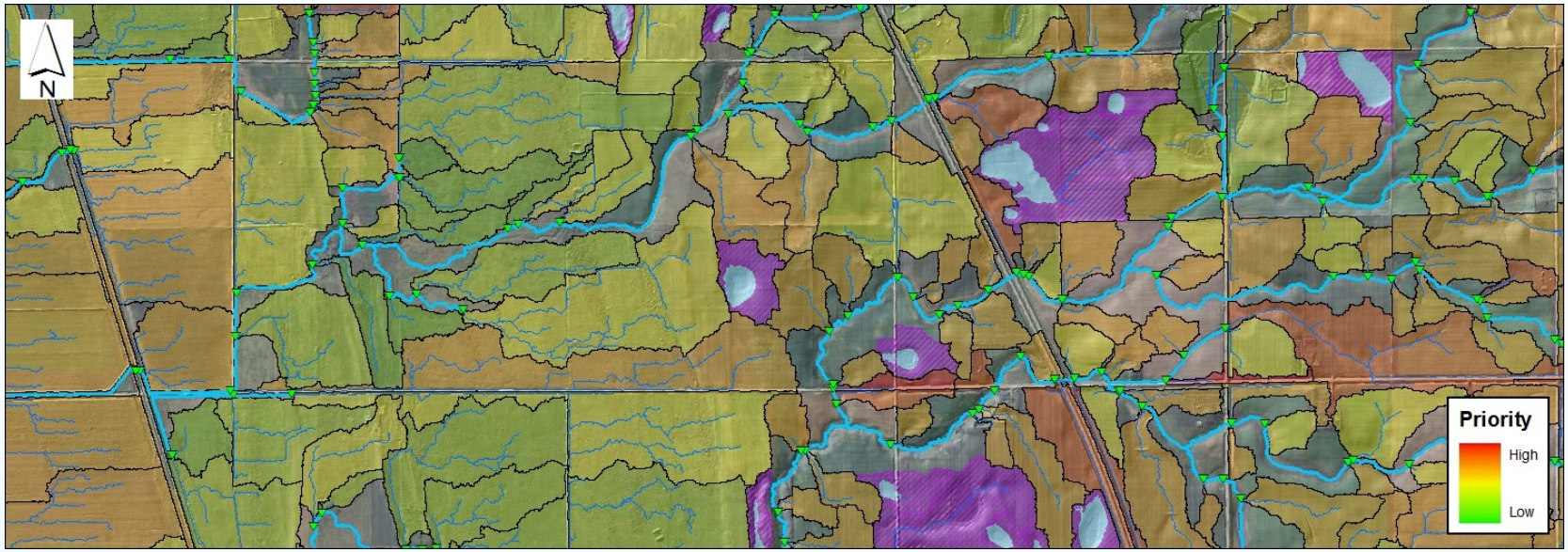
Terrain Analysis Applications

Value-added LiDAR Analysis



Zach Herrmann, PE

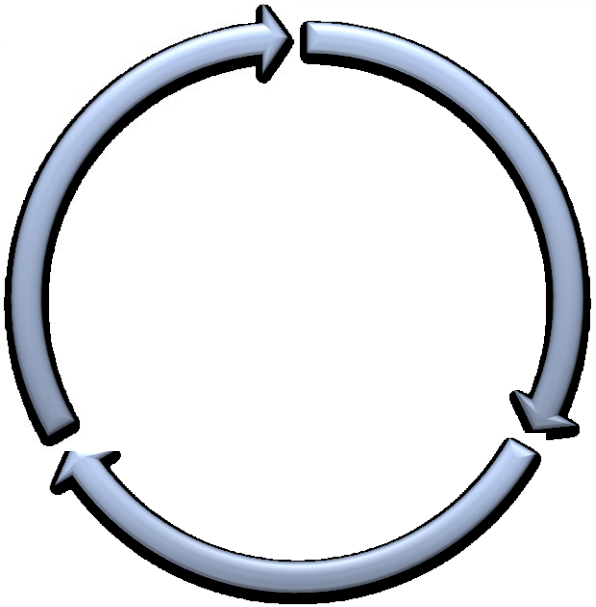
Houston Engineering, Inc.

ND Water Quality Monitoring Conference

Bismarck, ND

March 5, 2014

Houston Engineering Inc.



Hydrologically Reconditioned DEM

Landscape Prioritization

Results/Reporting

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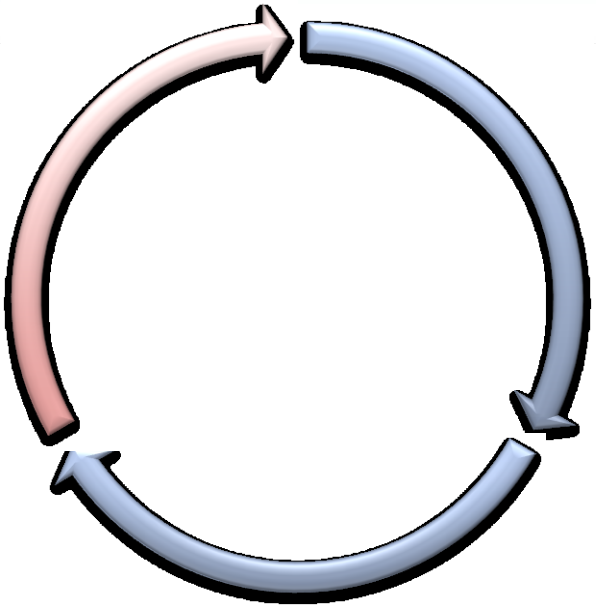

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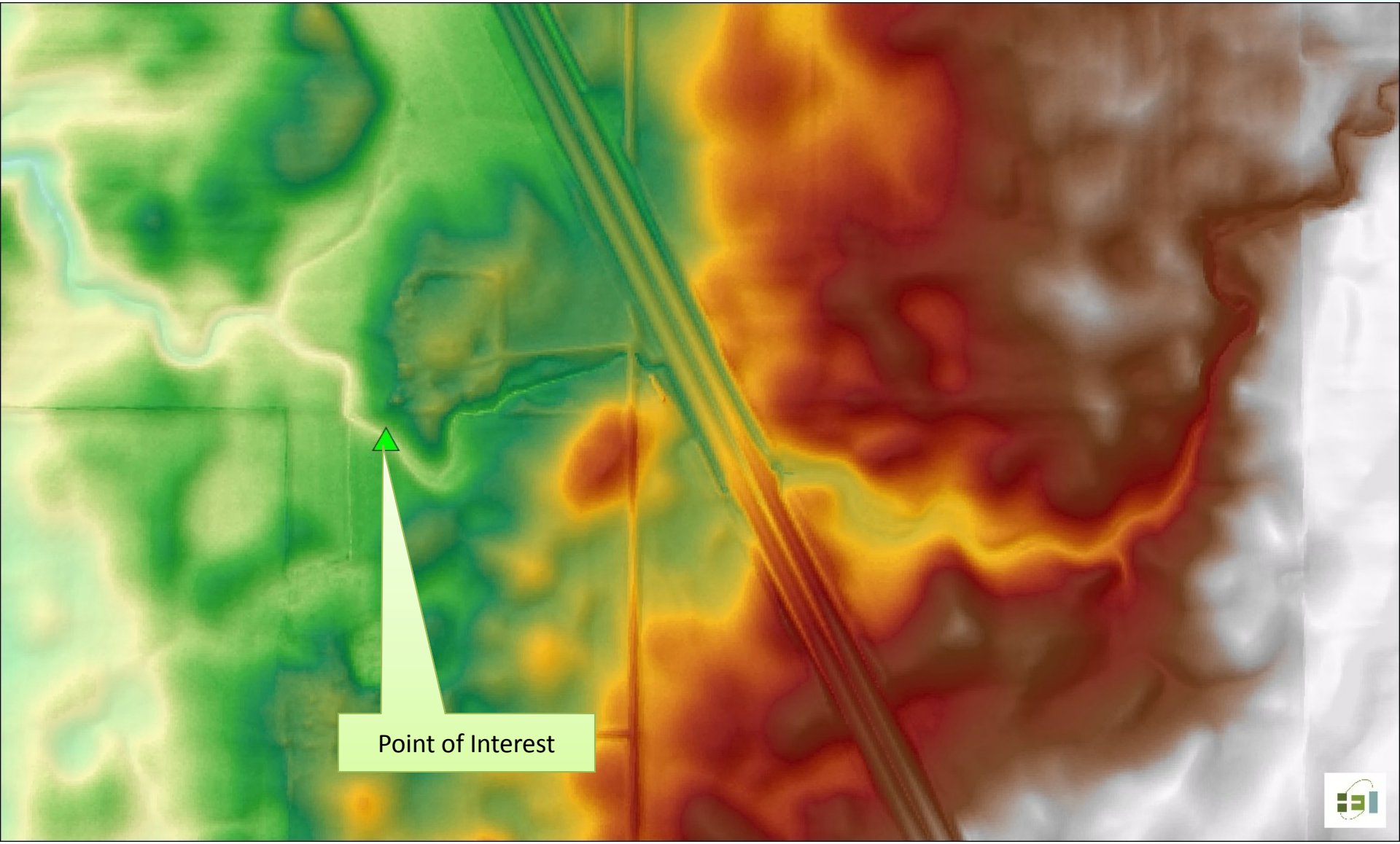
DEM Reconditioning

