SPATIAL VARIABILITY IN SOIL PHOSPHORUS

OLIVIA GROVE

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THE PROBLEM

Photo via Idaho DEQ

- High phosphorus (P) loading to Fernan lake
  - Toxic blue-green algae (cyanobacteria)
  - eutrophication
- CDA experiencing increased P loading ←
  - Potential for eutrophication in the future

WHY IS IT IMPORTANT?

- UNPOTABLE WATER, CARCINOGENS, FISH KILL
- CYANOBACTERIA & EUTROPHICATION RESTRICTS WATER USE
- TOURISM
- HEAVY METALS IN LAKEBED SEDIMENTS
  - 83 MILLION TONS ZINC, LEAD, ARSENIC, CADMIUM

RESEARCH

https://www.usask.ca/agriculture/plantsci/winter_cereals/

- Where is the phosphorus coming from in the CDA mixed watershed?
  - Forest, agriculture
    - Thick litter layer, ag fertilization applications
- How do we manage it?
  - Idaho DEQ and Tribe

P BACKGROUND

- Particulate
  - P is attached to mineral soil
  - Can move through soil erosion and sediment transport thru landscape
- Soluble
  - Most readily available to plants and algae (bioavailable)
  - Moves with water – transported through surface runoff

OBJECTIVES

- Compare soil P concentrations in forest and ag land types in the CDA basin
- Identify drivers of spatial variability of phosphorus within these land types

Most pertinent literature

- Modeling phosphorus transport in agricultural watersheds: Processes and possibilities
- by A N Sharpley, P J A Kleinman, R W McDowell, M Gitau, R B Bryant
  - Helped to understand Phosphorus transport

METHODOLOGY

- Idaho DEQ and Coeur d'Alene Tribe identified priority watersheds
  - Forest: Fernan, Wolf Lodge
  - Ag: Lake Creek
- Factors driving P distribution
  - Topography, litter thickness, vegetative growth, deposition (roads, creeks, buffers)

Sampling Protocol

- Used GIS to determine key sampling locations
- Sampled 0-7 cm depth
- Measured:
  - litter thickness, dry mass & soil pH and moisture content
  - Estimated Forest canopy cover
- Analyzed soil samples for:

  Total P

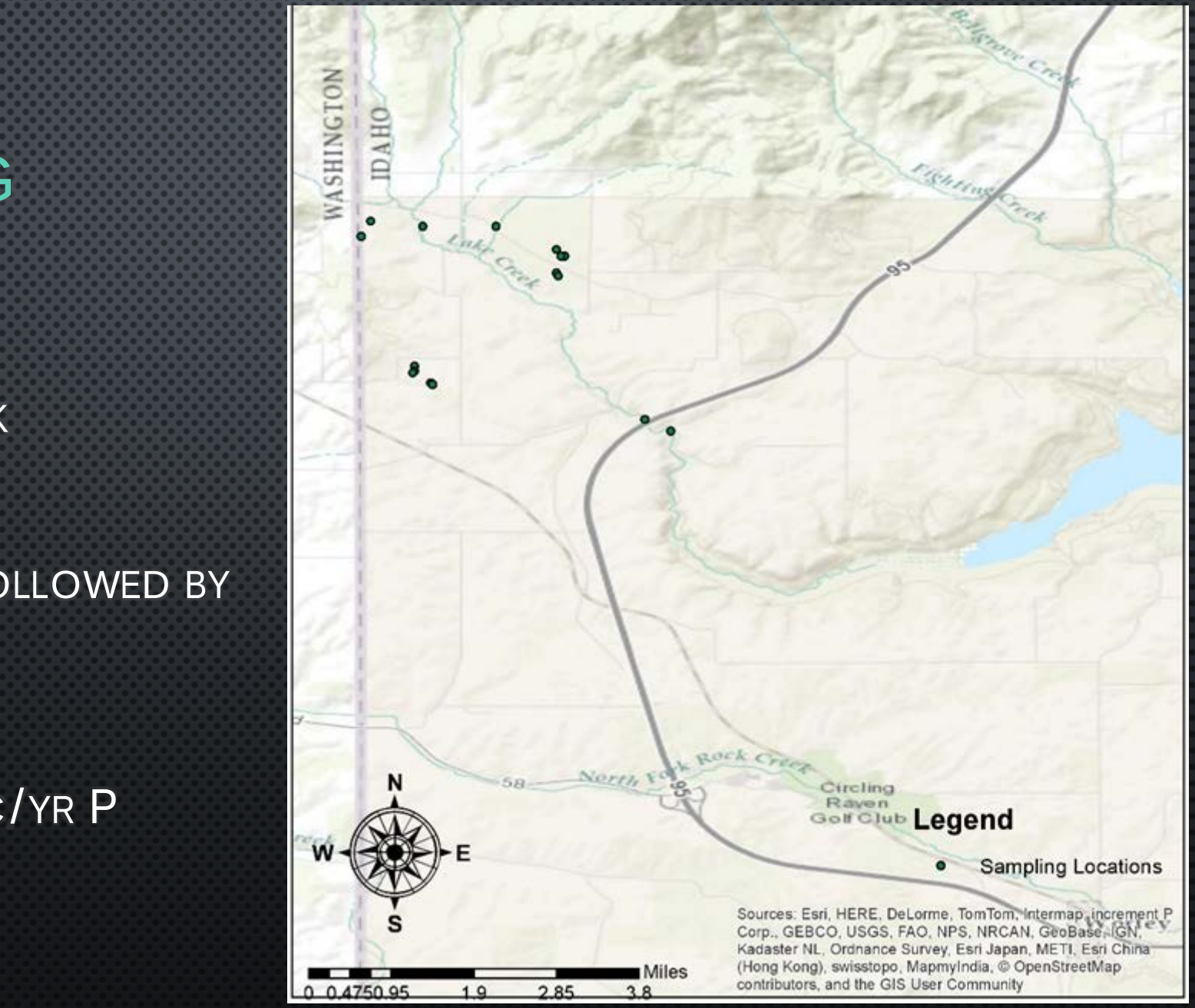
  Mehlich III, Water extractions

AG SAMPLING LOCATIONS

16 SAMPLES AT LAKE CREEK

6 -7 YEARS TIMOTHY HAY FOLLOWED BY 2 YEARS OF GRAIN

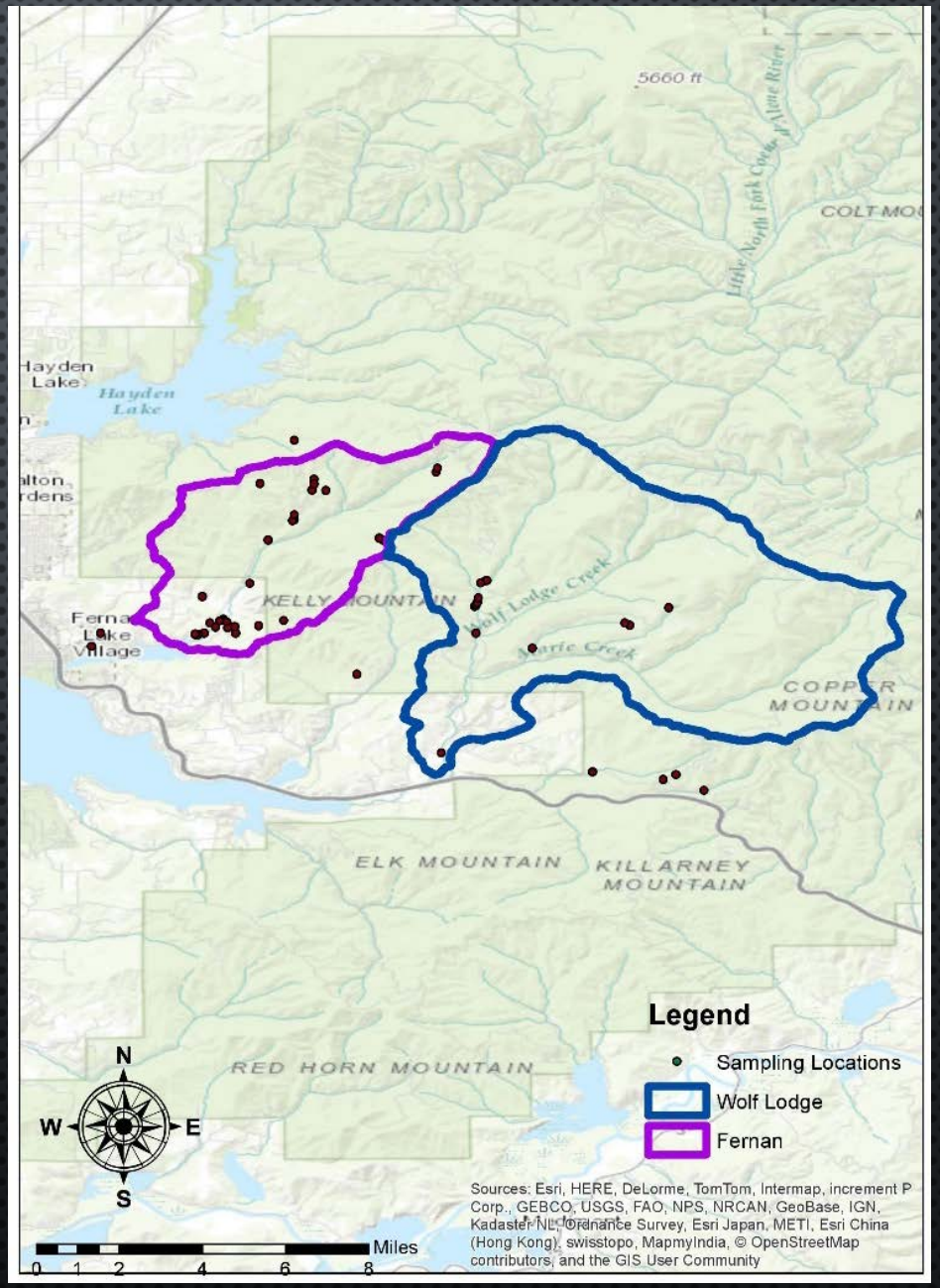
GROWER APPLIES 20 LB/AC/YR P



FOREST SAMPLING LOCATIONS

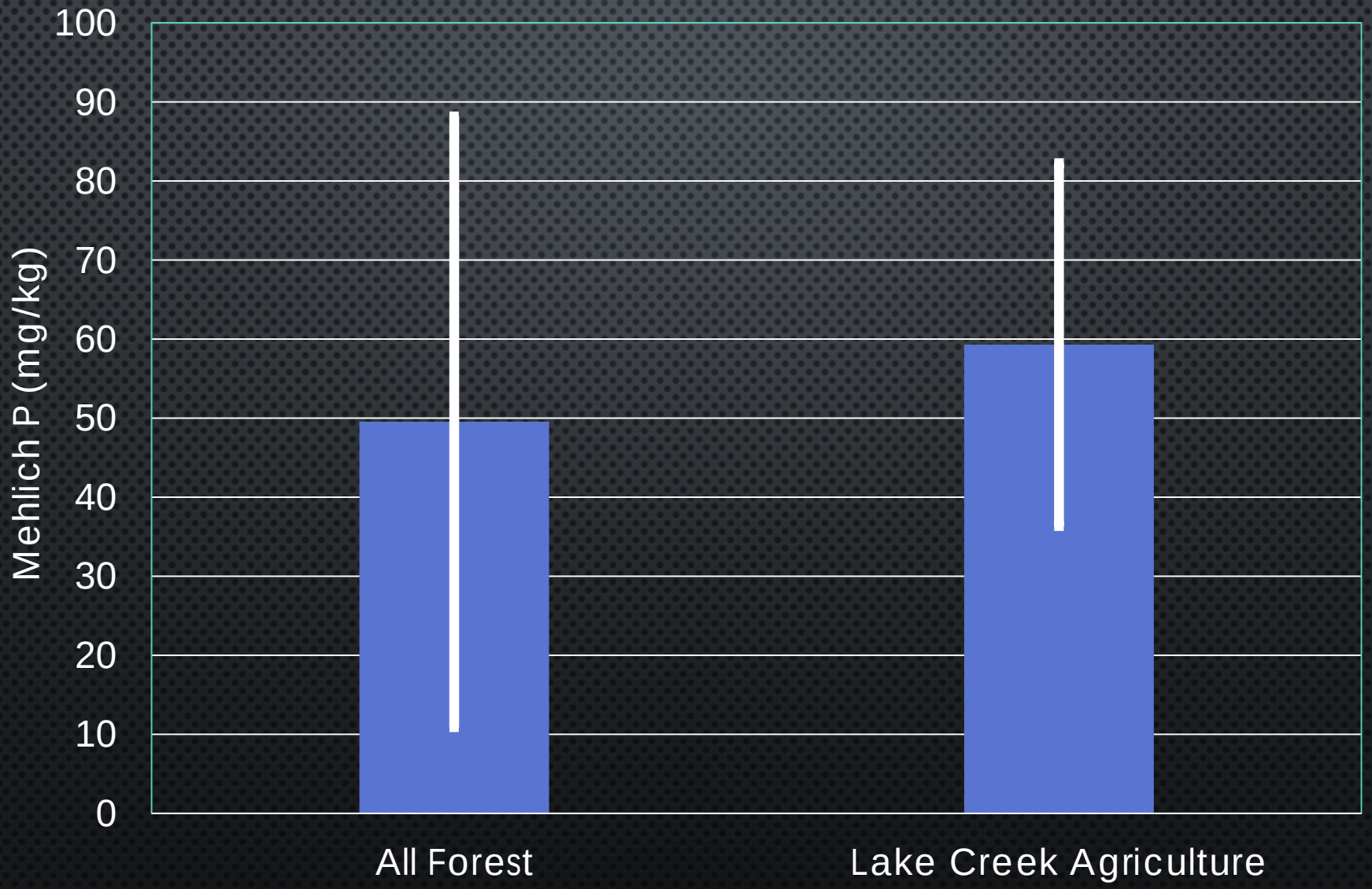
38 SAMPLES AT FERNAN CREEK

19 SAMPLES AT WOLF LODGE CREEK



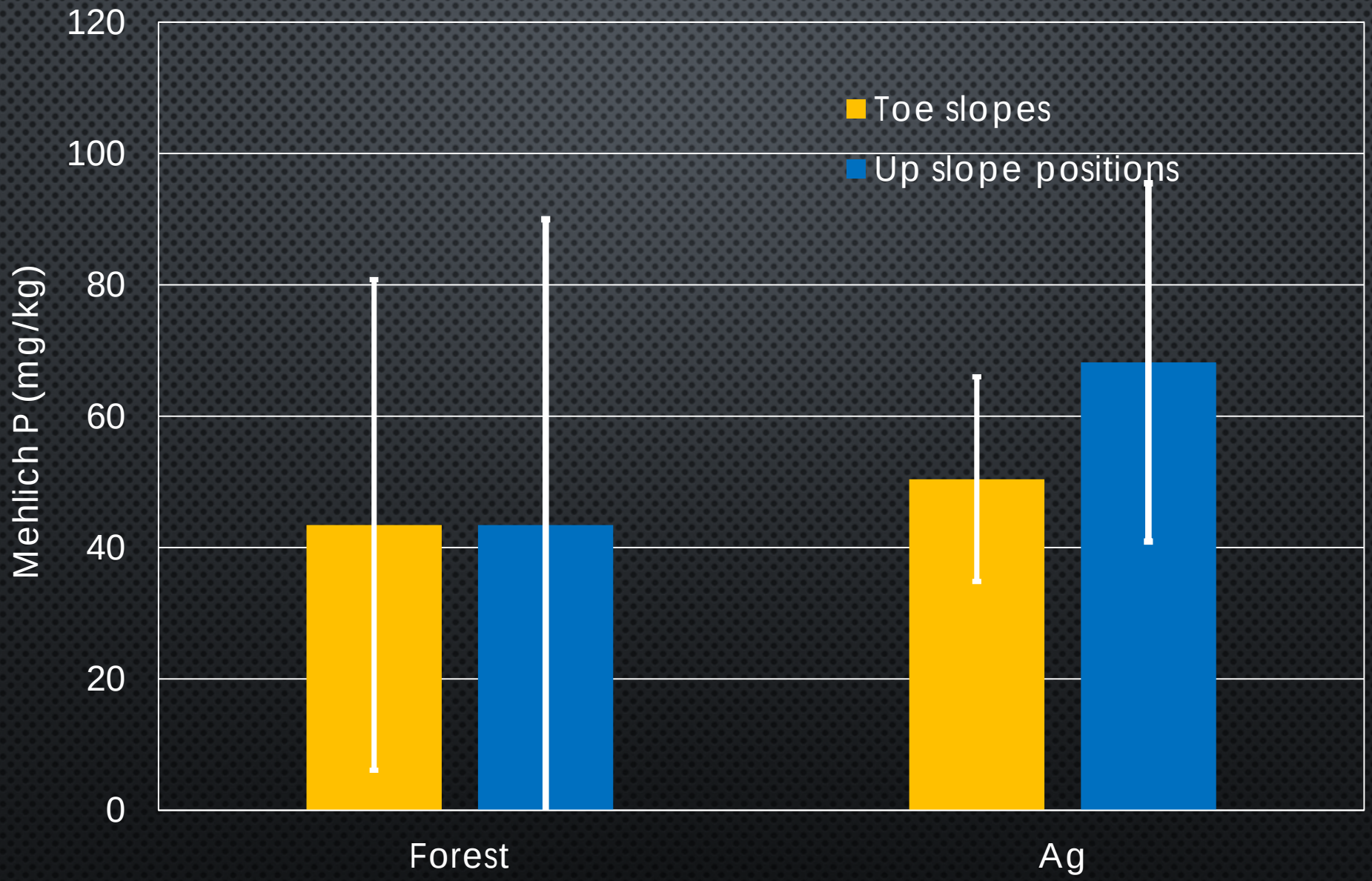
RESULTS – TOTAL P AG VS FOREST

RESULTS – MEHLICH III P

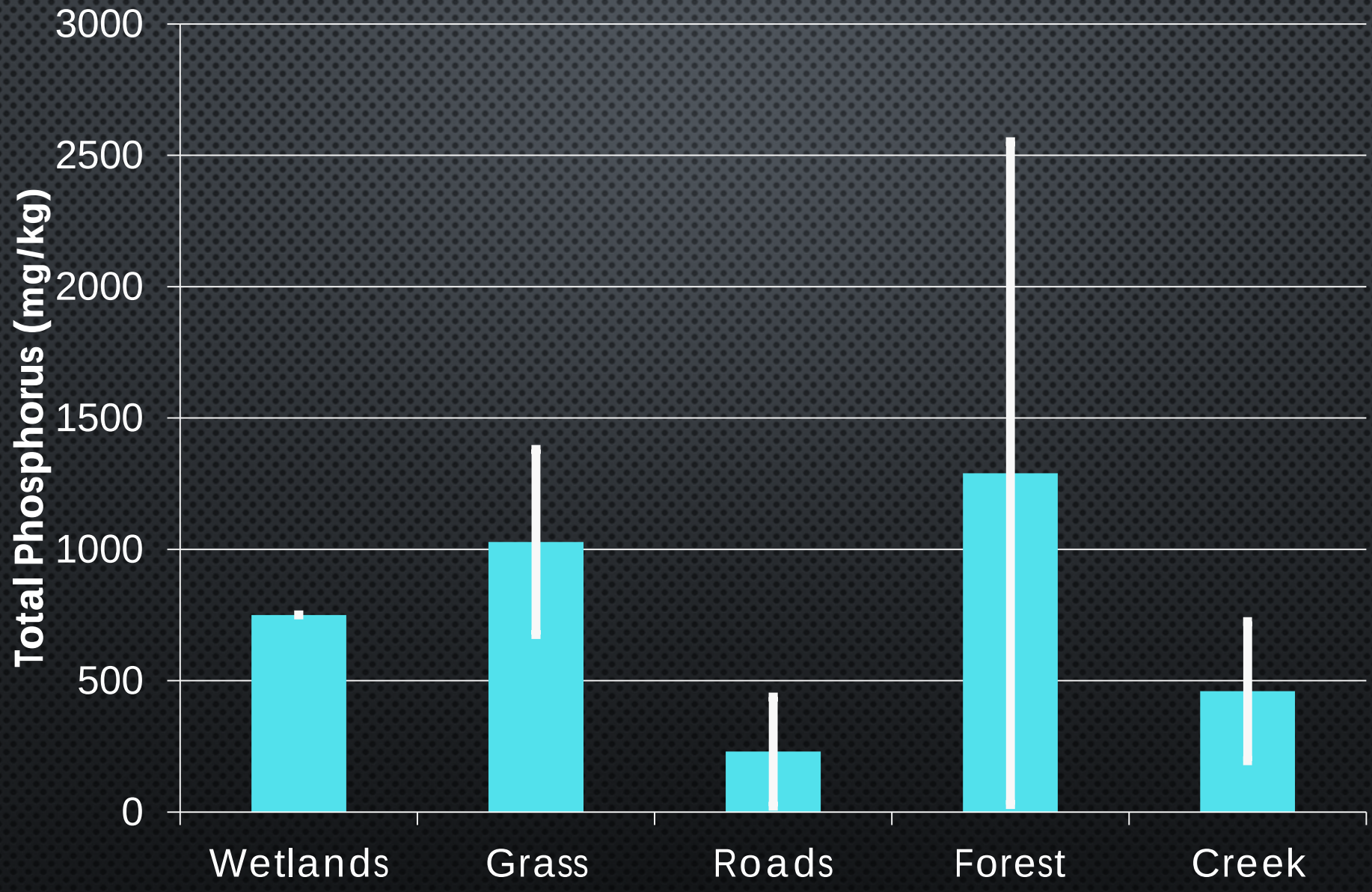


RESULTS – TOTAL SOIL P WITH TOPOGRAPHIC

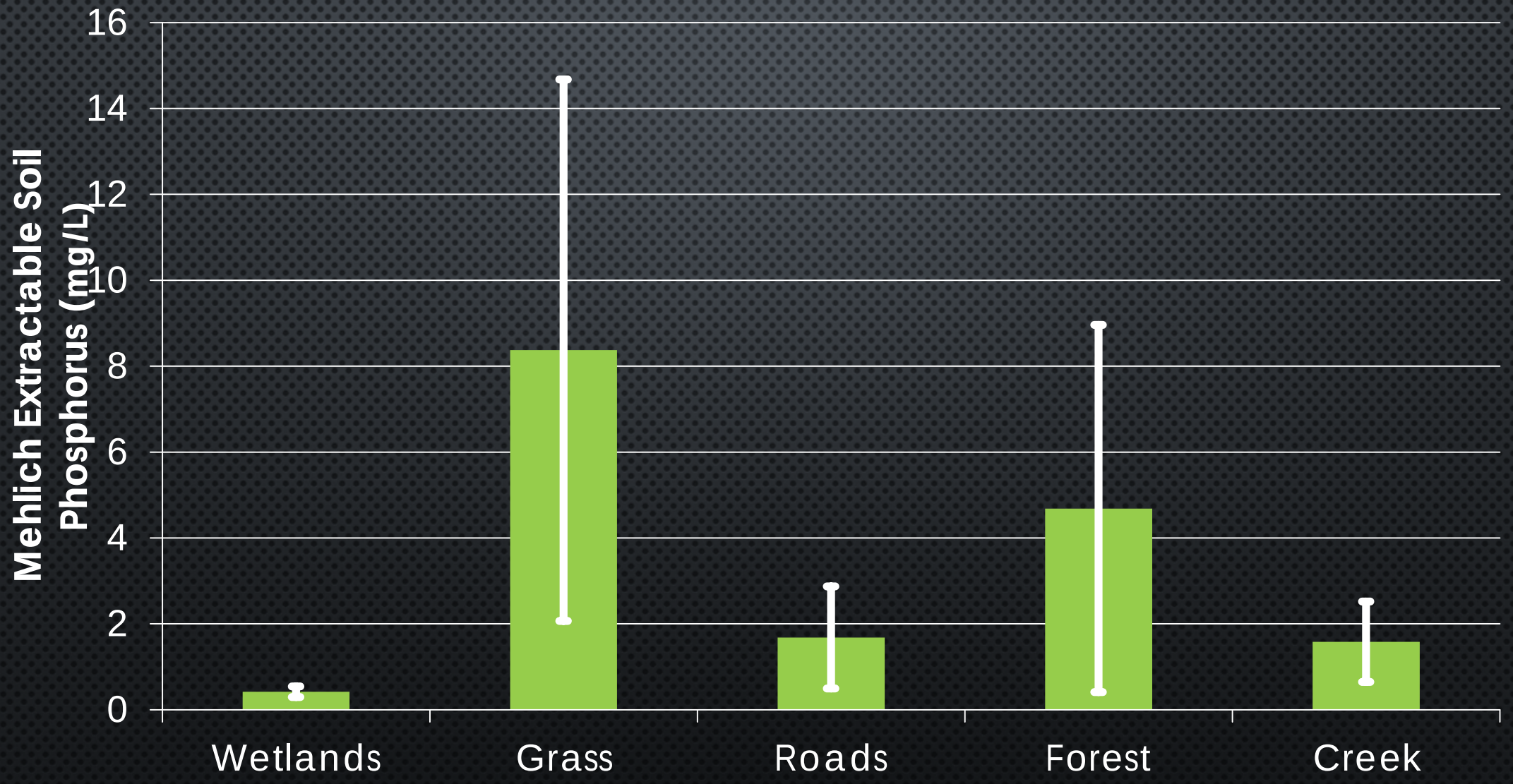
RESULTS – MEHLICH III SOIL P WITH TOPOGRAPHIC



RESULTS – FERNAN TOTAL PHOSPHORUS



RESULTS – FERNAN MEHLICH III PHOSPHORUS



CONCLUSION

- Higher totalP Concentrations in forest (toe slopes)
- Extractable P tends to be higher in ag settings comared to forest
- P in forest setting should also be managed
- 1. Lake creek ag variability is lower than forest
- 2. topographic position influenced P conc
- 3. more samples necessary to increase significance

http://www.forestcamping.com/dow/northern/coerinfo.htm

IN RELATION TO CLIMATE CHANGE

- HEIGHTENED DRY SEASON TEMPERATURES COULD INCREASE FREQUENCY AND INTENSITY OF FOREST FIRES
  - MORE FIRES, MORE ERODIBILITY OF SOIL

http://www.boiseweekly.com/boise/austin-fire-department-tells-boise-wildfire-is-everyones-fight/Content?oid=3466162

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- USDA

REFERENCES

Riet, K. V., & Steed, R. (n.d.). Blue-Green Algae Response Plan (Rep.).

Sharpley, A. N., Kleinman, P., & McDowell, R. W. (n.d.). *Modeling phosphorus transport in agricultural watersheds: Processes and possibilities* (Publication).

Winter, J. G., & Duthie, H. C. (2000). Export Coefficient Modeling to Assess Phosphorus Loading in an Urban Watershed. Journal of the American Water Resources Association, 36(5), 1053–1061. http://doi.org/10.1111/j.1752-1688.2000.tb05709.x