Increasing water yield with regional water storage possibilities

Innovative Water Technologies for California

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ENVIRONMENTAL CONSULTANTS

Water Supply Yield

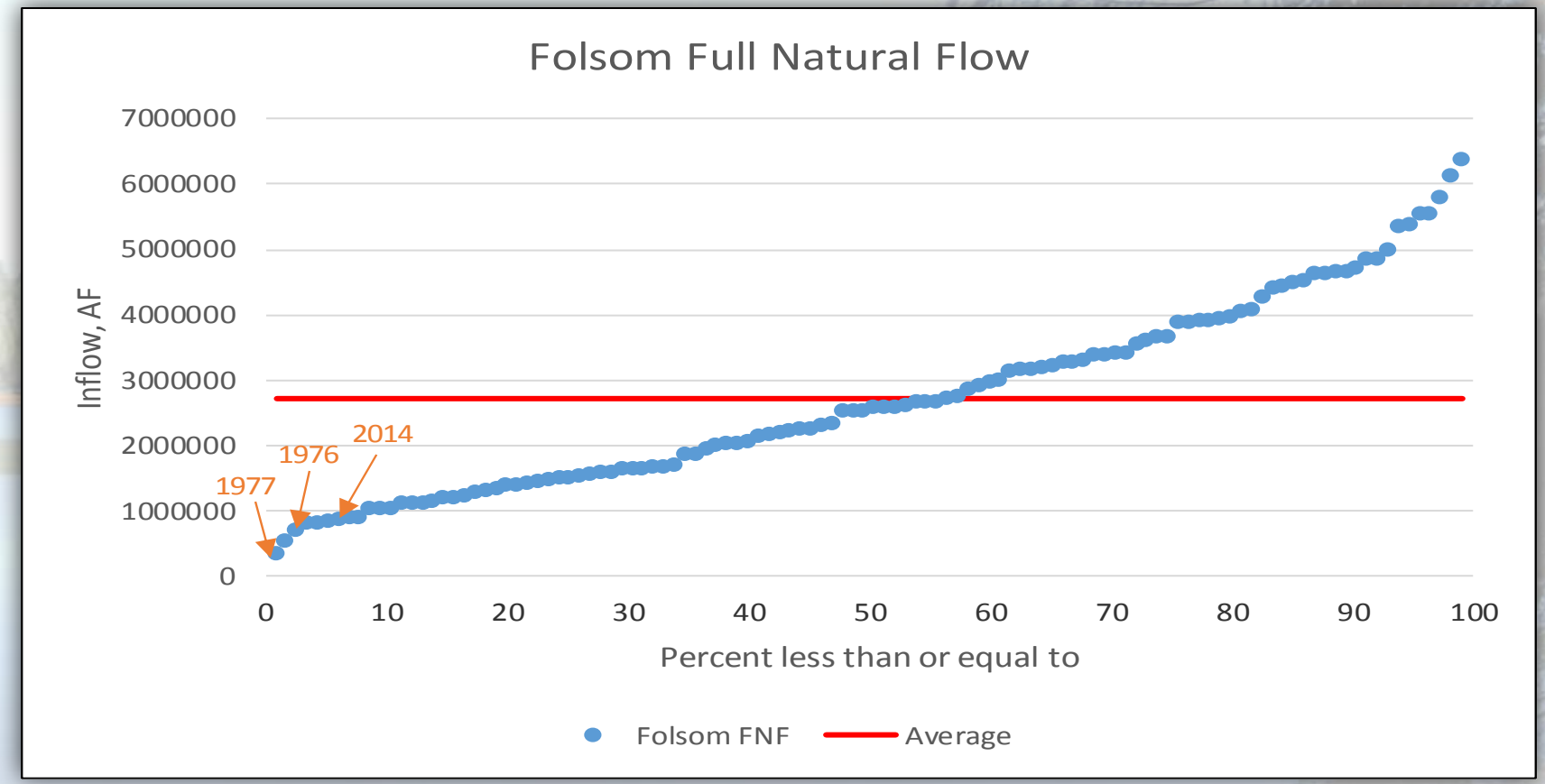
- The maximum supply that could have been delivered without failure during the historical drought of record (critical period)

- 1976-77 for Sierra Nevada

Driest Years on Record, American River

Ranking	Water Year	Folsom FNF
1	1977	349060
2	1924	543400
3	1931	715200
4	1976	800520
5	1994	811262
6	1988	853093
7	1987	879785
8	1992	900739
9	2014	907000
10	2001	1022437

Folsom Full Natural Flow



Catalysts for New Storage

- Growing Consumptive Demand
- Climate Change
- SWRCB Curtailment Notices

Future Diversion Limitations

- Hydrologic limitations
- Regulatory limitations
  - Curtailments to junior (post-1914) water rights
  - Curtailments to senior (pre-1914) water rights?

Effects of SWRCB Curtailments

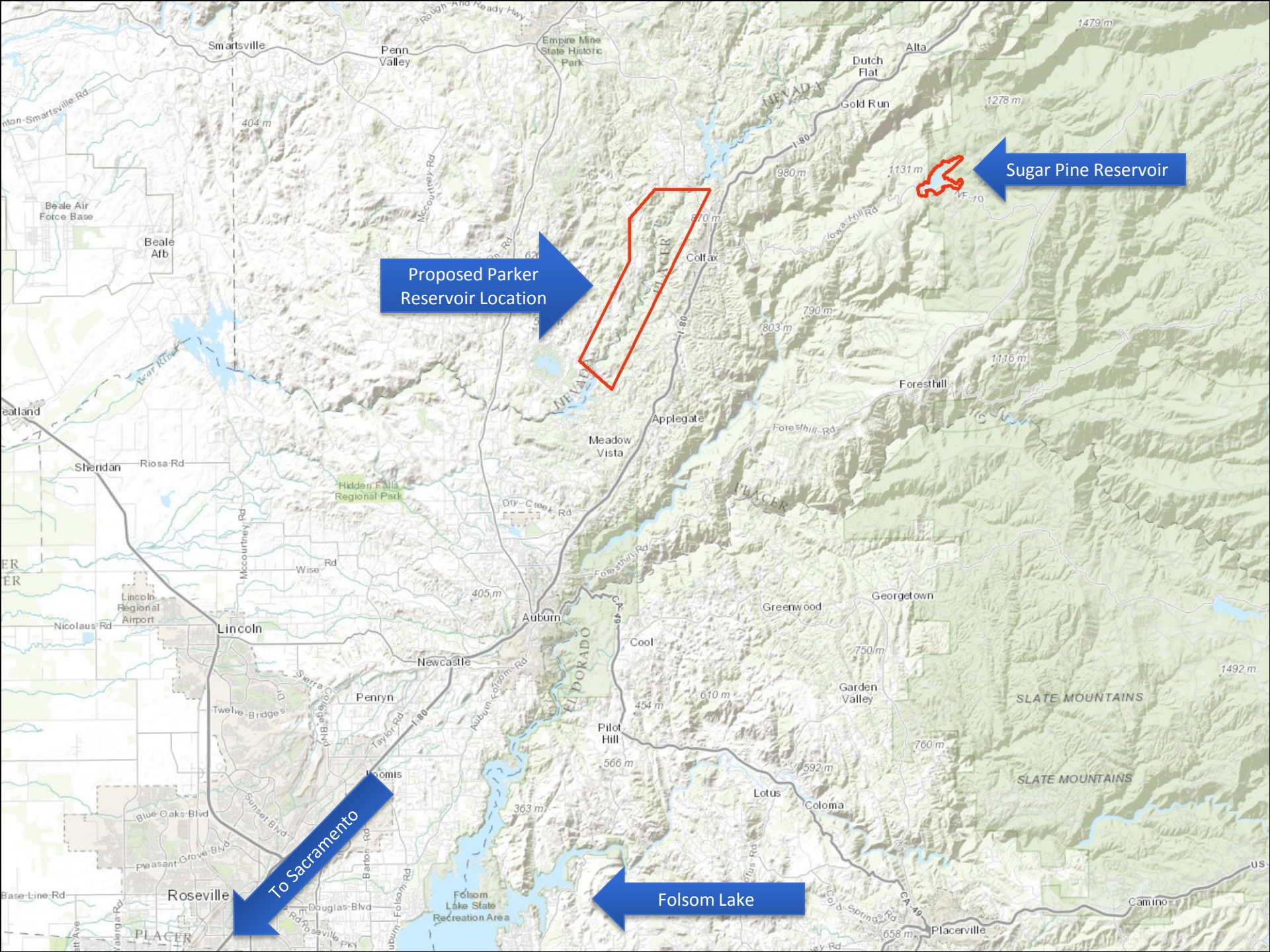
- As SWRCB begin to use curtailments to address water shortages, storage becomes more important.
- Delivery Contracts and Agreements based on water supply yield.
- Curtailments potentially reduce yield so that water suppliers may not be able to make deliveries.
- New storage essential to meet existing demand in dry years.

