Ten Principles of River Restoration and Four River Project of Korea

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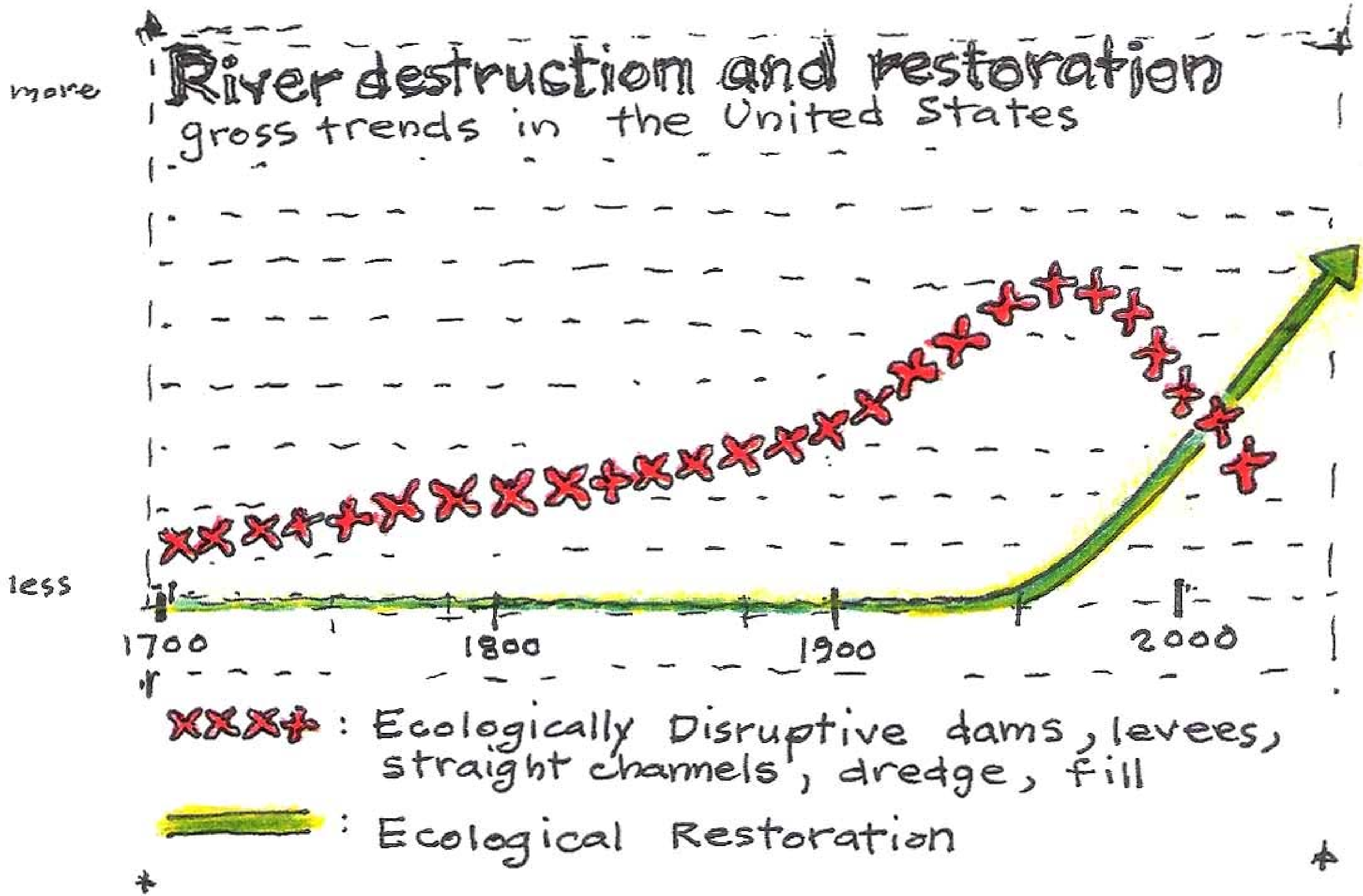

River destruction and restoration
gross trends in the United States
more
less
1700
1800
1900
2000
: Ecologically Disruptive dams, levees, straight channels, dredge, fill
: Ecological Restoration

Larger rivers and streams are conventionally put in straight concrete and earthen channels

Flood control channels have high velocities across entire width;
Fish are washed out,
People die if caught in the channel in flood
Unfriendly to animals and people

Pervasive impacts = loss of species diversity, ecosystem function through:

Catchment land-use impacts on water quality
- agriculture, urbanization, deforestation

Dams, diversions
- change flow regime, trap sediment

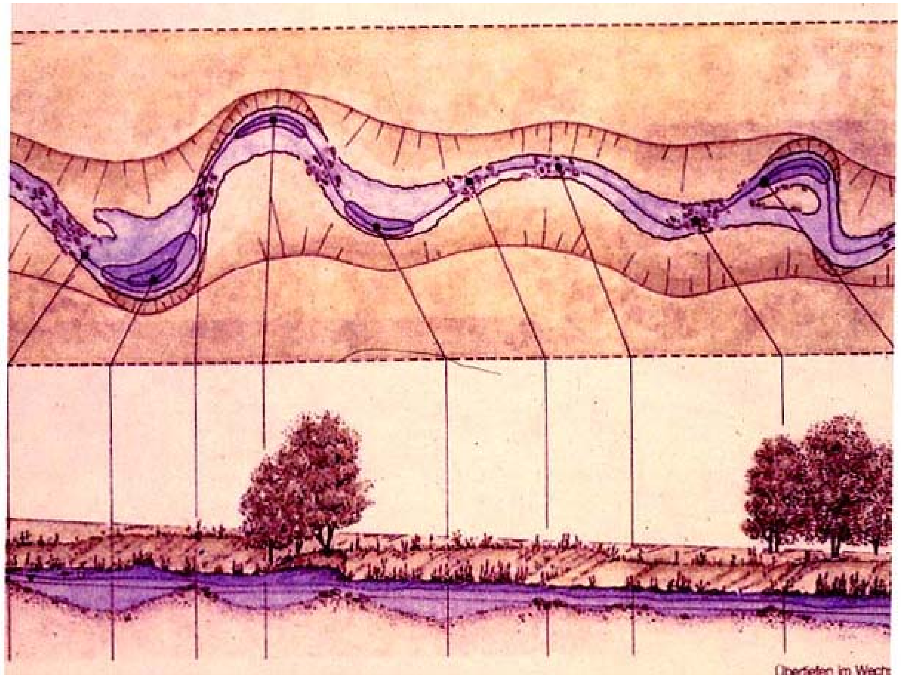
Navigation
- snagging, channelization/simplification

