

Lidar + GIS: Revolutionizing Landslide Mapping and Field Evaluation

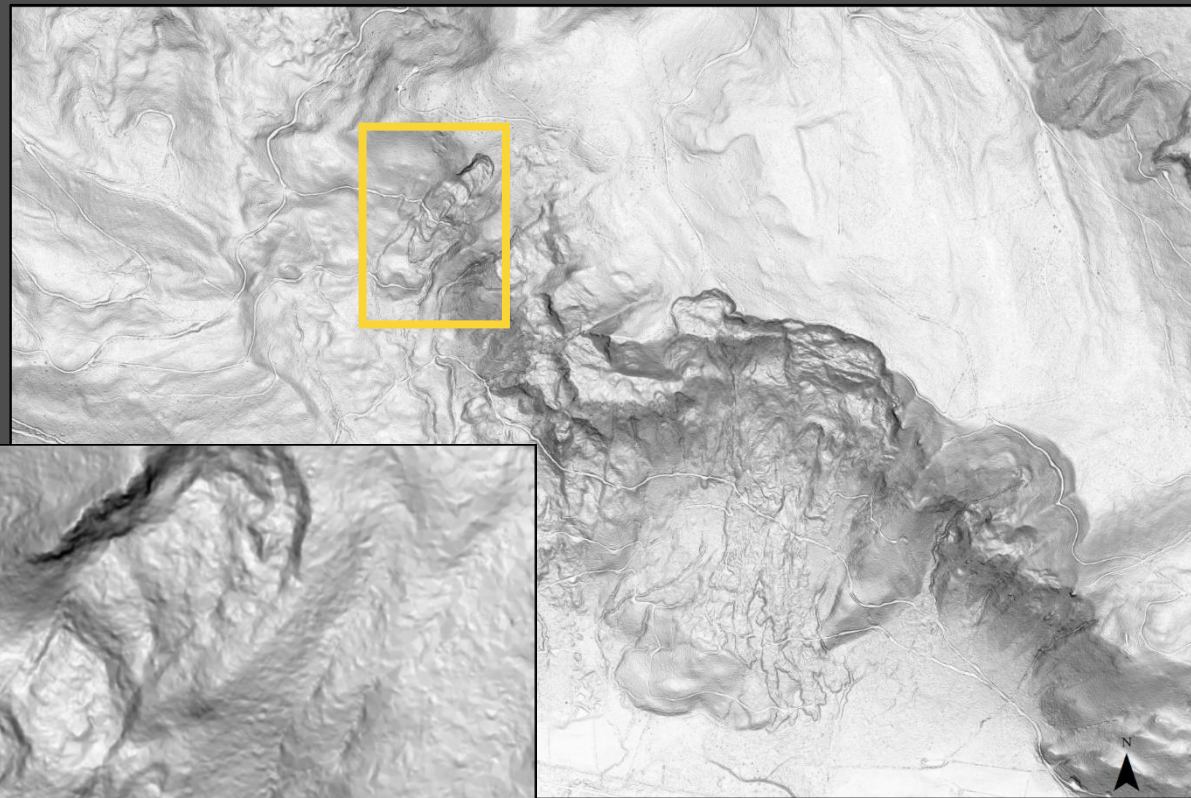
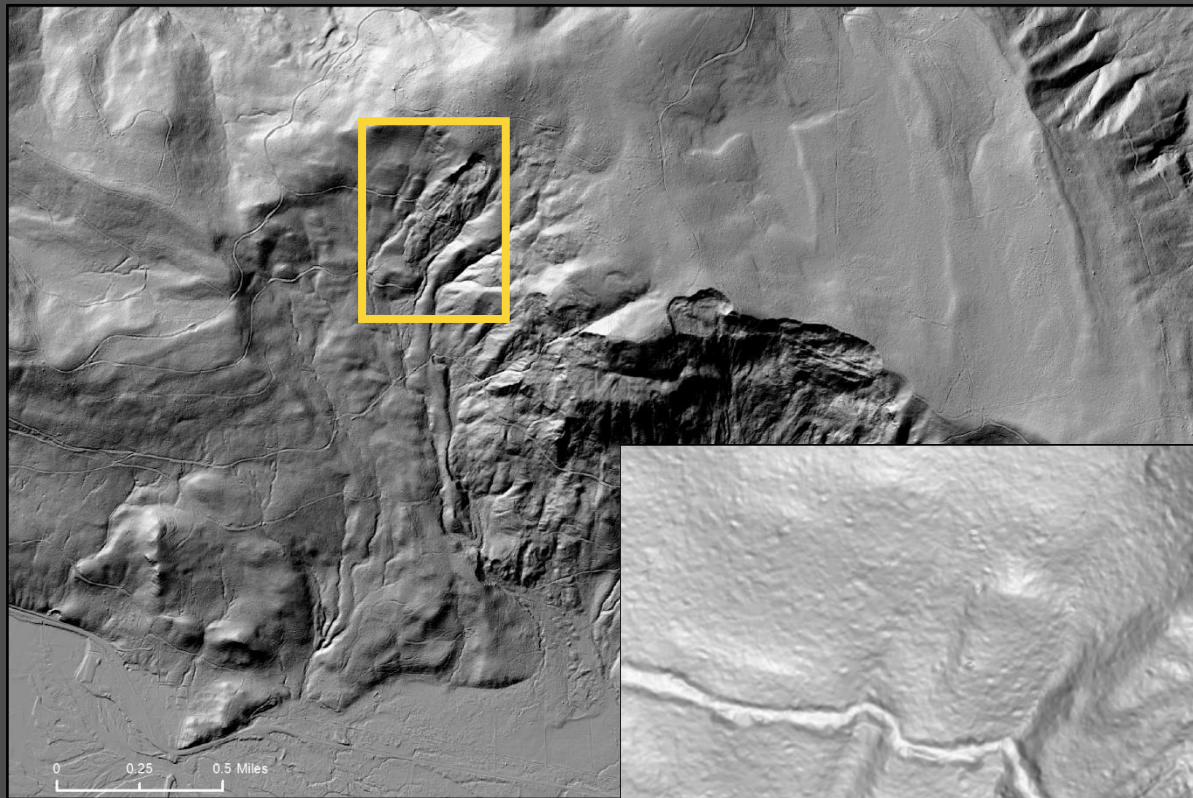


Kara Jacobacci, Washington Geological Survey (Division of Geology and
Earth Resources, DNR)



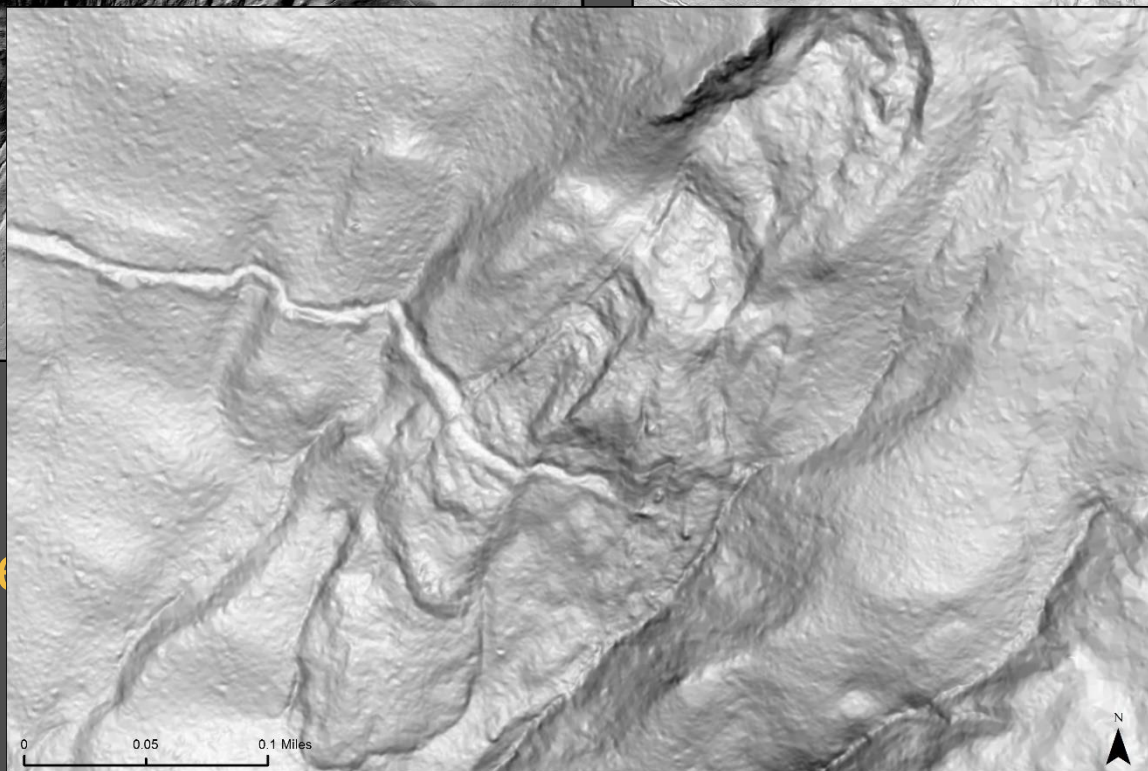
Part I: Lidar-Based Inventories and “Desktop” GIS