Incentives For New Storage Projects

- California Water Action Plan
  - Consistent with 8 of 10 actions in plan
- Proposition 1
  - $2.7 billion for water storage projects, dams and reservoirs

New Storage Projects

- Sugar Pine Reservoir, Foresthill Public Utility District
  - 3,000 AF of new storage
- Parker Reservoir, Nevada Irrigation District
  - Proposed 110,000 AF of new storage
  - New hydropower


Sugar Pine Reservoir
Proposed Parker Reservoir Location
To Sacramento
Folsom Lake
Smartsville
Penn Valley
Empire Mine State Historic Park
Alta
Dutch Flat
Gold Run
Beale Air Force Base
Beale Afb
Colfax
Foresthill
Applegate
Meadow Vista
Sheridan
Riosa Rd
Hidden Falls Regional Park
Auburn
Lincoln
Lincoln Regional Airport
Nicolaus Rd
Newcastle
Penryn
Loomis
Roseville
Folsom Lake State Recreation Area
Greenwood
Georgetown
Cool
Garden Valley
Pilot Hill
Lotus
Coloma
Placerville
SLATE MOUNTAINS
SLATE MOUNTAINS
I-80
CA-49
NEVADA
PLACER
EL DORADO

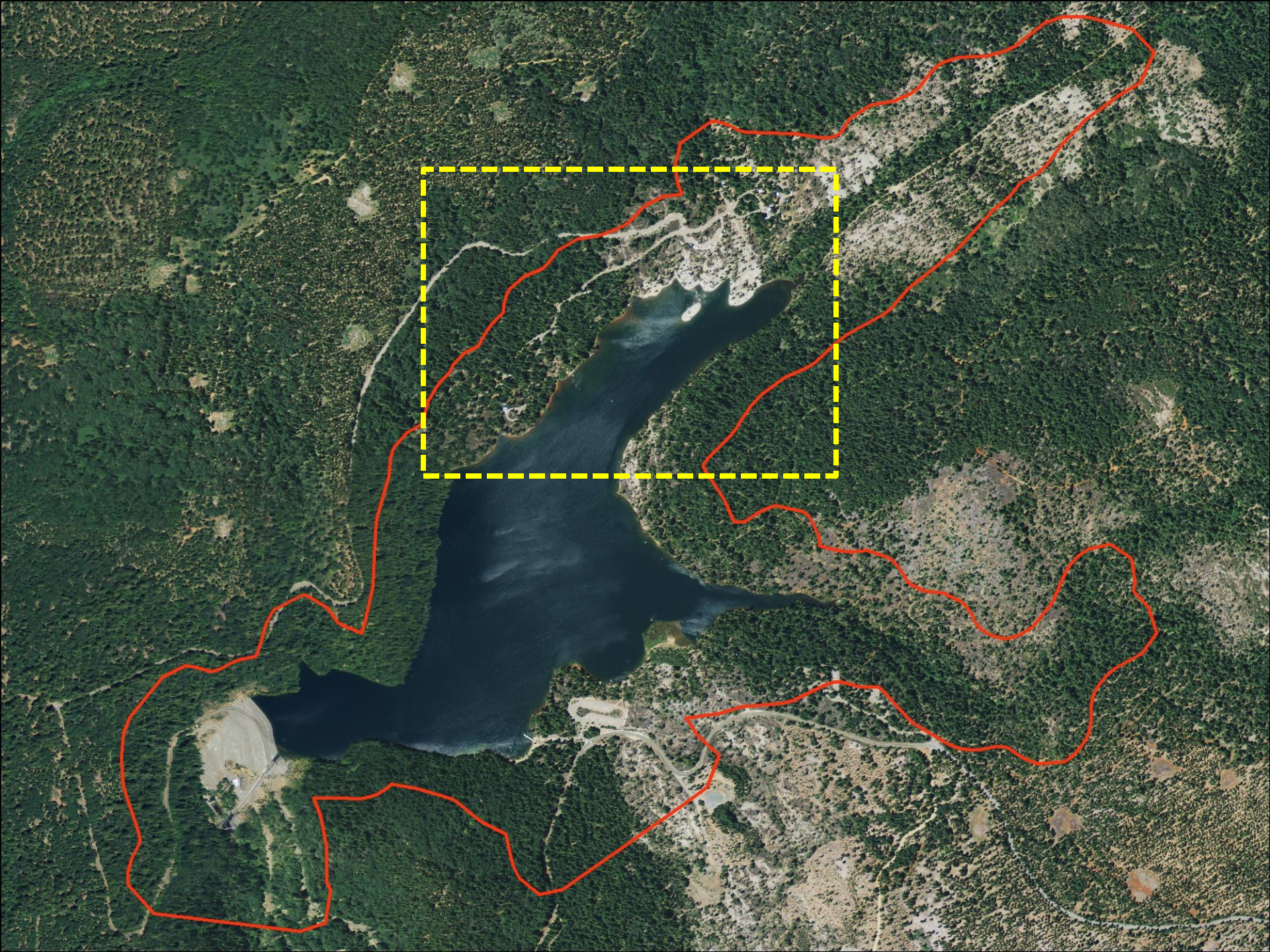
Sugar Pine Dam

Sugar Pine Spillway

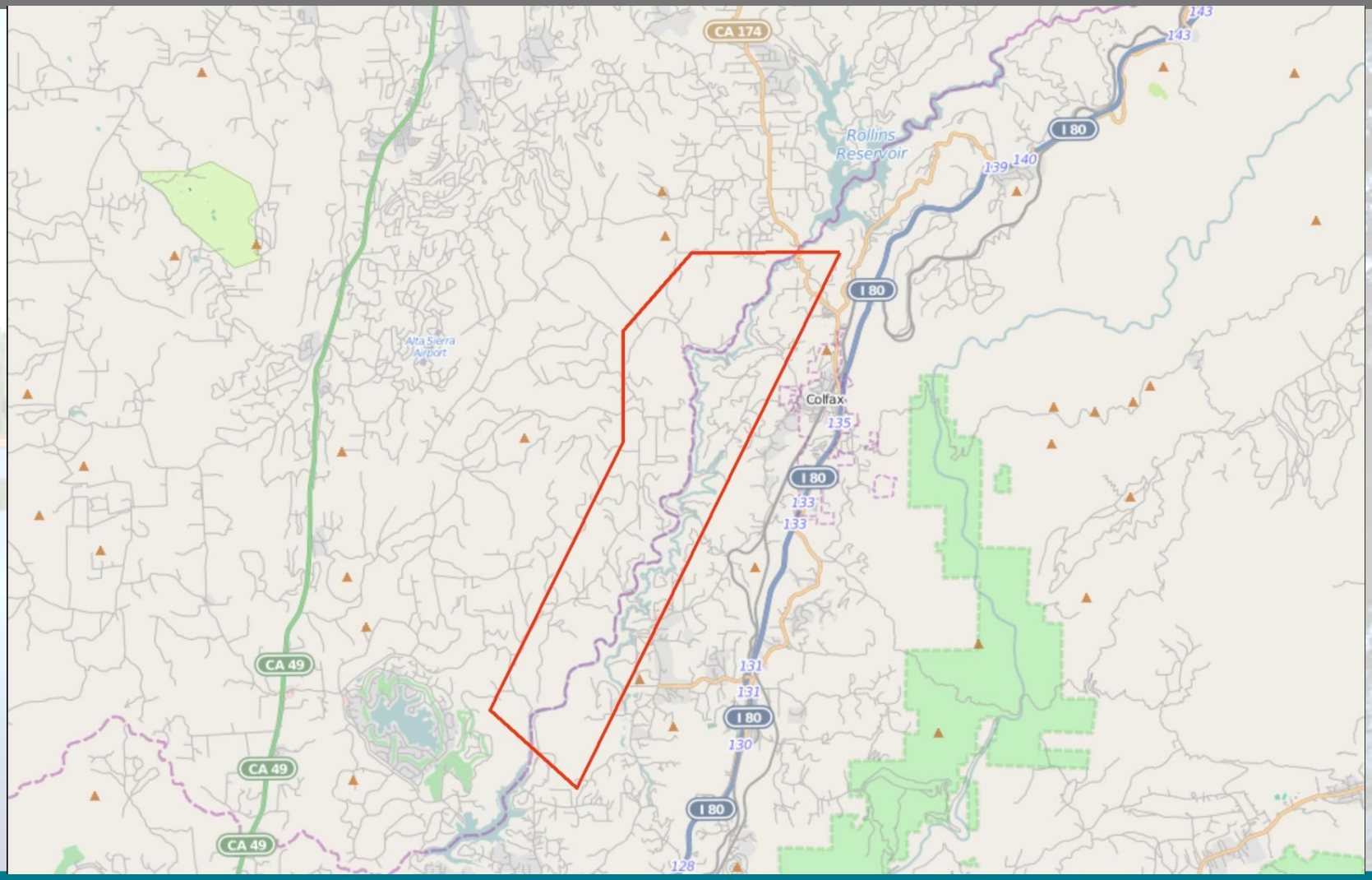
Radial Gates: LL Anderson Dam

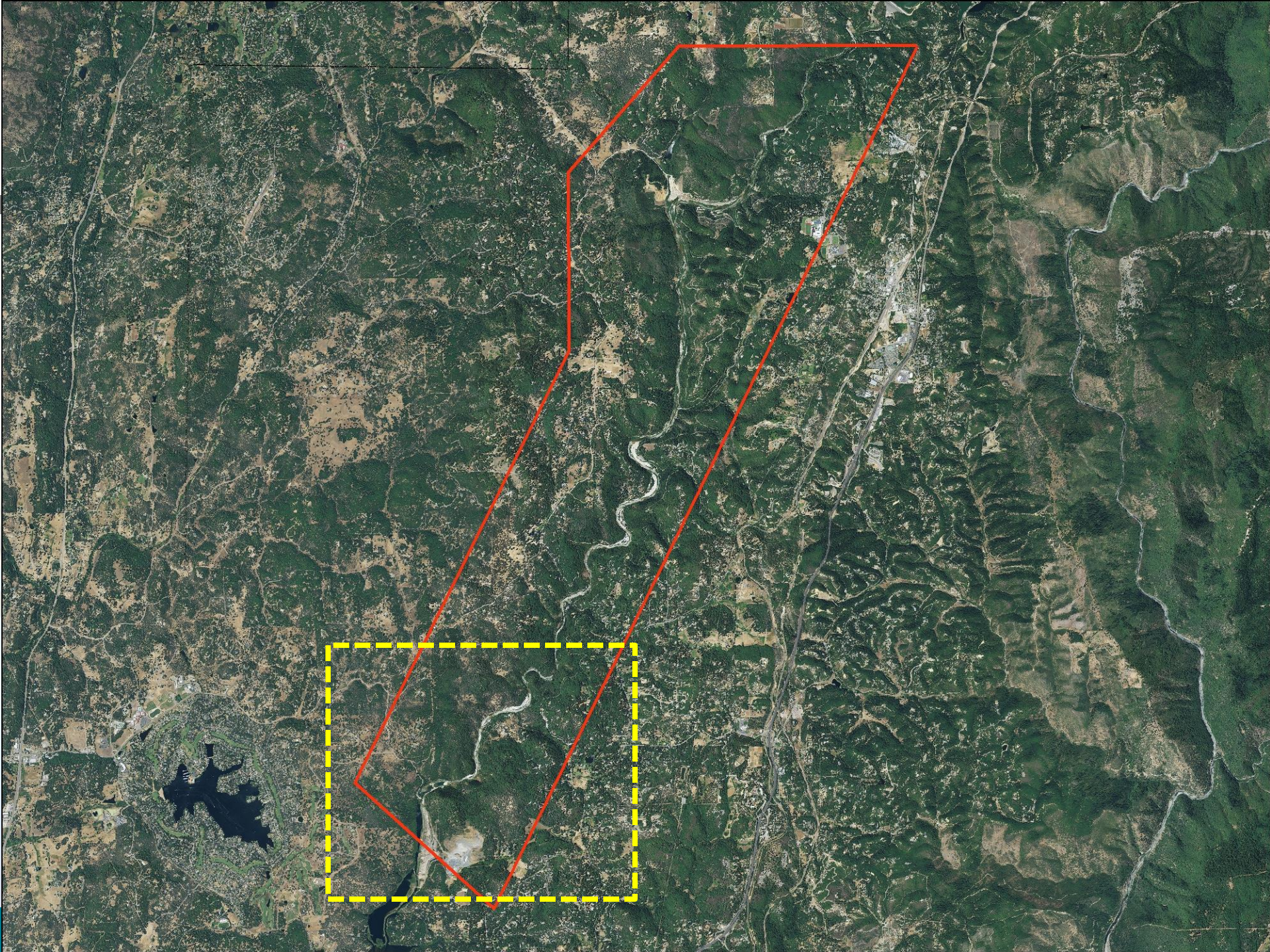
Radial Gates: Trunnion Block

Radial Gates: Operations Platform



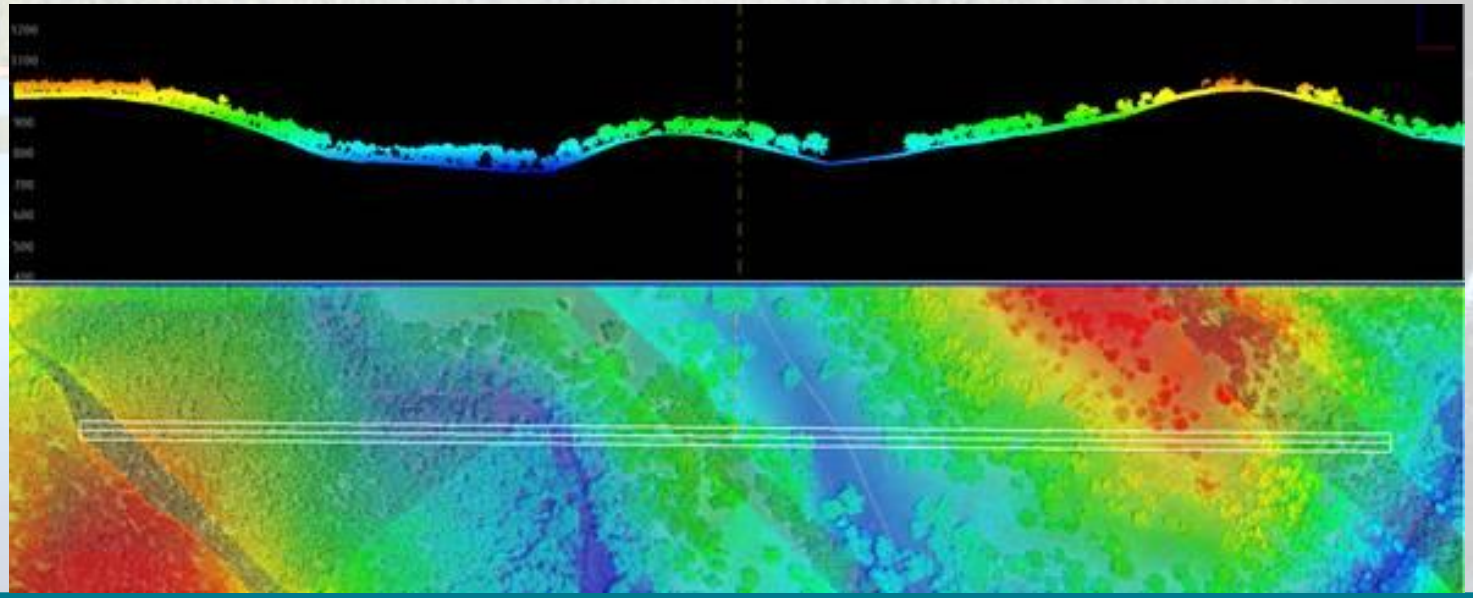
Parker Reservoir





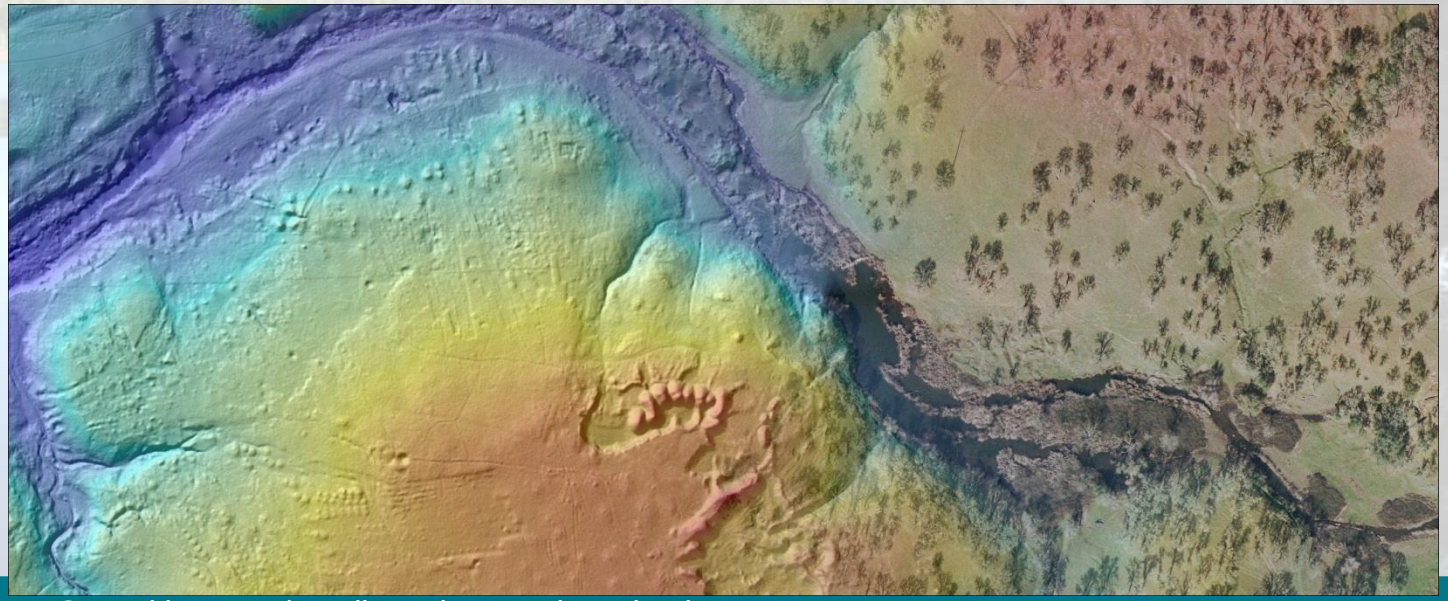
Introduction to Lidar

- Acronym for *Light-Imaging Detection and Ranging*
  - Also known as ALSM (*Airborne Laser Swath Mapping*) or Laser Altimetry or LADAR (*Laser Detection and Ranging*)



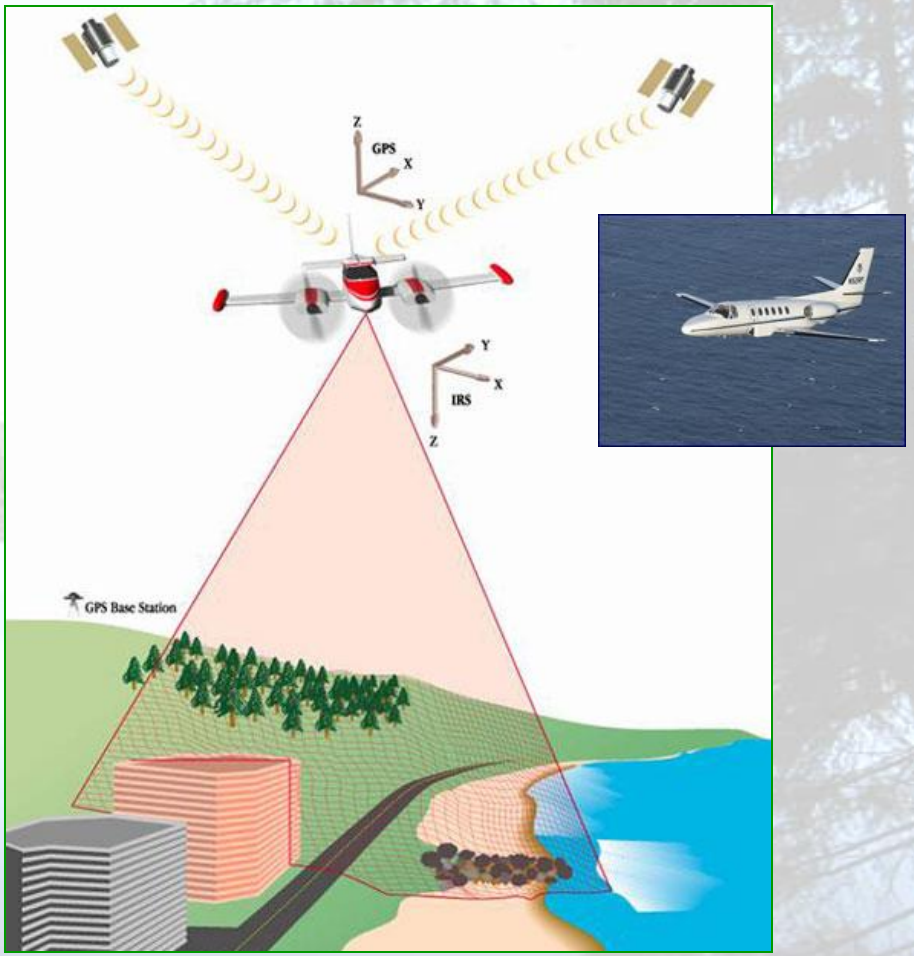
Introduction to Lidar (cont.)

- An optical remote sensing technology which measures properties of scattered light to find range and/or other information of a distant target



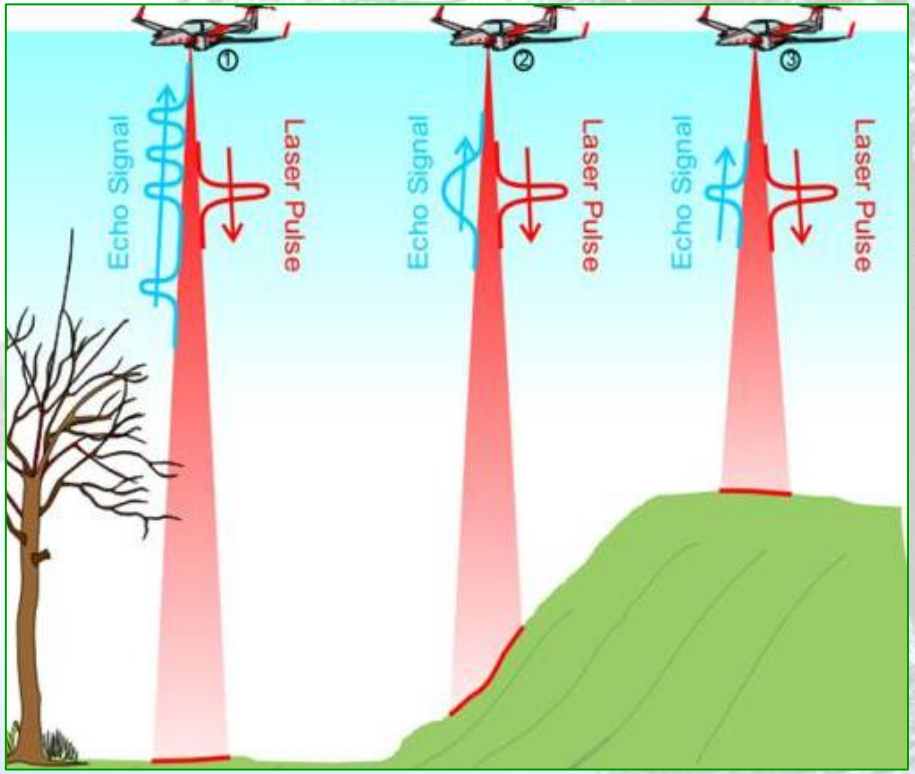
How Air-Based Lidar Works: System Components

- High-precision survey GPS unit
- Inertial Measurement System (IMS)
- Laser (in 600-1,500 nm range) but shorter wave available for Bathymetric mapping
- Ground base station



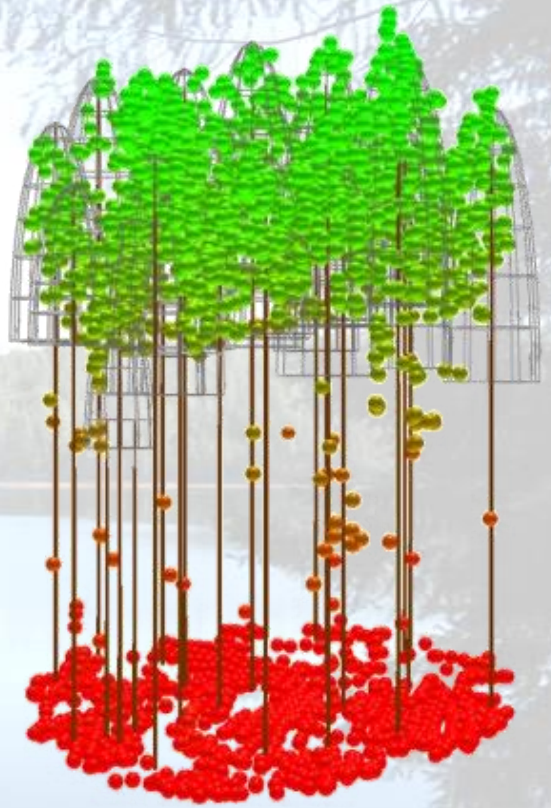
How Air-Based Lidar Works: The Process

- Aircraft flies transects of project site
- Laser oscillates at +/- 60Hz, pulsing at 40,000-60,000/second
- Sensor records reflected pulses, called returns, and georeferences them (approximately 8-12/m^2 for high density data)



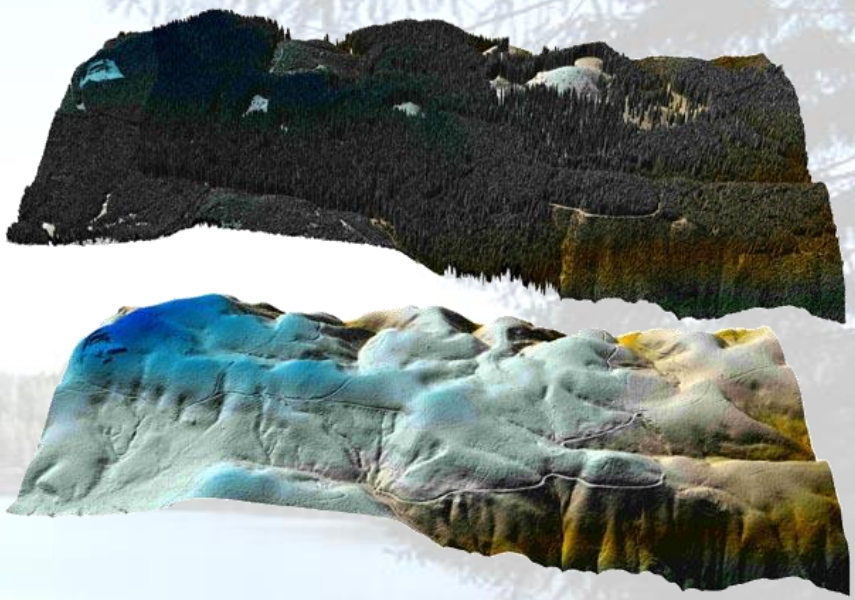
How Air-Based Lidar Works: The Process (cont.)

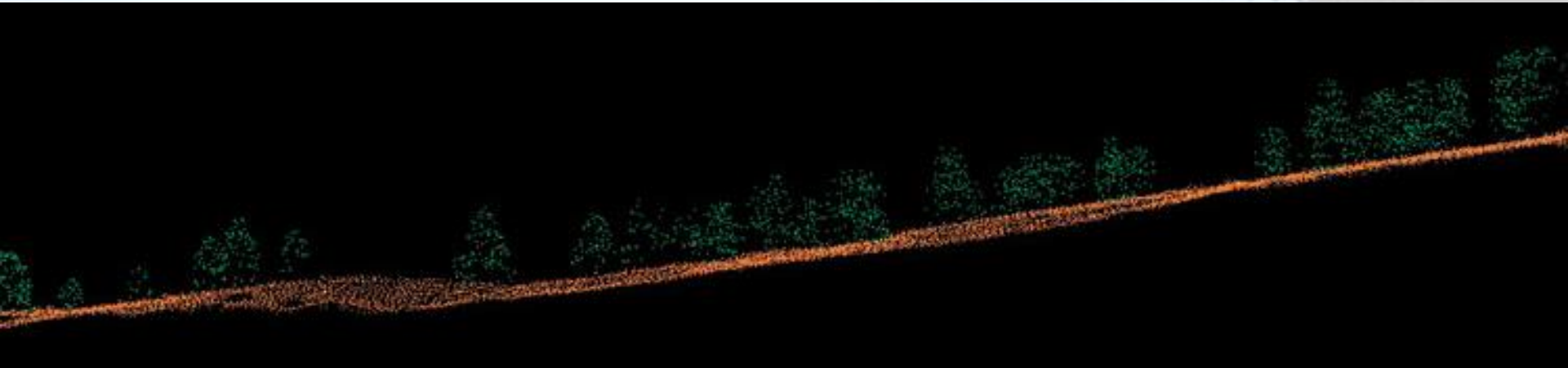
- A single pulse may return multiple times, generally indicating vegetation or stacked ground objects
- The pulse can return off of a tree crown, branch, trunk, and the ground below



Lidar Canopy Data

- Analyzing the resulting "point cloud" allows for the extraction of high accuracy, high-precision topographic data and vegetation height data





Lidar Mapping Applications

- Topographic Surveys
- Tree/Vegetation Mapping
- Hydrology/Hydraulics/Floodplain Mapping
- Geology (Mt. Tallac Fault Example)
- Archaeology/Architectural History
- Civil Engineering
- Route Planning/Alts Analysis

Why is This Technology Exciting?

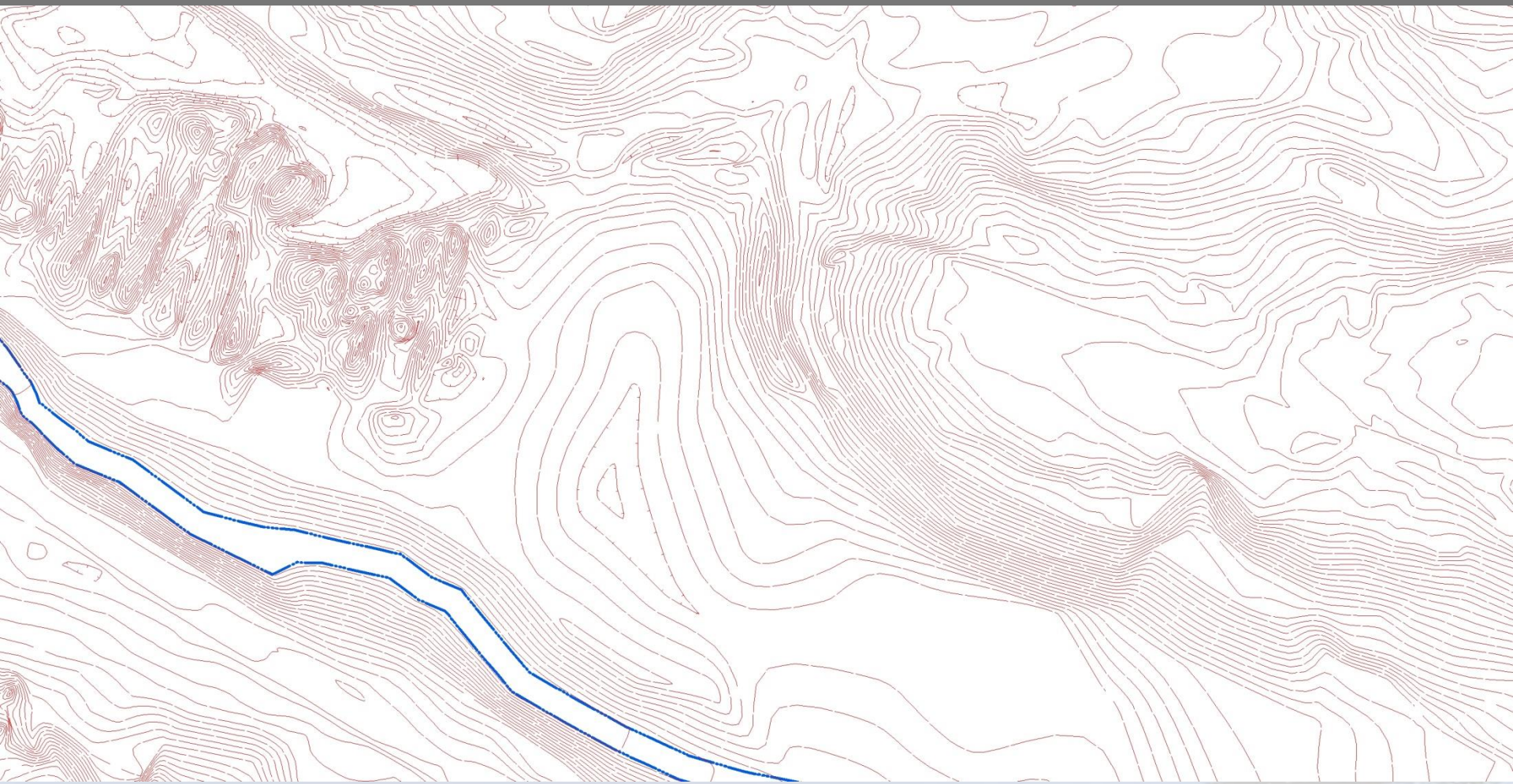
- Can map topography in areas that cannot be seen in aerial photographs and not easily accessed by surveyors
- Costs can be significantly lower than traditional methods for large projects or projects with specific types of conditions
- **Time to Collect 1 Million XYZ Locations**
  - Conventional Surveying: 15.5 years
  - Photogrammetry: 1.5 years
  - **Lidar: 6.7 seconds @ 150 kHz**

