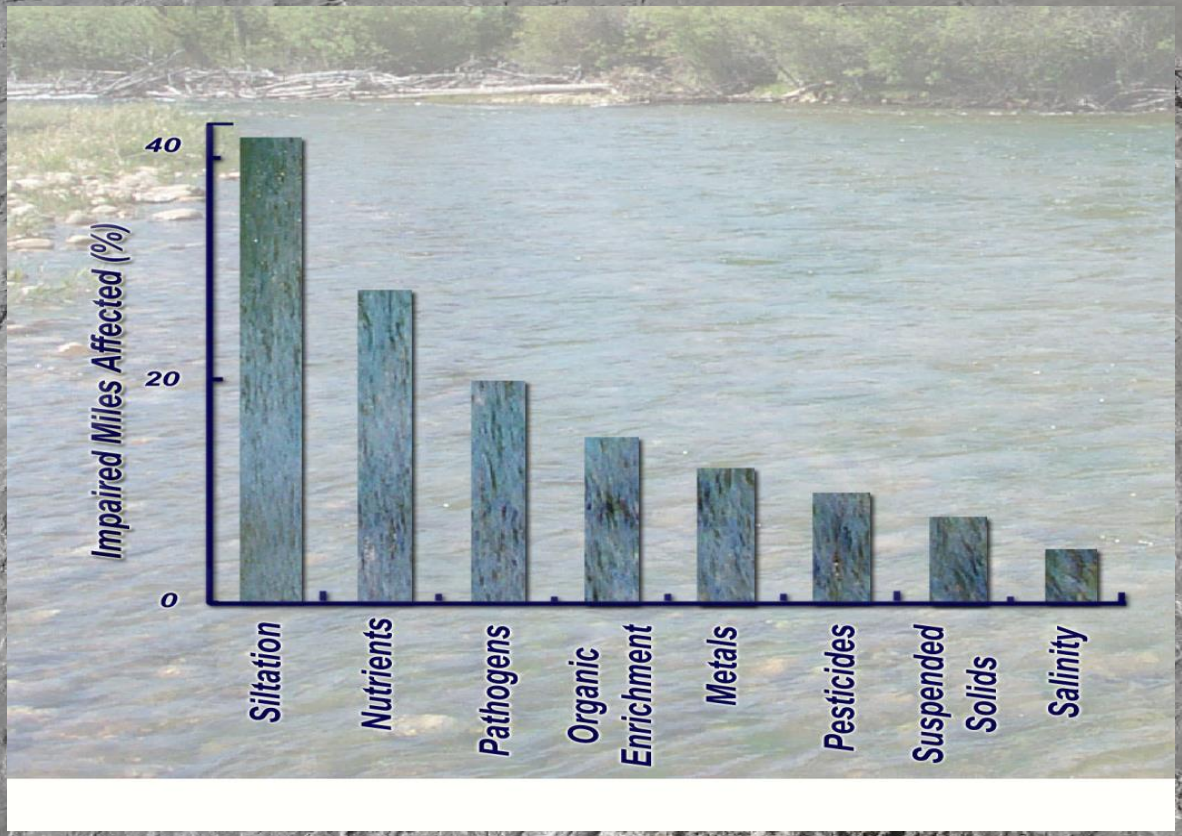
Geomorphic condition is a function of:

- Sediment addition or removal
- Flow addition or removal
- Channel form (alteration)

Geomorphology Model Considerations

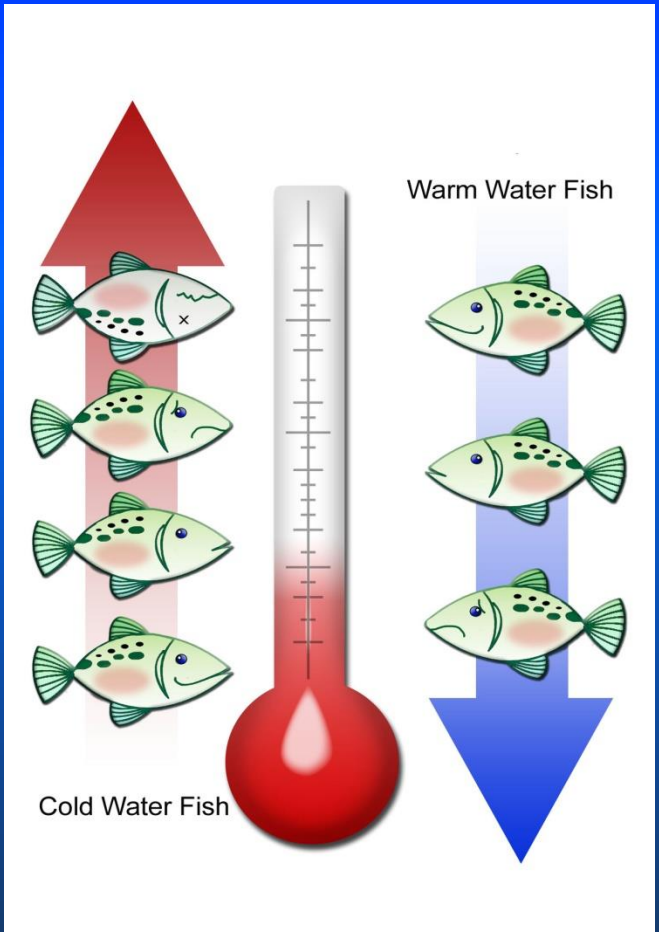
- Usually have broad confidence intervals
- Address long-term physical habitat (not tied to species)
- Need to specify timing, duration, ramping
- Need other tools to assess needs for other flow elements