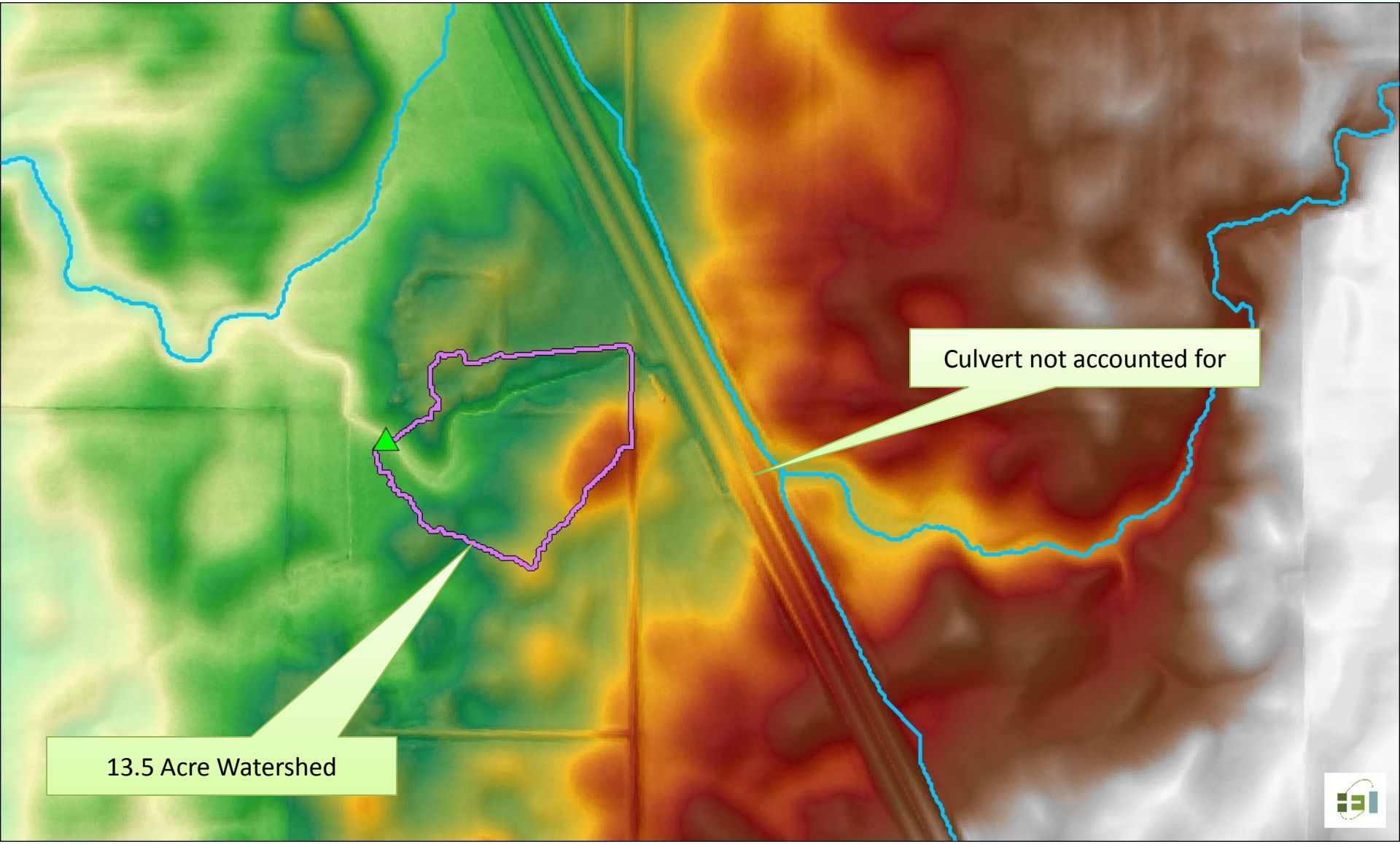
Why is raw LiDAR ground elevation data not sufficient?

- Unclear flow direction
  - Flat ditches
  - Standing water at the time of LiDAR acquisition
  - Dense vegetation
- "Digital Dams"
  - Culverts, bridges, any subsurface drainage alterations
  - Creates errors in subwatershed areas at points downstream
- Requirements
  - High quality elevation data
  - Technical expertise with sophisticated GIS processing software
  - **LOCAL KNOWLEDGE**
    - Drainage patterns, bridge and culvert location, etc…

