Where Does it Hurt? Ecological Needs of the Poudre

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Outline

Address three questions:

- How does the river work (ecologically)?
  - River integrity
  - Hydro-ecology 101

- What kind of river do we have today, and what might we be most concerned about in the future (ecologically)?

- What can we do?

  ➢ Take home messages and a question for you
Geographic Focus

- Canyon mouth to Greeley
  - integrates the 1000+ square miles upstream
  - hardest working segment of the river
  - most vulnerable segment of the river
  - a focal point of the relationship between people and the river
How does the river work (ecologically)?

What is river integrity?
“To restore and maintain the chemical, physical, and biological integrity of the Nation’s waters”
River Flow Patterns

- The “conductor” or master variable of the river ecosystem

- 5 key characteristics:
  - Magnitude
  - Frequency
  - Duration
  - Timing
  - Rate of Change
Silt flushed from river bed
River bed rejuvenation
Channel maintenance
Gravels and cobbles – transport common
Maintain river channel size

Sediment size is a major determinant of river bed biological communities
Silt flushed from river bed

River bed rejuvenation

Gravels and cobbles – transport common

Channel maintenance

Riparian inundation / connectivity

Maintain river channel size

Creates germination sites

Two-way exchange of energy and materials

Shallow groundwater recharge

Floodplain

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Gravels and cobbles – transport common

River bed rejuvenation

Silt flushed from river bed

Channel maintenance

Riparian inundation / connectivity

Maintain river channel size

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Floodplain

Duration of bed rejuvenation?

Plains cottonwood seed dispersal

River flow

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Gravels and cobbles – transport common

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Channel maintenance

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Silt flushed from river bed

Water table decline → seedling establishment aquatic insects emerging → food

Plains cottonwood seed dispersal

Duration of bed rejuvenation?

Floodplain

Floodplain

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Gravels and cobbles – transport common

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Duration of bed rejuvenation?

Plains cottonwood seed dispersal

Water table decline → seedling establishment

aquatic insects emerging → food

Highest temperatures

Water quality/quantity interactions - algal growth

Stable base flows

River flow

Gravels and cobbles – transport common

River bed rejuvenation

Silt flushed from river bed

Trout emerge

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

Low

High

Low

High

Low

High

Low

High

Low

High
Brown trout

Late summer / fall temps
Fall spawning

Spring emergence
What kind of river do we have today (ecologically)?

What might we be most concerned about?
Gravels and cobbles – transport common

Channel maintenance

Riparian inundation / connectivity

Maintain river channel size

Creates germination sites

Shallow groundwater recharge

Plains cottonwood seed dispersal

Duration of bed rejuvenation?

Water table decline → seedling establishment

aquatic insects emerging → food

Highest temperatures

Water quality/quantity interactions - algal growth

Stable base flows

Most years in our invented river

Brown trout emerge

Silt flushed from river bed

River flow

Floodplain

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Some Key Concerns

- Degraded water quality
  - River bed clogged with sediment
  - More filamentous algae
- Maintain fisheries (trout and native)
- Maintain flood conveyance
- Maintain recreation and aesthetic appeal
- Maintain valued biota
Reduced Summer Low Flows

- Loads of N and P result in higher concentrations in less water / less scour
- Higher temperatures
- Water quality / quantity interactions

MORE PRODUCTION OF ALGAE

WITH SHIFTS TO FILAMENTOUS FORMS
- reduced aesthetic appeal for fishing and recreation, also food web effects
Summer / Fall Base Flows

Stable base flows

Temperatures cool enough to maintain trout

Jul  Aug  Sep
Unstable base flows

Too warm for trout survival

USGS 06752260 Cache La Poudre River at Fort Collins, CO

--- Provisional Data Subject to Revision ---

- Discharge
- * Measured discharge

Jul Aug Sep
What if very low flows extend into winter?

Spring emergence or frozen?
Flood Conveyance
Looking upstream from Shields Ave. in Fort Collins - 2004

Same location 2010
Valued biota
Plains cottonwood
Trout and Native Fish
Habitat
A meandering river…

But does it have diverse habitat for fishes?

Many combinations of depth, flow velocity, and gravel sizes?
What can we do?
What can we do?

