

Jun 27th, 2:10 PM - 2:30 PM

Concurrent Sessions A: Passage Effectiveness Monitoring in Small Streams II - An Evaluation of the Stream Simulation Culvert Design Method in Washington State

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Barnard, Robert J.; Yokers, Sheila; Nagygyor, Alex; and Quinn, Timothy, "Concurrent Sessions A: Passage Effectiveness Monitoring in Small Streams II - An Evaluation of the Stream Simulation Culvert Design Method in Washington State" (2013). *International Conference on Engineering and Ecohydrology for Fish Passage*. 47.
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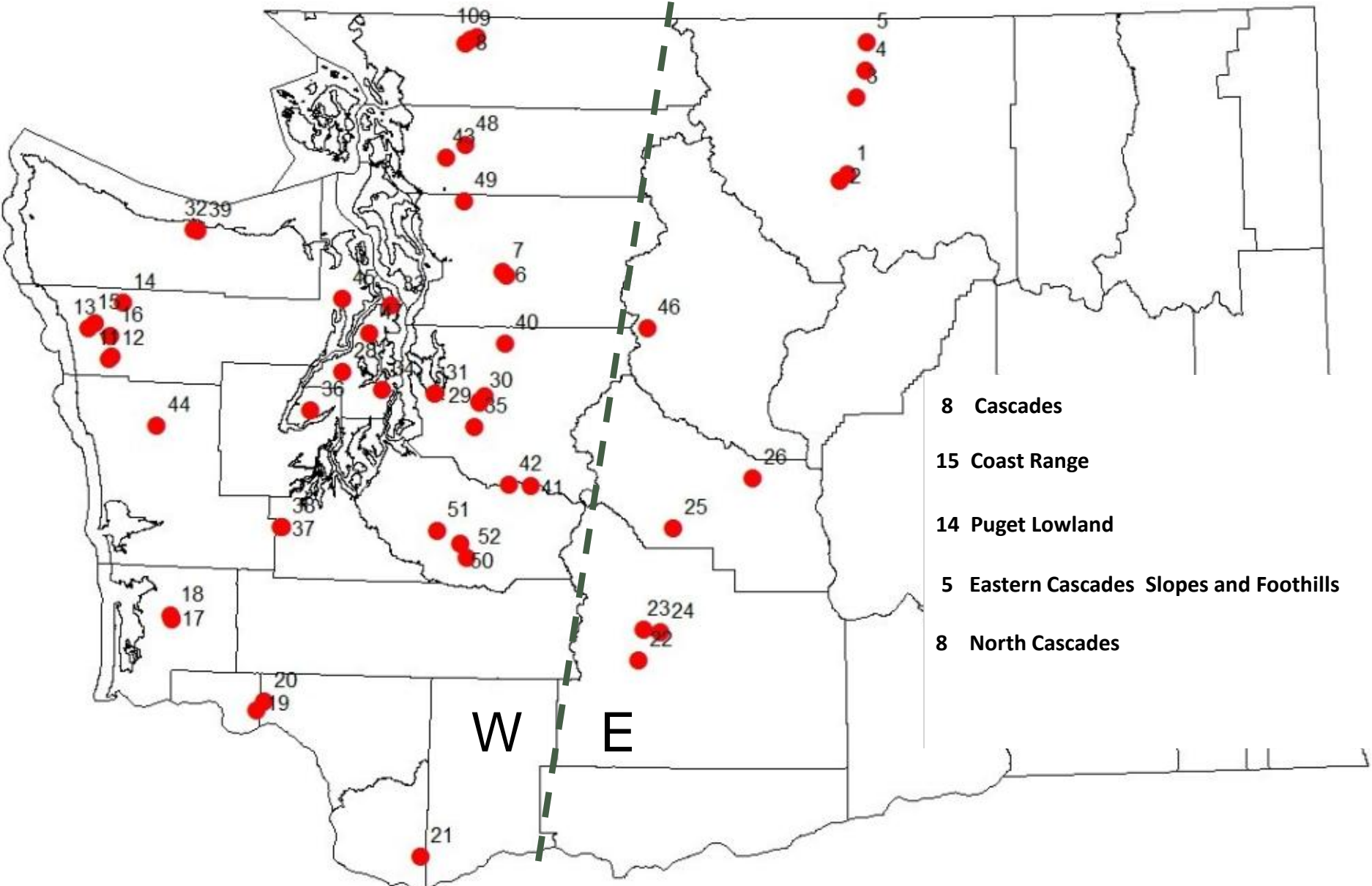
Stream Simulation Culvert Effectiveness Study

