

Ten Principles of River Restoration and Four River Project of Korea

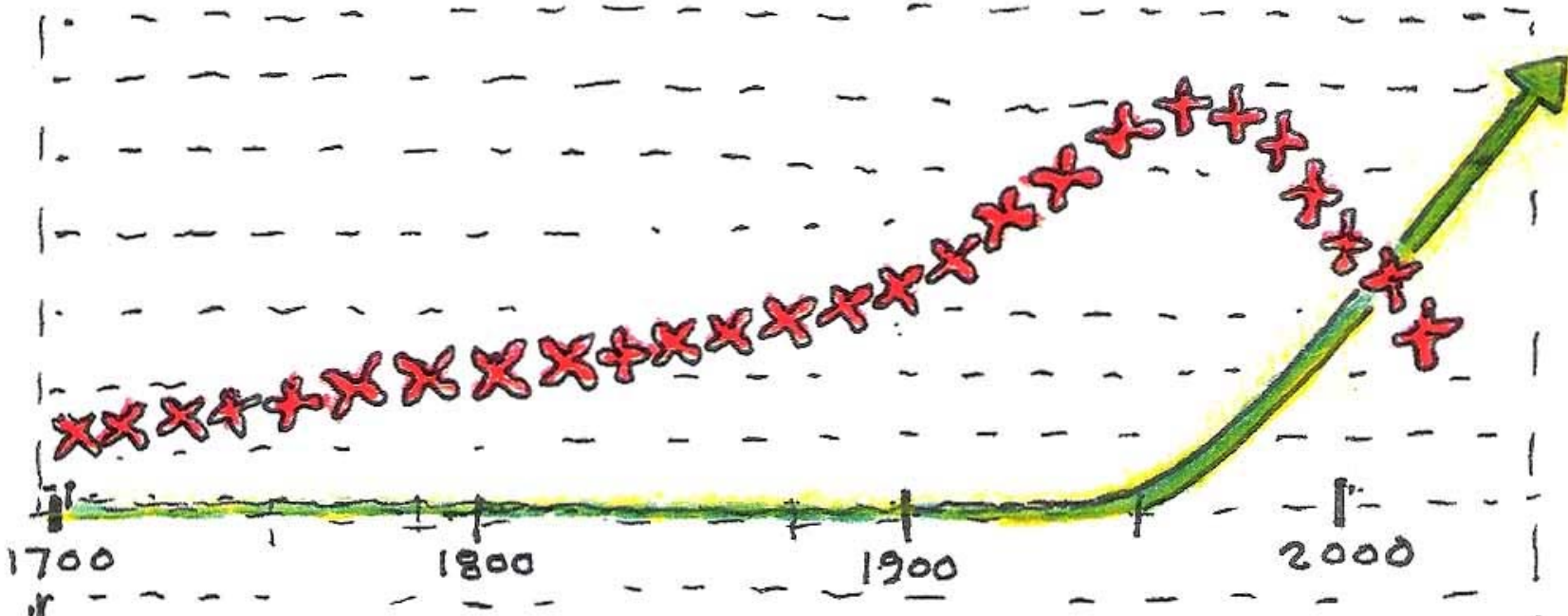
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more

