OKLAHOMA STATE UNIVERSITY
Biosystems and Agricultural Engineering
Plant and Soil Sciences

Estimating Sediment and Phosphorus Loads from Streambanks in the Barren Fork Creek Watershed

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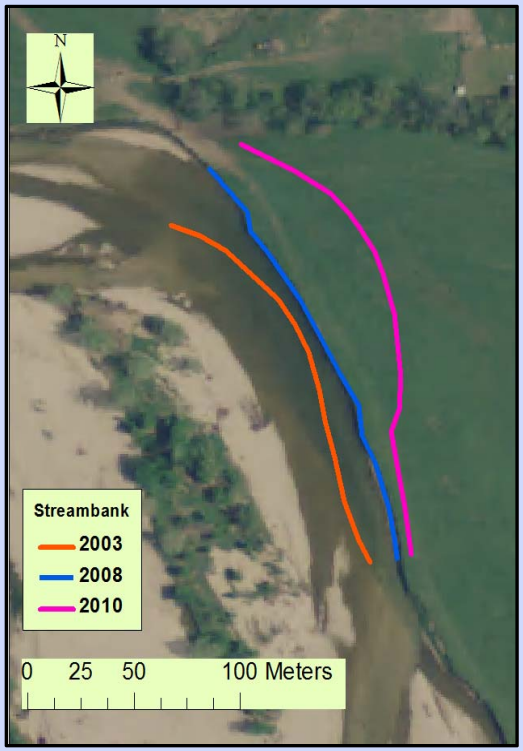
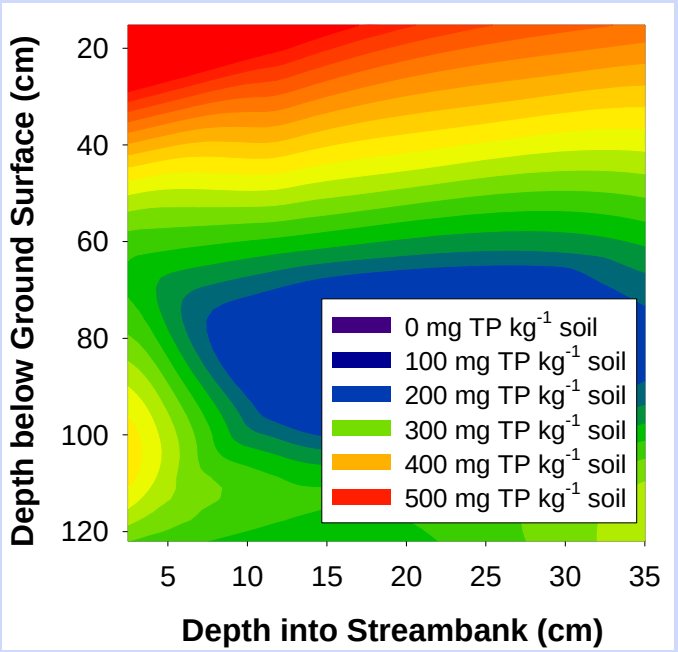
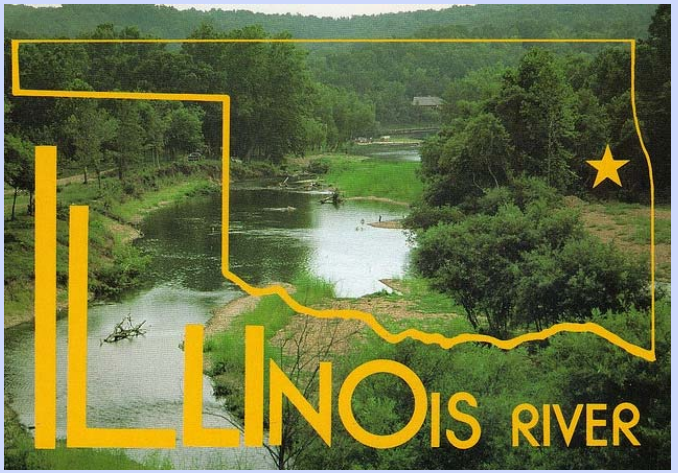




What is the Issue?

- Composite banks:
  - Erode by fluvial undercutting of gravel
  - Failure of cohesive topsoil layer

- Sediment and phosphorus (P) loading from streambanks unknown

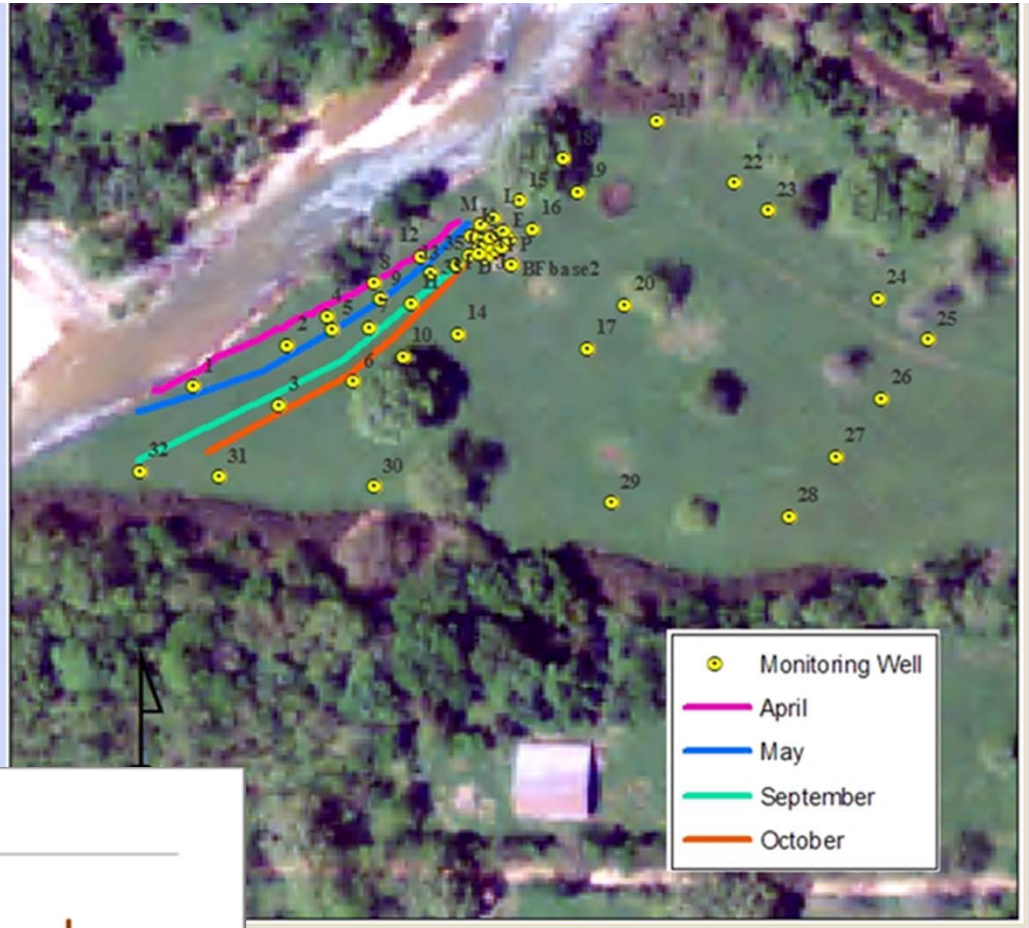


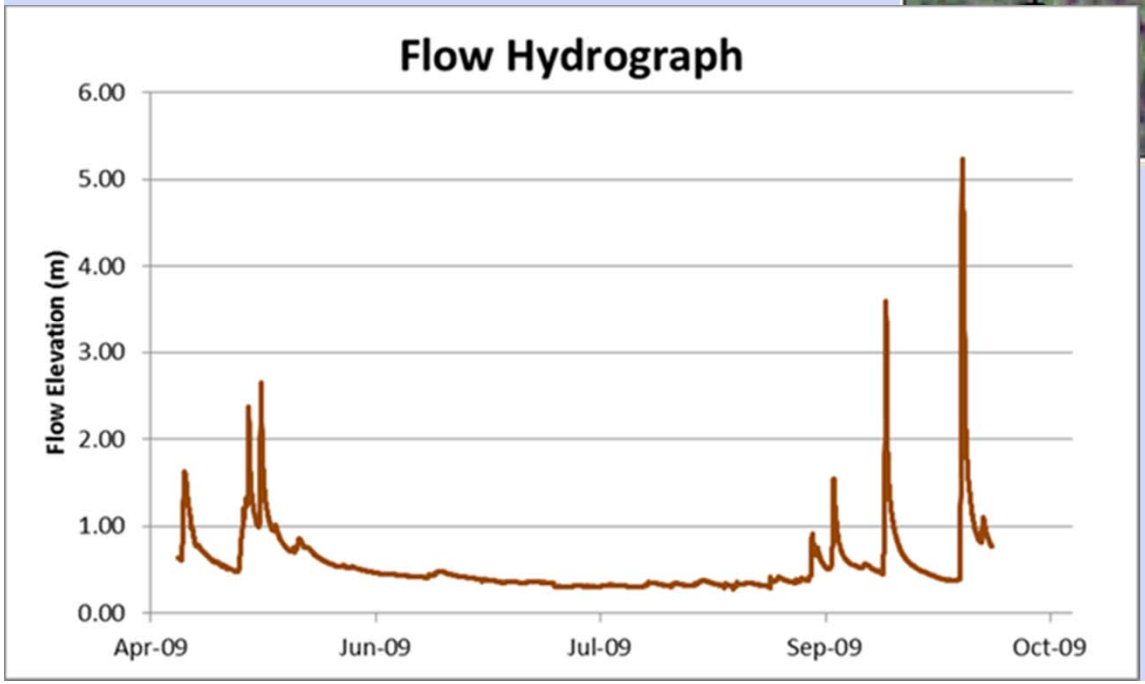
April 3rd, 2009

May 2nd, 2009

Sept. 23rd, 2009

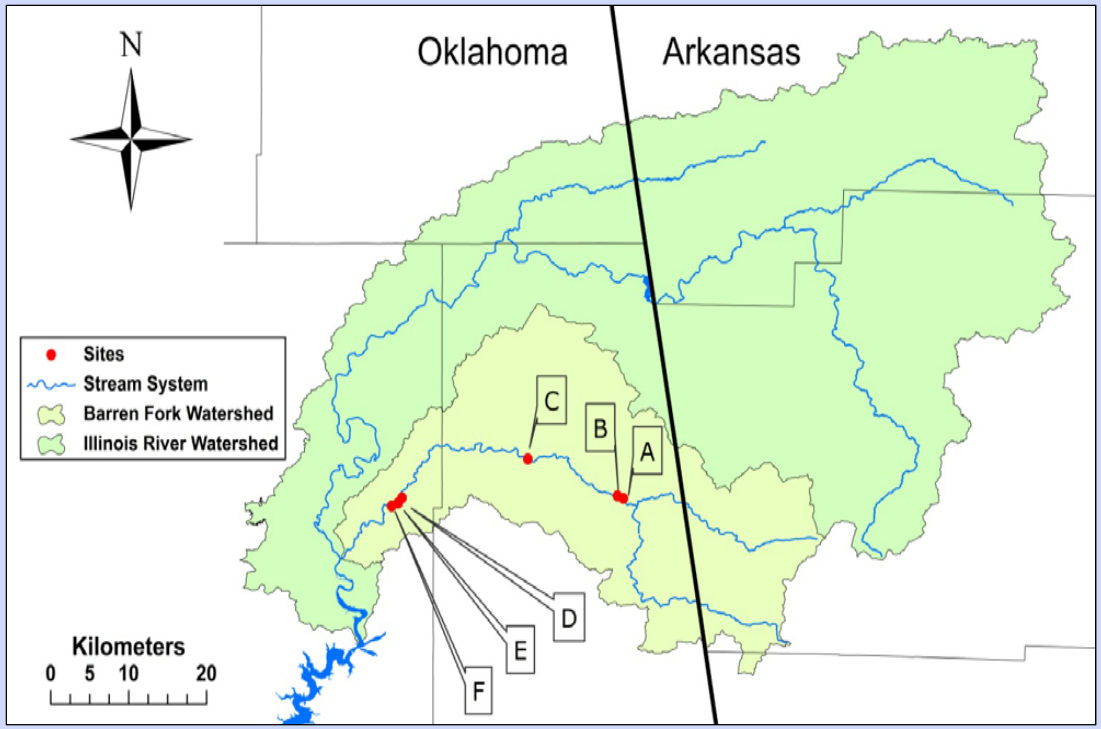
7.8 to 20.9 m of bank retreat during the summer of 2009 over a 100 m reach



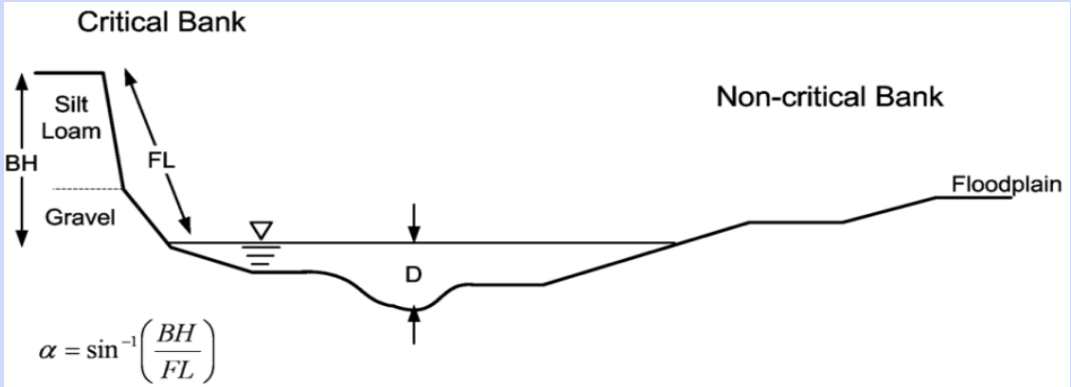


Objectives

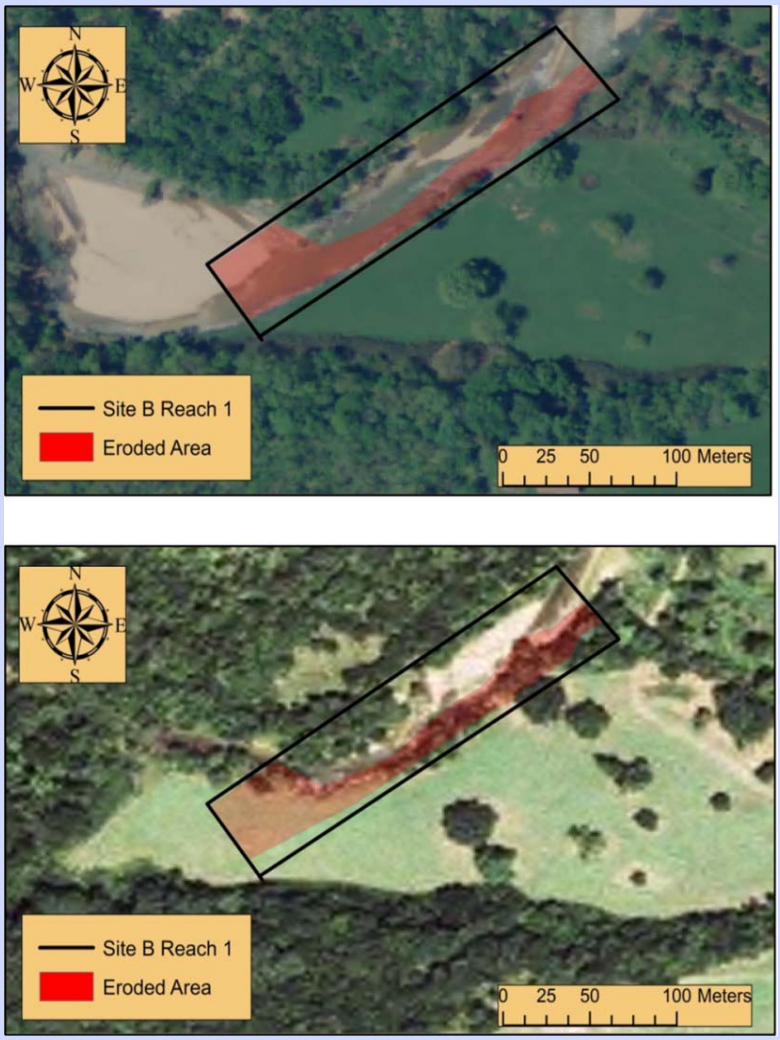
- Estimate sediment and P loading from streambanks in the Barren Fork Creek
- Quantify impact of riparian protection on sediment and P loading rates



Typical Bank Profile



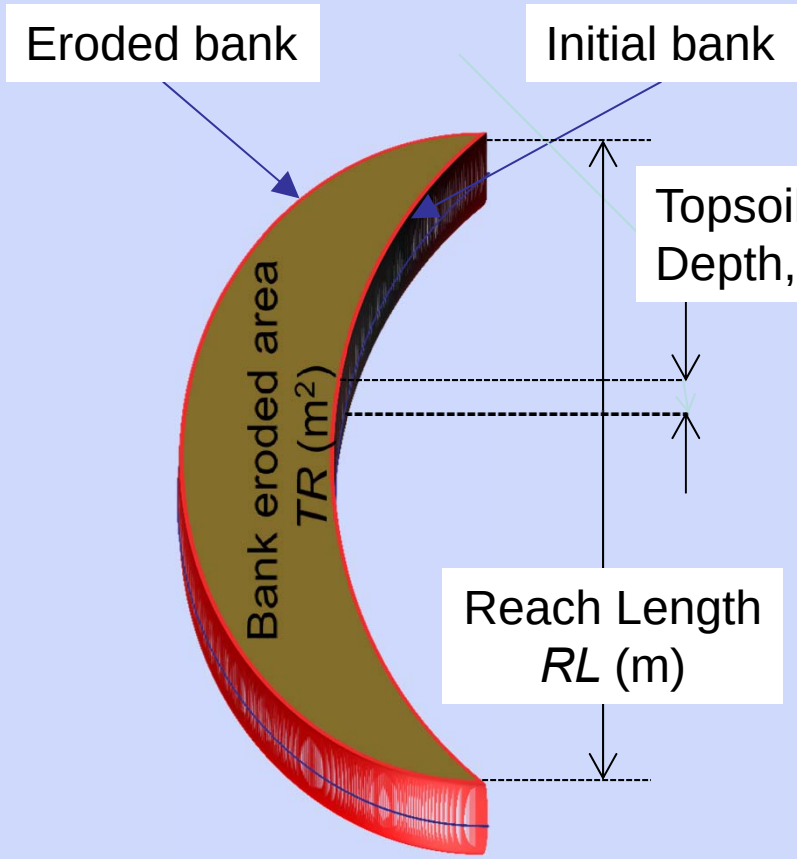
Streambank P Loading



Eroded Area

- NAIP Aerial Imagery
  - 2003 (below)
  - 2008 (Above)
- Digitize bank location
- Calculate area difference

Eroded Area and Loading



Reach-averaged bank retreat:

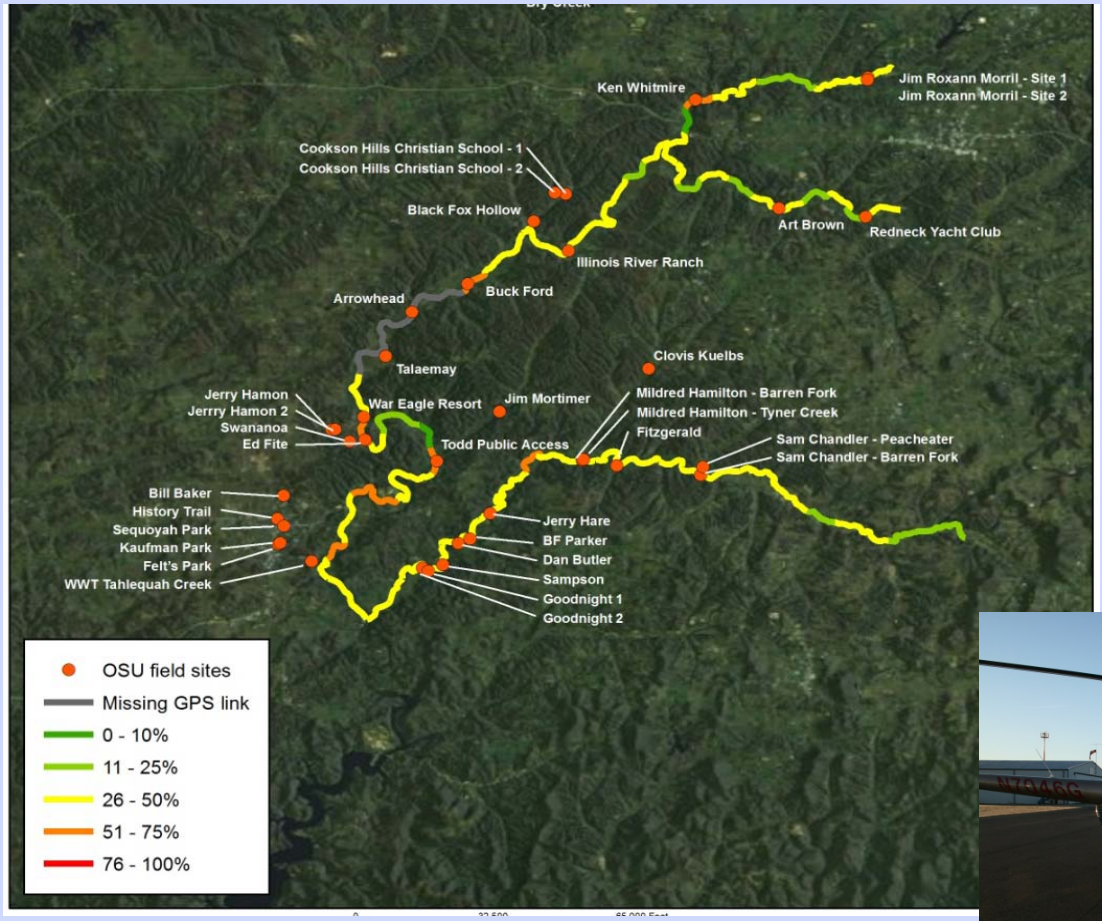
$$SR\ (m) = TR \div RL$$

Reach sediment loading:

$$SL\ (kg/yr) = RL \times SR \times D_{ts} \times \rho_b$$

$\rho_b \approx 1500$ kg/m

Eroded Banks in Watershed



P Sampling from Streambanks

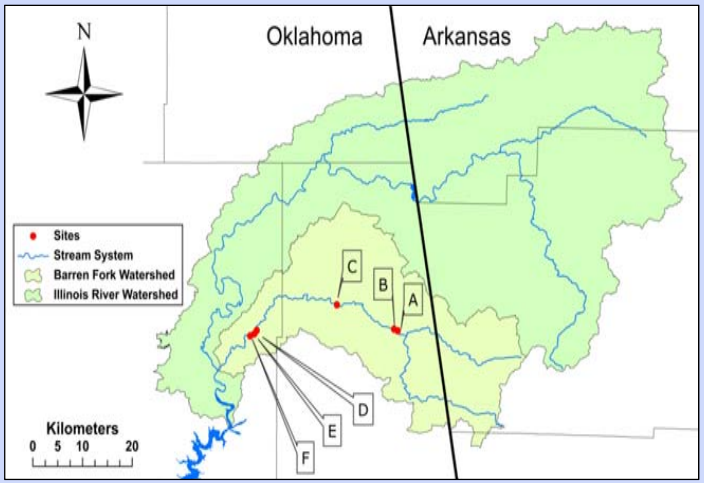
- Cores to 1 m depth
  - 5 cm below GS
  - 15 cm below GS
  - Center of topsoil
  - Topsoil/Gravel interface
- Cores divided
  - 0-5 cm
  - 5-50 cm
  - 50-100 cm
- pH, EC, WSP, Mehlich III Soil P, TP

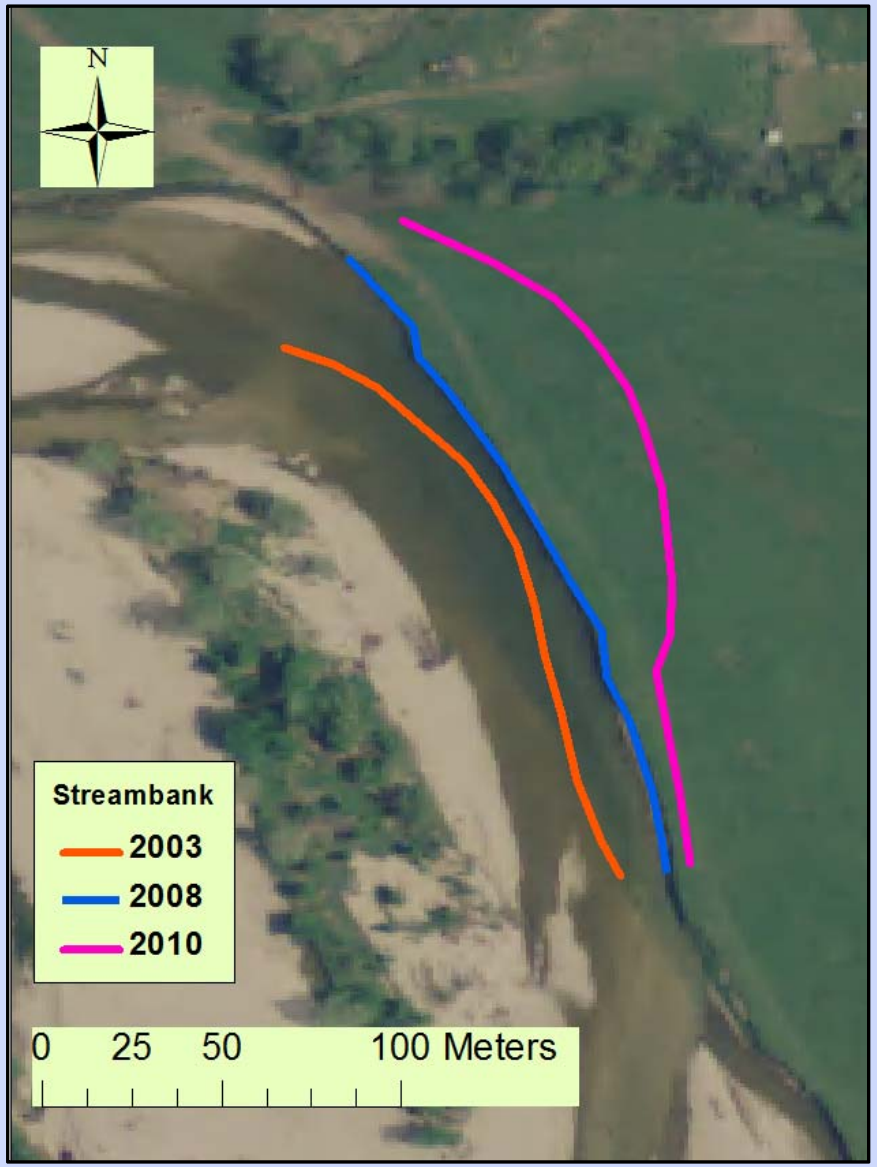
P Sampling from Streambanks

- WSP = soil P concentration readily available to the water phase (8.6 mg P/kg soil)
- DPS = degree of phosphorus saturation (25%)
- Melich III Soil P = typically used as standard for agronomic practices (agronomic optimum = 32.5 mg/kg)
- TP = total P content in the soils, not necessarily correlated to WSP

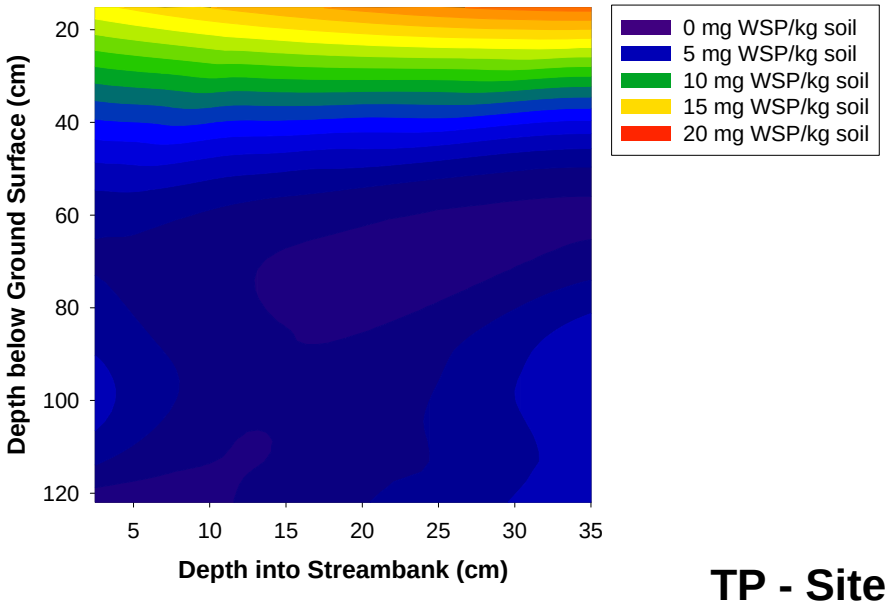
Site A - Unprotected

Watershed Area: 363 km^2
Reach Length: 190 m
Average of 33.7 m of lateral migration

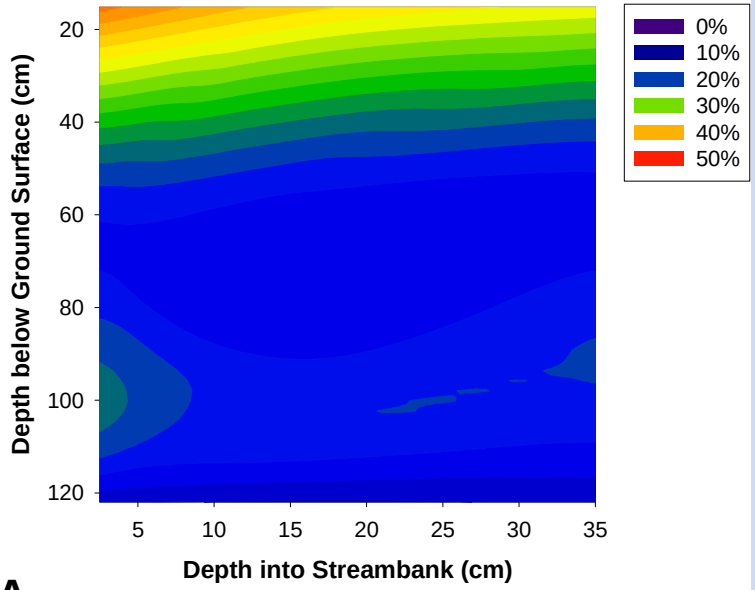




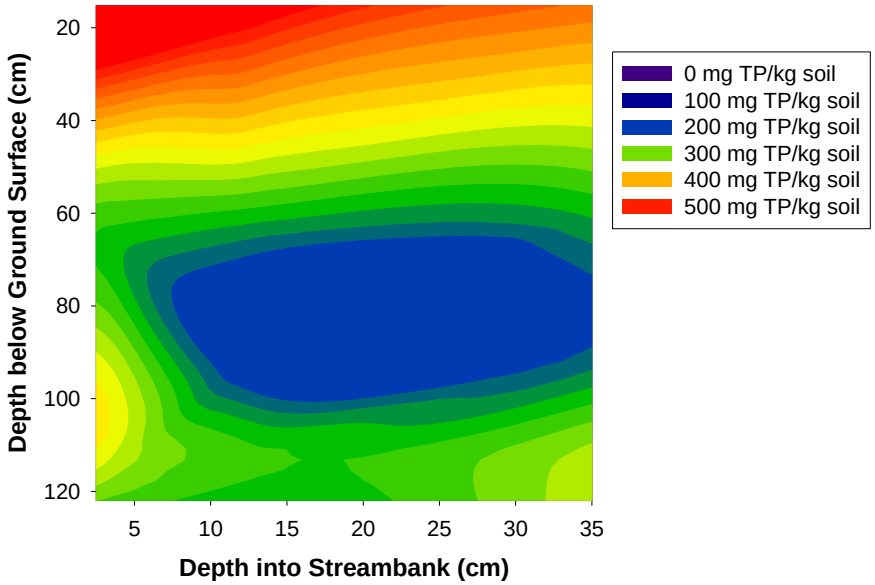
WSP - Site A



DPS - Site A

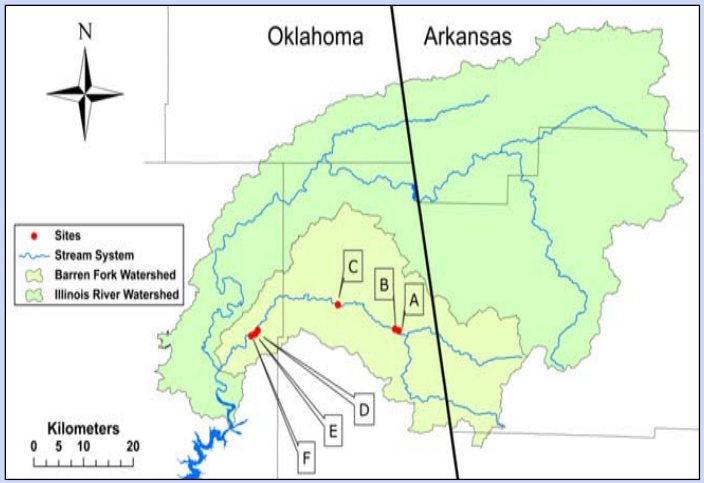


TP - Site A

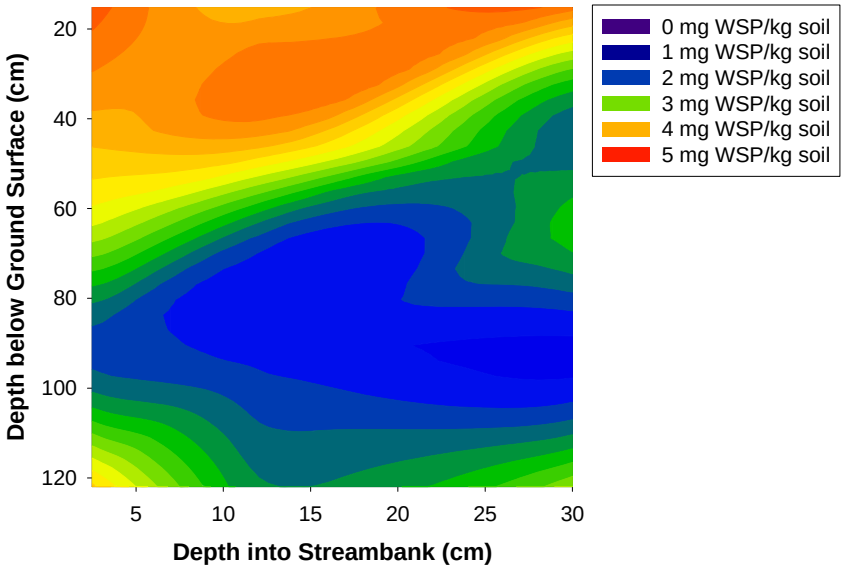


Site C – Protected (Historically)

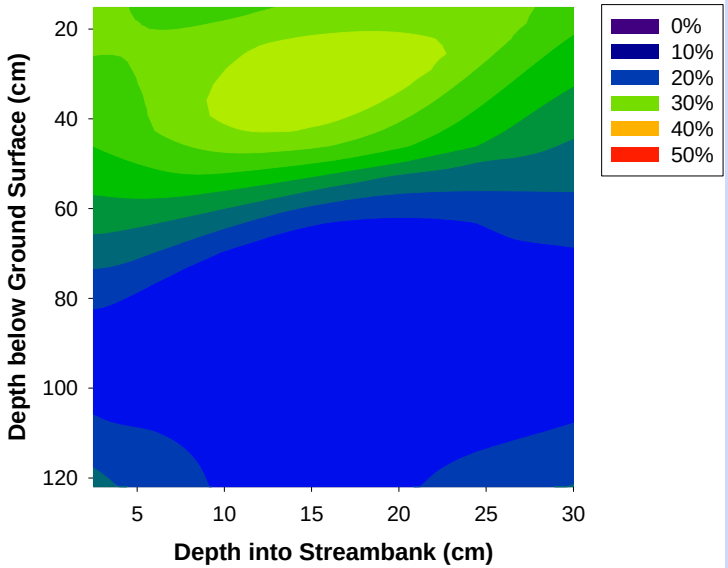
Watershed Area: 544 km^2
Reach Length: 138 m
Average of 7.3 m of lateral migration