Washington Geological Survey's High-Res lidar



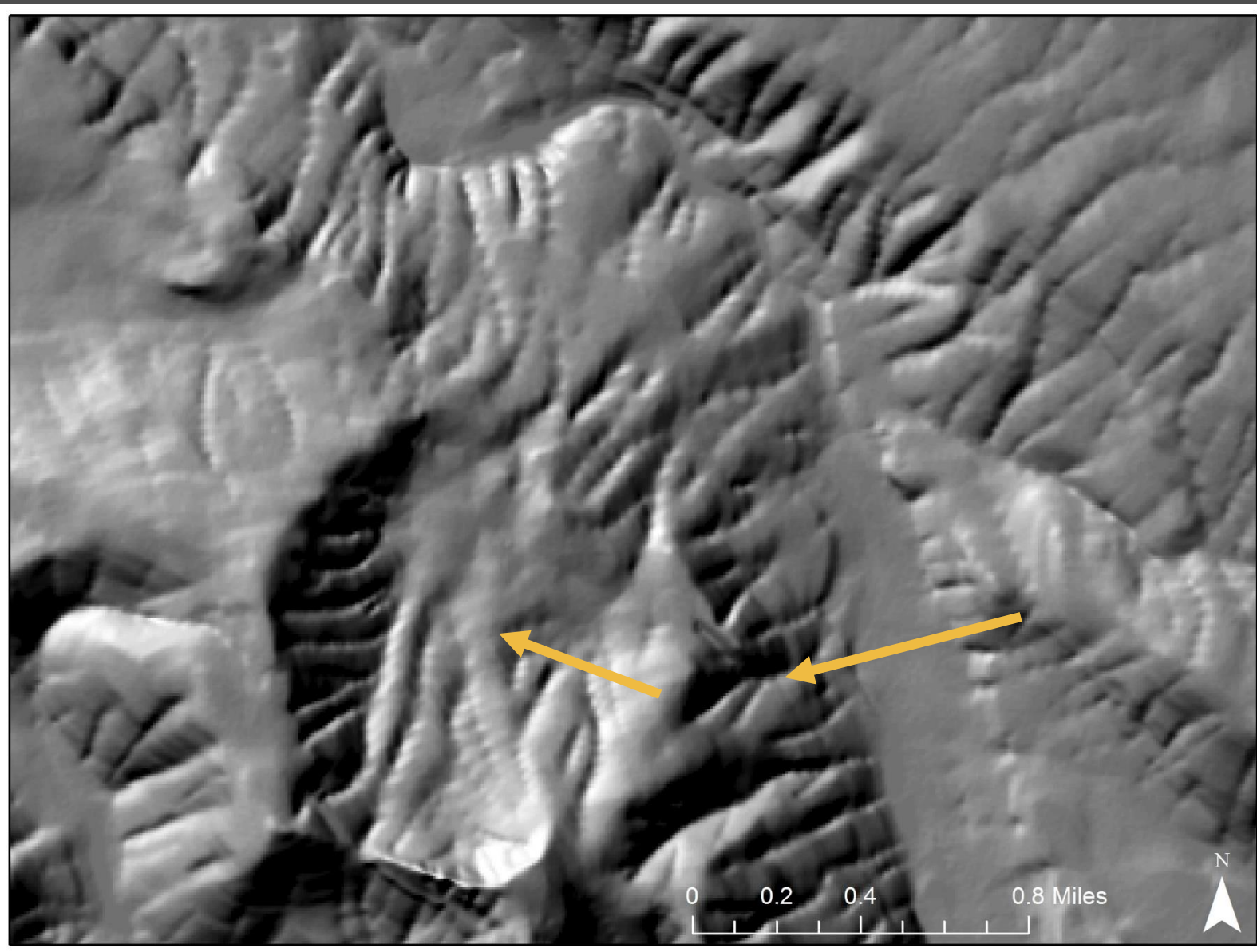
Hillshade

Shape Shade



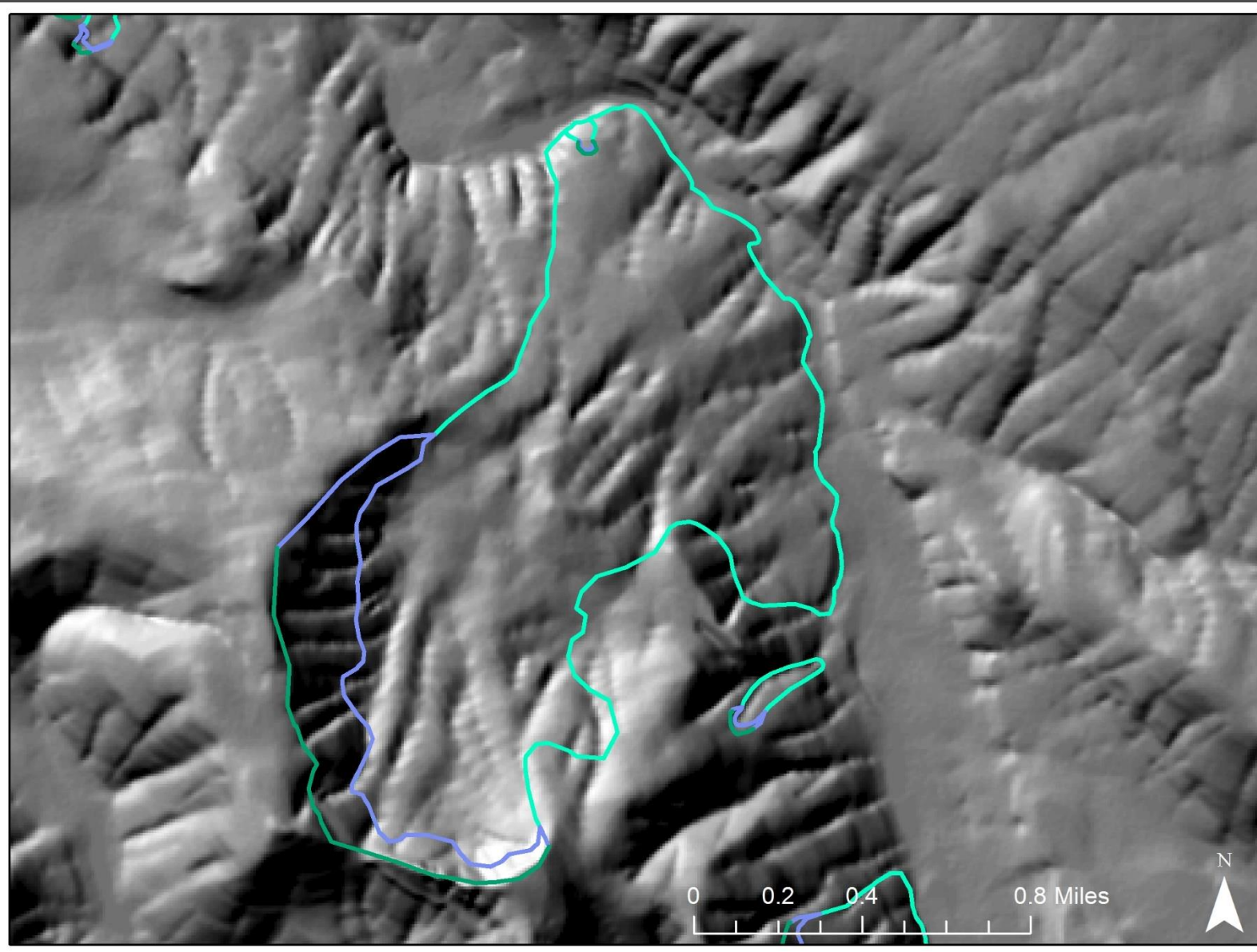
Landslides on 10m DEM Shaded Relief

USGS 10m
Shaded Relief



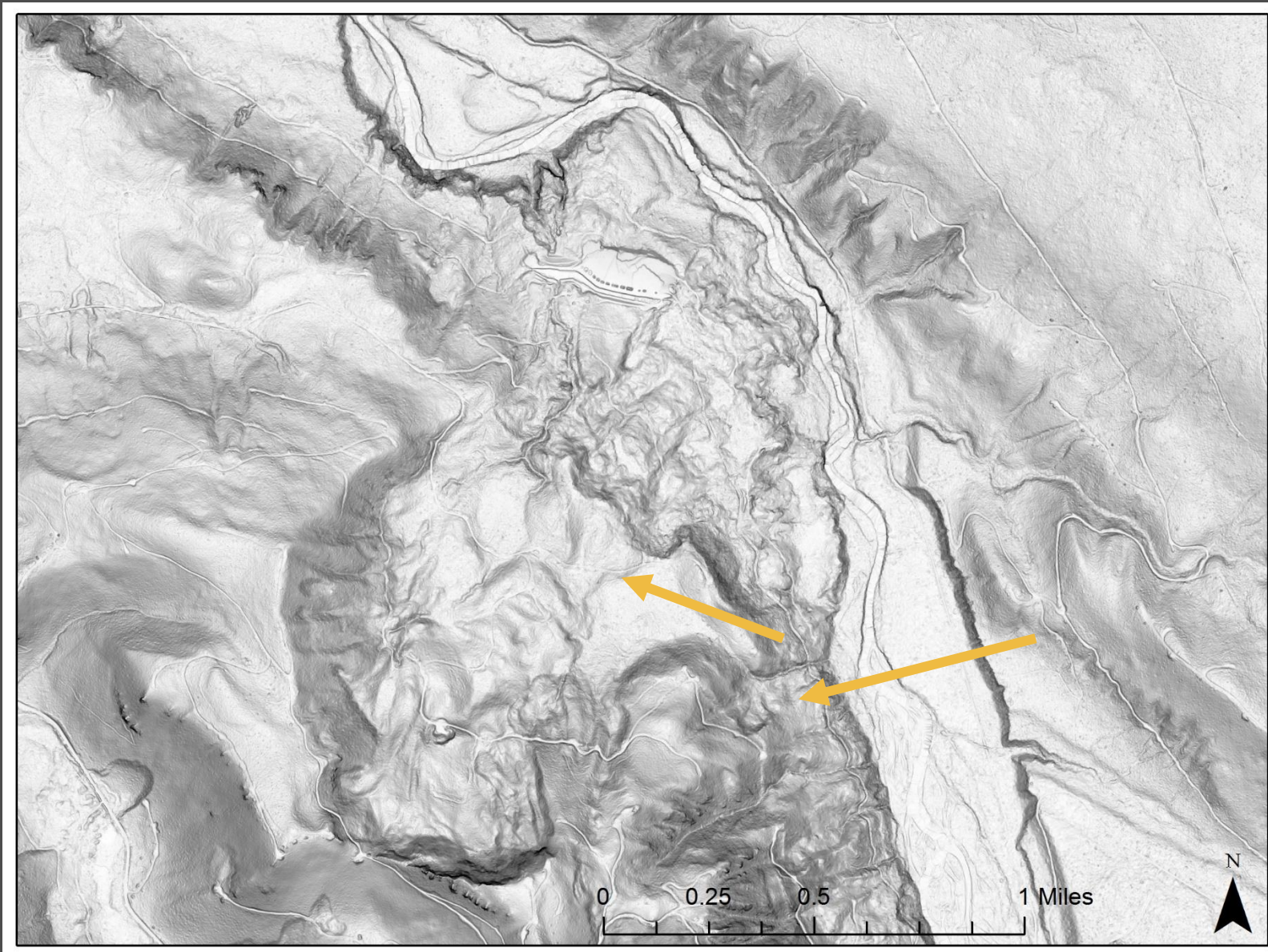
Landslides on 10m DEM Shaded Relief

USGS 10m
Shaded Relief



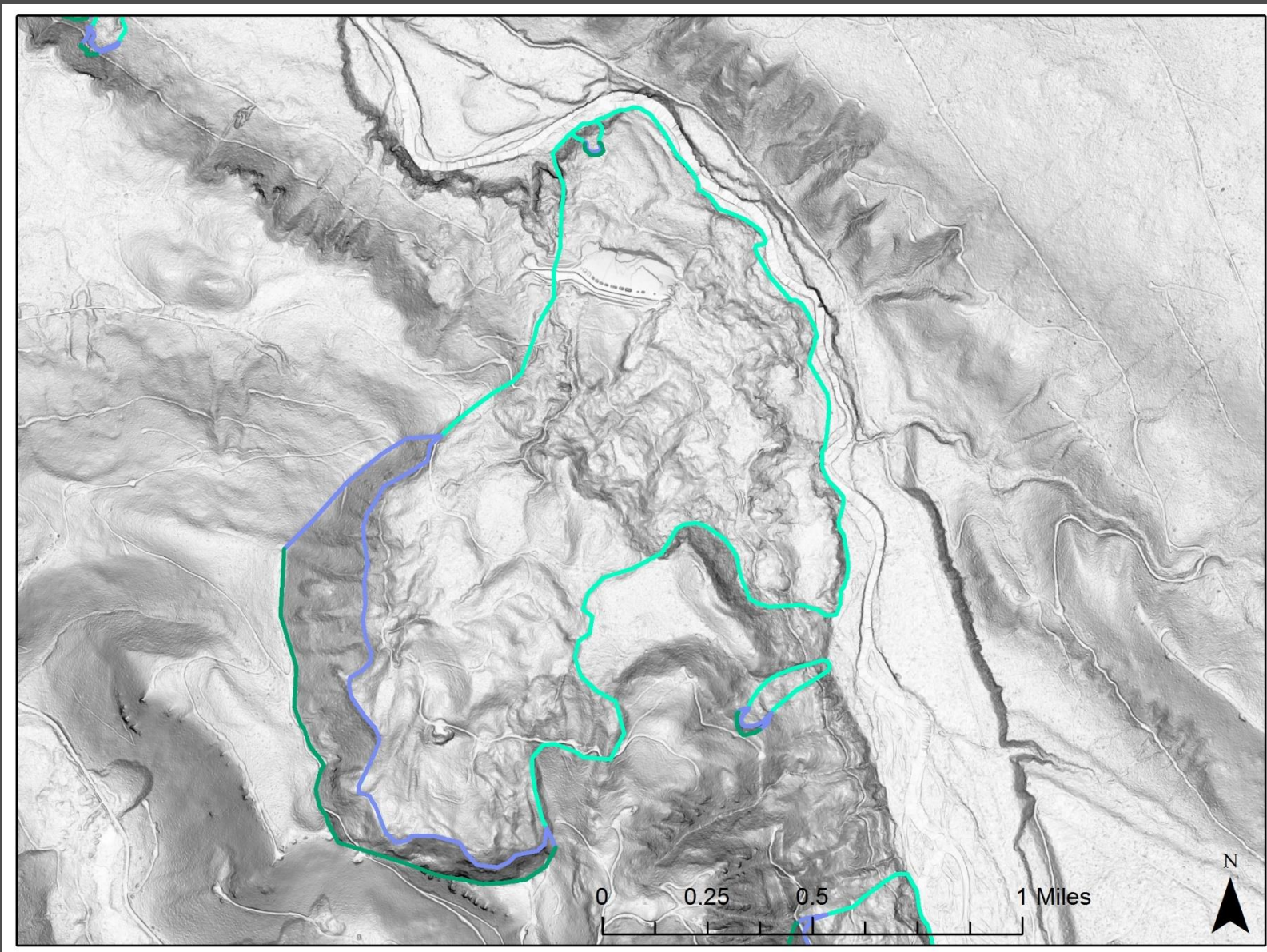
Landslides on 3ft Lidar Derivatives

Slope Shade

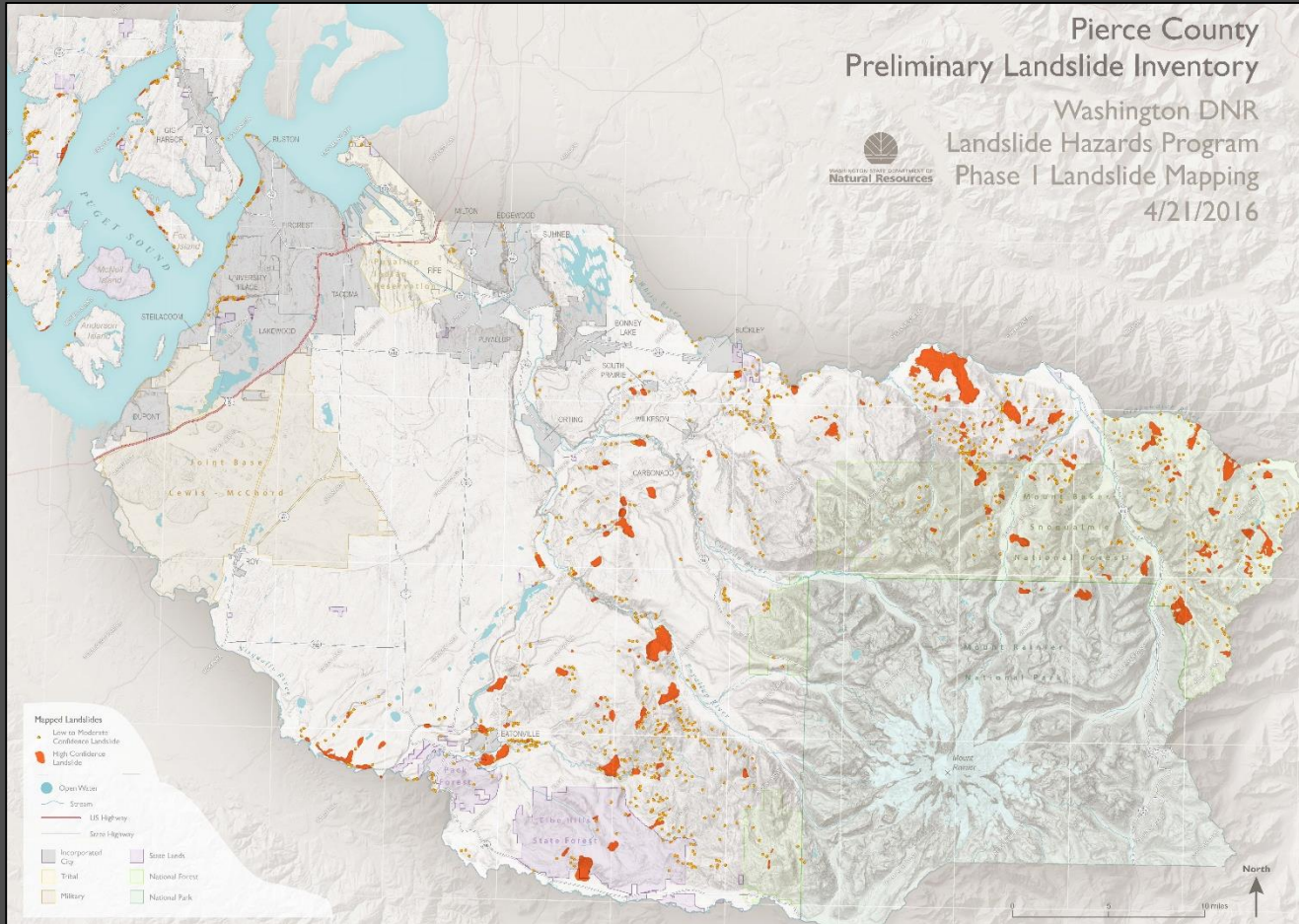


Landslides on 3ft Lidar Derivatives

Slope Shade



SLIP (Streamlined Landslide Inventory Protocol)



- Rapid mapping over large areas
- Generates a comprehensive database, which can stand alone or be used to focus on areas for detailed mapping

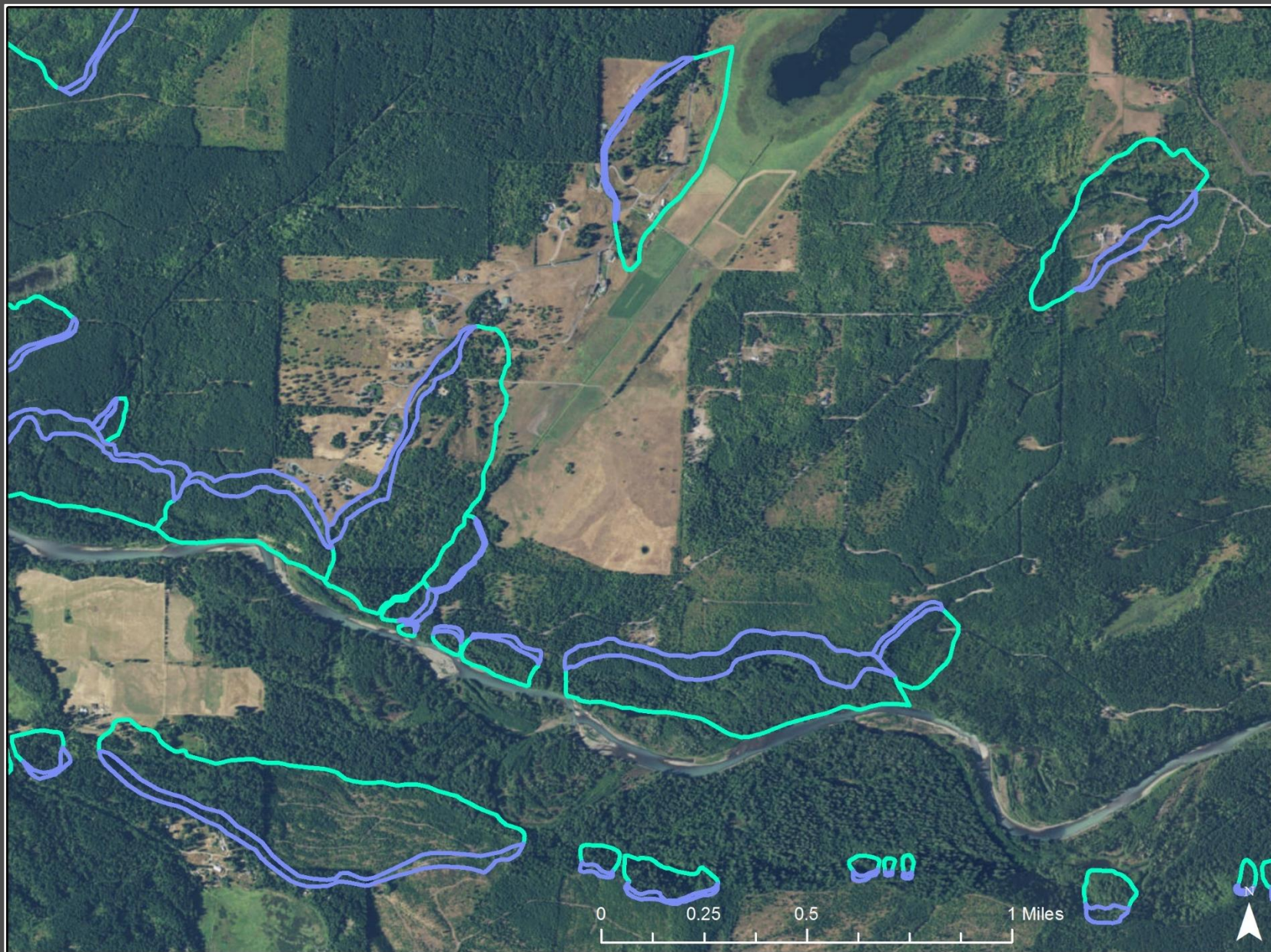
Inventories from lidar vs. Aerial Photo Interpretation

Literally can't see the landslides for the trees.

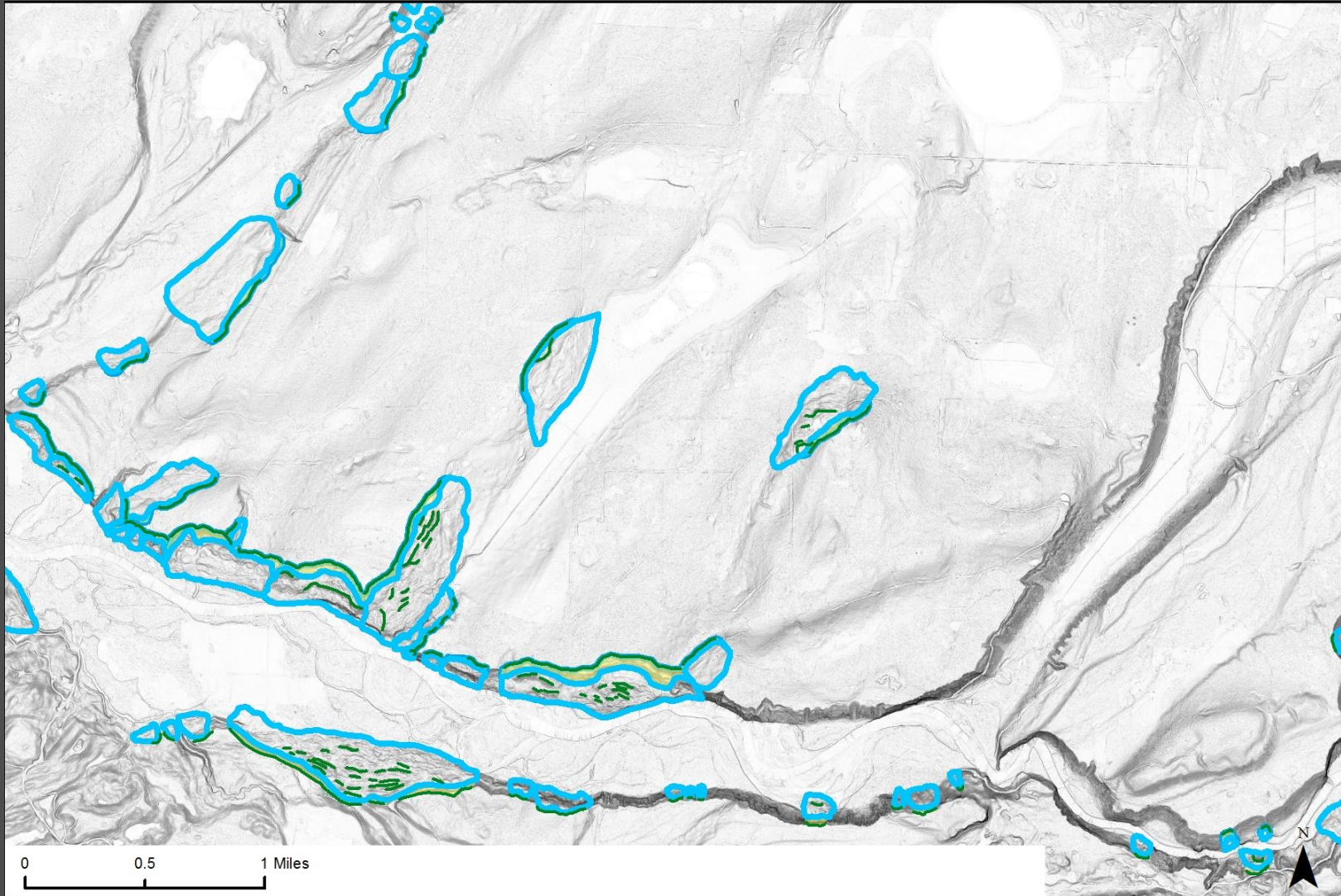


Inventories from lidar vs. Aerial Photo Interpretation

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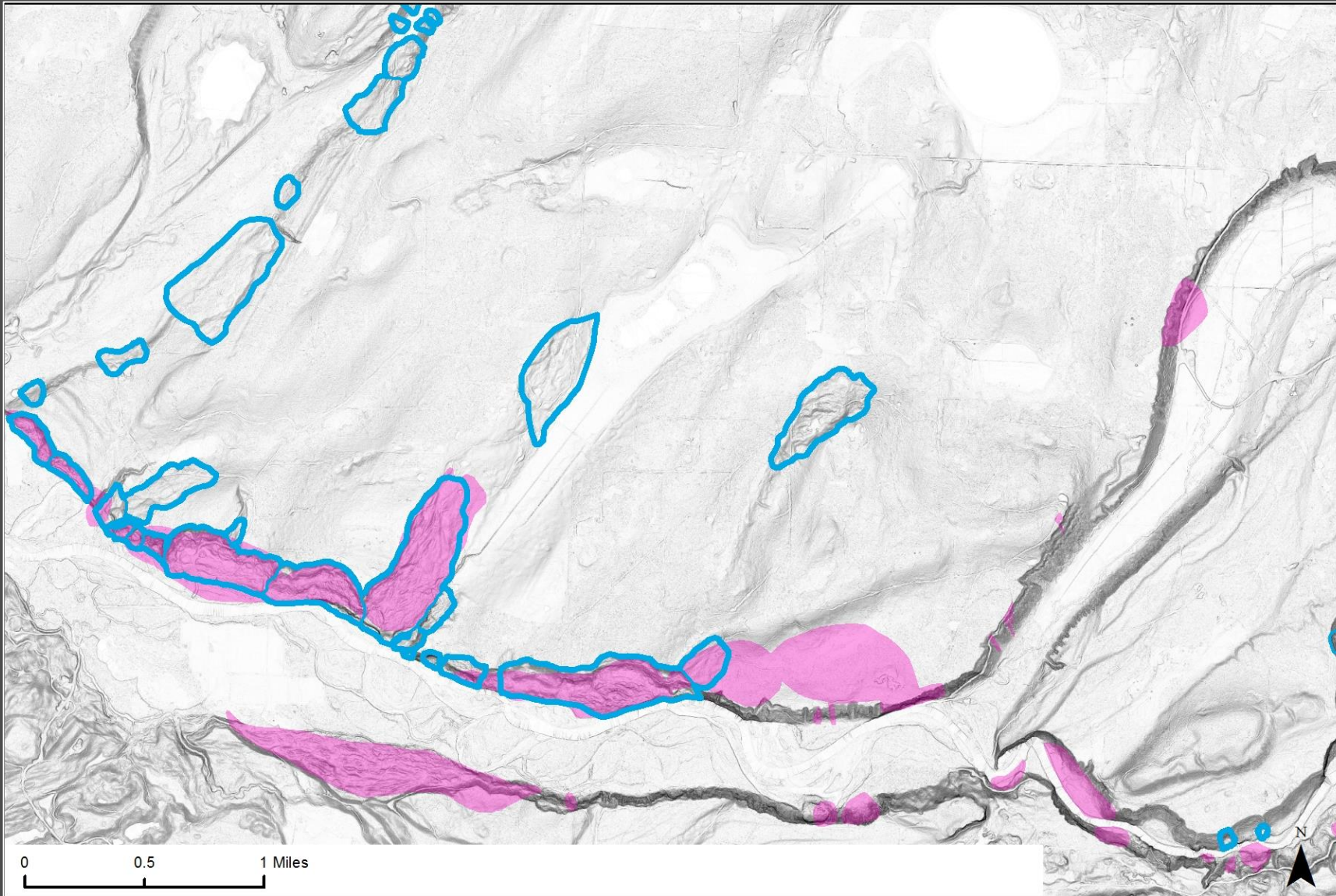


Detailed Landslide Inventory – Partnership with Pierce County



- Landslide Hazards Pilot Project: Pierce County
- Comprehensive inventory for the whole county
- 702 landslides with detailed attributes (over 25 attributes per slide)
- 547 SLIP (previous slide) landslides

New lidar inventory vs. 10m DEM/Orthophoto inventory



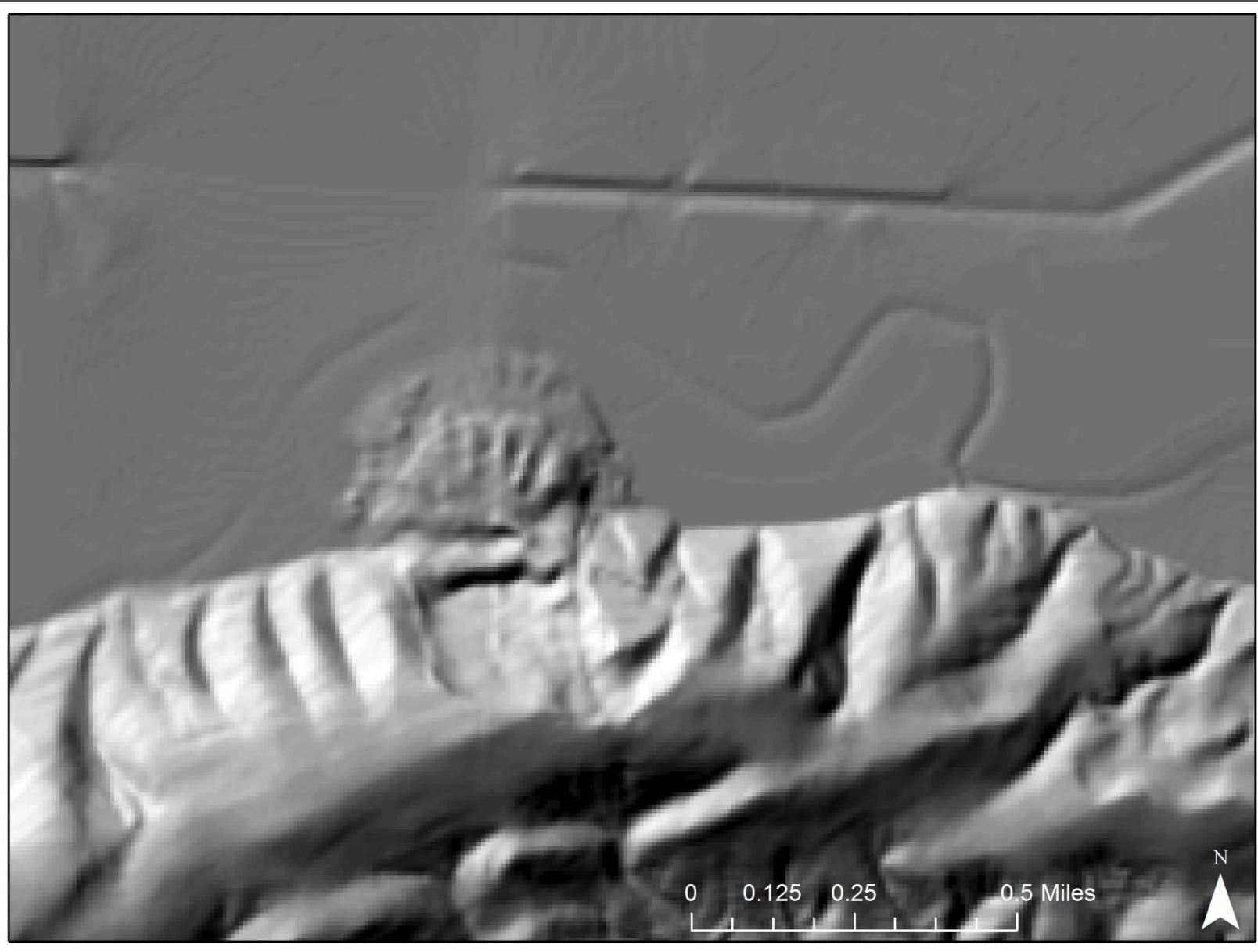
Old inventory (pink polygons) with new lidar-based inventory (blue outline) superimposed.

Old inventory – mapped from 10m DEMs and aerial photography

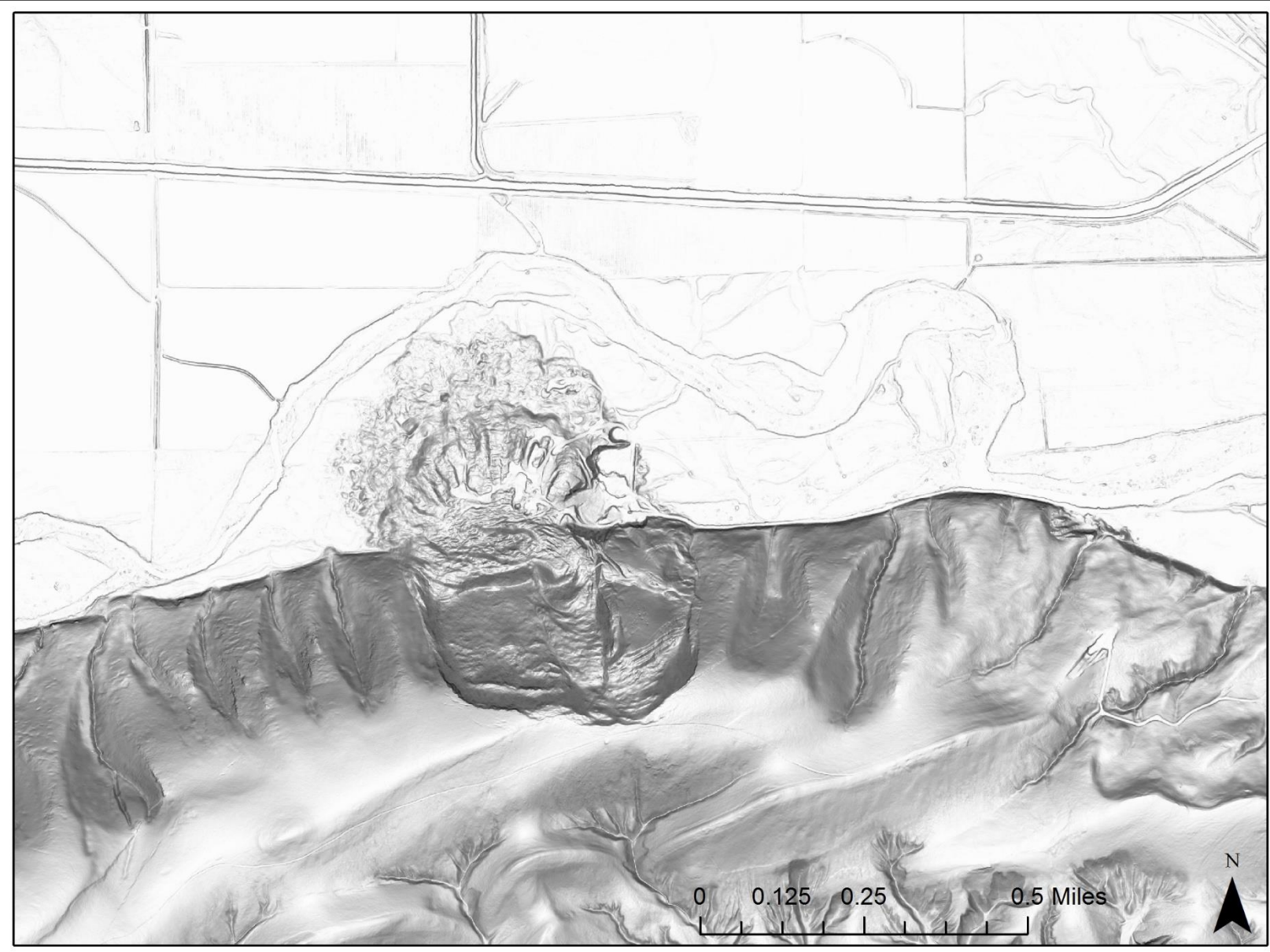
New inventory – 3ft DEM

Landslides on 10m DEM Shaded Relief vs Lidar

USGS 10m
Shaded Relief

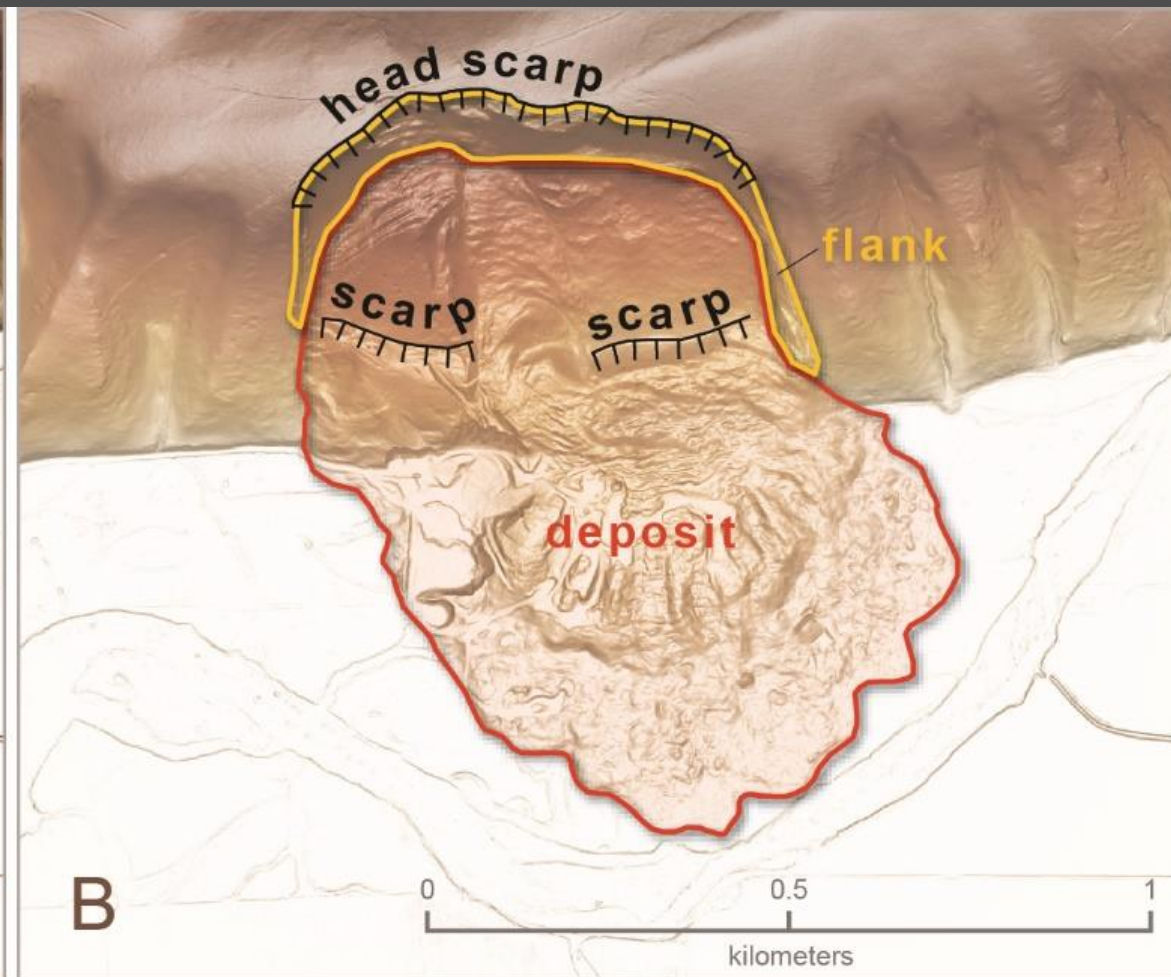
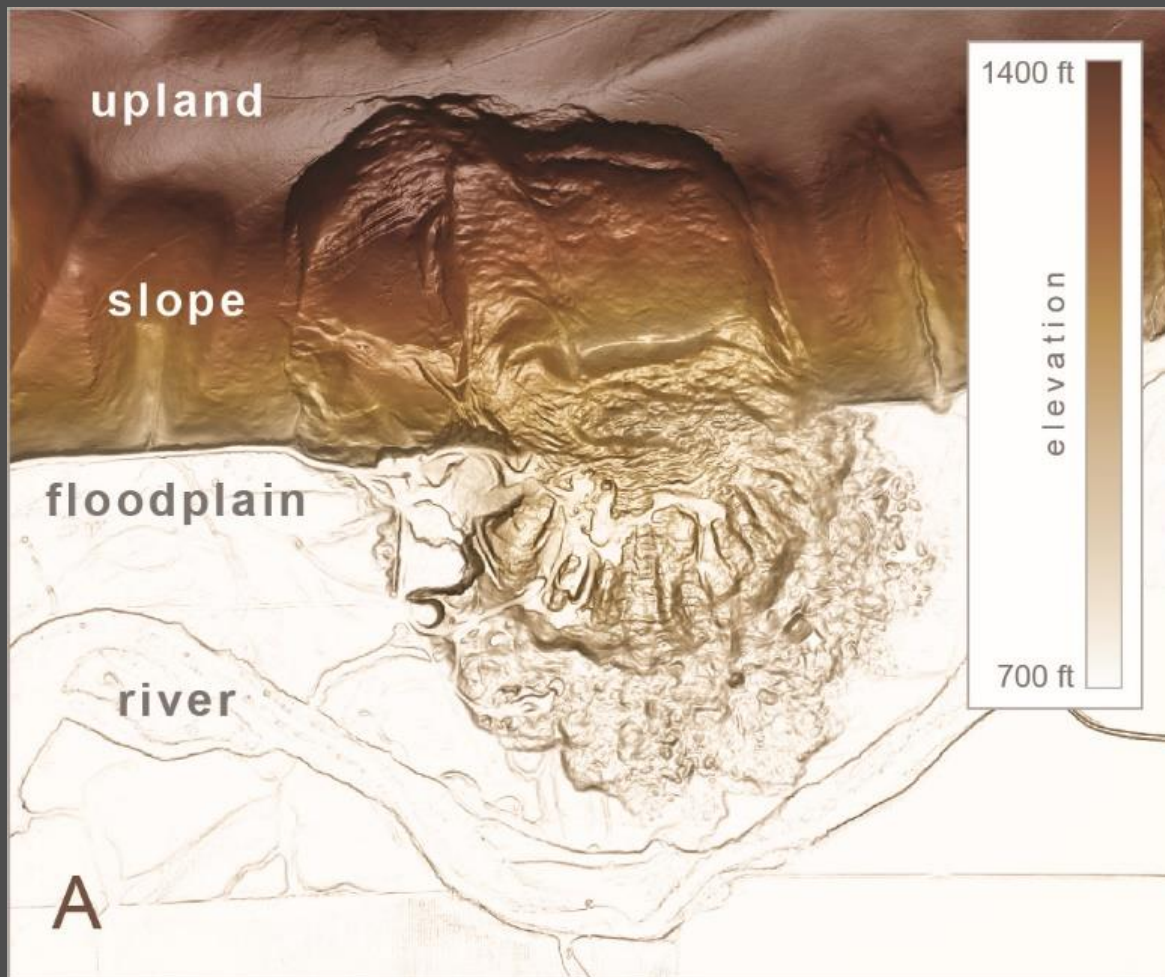


Landslides on 10m DEM Shaded Relief vs Lidar

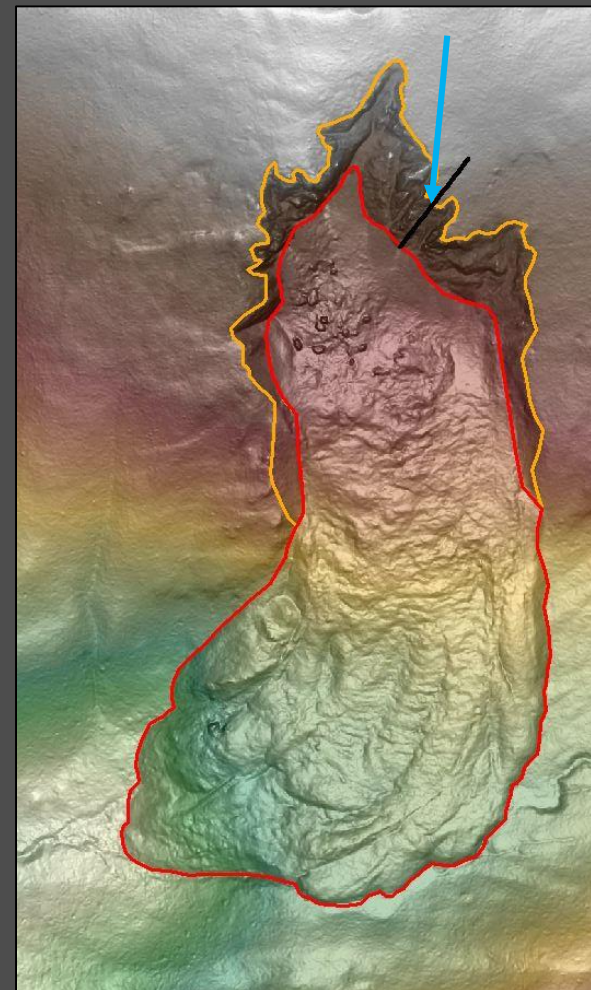
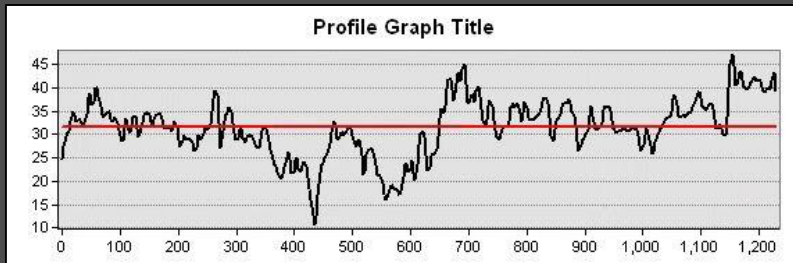
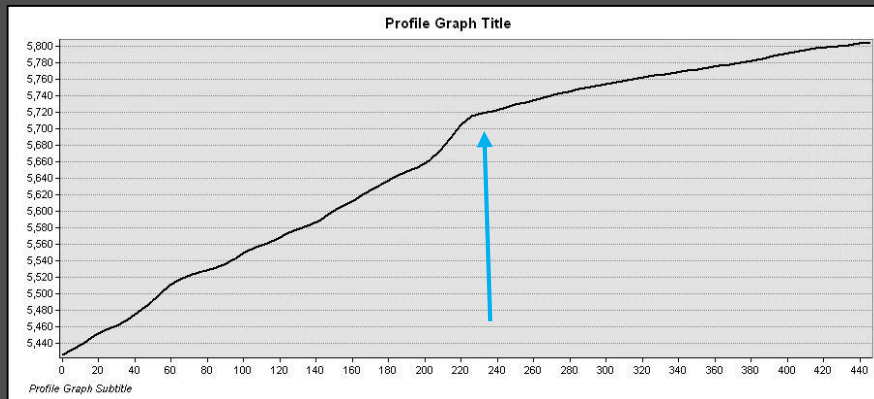
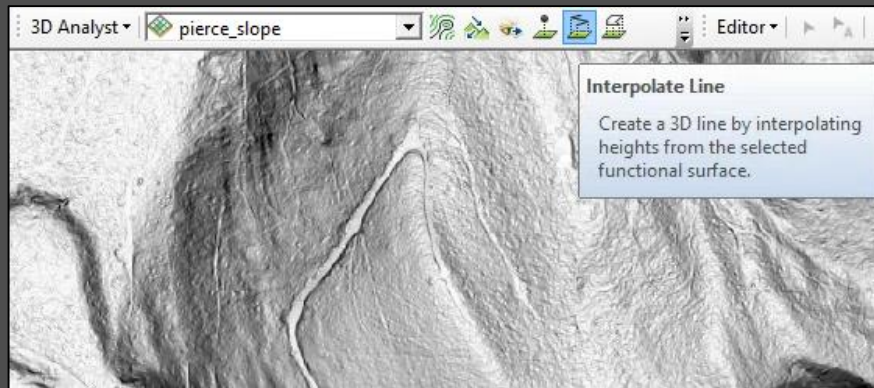
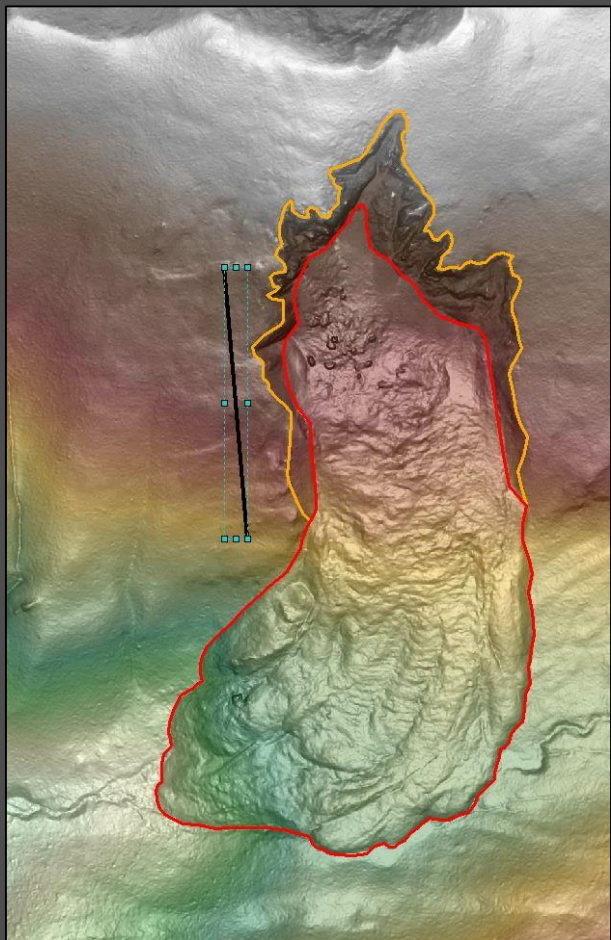