Water Quality



Water temperature

. . . any time of day or year

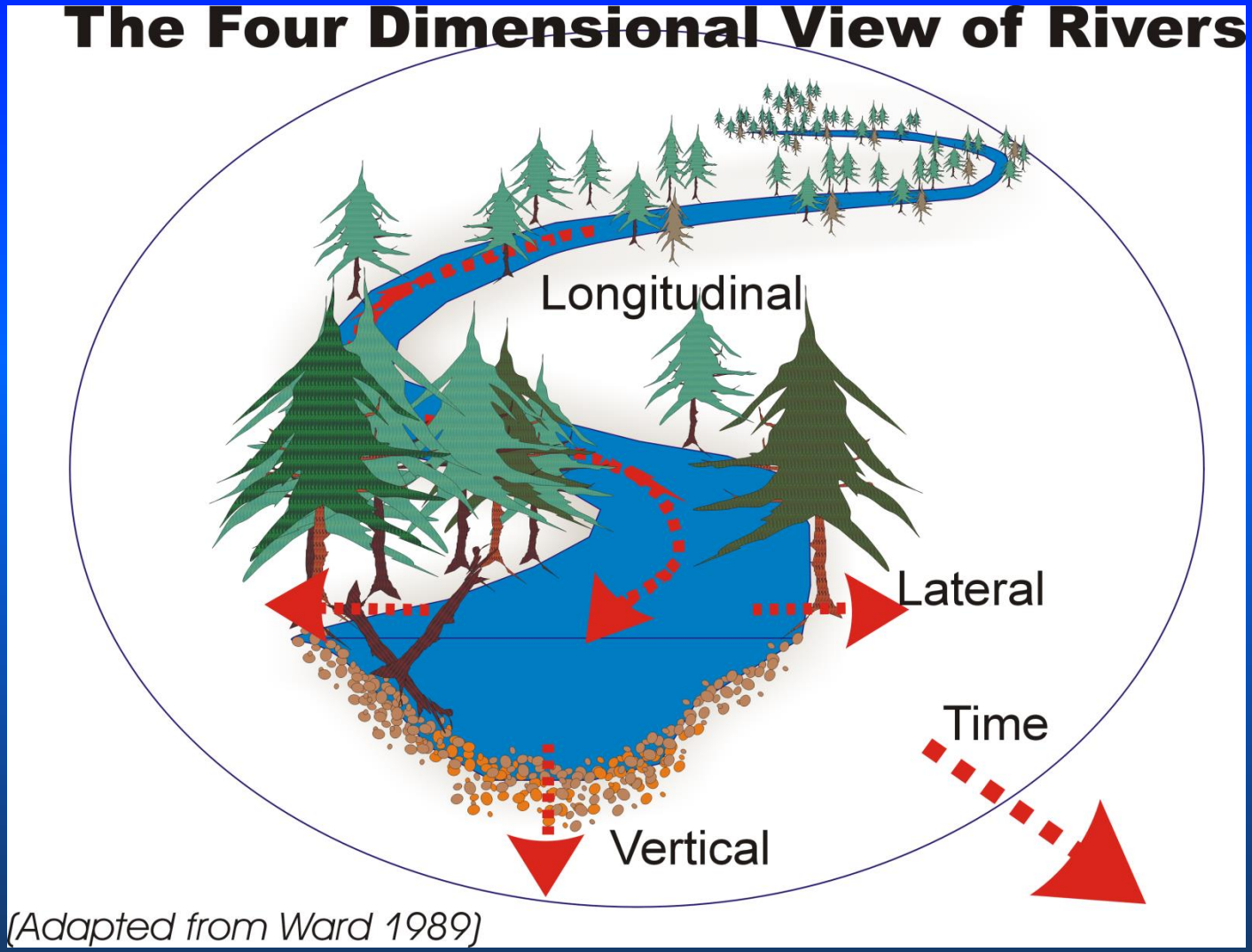



Ice formation processes are a
function of flow and temperature

Water Quality Considerations

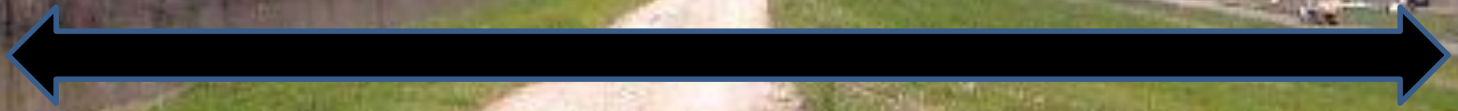
- Addressed long before water quantity
- Focus on minimum flows and thresholds
- Don’t identify ecological trade-offs
- Need other tools to assess needs for other flow elements

Connectivity



Lateral Connectivity

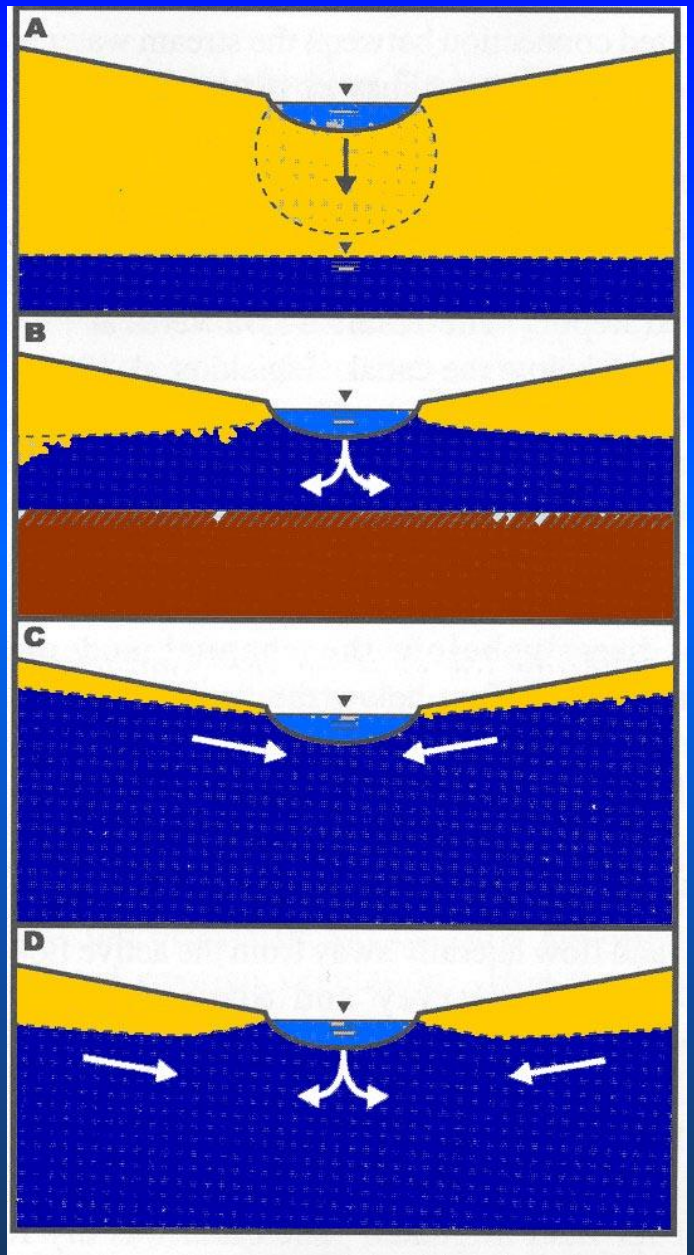
(Floodplains)