River destruction and restoration

gross trends in the United States

less



xxxxx : 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

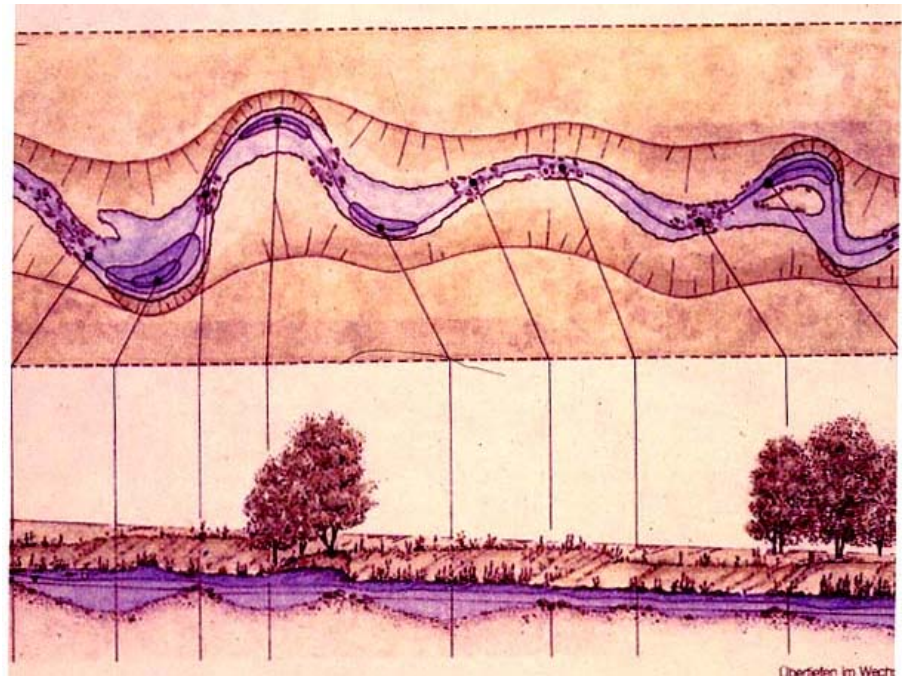
Floodplain conversion

- 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

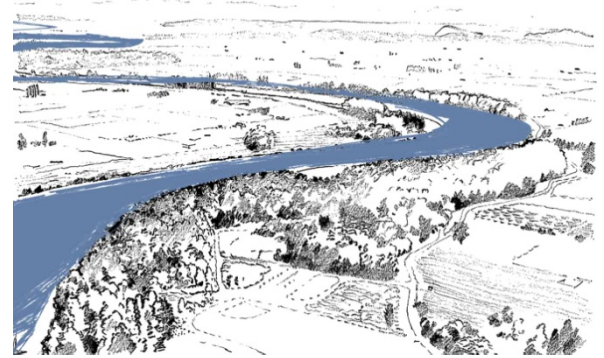
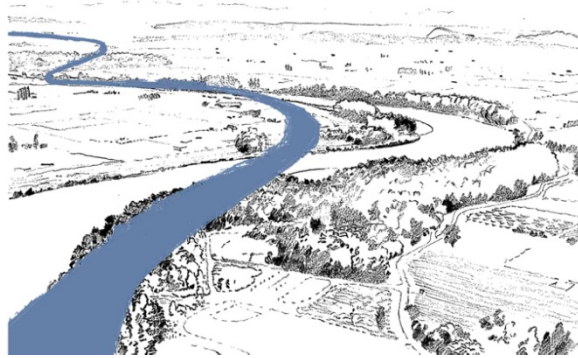
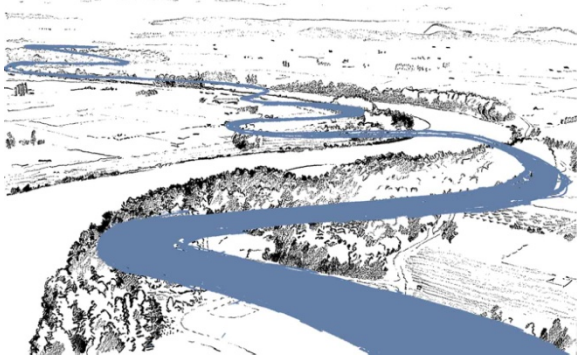
1. Preserve what's working







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!)

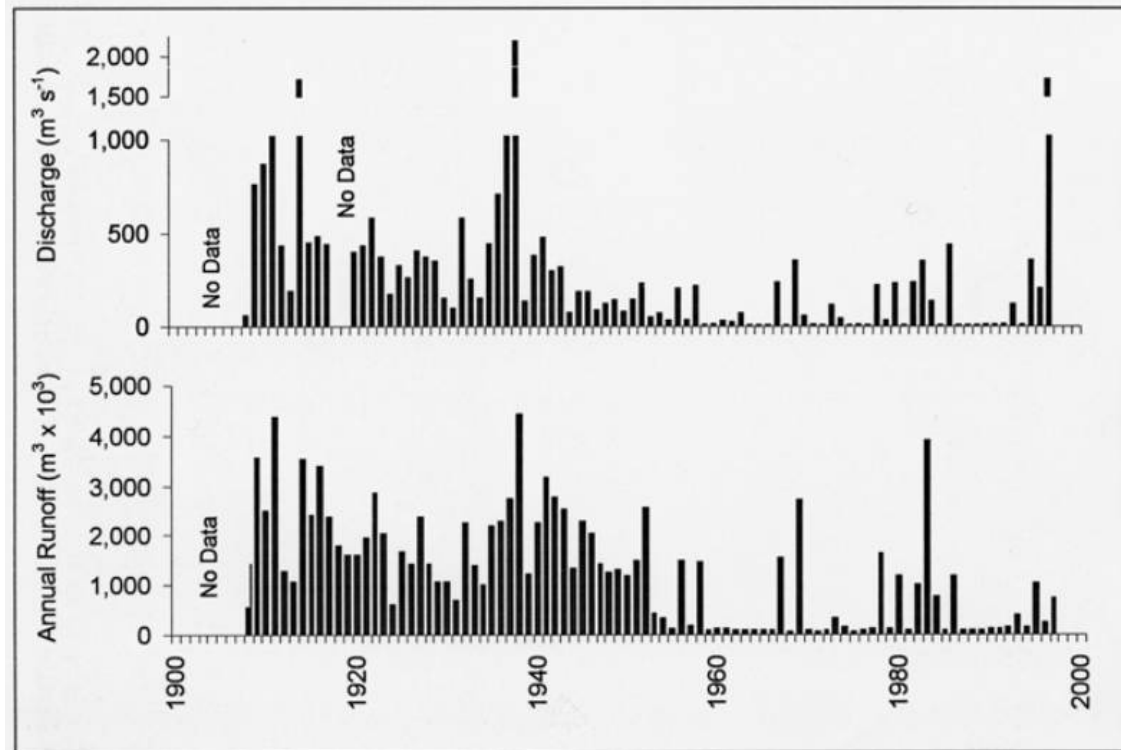
Potential downstream sediment effects the overriding issue





