# Swirling in Sediment and Slowing Fisheries Recovery

A Concurrent Session at the 35th Annual Salmonid Restoration Conference held in Davis, CA from March 29 – April 1, 2017.

# Session Overview

- Session Coordinator:
  - Brain Cluer, Ph.D. and
    Michael Pollock, Ph.D.
    NOAA Fisheries

# Presentations

(Slide 4) Swirling in Sediment and Slowing Fisheries Recovery
Brian Cluer, Ph.D., NOAA Fisheries

(Slide 14) Engineering is the Easy Part
Jim Robins, Alnus Ecological

(Slide 81) Incorporating Geomorphic Processes and Sediment Dynamics into Salmonid Habitat Restoration Design
Jason Q. White, Environmental Science Associates

# Swirling in Sediment and Slowing Fisheries Recovery

Brian Cluer

NOAA Fisheries

West Coast Region

- Sediment is considered by fisheries resource agencies as harmful to spawning beds and filling over-summering pools.  Water quality jurisdictions regulate sediment as a pollutant, and yet there is no salmonid habitat that is not created by sediment.

- the processes governing the mode of sediment transport (bedload, suspended load, and wash load) are significantly different for different grain sizes, although sediment typically is managed as a whole.

- For example, two common sediment condition evaluation methods are V* and embeddedness, where V* is a measure of fines in pools and embeddedness is a ratio of fine vs coarse on the stream bed. Typically, neither measure is applied in context to watershed sediment delivery timing with respect to measurement, sediment transport modes and grain sizes, seasonal cycles of sediment transport, or linked to the physical processes that are reflected in the evaluations that are only a snapshot in time.

- There are language barriers between disciplines; at the particle scale, fisheries managers consider small gravel and sand to be fines, while engineers and geologists classify fine particles as silt and clay.  The fines that fisheries managers refer to are actually the coarsest sand or finest gravel by size class.

- Geomorphic process domains and channel evolution are important but underutilized concepts in stream management and restoration. Sediment source areas are distinct from sorting and transfer areas, which are distinct from deposition zones; these process domains are directly related to the quantity and quality of habitat in any given watershed location.

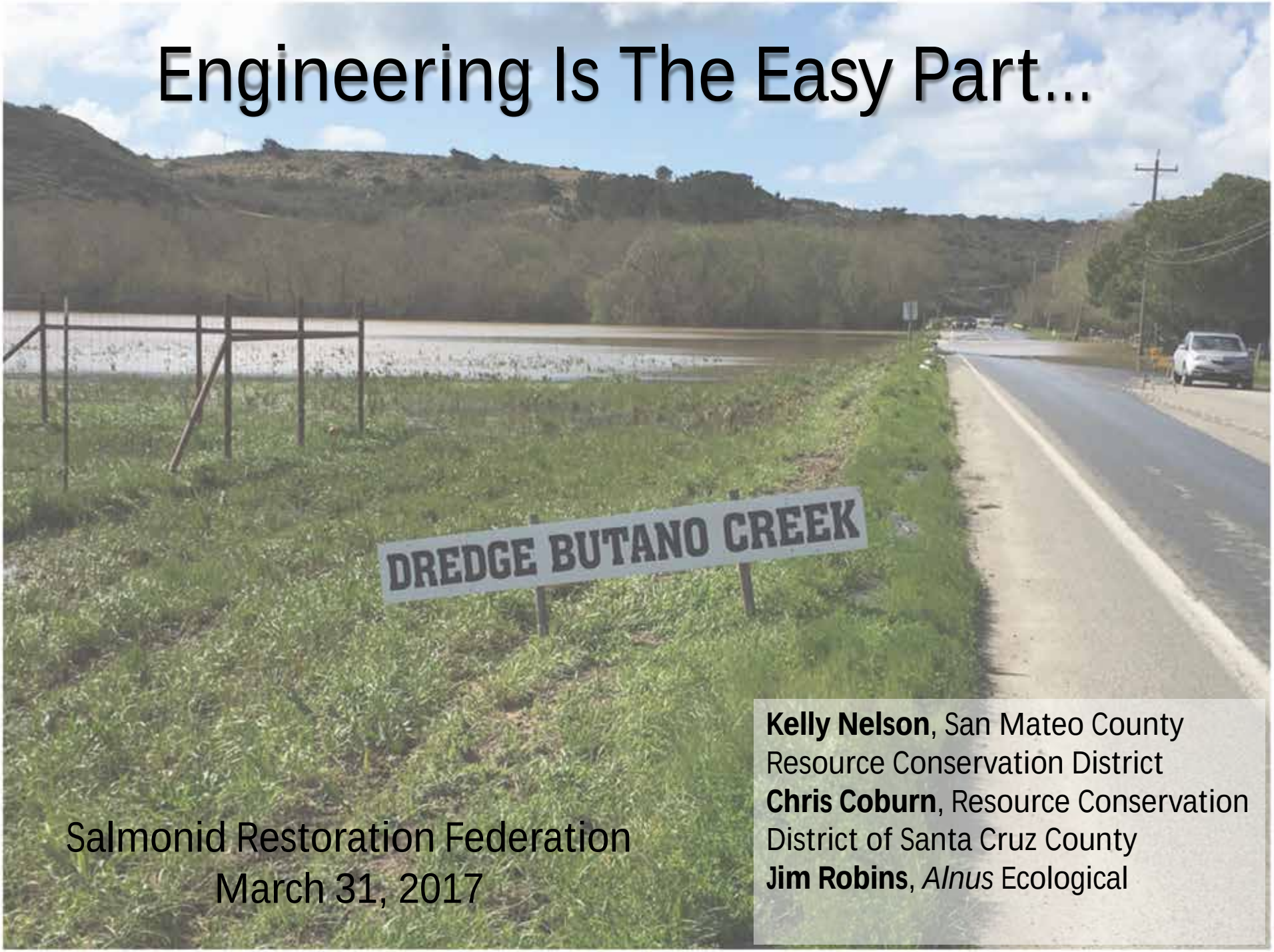
- However, sediment continuity is commonly applied in management and restoration regardless of geomorphic context or geologic history, making every site a transfer zone and clearly undervaluing deposition zones in management and restoration. Land development in general created transport zones out of former deposition zones, losing the significant ecosystem richness that deposition zones support.

- Natural channel design approaches assume sediment continuity is a goal, and sometimes continuity is a regulatory or grant requirement. But sediment continuity and bank stabilization projects in deposition zones both retard restoration and species recovery by keeping ecosystem benefits depressed.

- Sediment TMDL's for fines are considered inconsistent with beach replenishment and coastal sand management.

- This session will explore some of the common misunderstandings of sediment, modes of sediment transport, seasonal and decadal cycles, how sediment and habitat interact, and how standard practices are in many cases at odds with science.
- Most importantly, sediment as a resource will be presented.

# Engineering Is The Easy Part…



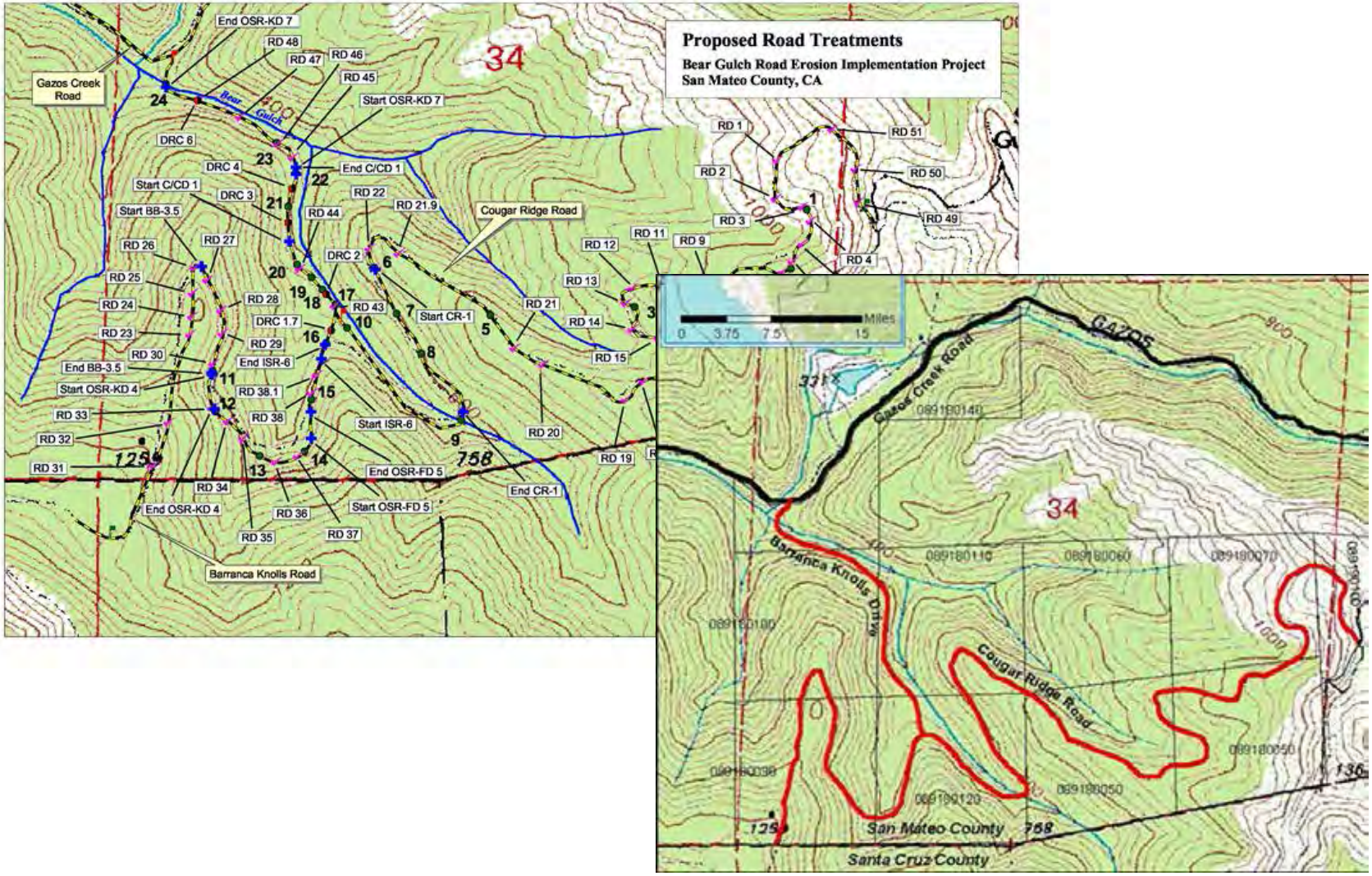

Salmonid Restoration Federation
March 31, 2017

**Kelly Nelson**, San Mateo County Resource Conservation District
**Chris Coburn**, Resource Conservation District of Santa Cruz County
**Jim Robins**, *Alnus* Ecological

# Beyond Engineering

- Landowner needs and concerns
- Regulatory complexity
- Social/ political context
- Funding
  - Funding the true cost of restoration work
  - Timing of funding availability with on the ground realities

# Landowner Concerns



# Landowner Concerns

# Regulatory Complexity

| REGULATION | AGENCY | REQUIRED DOCUMENTS |
|---|---|---|
| Clean Water Act Section 404 | U.S. Army Corps of Engineers | Nationwide Permit **or** Individual Permit |
| Clean Water Act Section 401 | Water Quality Control Board | 401 Certification |
| Endangered Species Act Section 7 or Section 10 | U.S. Fish and Wildlife Service/National Marine Fisheries Service | Biological Assessment/Biological Opinion **or** Habitat Conservation Plan |
| National Historic Preservation Act Section 106 | State Historic Preservation Office | Cultural resources report |
| National Environmental Policy Act | U.S. Army Corps of Engineers (probably) | None **or** Environmental Assessment **or** Environmental Impact Statement |
| California Fish and Game Code Section 1602 | California Department of Fish and Wildlife | Streambed Alteration Agreement |
| California Water Code | Water Quality Control Board | Waste Discharge Requirements |
| Coastal Development Permit | San Mateo County | Coastal Development Permit application |
| California Environmental Quality Act | California Department of Fish and Wildlife or San Mateo County | Initial Study/Negative Declaration **or** Initial Study/Mitigated Negative Declaration **or** Environmental Impact Report |
| California Endangered Species Act | California Department of Fish and Wildlife | Streambed Alteration Agreement, CEQA Document, perhaps Incidental Take Permit |
| Right of Entry Permits | San Mateo County, State Parks, private landowners | Permit applications |
| Non-Discretionary Permits | San Mateo County | Permit applications |

# Regulatory Complexity

# Butano Floodplain Restoration Project

## FLOODPLAIN RECONNECTION

Options:

- Lower the floodplain
- Raise the channel to reconnect to historic floodplain


**Raising the channel allowed reconnection to 100 acre historic floodplain** with minimal excavation

Project Benefits:

- More frequent floodplain inundation
- Provide sediment storage capacity
- Floodplain/wetland/off-channel habitat restoration
- Some downstream flood attenuation


衆聲
探象之圖

## LET'S PULL THE PLUG IN PESCADERO

**Do you want to reduce flooding in Pescadero?**

Simple solution: let the water flow down the creek, into the marsh and out to the ocean.

**Where do we want the water?**

In Pescadero or in the Marsh? The drainage system is blocked. Soon marshland with all of its diverse flora and fauna will become farmland. It cost over a million of YOUR dollars to dig two holes which divert flood water into Pescadero.

**Do you want to spend millions (current estimate 15 – 20 million) of YOUR dollars on a Causeway which is a complicated Band Aid and no solution?**

The Causeway is not the answer. The Causeway delays a solution.

**Pull the plug in Pescadero.**

**Who can do that?**

San Mateo County and State Parks have the power, not the will. They own the plug, they can remove it.

**Can you make your voice heard?**
Call and write to

Doe Horsley, your representative. Don Horsley and San Mateo County employees have forgotten that they work for YOU, the taxpayer.
dhorsley@smcgov.org
(650) 363 4569

State Parks, Chris Spohrer
Acting Santa Cruz District Superintendent

**FEBRUARY 14, 2017**

**REQUEST FOR FINANCIAL DISCLOSURES FROM RESOURCE CONSERVATION DISTRICT, COUNTY OF SAN MATEO**

1) Accounting for the last five years with respect to grants obtained and which projects have been funded by which organizations. Also to include collaborative funding, for example, P. O. S. T.

2) List of current projects accounting for the dollars, funding and grants, and which operations are funded by which grant and the source of each grant.

3) List of current grant applications and other funding applications.

4) List of current employees, job descriptions and employment packages.

5) Butano Creek plan, funding sources and monies spent so far and fund to be spent on projected expenses. Details of where the monies will be allocated and to whom.

Hopefully, this information can be provided voluntarily and if not we will put this request under the Freedom of Information Act. Just let us know if necessary.

Thank you Kellyx.

Bob Skinner

Corresponding Sect'y

Pescadero Municipal Advisory Council

"Come discuss your experiences in the past two floods and heavy rains. Property damage, inconveniences, misery and hopes. This is for residents and victims. **No government officials or outsiders.** Drive, walk, swim or boat to the hall."

U. S. Fish and Wildlife Service

CA Department of Fish and Wildlife

U. S. Army Corps of Engineers

Program

Santa Cruz County

California Coastal Commission

Regional Water Quality Control Board

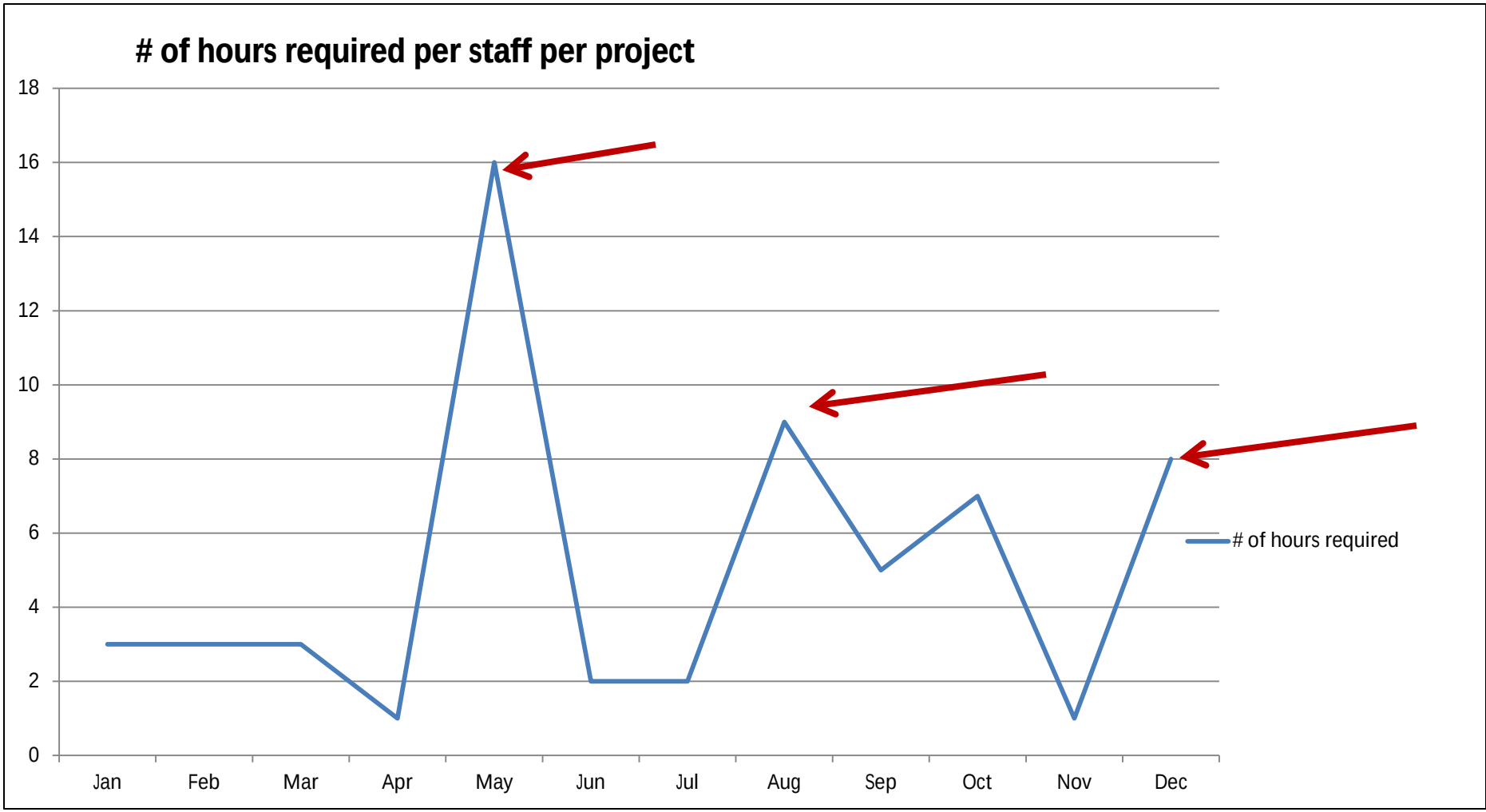
National Marine Fisheries Service

Cost to Develop, ~$125,000
Cost to Renew, ~$65,000
Cost per Staff (training), ~$4,000
Cost per Staff (per project), ~$5,000-$8,000

(i.e. a lot…)

Timeline
Initial Program 2005 – 2009 (15 practices)
2009 Renewal – 10 years (revised list of practices)

# Build and Manage




# Peaks and Valleys

**Benefits**

Trust
Environmental Improvement
Quick implementation
Relationships with Regulatory Staff (beyond PIR)
Pathway for local permits
Grant Funding
...and beyond grant funding

**Challenges**

Funding for Program Development
Funding to Manage Program
Funding for Renewal
Every Project is different
Limited Scope of Projects
**Staff Turnover**

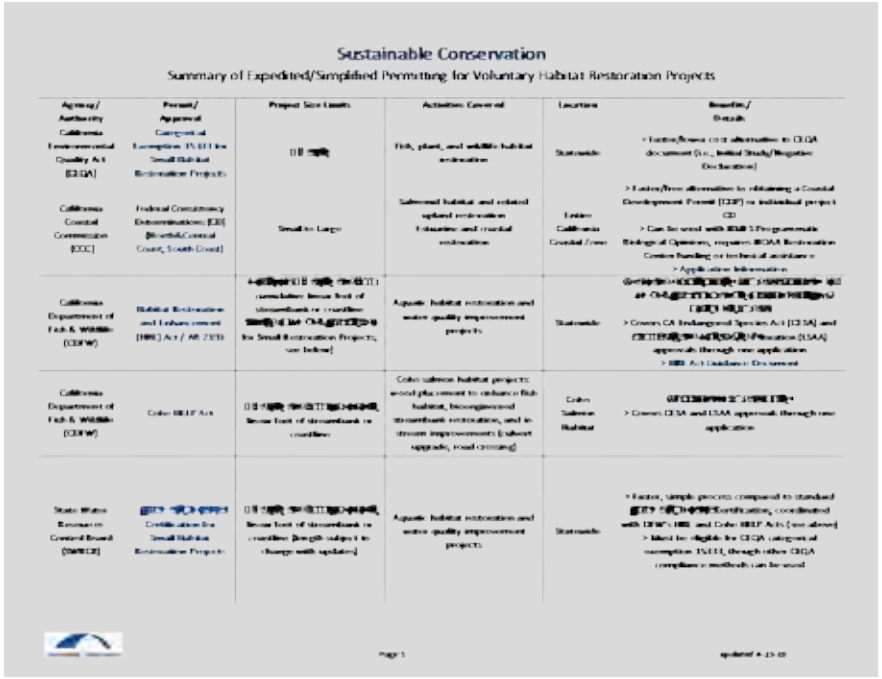
# Solutions:


We have the decision-making at our board meetings down to a science.

# Solutions: Project Development

$$$

# Solutions: Project Permitting



Sustainable Conservation

Summary of Expedited/Simplified Permitting for Voluntary Habitat Restoration Projects

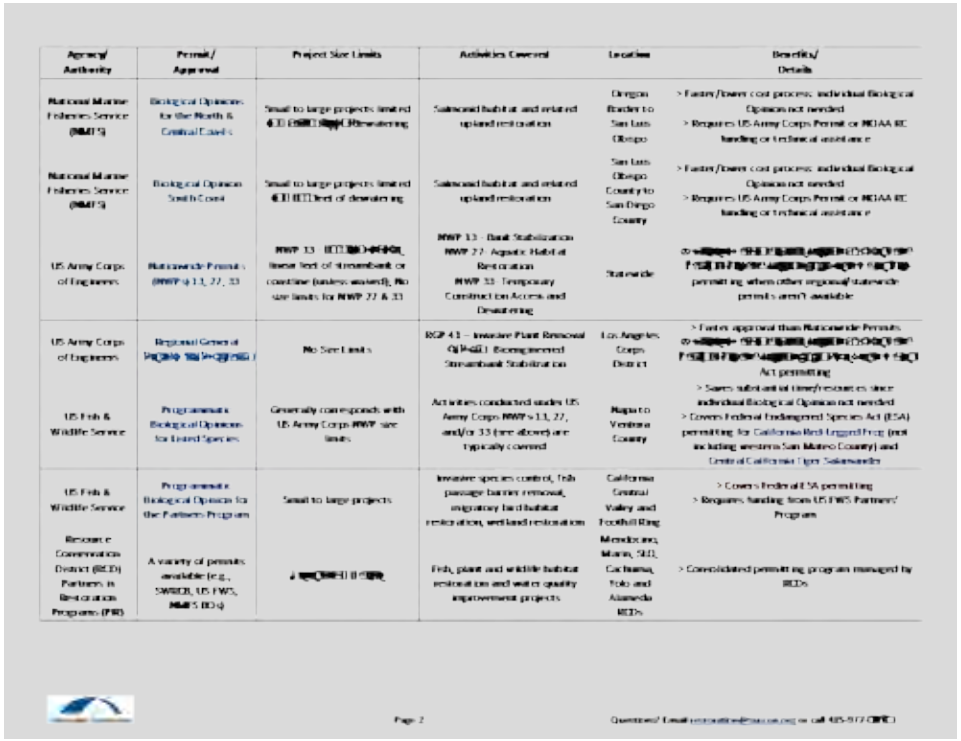
| Agency/ Authority | Permit/ Approval | Project Size Limits | Activities Covered | Location | Benefits/ Details |
|---|---|---|---|---|---|
| California Environmental Quality Act (CEQA) | Categorical Exemption 15333 for Small Habitat Restoration Projects | [redacted] | Fish, plant, and wildlife habitat restoration | Statewide | > Faster/lower cost alternative to CEQA document (i.e., Initial Study/Negative Declaration) |
| California Coastal Commission (CCC) | Federal Consistency Determinations (CD) (North/Central Coast, South Coast) | Small to Large | Salmonid habitat and related upland restoration<br>Estuarine and coastal restoration | Entire California Coastal Zone | > Faster/lower alternative to obtaining a Coastal Development Permit (CDP) or individual project CD<br>> Can be used with RSM 15 Programmatic Biological Opinions; requires NOAA Restoration Center funding or technical assistance<br>> Application Information |
| California Department of Fish & Wildlife (CDFW) | Habitat Restoration and Enhancement (HREA) Act / AB 2193 | [redacted] | Aquatic habitat restoration and water quality improvement projects | Statewide | [redacted]<br>> Covers CA Endangered Species Act (CESA) and [redacted] approvals through one application<br>> HREA Guidance Document |
| California Department of Fish & Wildlife (CDFW) | Coho HREP Act | [redacted] | Coho salmon habitat projects: wood placement to enhance fish habitat, bioengineered streambank restoration, and in-stream improvements (culvert upgrade, road crossing) | Coho Salmon Habitat | [redacted]<br>> Covers CESA and LSAA approvals through one application |
| State Water Resources Control Board (SWRCB) | [redacted] Certification for Small Habitat Restoration Projects | [redacted] | Aquatic habitat restoration and water quality improvement projects | Statewide | > Faster, simple process compared to standard [redacted] certification, coordinated with CDFW's HREA and Coho HREP Acts (see above)<br>> Most be eligible for CEQA categorical exemption 15333, though other CEQA compliance methods can be used |

Page 1 — updated 4-15-13

**Major Successes**: CEQA, ESA, Coastal Zone, NWP, 401 Cert, HREA .....

## Key Next Steps:

- Remove 500 lf of stream constraint (HREA/Small Habitat 401)
- Expansion/Replication of FWS BO's for Restoration
- **State Fully Protected Species**



| Agency/ Authority | Permit/ Approval | Project Size Limits | Activities Covered | Location | Benefits/ Details |
|---|---|---|---|---|---|
| National Marine Fisheries Service (NMFS) | Biological Opinion for the North & Central Coast | Small to large projects limited [redacted] (Dewatering | Salmonid habitat and related upland restoration | Oregon Border to San Luis Obispo | > Faster/lower cost process; individual Biological Opinion not needed<br>> Requires US Army Corps Permit or NOAA RC funding or technical assistance |
| National Marine Fisheries Service (NMFS) | Biological Opinion South Coast | Small to large projects limited [redacted] feet of dewatering | Salmonid habitat and related upland restoration | San Luis Obispo County to San Diego County | > Faster/lower cost process; individual Biological Opinion not needed<br>> Requires US Army Corps Permit or NOAA RC funding or technical assistance |
| US Army Corps of Engineers | Nationwide Permits (NWP's 13, 27, 33 | [redacted] feet of streambank or coastline (unless waived); No size limits for NWP 27 & 33 | NWP 13 - Bank Stabilization<br>NWP 27 - Aquatic Habitat Restoration<br>NWP 33 - Temporary Construction Access and Dewatering | Statewide | [redacted] permitting when other regional/statewide permits aren't available |
| US Army Corps of Engineers | Regional General [redacted] | No Size Limits | RGP 43 – Invasive Plant Removal [redacted] Bioengineered Streambank Stabilization | Los Angeles Corps District | > Faster approval than Nationwide Permits [redacted] Act permitting |
| US Fish & Wildlife Service | Programmatic Biological Opinion for Listed Species | Generally corresponds with US Army Corps NWP size limits | Activities conducted under US Army Corps NWP's 13, 27, and/or 33 (see above) are typically covered | Napa to Ventura County | > Saves substantial time/resources since individual Biological Opinion not needed<br>> Covers Federal Endangered Species Act (ESA) permitting for California Red Legged Frog (not including western San Mateo County) and Central California Tiger Salamanders |
| US Fish & Wildlife Service | Programmatic Biological Opinion for the Partners Program | Small to large projects | Invasive species control, fish passage barrier removal, migratory bird habitat restoration, wetland restoration | California Central Valley and Foothill Ring | > Covers Federal ESA permitting<br>> Requires funding from US FWS 'Partners' Program |
| Resource Conservation District (RCD) Partners in Restoration Programs (PIR) | A variety of permits available (e.g., SWRCB, US FWS, [redacted] BOs) | [redacted] | Fish, plant and wildlife habitat restoration and water quality improvement projects | Mendocino, Marin, SRD, Cachuma, Yolo and Alameda RCDs | > Consolidated permitting program managed by RCDs |

Page 2 — Questions? Email [redacted] or call 415-977-[redacted]

# Solutions: Project Permitting

## State Fully Protected Species….

**1654.**
(a) The director's approval of a habitat restoration or enhancement project pursuant to Section 1652 or 1653 **shall be in lieu of any other permit, agreement, license, or other approval issued by the department**, including, but not limited to, those issued pursuant to Chapter 6 (commencing with Section 1600) and Chapter 10 (commencing with Section 1900) of this Division and Chapter 1.5 (commencing with Section 2050) of Division 3.

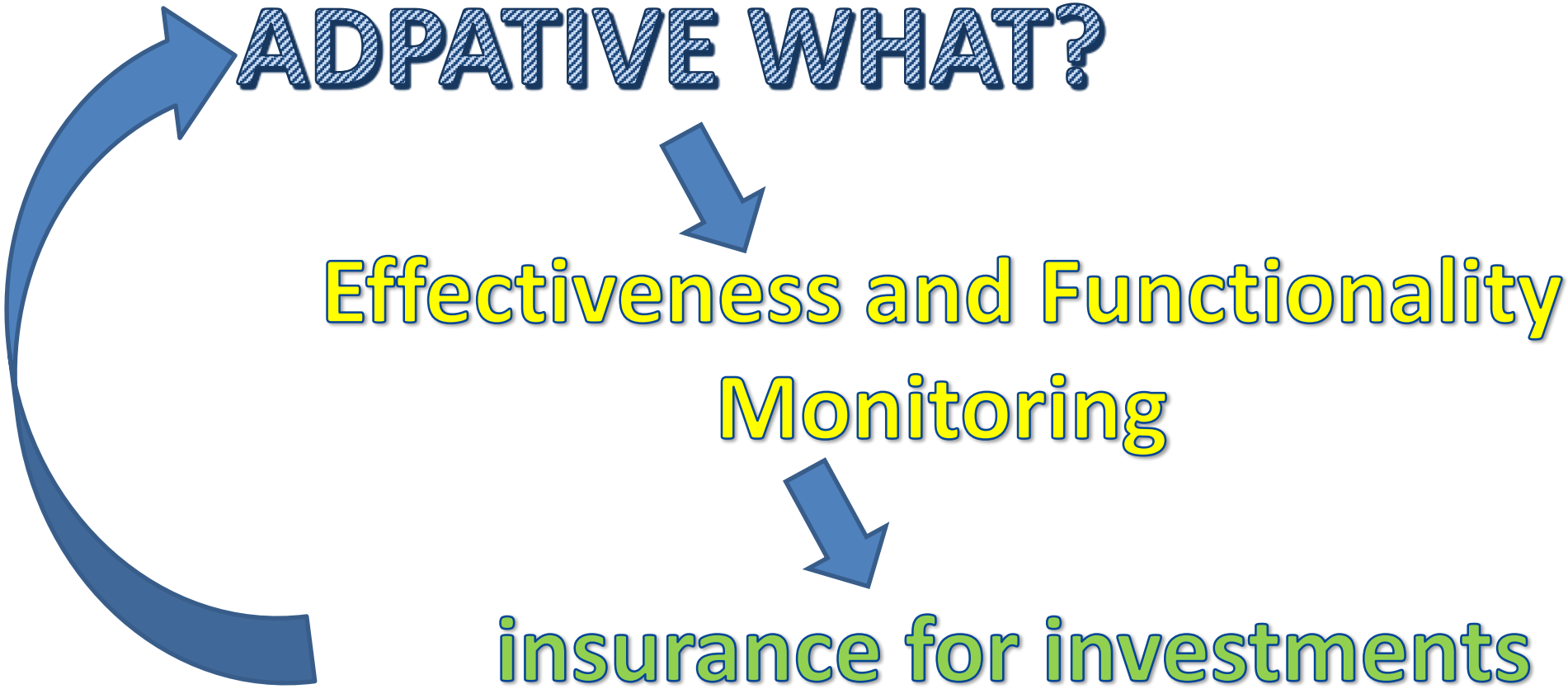
# Solutions: Construction

"The best laid schemes o' mice an' men / Gang aft a-gley."

Robert Burns


- FRGP QA/QC Process developed with Marcin Whitman.
- $ for Designers to be actively engaged in construction.

# Solutions: Beyond



# Incorporating Geomorphic Processes and Sediment Dynamics into Salmonid Habitat Restoration Design

Salmonid Restoration Federation

35th Annual Salmonid Restoration Conference
Davis, CA

Concurrent Session: Swirling in Sediment and Slowing Fisheries Recovery

by

Jason Q. White
Aaron A. Fulton, P.E.
Jorgen A. Blomberg
Ann E. Borgonovo, P.E.

# Geomorphic Design Approach

Salmonid Restoration Federation

35th Annual Salmonid Restoration Conference
Davis, CA

Concurrent Session: Swirling in Sediment and Slowing Fisheries Recovery

by

Jason Q. White
Aaron A. Fulton, P.E.
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# Purpose:

- Illustrate the Geomorphic Design Approach using the stream evolution model
- Present examples of Geomorphic Design Approach
- Demonstrate that with the Geomorphic Design Approach sediment becomes an asset rather than an impairment to salmondid habitat restoration

# Stream Evolution Model

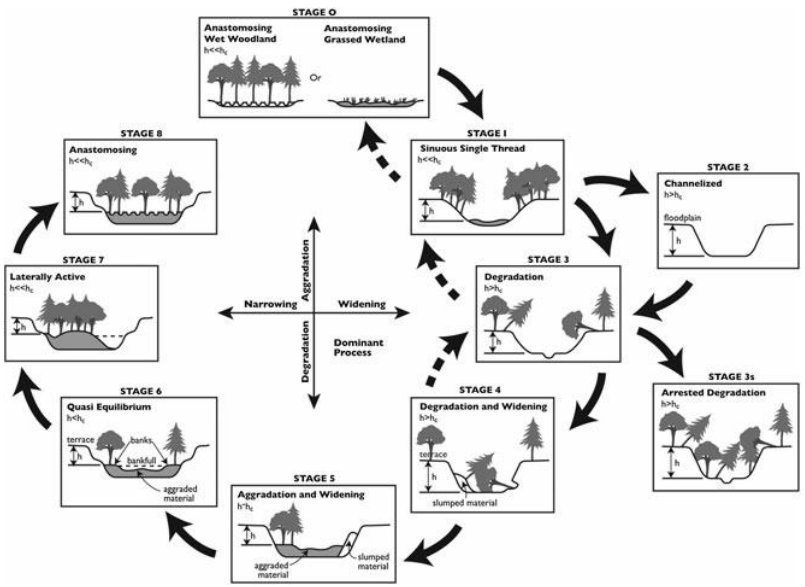
RIVER RESEARCH AND APPLICATIONS
*River Res. Applic.* (2013)
Published online in Wiley Online Library
(wileyonlinelibrary.com) DOI: 10.1002/rra.2631

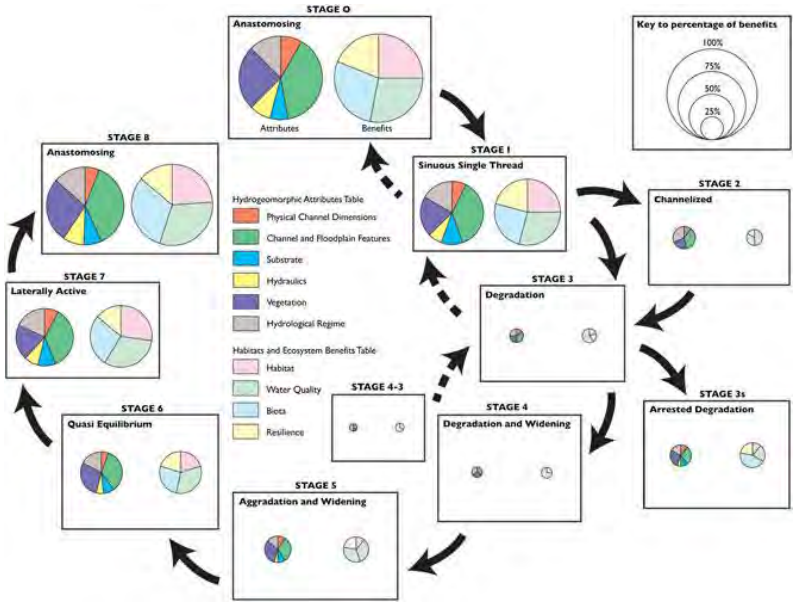
## A STREAM EVOLUTION MODEL INTEGRATING HABITAT AND ECOSYSTEM BENEFITS

B. CLUER[a]* and C. THORNE[b]

[a] *Fluvial Geomorphologist, Southwest Region, NOAA's National Marine Fisheries Service, Santa Rosa, California, USA*
[b] *Chair of Physical Geography, University of Nottingham, Nottingham, UK*

- Considers stream evolution as a cycle
- Adds Stage 0
- Evaluates habitat and ecosystem benefits

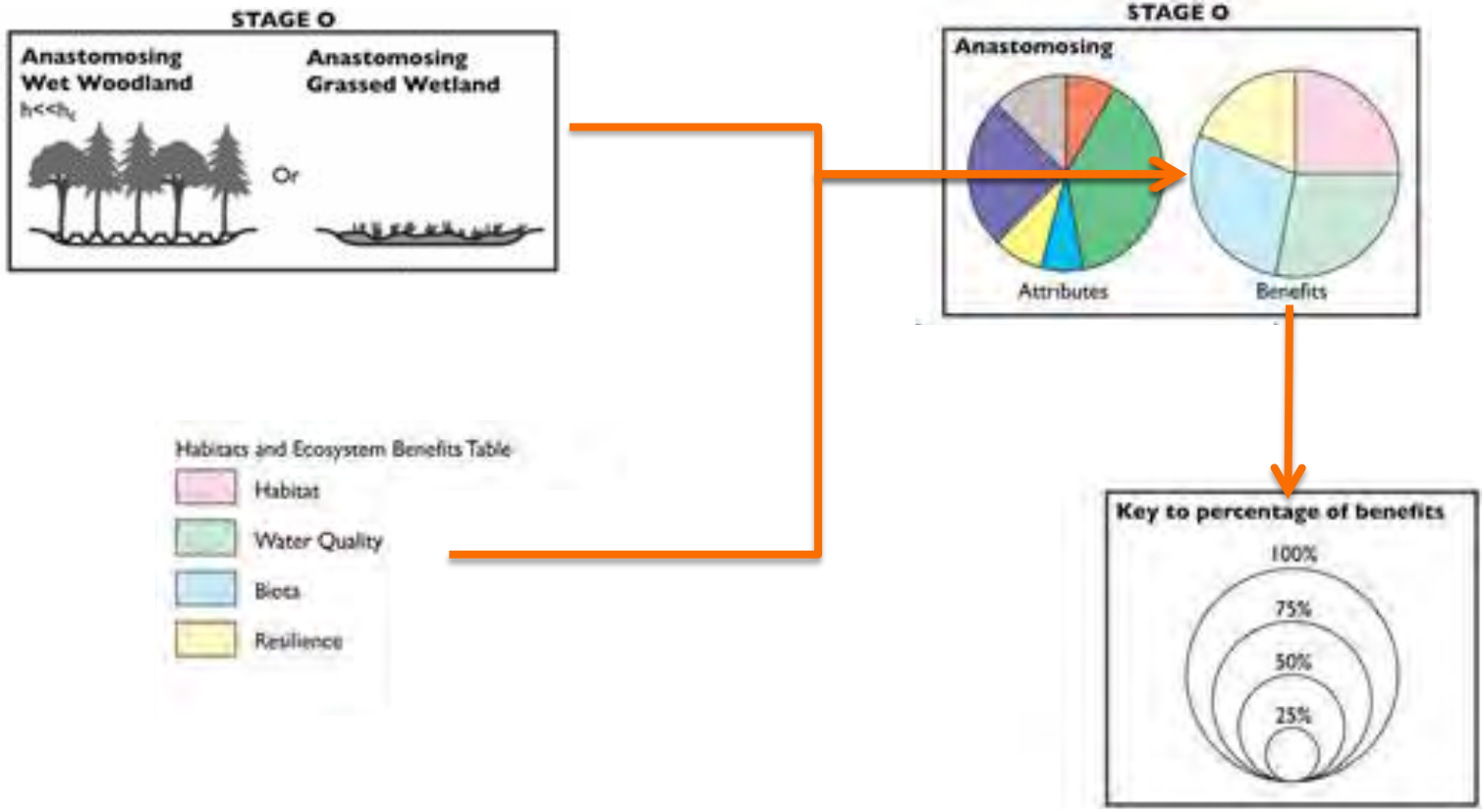



Graphic source: Cluer and Thorne (2013)

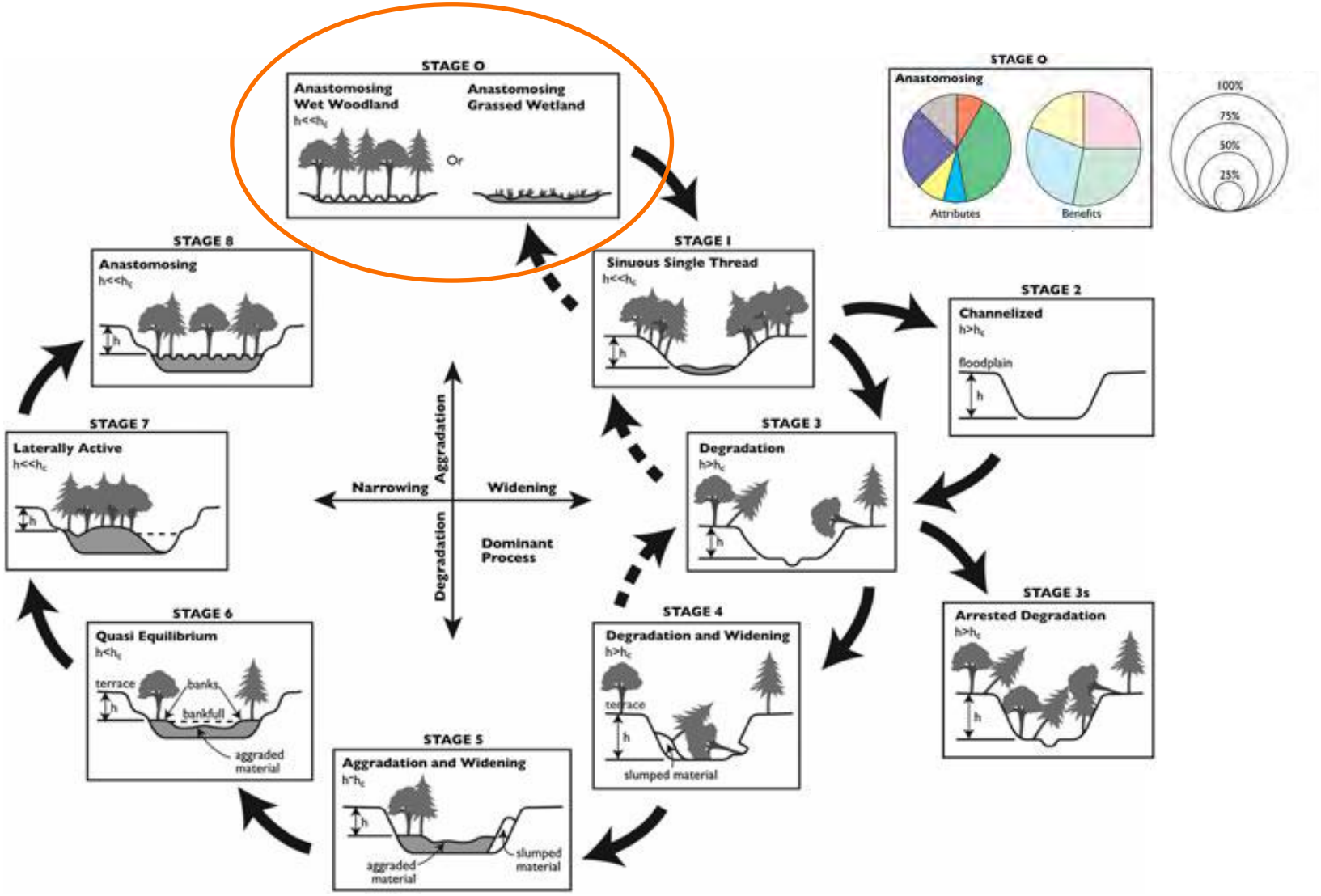
# Stream Evolution Model

## Habitat and Ecosystem Value



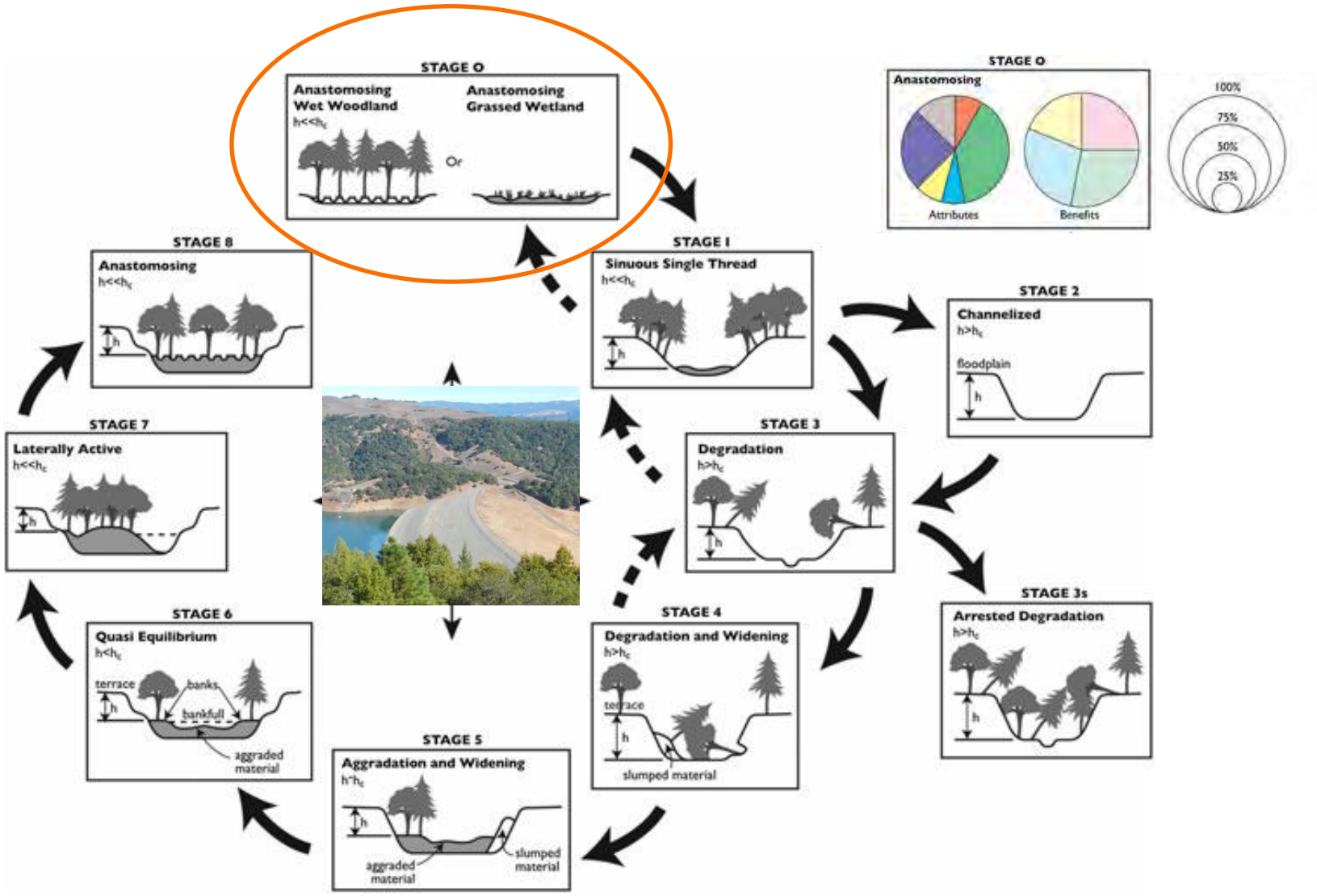

Graphic source: Cluer and Thorne (2013)

# Cycle begins at Stage 0…



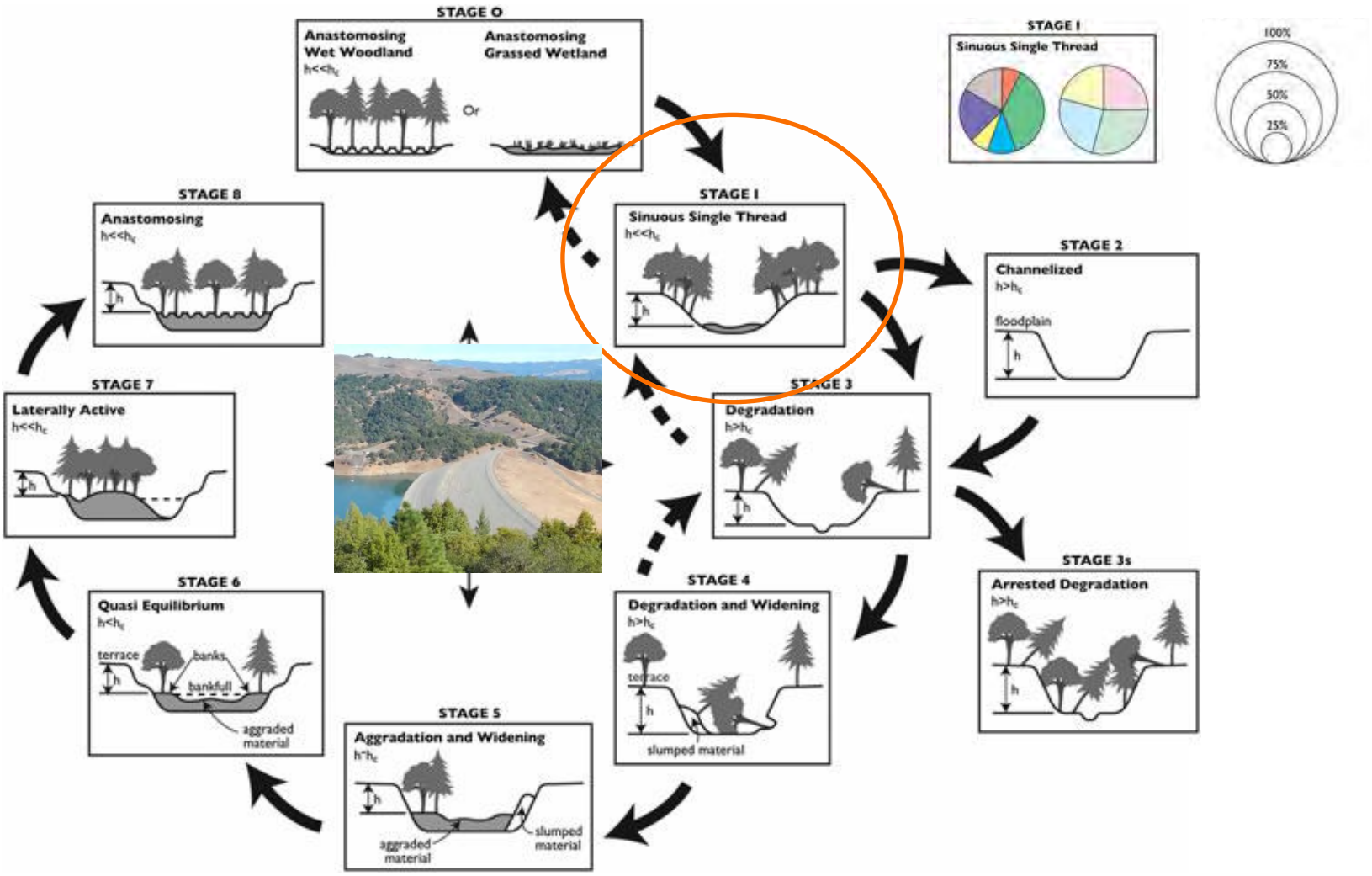

Graphic source: Cluer and Thorne (2013)

# Stressor introduced….



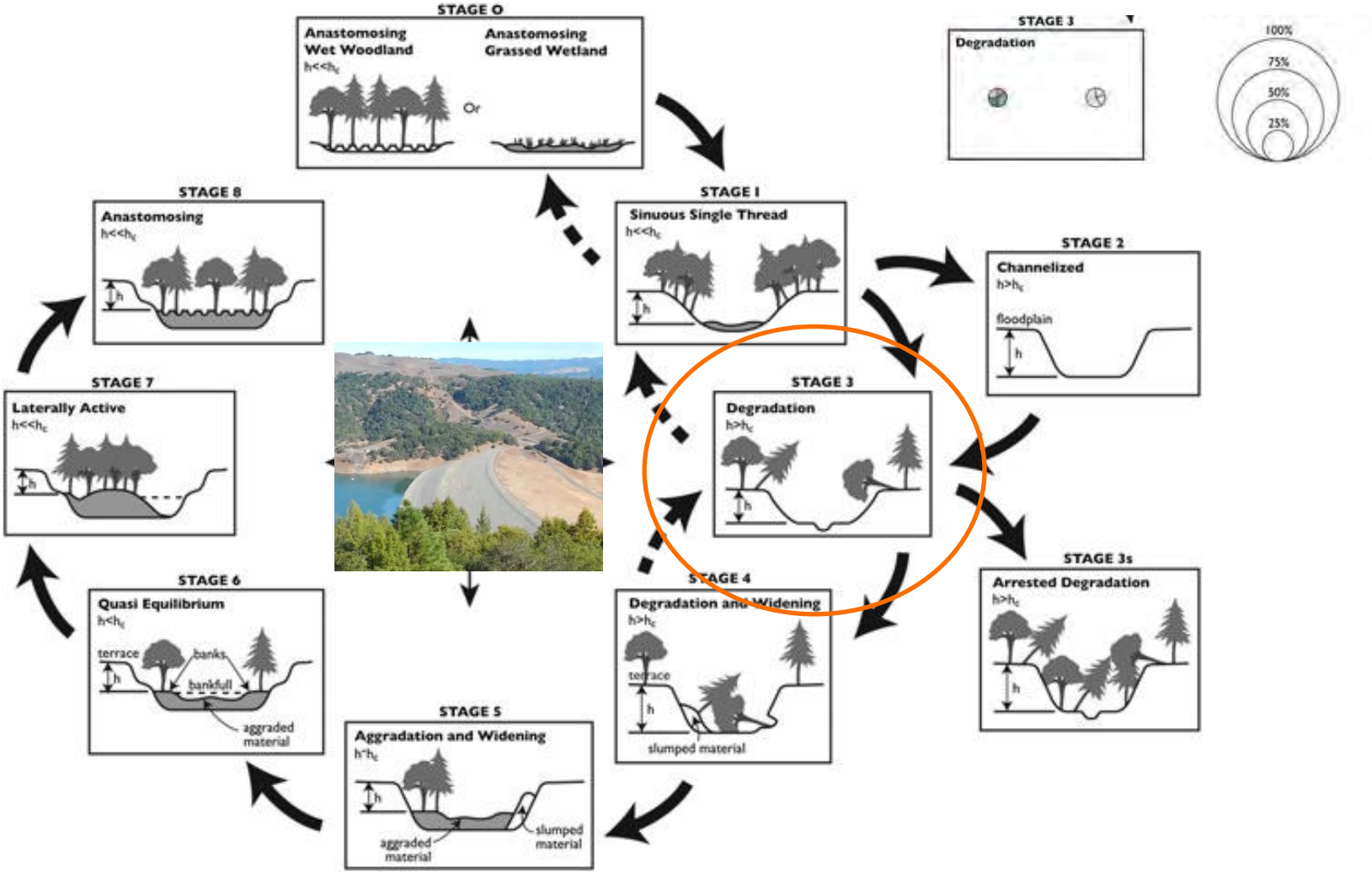

Graphic source: Cluer and Thorne (2013)

# Stressor caused evolution…



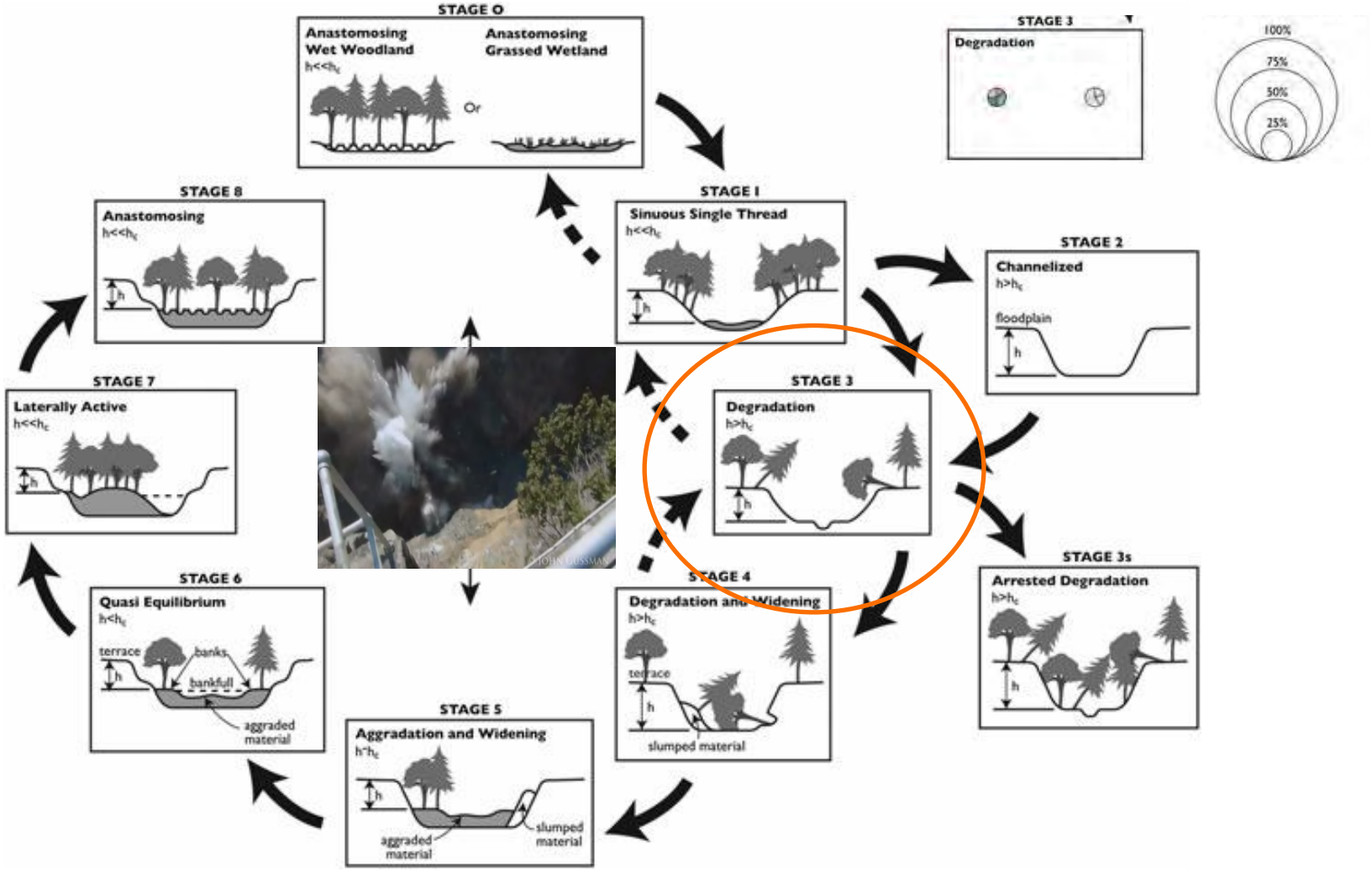

Graphic source: Cluer and Thorne (2013)

# Stressor caused degradation…



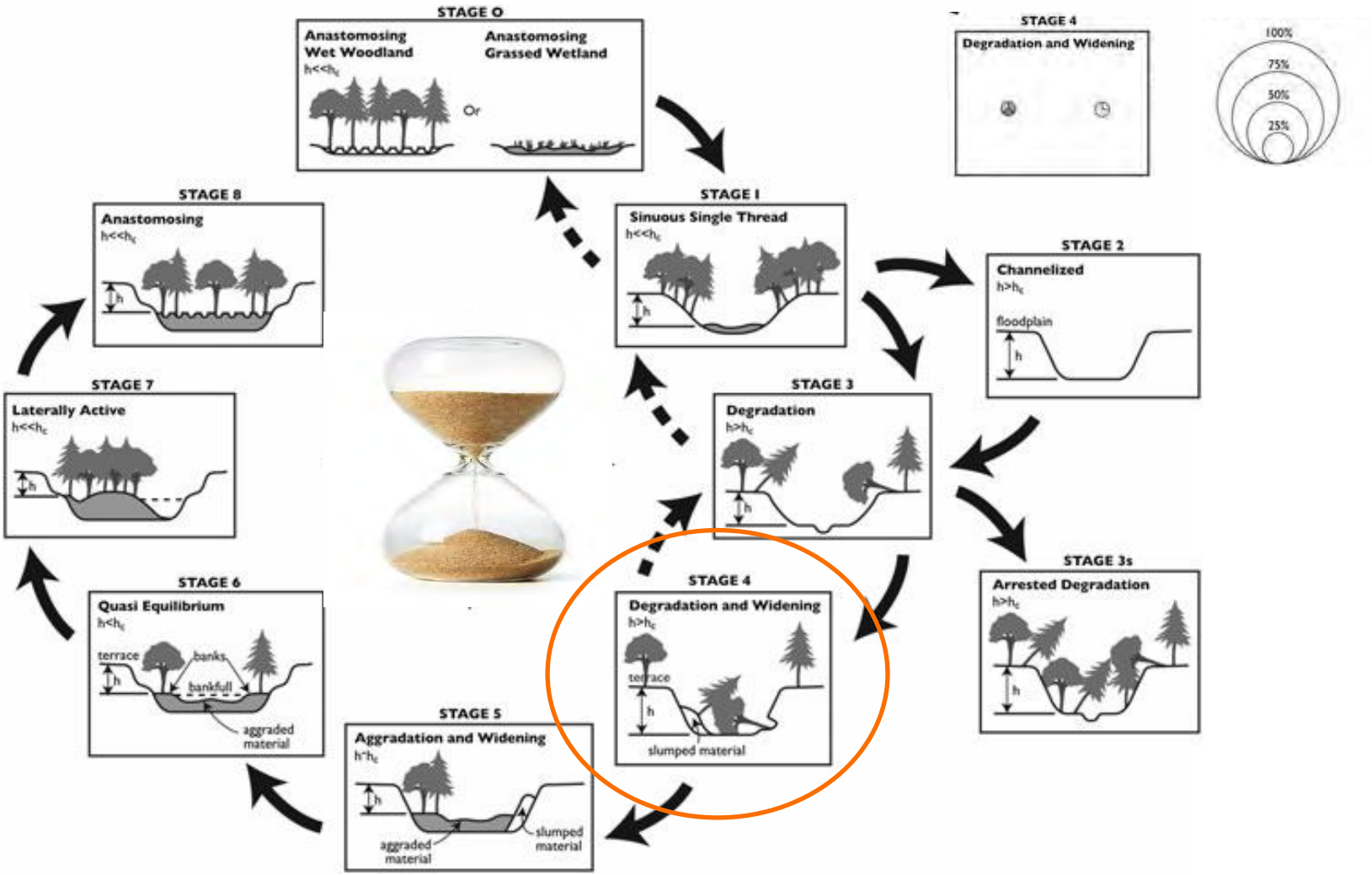

Graphic source: Cluer and Thorne (2013)

# Ideal World ⇨ Remove Stressor



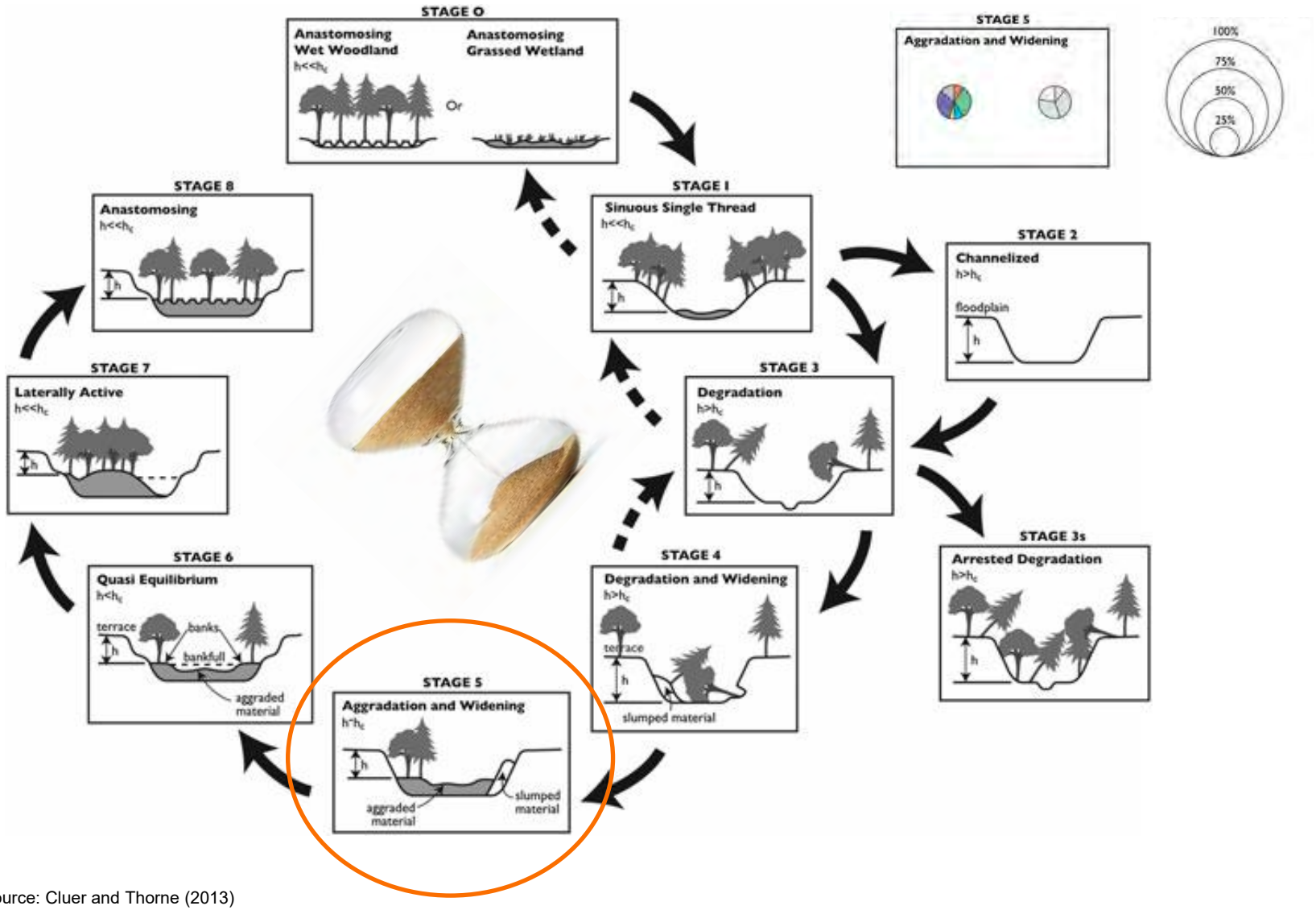

Graphic source: Cluer and Thorne (2013)

# Ideal World ⇨ Give it time



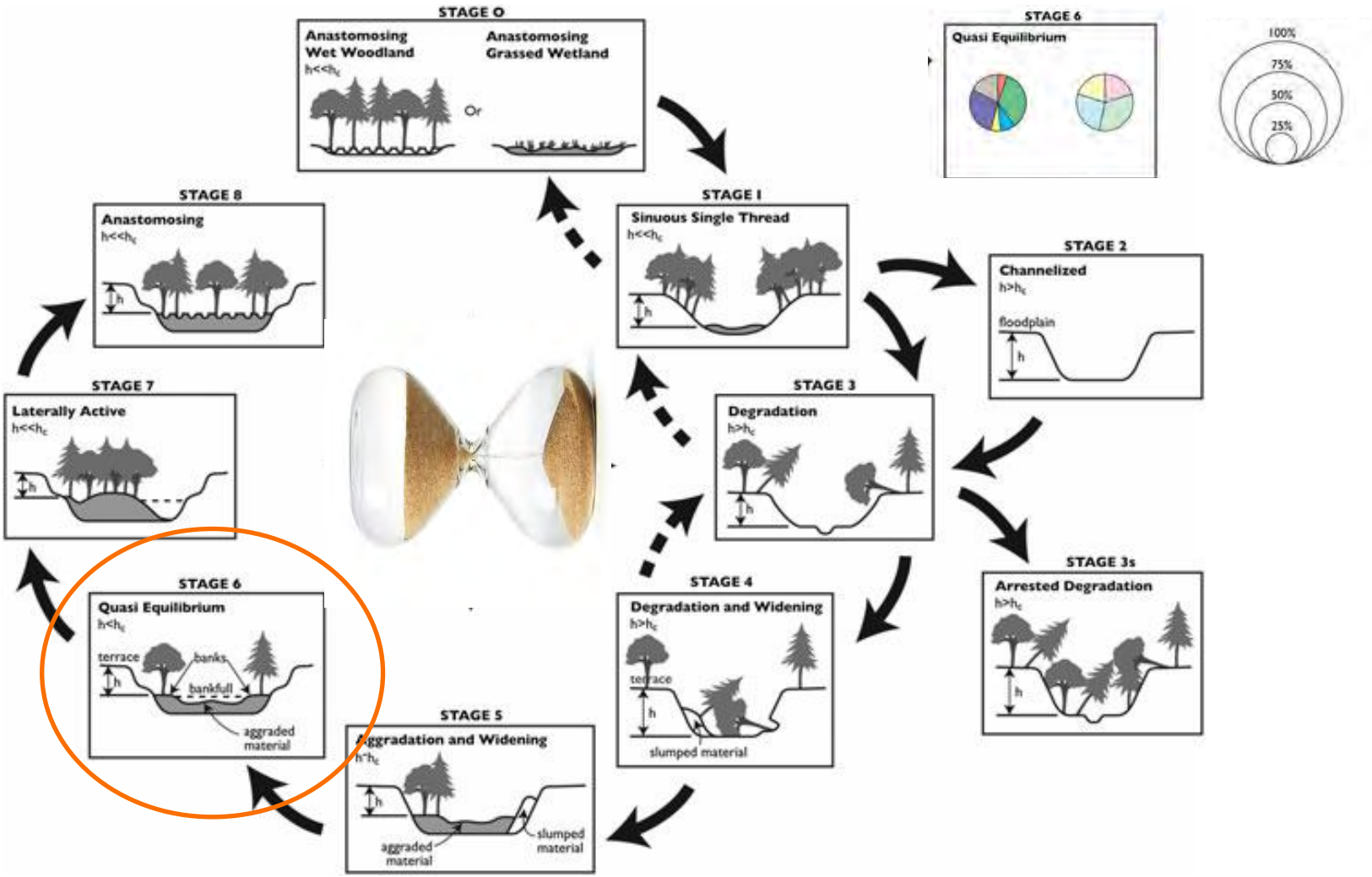

Graphic source: Cluer and Thorne (2013)

# Ideal World ⇨ Give it time



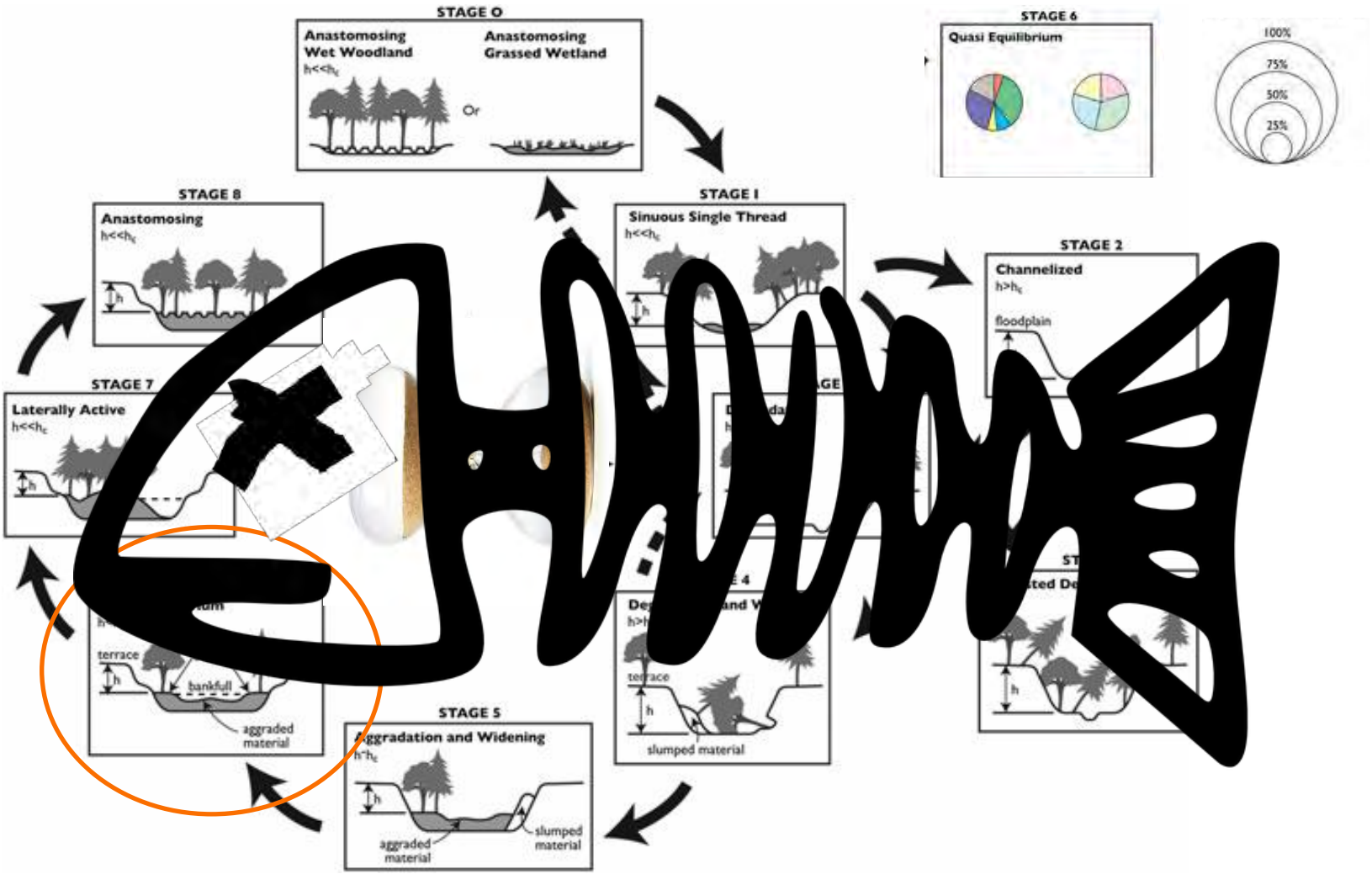

Graphic source: Cluer and Thorne (2013)

# Ideal World ⇨ Give it time



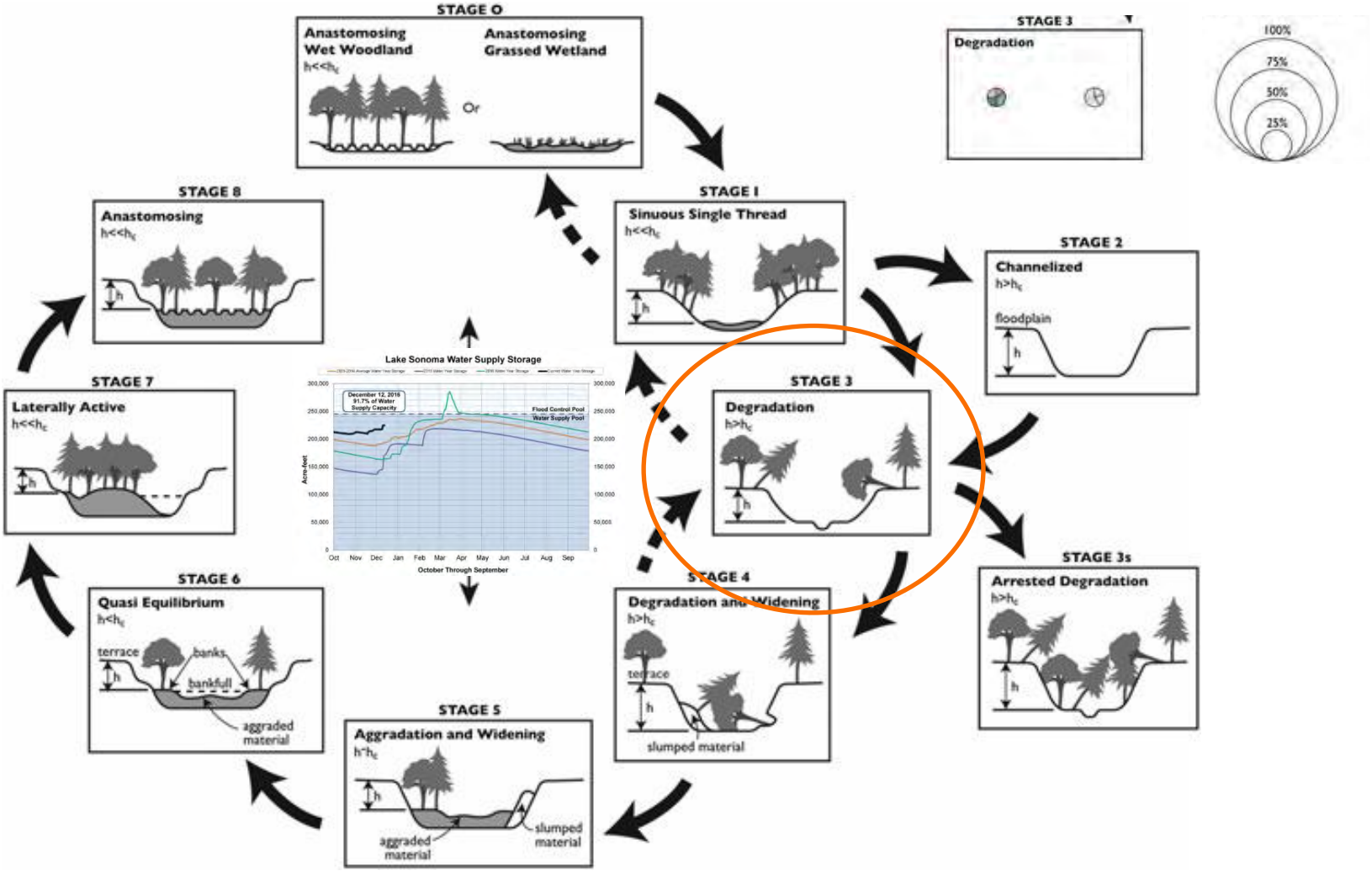

Graphic source: Cluer and Thorne (2013)