- Fish & other aquatic organisms
- Nutrients & minerals
- Woody material
- Sediment and bed material

Longitudinal Connectivity

Vertical Connectivity



Losing to deep groundwater

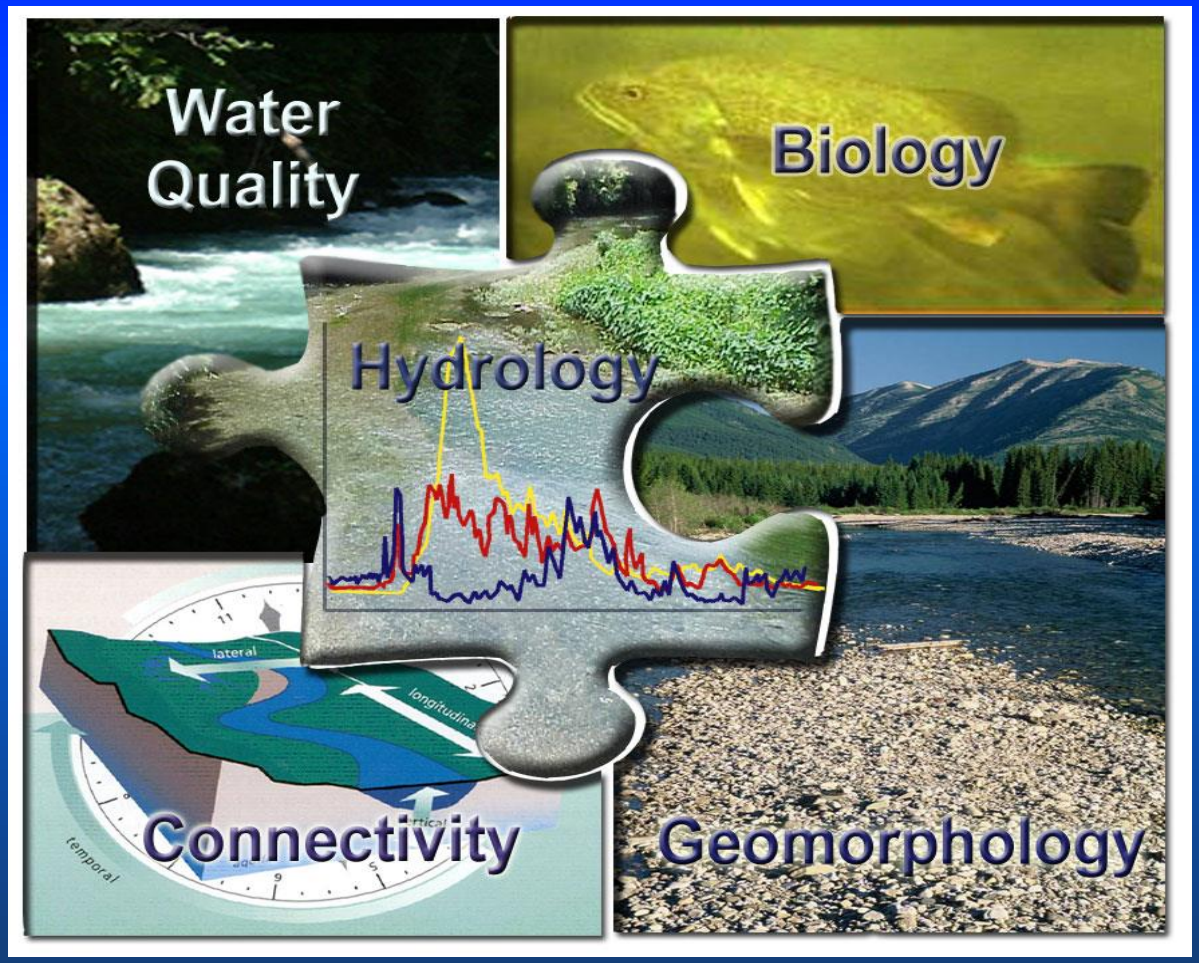