3ft Grid lidar –
derived vertical
hillshade

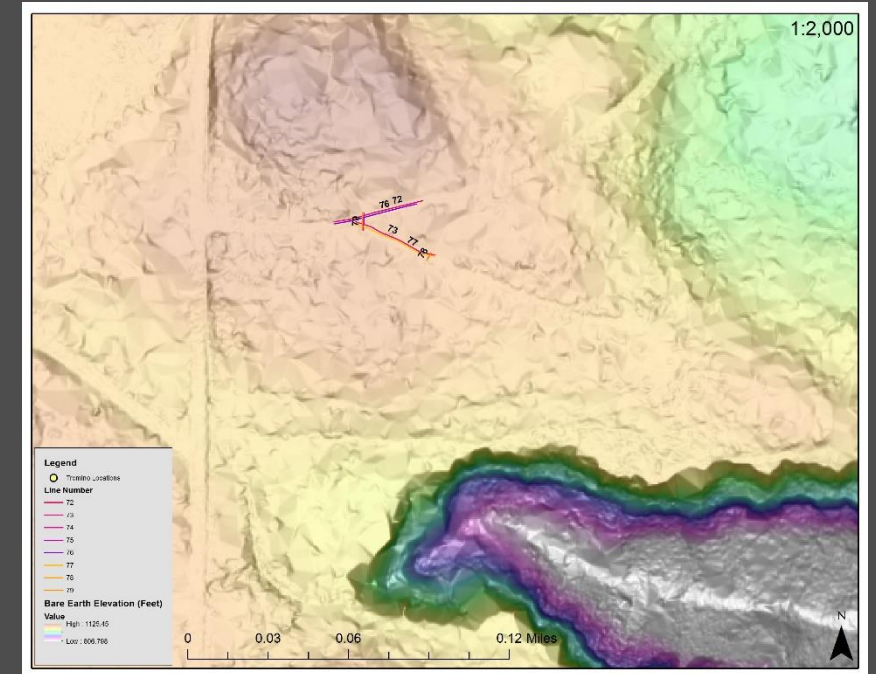
Mapping Landslide Features with Lidar



Detailed Landslide Attributes and Lidar



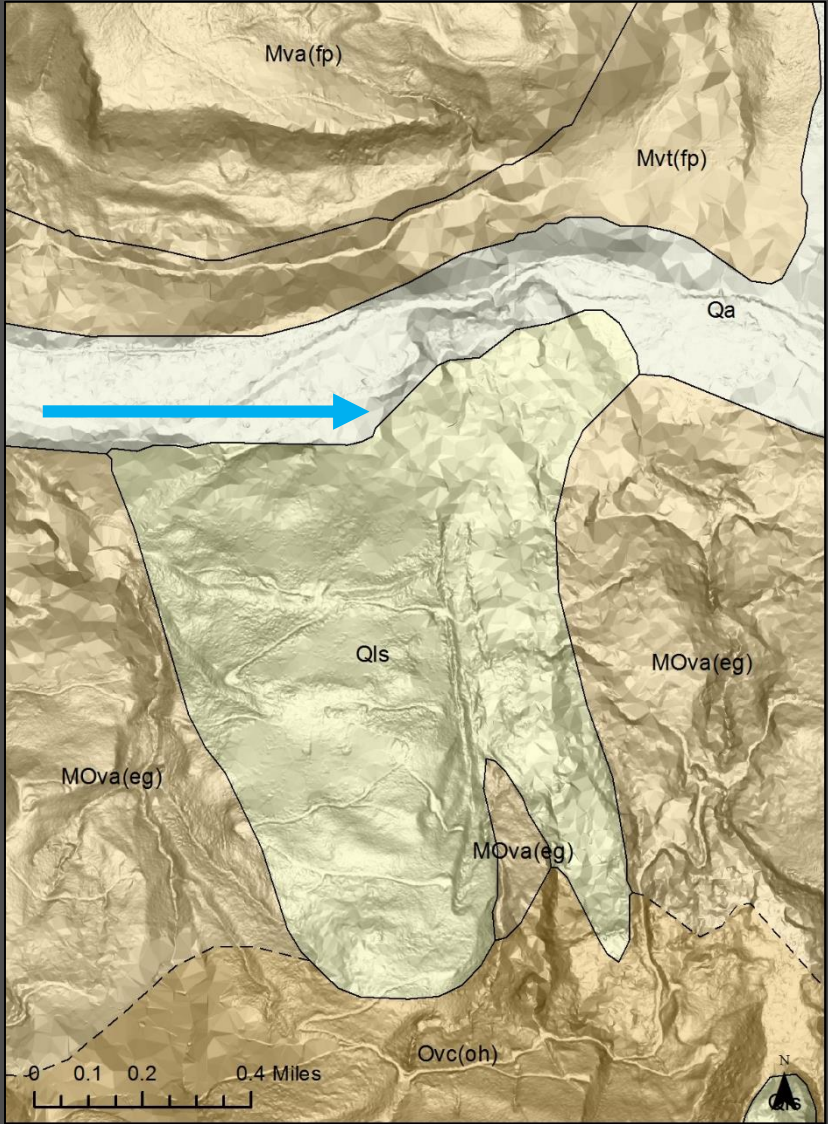
Part II: GIS in the Field



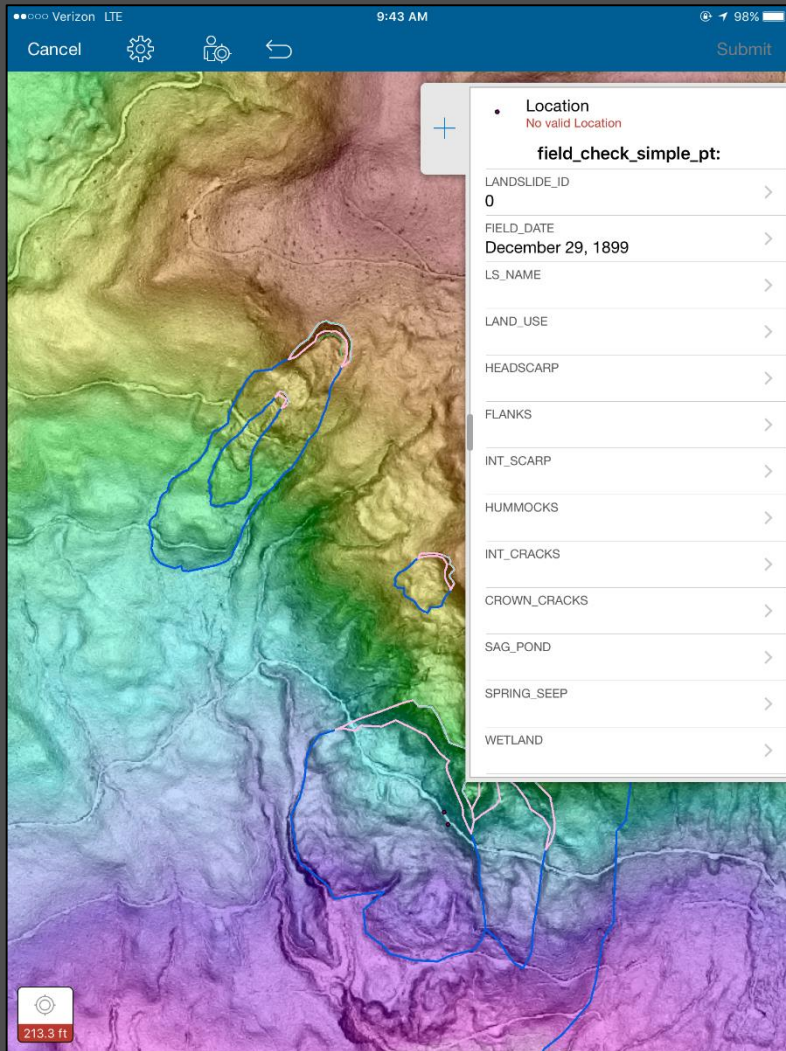
Accurately Mapping Geologic Contacts with Lidar



Coarse-scale geologic mapping (1:100,000) can be refined through the use of lidar



ArcCollector: No more soggy notes!



Replacing This →
← With this

DNR LANDSLIDE QUICK FIELD RECONNAISSANCE DATA SHEET
 The sheet is intended to assist in quick and consistent field data recording for a reconnaissance-level landslide response by a DNR geologist. Only readily observable information will be recorded and data fields may be blank when observations are not easily made. Please submit copies to [Brian Skov](#) (FPD) and [Stephen Slaughter](#) (DGER)

Geologist name	Field date/time
Geographic name	Landslide date/time
DNR region	GPS lat/long
Photo numbers	GPS points
Who reported landslide Contact info	Landslide process/type

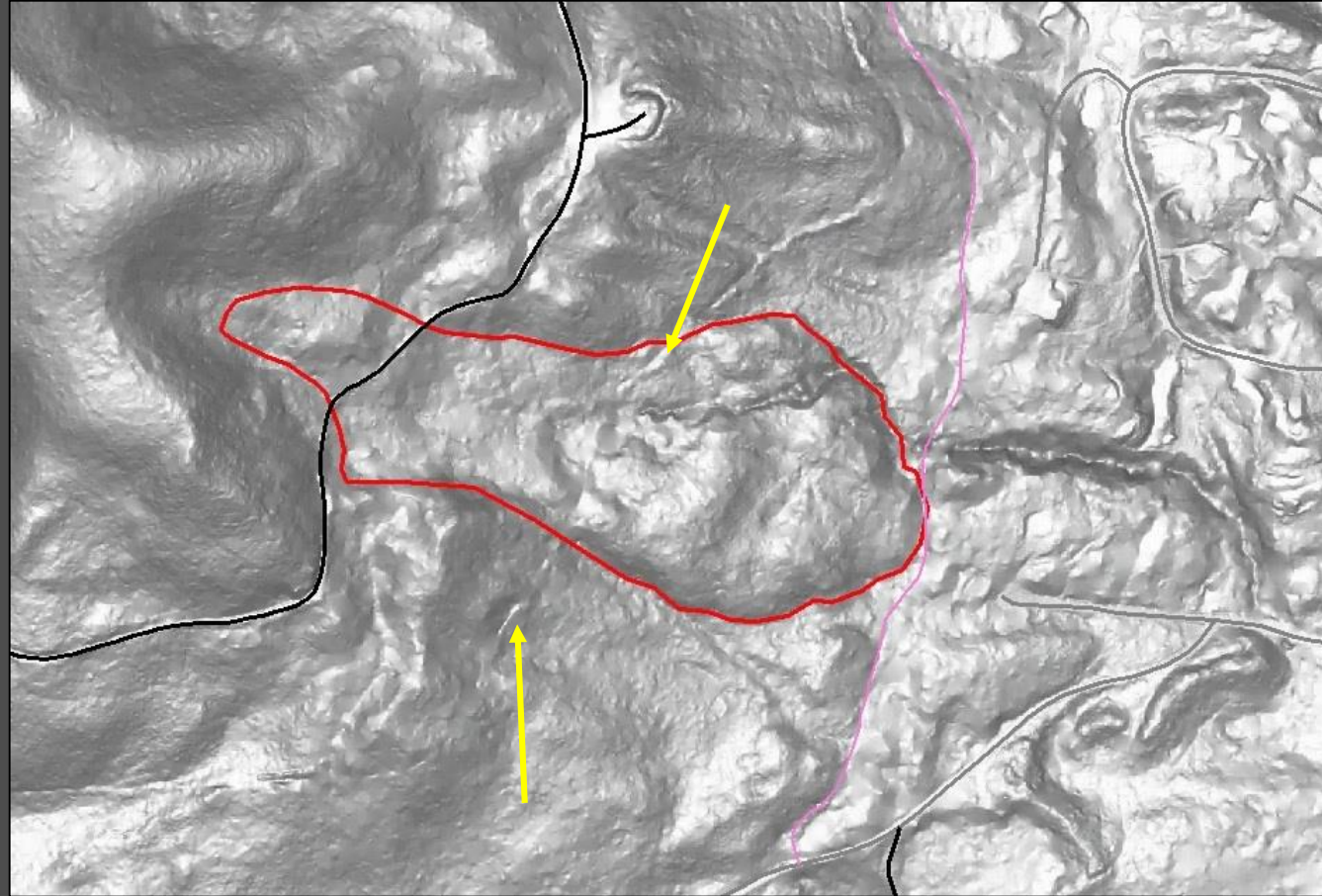
OBSERVATIONS

LAND USE AT INITIATION AREA <input type="checkbox"/> Rural <input type="checkbox"/> Urban <input type="checkbox"/> Agriculture <input type="checkbox"/> Forestland, mature, >50 yrs <input type="checkbox"/> Forestland, submature 10-50 yrs <input type="checkbox"/> Forestland, young, <10 yrs <input type="checkbox"/> Right of way <input type="checkbox"/> Other	IMPACTS TO BUILT ENVIRONMENT <input type="checkbox"/> Road <input type="checkbox"/> Gravel road <input type="checkbox"/> Rail <input type="checkbox"/> House <input type="checkbox"/> Building, business, shop, etc. <input type="checkbox"/> Outbuilding, barn, shed, etc. <input type="checkbox"/> Pipeline <input type="checkbox"/> Bridge <input type="checkbox"/> Utilities <input type="checkbox"/> Other	IMPACTS TO NATURAL ENVIRONMENT <input type="checkbox"/> Stream <input type="checkbox"/> Lake <input type="checkbox"/> Wetland <input type="checkbox"/> Saltwater <input type="checkbox"/> Forest <input type="checkbox"/> Grassland <input type="checkbox"/> Other
ZONE OF DEPLETION Main scarp <input type="checkbox"/> Single <input type="checkbox"/> Multiple Height Vol. Area <input type="checkbox"/> Approximate <input type="checkbox"/> Measured Material Tension crack above main scarp? <input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> Multiple	ZONE OF ACCUMULATION Deposit or toe <input type="checkbox"/> Single <input type="checkbox"/> Multiple Thickness Vol. Area <input type="checkbox"/> Approximate <input type="checkbox"/> Measured Material Largest sediment observed:	RUNOUT Runout distance <input type="checkbox"/> Approximate <input type="checkbox"/> Measured Levees present? Did it follow a channel? Trees damaged? Trees felled by runout? Largest sediment size mobilized:
POSSIBLE CONTRIBUTING FACTORS <input type="checkbox"/> Road cut <input type="checkbox"/> Road fill <input type="checkbox"/> Construction <input type="checkbox"/> Altered drainage <input type="checkbox"/> Pre-existing LS <input type="checkbox"/> Rain-on-snow <input type="checkbox"/> Steep, natural slope <input type="checkbox"/> Earthquake <input type="checkbox"/> Coastal bluff <input type="checkbox"/> Other	SITE OF PREVIOUS LANDSLIDES? <input type="checkbox"/> Yes <input type="checkbox"/> No Likelihood of reactivation? <input type="checkbox"/> Possible <input type="checkbox"/> Unlikely Weather at time of landslide	Is public safety at risk? <input type="checkbox"/> Possible <input type="checkbox"/> Unlikely If "possible", report to supervisor Are public resources at risk? <input type="checkbox"/> Possible <input type="checkbox"/> Unlikely If "possible", report to supervisor

Use reverse side for sketches, notes, or other information. Click here to reset form:

v. 2.22; Edited 10/12/2016 by SLS
 L:\landslide_hazards\General_Info\data_sheets\Landslide quick field recon sheet v 1.22.pdf

Other Mobile GIS applications



- Trimble – hillshades loaded into device, provide good position accuracy for locating ourselves in the forest and near landforms.
- Laptop with ArcGIS loaded, connected to a GPS



WASHINGTON STATE DEPT OF
**NATURAL
RESOURCES**
DIVISION OF GEOLOGY
AND EARTH RESOURCES