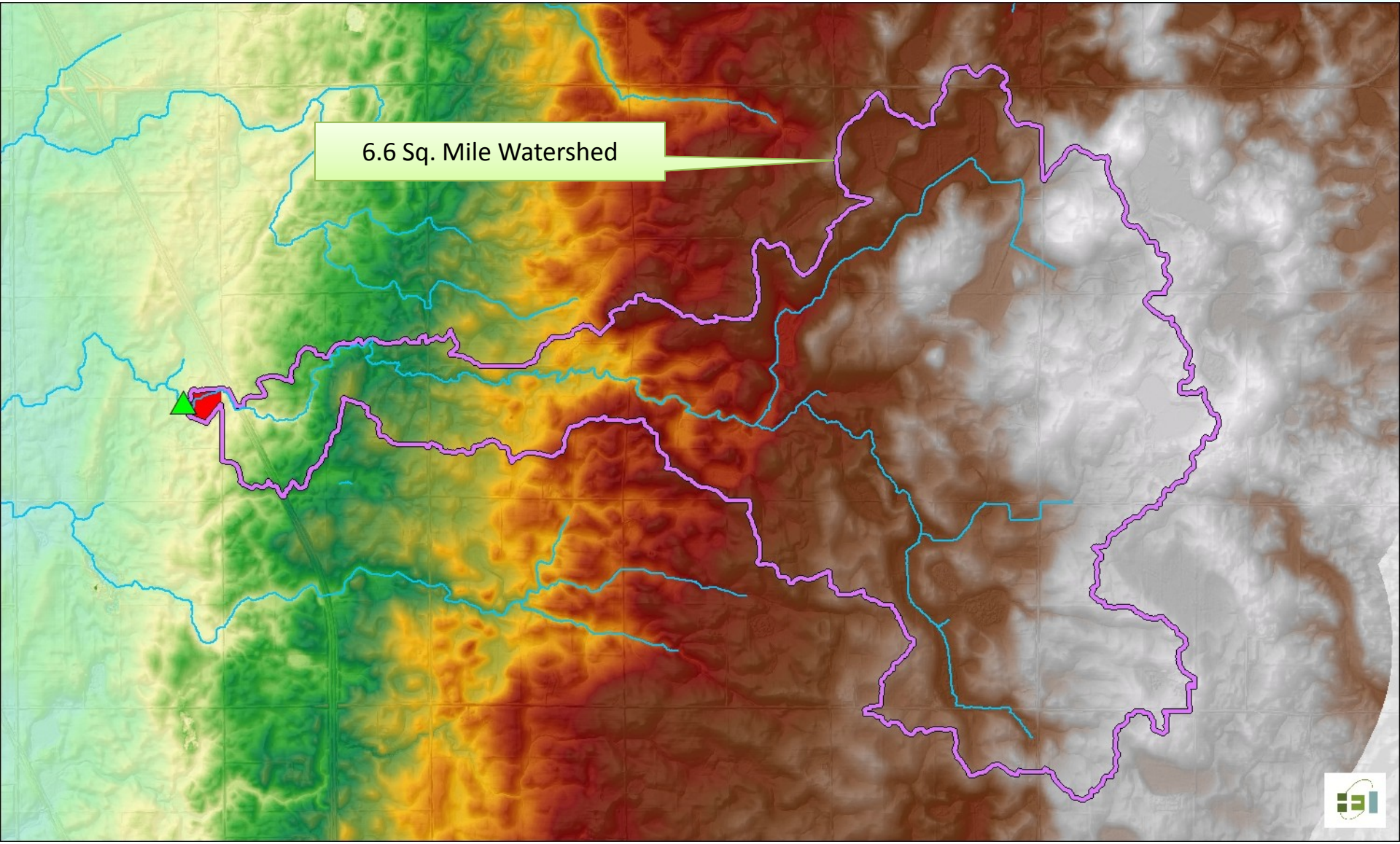
Impacts of Reconditioning

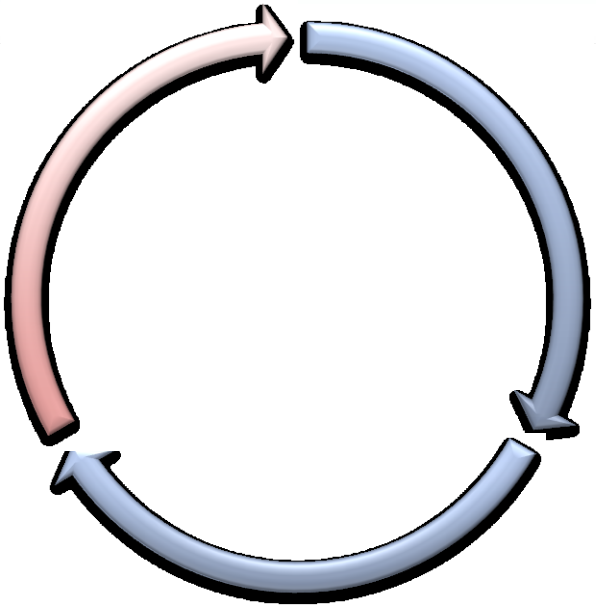


Impacts of Reconditioning



Impacts of Reconditioning





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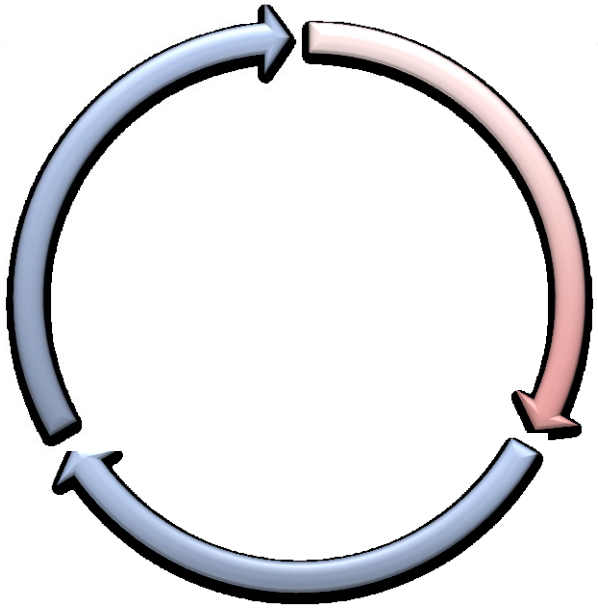

Hydrologically Reconditioned DEM

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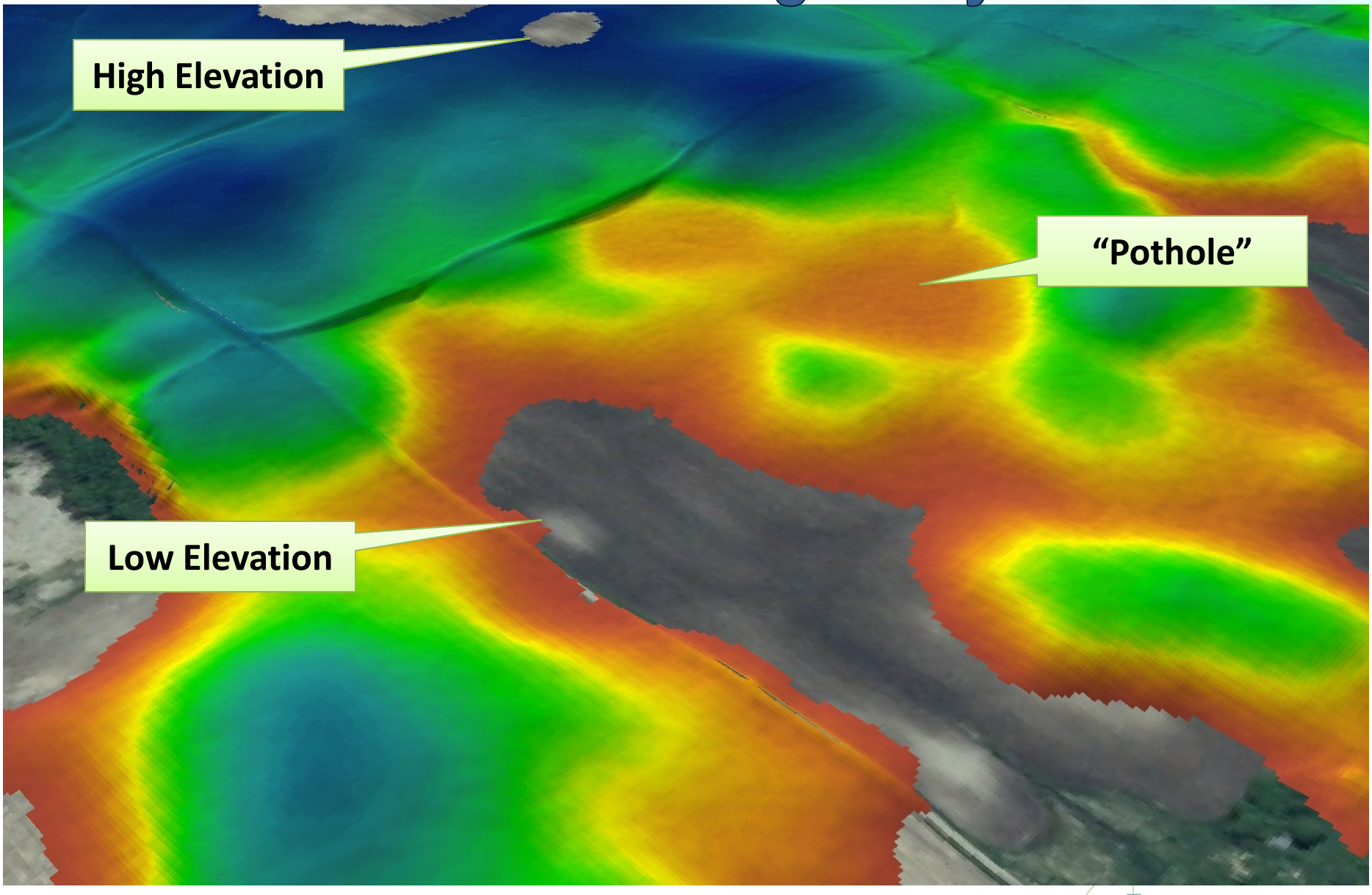
Non-Contributing Analysis

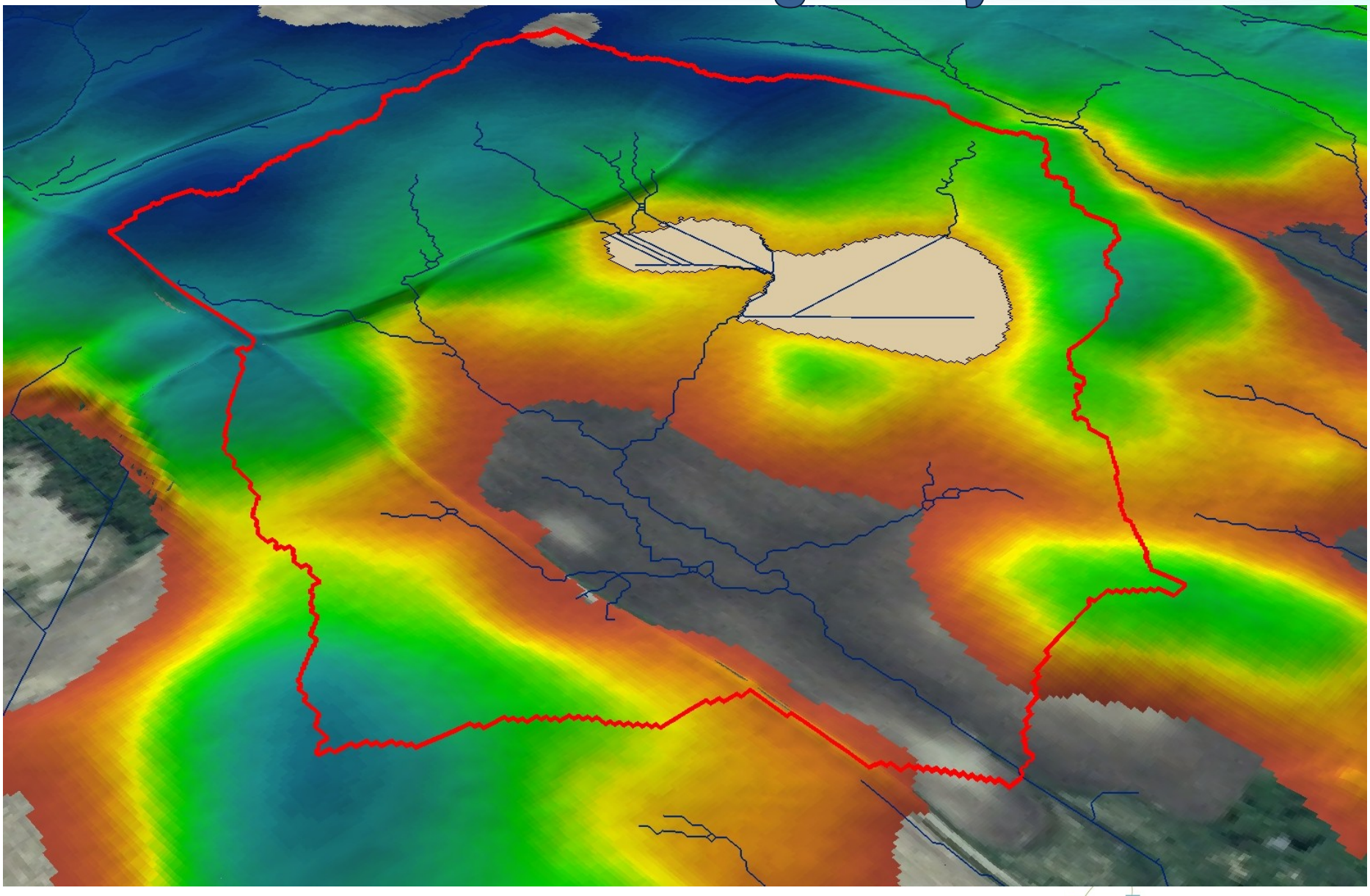
- **Not all areas contribute equally during every rainfall/runoff event**
- **Depressed areas within the watershed store runoff**