Flood control
- Levees disconnect floodplains
- Reservoirs reduce peak flows

Floodplain conversion
- to agriculture, urban uses, loss of riparian habitat

Bank stabilization
- rocking banks to stop erosion/migration

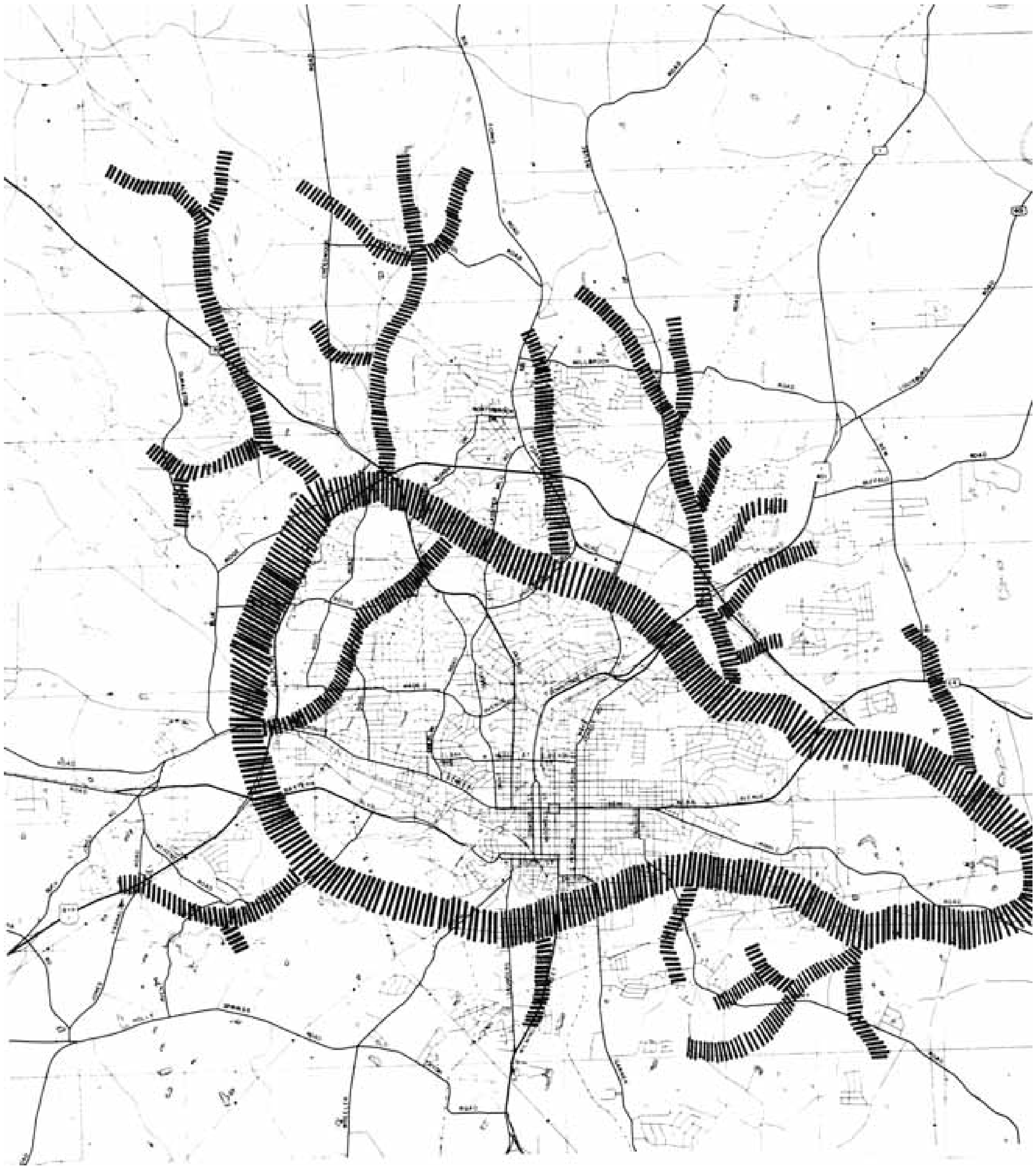
The new approach:
Restore function,
Recreate complex natural channels,
Restore meander bends



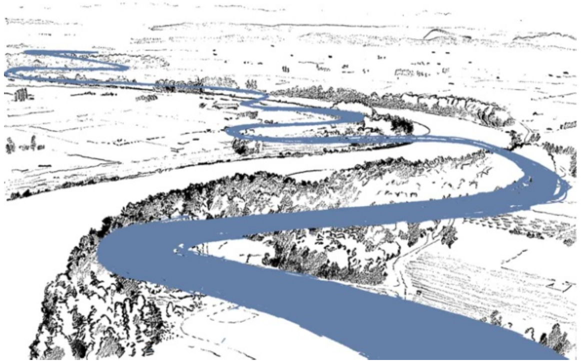
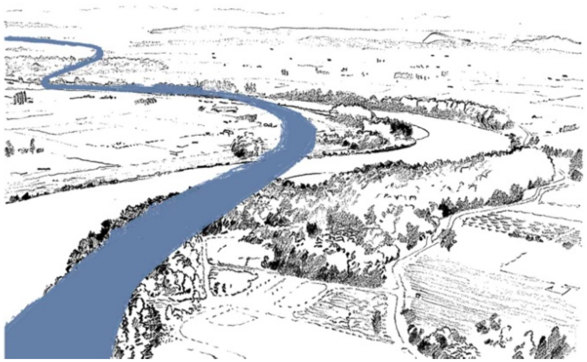
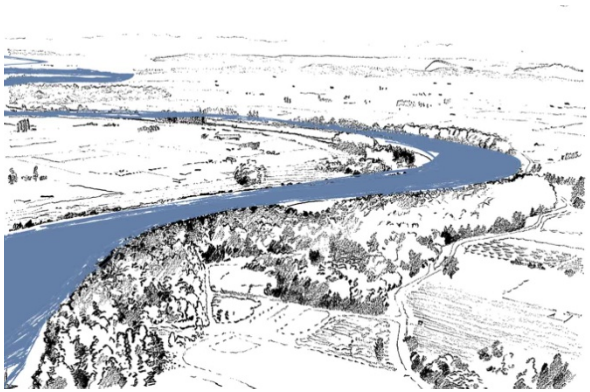
From 1990-2004 at least 37,000 restoration projects with over $17 billion in investment were documented in the U.S. (Bernhardt et al. 2005). The goals of most of these projects were to enhance or rehabilitate river ecosystems degraded by previous actions such as channelization, dredging, straightening, dam building, gravel mining, or diversion. These are the lessons learned to date.