Losing to shallow groundwater

Gaining from shallow groundwater

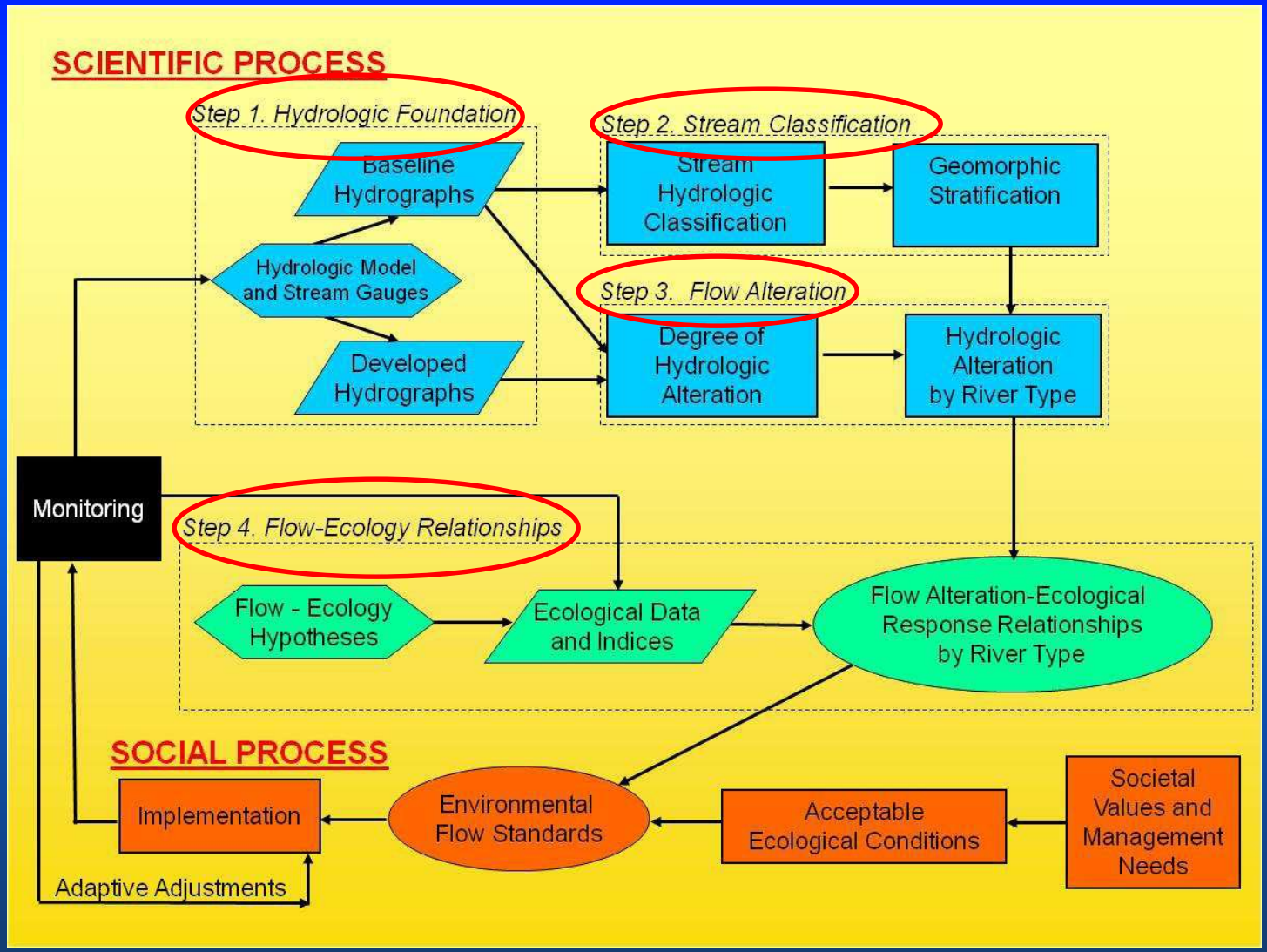
Losing and gaining from groundwater

Temporal Connectivity

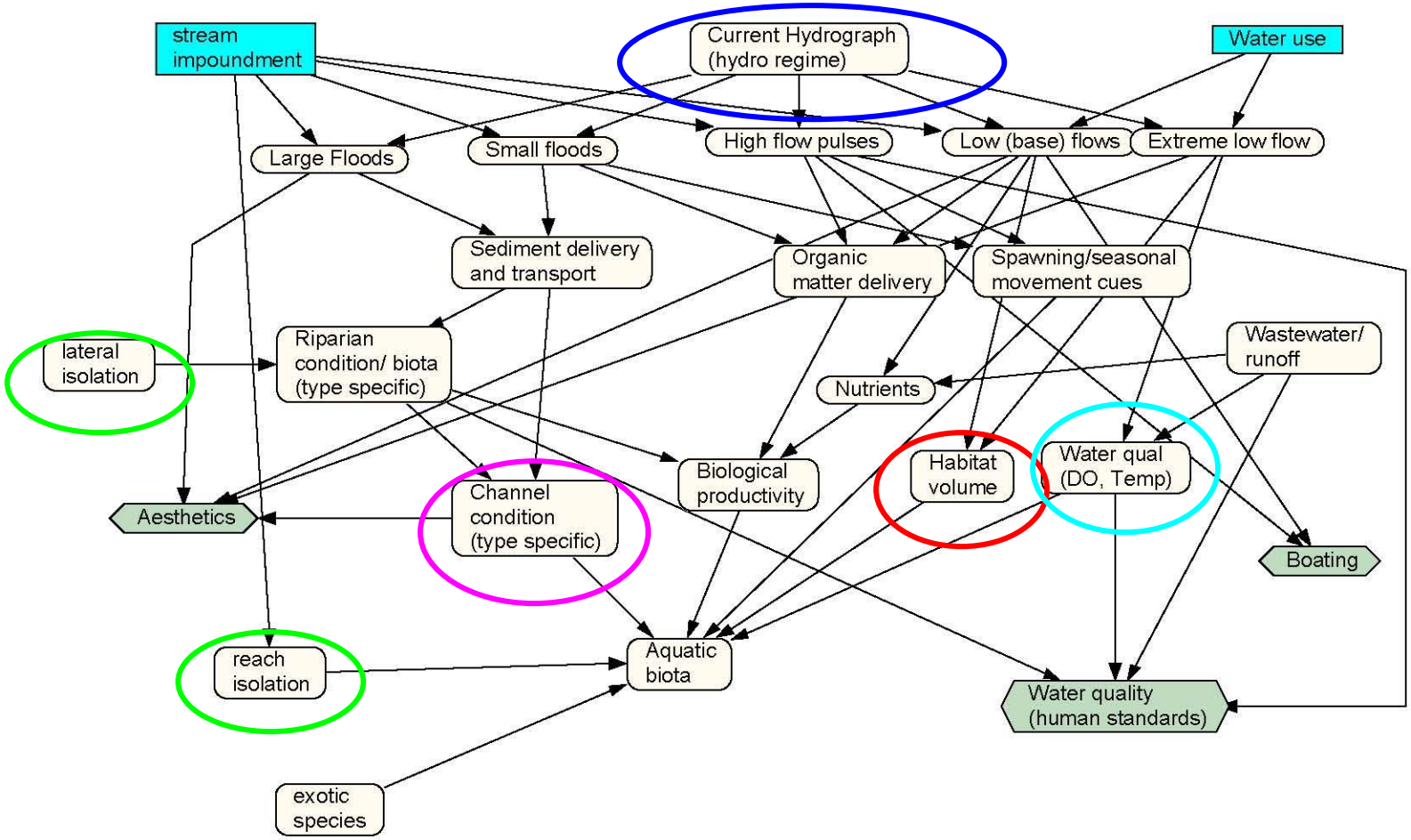