Real World Example #1

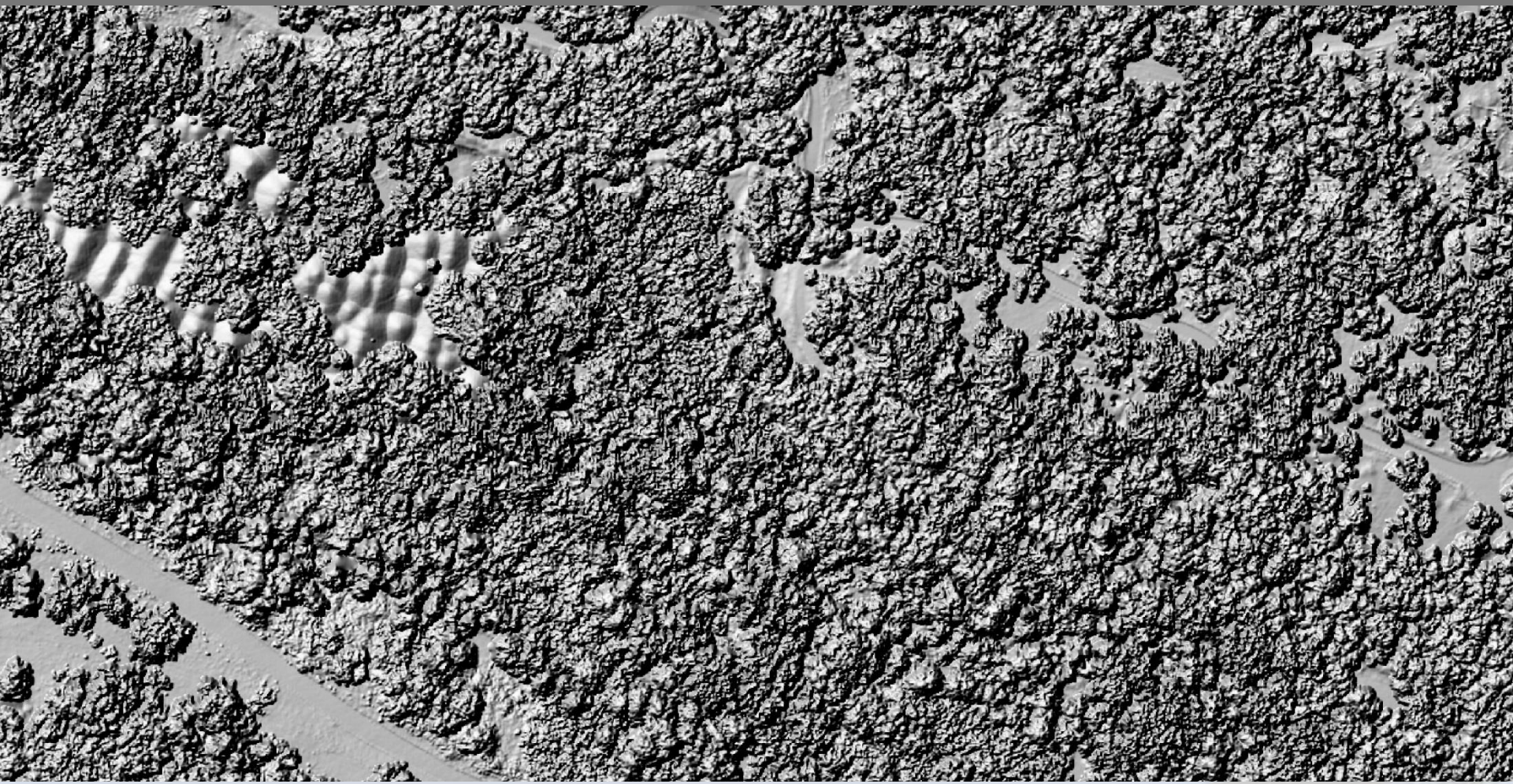
CREEK NEAR HWY 50 IN SACRAMENTO COUNTY

Heavy Canopy Area

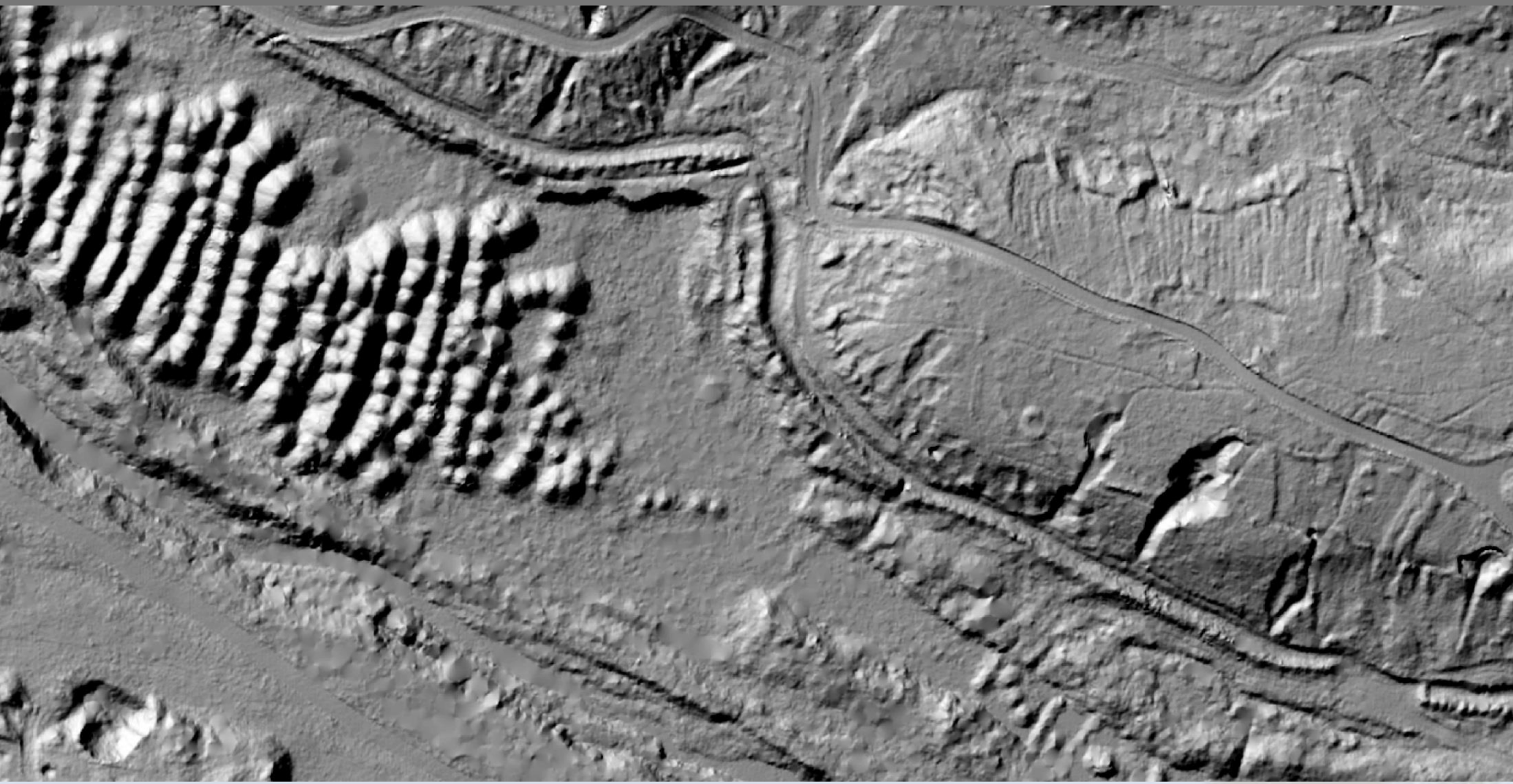
Photogrammetric Topo (1’ contours)



