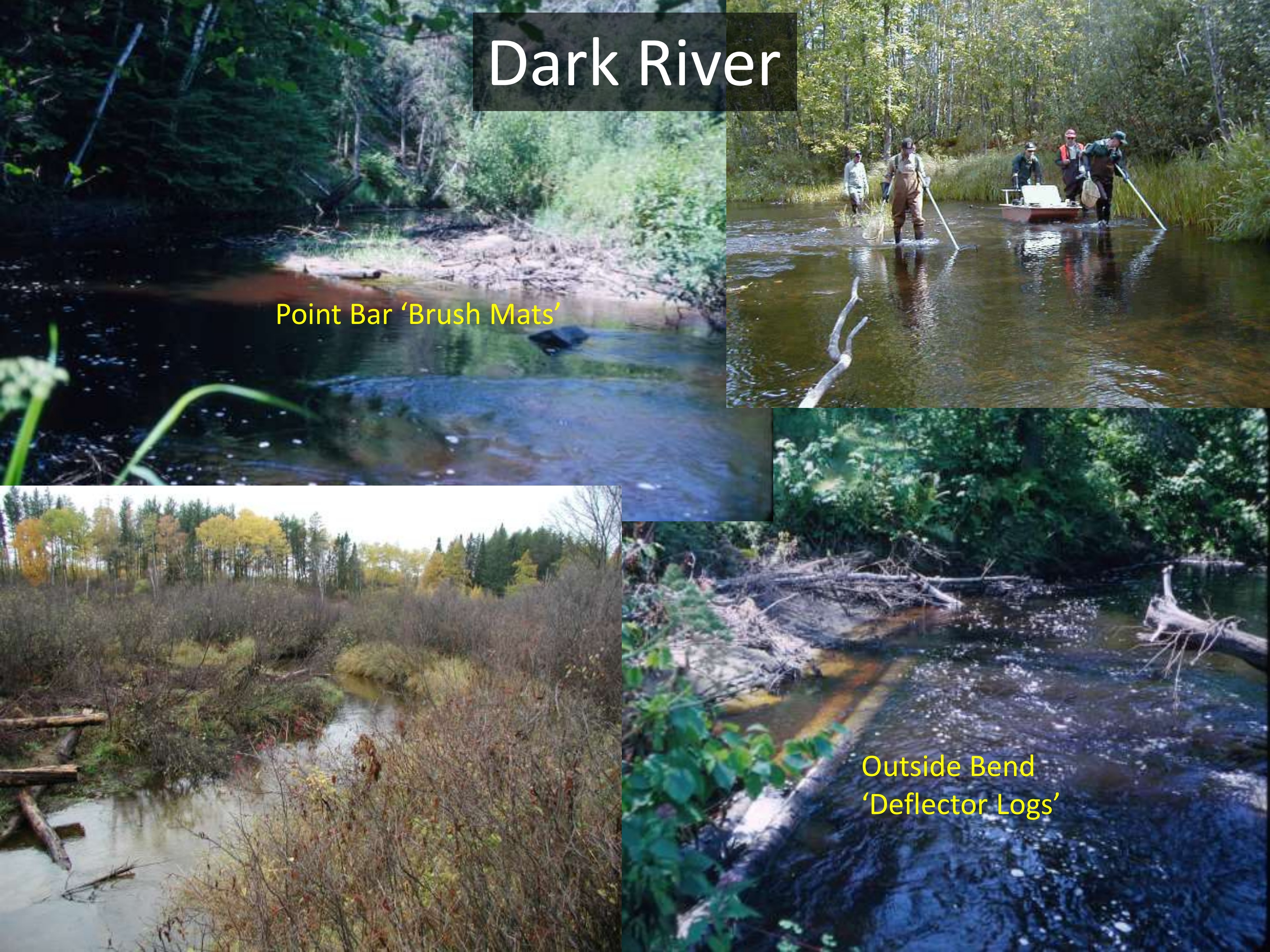
Observations on Natural Channel Design approaches: where can we improve?

Karl Koller

MN Dept. Of Natural Resources

Dark River

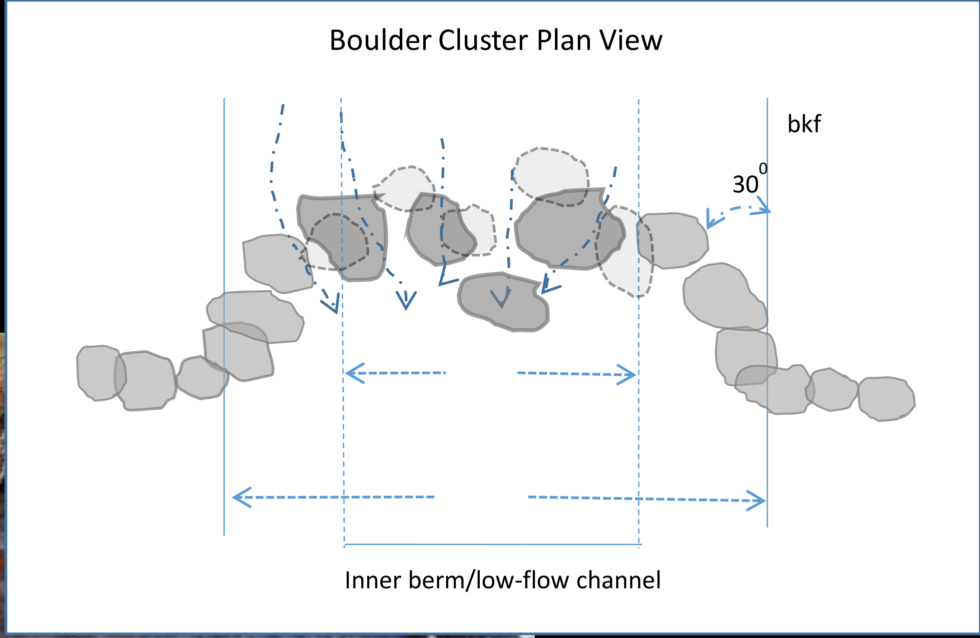


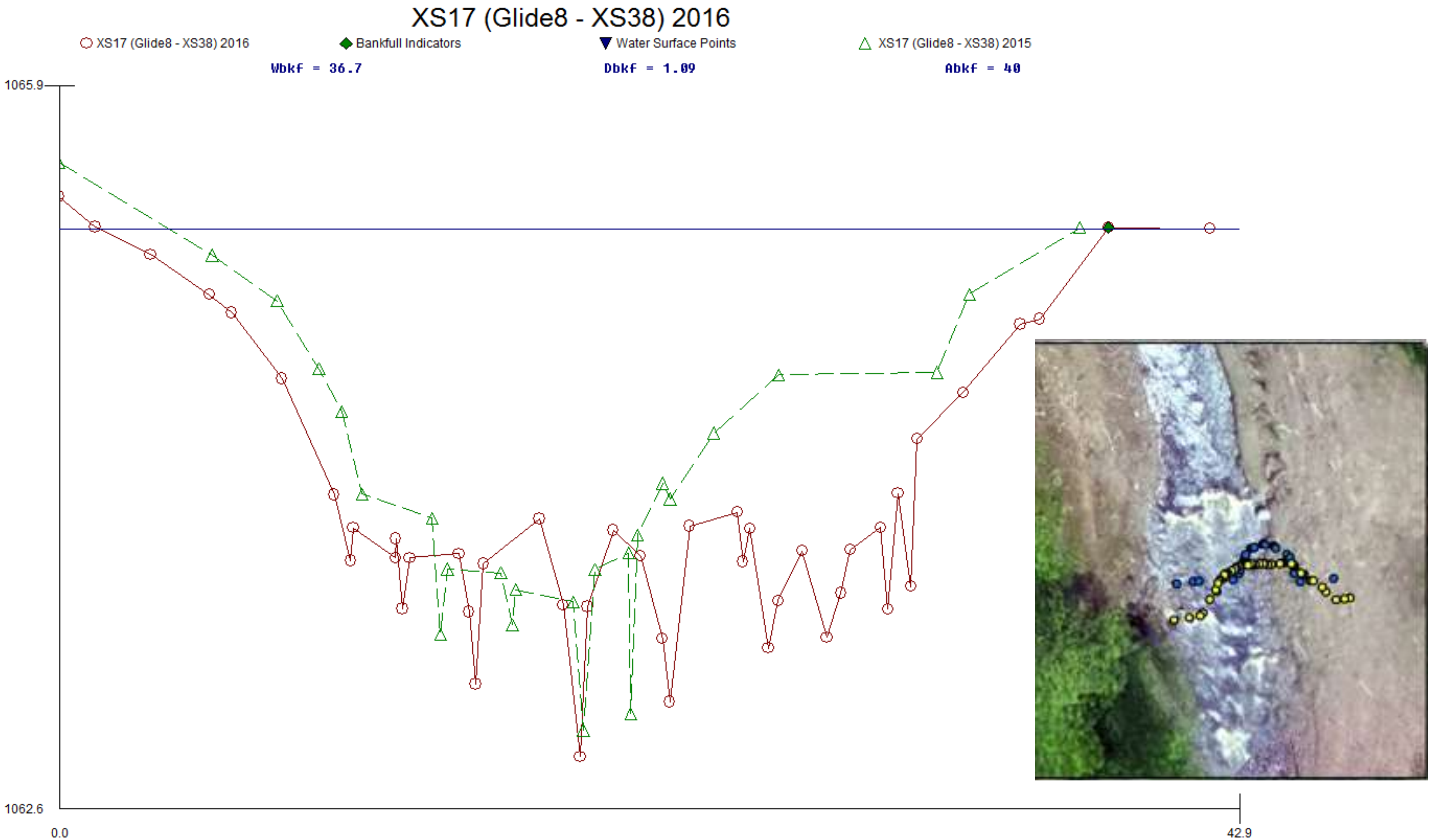
Construction Observations

Stewart River


2015


Fall 2015


Boulder Cluster Plan View
bkf
30⁰
Inner berm/low-flow channel

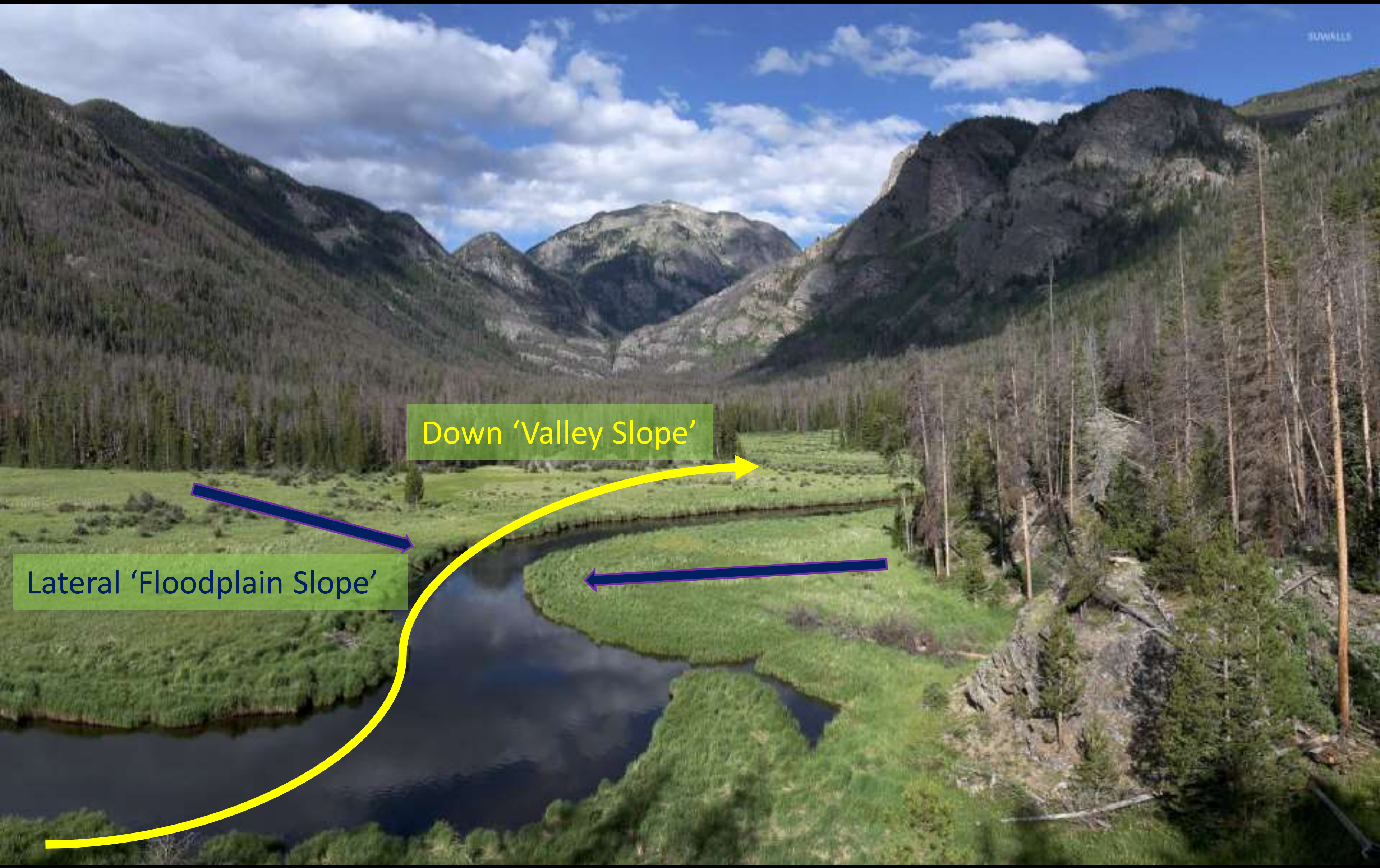


Glide Structures					
Glide#	Year	Wbkf	Dbkf	W:d	Abkf
Glide8	**2015**	33.2	0.87	32.5	28.8
Glide8	**2016**	36.7	1.09	33.7	40.0

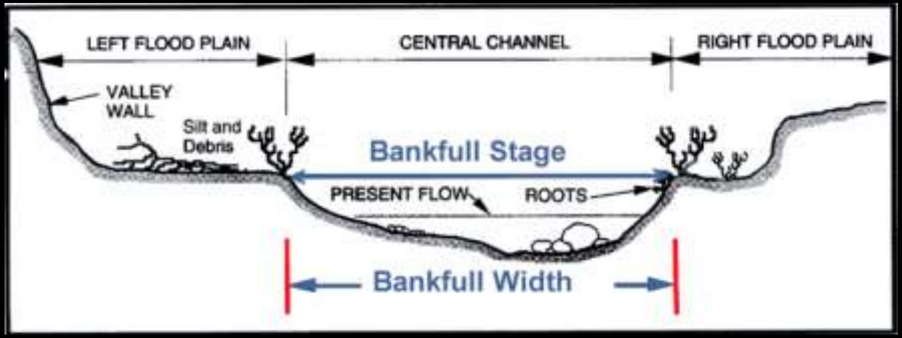
Abkf Design = 52 ft^2 (44-62 ft^2)

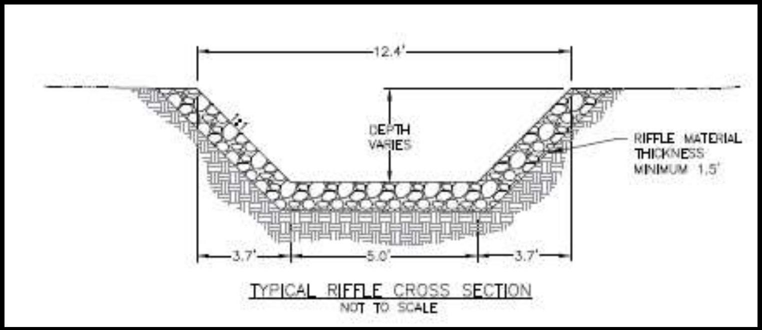
Oversite is critical
Check your design
with cross sections

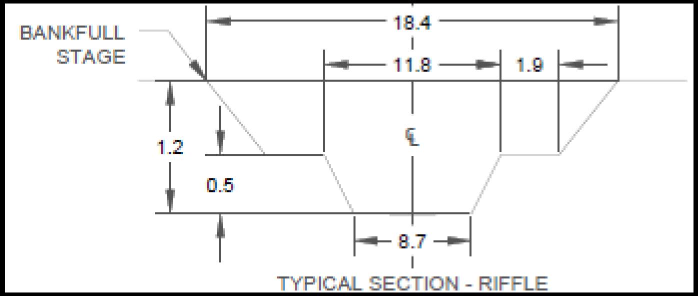
Mission Creek

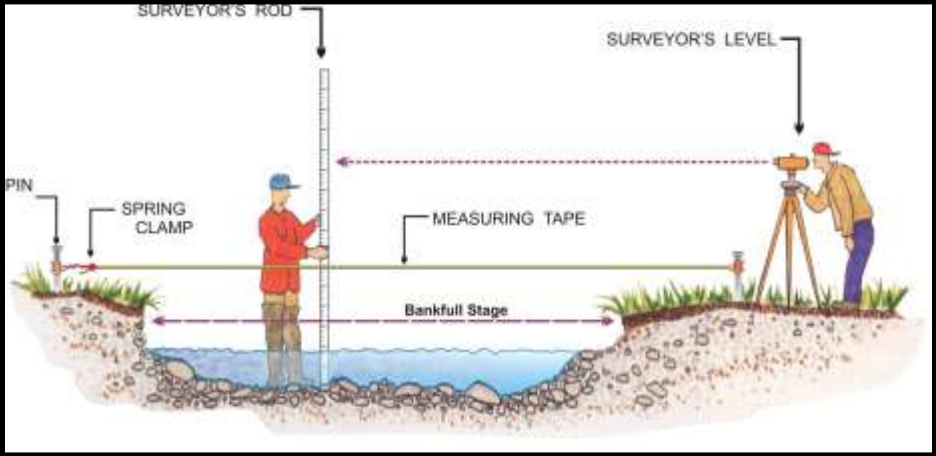

Down ‘Valley Slope’
Lateral ‘Floodplain Slope’

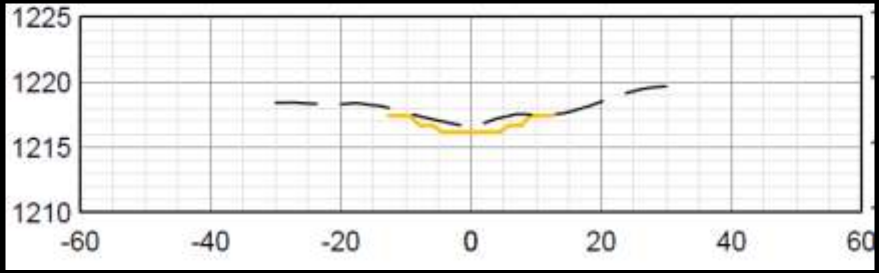
Floodplains are always flat?

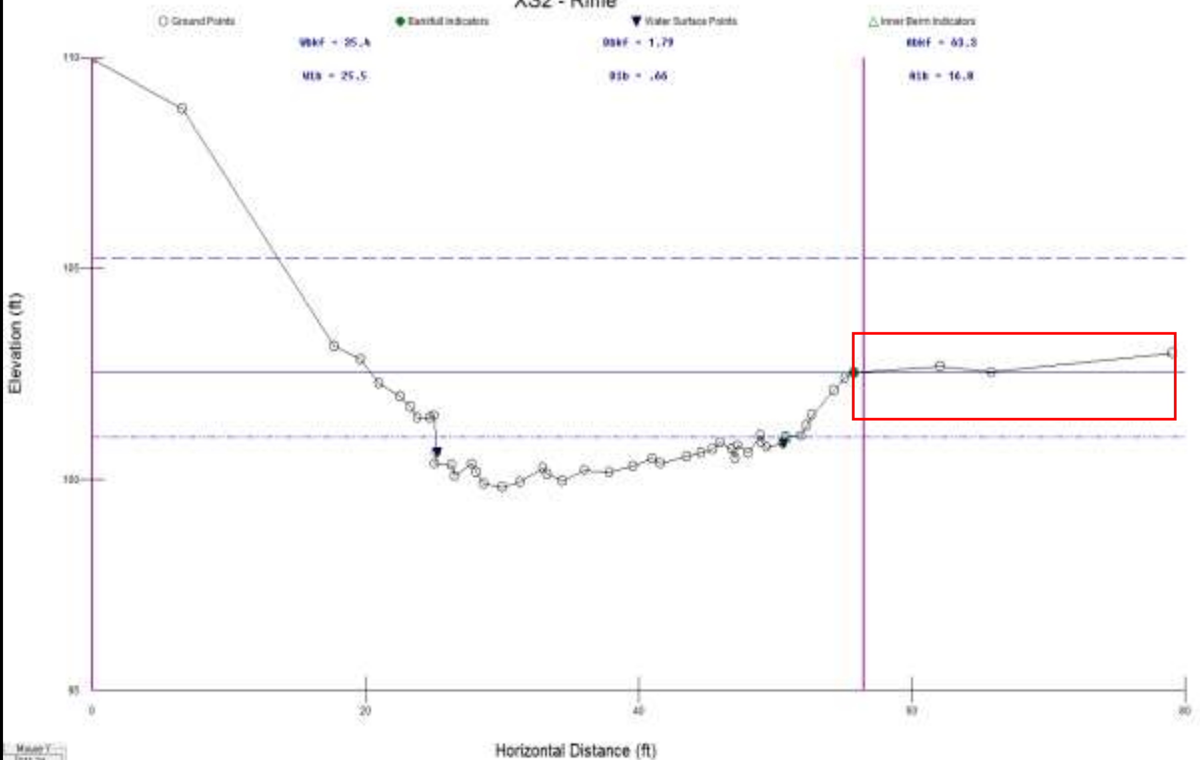




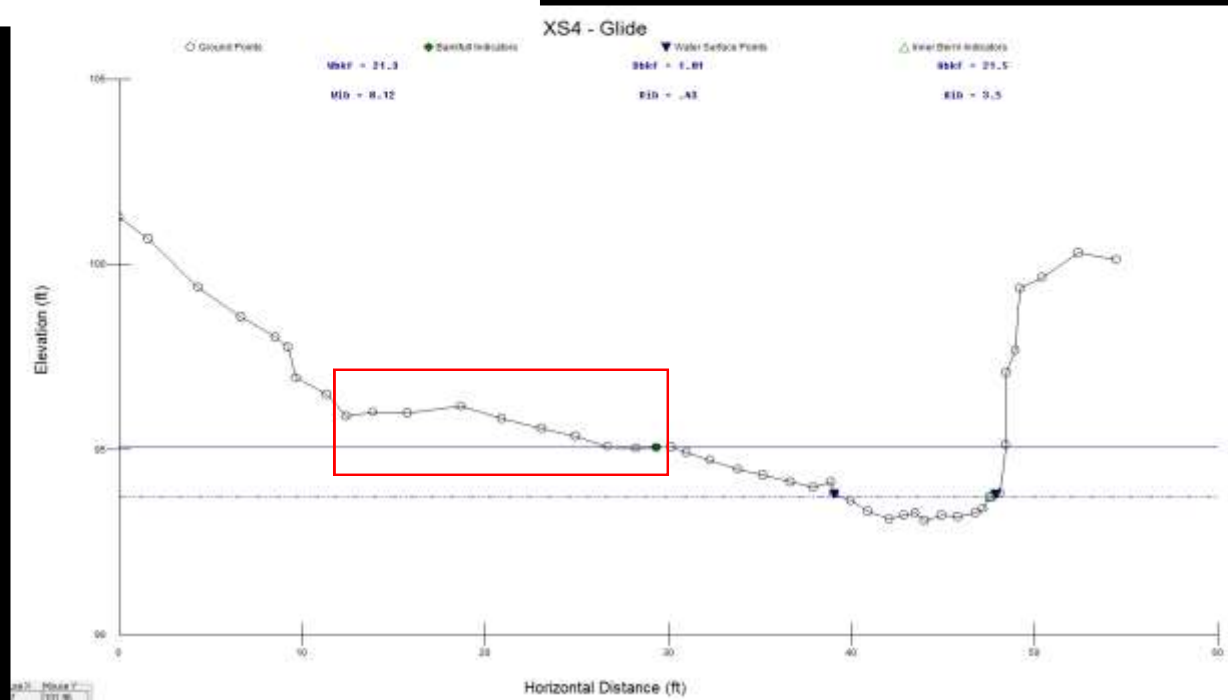




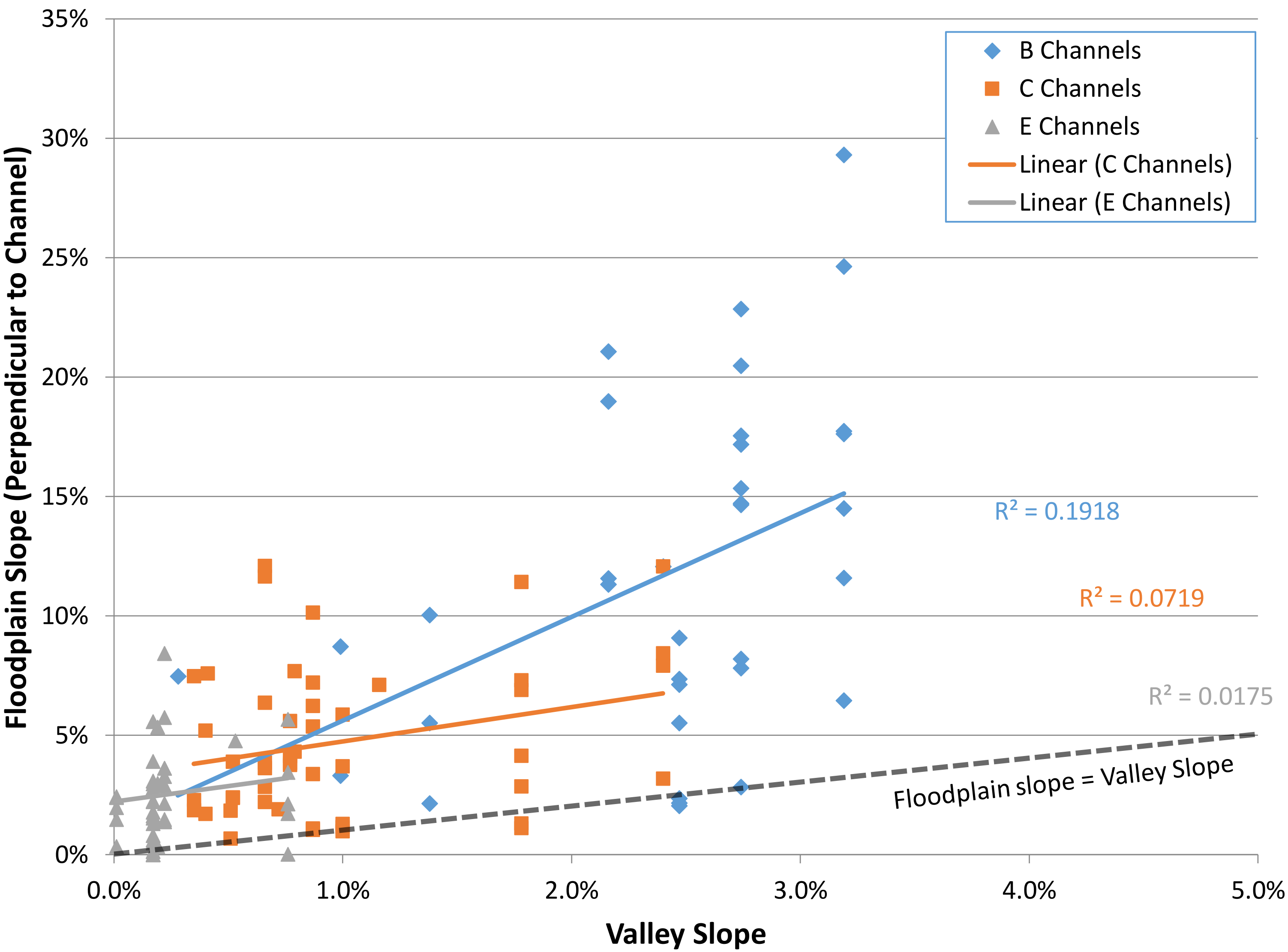




Floodplain Slope Measurements



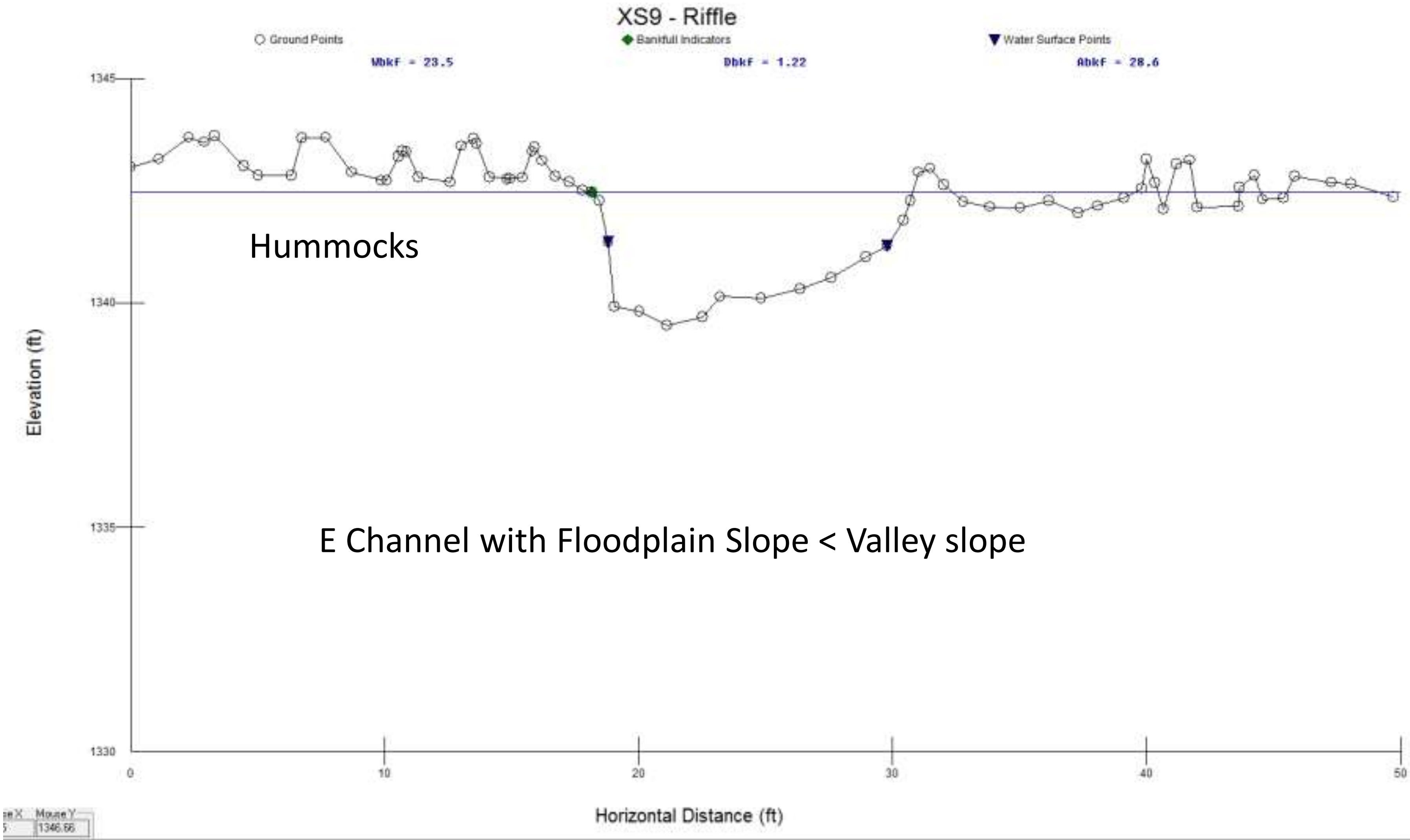
Floodplain Slope (perpendicular to channel) vs. Valley Slope by stream Type



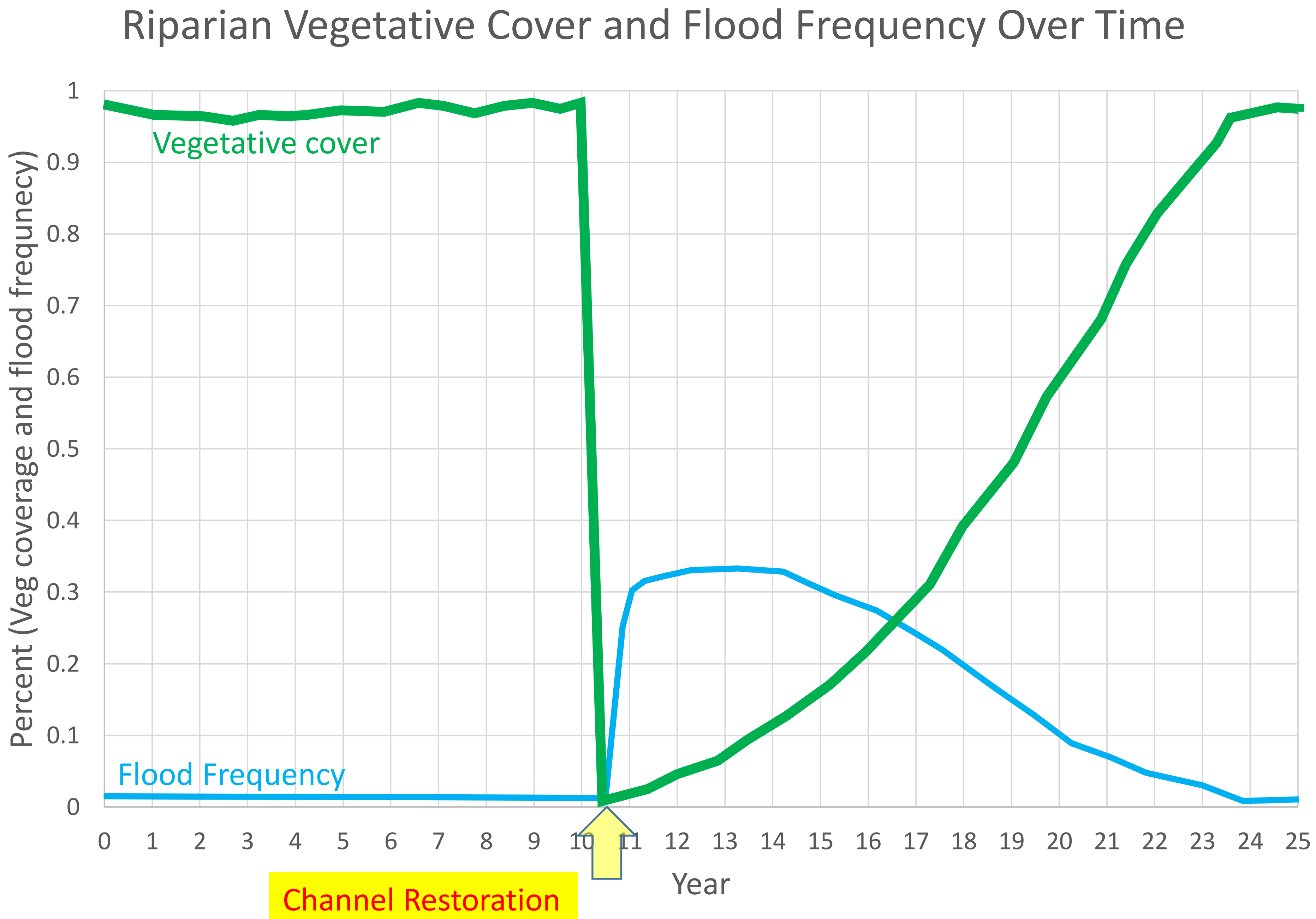
Tim Beaster

Floodplain Roughness

Lester STAR XS9



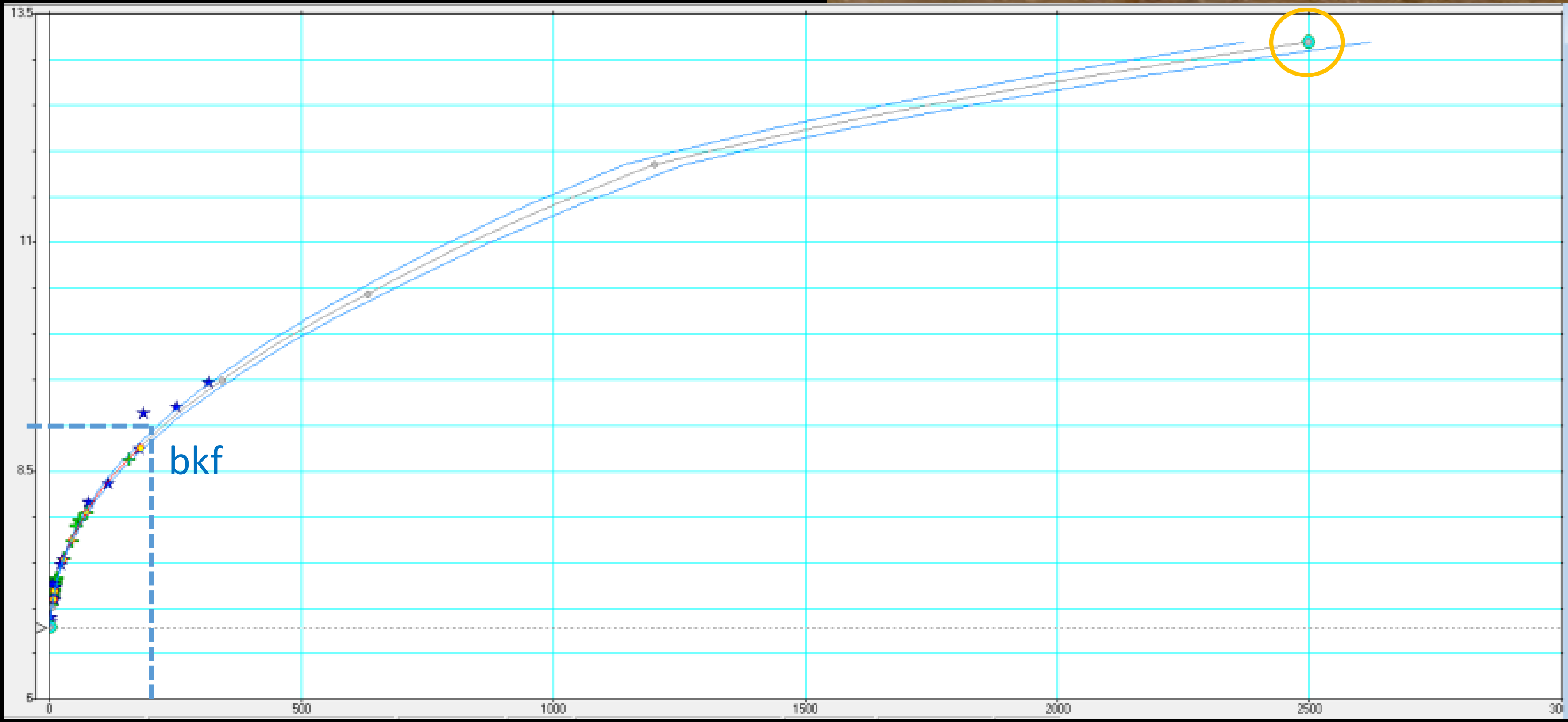
Murphy's Law of Stream Restoration



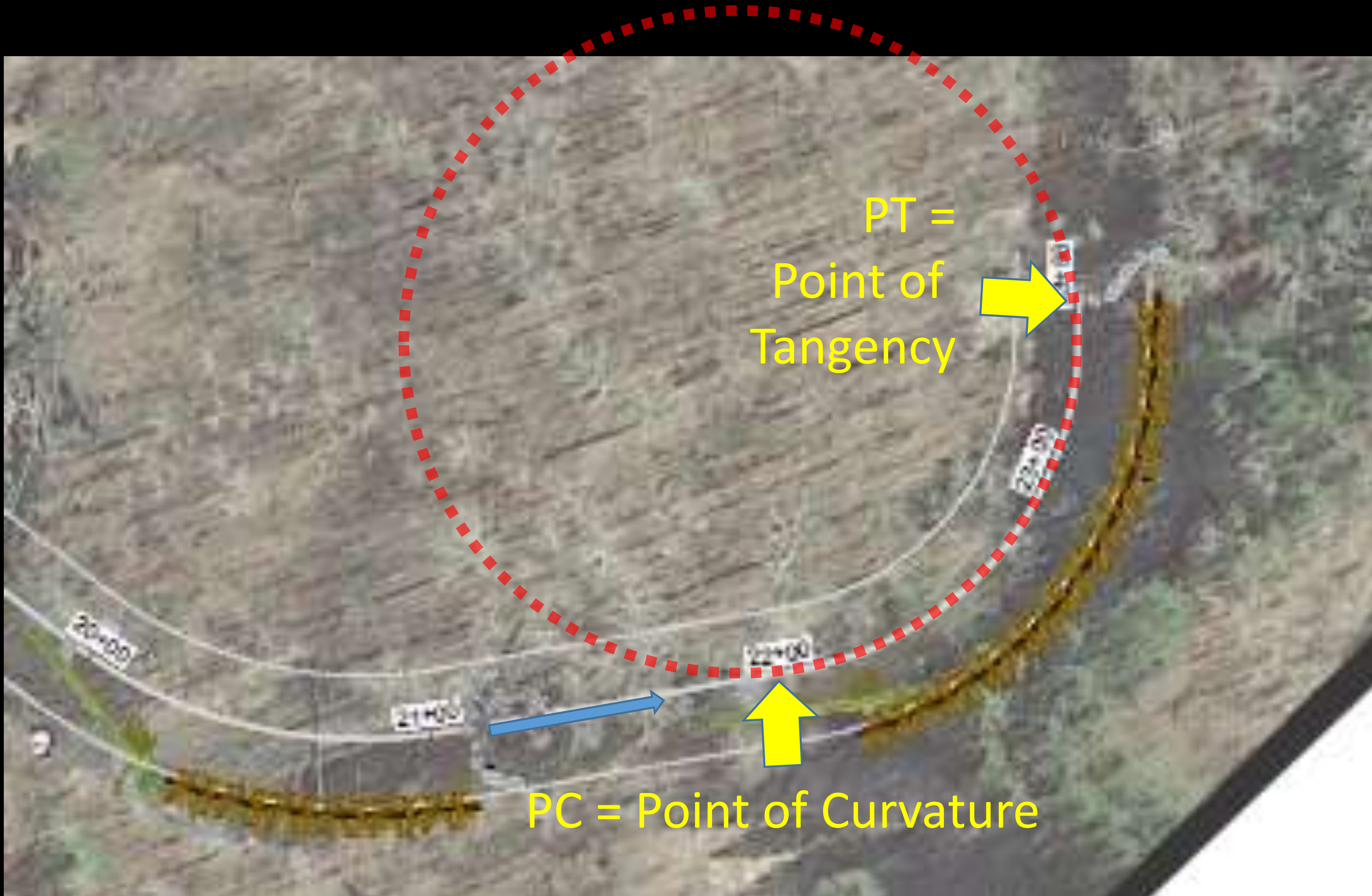
Stewart River

Flood of 2018

> 100 yr Flood

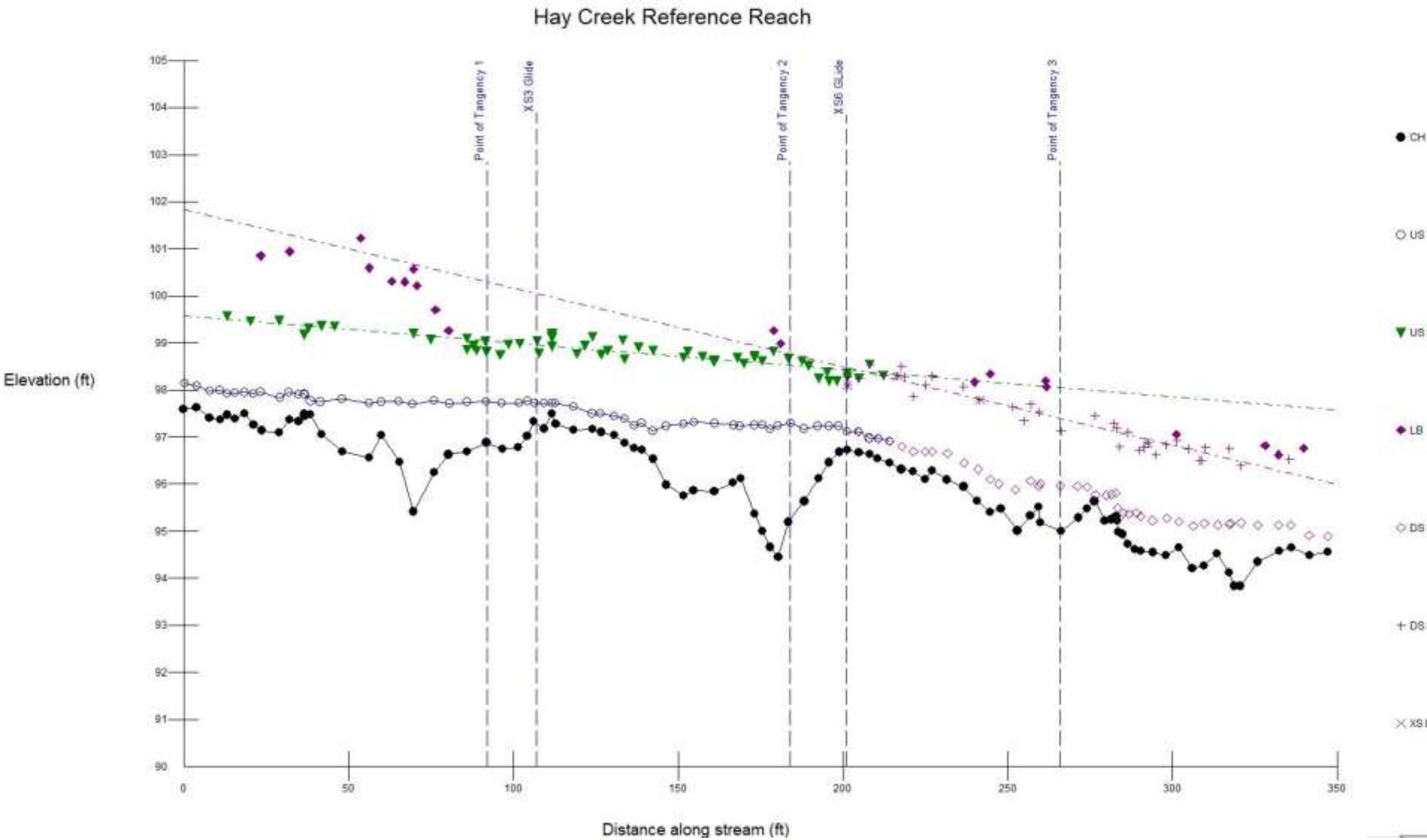



Eroded Bank

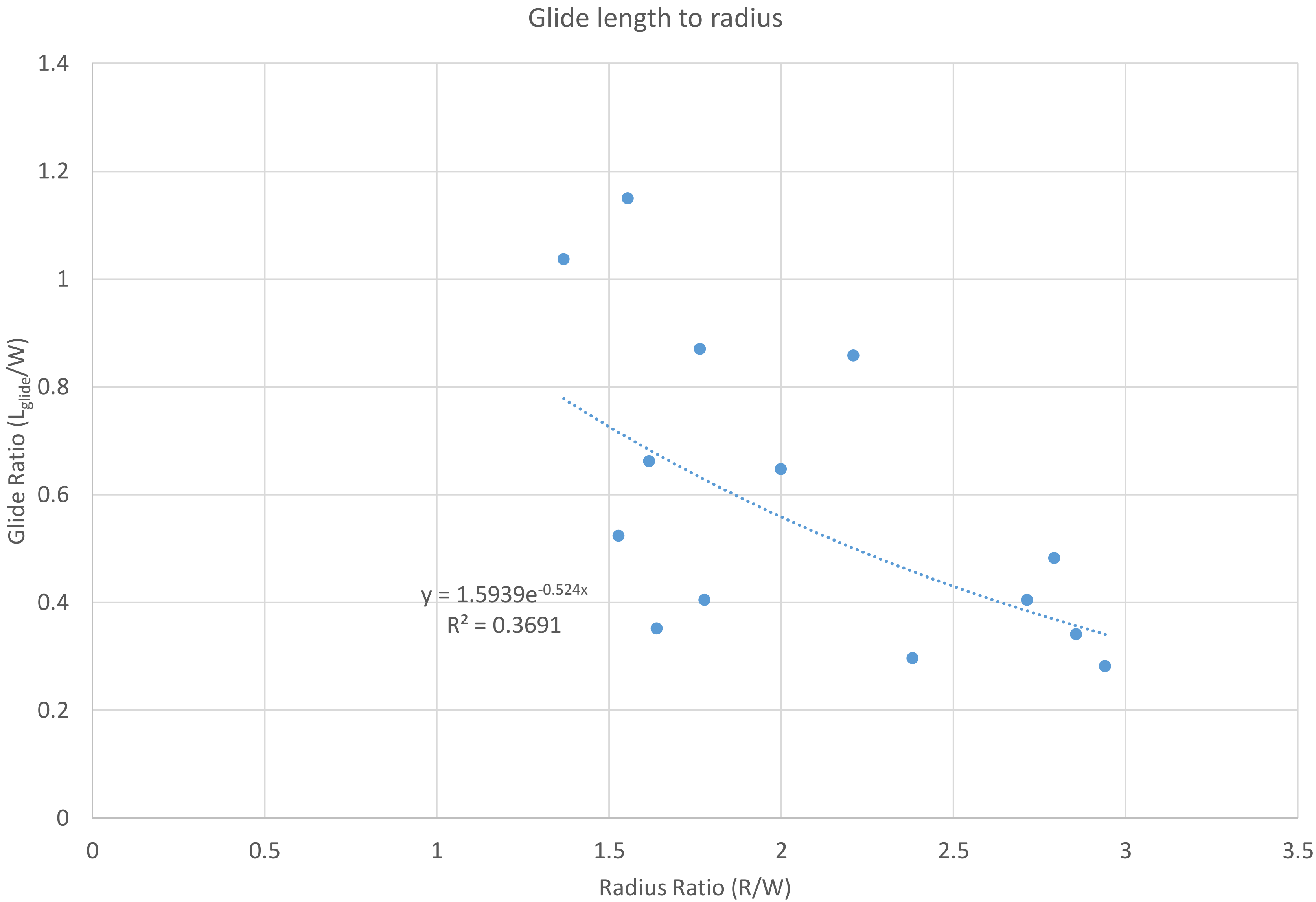

PT =
Point of
Tangency
20+00
21+00
22+00
PC = Point of Curvature

Stewart River Glide Structure

Point of Tangency (PT) and riffle crest locations on LP



For Lateral Scour Pools on C and B channels, top of riffle located on average about ½ W DS of PT



Top of riffle distance from PT slightly inversely correlated to R/W

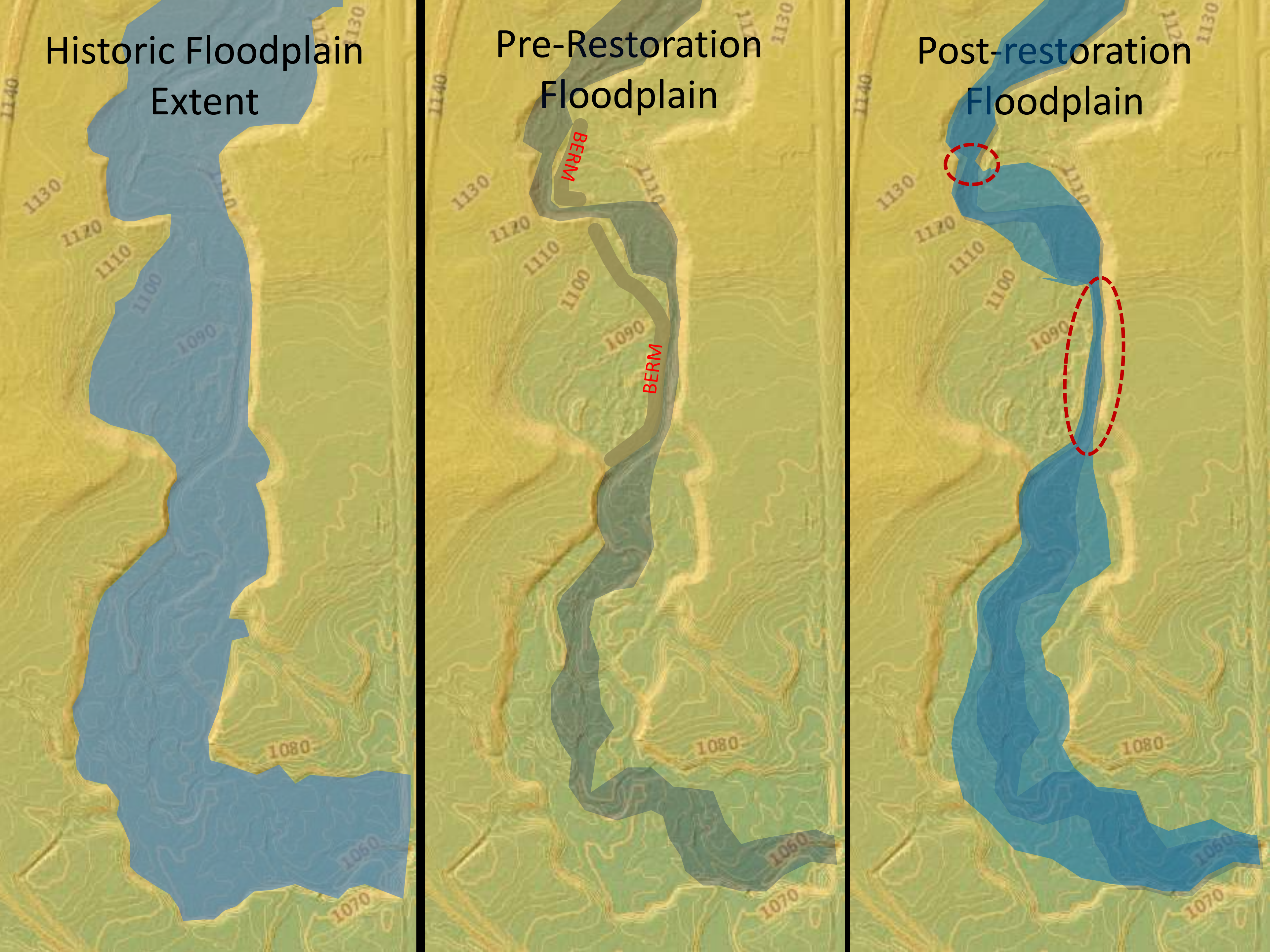
Glide Structures Improvements

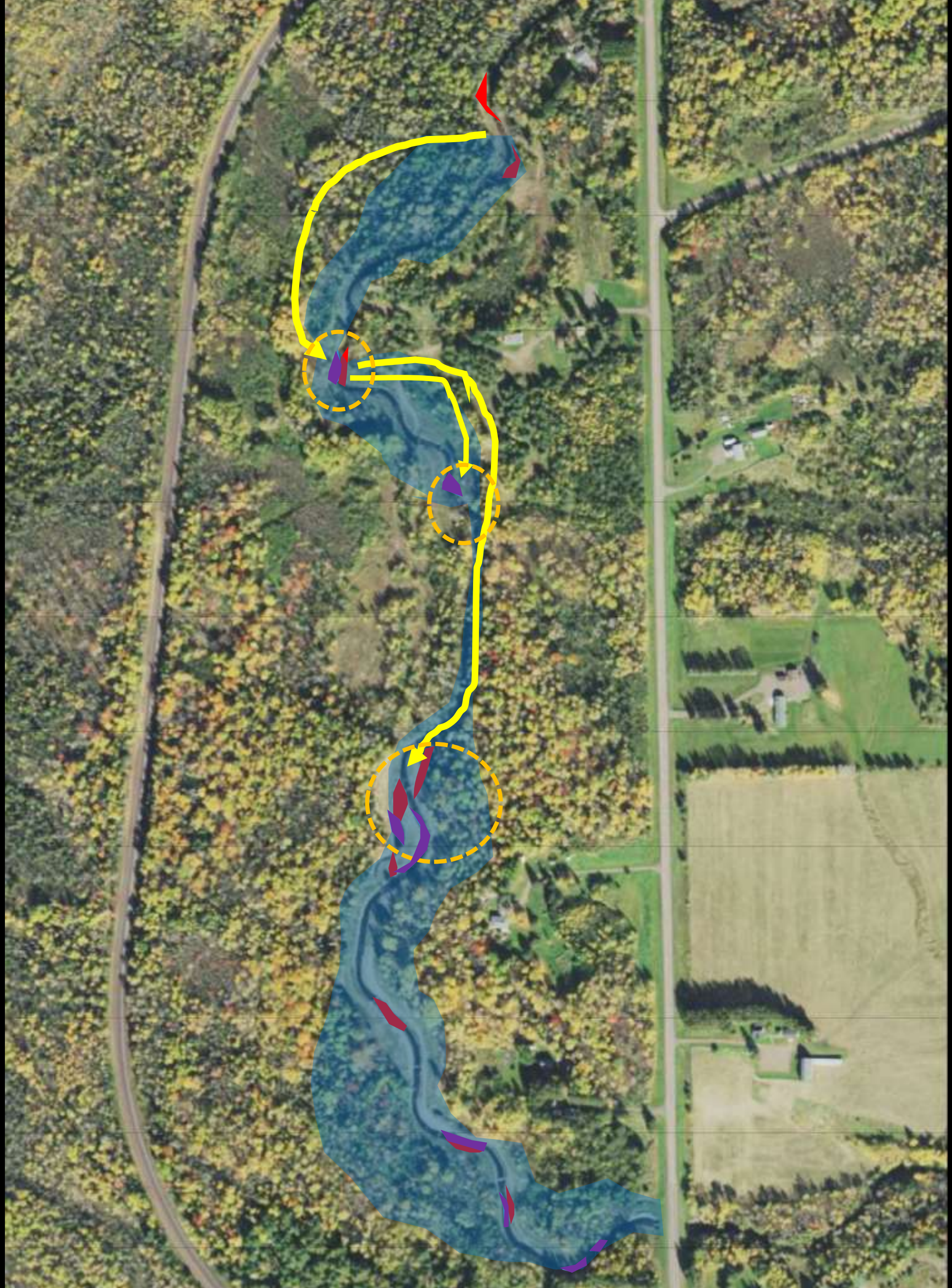
1. Relocate downstream
2. Longer sill on outside
3. More irregular shape across front
4. Ramp glide and riffle up to GS elevation

Pool Aggradation


Pre-Flood


Post-Flood


Historic Floodplain Extent
Pre-Restoration Floodplain
BERM
BERM
Post-restoration Floodplain
1140
1130
1120
1110
1100
1090
1080
1060
1070



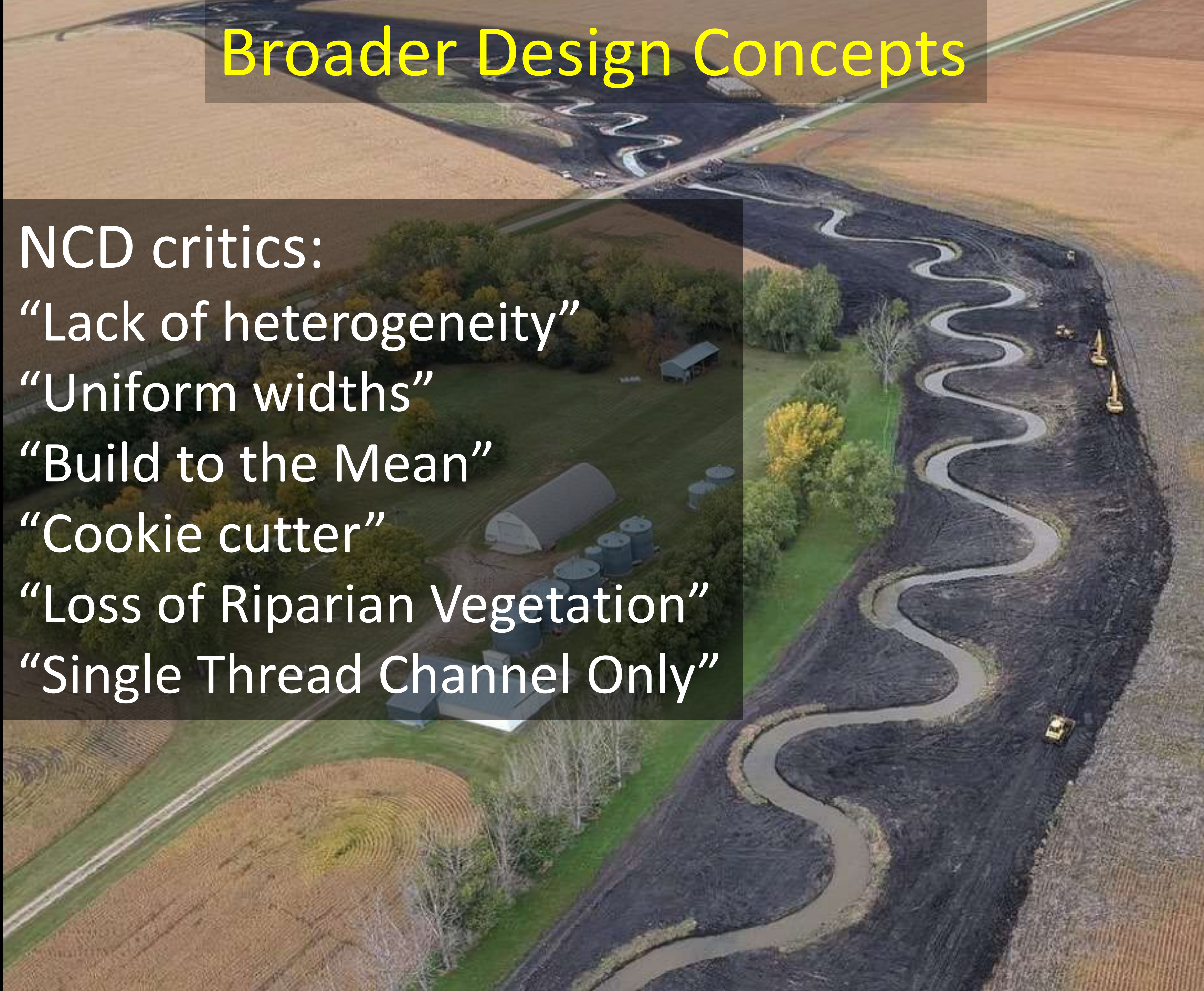
RED = Erosional Areas during 2018 flood

Purple = Depositional Areas during 2018 flood

Floodplain capacity and continuity is critical. It is the channel for large floods, and one should apply similar considerations for its construction as the channel.

Ann Thompson

Broader Design Concepts



NCD critics:

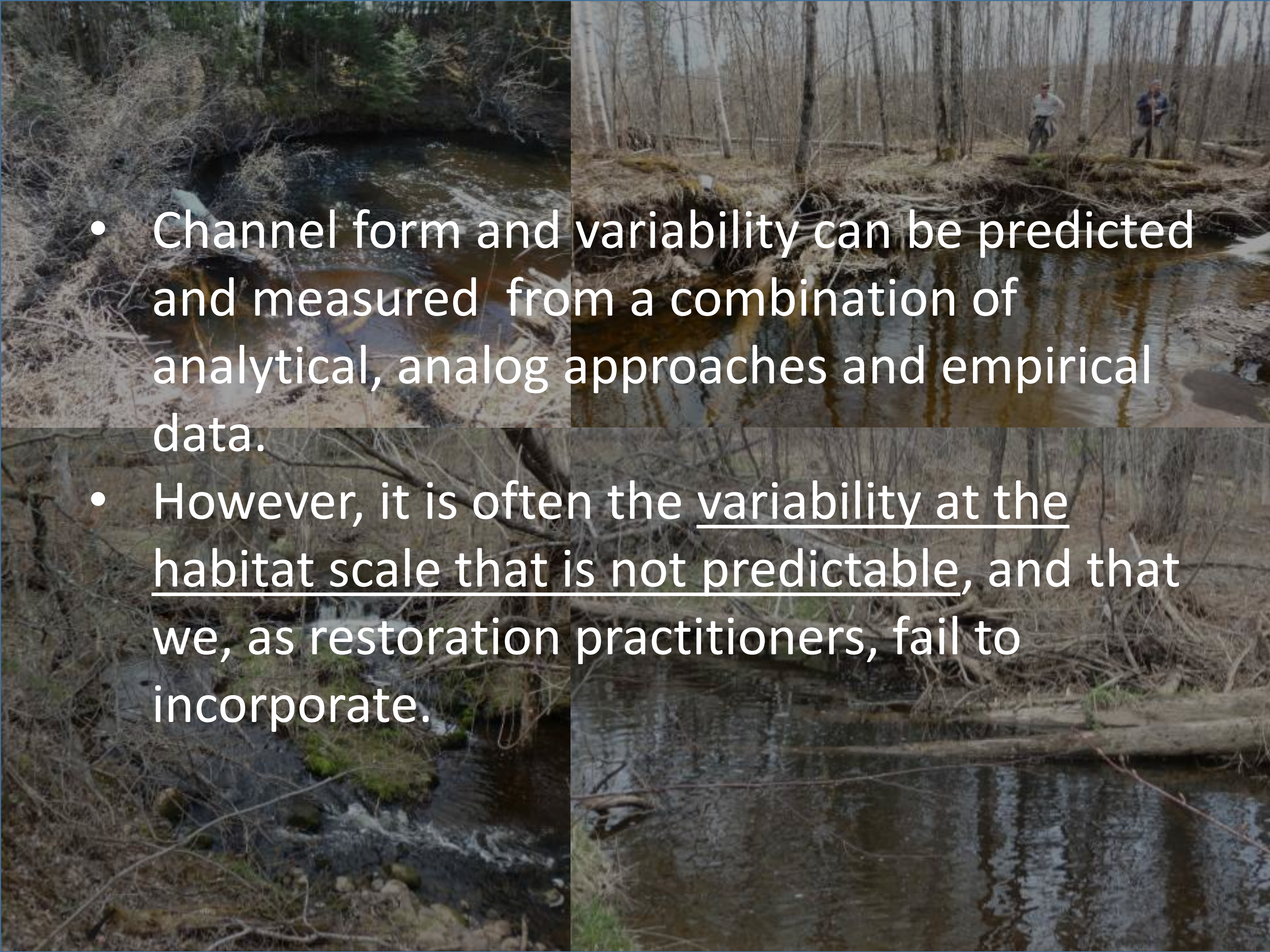
“Lack of heterogeneity”
“Uniform widths”
“Build to the Mean”
“Cookie cutter”
“Loss of Riparian Vegetation”
“Single Thread Channel Only”

The tools we design with and the way we quantitatively think of designs favors homogeneity

River Reach Dimension Summary Data.....1

Riffle Dimensions*, **, ***	Mean	Min	Max		Riffle Dimensions & Dimensionless Ratios****	Mean	Min	Max
Riffle Width (W_{bkf})	24.4	22.3	28.1	ft	Riffle Cross-Sectional Area (A_{bkf}) (ft^2)	31.37	25.31	35.16

Dark River



- Channel form and variability can be predicted and measured from a combination of analytical, analog approaches and empirical data.
- However, it is often the variability at the habitat scale that is not predictable, and that we, as restoration practitioners, fail to incorporate.

Connected oxbow habitat

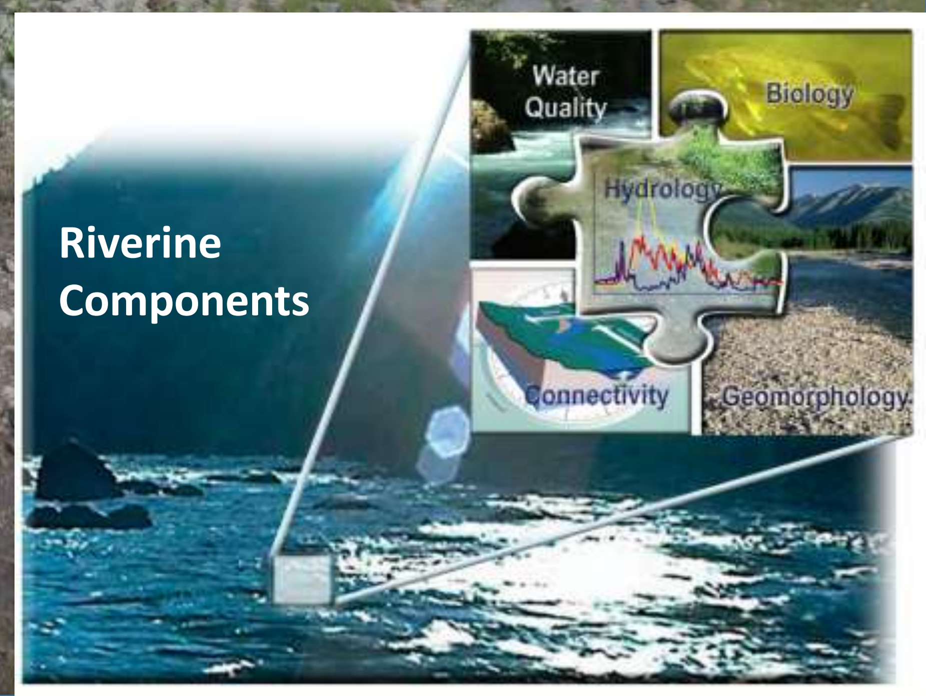
Wood complex

Habitat heterogeneity can be constructed

Project Management

What factors limit the complexity and quality of design on public projects?

Why do projects often fall short of systemically restoring physical and ecological functions and incorporating heterogeneity?



Low-Bid Request for Proposal (RFP) bidding approach often favors simpler/cheaper approaches than NCD

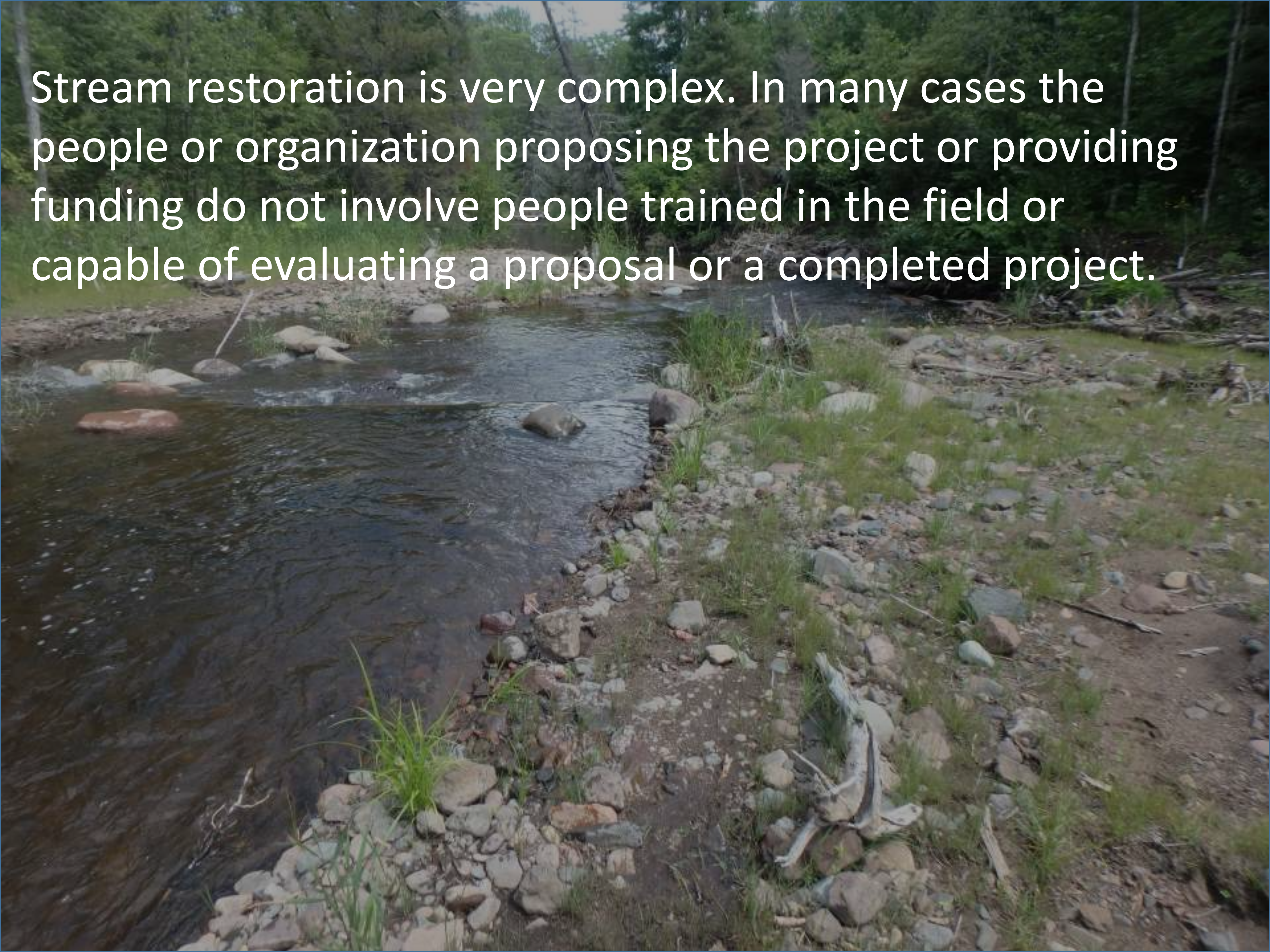
RFP's with limited objectives (e.g. sediment reduction, bank stabilization) that can be met without addressing stability

If NCD is specified, difficult to ensure bidder is experienced and fully applying NCD in design and construction

- Even if the RFP is specific enough to require full application of NCD using a reference reach(es), and competent consultants apply that will address not only diversity in channel geometry but also in microhabitat complexity, the higher design and construction cost can make these projects less competitive for public funds.

- Short grant timeframes limit the amount of time that can be spent on complex designs and construction.

Stream restoration is very complex. In many cases the people or organization proposing the project or providing funding do not involve people trained in the field or capable of evaluating a proposal or a completed project.



National Stream Restoration Certification Proposal

B = Undergrad
M = Masters
DOC = Doctorate
PD = Professional Development
E = Experience

Stream Restoration Body of Knowledge - General Practitioner						
	Level of Achievement					
Outcome Number and Title	**L1**	**L2**	**L3**	**L4**	**L5**	**L6**
Foundational						
1. Hydrology	B	B	B	B/M	M	DOC
2. Hydraulics	B	B	B	B/M	M	DOC
3. Fluvial Geomorphology	PD	PD	PD			
4. Sediment Transport	B	M	M	M	M/DOC	DOC
5. Stream Ecology	B	PD	PD			
6. Habitat Structure and Function	PD					
7. Fish Biology	PD	PD				
8. Plant Ecology and Riparian Dynamics	PD	PD				
Technical						
9. Surveying/Hydrometry	B	B	B	B/M	M/DOC	
10. Watershed Analysis	B	B	B	M/E	DOC/E	
11. Geomorphic and Habitat Assessment	PD	PD				
12. Biomonitoring/Bioassessment	PD	PD				
13. Alternatives Analysis	B	B	B	B/M	M/E	DOC/E
14. Analytical Techniques	B	B	M	M/E	DOC/E	DOC/E
15. Restoration Design	E	E	DOC	DOC		
16. Uncertainty and Risk	M	DOC	DOC	DOC	DOC	DOC
Professional						
17. Project Development	E/PD	E/PD				
18. Restoration Policy (codes and regulations)	M	E/PD				
19. Communication and Information Management	E/PD	E/PD				
20. Construction Inspection	E					
21. Professional and Ethical Responsibility	B	B	M	M/E	DOC/E	DOC/E

Sue Niezgoda, Gonzaga University


Will natural processes following restoration
restore heterogeneity?
Time will tell.

CONCLUSIONS

- Pay attention to details during oversite
- Floodplains, floodplains, floodplains – floodplain form is just as important as channel form
- Maximize habitat diversity and heterogeneity
- Project managers, examine your RFP process to determine if you are getting best possible projects
- Teams with diverse skills, knowledge and experience can improve outcomes

Visit past projects to learn, especially after large events – Monitor if possible- and compare to natural streams – continue to evolve/improve

Oliver Grunewald