Friant Dam (1940s)

blocked upstream migration
and so reduced flows
that the river dried up downstream
once-mighty Spring-run salmon
exterminated from river





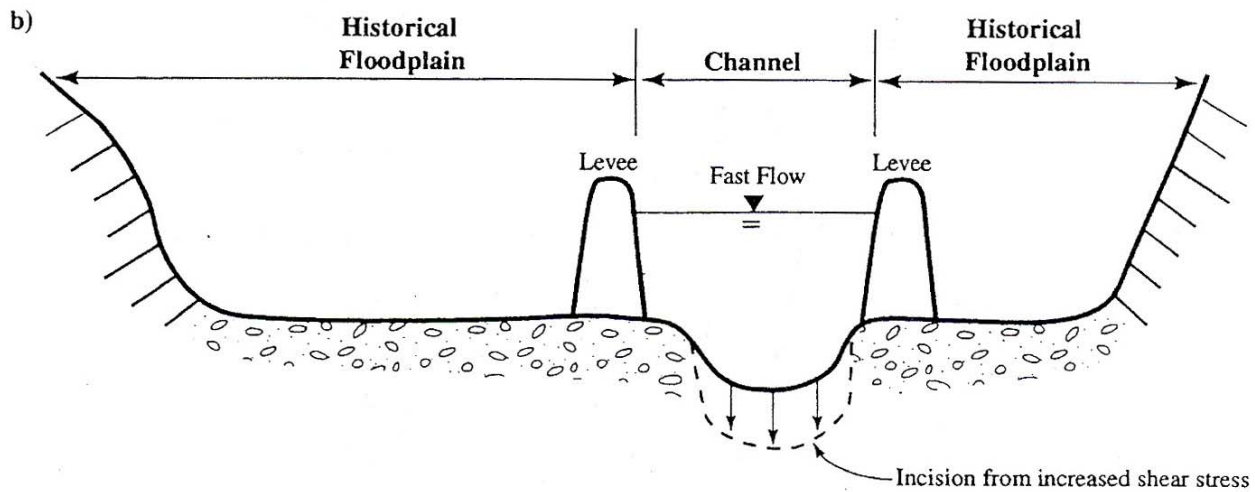
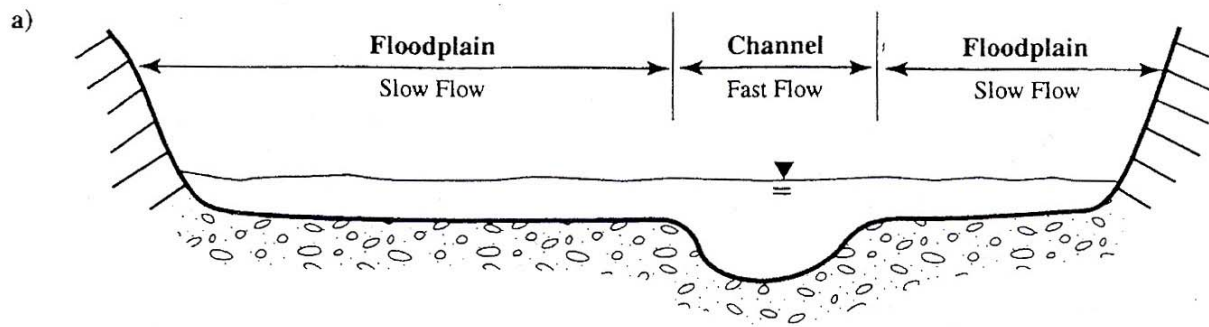
1938