WDFW and WADNR

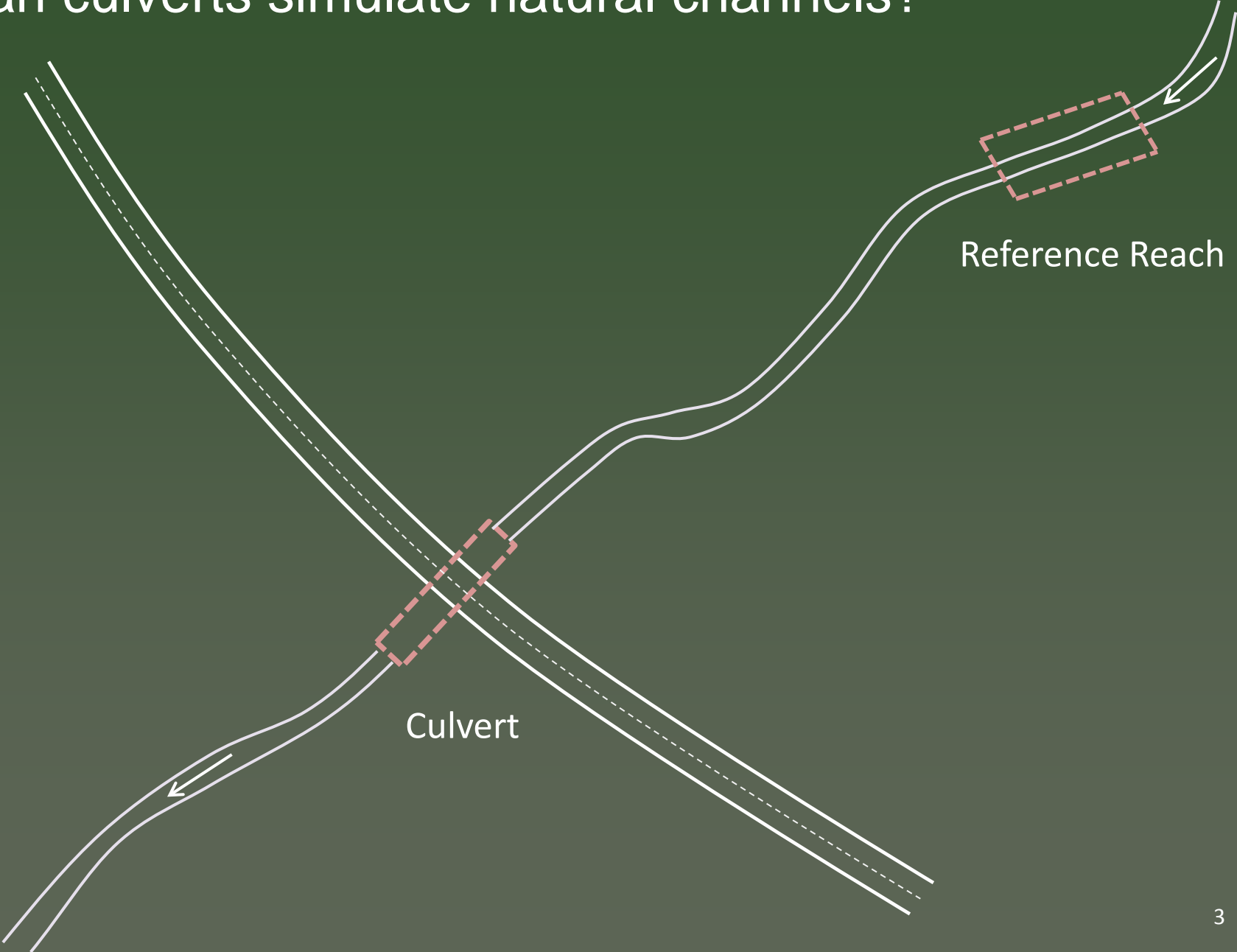


Bob Barnard
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Heather Tschaekosfske
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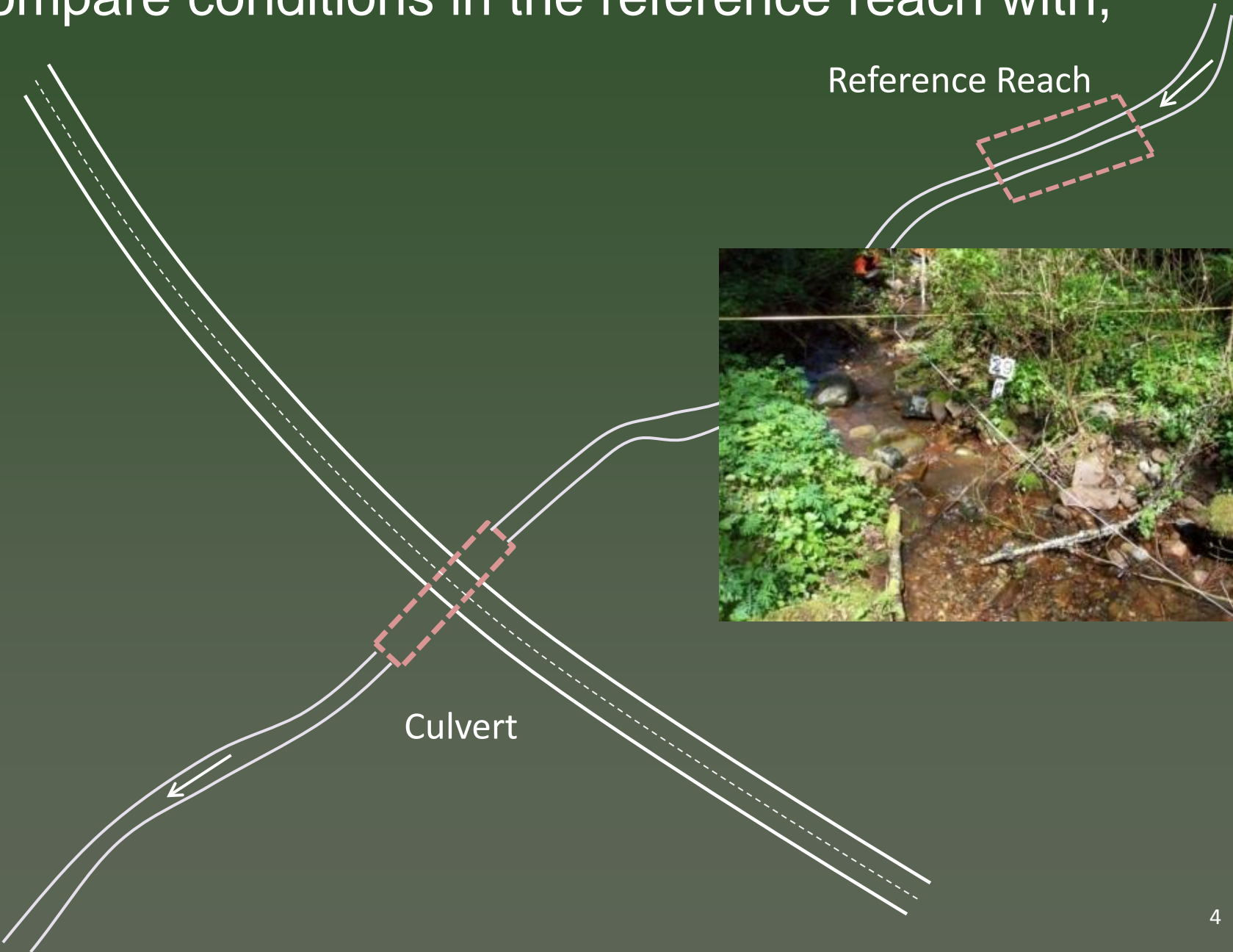
50 study culverts (35 WADNR, 15 other)



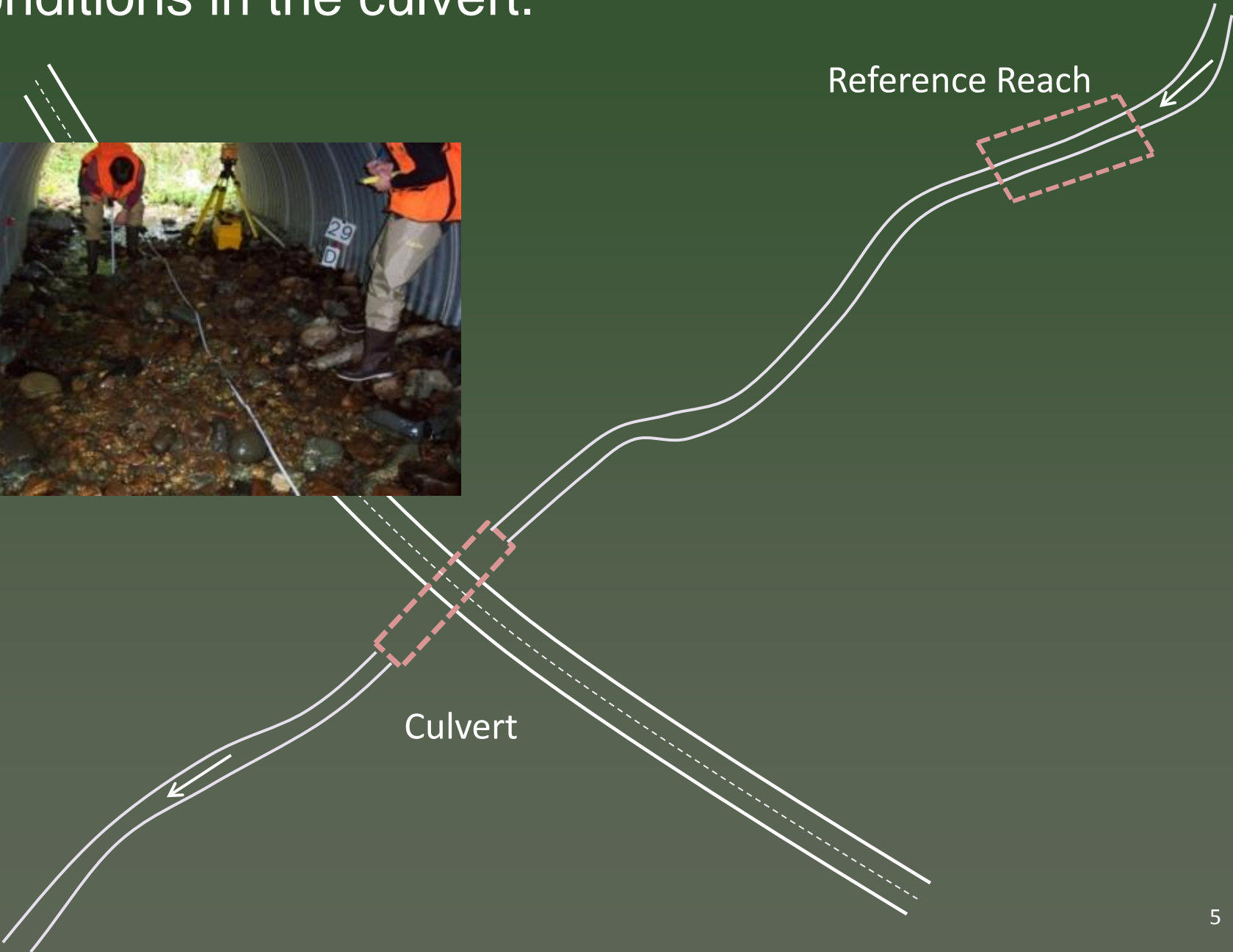
Can culverts simulate natural channels?