# Most salmonid populations don't have time



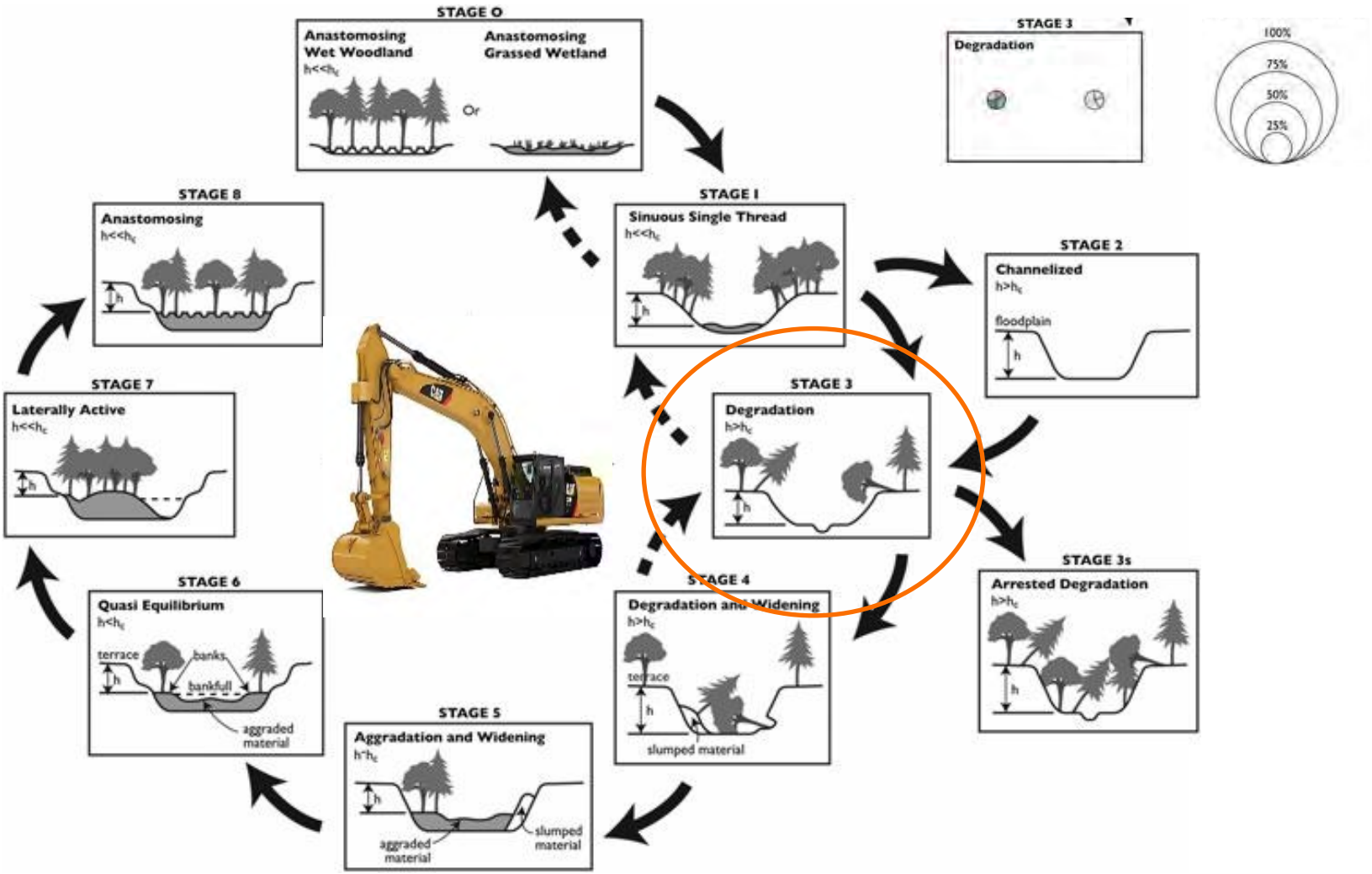

Graphic source: Cluer and Thorne (2013)

# …also most stressors are here to stay




Graphic source: Cluer and Thorne (2013)

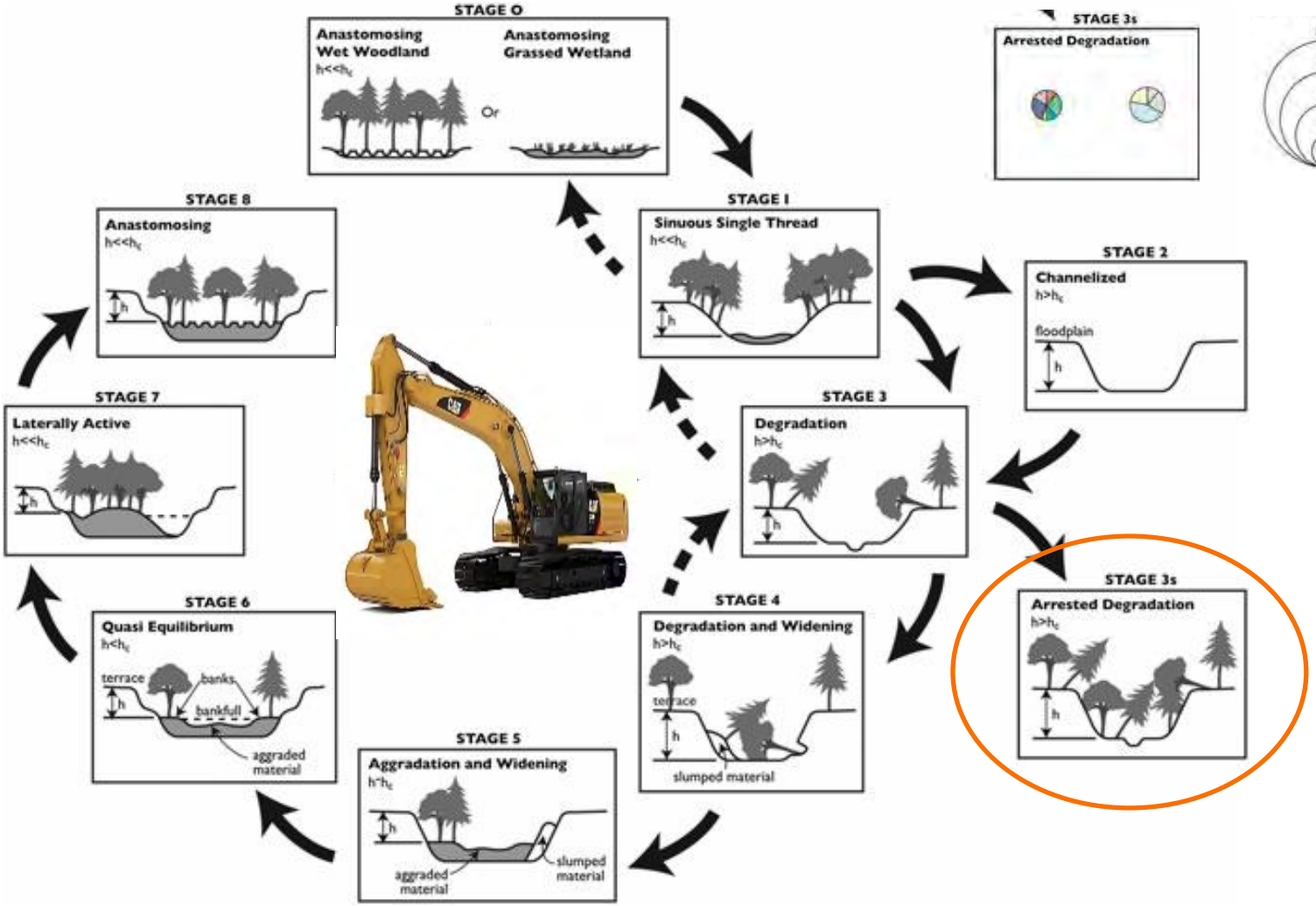
# Solution ⇨ Restoration




Graphic source: Cluer and Thorne (2013)

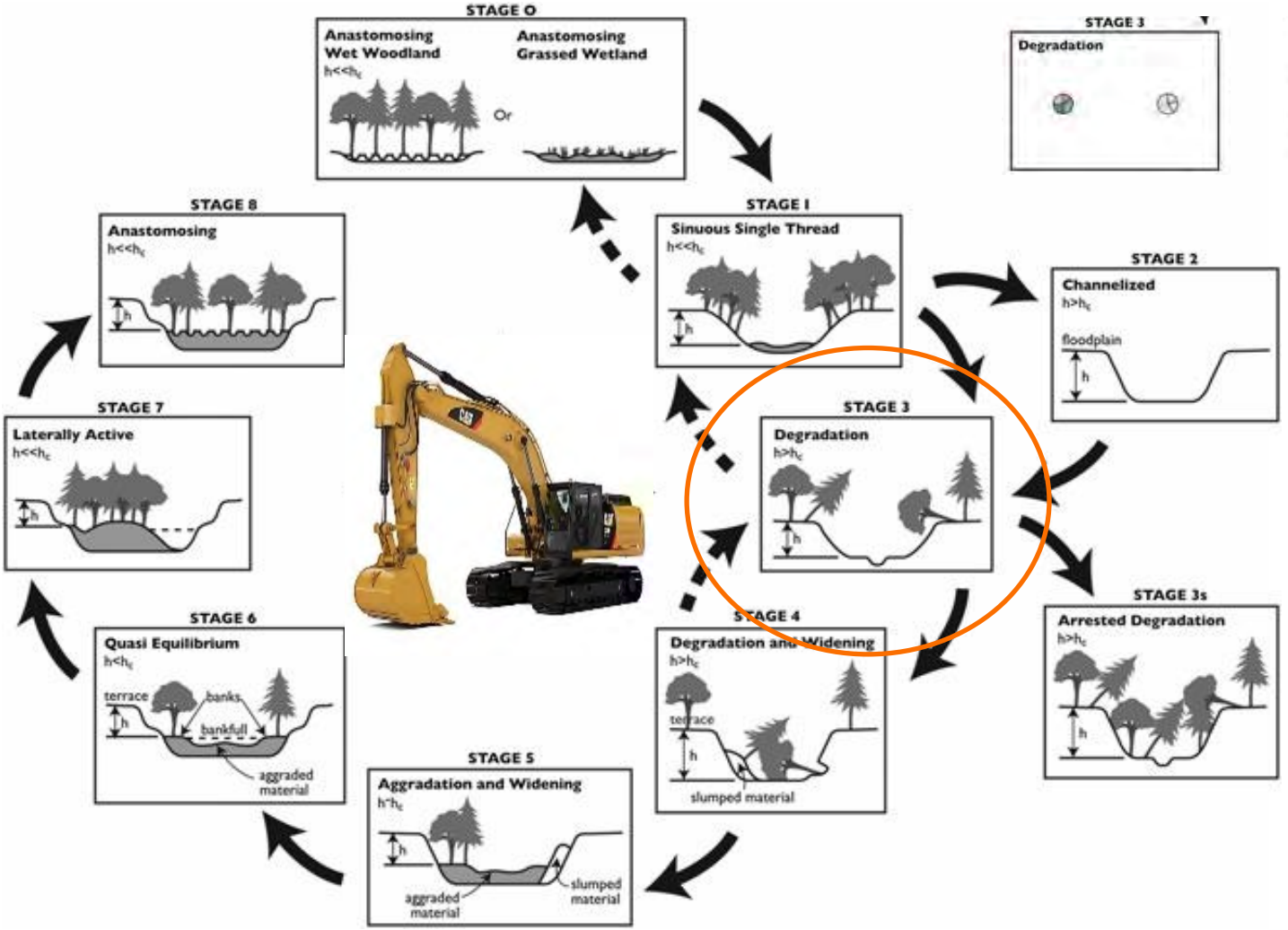
# “Conventional” Approach ⇨

Construct the “good”, Stabilize the “bad”, Lock in the “ugly”




Graphic source: Cluer and Thorne (2013)

# Geomorphic Approach ➡ Accelerate Stream Evolution

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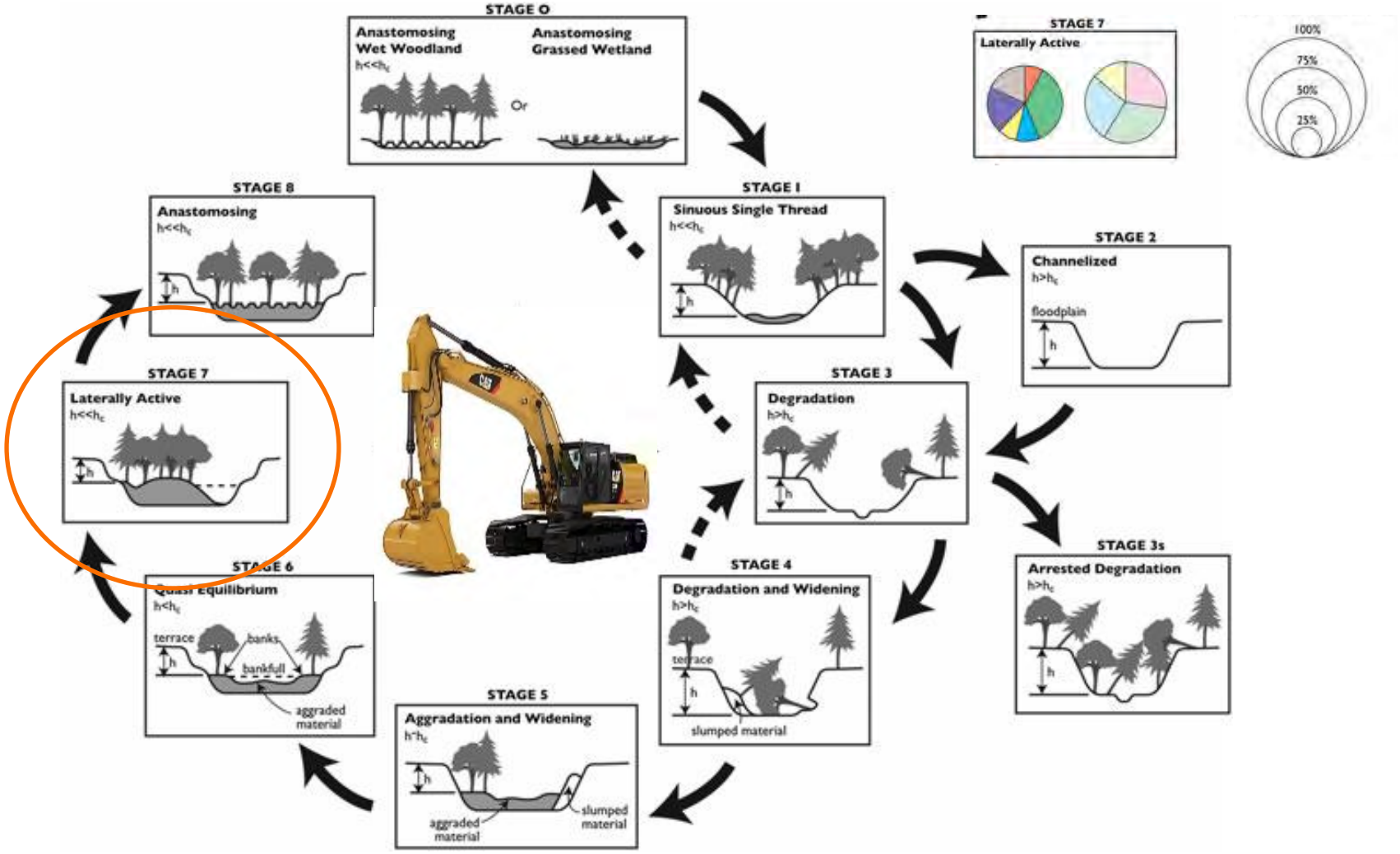
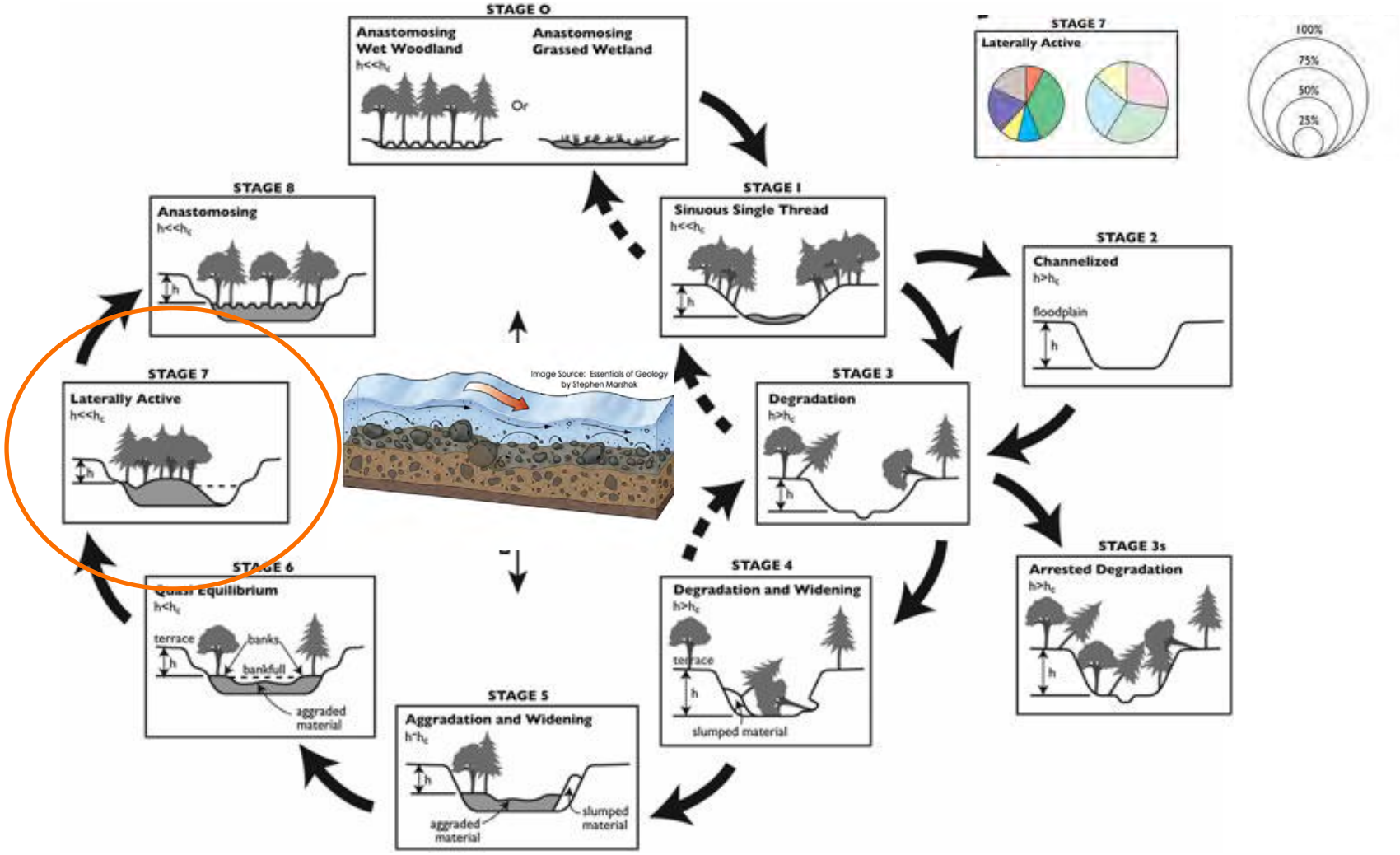
# Geomorphic Approach ➡ Accelerate Stream Evolution