Holistic (integrated) approaches

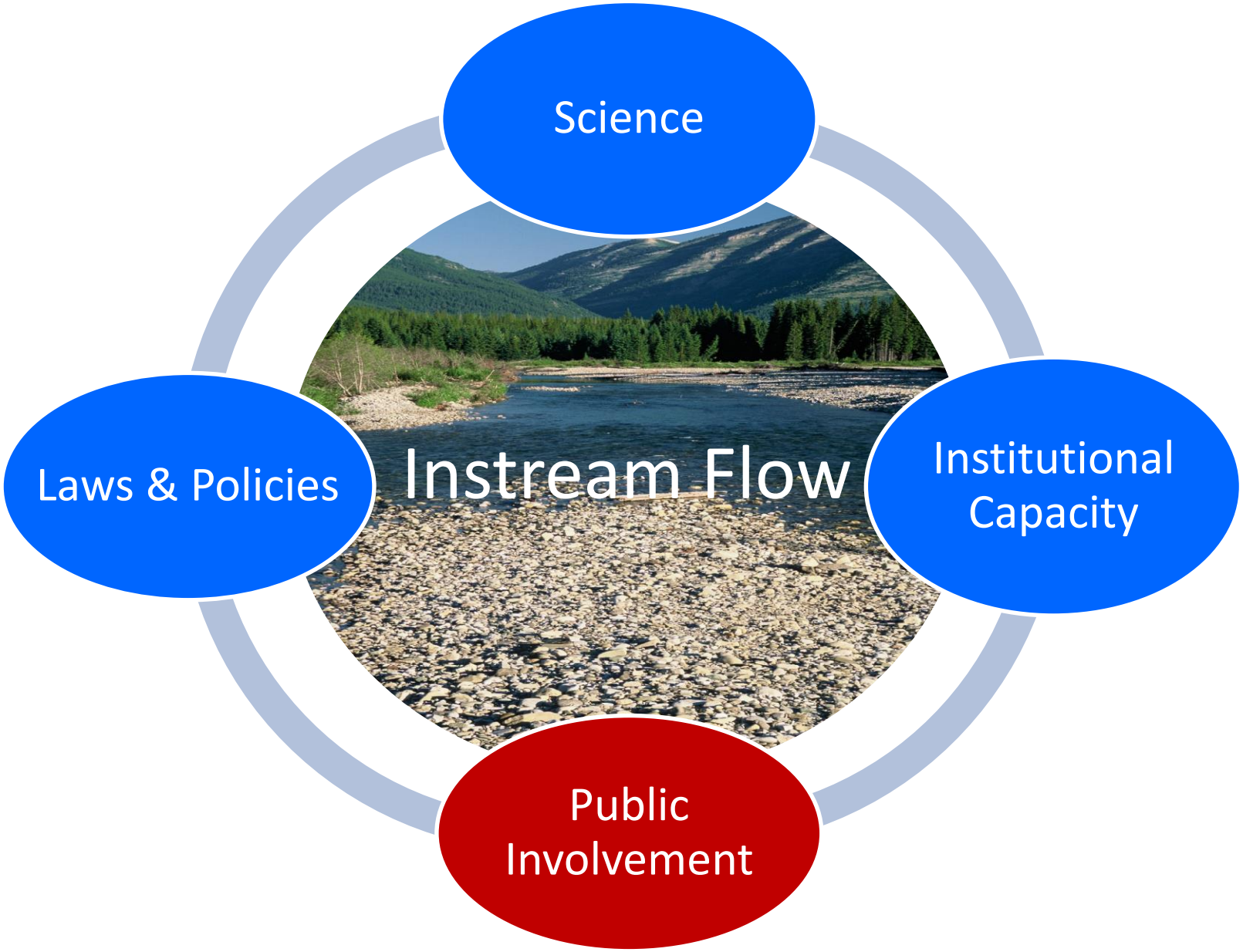


Ecological Limits of Hydrologic Alteration (ELOHA)



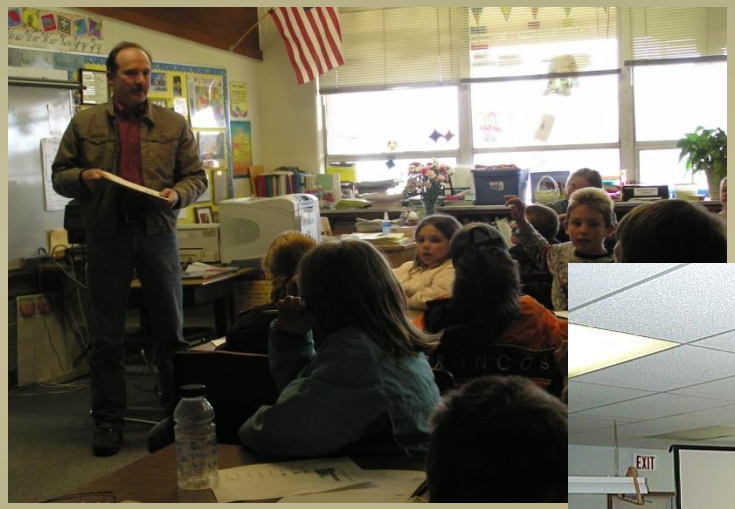
Even simple ecosystem modeling can be complicated