- **Non-Contributing Basins**
  - Any closed basin that has sufficient storage to contain runoff produced from a given rainfall event
    - Variable depending on amount of rainfall analyzed
    - “Potholes” on the landscape
    - Existing wetlands and lakes

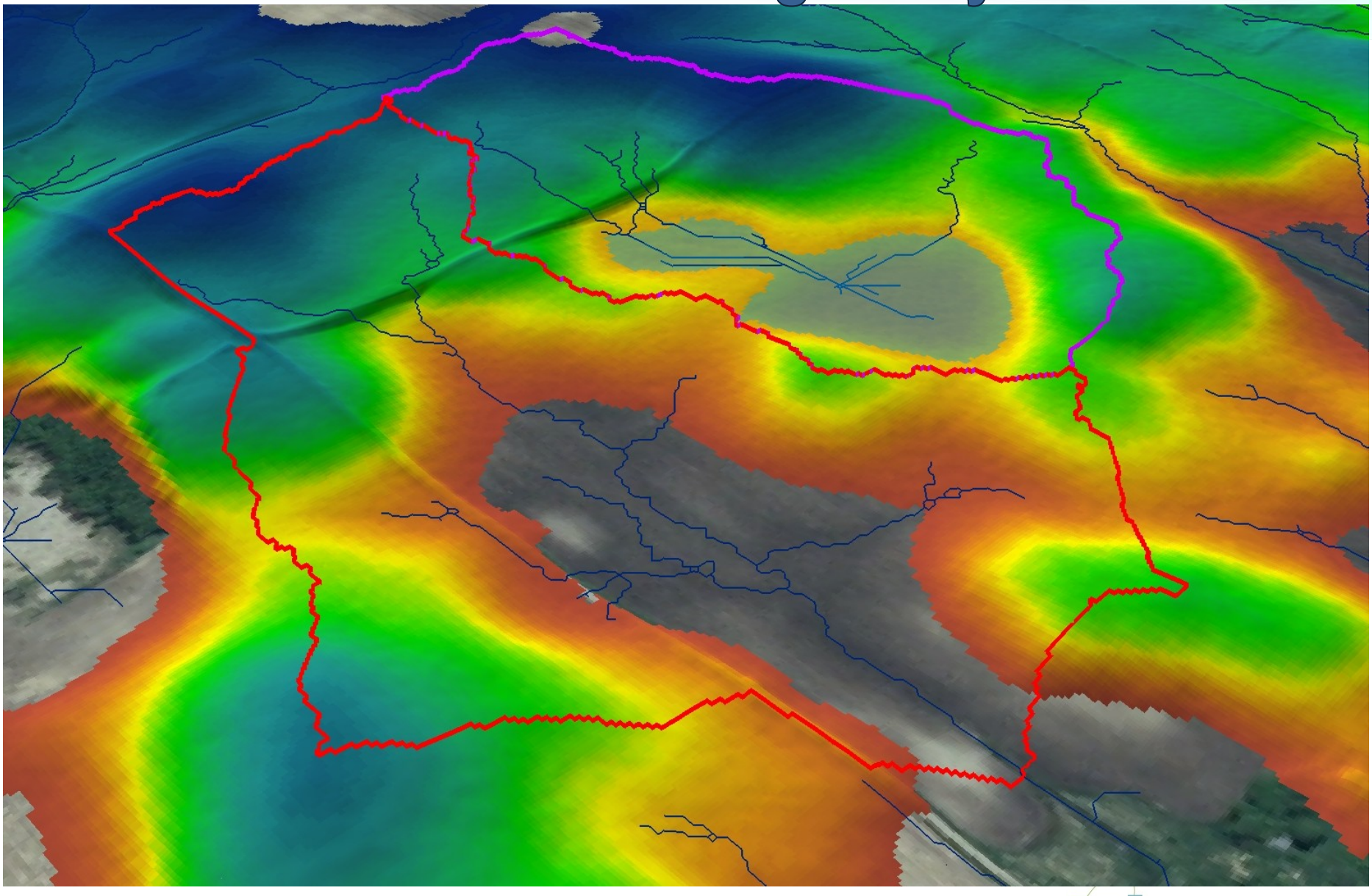
Non-Contributing Analysis

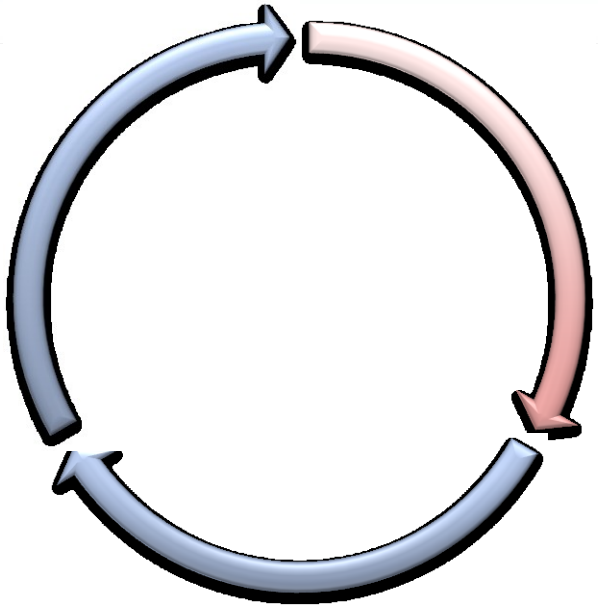


Non-Contributing Analysis



Non-Contributing Analysis





Hydrologically Reconditioned DEM

Landscape Prioritization

Results/Reporting

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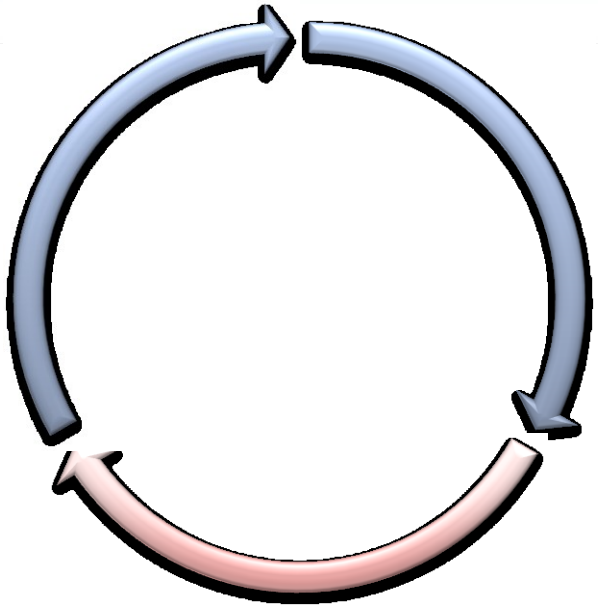

Hydrologically Reconditioned DEM

Landscape Prioritization

Results/Reporting

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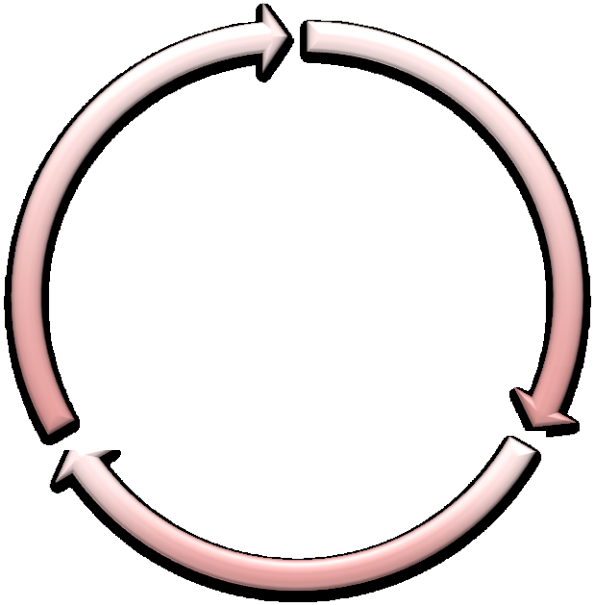
Stakeholder Review

- **Local Review of Reconditioned LiDAR data**
  - Questionable culvert locations
  - Potential tile inlet locations

- **Incorporate into Reconditioned DEM**

- **GOAL – *Reconditioned LiDAR dataset to a scale that best reflects drainage patterns for the intended use of the dataset.***

- **Landscape Prioritization data layers are only as good as the input reconditioned DEM.**



Hydrologically Reconditioned DEM

Landscape Prioritization

Results/Reporting

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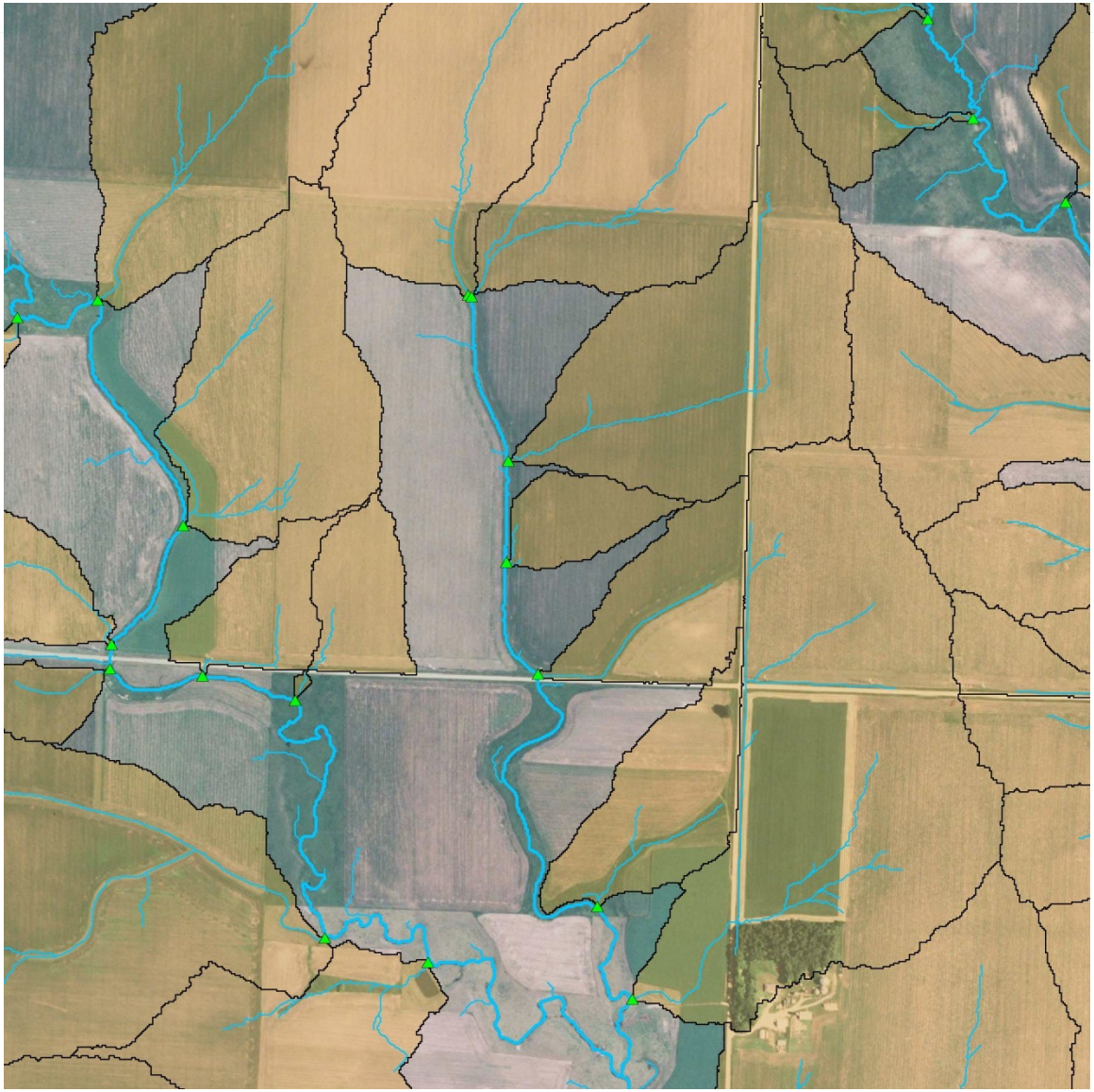
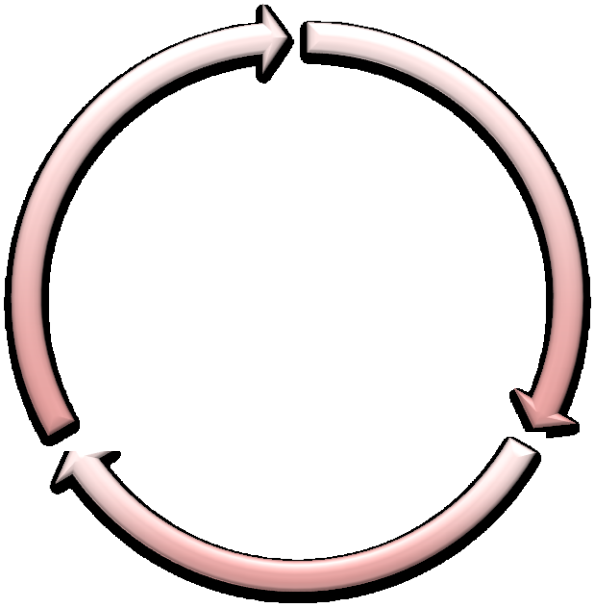
Reconditioned DEM

Reconditioned DEM





Hydrologically Reconditioned DEM

Landscape Prioritization

Results/Reporting

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Stream Power Index

Measurement of potential energy of water as it flows over bare ground

$$SPI = (\text{contributing area}) \times (\text{slope})$$

Amount of water expected

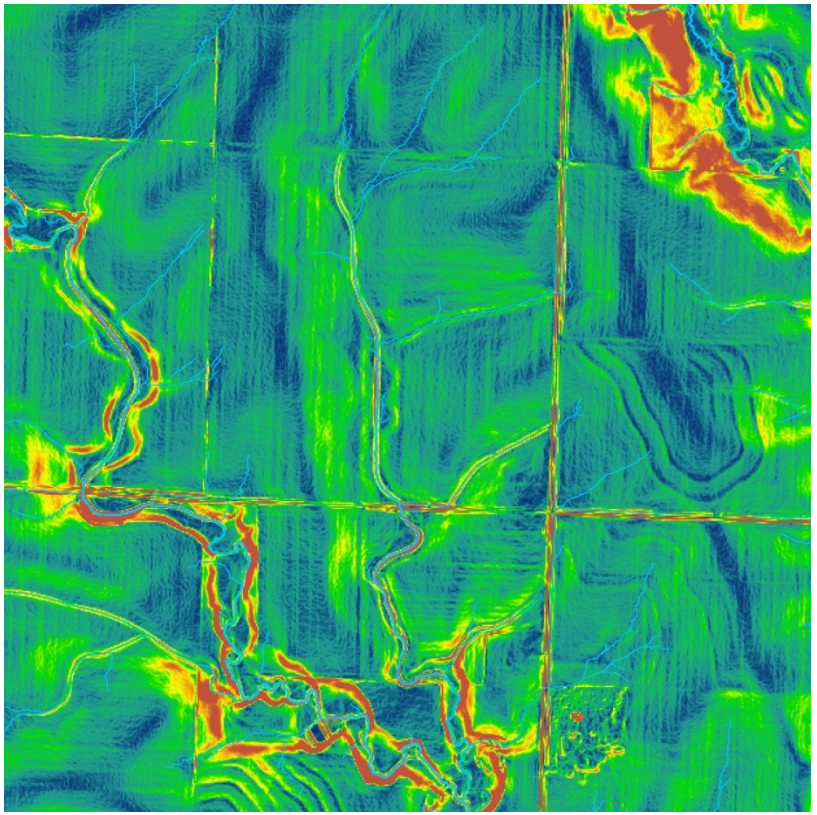
Slope of flow path

Purpose: Identify locations with high potential for gully erosion

Stream Power Index Example

Contributing Area

Slope



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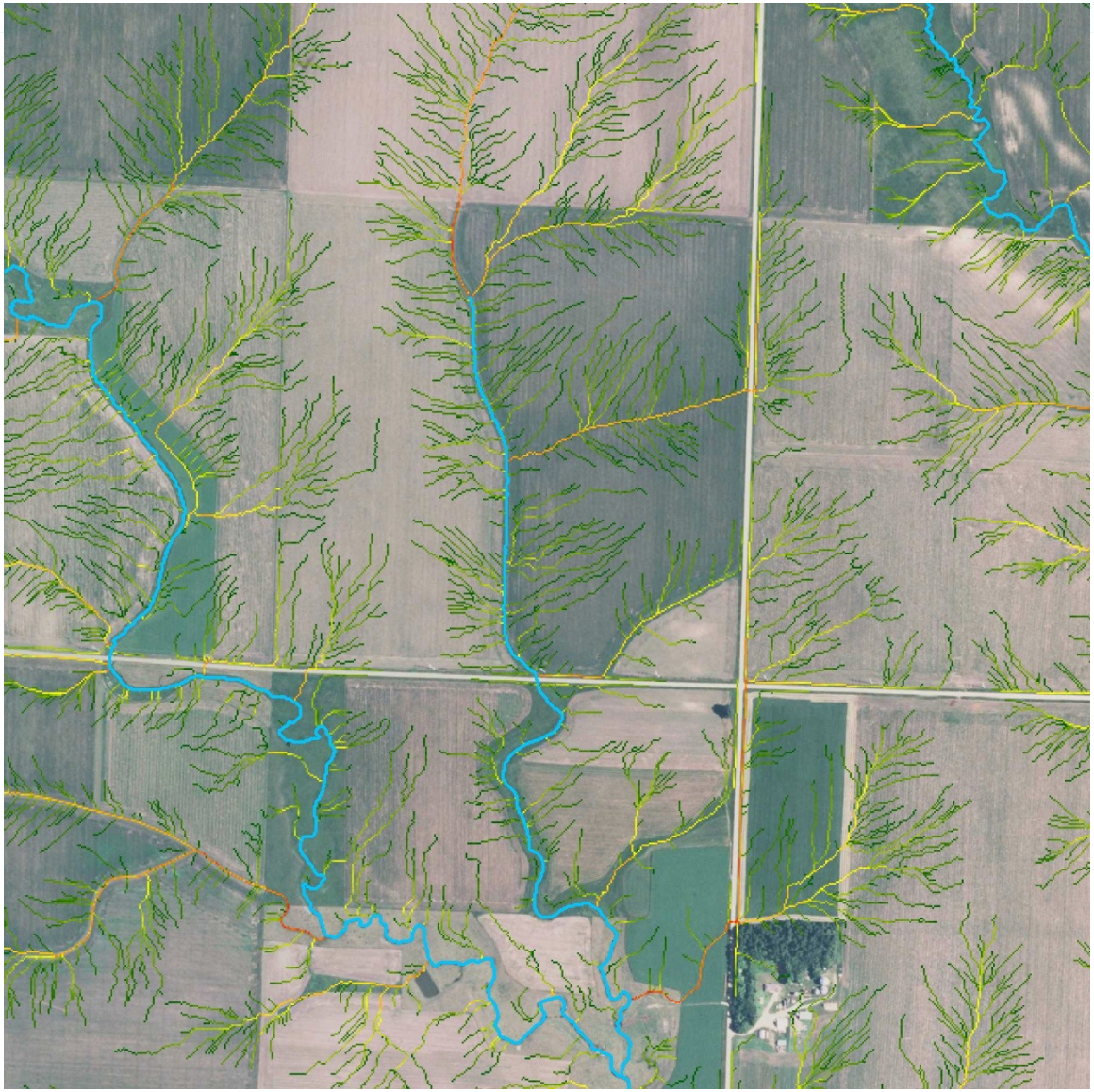
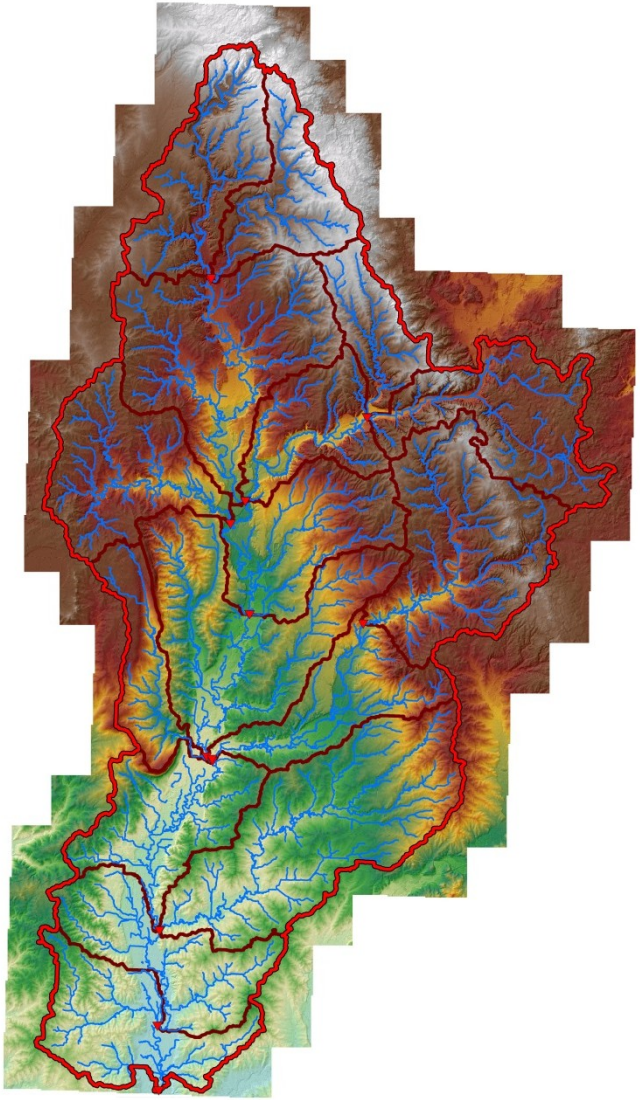
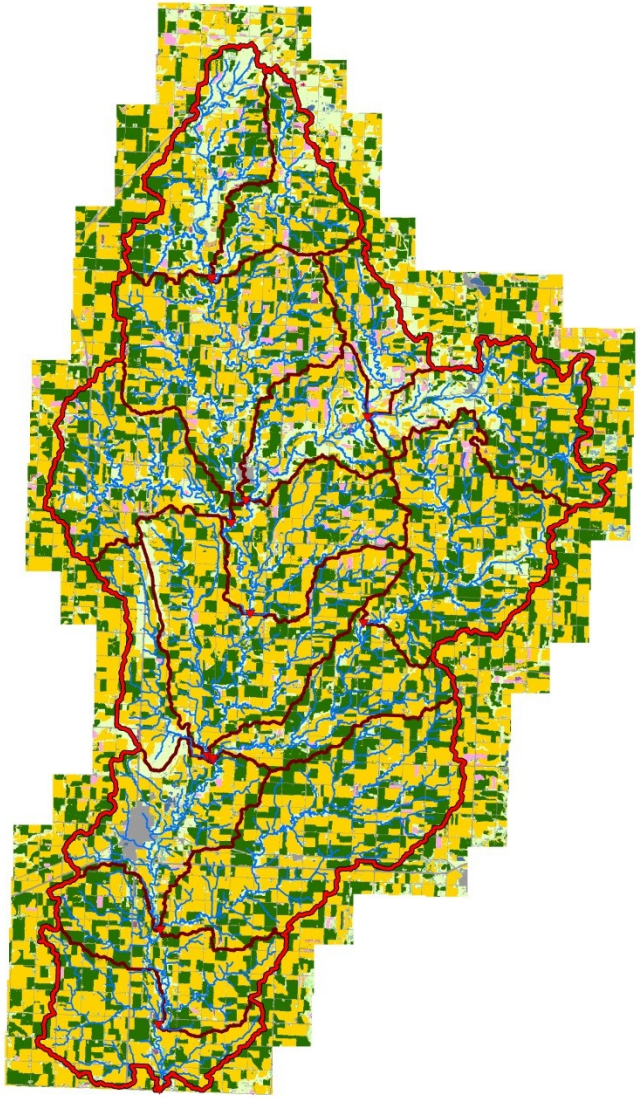
Stream Power Index Example



Total Loading Estimates – *Background Info.*

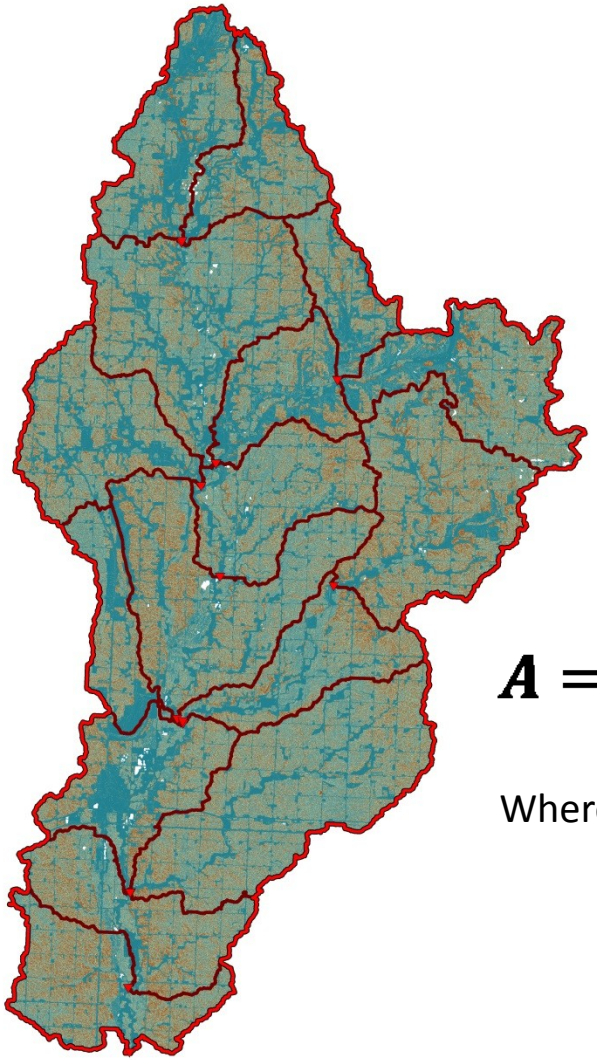




Legend

- Alfalfa
- Barley
- Barren
- Canola
- Corn
- Dbl Crop Barley/Soybeans
- Dbl Crop Corn/Soybeans
- Deciduous Forest
- Developed/High Intensity
- Developed/Low Intensity
- Developed/Med Intensity
- Developed/Open Space
- Dry Beans
- Evergreen Forest
- Flaxseed
- Grassland Herbaceous
- Herbaceous Wetlands
- Mixed Forest
- Oats
- Open Water
- Other Hay/Non Alfalfa
- Peas
- Potatoes
- Rye
- Shrubland
- Soybeans
- Spring Wheat
- Sugarbeets
- Sunflower
- Sweet Corn
- Woody Wetlands

RUSLE – *Sediment Loading*



- Developed by USDA
- Estimate soil erosion from fields

  due to raindrop impact and

  surface runoff

$$A = R \times K \times LS \times C \times P$$

Where,
R = Rainfall and Runoff Factor
K = Soil Erodibility Factor
LS = Length-Slope Factor
C = Cover and Management Factor
P = Support Practice Factor

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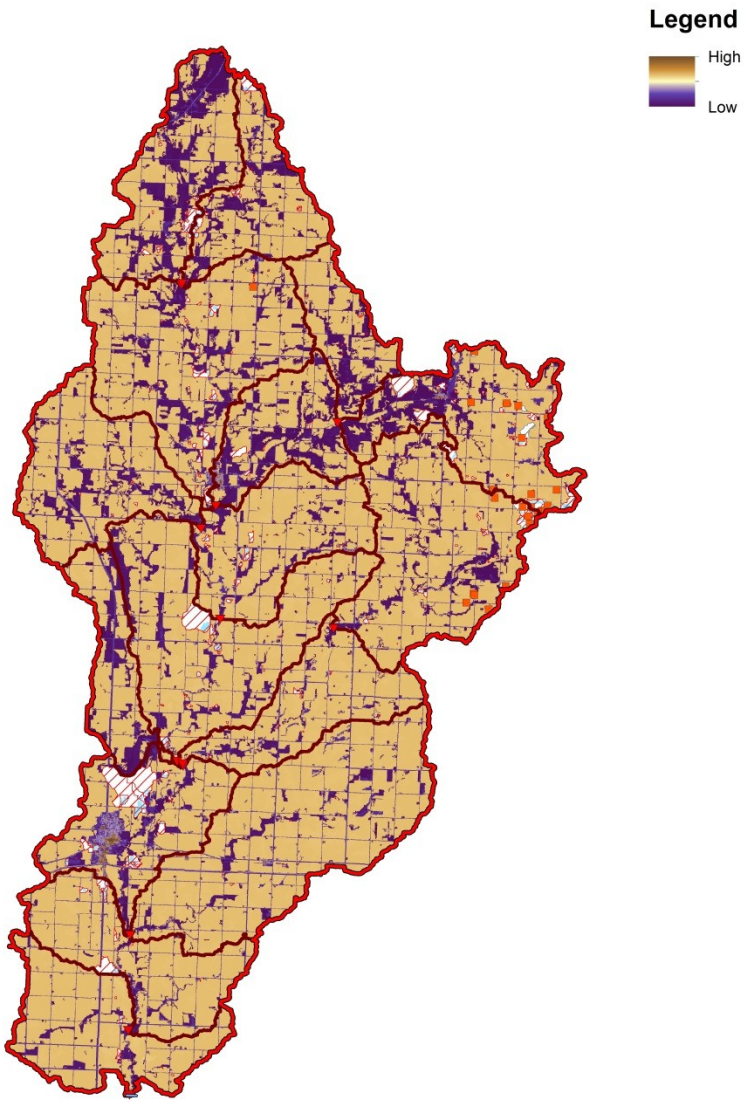
Total Nitrogen



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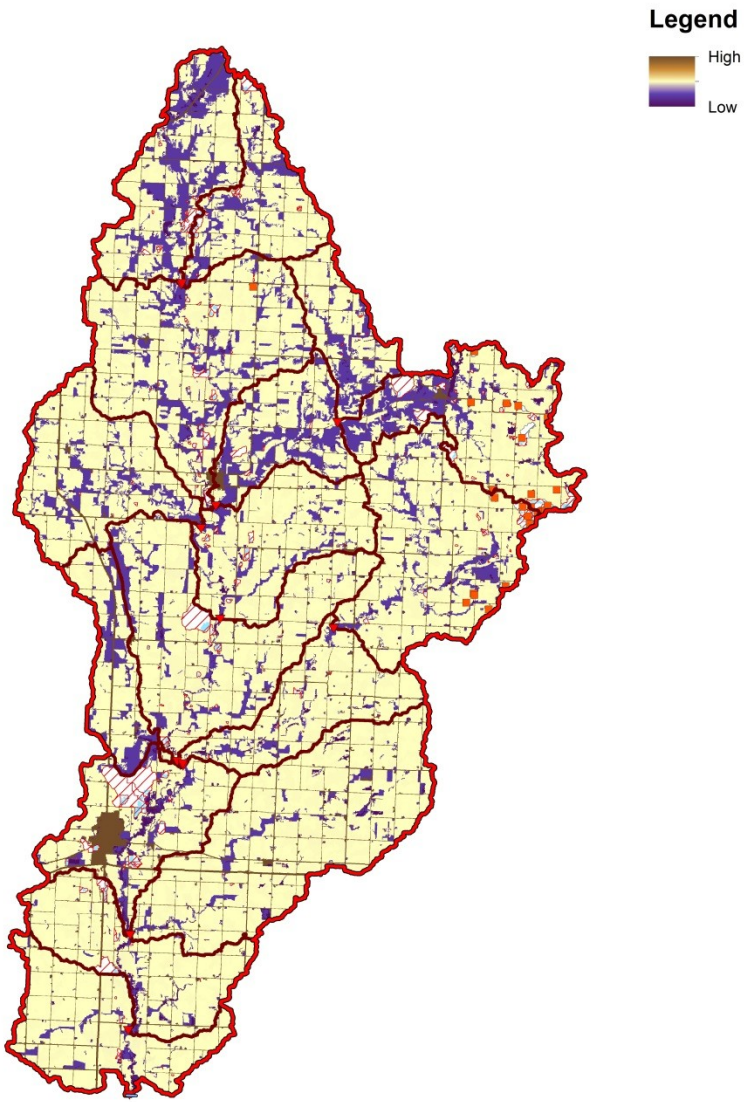
Total Phosphorus



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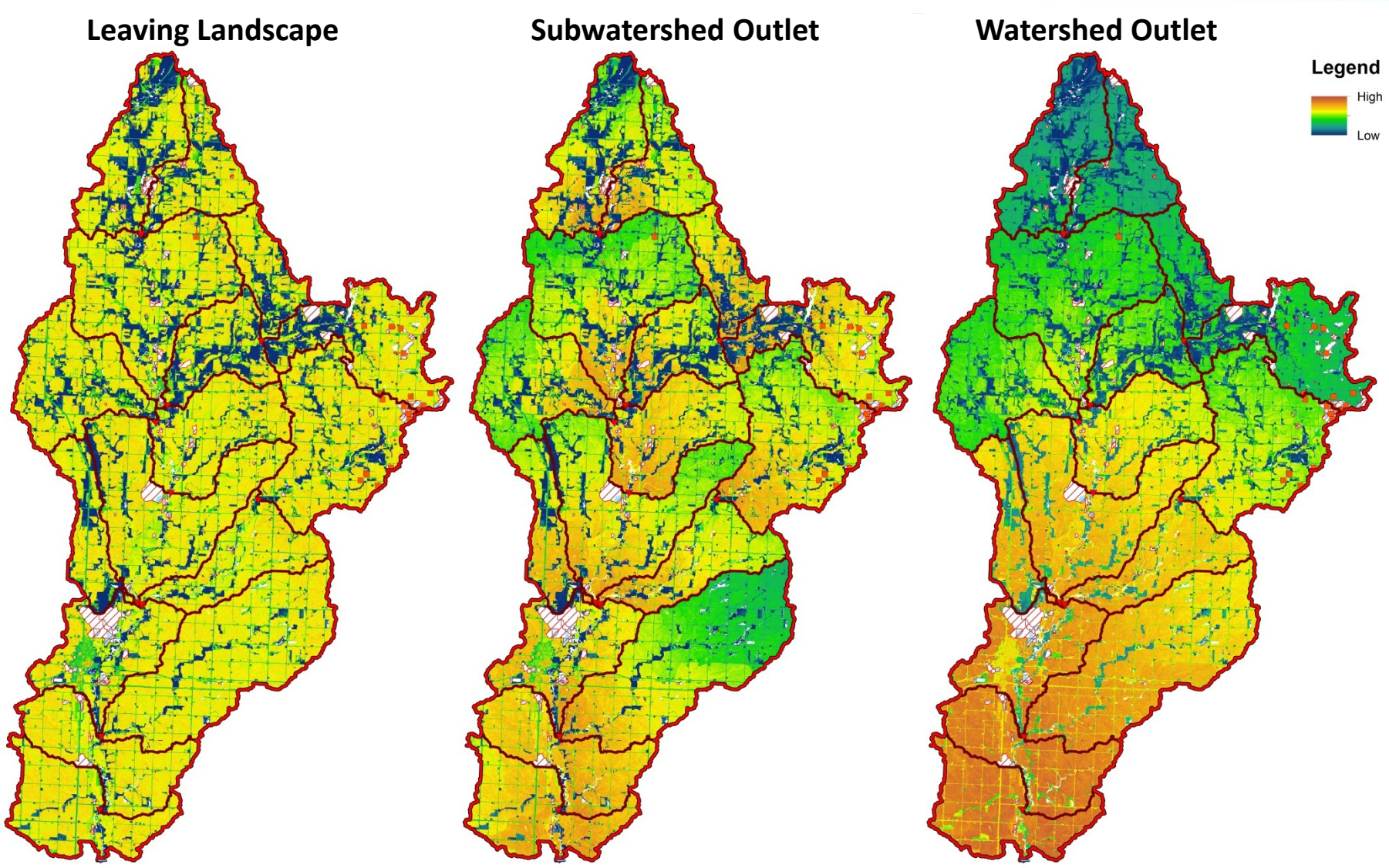
Water Quality Index