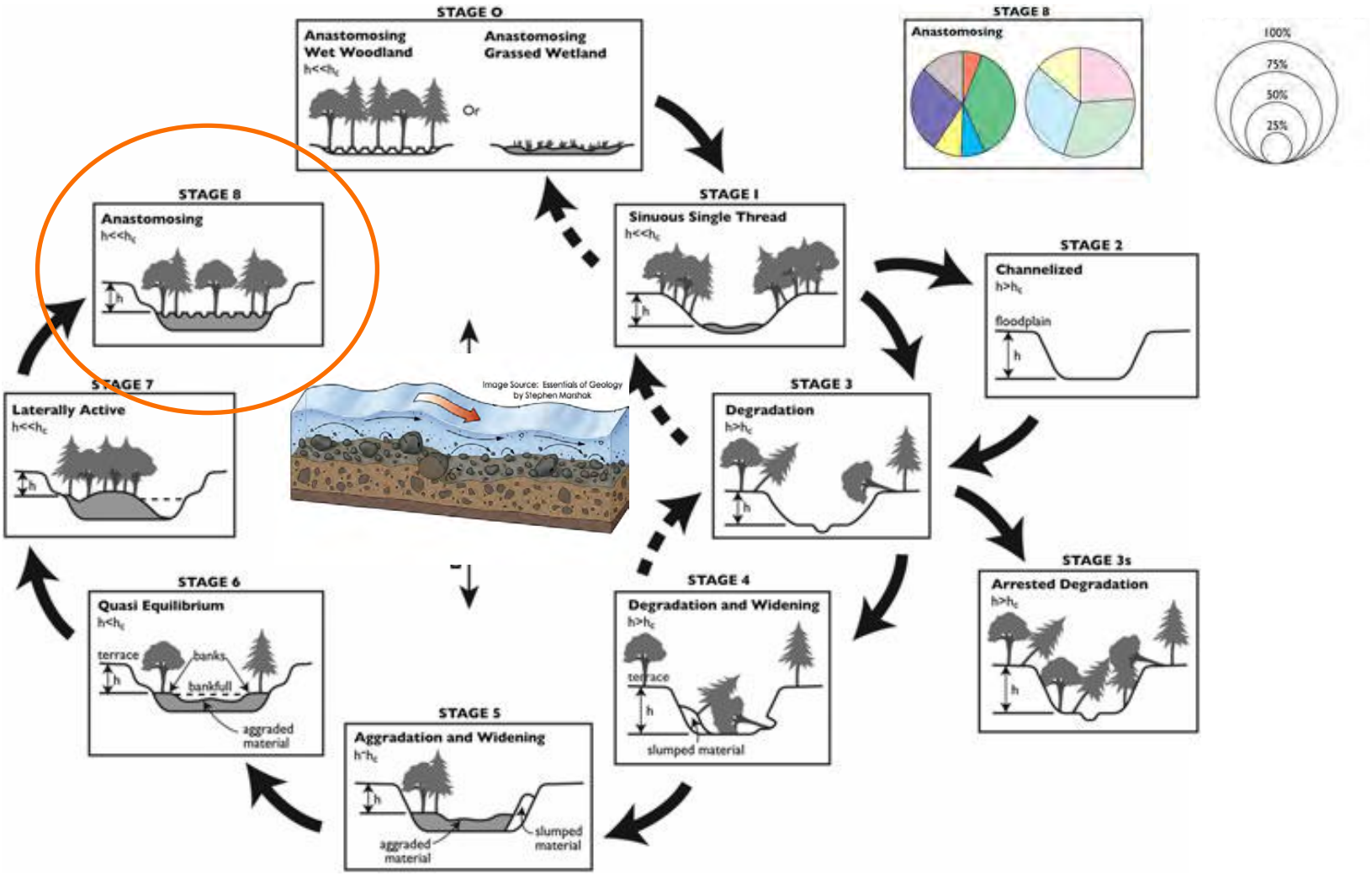

Graphic source: Cluer and Thorne (2013)

# Geomorphic Approach ➡
# Use geomorphic processes…




Graphic source: Cluer and Thorne (2013)

# Geomorphic Approach ➡
# Allow evolution, sustainable habitat



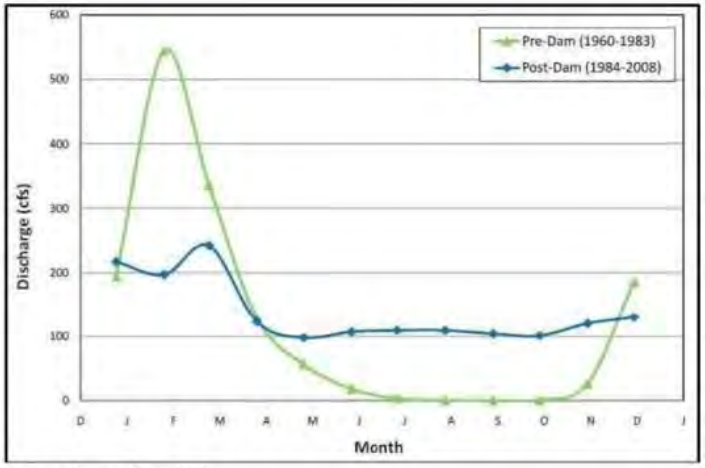

Graphic source: Cluer and Thorne (2013)

# Geomorphic Design Approach Examples

- Dry Creek
  (near Healdsburg, CA)
- Napa River
  (near Yountville, CA)

# Dry Creek Project

- Major tributary to the Russian River
- Supports
  - Coho salmon
  - Steelhead trout
  - Chinook salmon
- Major Stressors
  - Gravel mining
    - Incision and widening
  - Warm Springs Dam
    - Provides flood control and water supply
    - Lower Winter Flows
    - Higher Summer Flows
      - High summer flows detrimental to rearing coho and steelhead



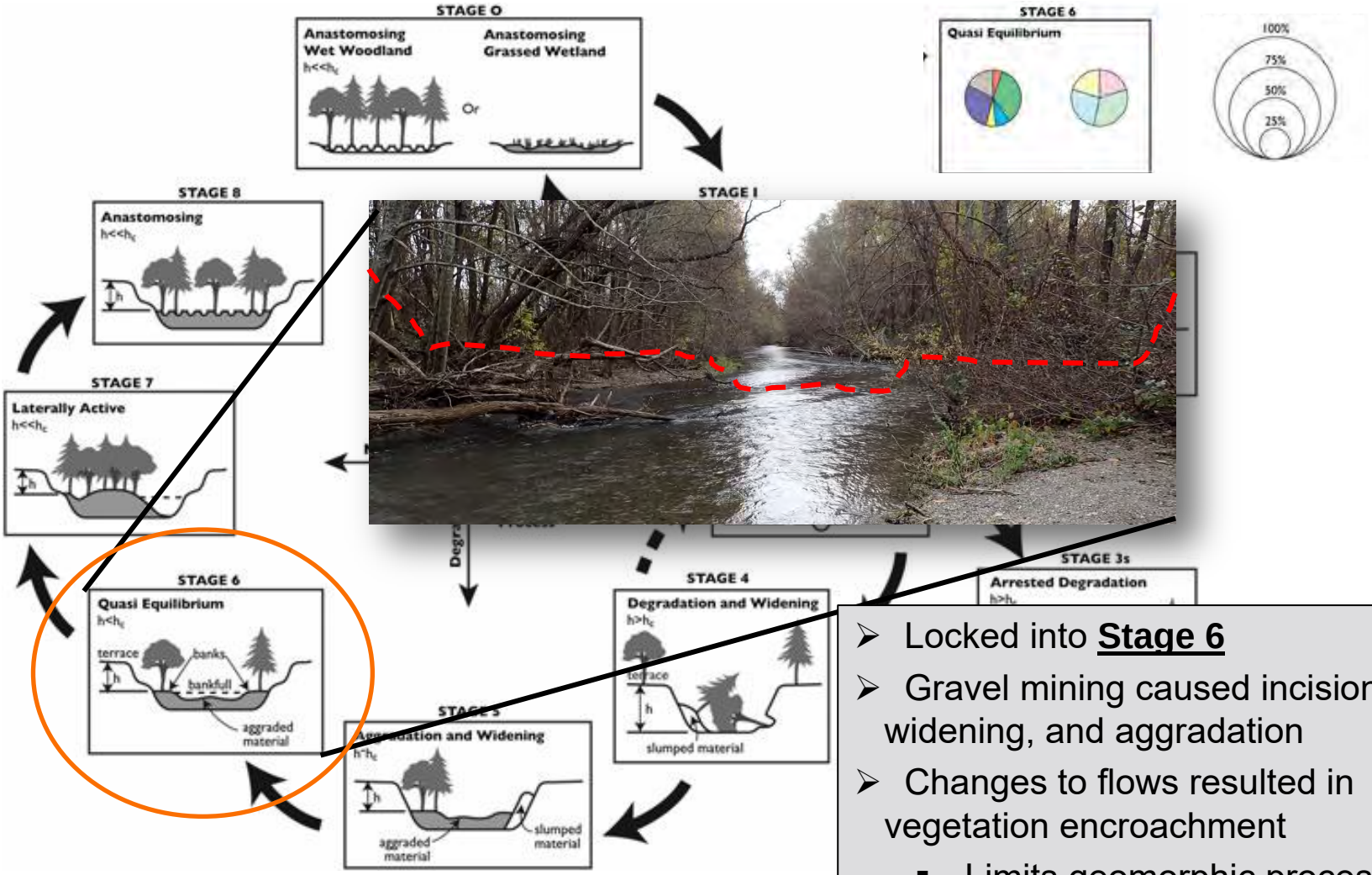

Reprinted from Inter-Fluve, 2010

Comparison of Monthly Median Discharges for Pre- and Post-dam Periods at Yoakim Bridge (USGS No. 11465200)

## Project Goal:

*Enhance summer rearing conditions for Coho salmon and Steelhead trout*

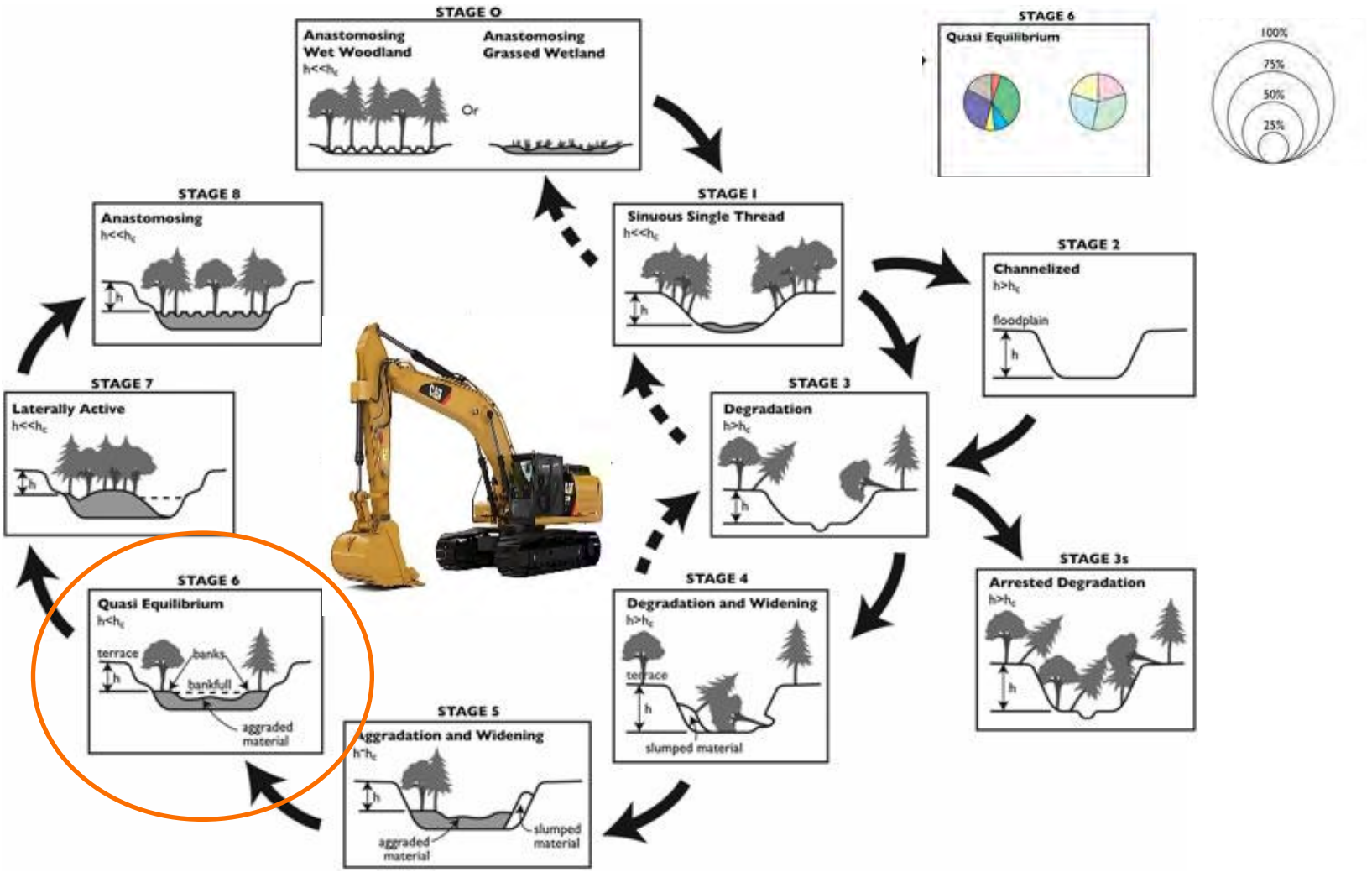
# Dry Creek – Stage 6




- Locked into **Stage 6**
- Gravel mining caused incision, widening, and aggradation
- Changes to flows resulted in vegetation encroachment
  - Limits geomorphic processes

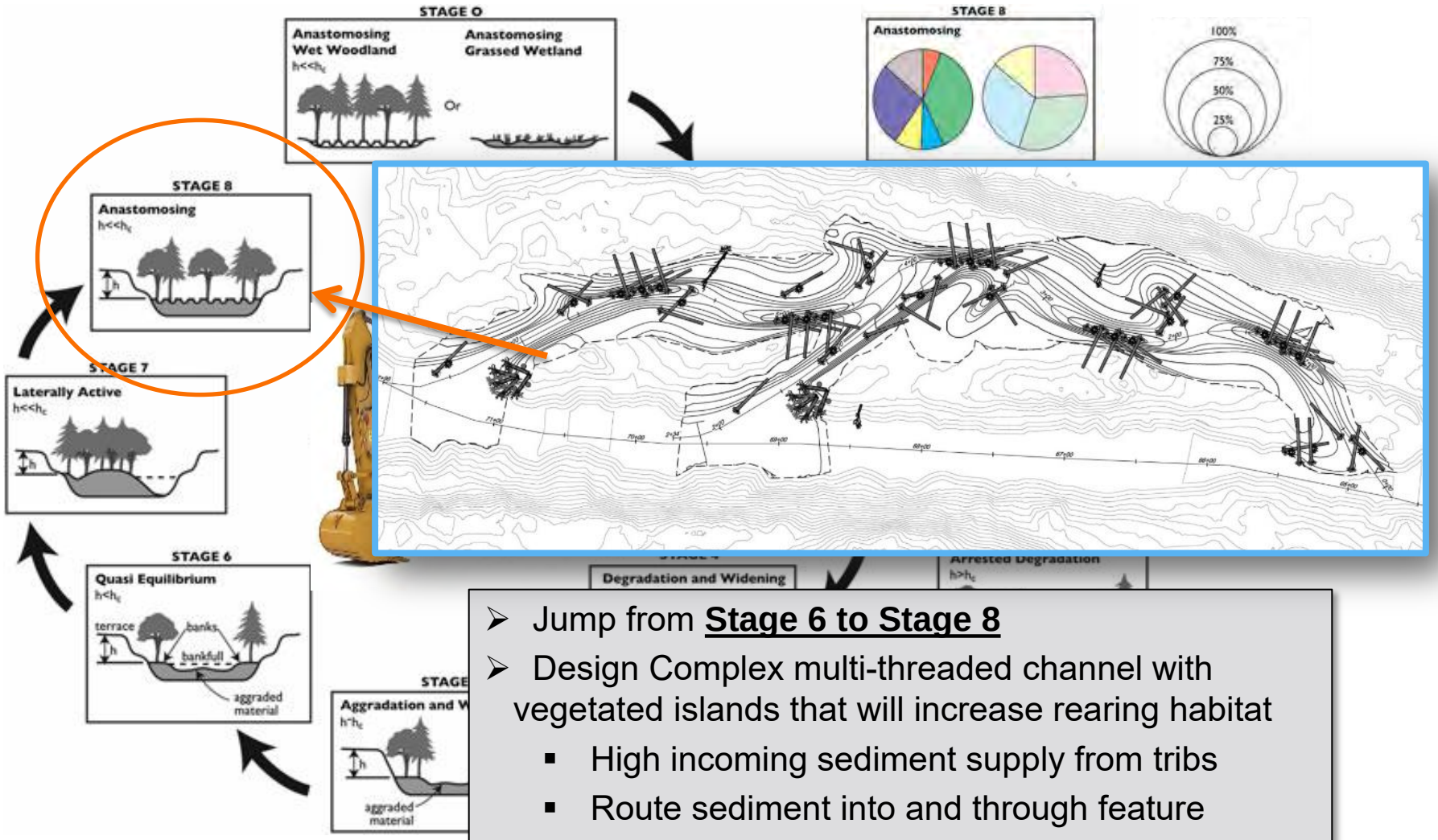
Graphic source: Cluer and Thorne (2013)

# Dry Creek “Jump Start” Stream Evolution




Graphic source: Cluer and Thorne (2013)

# Dry Creek “Jump Start” Stream Evolution



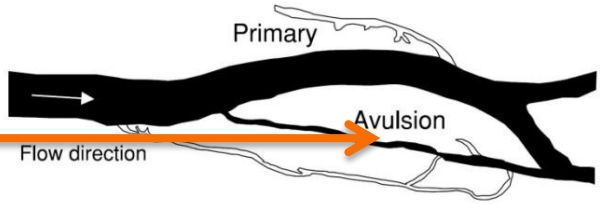

- Jump from **Stage 6 to Stage 8**
- Design Complex multi-threaded channel with vegetated islands that will increase rearing habitat
  - High incoming sediment supply from tribs
  - Route sediment into and through feature
  - Consider processes at **multiple scales**

# **Reach Scale** design consideration

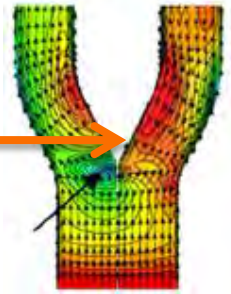
## Secondary channel processes:

- Align through existing abandoned channels
- Create natural bifurcations
  - Low angle
  - Expansive and aligned with riffle
- Match sediment transport between channels

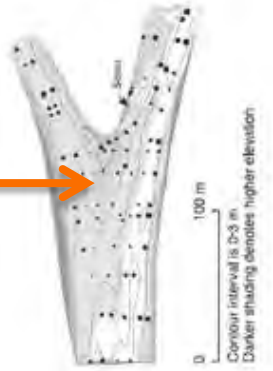
Burge and Lapointe (2005)




Hydrodynamics
Hardy et al. (2011)



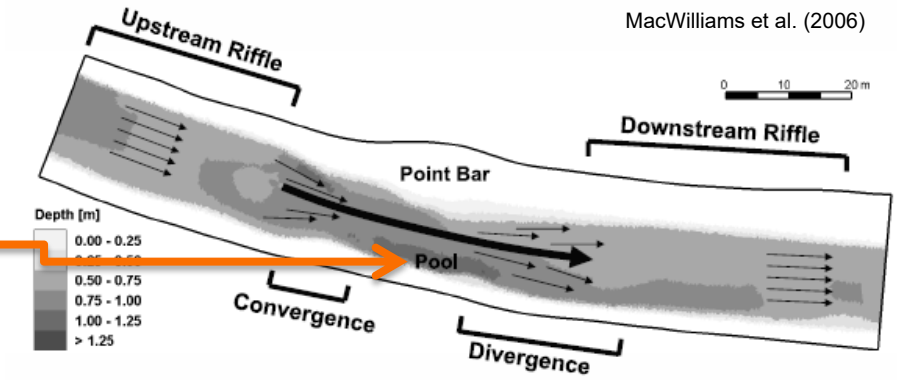
Topo Survey
Burge (2006)