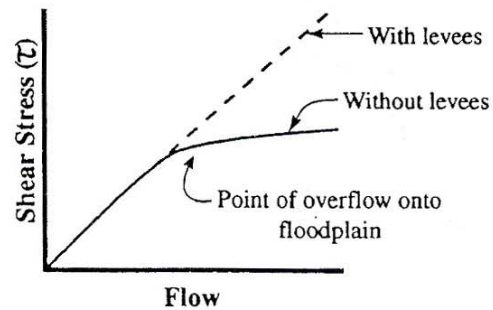
1996

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

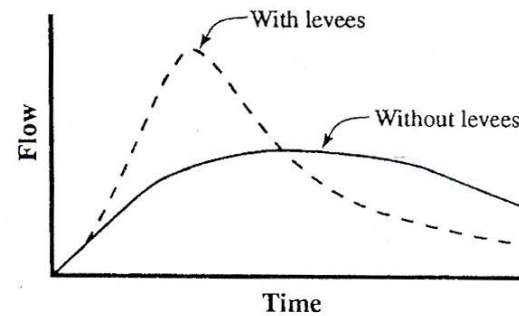
simplified, wider channel with high shear stress in floods. (Added gravels and planted trees would scour) Less complex habitat, less hyporheic interaction. To restore habitat, restore floodplain connectivity!



c) Shear stress on bed



d) Downstream flow



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

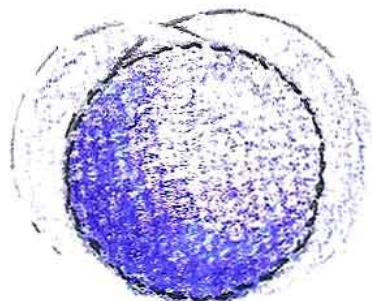
Restoration/mitigation projects seek to reconnect side channel habitats
– not sustained, fill with sediment.



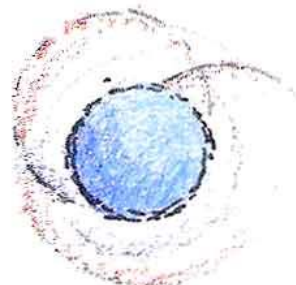
Battle Bend: repeated excavations, largest in 2006, ph 2 to open upstream inlet to flush sediment

4. Set goals in the context of constraints and opportunities

Undisturbed

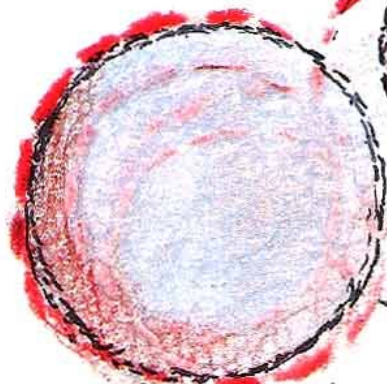


preservation, do no harm, wild and scenic, often upstream



purchase floodplain allow freedom to roam

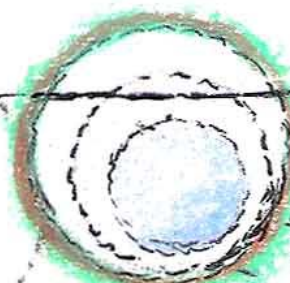
Wilderness



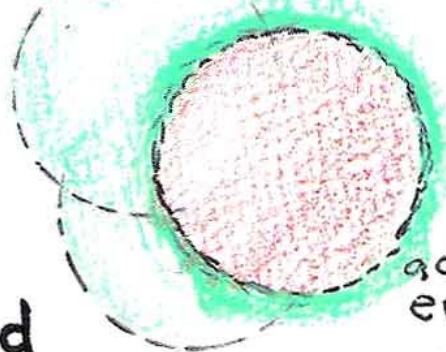
process restoration
dam removal
meander complex

Disturbed

Urban



fluvial restoration
ecological function



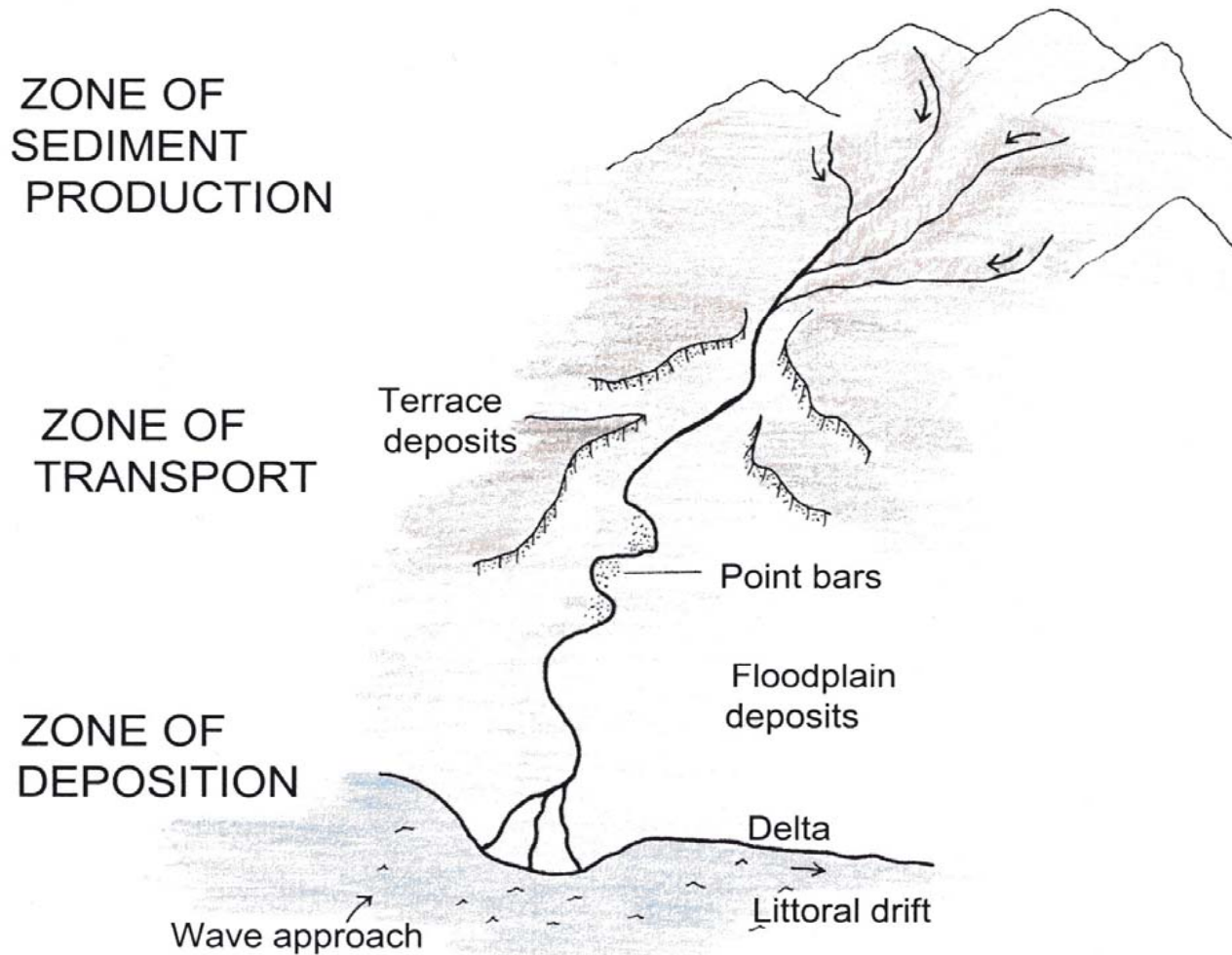
adaptive reuse
ersatz nature



5. Prioritize projects at the system-wide scale

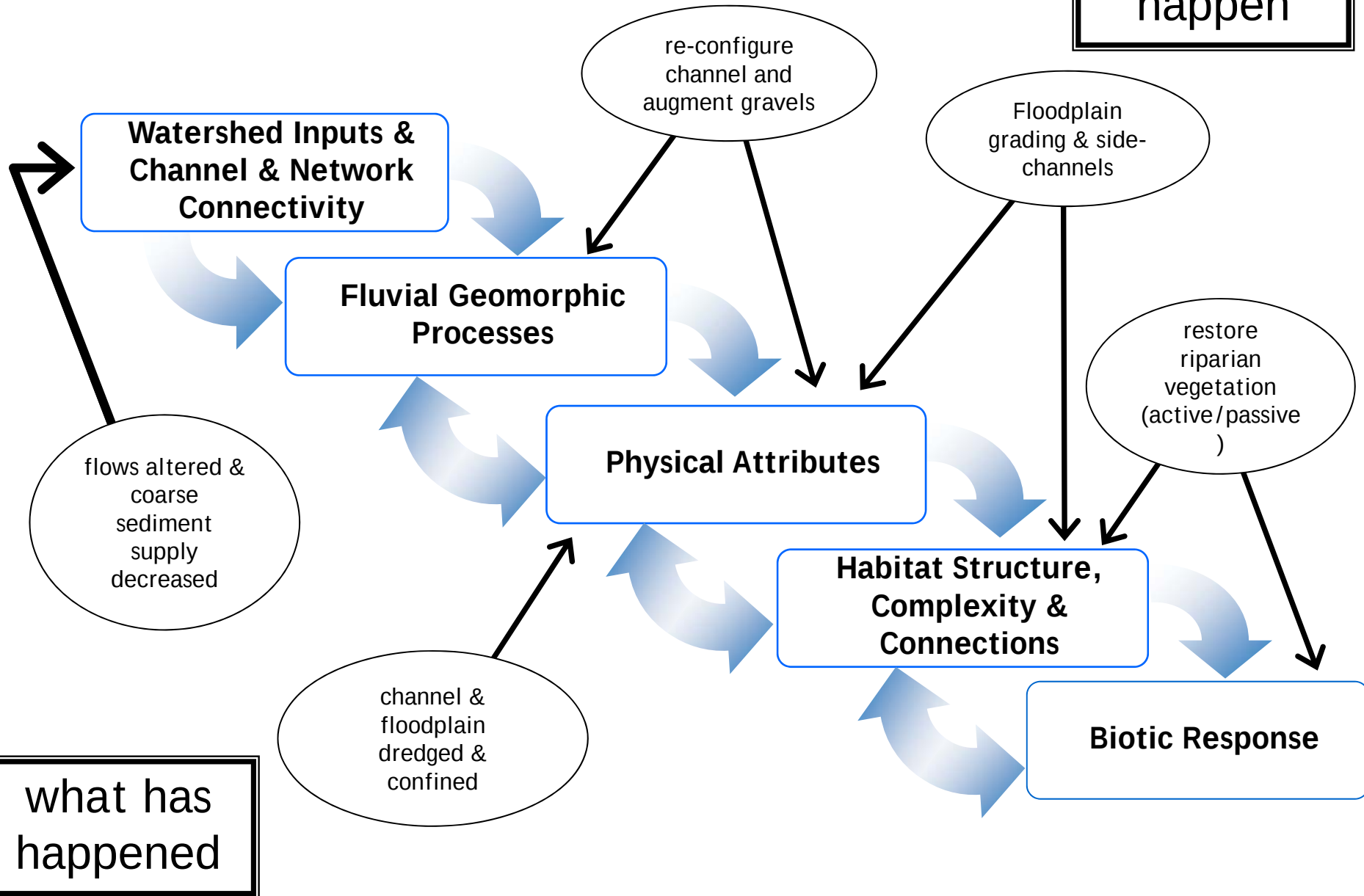
Restoring Process

Keeping the big picture in mind



The Downs Cascade of Geomorphic Processes