Science
Laws & Policies
Instream Flow
Institutional Capacity
Public Involvement

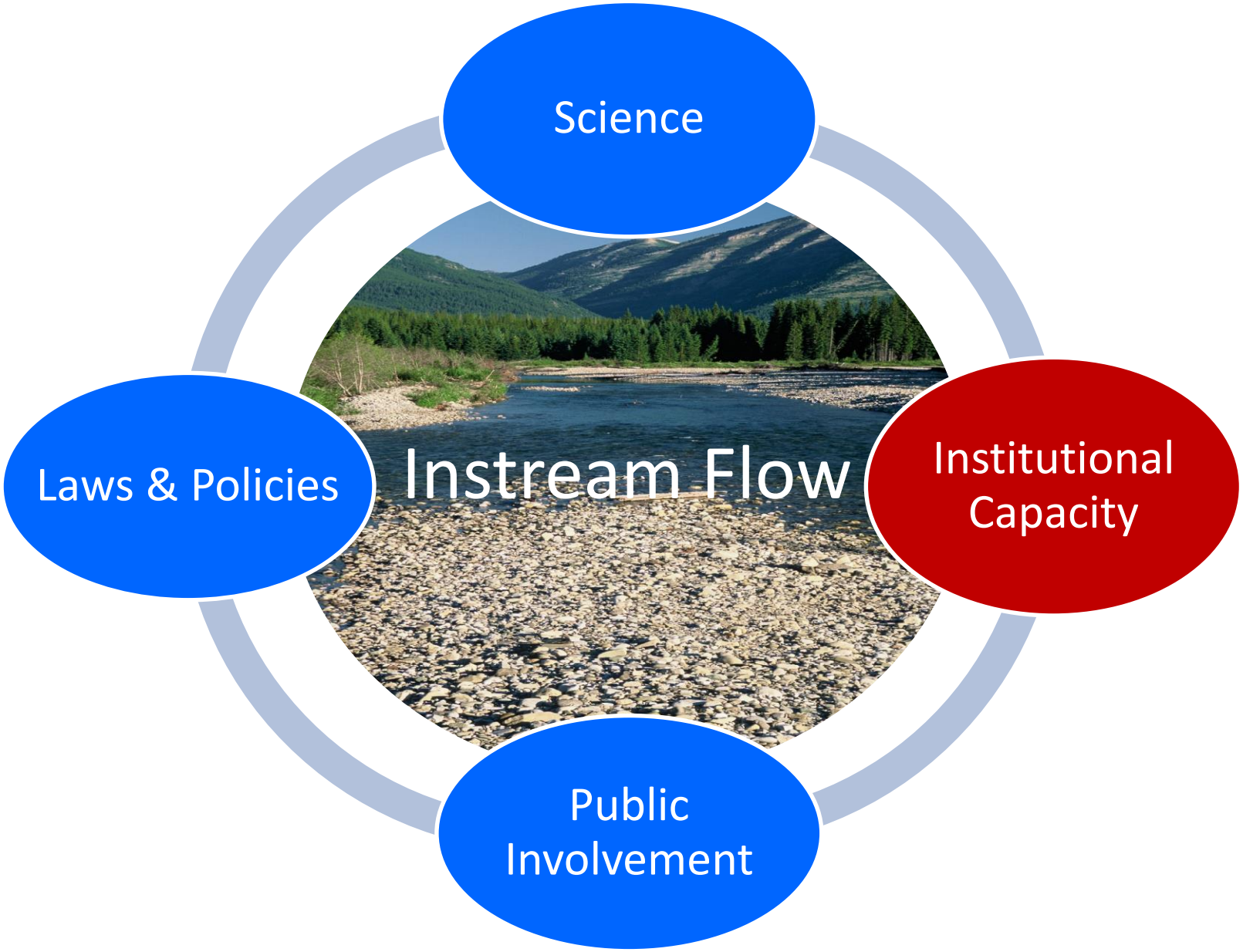
Public Involvement

Education



Input (hearings)

Activism


Science
Laws & Policies
Instream Flow
Institutional Capacity
Public Involvement

Institutional Capacity

- Formal instream flow program
- At least a strategic plan
- Staff
- Budget
- Training
- Interagency coordination

The Problem?

Institutional capacity is one of the easiest ways to undermine water management programs

International Instream Flow Program Initiative

A Status Report of State and Provincial Fish and Wildlife Agency Instream Flow Activities and Strategies for the Future