1. Preserve what's working
2. Restore process not form
3. Do no harm
4. Set goals in the context of constraints and opportunities
5. Prioritize projects at the system-wide scale
6. Learn from restoration
7. Empower rivers through legislation understood by the public
8. Make river decisions transparent
9. Make river restoration a part of everyday life
10. Build a constituency of stewardship system-wide

1. Preserve what's working



2. Restore process not form


Restoring connectivity: longitudinal

Dam Removal

-restore fish migration
-remove risky dams filled with sediment

So far mostly small dams removed

Key issue: What to do with the sediment?
Impacts on downstream populations/structures

Matilija Dam, Ventura River, California

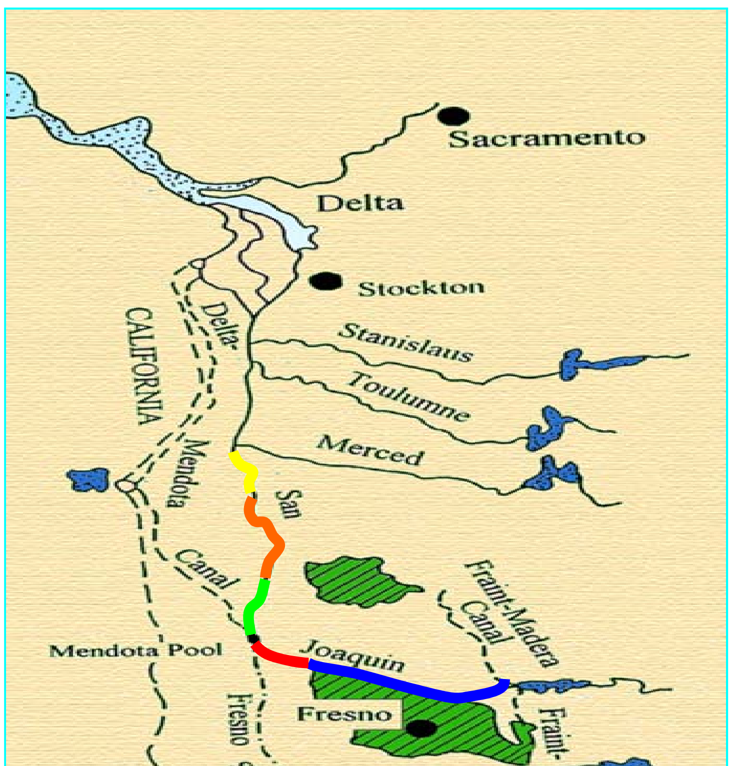
Filled with sediment, poses safety hazard

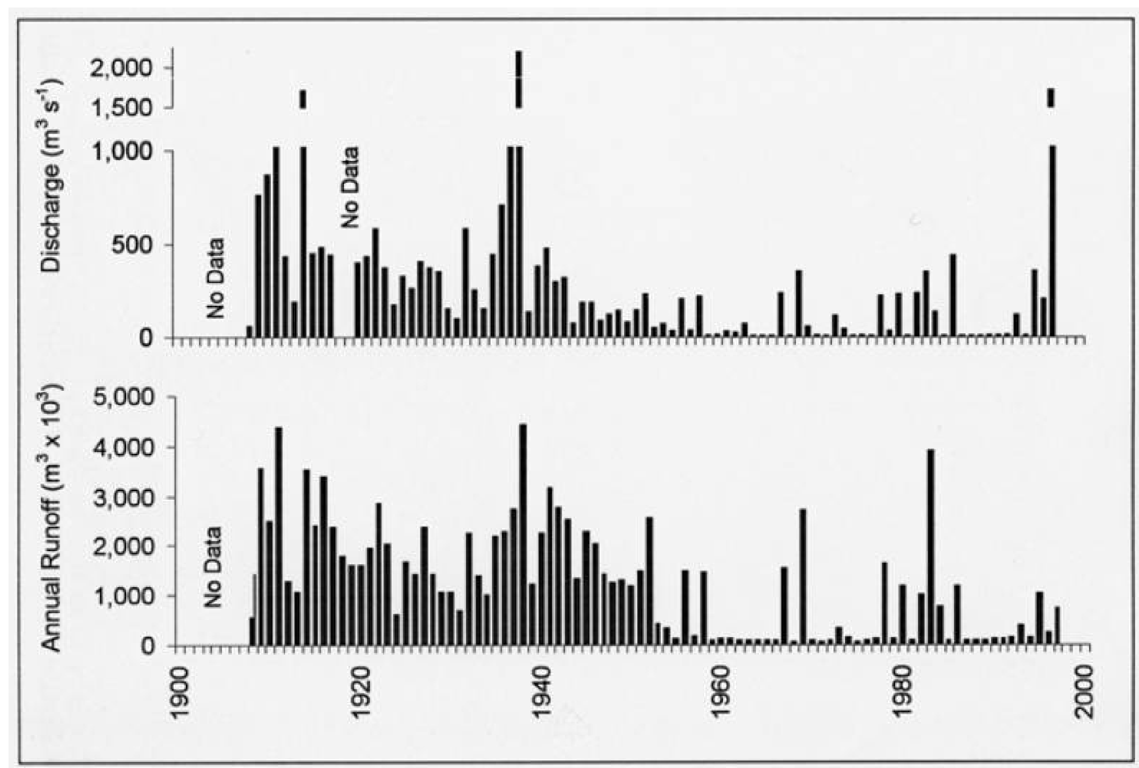
Blocks migration of steelhead trout

Will be removed (eventually!)

Potential downstream sediment effects the overriding issue

Friant Dam (1940s)
blocked upstream migration
and so reduced flows
that the river dried up downstream
once-mighty Spring-run salmon
exterminated from river

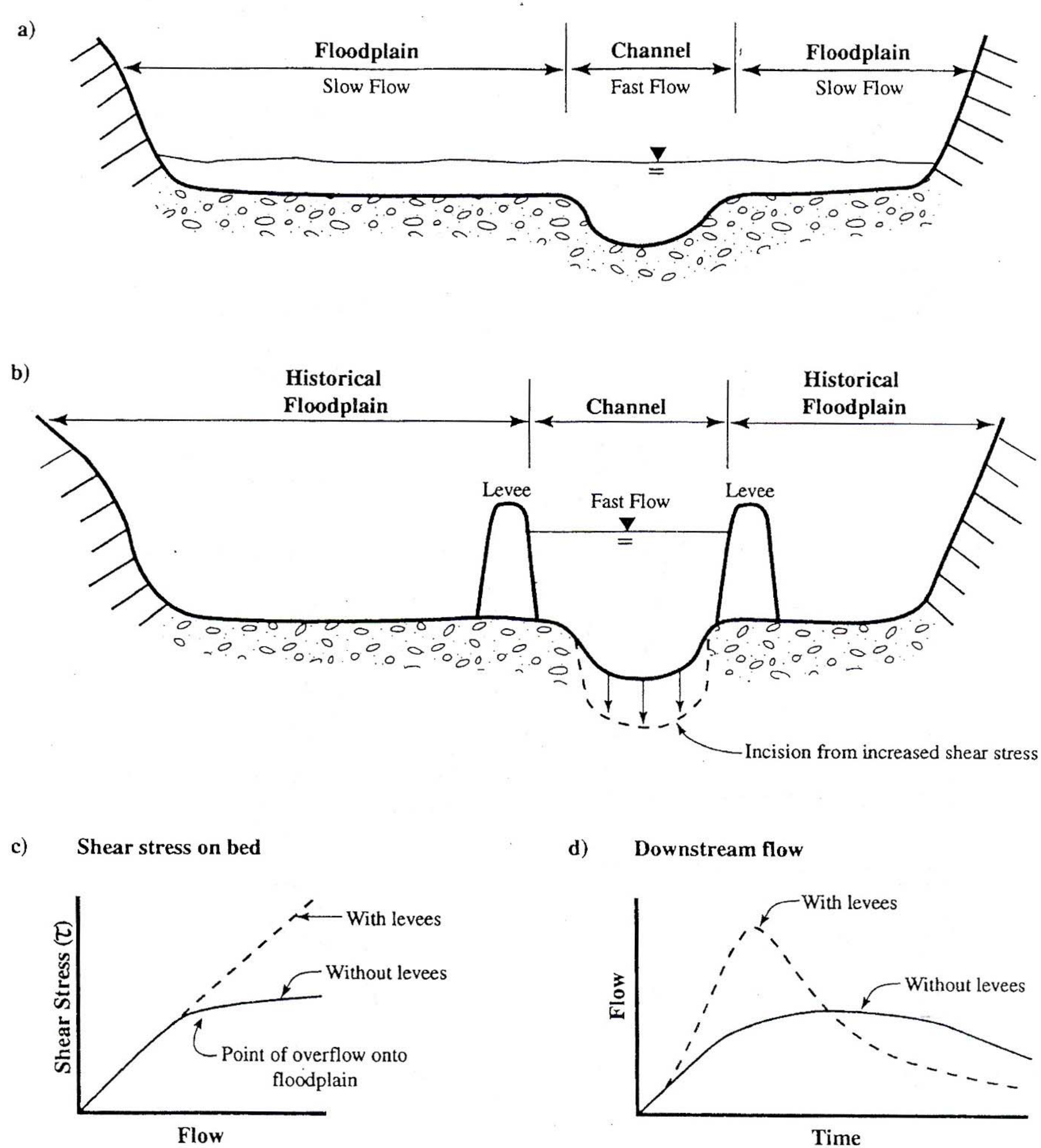




Historical-geomorphic analysis showed that 1949 flood control project changed channel from multi-threaded, complex, shaded, frequent pool-riffle alternations

to

simplified, wider channel with high shear stress in floods. (Added gravels and planted trees would scour) Less complex habitat, less hyporheic interaction. To restore habitat, restore floodplain connectivity!


a)
Floodplain
Slow Flow
Channel
Fast Flow
Floodplain
Slow Flow
b)
Historical Floodplain
Channel
Historical Floodplain
Levee
Fast Flow
Levee
Incision from increased shear stress
c)
Shear stress on bed
Shear Stress (τ)
With levees
Without levees
Point of overflow onto floodplain
Flow
d)
Downstream flow
Flow
With levees
Without levees
Time

3. Do no harm

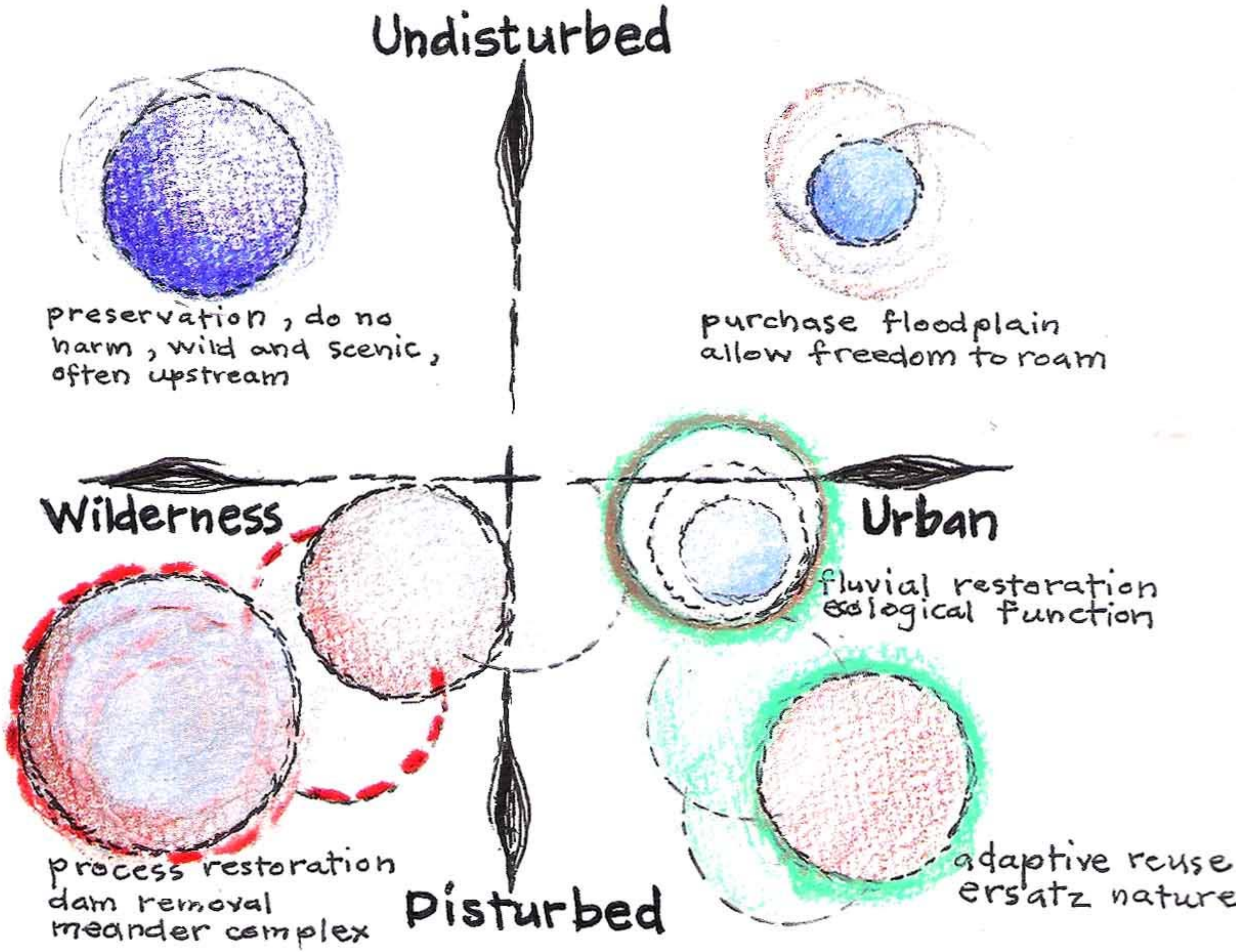
Apalachicola River, Florida: How to Restore?

- History of navigational dredging by US Army Corps, disposal of dredged sand, channel instability/enlargement, water level decline from channel change and reduced flows from catchment (Atlanta, center-pivot irrigation SW Georgia)
- Side channels/sloughs dried out from lowered water levels,
- Meander bends cut-off for navigation

Restoration/mitigation projects seek to reconnect side channel habitats – not sustained, fill with sediment.

Battle Bend: repeated excavations, largest in 2006, ph 2 to open upstream inlet to flush sediment

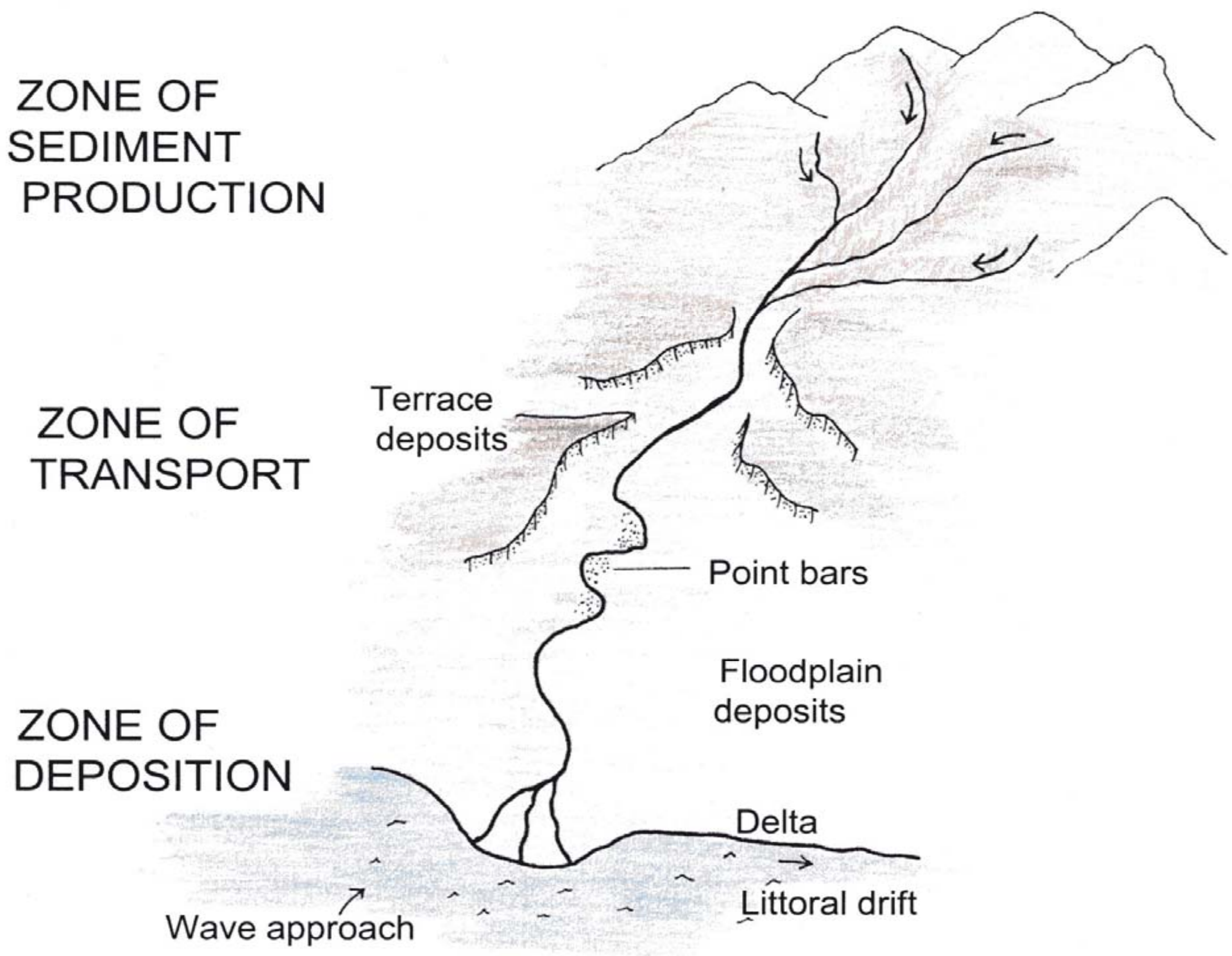
4. Set goals in the context of constraints and opportunities


Undisturbed
preservation, do no harm, wild and scenic, often upstream
purchase floodplain allow freedom to roam
Wilderness
Urban
fluvial restoration ecological function
process restoration dam removal meander complex
Disturbed
adaptive reuse ersatz nature

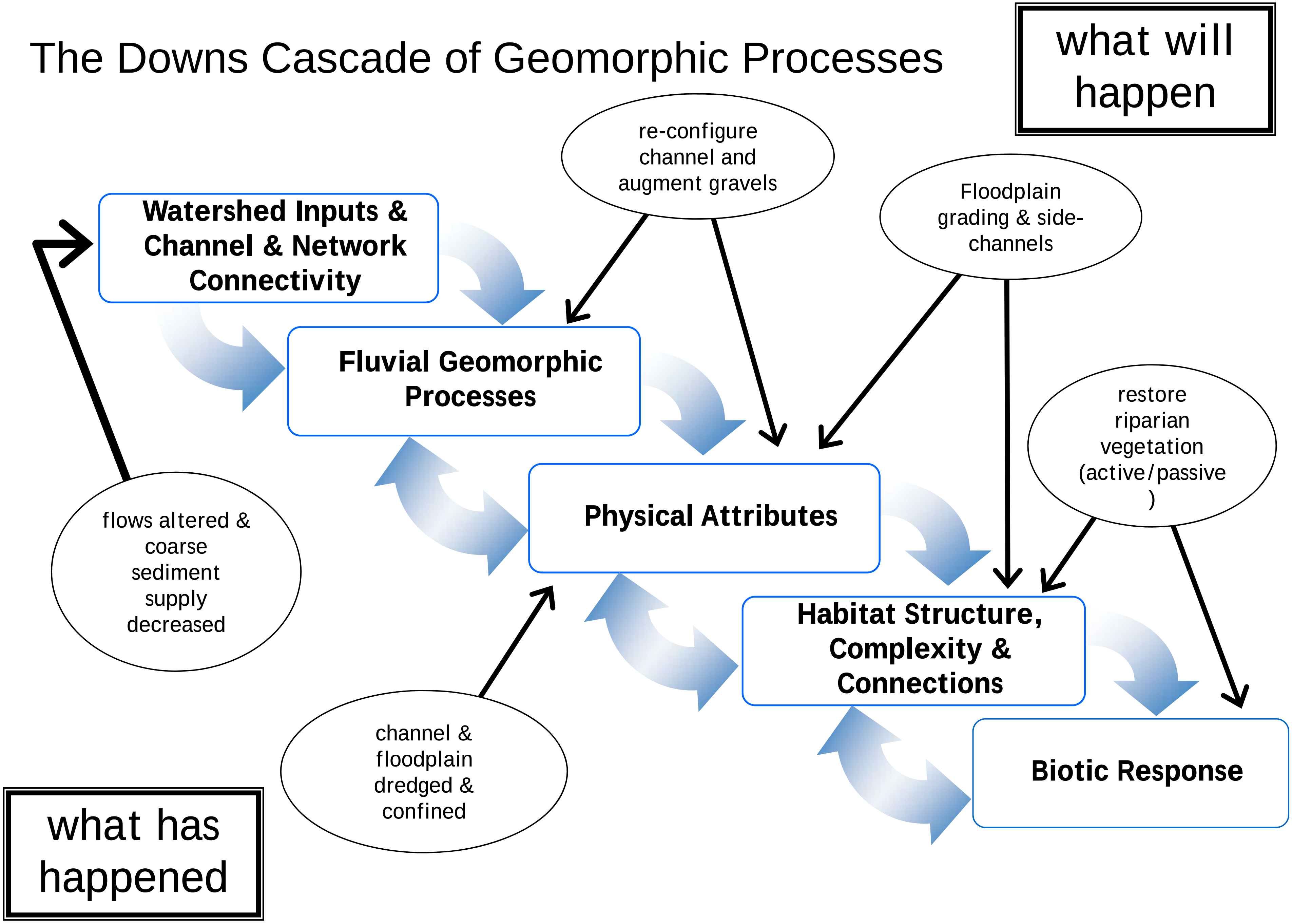
5. Prioritize projects at the system-wide scale

Restoring Process

Keeping the big picture in mind



The Downs Cascade of Geomorphic Processes



Hierarchy of processes influencing watershed biological baseline conditions.