- Work towards environmental flows that conserve river amenities and functions
  - Some aspects easier than others
  - Engineers need numbers
  - Reduce waste and inefficiency
  - Cooperation, conservation, reuse
- “Pearls on a String” / “Room for the River”
- Economic valuation of ecosystem services
Environmental Flows

Amount of the original flow regime of a river that should continue to flow down it and onto its floodplains to maintain specified, valued features of the ecosystem such as:

- recreation and aesthetics
- channel form and capacity
- habitat quantity, quality, complexity
- fish and wildlife
- life history patterns – spawning and recruitment
- longitudinal continuity
- riparian vegetation
Every dollar spent results in $3 direct medical benefit
Ecological restoration is the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed.
A Spectrum of Poudre River Futures

Water quality

Trout fishery

Siltation / filamentous algae

Flood conveyance

Valued biota – e.g., native fishes, plains cottonwood, birds

Recreation and aesthetic appeal

Large ditch

Functioning river

More Risk

Less Risk
Take Home Messages

- The Poudre River is not going back to pre-development conditions – irreversible change has occurred – now an invented river ecosystem

- Restoration is not returning the river to an undeveloped historical condition. It is assisting and sustaining the recovery of an ecosystem that has been damaged.
Take Home Messages

- The current trend of deteriorating river integrity and amenities can be reversed with environmental flows and sound long-term stewardship that balances human demands with ecosystem needs.
- A wide range of alternative river futures is still available to us (for now).
- Engineers need numbers – those numbers are mostly available.
Take Home Messages

- Focus on river services / amenities that we value the most:
  - Clean water
  - Trout and native fishes
  - Valued flora and fauna
  - Flood conveyance
  - Recreation and aesthetic appeal…

- Healthy farms and cities are compatible with sustaining these river amenities

- WE MUST HAVE A VISION!
Planning a future for the river

What’s your vision?
HARDBENED ENGINEERING TO PROTECT INFRASTRUCTURE

- impervious catchment causes higher flood peaks, induces incision and widening in unprotected channels
- biotechnical approaches probably ineffective
- opportunities to provide amenities along urban streams (open space, trails, recreation, woodlands, limited habitat)

ESPACE DE LIBERTE or Erodible Corridor

- where flow dynamic and sediment load intact (or nearly so) can set aside a corridor for flooding and for the active channel to erode, deposit and migrate
- high potential for self-restoration

ANTICIPATORY MANAGEMENT

- identify hotspots of likely erosion to setback infrastructure

FLOW + SEDIMENT RESTORATION

- flow regulation + sediment trapping by upstream dams shift channel dynamics downward
- restoring high flows + sediment can increase potential for self-restoration

“GARDENING” URBAN RIVER RESTORATION

- removing barriers
- planting riparian vegetation
- removing invasive plant species
- high potential for social benefit of trails, parks, recreation

CHANNEL RECONSTRUCTION

- river may be slow to self-heal
- reconstruction and habitat structures may be justified

Kondolf (2011)
Reach 3, moderately connected
Hydrophytes, Scenario 5

Probability of Occurrence
0.0 to 0.1
0.1 to 0.2
0.2 to 0.3
0.3 to 0.4
0.4 to 0.5
0.5 to 0.6
0.6 to 0.7
0.7 to 0.8
Reach 3, moderately connected
Dynamic mosaic (Sallie), Scenario 1

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Reach 3, moderately connected
Dynamic mosaic (Salix), Scenario 3
Reach 3, moderately connected
Dynamic mosaic (Salix), Scenario 5

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Reach 6, connected Hydrophytes, Scenario 2

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Reach 6, connected Hydrophytes, Scenario 3

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Reach 6, connected Hydrophytes, Scenario 5
Reach 6, connected
Dynamic mosaic (Salix), Scenario 1
Reach 6, connected
Dynamic mosaic (Salix), Scenario 2

Probability of Occurrence
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Reach 6, connected
Dynamic mosaic (*Salix*), Scenario 3

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Reach 6, connected
Dynamic mosaic (Salix), Scenario 5
“The significant problems we face cannot be solved at the same level of thinking we were at when we created them.”

-Albert Einstein

Einstein also studied rivers: