ORDA Science Webinar Series:
GIS-Based Tool to Aid in Responding to Spills

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USGS Dakota Water Science Center

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Development of an Interactive GIS-Based Tool to Aid in Responding to Spills for Theodore Roosevelt National Park, North Dakota

Benjamin York

Ryan Thompson

Greg Delzer

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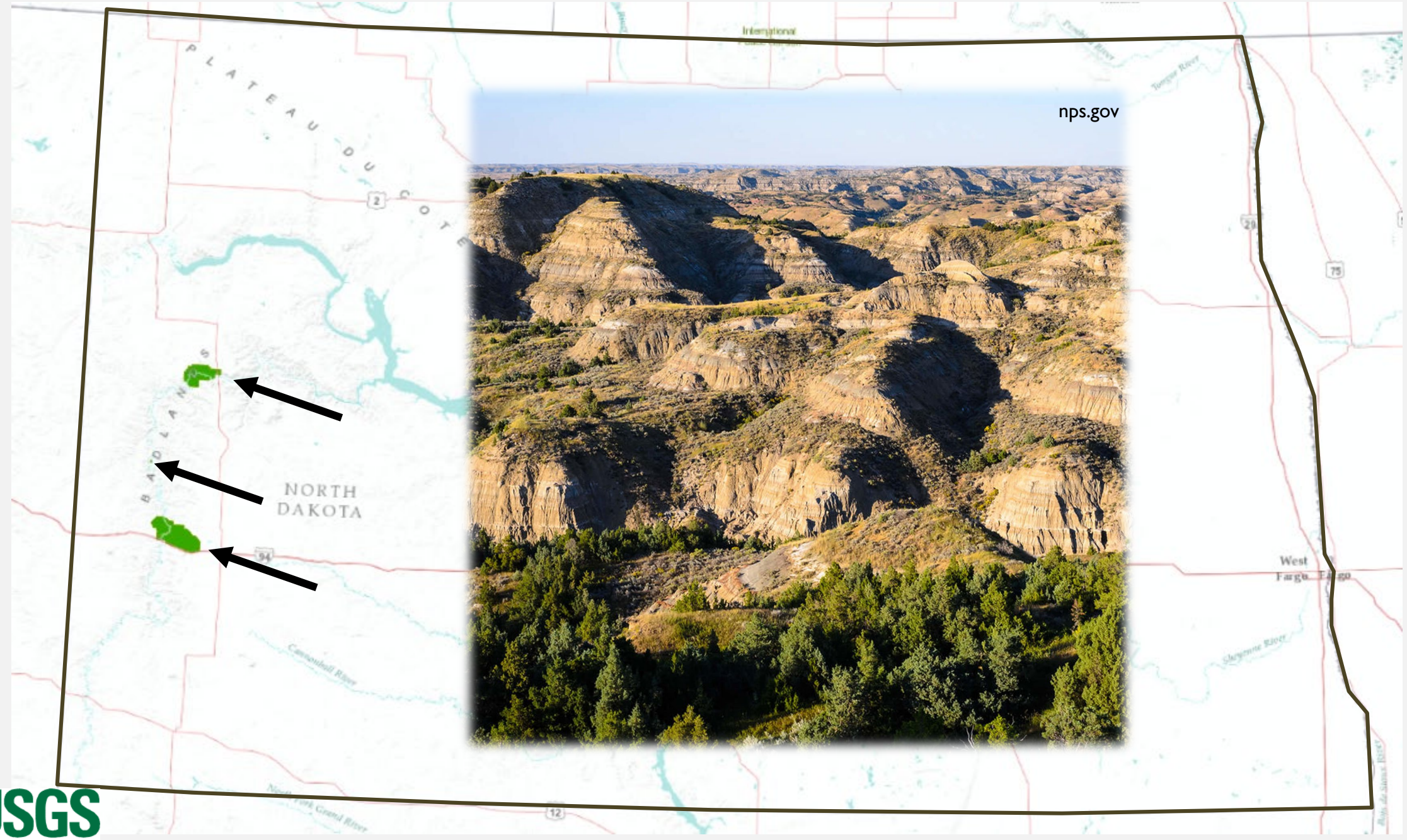
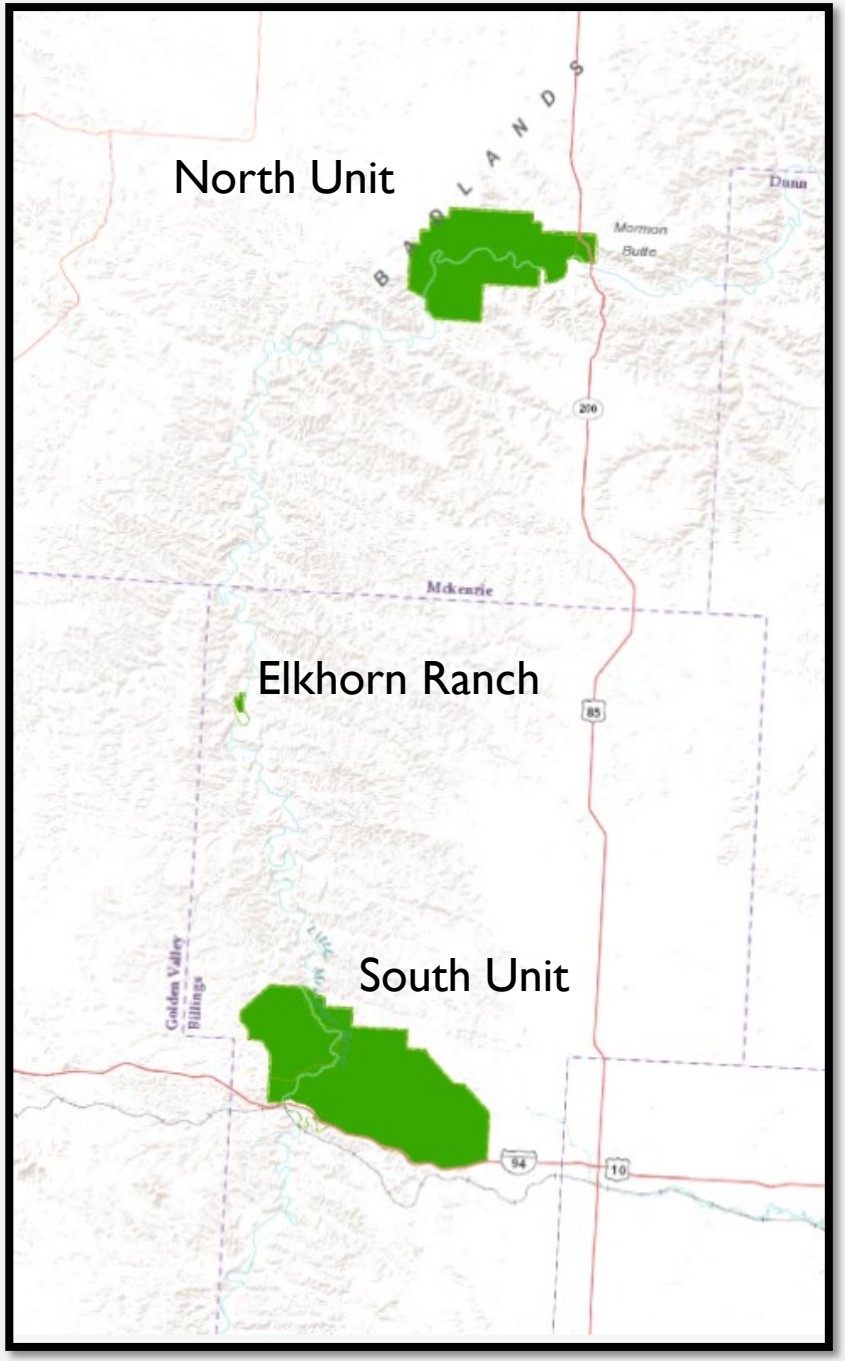