Reducing Non-point Source Pollution: Managing Urban Stormwater Runoff

Objectives:

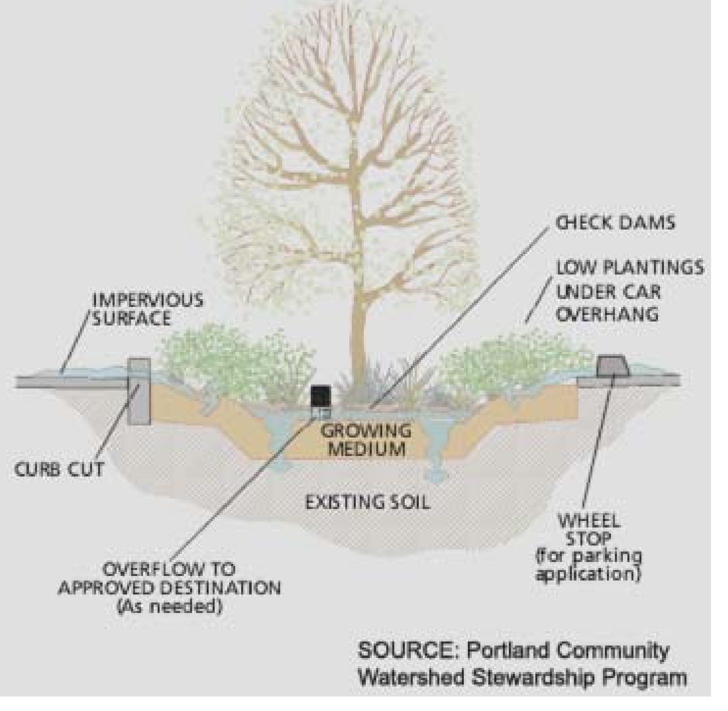
Slow, hold back runoff

Infiltrate runoff into the ground

Filter runoff through vegetation and soil

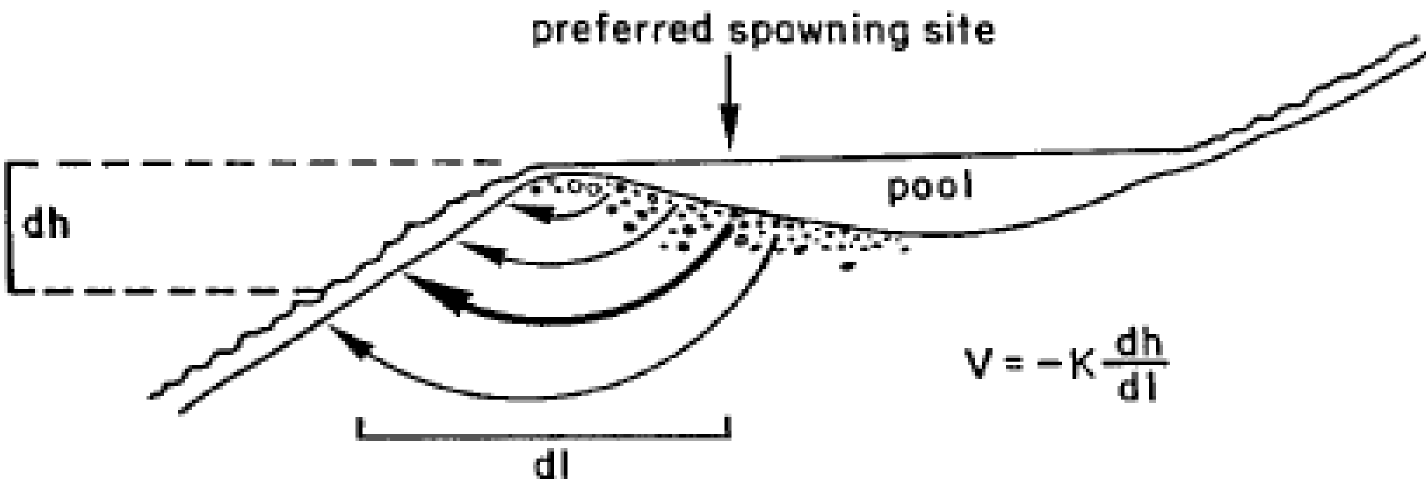
Swales*:*

Graded, engineered, shallow, vegetated open channels that convey water but slowly, filtering runoff in vegetation, and allowing some water to infiltrate