Final Report for Multi-State Conservation Grant Project WY M-7-T

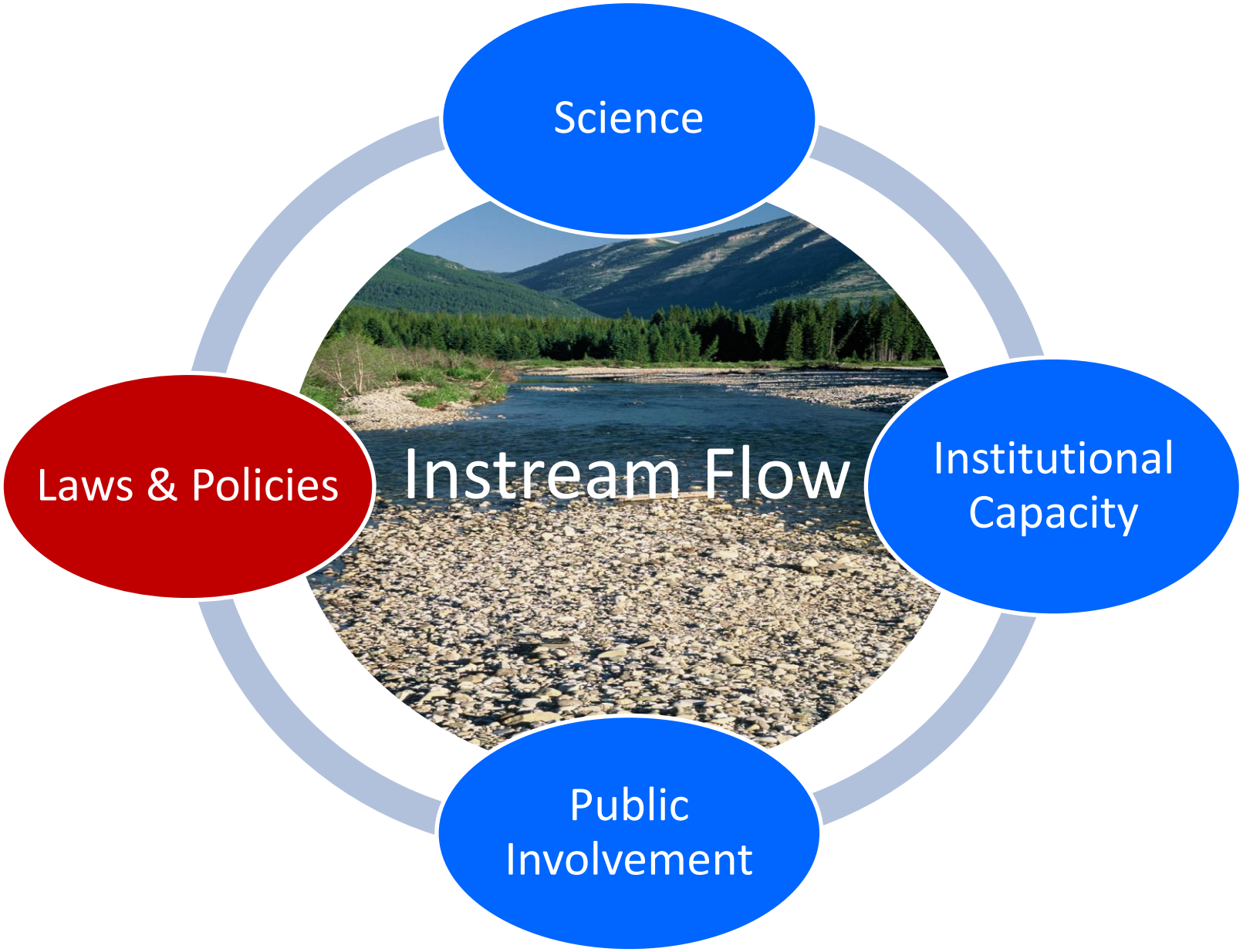
February 2009

Instream Flow Council
www.instreamflowcouncil.org

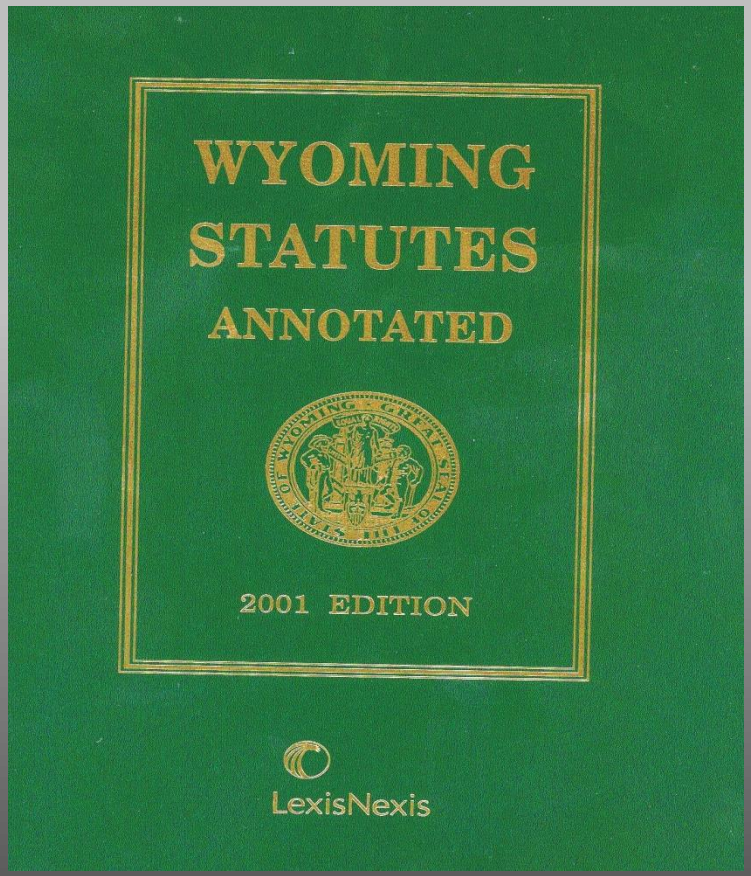
Top five needed resources by F&W agencies:

- More staff
- More supportive laws
- More knowledgeable public
- More actively supportive public
- More supportive regulations and policies