what will happen



Hierarchy of processes influencing watershed biological baseline conditions.

Reducing Non-point Source Pollution: Managing Urban Stormwater Runoff

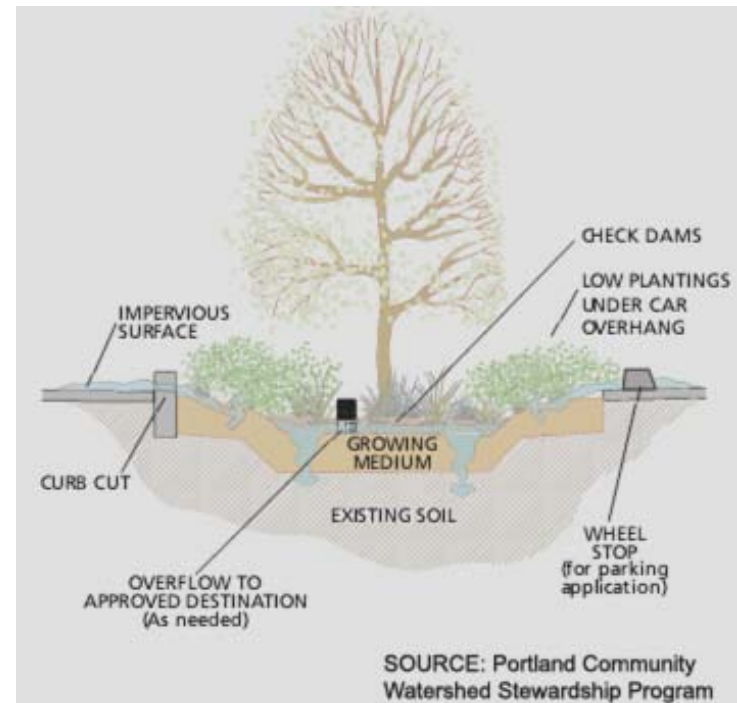
Objectives:

*Slow, hold back runoff
Infiltrate runoff into the
ground*

*Filter runoff through
vegetation and soil*

Swales:

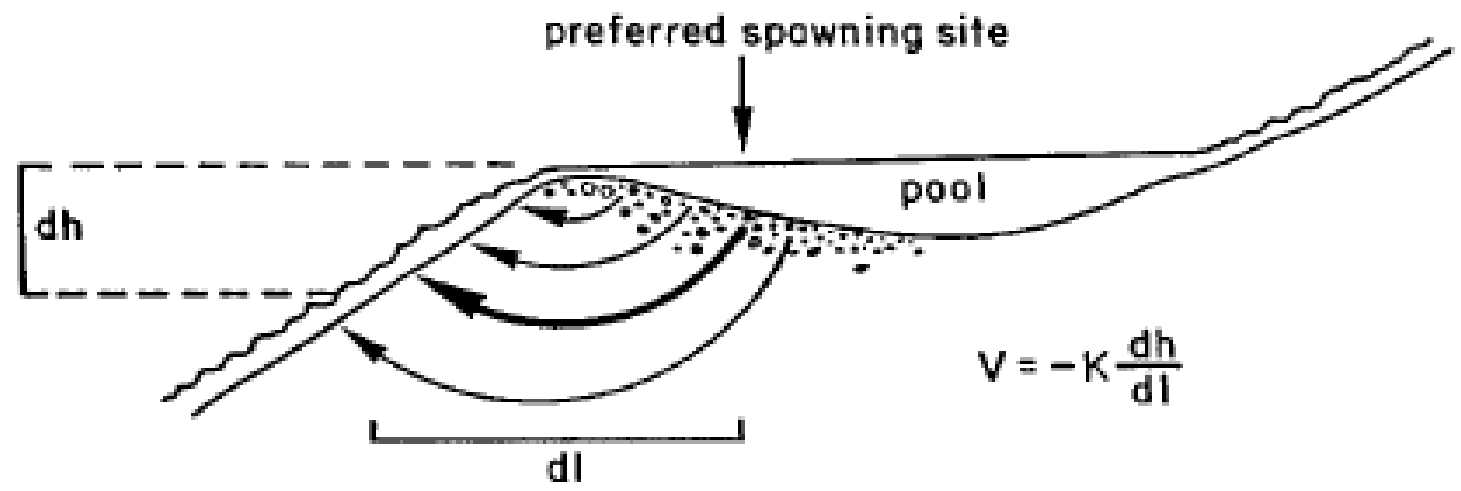
*Graded, engineered,
shallow, vegetated open
channels that convey
water but slowly, filtering
runoff in vegetation, and
allowing some water to
infiltrate*