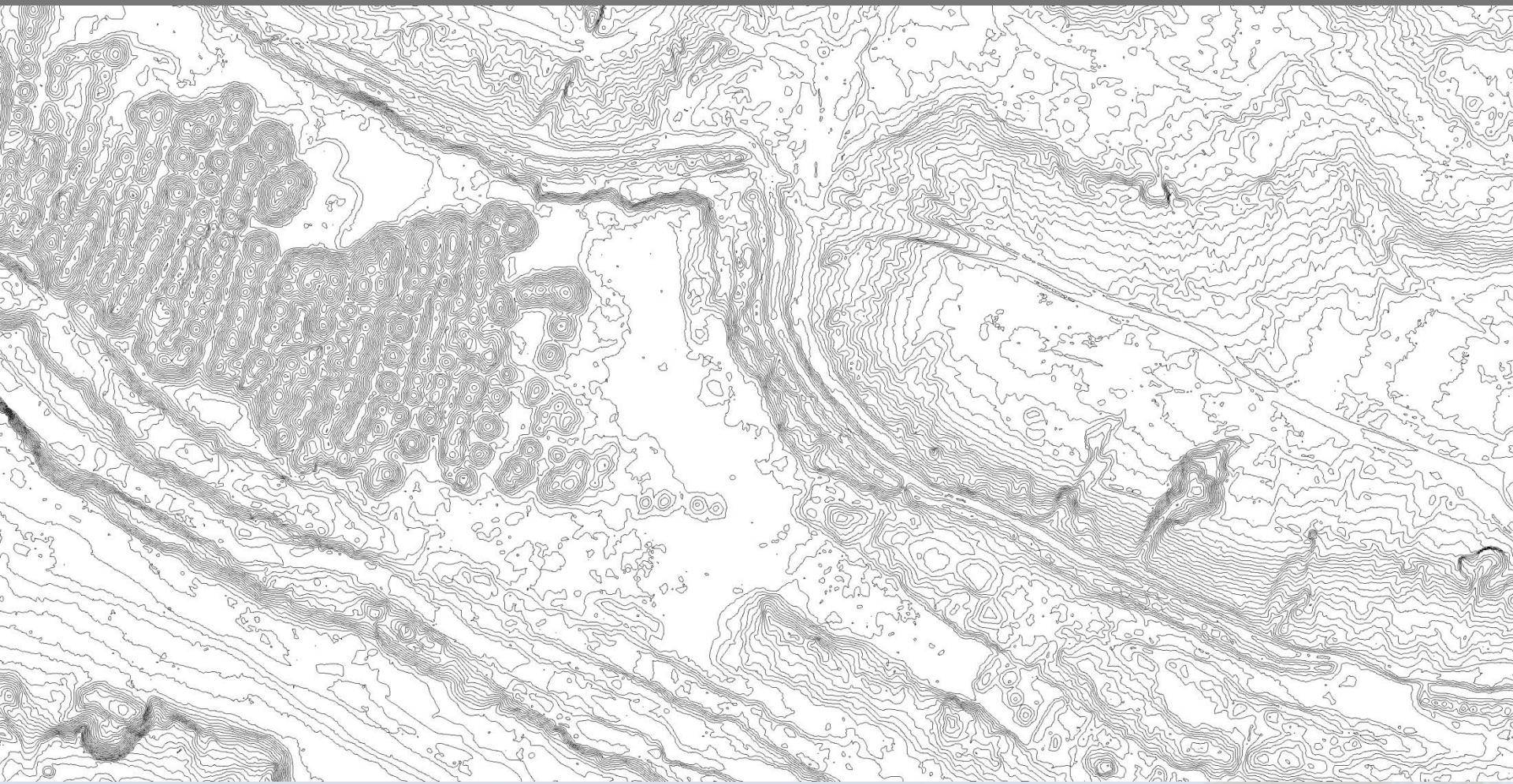
Lidar Data for Area



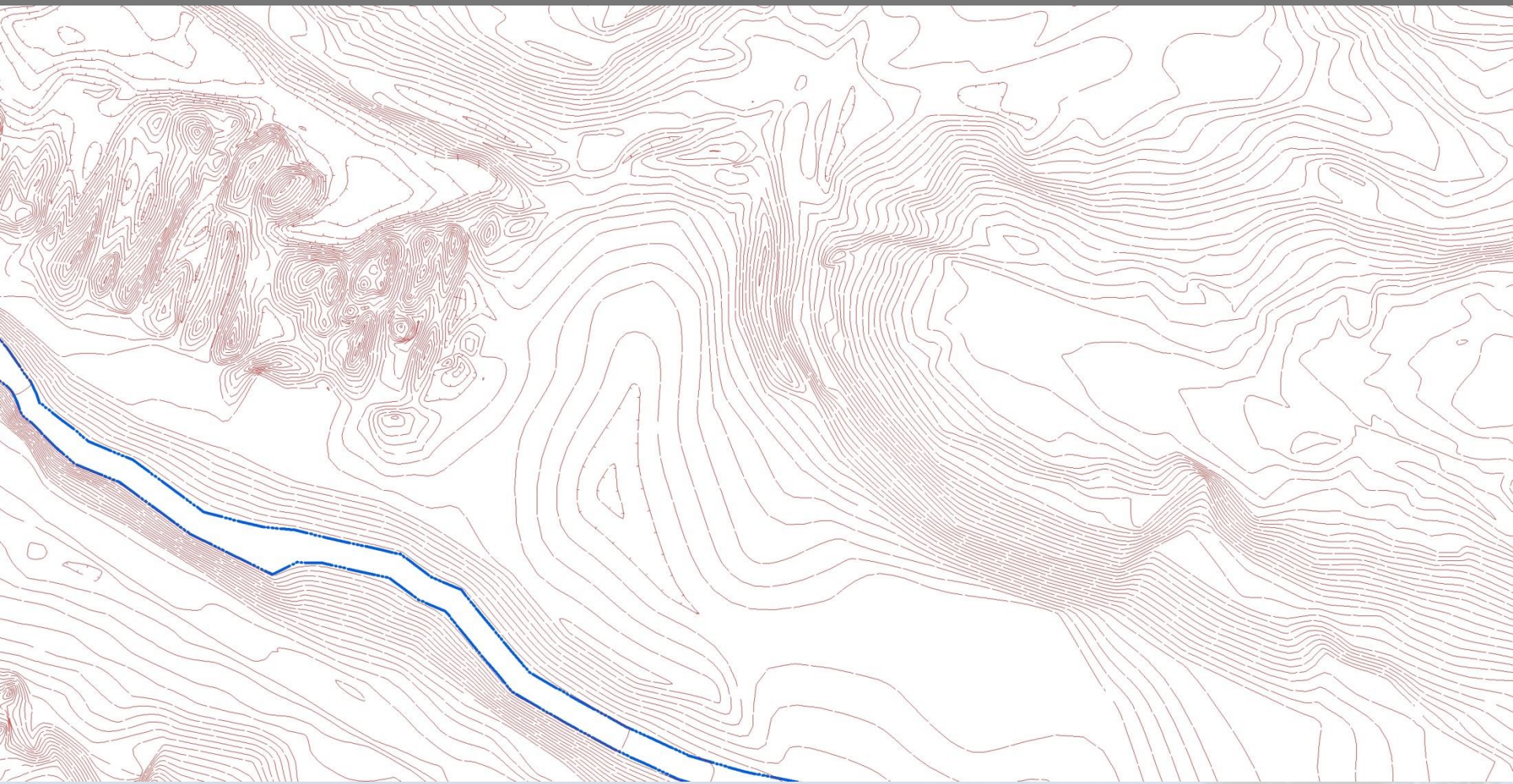
Lidar with Canopy Removed



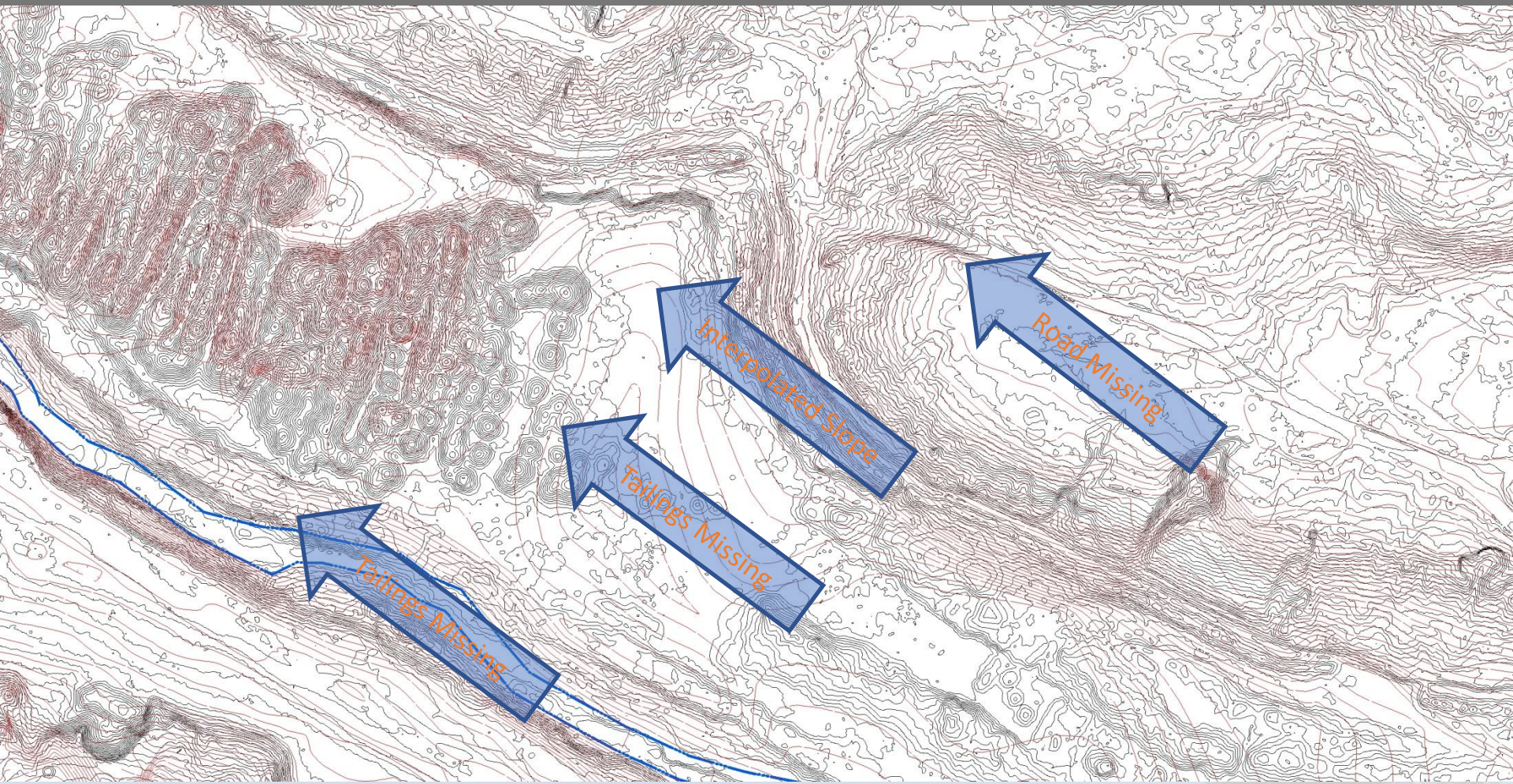
Lidar-Derived Topo (1’ contours)



Photogrammetric Topo (1’ contours)