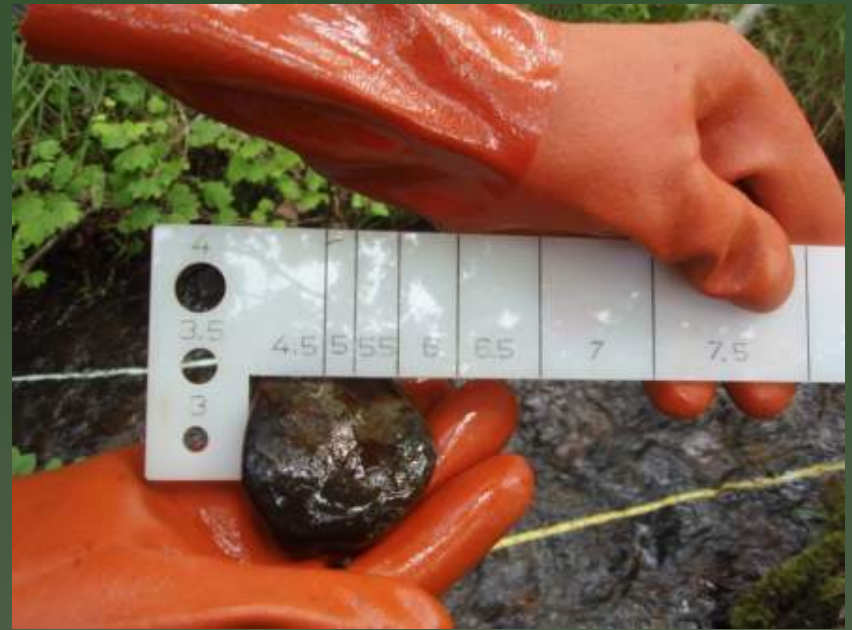
Compare conditions in the reference reach with,



conditions in the culvert.