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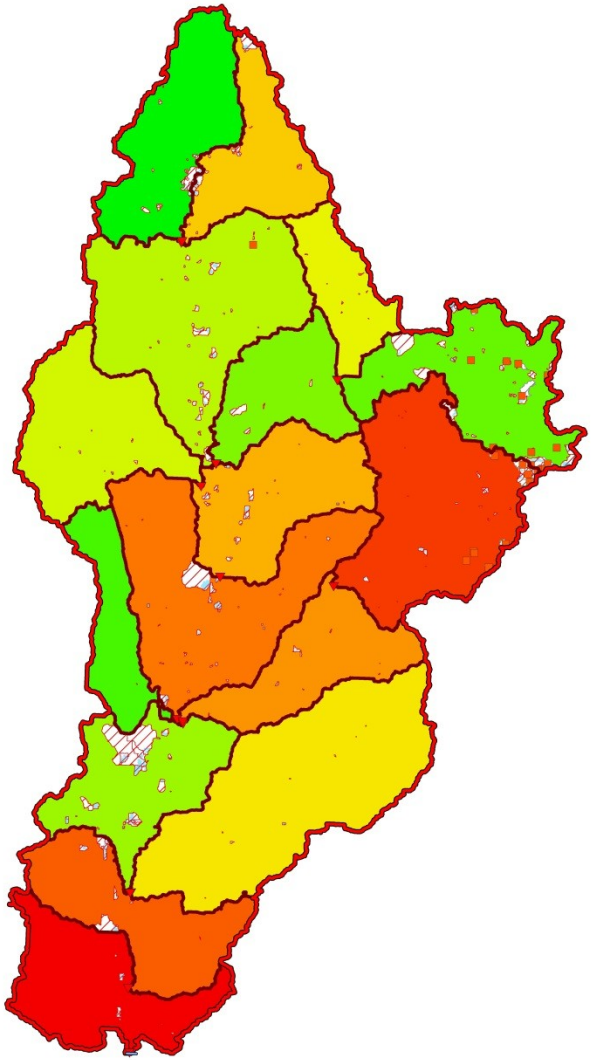
Where to Implement? – *In the Watershed*



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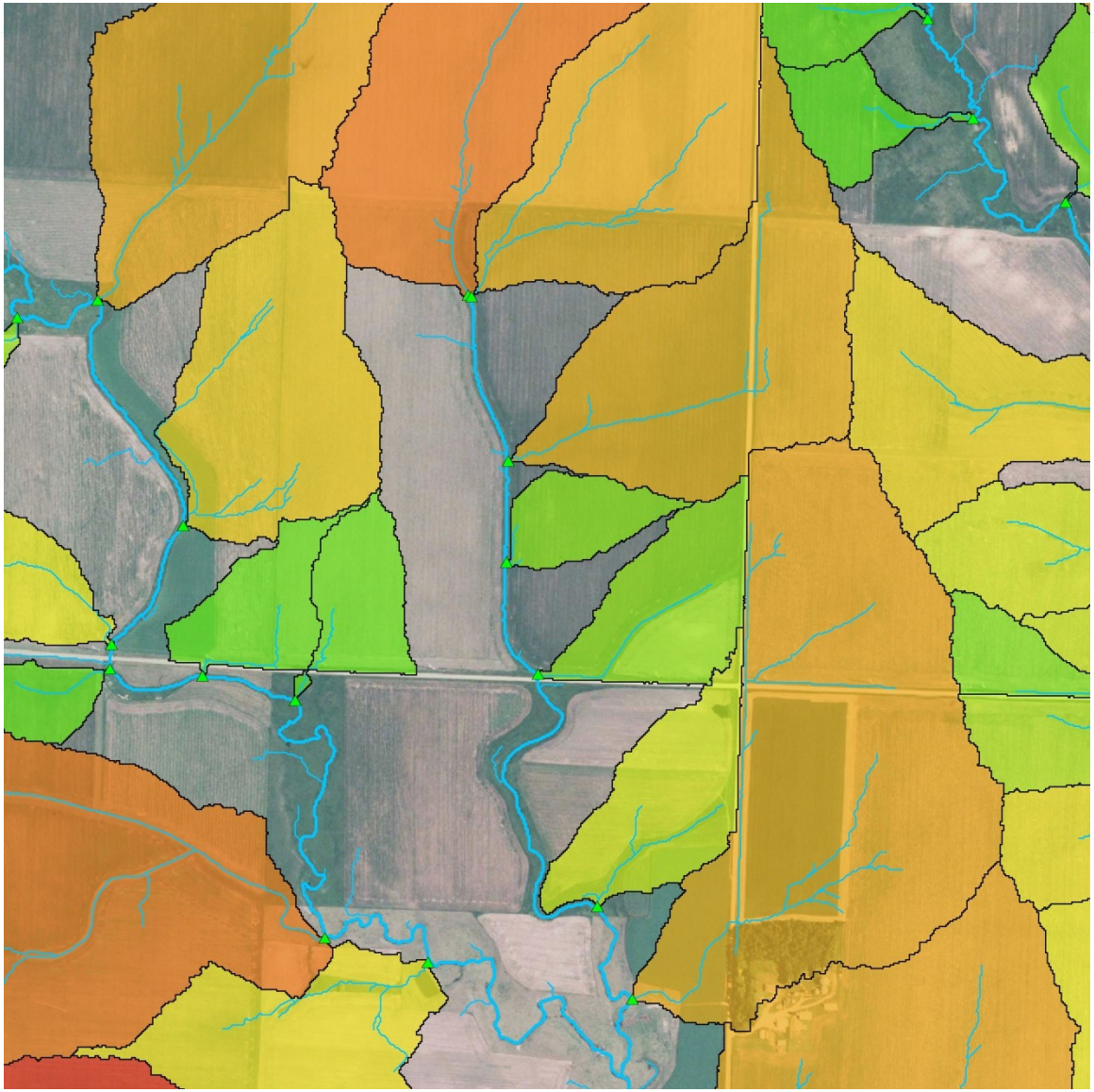
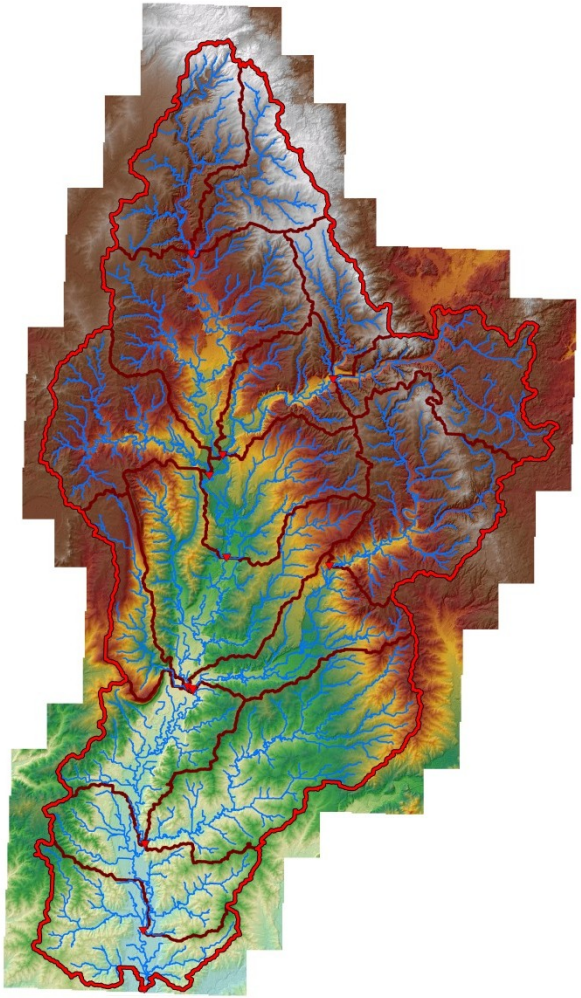
Where to Implement? – *On The Field*



Why?



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Terrain Analysis Applications

Value-added LiDAR Analysis

Questions?

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