THEODORE ROOSEVELT NATIONAL PARK (THRO)

- Just over 110 square miles between three sections
- One of the biggest and last petrified forests in the country
- Over 400 species of plants and trees, 185 species of birds
- One of the few NPS-managed herds of feral horses
- Home to iconic western animals
- The Little Missouri River flows through all three sections



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OIL SPILLS IN NORTH DAKOTA: 10/1/2018 – 10/1/2019

- ND Department of Health reports over 345 oil spills from 10/1/2018 – 10/1/2019
  - Definition of "not contained" means that the spill originated outside facilities, or spilt within the facility and escaped
- There were six reports over 100 barrels (4,200 gallons)
- The newest development (not part of the above stats) was on Oct 29th, 2019 with the Keystone pipeline leaking 9,120 barrels of crude oil near Edinburg, ND
  - Currently has impacted half an acre (22,500 square feet)
  - Nearly half the oil has been recovered as of Nov. 4th, 2019

Grand Forks Herald, 2019

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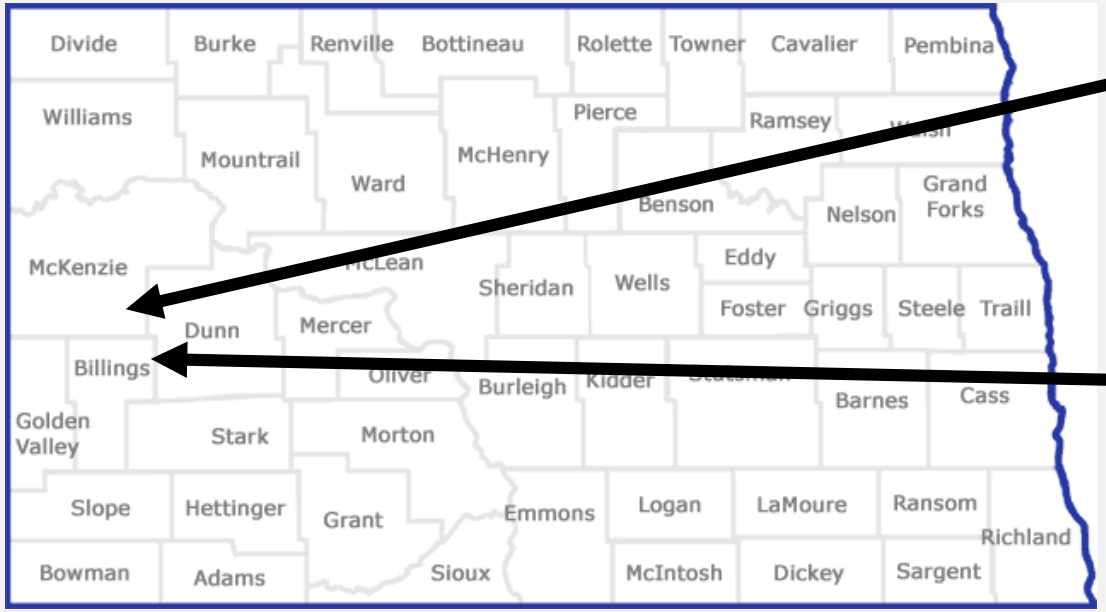
OIL SPILLS IN BILLINGS AND MCKENZIE COUNTY: 10/1/2018 – 10/1/2019



- The North Unit resides in McKenzie county
  - There were 118 oil spills reported from 10/1/2018 – 10/1/2019
  - The North Unit is in the southern part of the county, so not all spills are near the park
- The South Unit and Elkhorn Ranch reside in Billings county
  - There were 16 oil spills reported from 10/1/2018 – 10/1/2019

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OIL SPILLS NEAR THRO:
GETTING AHEAD OF THE SPILL

- Response to spills inside and outside the park
- Could harm sensitive species and iconic western animals
- The **2016** spill into Ash Coulee was situated between the South Unit and Elkhorn Ranch of Theodore Roosevelt National Park, 9 miles above the confluence of the Little Missouri River

Caption: A ruptured pipeline caused when a hillside slumped spilled 12,600 barrels of oil into a creek in Billings County near Belfield, N.D., in December 2016. North Dakota Department of Health

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WHAT CAN BE DONE?

<u>Figure out how to track or predict spills using GIS</u>

- Create a hydro-enforced Digital Elevation Model (DEM)
- Find flow paths
- Determine upstream watersheds

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WHAT IS A HYDRO-ENFORCED DEM?

- DEM with actual surface that water would travel on
  - Standard DEM files don't have underground drainage or culverts
- Applied Selective Drainage Tool (Curtis Price) on a high-resolution (2-meter) DEM
- Locates possible culverts and drainage
- Now can run "flow direction" tools and get accurate results

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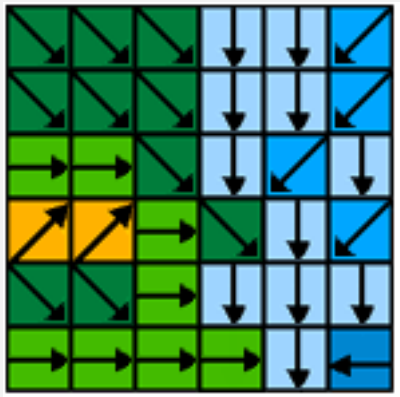
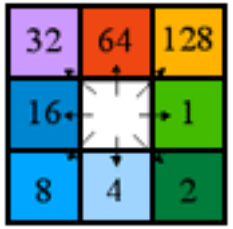
THE PROCESS

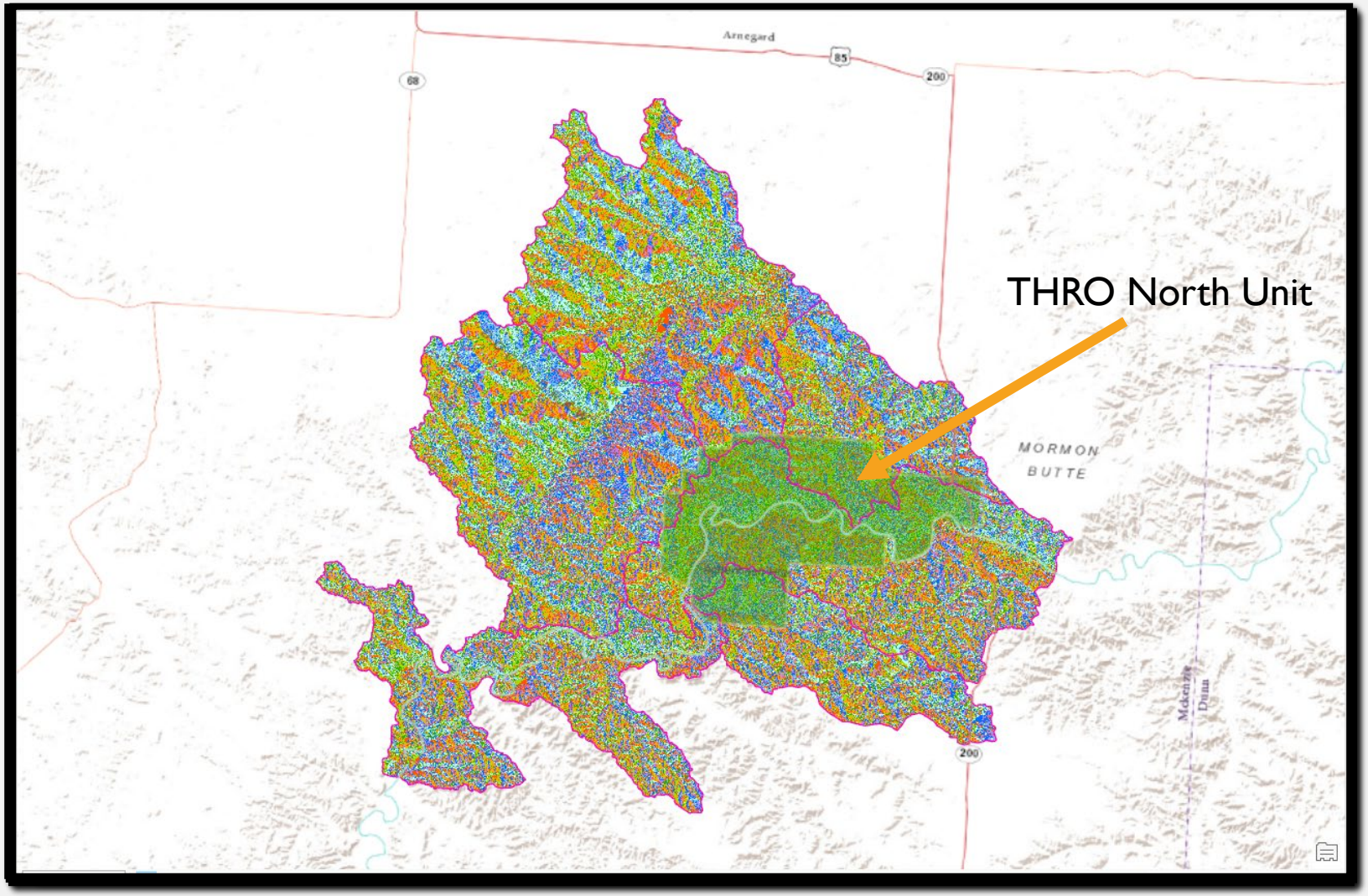


Flow direction



Direction coding

THRO North Unit and Study Area



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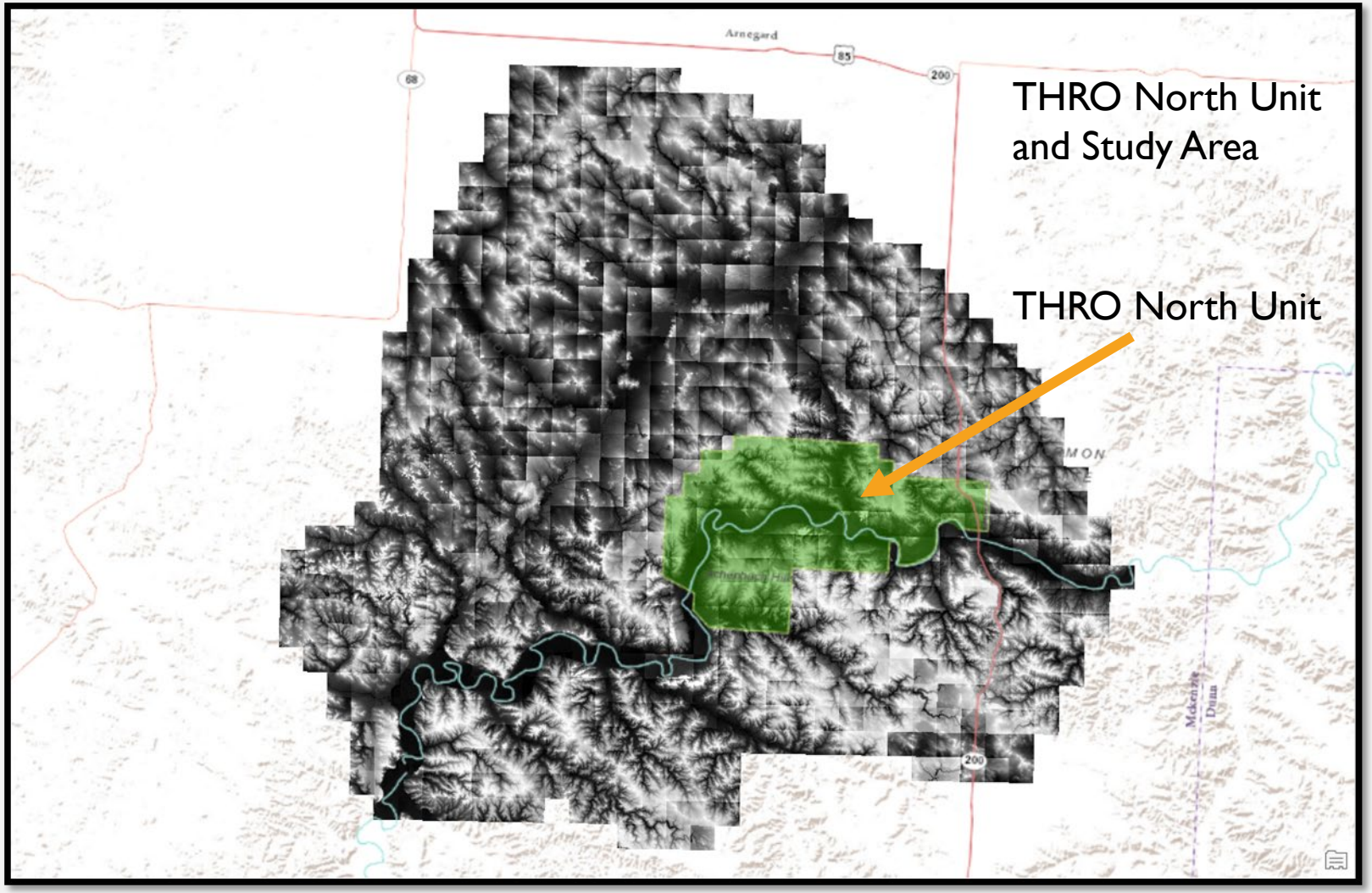
CHALLENGES ALONG THE WAY

- Too many 2m DEM tiles
- Tile seams and proper software
- Time
- Selective Drainage Tool updates



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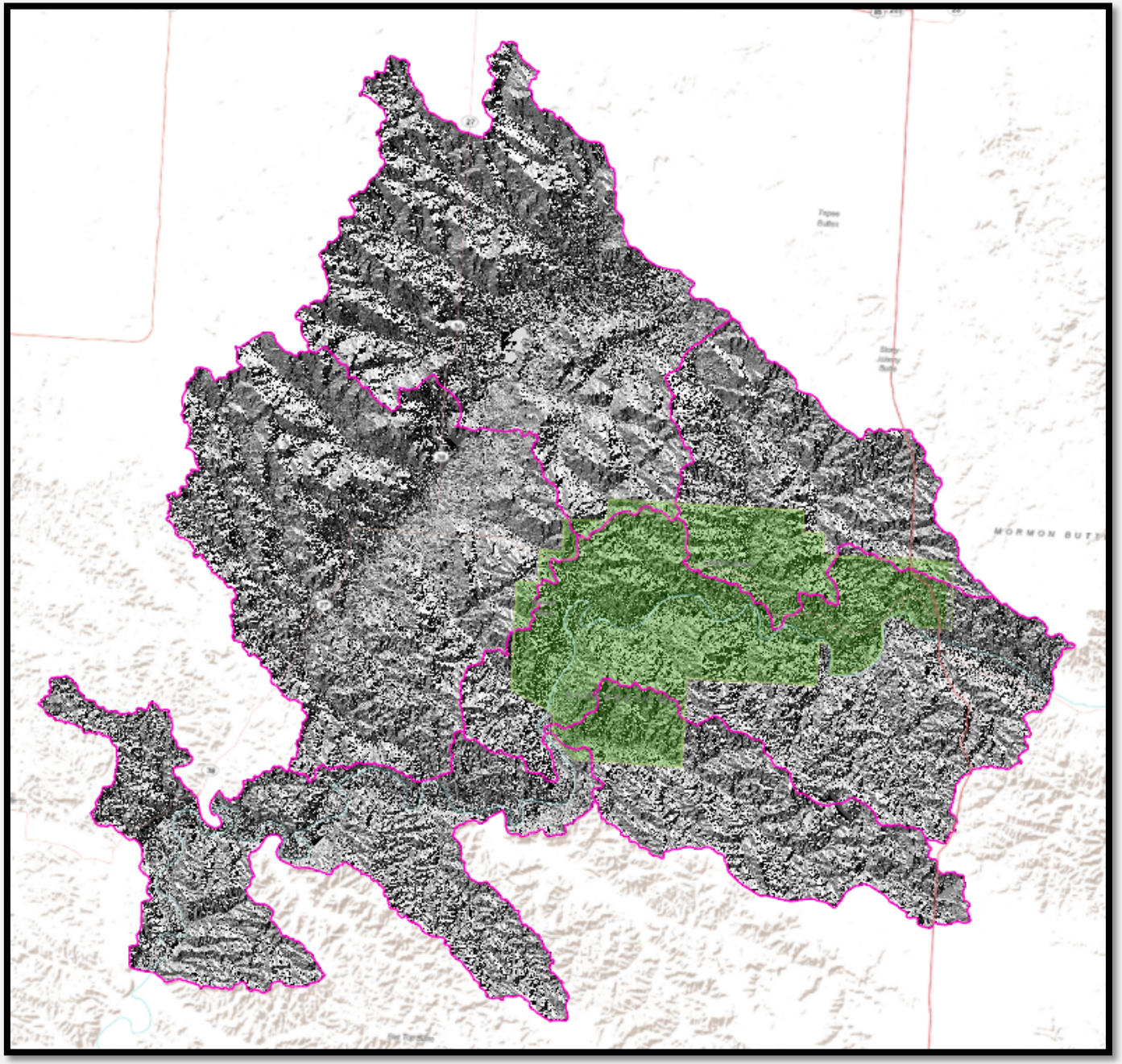
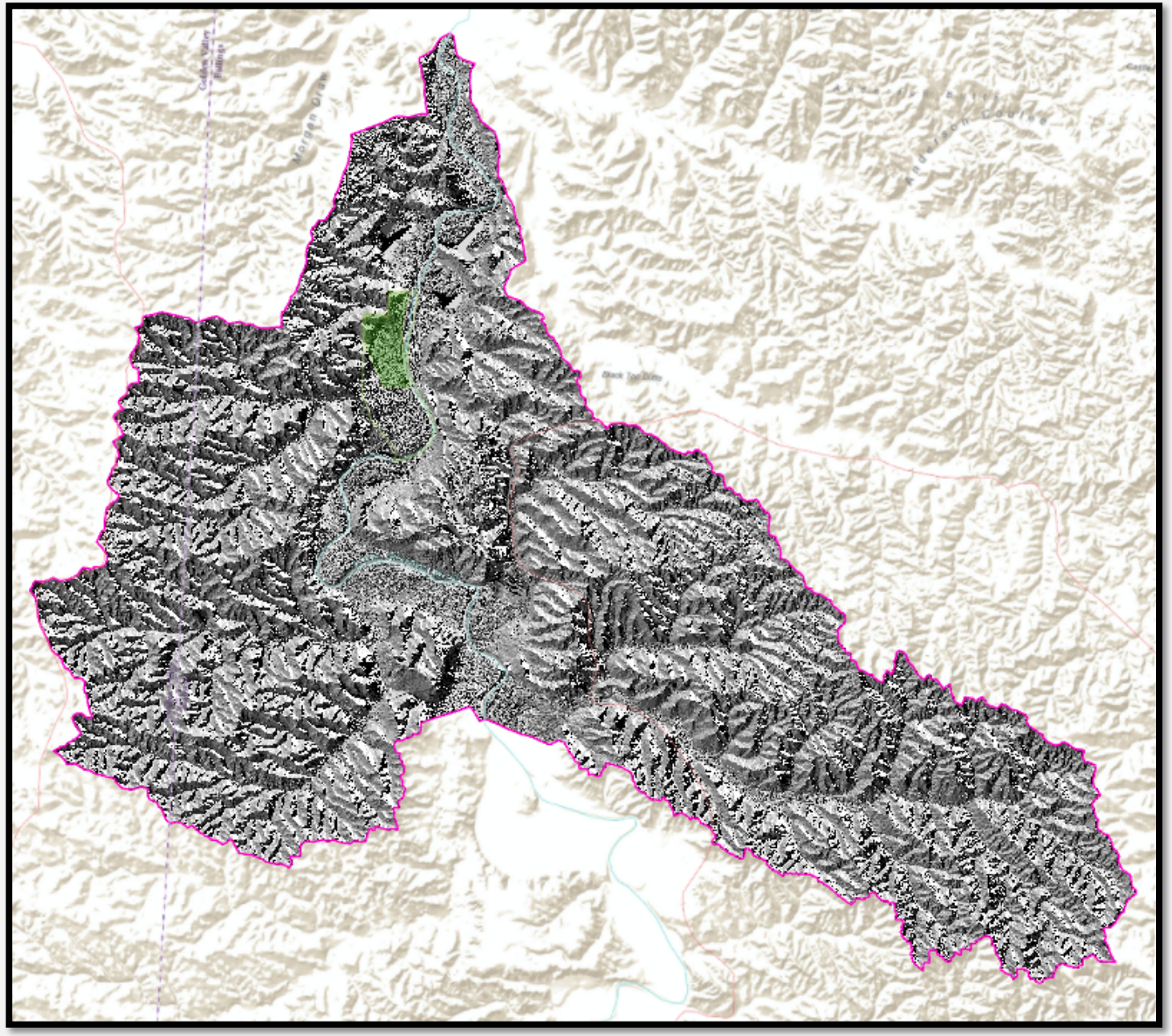
THRO NORTH UNIT AND STUDY AREA



THRO ELKHORN RANCH AND STUDY AREA



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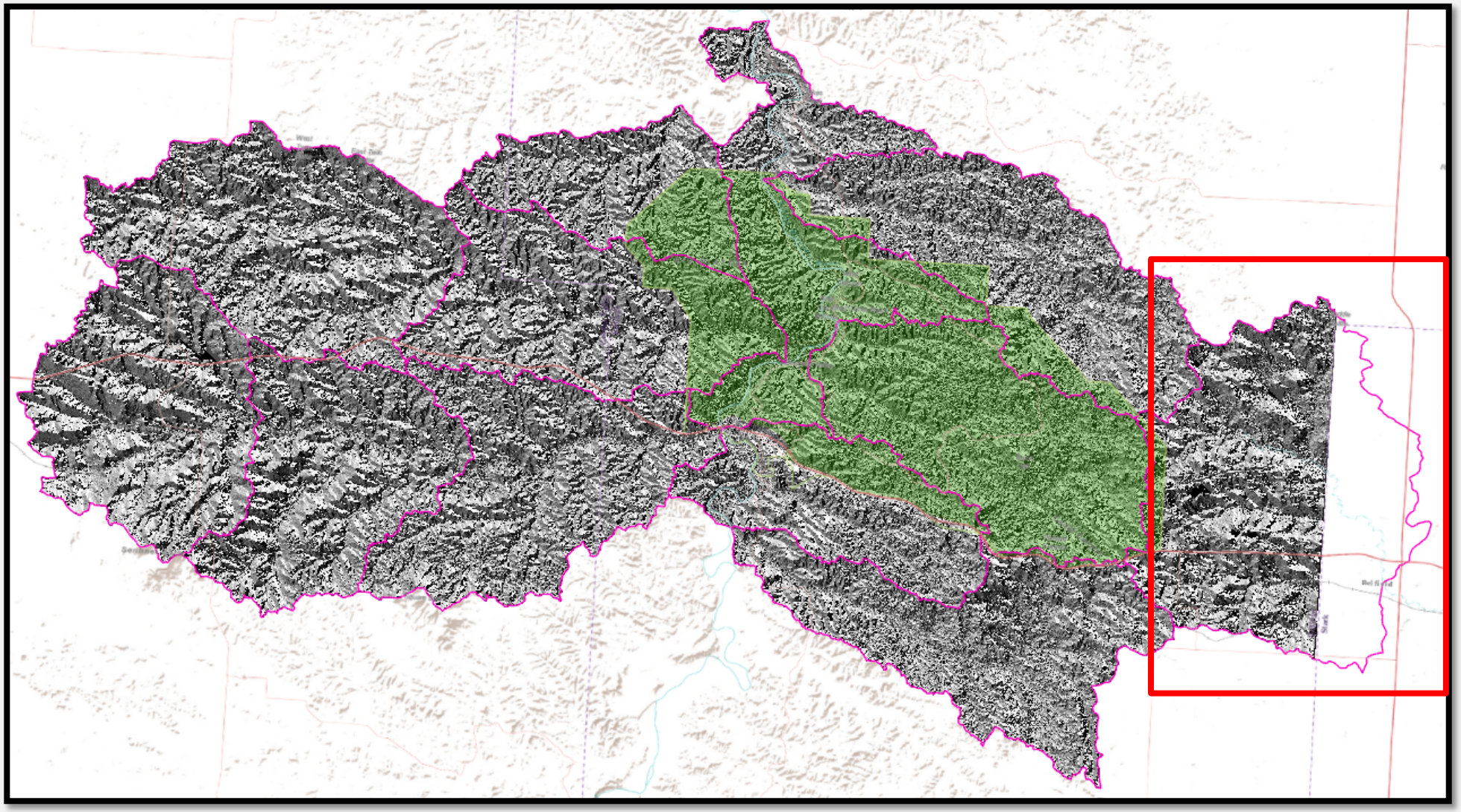
THRO SOUTH UNIT AND STUDY AREA



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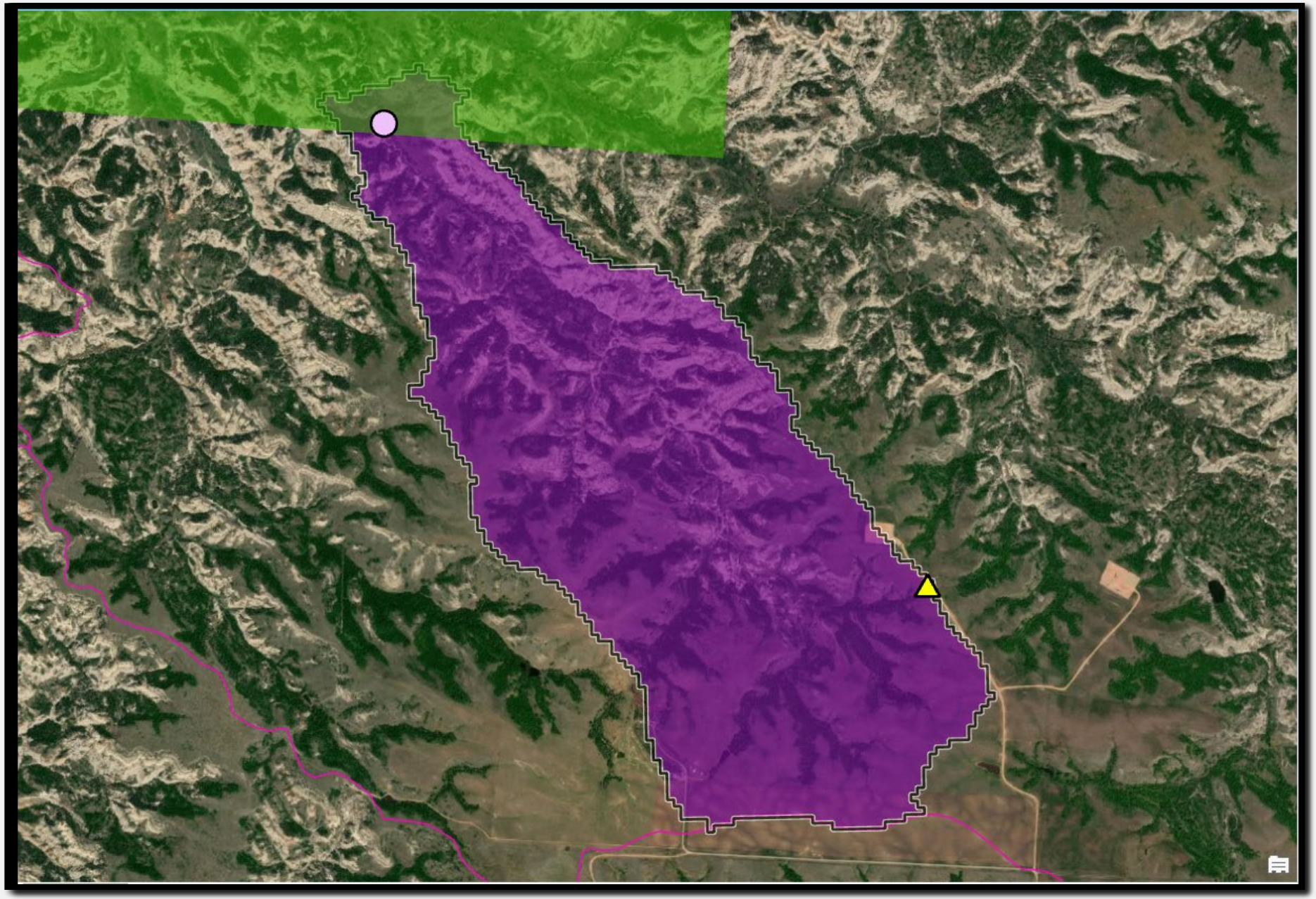
FLOW PATH TRACING

AND

UPSTREAM WATERSHED



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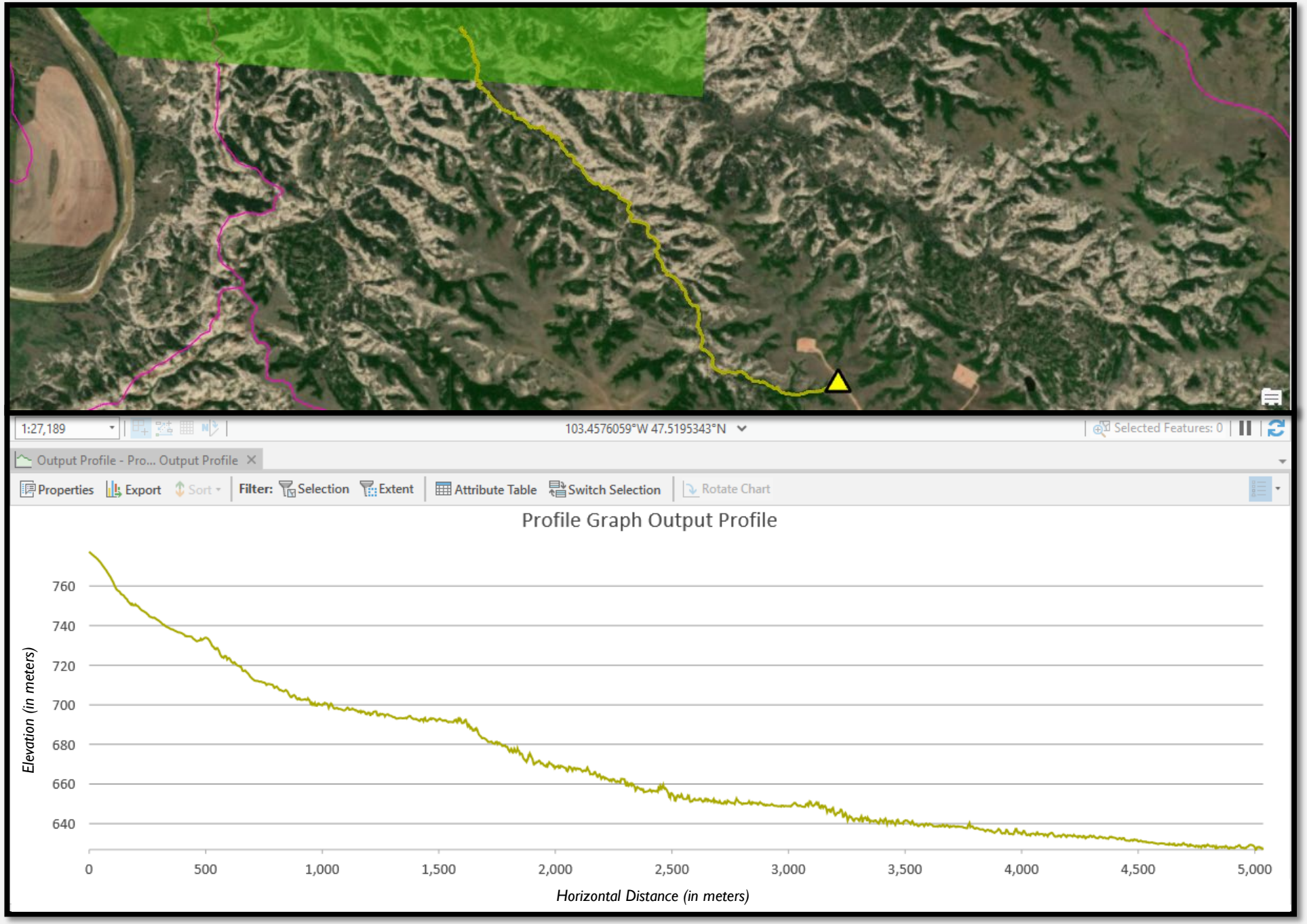
STREAM PROFILE

South side of Park North Unit



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USING THE TOOL

- Once the large ArcGIS file is downloaded to a local computer, the tools are quite quick
  - Flow Path finishes within 5 minutes
  - Upstream watershed finishes within 10 minutes
  - Profile is created within 10 minutes (depending on how many nodes)
- Within an hour of receiving the lat/long of a spill, a comprehensive report can be made of the spills possible flow path or origin

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GIS Tool vs StreamStats

- This GIS Tool = 2 meter resolution, hydro-enforced
- StreamStats = ND 10 meter resolution, not hydro-enforced

SUMMARY

- Combine existing tools to create graphics for NPS staff, On-Scene Coordinators, and other responders
- Requirements:
  - High-resolution DEM or LIDAR files
  - Understanding of terrain to verify culvert placement
- Could potentially protect sensitive species and landscapes

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WHAT NEXT?

- Will be proposed to the Fort Berthold Indian Reservation in North Dakota
  - Reservation is in the heart of oil development land in ND
- Possibilities of from-scratch small spill analysis could be finished within a week
- USGS Dakota Water Science Center personnel have begun Phase 2
  - Using projected oil flow paths to locate vulnerable areas in and around the THRO

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QUESTIONS?

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