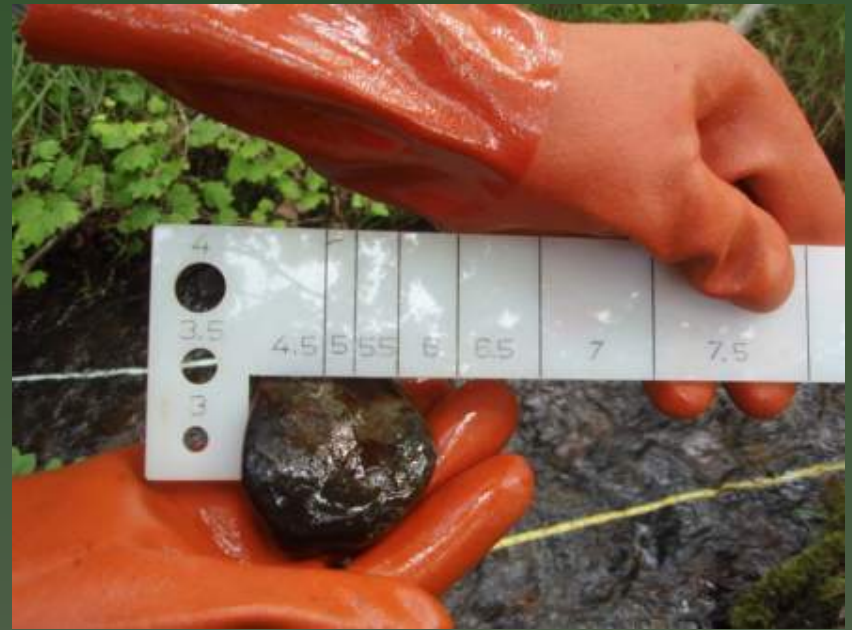


Sediment characterization



Sediment characterization

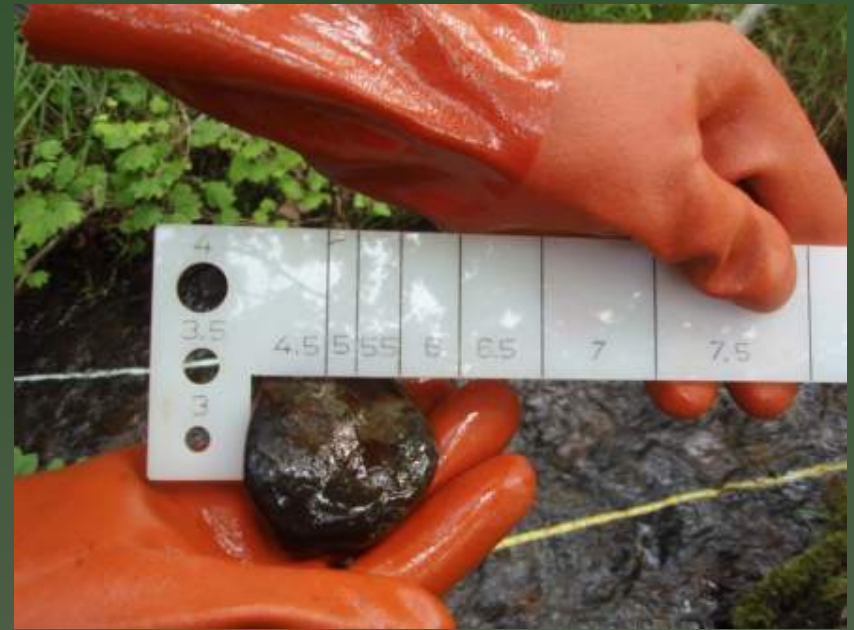
Thalweg depth profile



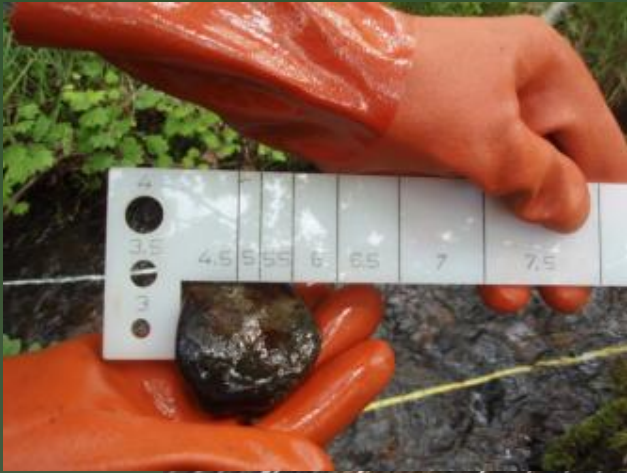
Sediment characterization

Thalweg depth profile

Cross section analysis



Pebble count



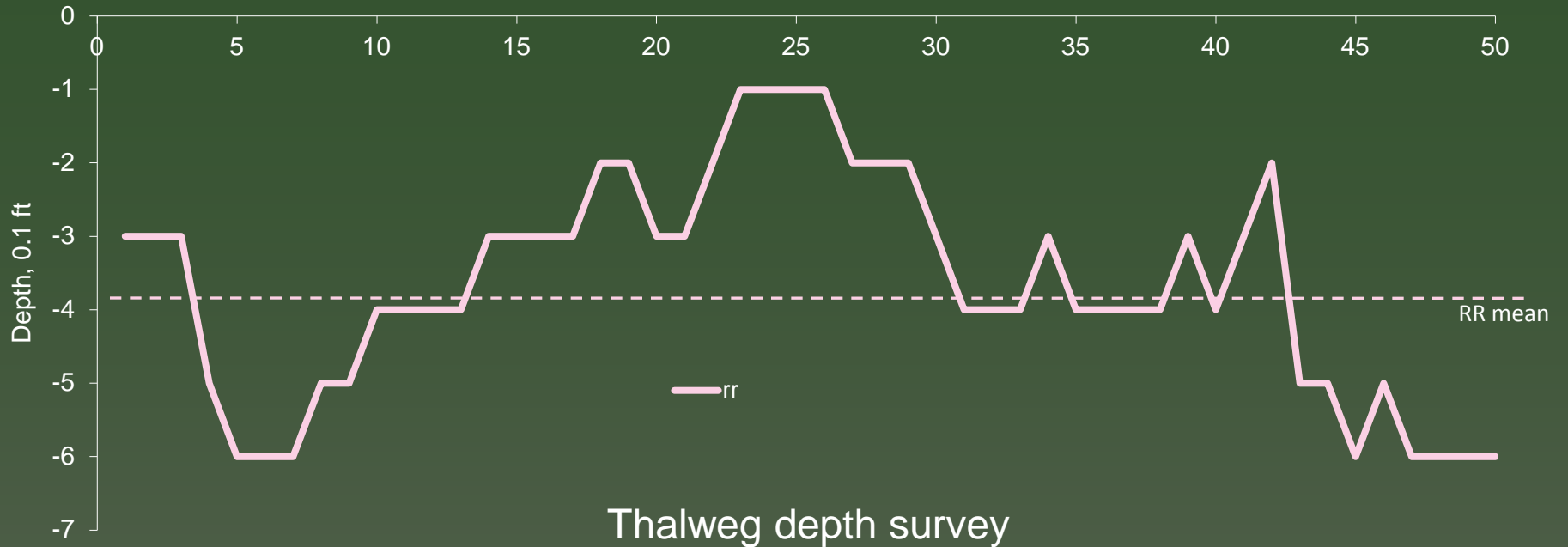
Thalweg Depth Profile

Depth measured every 1.0 ft in
1/10ths ft



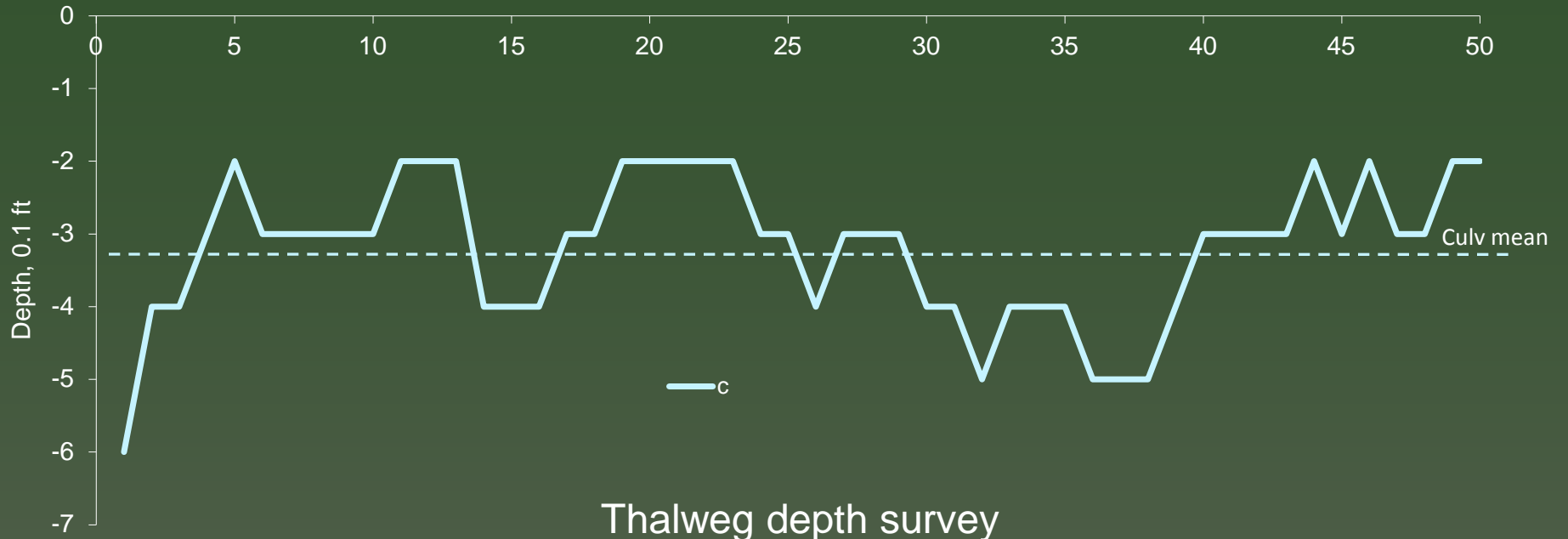
49

Station, ft



49

Station, ft

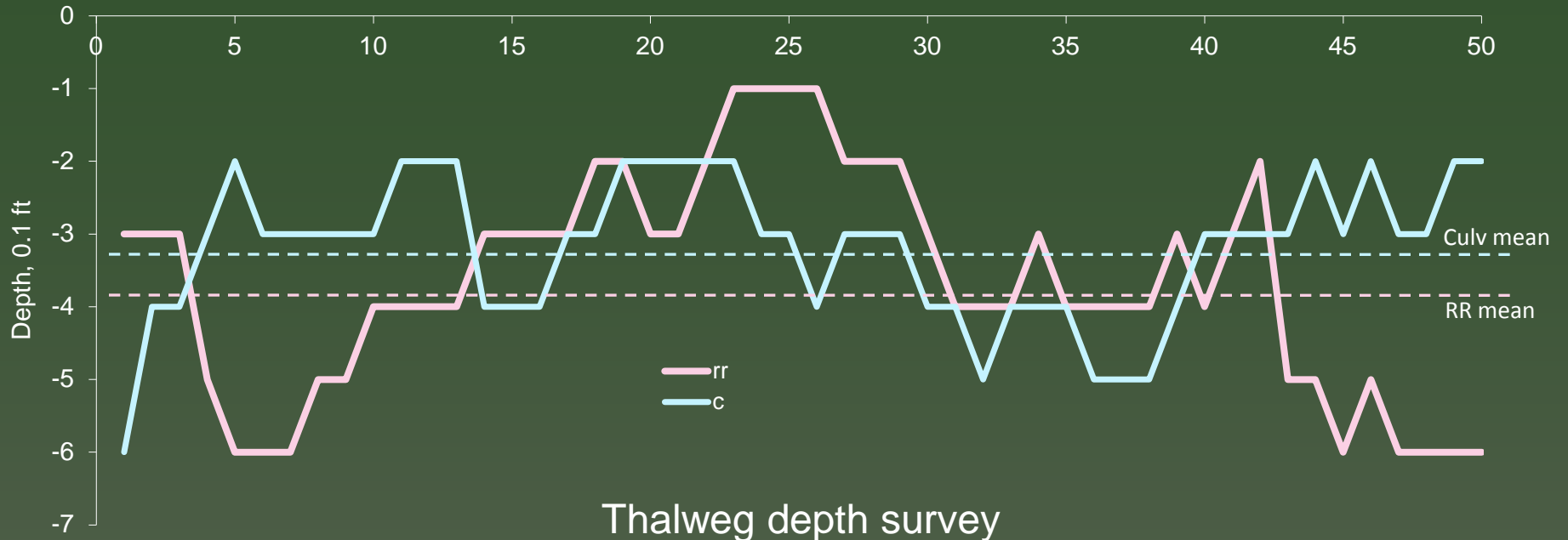


Thalweg depth survey



49

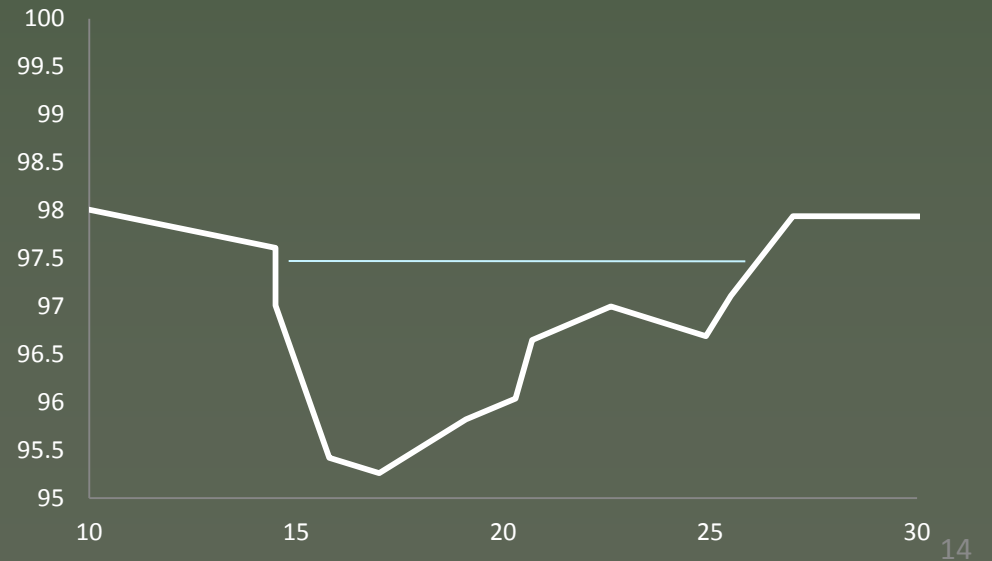
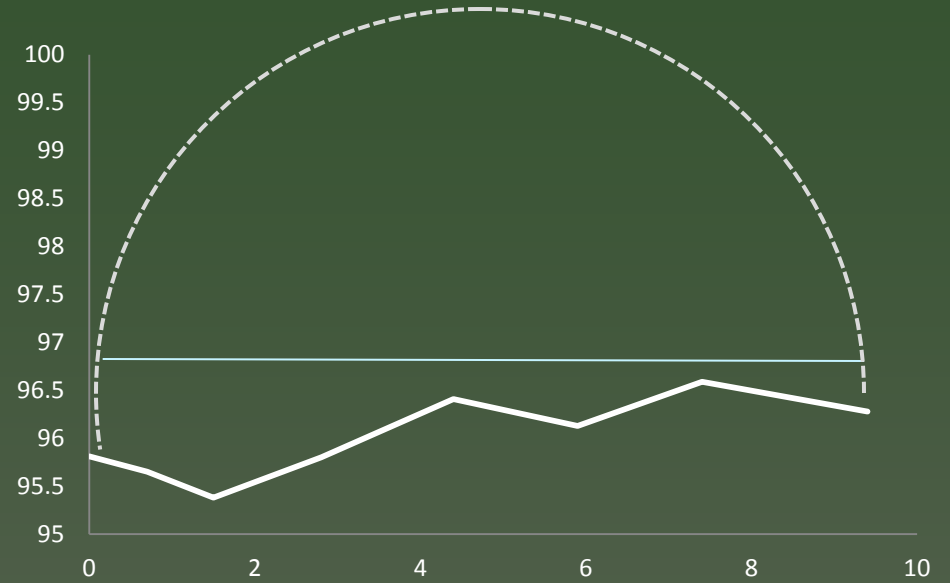
Station, ft



Thalweg depth survey



Cross section hydraulic analysis



Results: Group Similarity

		Wilcoxon p	
Sediment	D_{50}	0.4	← Similar
	D_{84}	0.9	← Similar

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	D_{84}	0.9	
Hydraulics	Q_{100} velocity	0.5	← Similar
	Q_{100} width	0.002	
	Q_{100} stage	0.005	
	Q_2 velocity	0.02	
	Q_2 width	0.05	← Similar
	Q_2 stage	0.03	

Results: Group Similarity

		Wilcoxon p	
Sediment	D_{50}	0.4	
	D_{84}	0.9	
Hydraulics	Q_{100} velocity	0.5	
	Q_{100} width	0.002	
	Q_{100} stage	0.005	← Culv. shallow
	Q_2 velocity	0.02	
	Q_2 width	0.05	
	Q_2 stage	0.03	← Culv. shallow