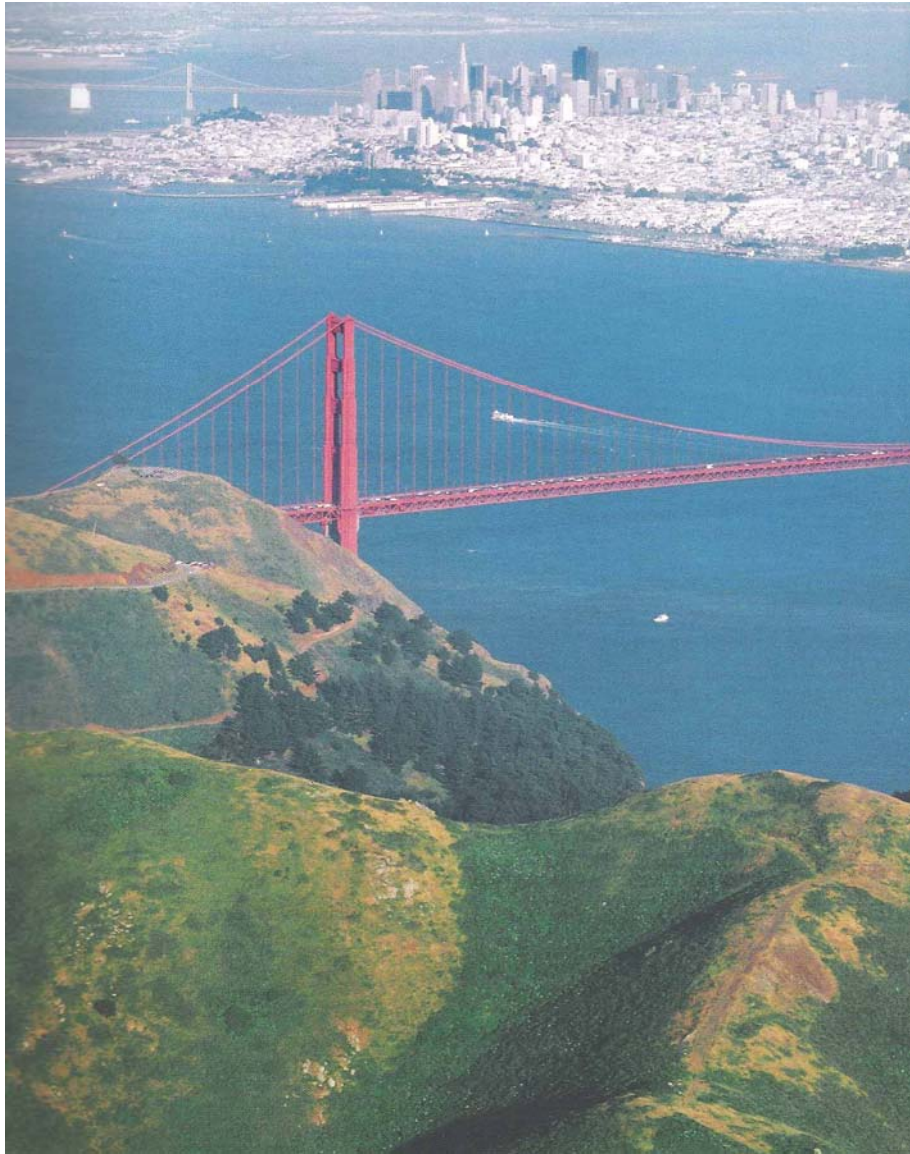
6. Learn from restoration



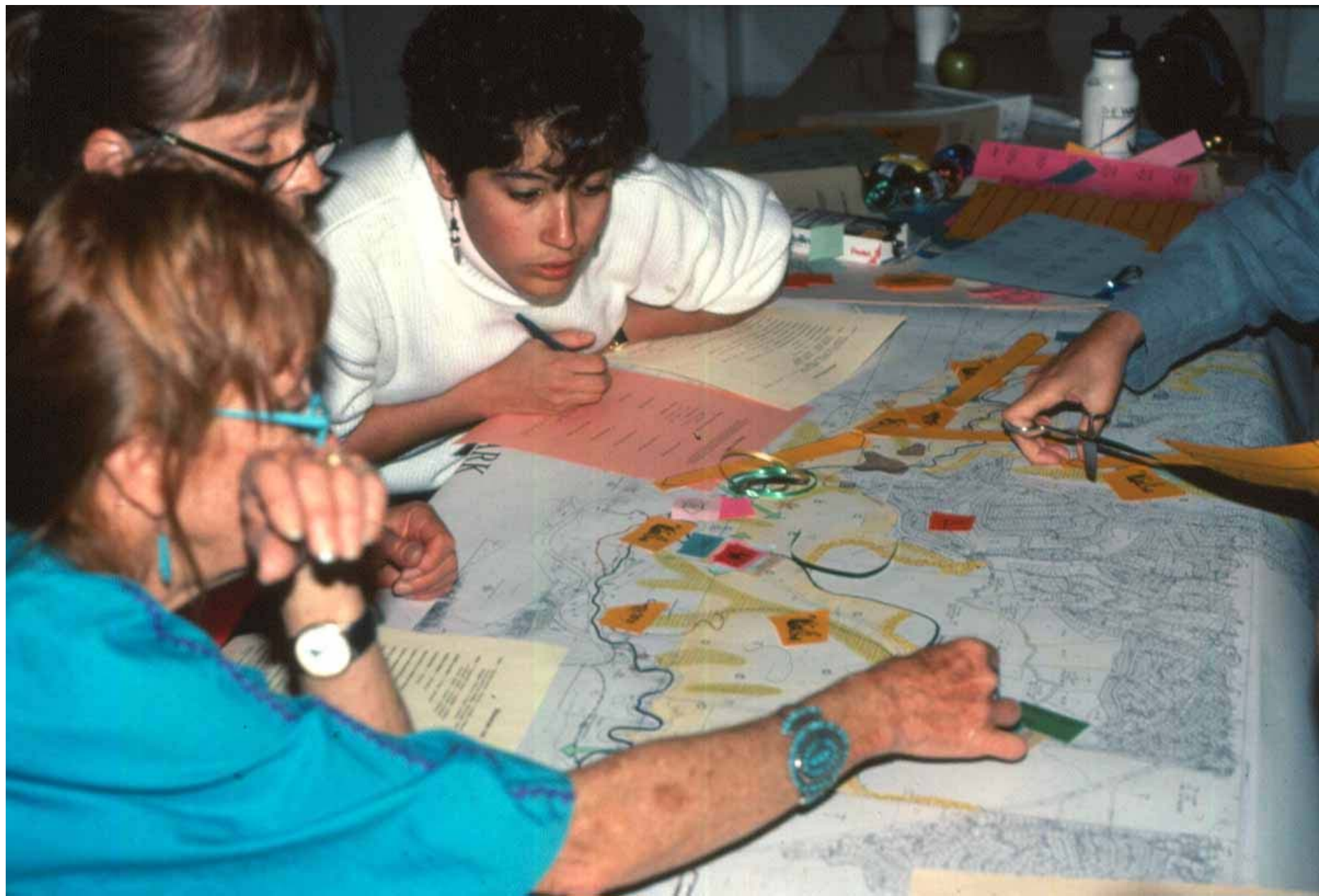
Temperature sensors deployed by Mark Tompkins

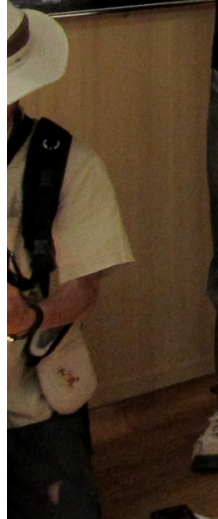


7. Empower rivers through
legislation understood
by the public



8. Make river decisions
transparent





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