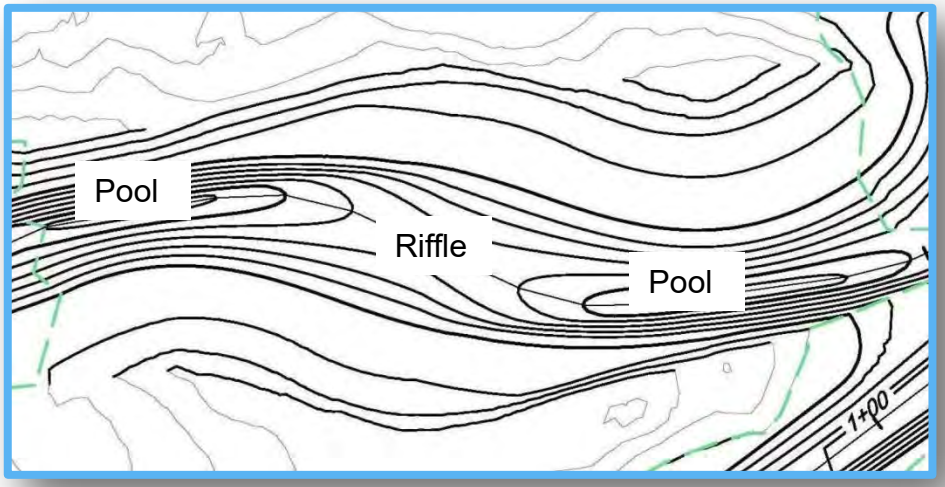



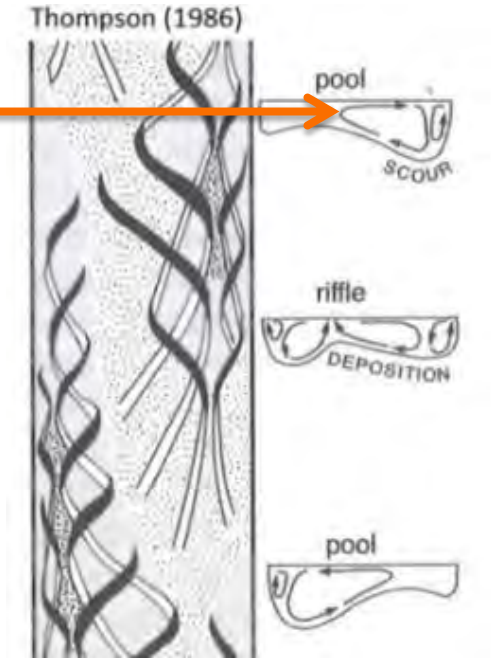
# **Morphologic Unit Scale** design consideration

## Riffle-pool process:

- Vary channel width
  - ➢ Velocity Reversal
- Meander channel
  - ➢ Secondary Flow



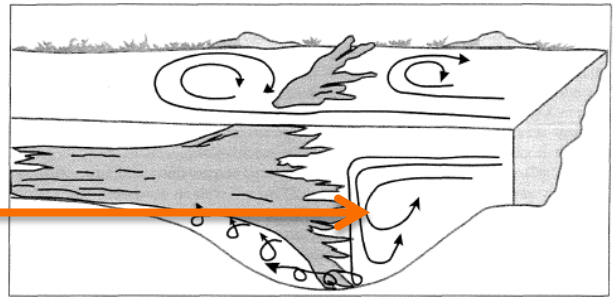



# **Hydraulic Unit Scale** design consideration

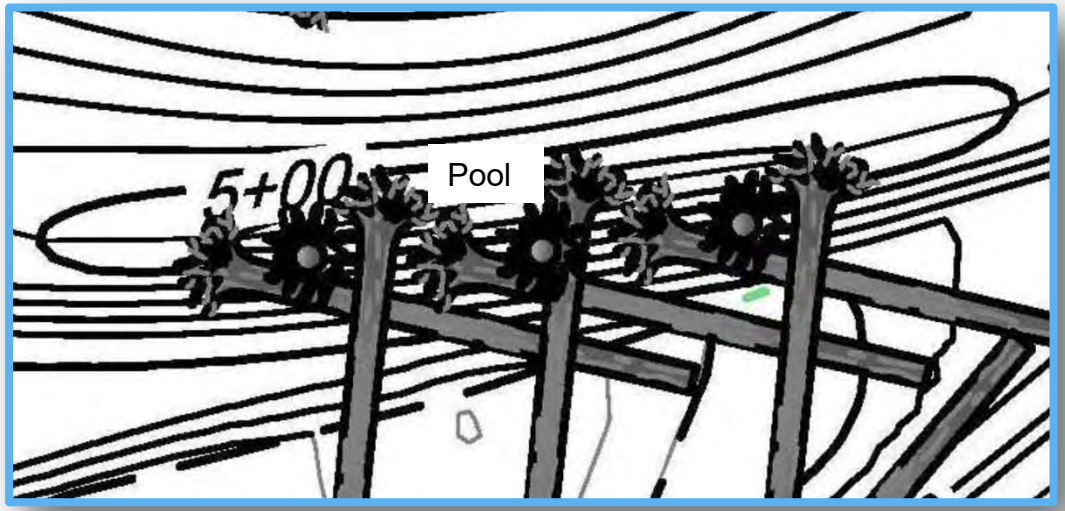
## Obstruction processes:

- Place large wood to enhance pool scour
  - Turbulence
  - Flow constriction
- Sediment deposits downstream

Woodsmith and Hassan (2005)

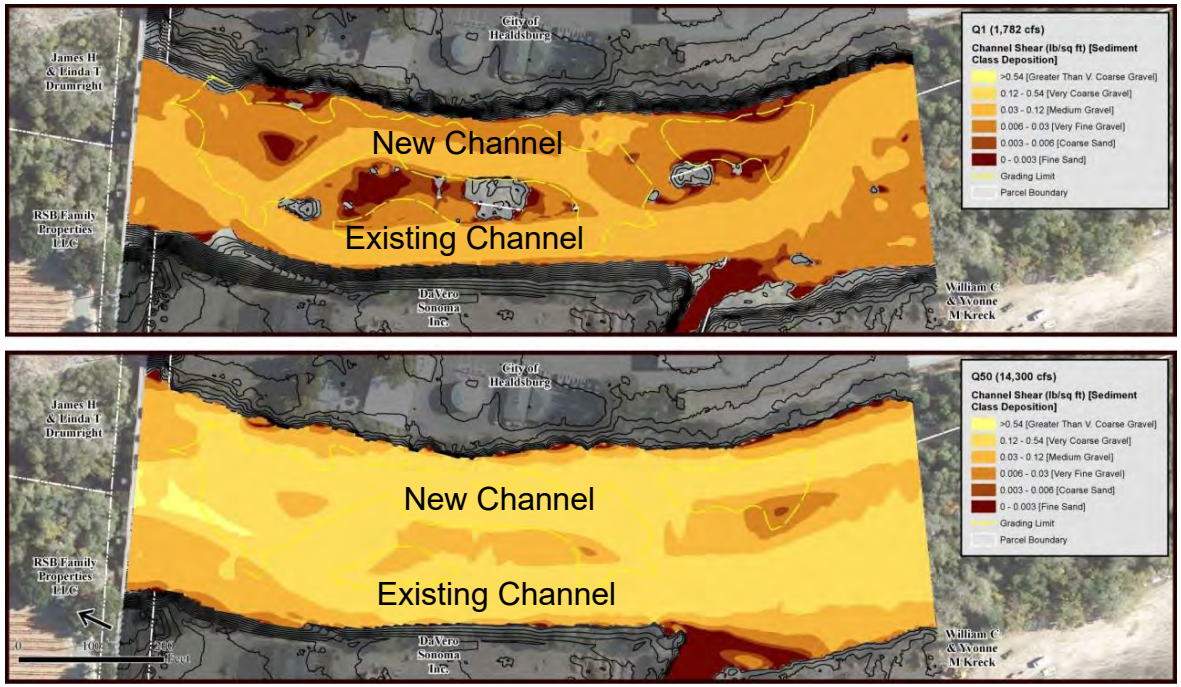


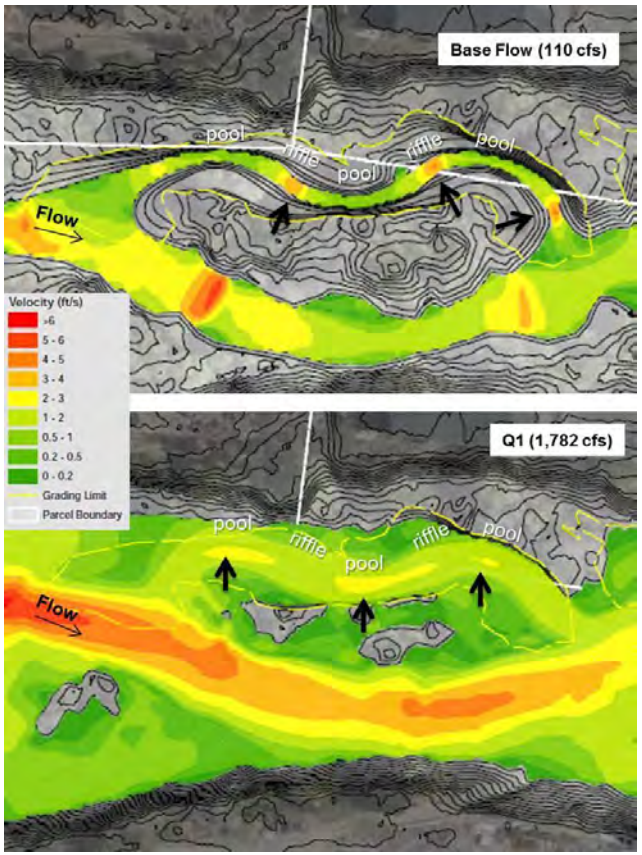
Thompson (2001)

# Assess designs for processes

- Matched shear stress between branches during high flows
- Velocity reversal from low flow to high flow



# Dry Creek Final Design

Anastomosing **Stage 8** channel

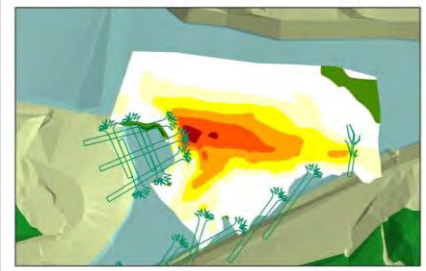
# Dry Creek in the ground…


# Dry Creek performance….

High Flow Event (4000 cfs, ~1.5-year event)

After High Flow Event (riffle and bifurcation deposition)

Gravel deposition

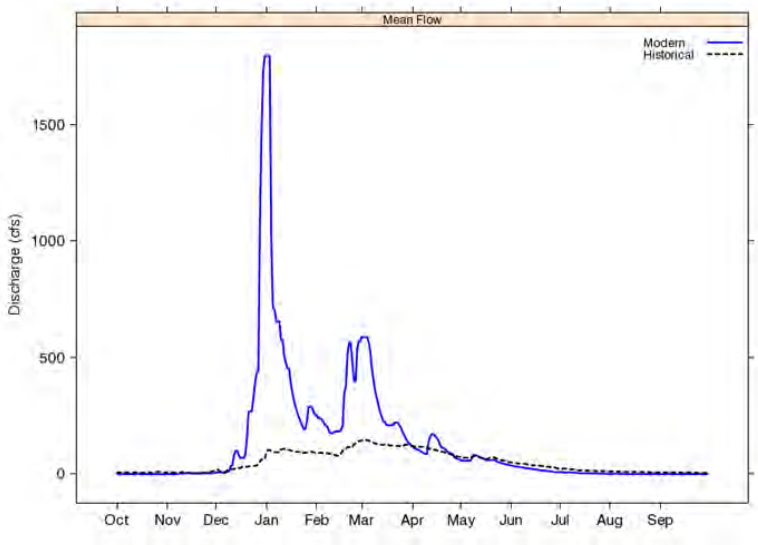


# Dry Creek performance….

# Napa River Project

- Drains to San Pablo Bay
- Supports
  - Steelhead trout
  - Chinook salmon
- Major Stressor
  - Land development
    - Tributary fan wetlands channelized
    - Napa River confined and bermed
    - Increased flow
      - Channel adjusted capacity


San Francisco Estuary Institute (2012)




## Project Goal:

*Improve salmonid habitat, reduce bank erosion, while maintaining existing levels of flood conveyance*

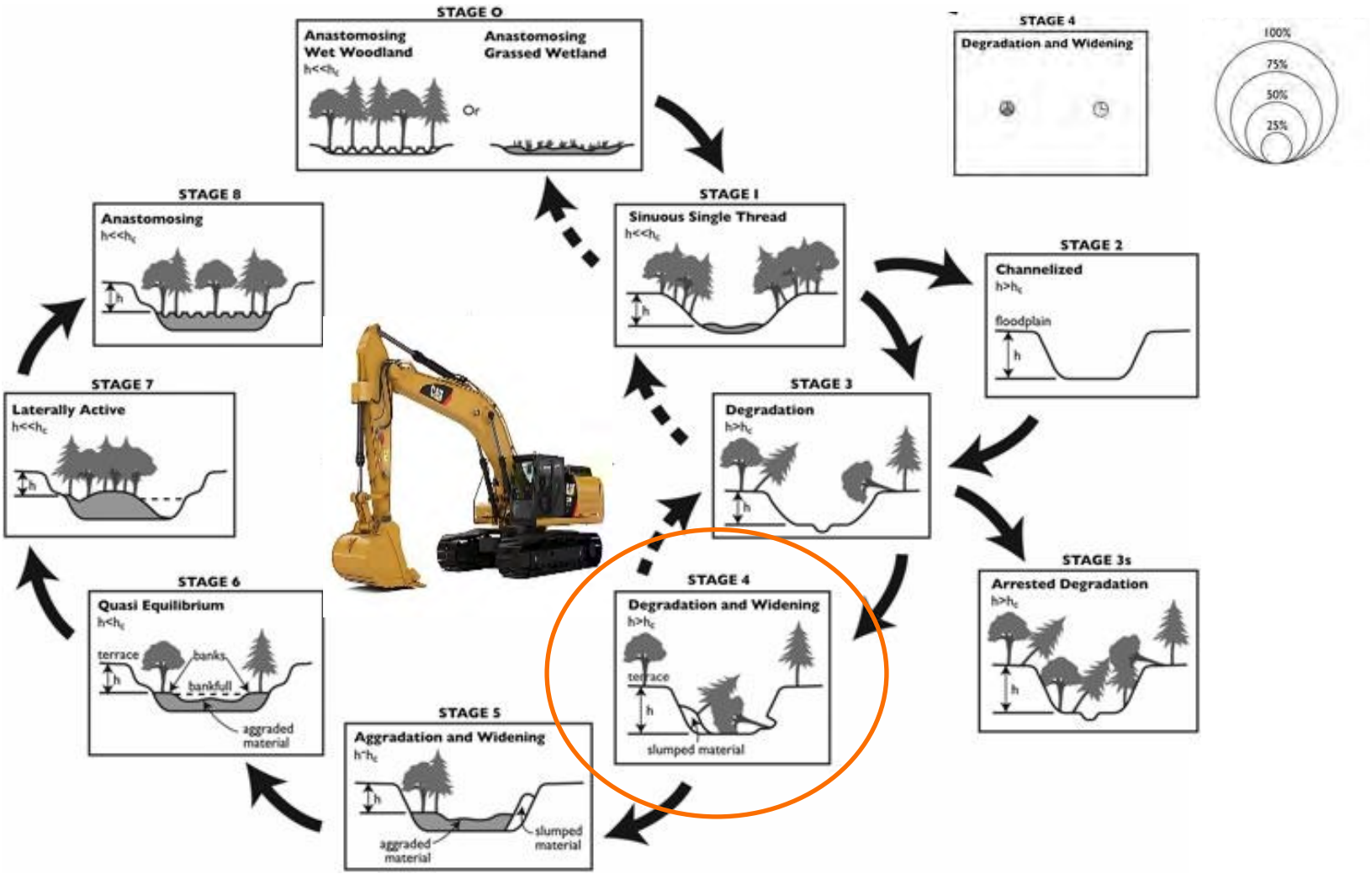
# Napa River – Stage 4




- **Stage 4**
- Increased flow caused incision and bank failure
  - Inadequate coarse sediment storage
  - Excessive fine sediment input

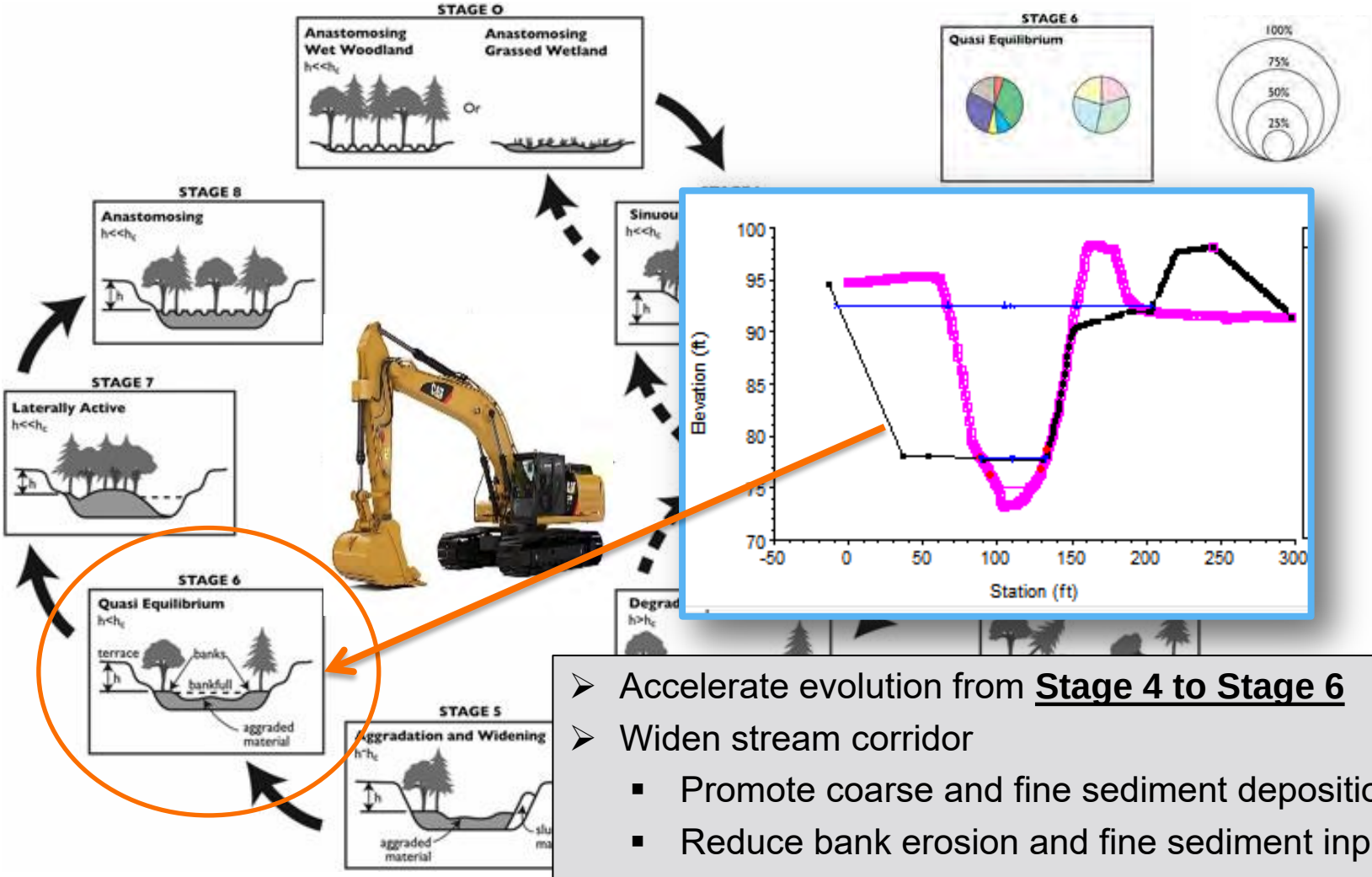
Graphic source: Cluer and Thorne (2013)

# Napa River “Jump Start” Stream Evolution




Graphic source: Cluer and Thorne (2013)

# Napa River “Jump Start” Stream Evolution




- Accelerate evolution from **Stage 4 to Stage 6**
- Widen stream corridor
  - Promote coarse and fine sediment deposition
  - Reduce bank erosion and fine sediment input
  - Provide comparable flood conveyance

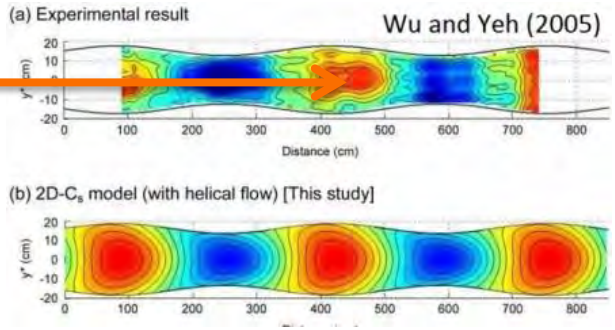
Graphic source: Cluer and Thorne (2013)

# **Widening** design considerations

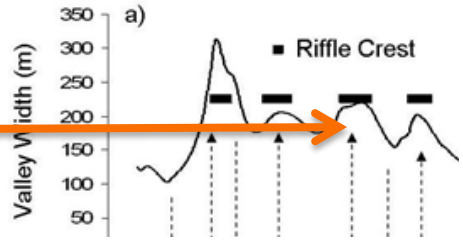
- Why local width expansion instead of full corridor widening?