Results: Group Similarity

		Wilcoxon p	
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	Q_2 stage	0.03	
Profile roughness	Thalweg depth mean	0.0009	← Profile flat
	Thalweg depth std dev	0.01	← Profile flat

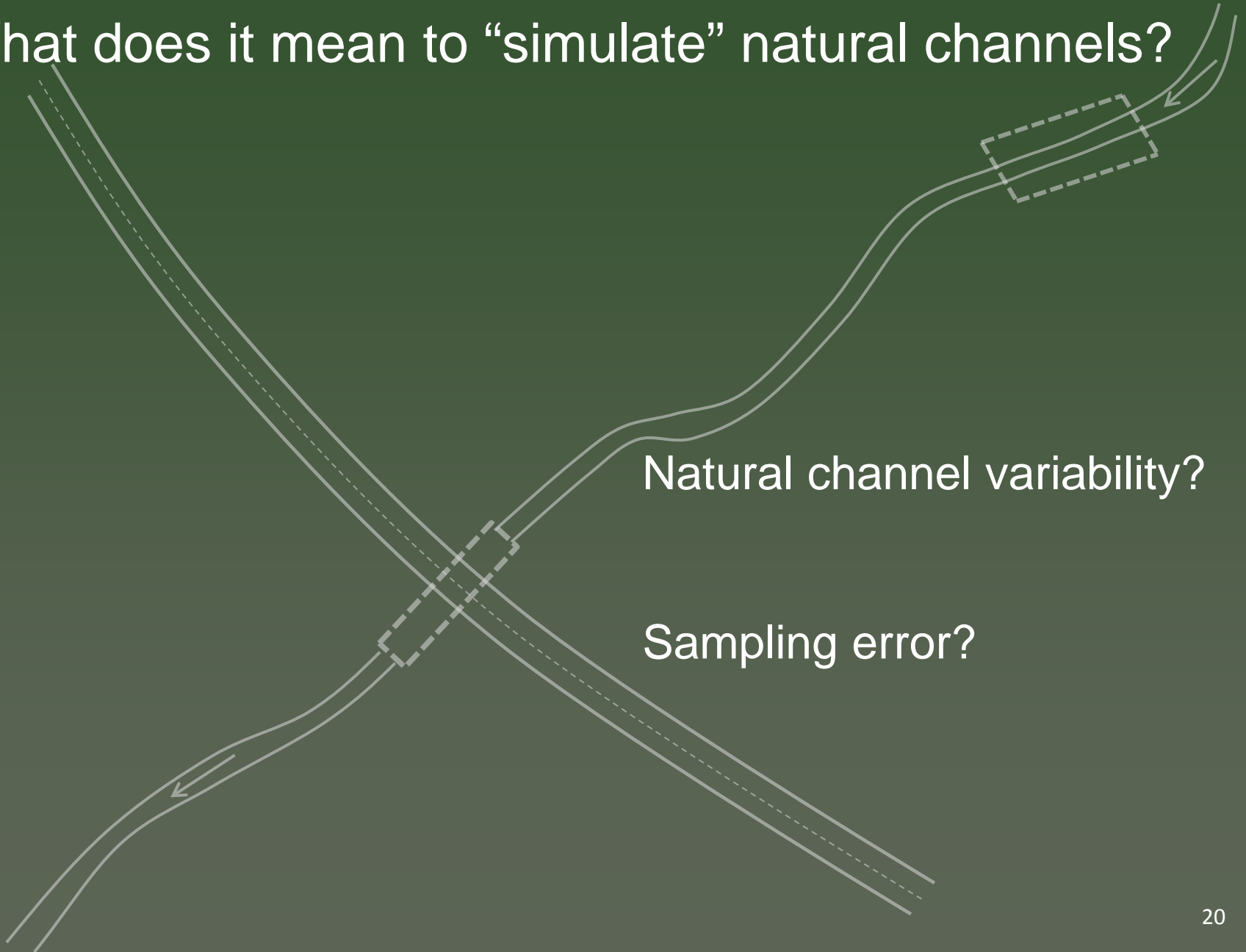
Channel structure doesn't form on its own inside a culvert: you have to build it in.

Flat cross section and profile: no thalweg or pools or riffles

No banks



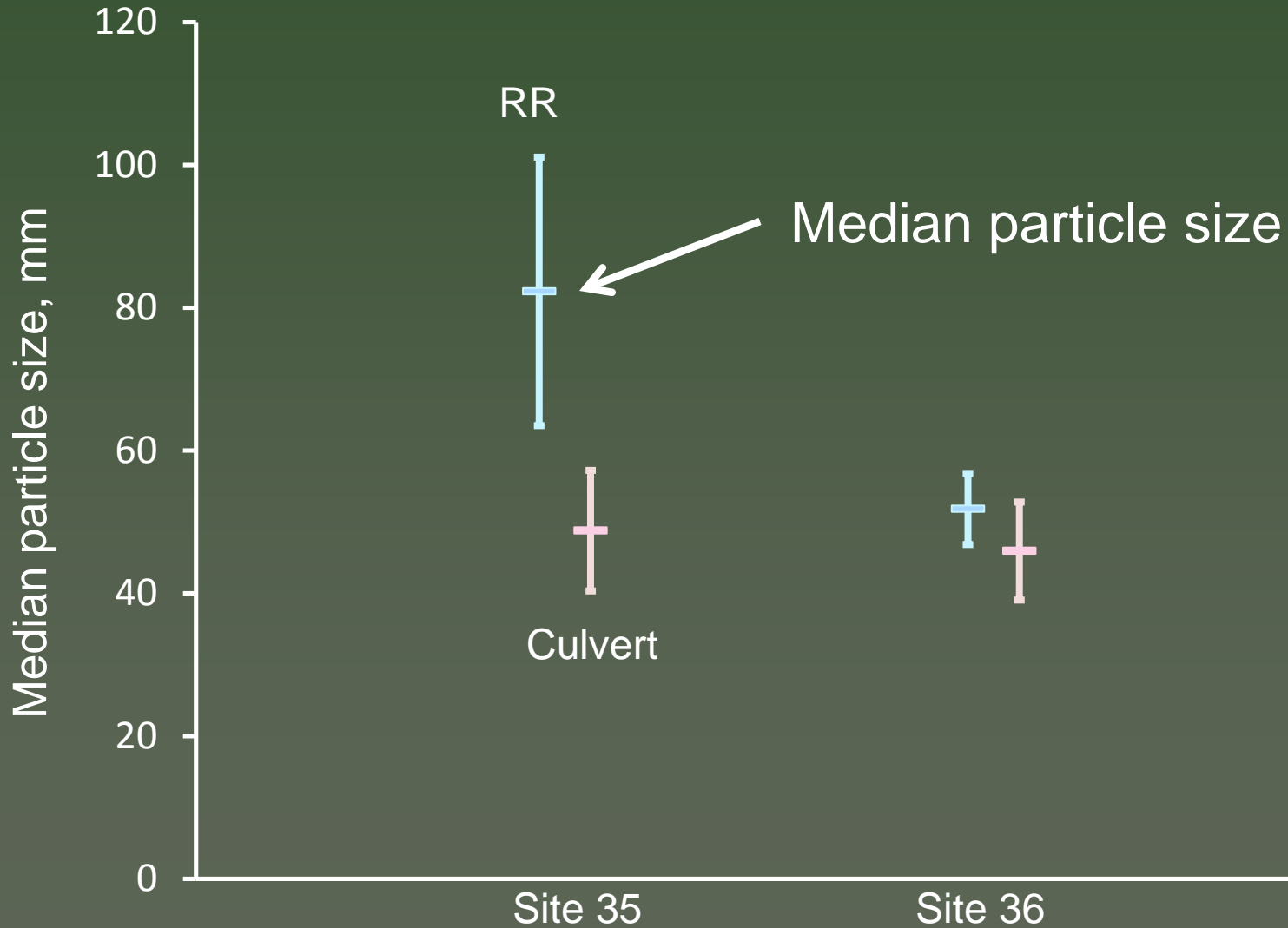
What does it mean to “simulate” natural channels?