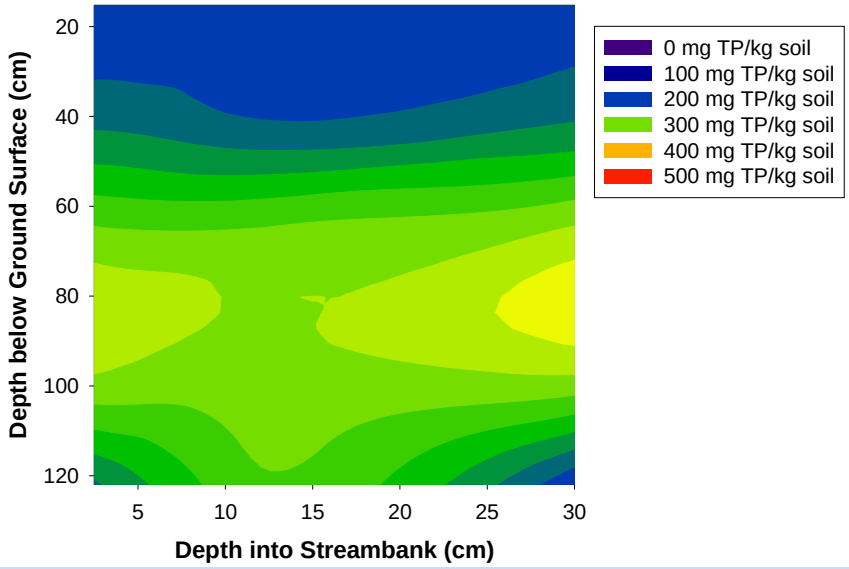
WSP - Site C



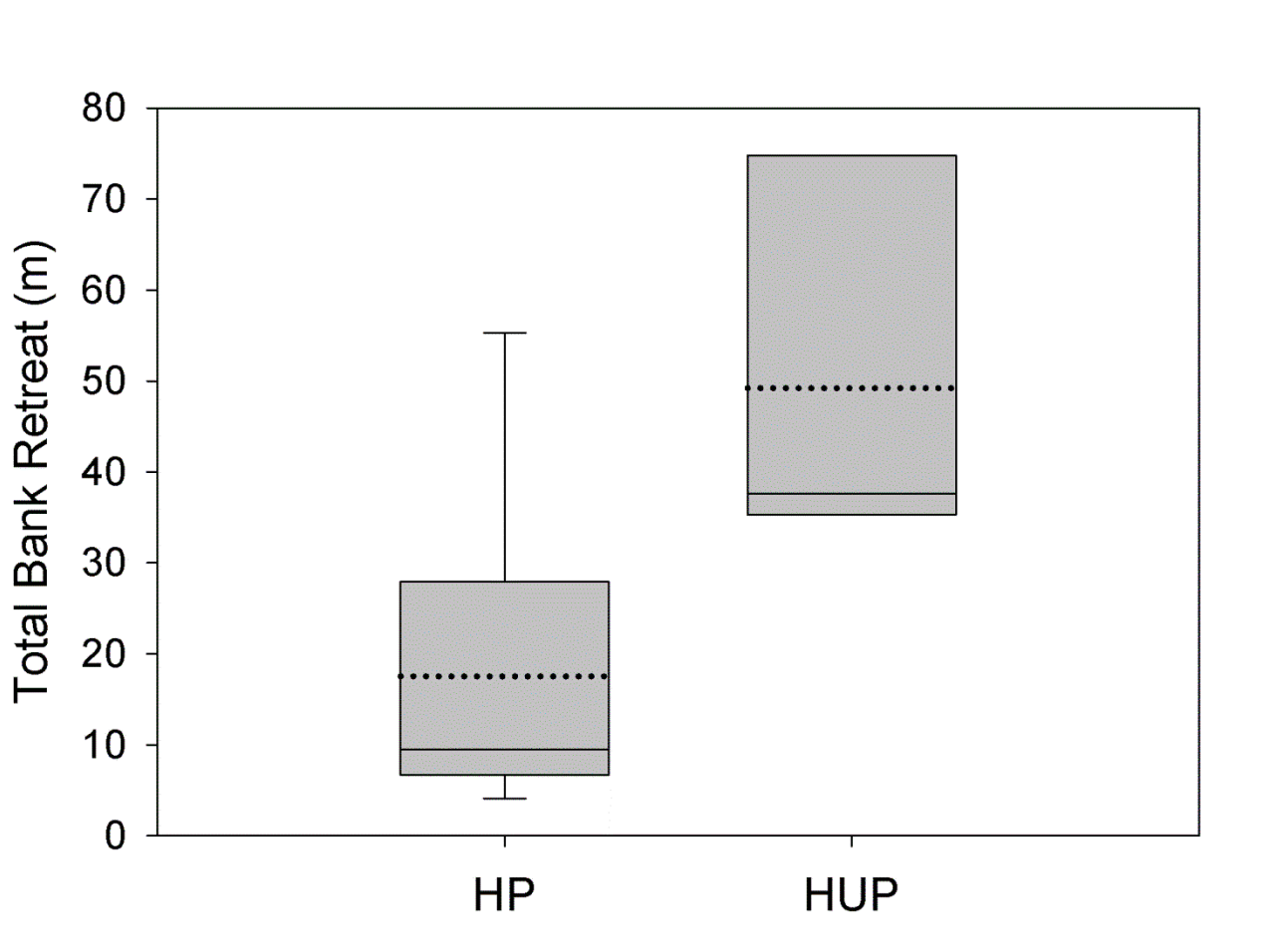
DPS - Site C



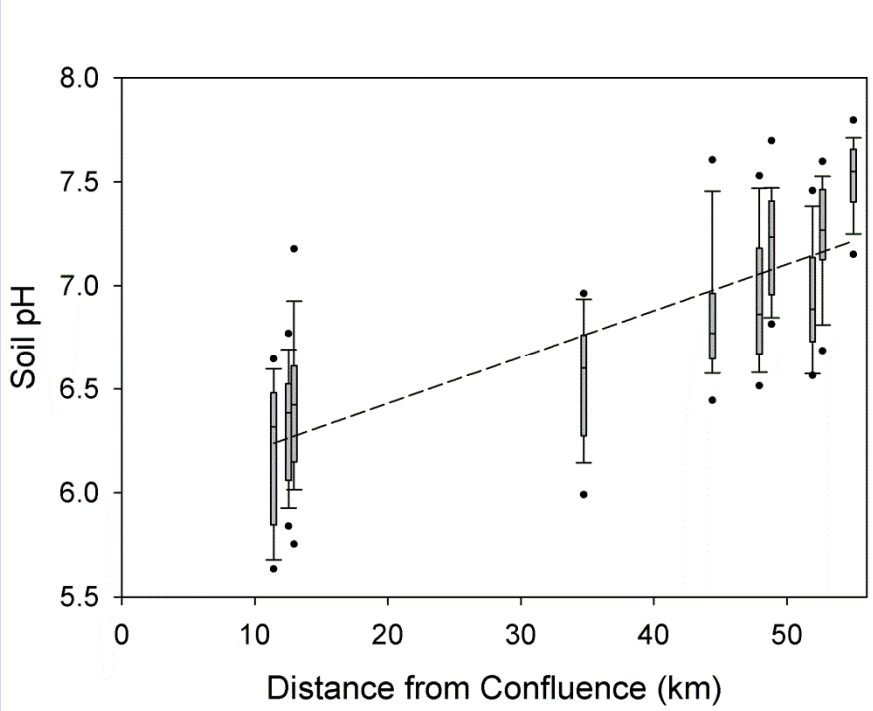
TP - Site C

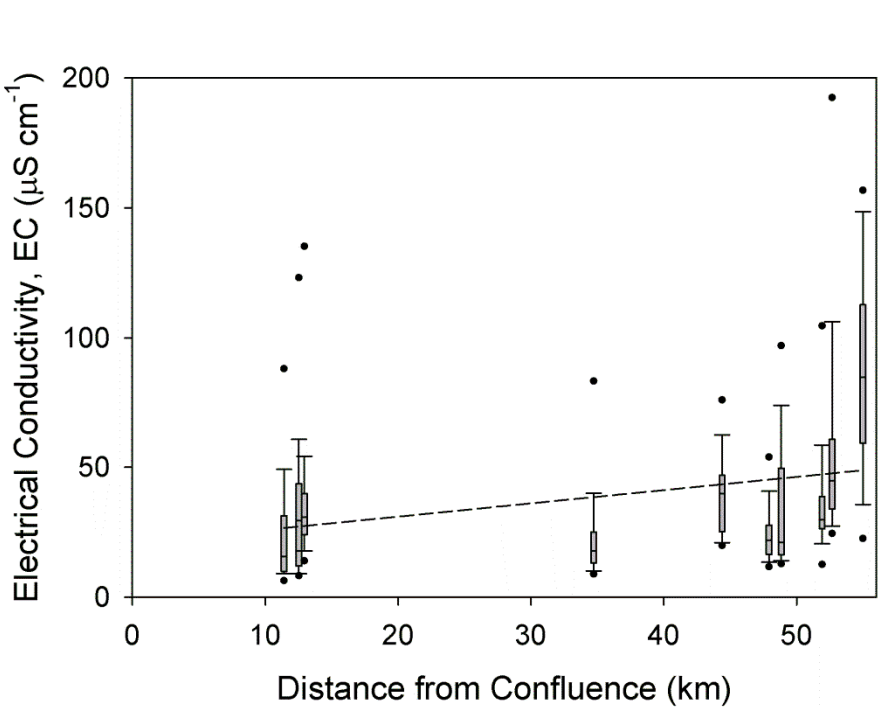


Impact of Riparian Protection



Longitudinal Patterns





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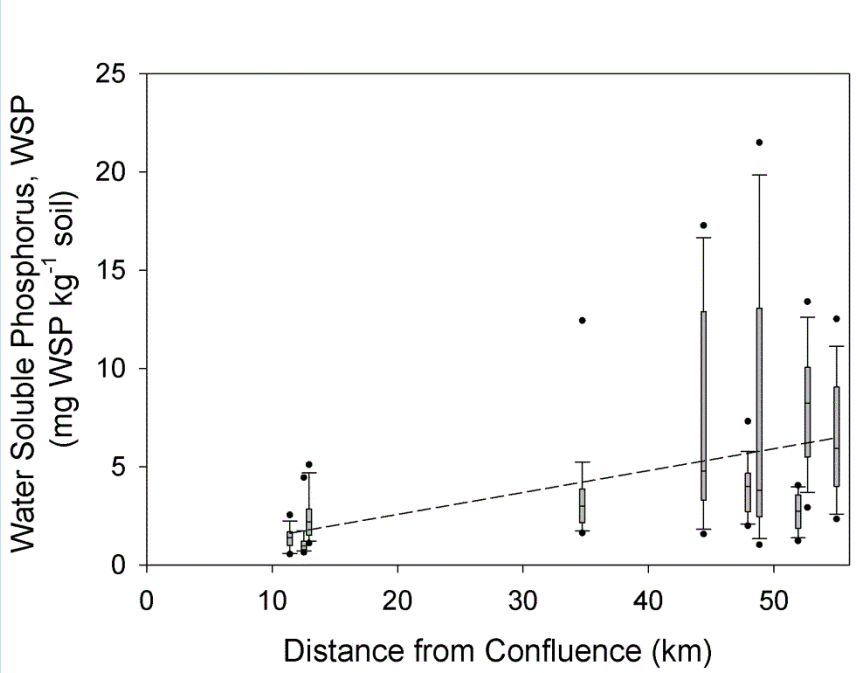
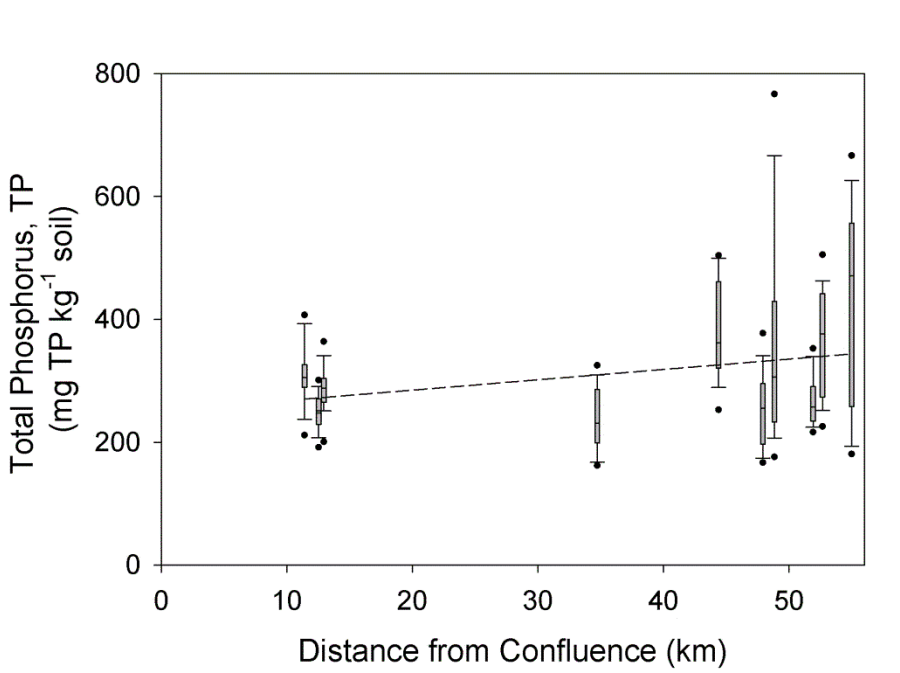
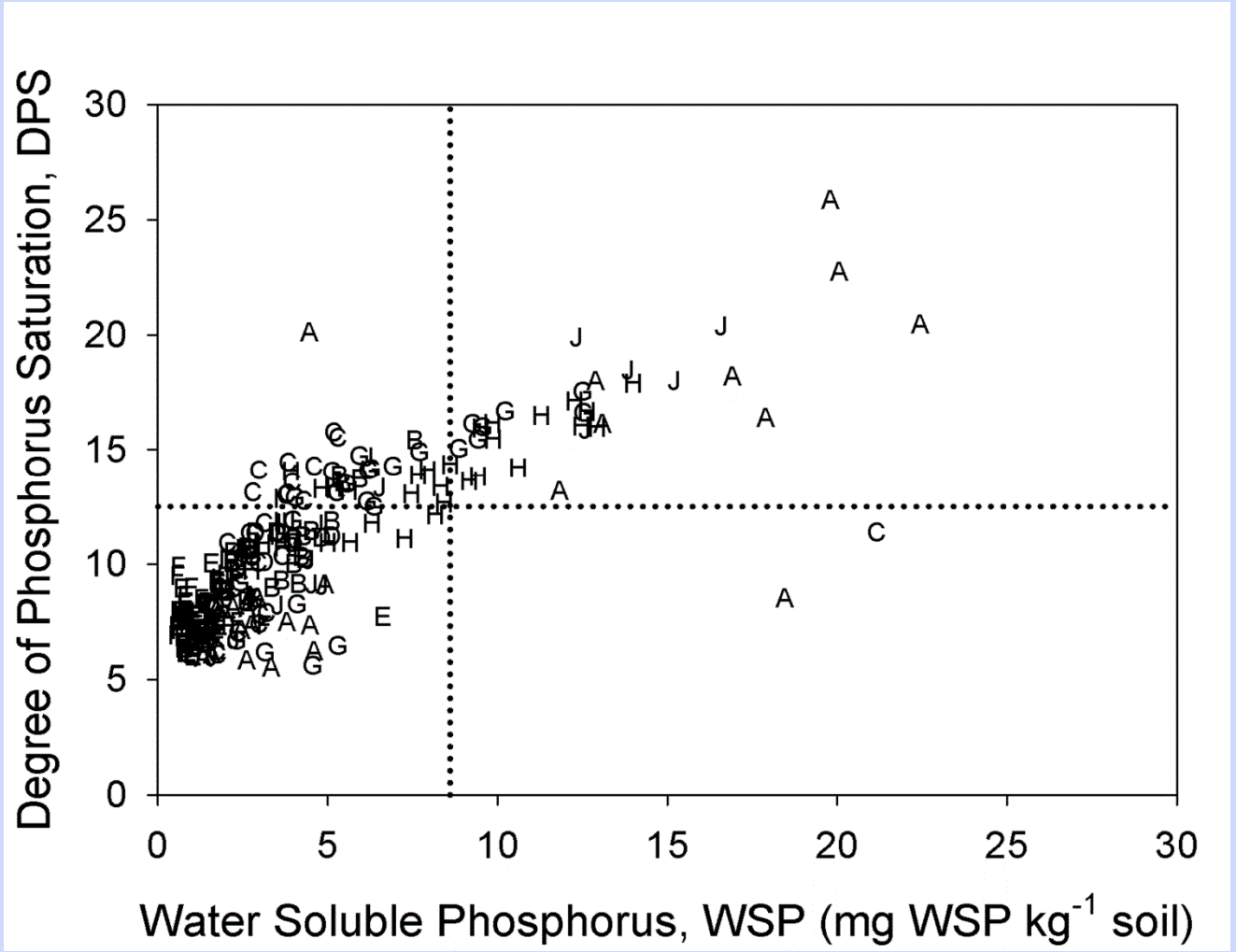


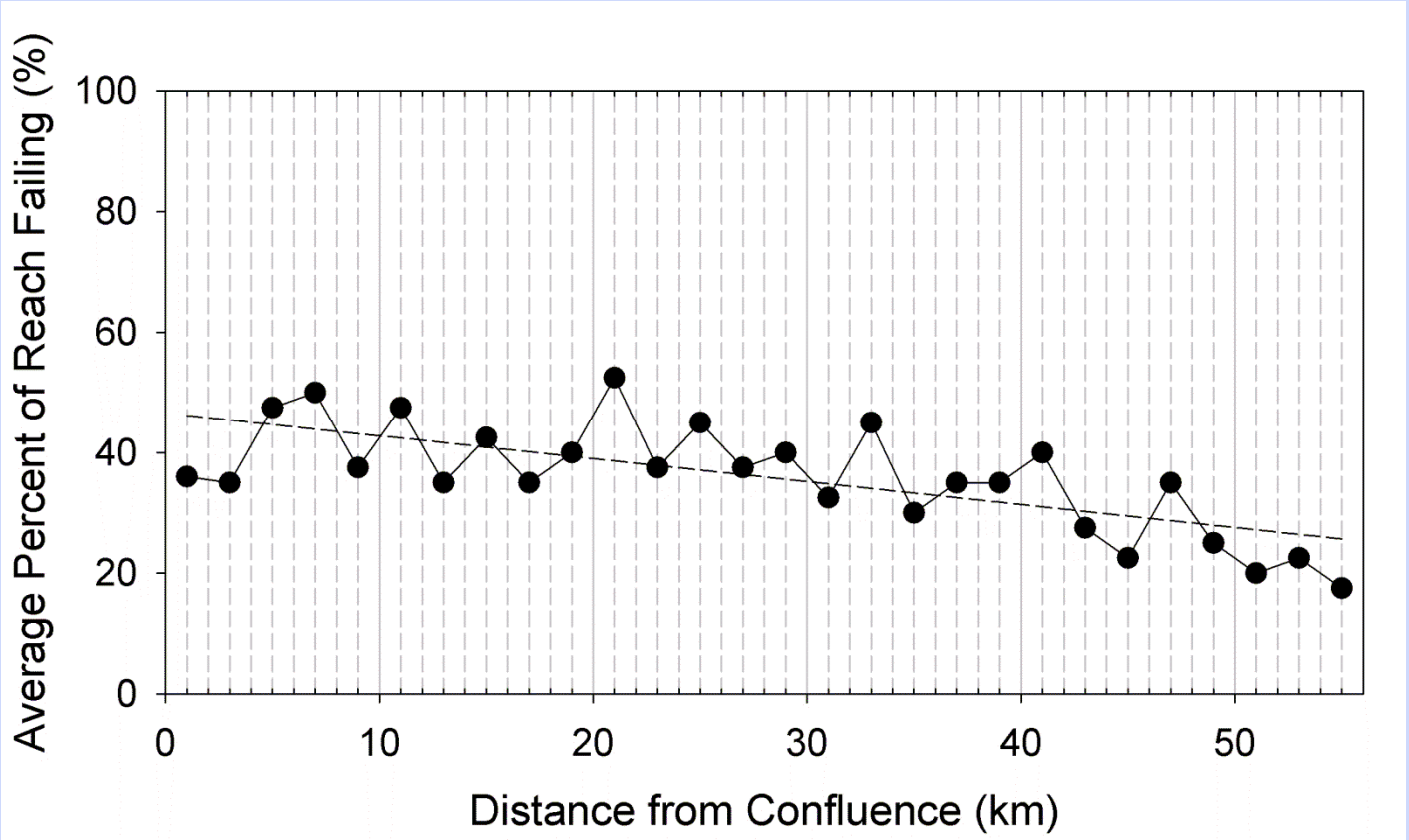


DPS vs. WSP


Degree of Phosphorus Saturation, DPS
0
5
10
15
20
25
30
Water Soluble Phosphorus, WSP (mg WSP kg-1 soil)

Percentage of Stream Reach Failing

- Stream length ~55 km
- 11 to 50% of reach failing - Average of 36% failing



Loading Rates

- LOADEST (USGS, Runkel et al., 2004)
- ~10-15% of dissolved P load from streambanks
- Greater than 100% of TP from streambanks
- 3x to 5x reduction in contributed WSP and TP per m of bank per year with riparian protection

Conclusions

- Longitudinal trends in soil chemistry, soil P concentrations, and streambank erosion rates
- 10% of WSP load from streambanks
- TP loads on the same order of magnitude
- 3x-4x reduction in sediment with riparian protection; 3x-5x reduction in P with riparian protection

- Future work – Spavinaw Creek!

Questions?

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