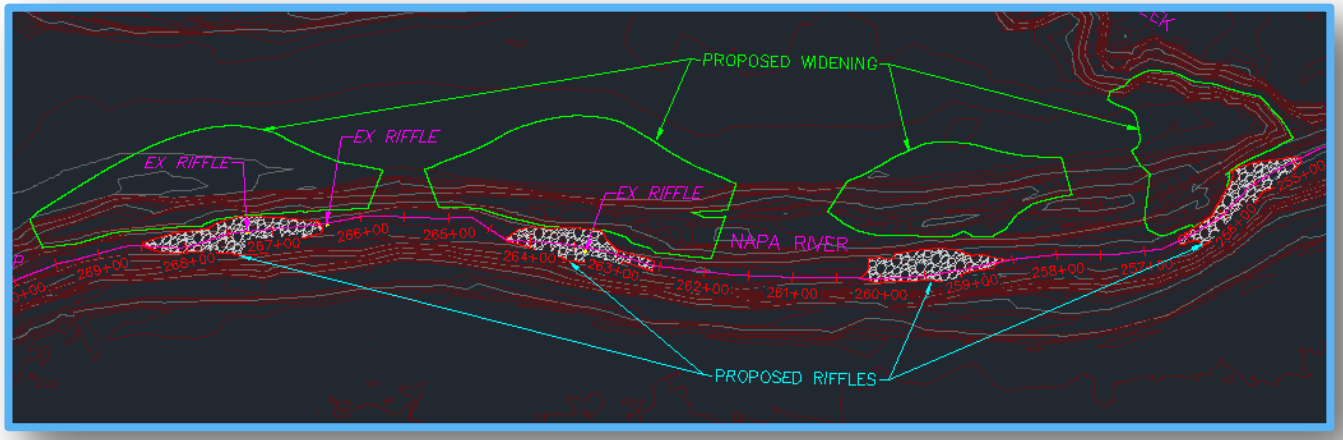
## Width expansion processes:

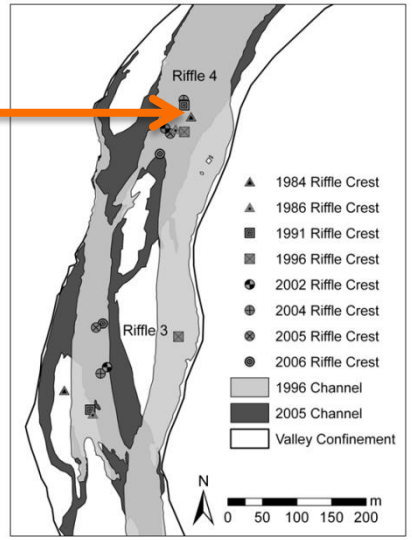
- Expand width of corridor
  - Promotes deposition
  - Persistent coarse sediment storage
- Align expansion with new riffles
- Existing narrow corridor maintains pools




(White et al, 2010)

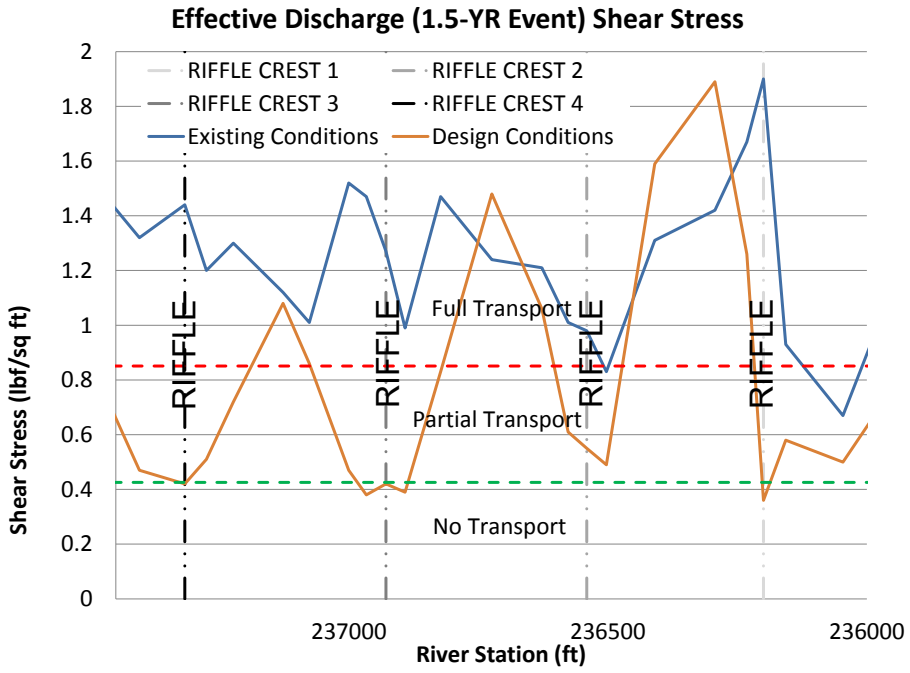


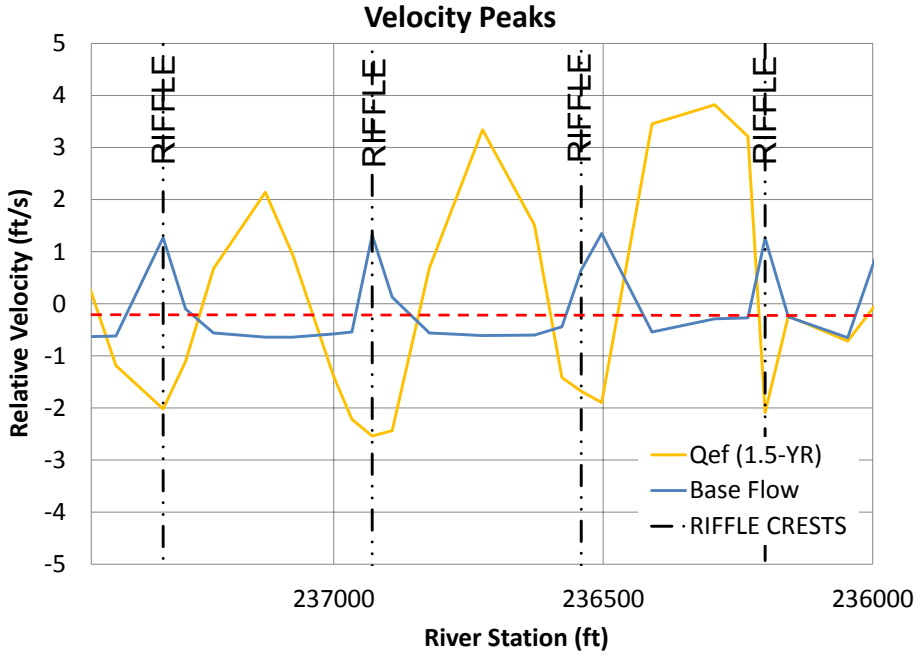



# Assess designs for processes

- "No Transport" for spawning gravels at width expansions during high flows
- Velocity reversals from low flows to high flows



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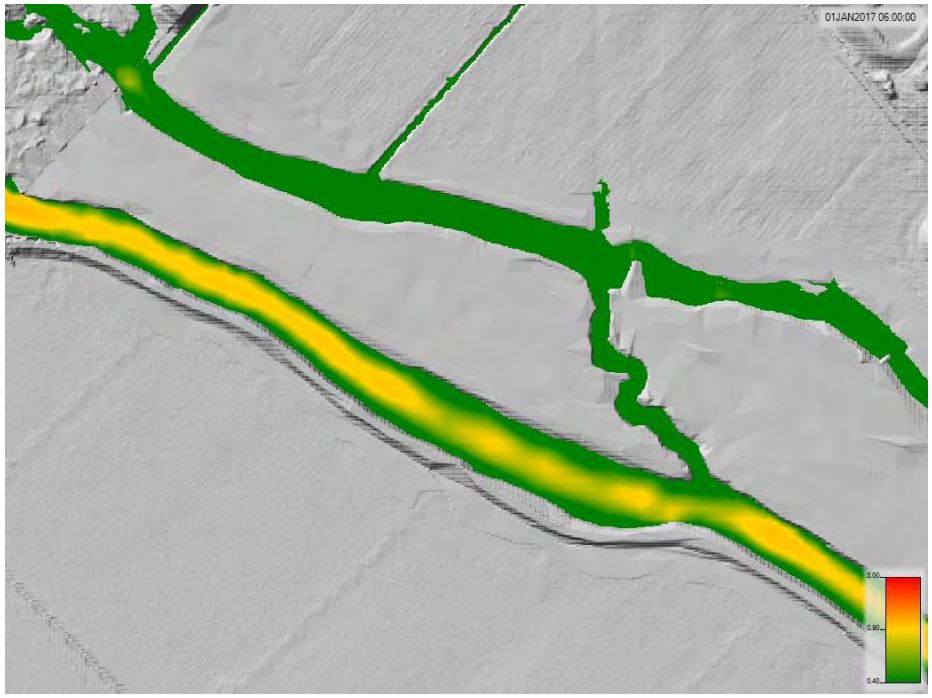
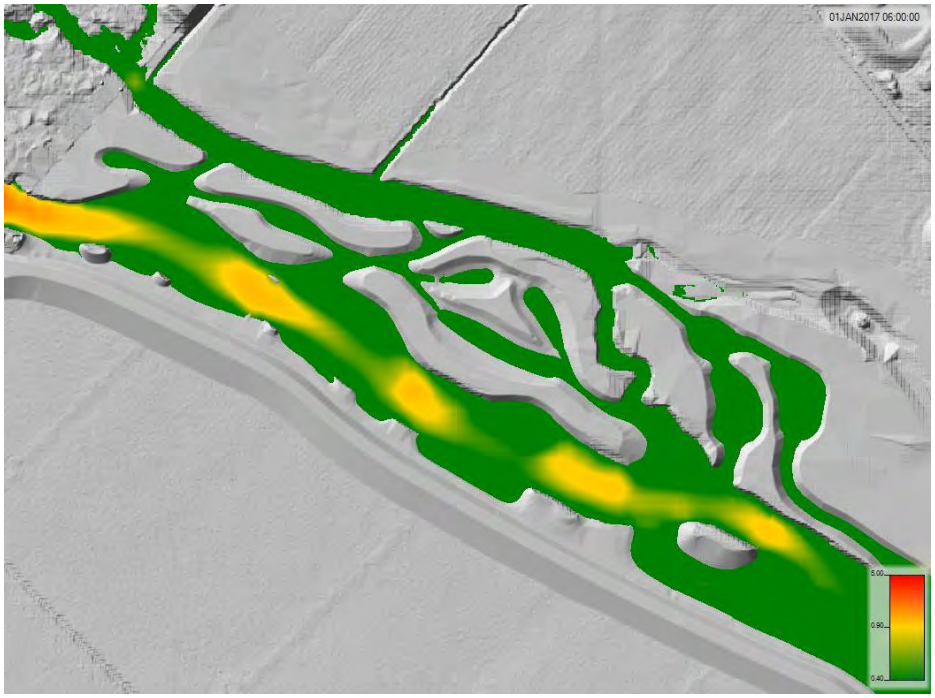
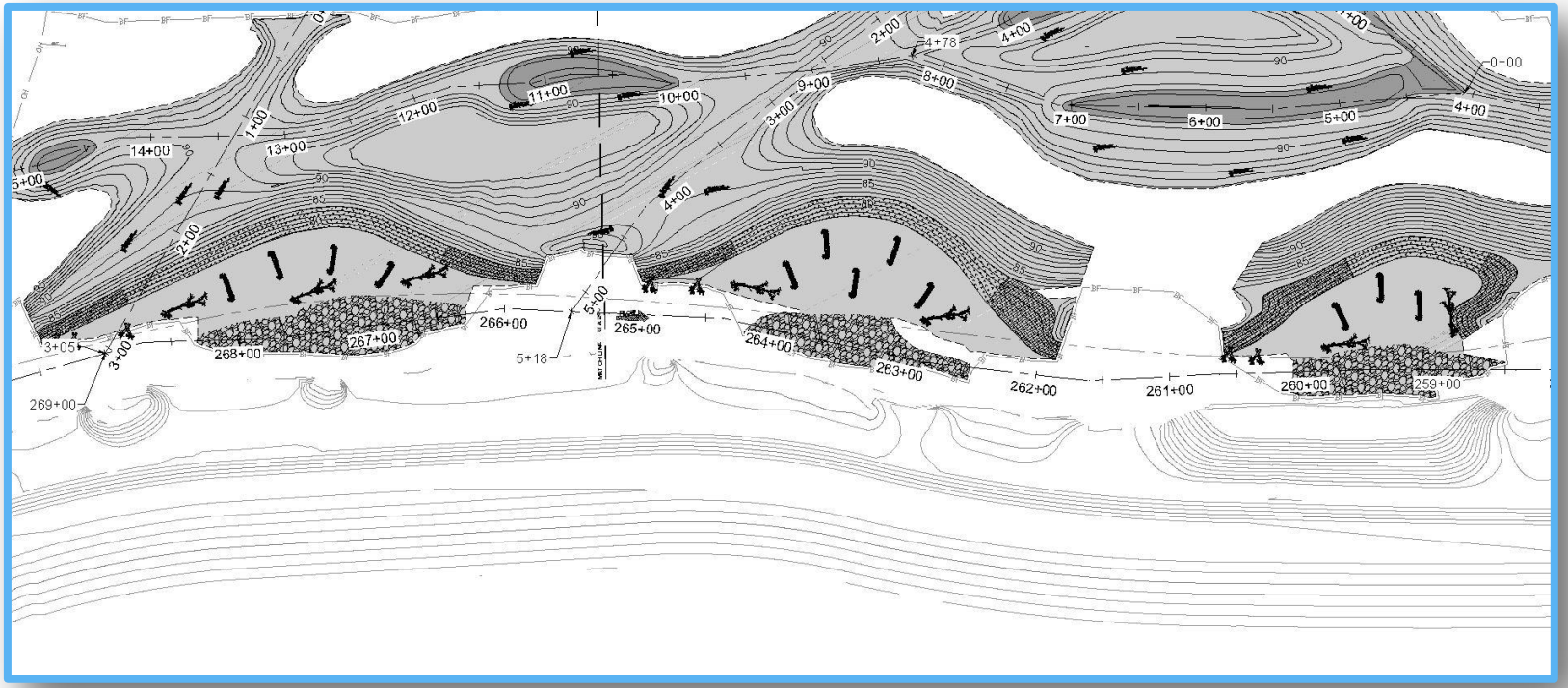


# Napa River Final Design




Quasi equilibrium **Stage 6** channel

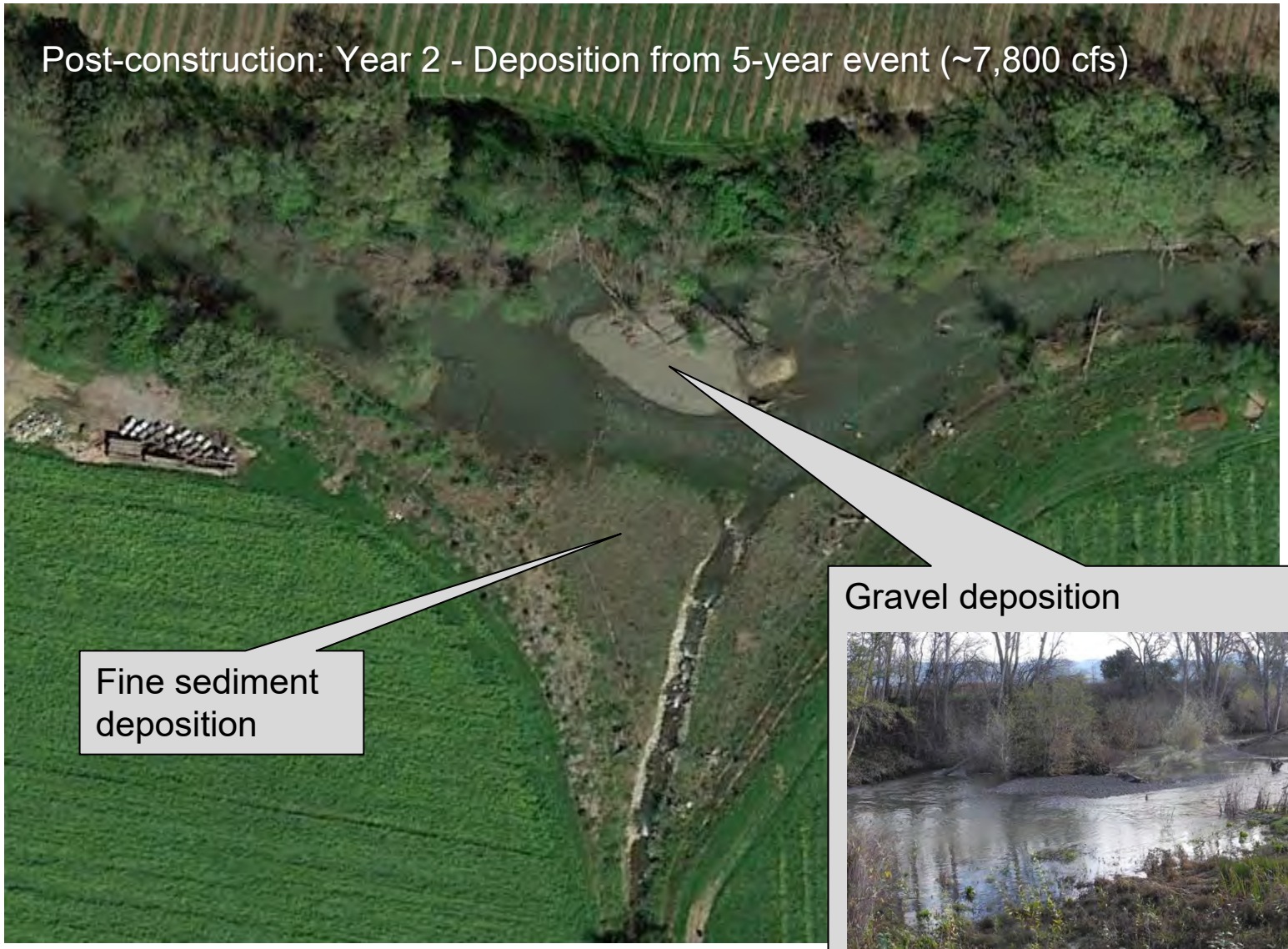
# Napa River in the ground….


Aerial Image Source: Google Earth

# Napa River in the ground…


Aerial Image Source: Google Earth

# Napa River performance….




Aerial Image Source: Google Earth

## Common concerns:

- How to keep it from filling in with sediment?
- Is there enough sediment to support approach?
- Can you “predict” what it will look like in so many years?
- Can you “guarantee” habitat will continue to function as built?

# In Summary

- The **Geomorphic Design Approach** goes beyond “building” habitat, it improves geomorphic function that will naturally create and sustain habitat
- Then sediment becomes an asset rather than an impairment to salmonid habitat restoration

# Thank You


## Acknowledgements

**Dry Creek Project Owner: Sonoma County Water Agency**

**Napa River Project Owner: County of Napa Public Works**

Dry Creek ESA Consultant Team: Cramer Fish Sciences (CFS), Prunuske Chatham (PCI), A3GEO

Napa River ESA Consultant Team: Cramer Fish Sciences (CFS), Horizon, HRS/Restoration Resources/ A3GEO, Doble Thomas & Associates

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