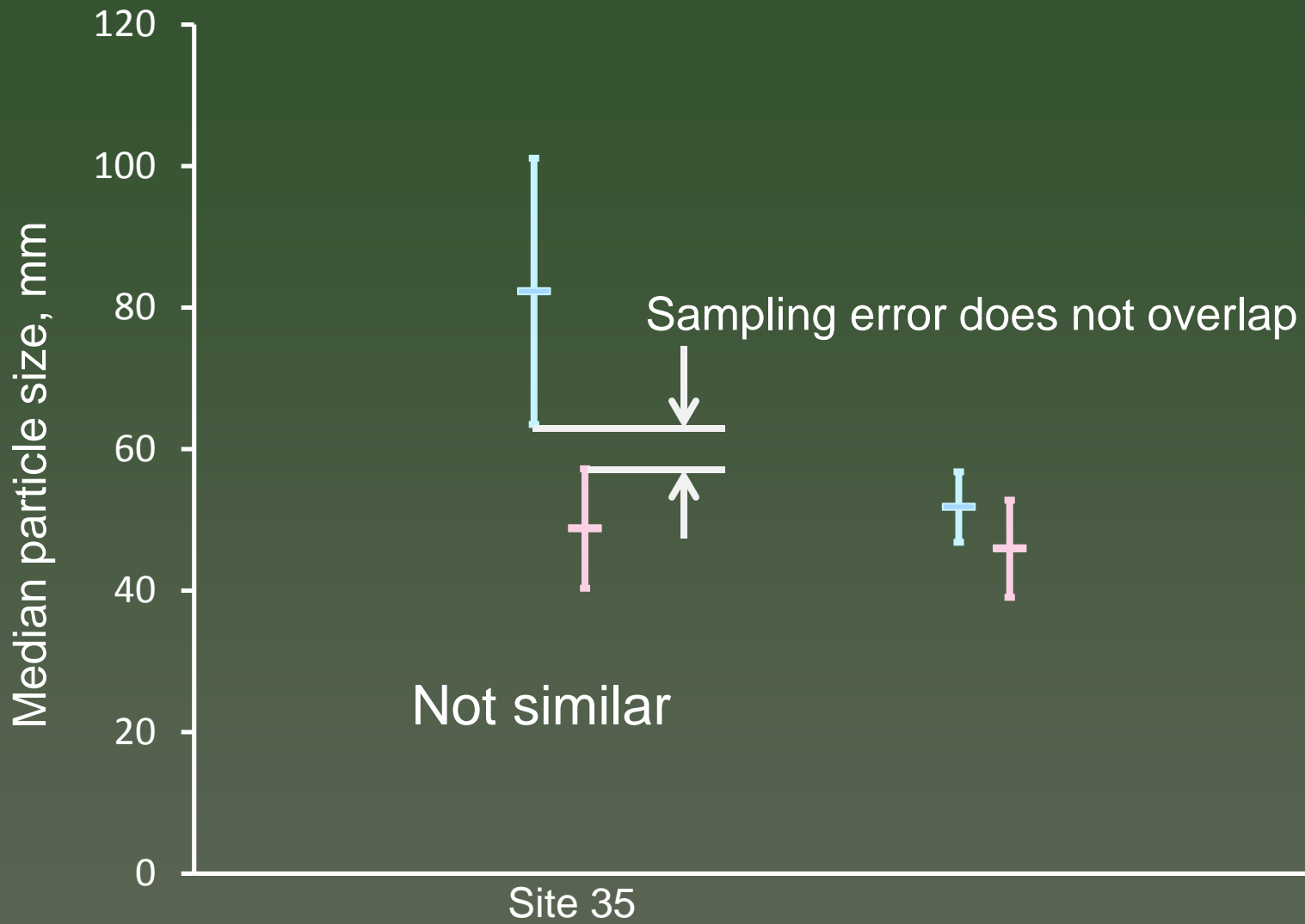


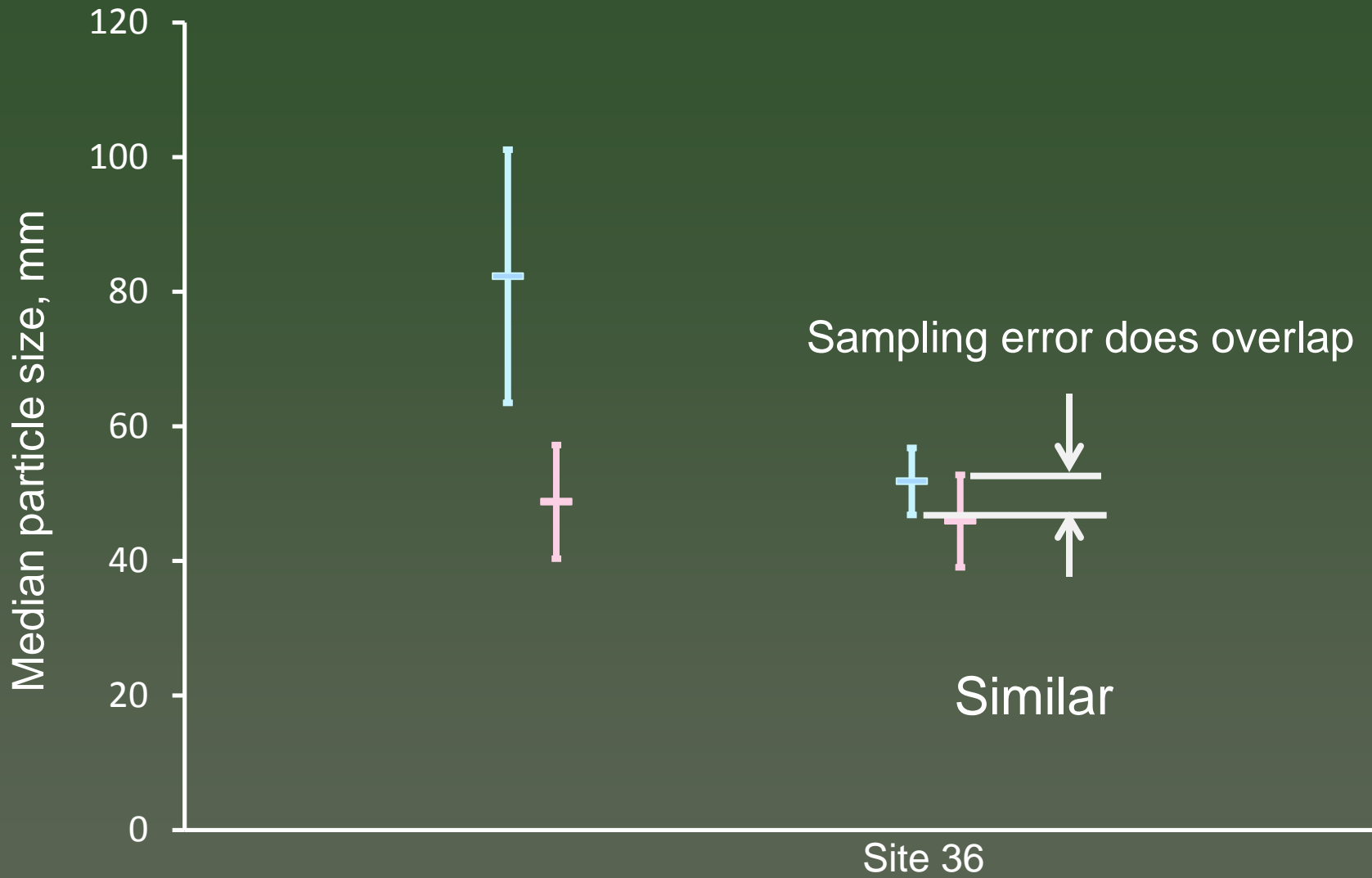
Natural channel variability?