Not more or better scientific methods


Science
Laws & Policies
Instream Flow
Institutional Capacity
Public Involvement

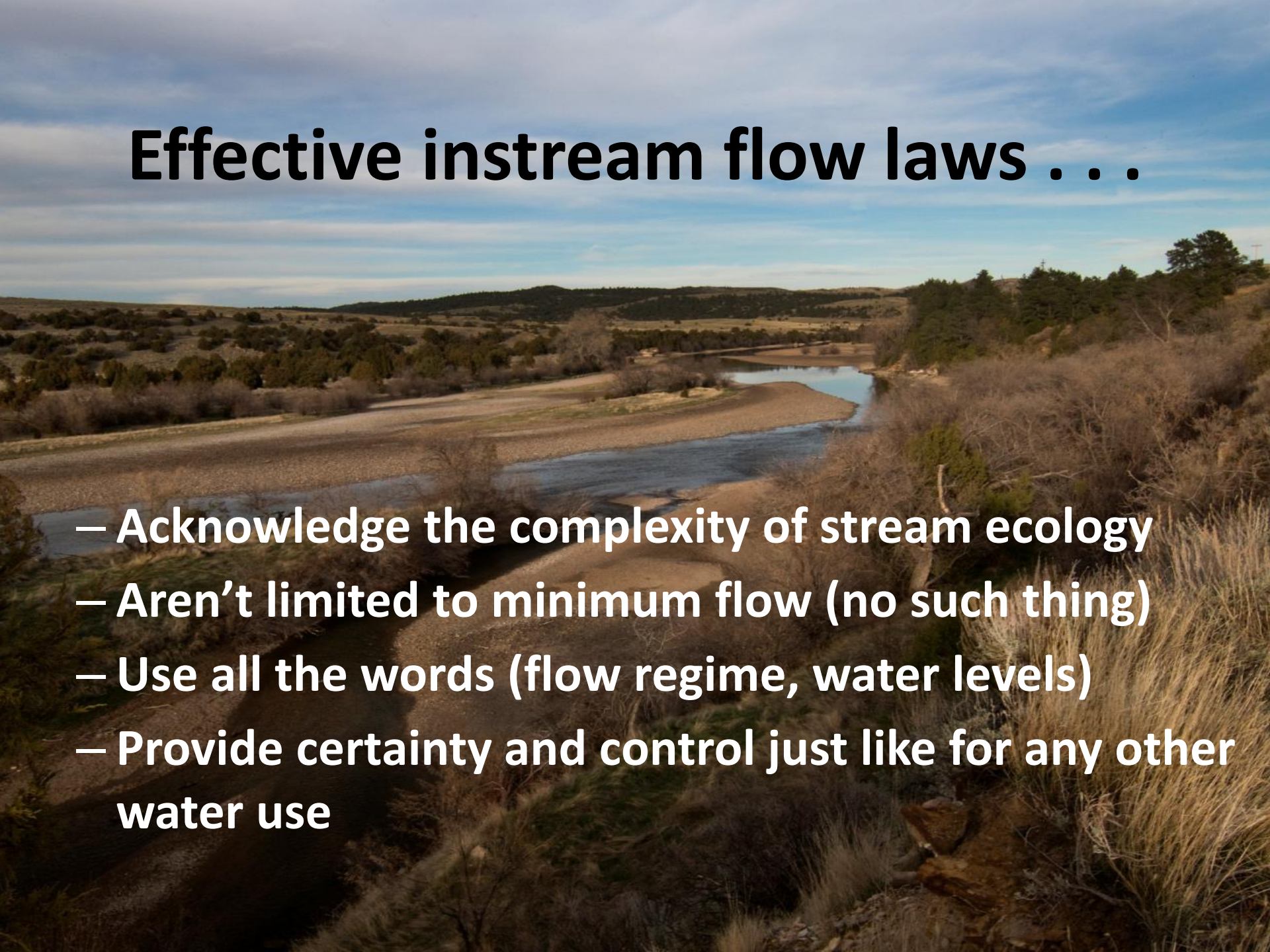
Legal



- Doctrines
- State laws
- Federal laws
- Interstate agreements

So what do effective laws do?

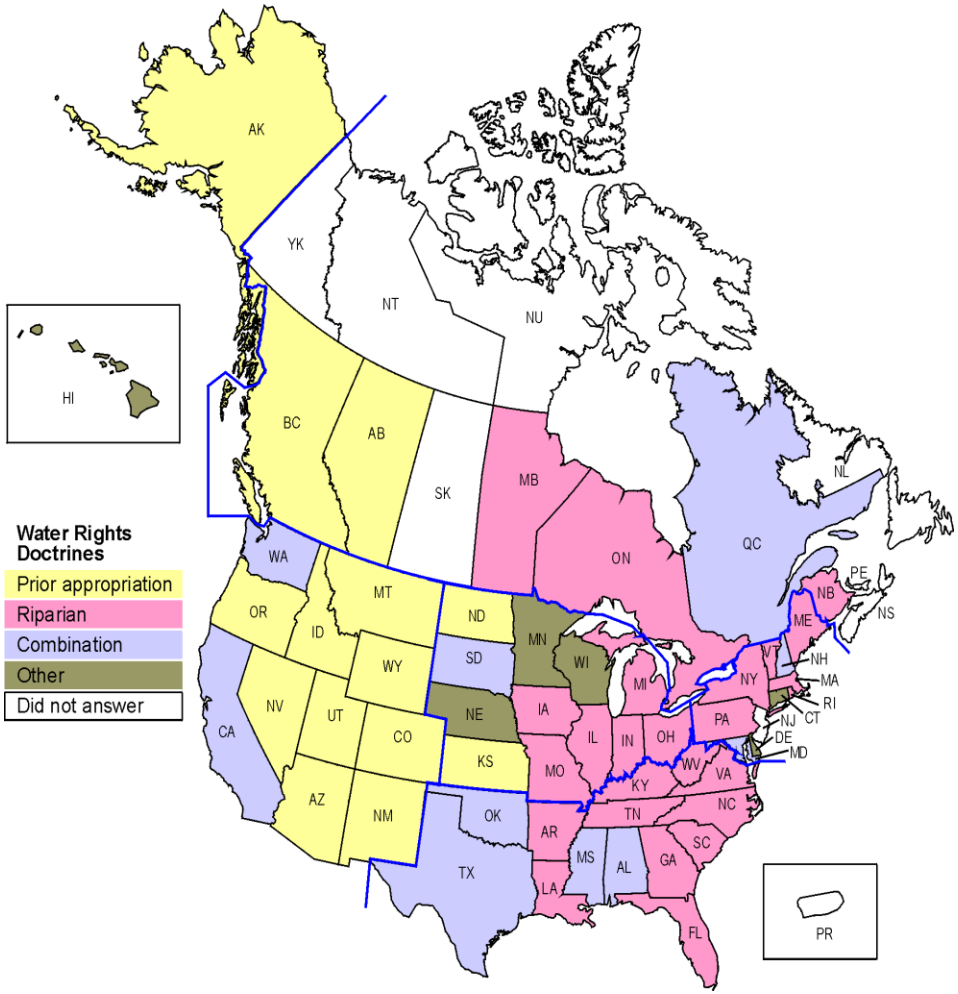
Effective instream flow laws . . .



- Acknowledge the complexity of stream ecology
- Aren't limited to minimum flow (no such thing)
- Use all the words (flow regime, water levels)
- Provide certainty and control just like for any other water use

Water Right Doctrines Matter

- **Prior Appropriation**
- **Riparian**
- **Regulated Riparianism**
- **Reasonable Use**
- **Public Trust**



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