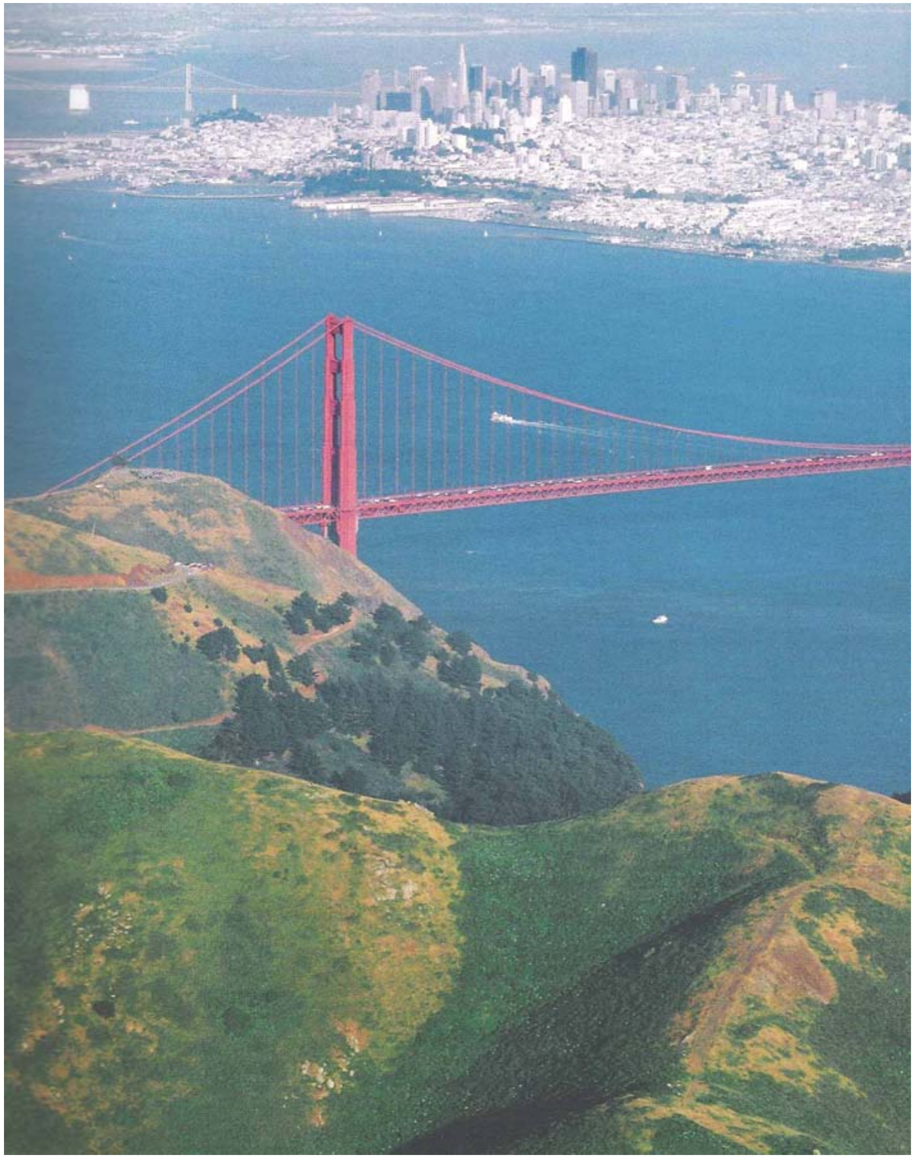


6. Learn from restoration

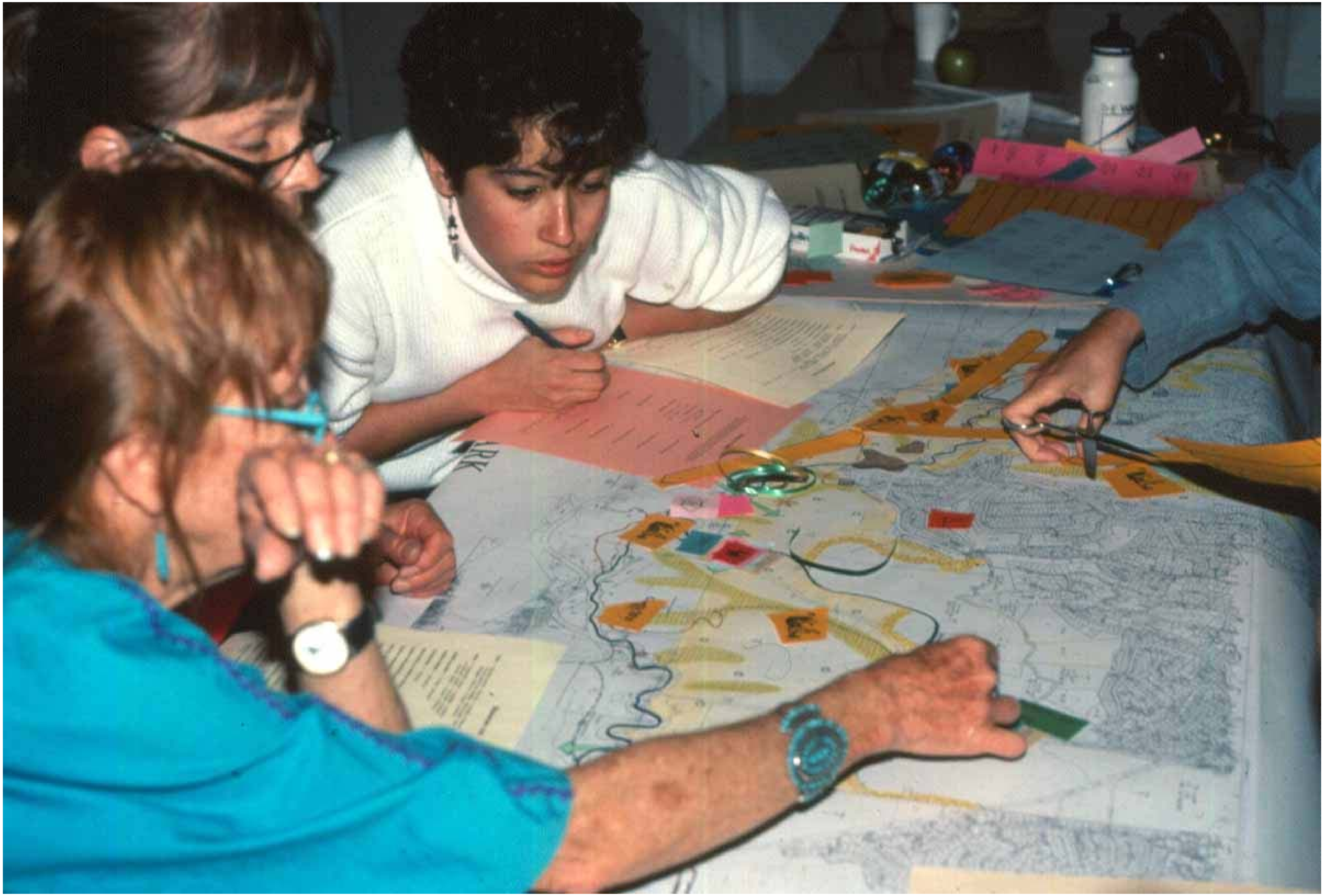

Temperature sensors deployed by Mark Tompkins



7. Empower rivers through legislation understood by the public



8. Make river decisions transparent



디자인 컨셉
보의 제원
공사개요
위치도
시설계획(상주보)
2단계 시공계획(2010.9~2011.6)
하도정비계획
준설량 검토
하도정비 전

9. Make river restoration science a part of everyday life

‘Daylighting’ buried urban creeks

one of the first:
Strawberry Creek Park,
Berkeley, California
1980s

10. Build a public constituency of stewardship system-wide