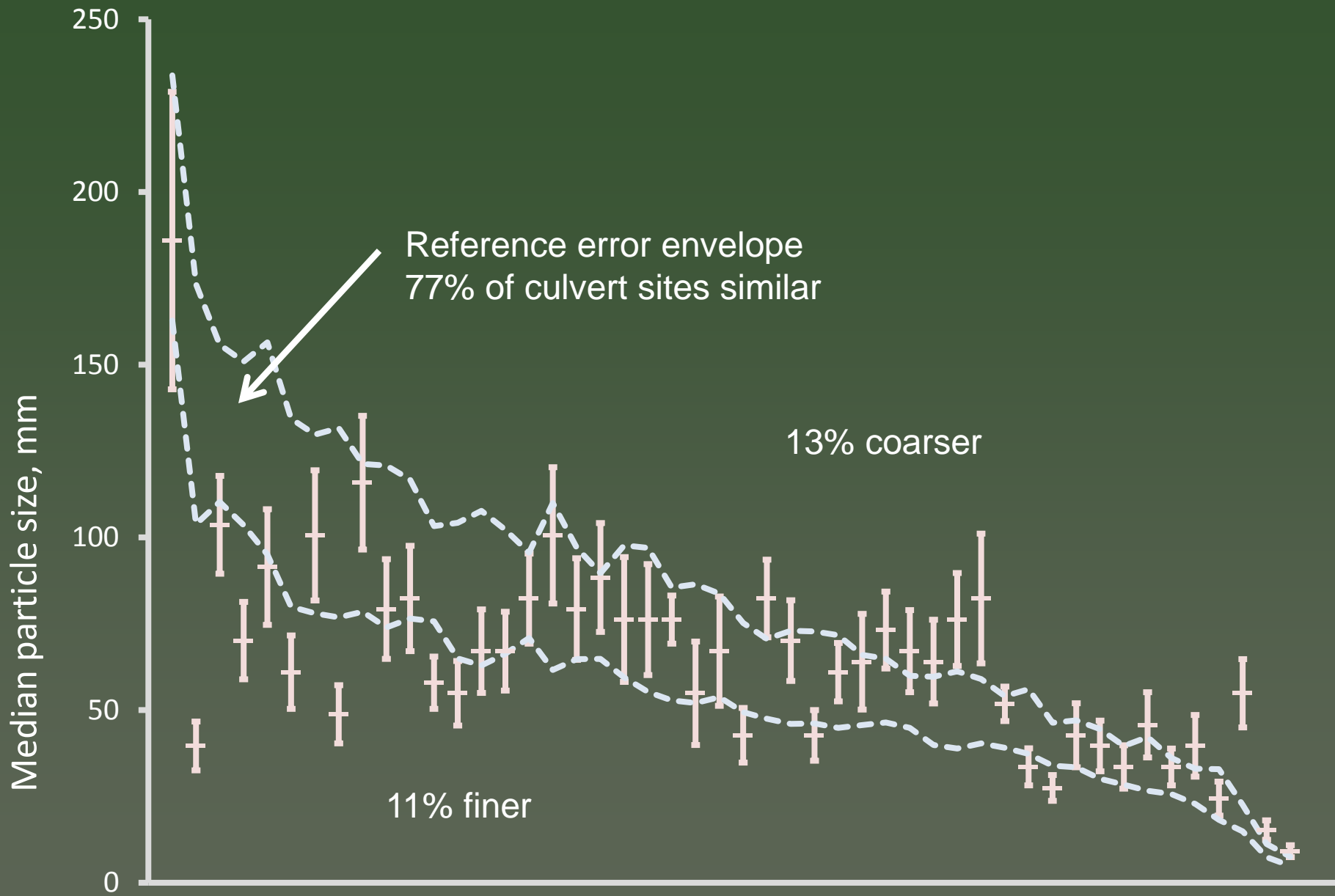
Sampling error?

To “simulate” means to get close enough that we can’t measure the difference with certainty.









Median Particle Size

	Sites
Above	11%
Similar	77%
Below	13%

Slope ratio

Hydraulic Radius

Width ratio

Q_{100} width

Thalweg Depth



Median Particle Size

	Sites
Above	11%
Similar	77%
Below	13%

ANOVA p

Slope ratio 0.009

Hydraulic Radius 0.98

Width ratio 0.13

Q_{100} width 0.41

Thalweg Depth 0.54



Culverts sloped $> 1.25 \times$ channel slope fail to simulate the adjacent channel



Water surface slope = 0.5%



3%

Generally, stream simulation culverts were similar ($p>0.05$) for sediment size, high flow velocity and top width.

They were *not* similar for cross sectional shape, profile variation and other hydraulic parameters.



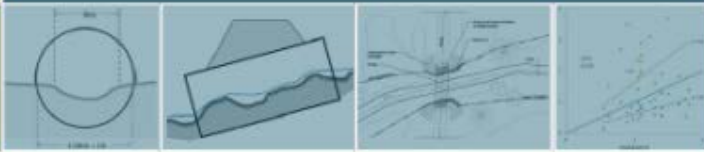
To simulate means to come close enough that we can't measure the difference with certainty.

Stream simulation culverts can simulate some stream processes (design successful),

but we must build in channel structure at the time of construction (implementation unsuccessful).



2013



Water Crossing Design Guidelines

Washington Dept. of Fish and Wildlife





WDFW Habitat Program

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