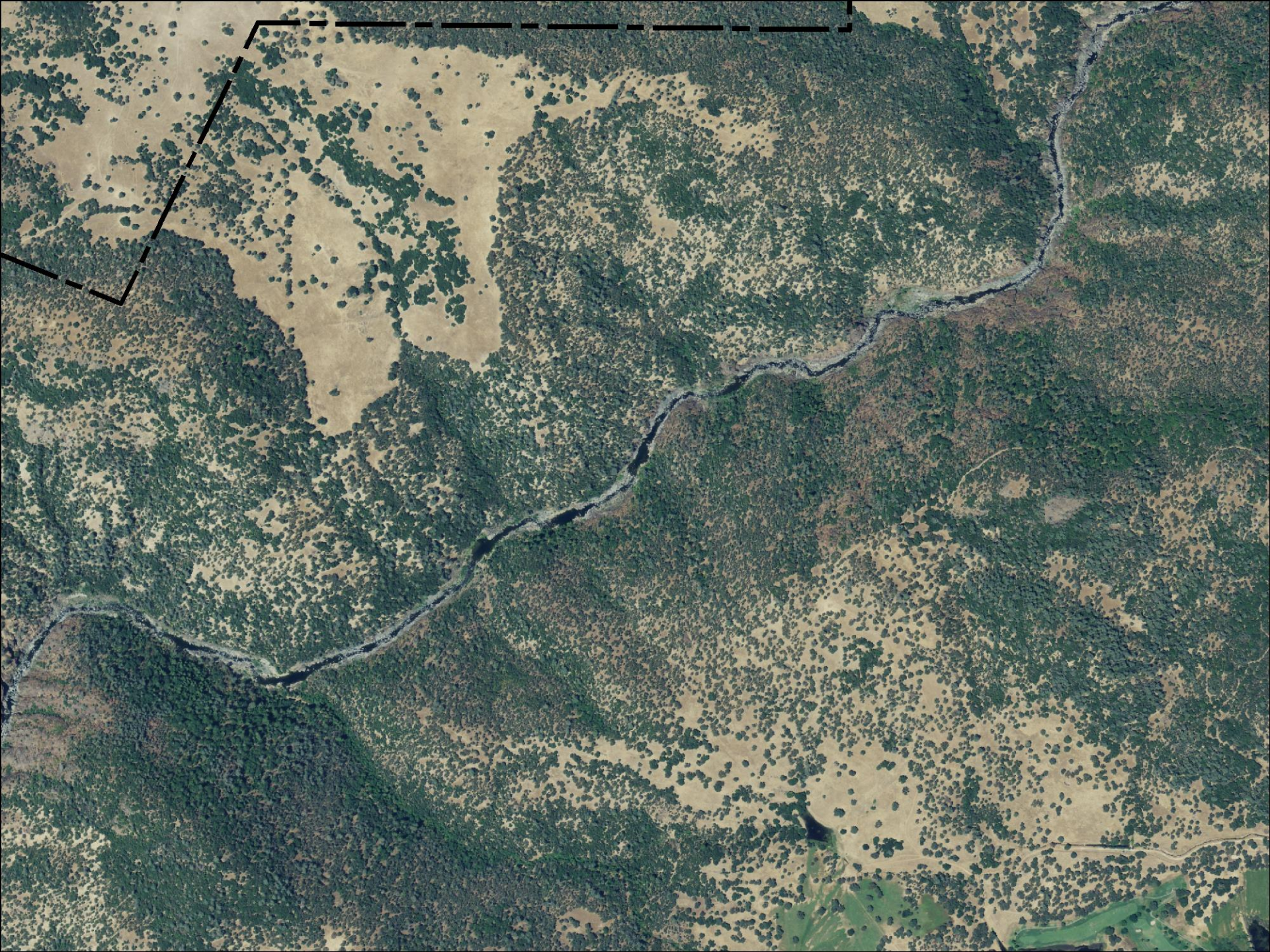


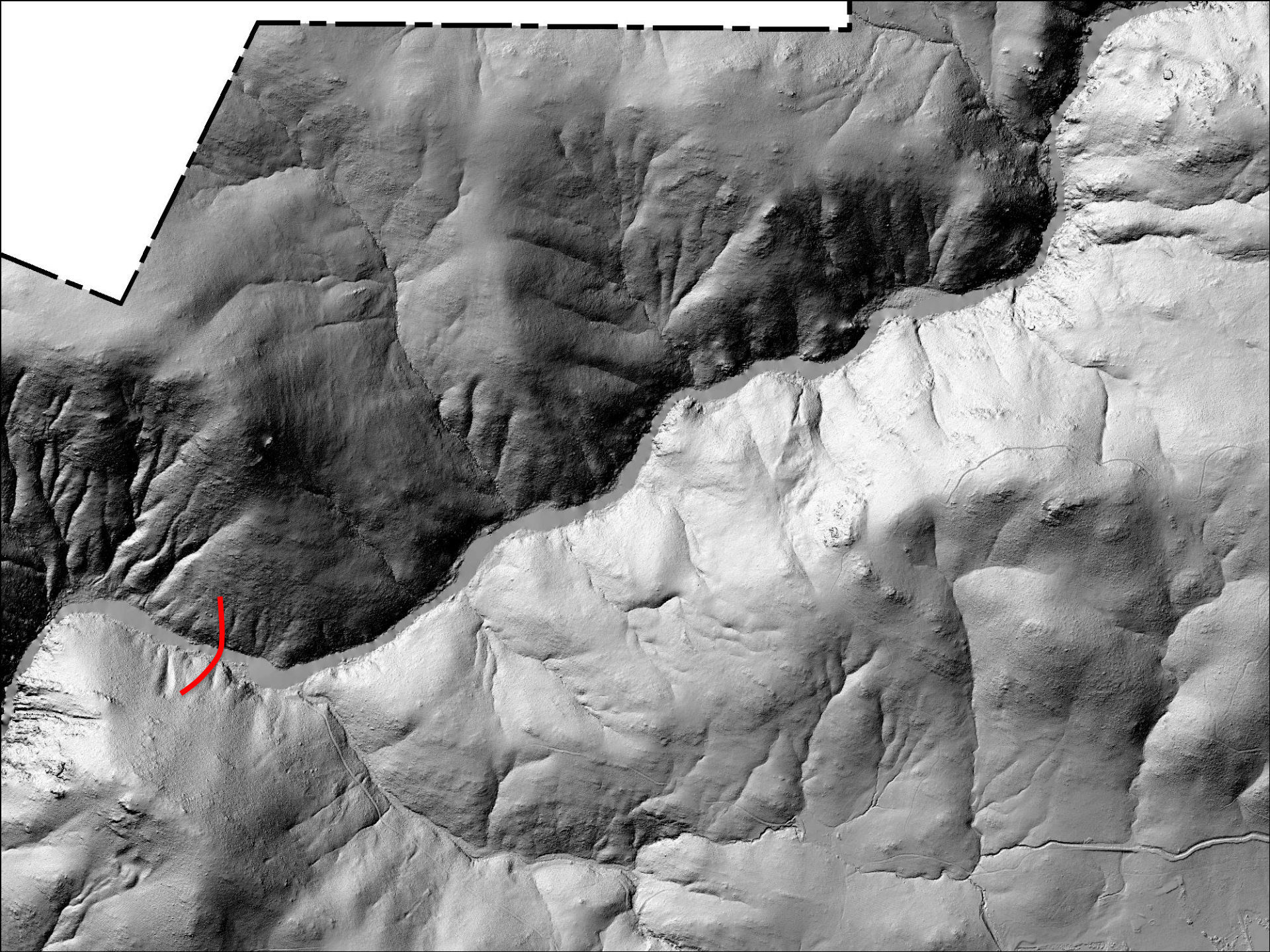
Topo Comparison

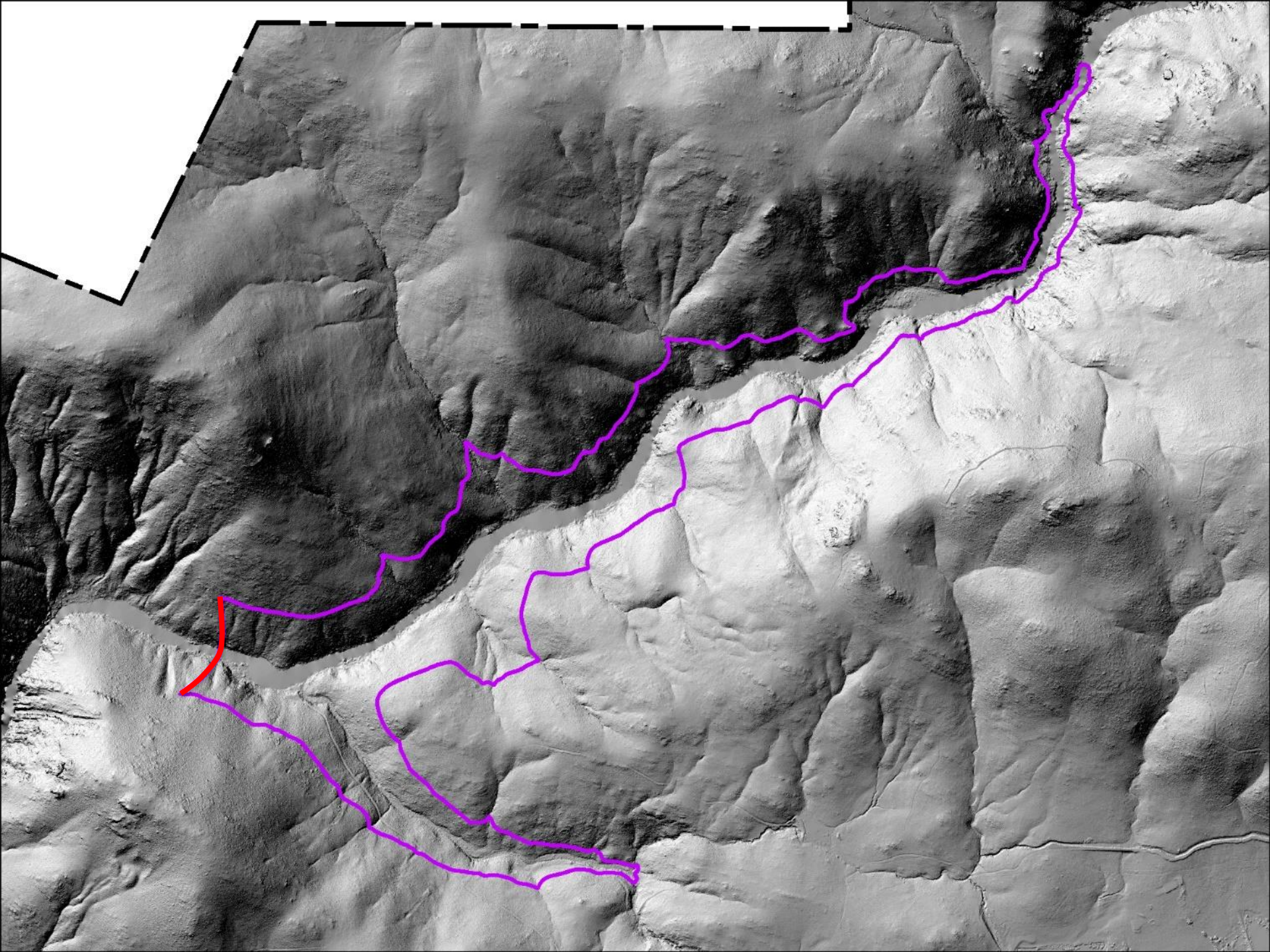


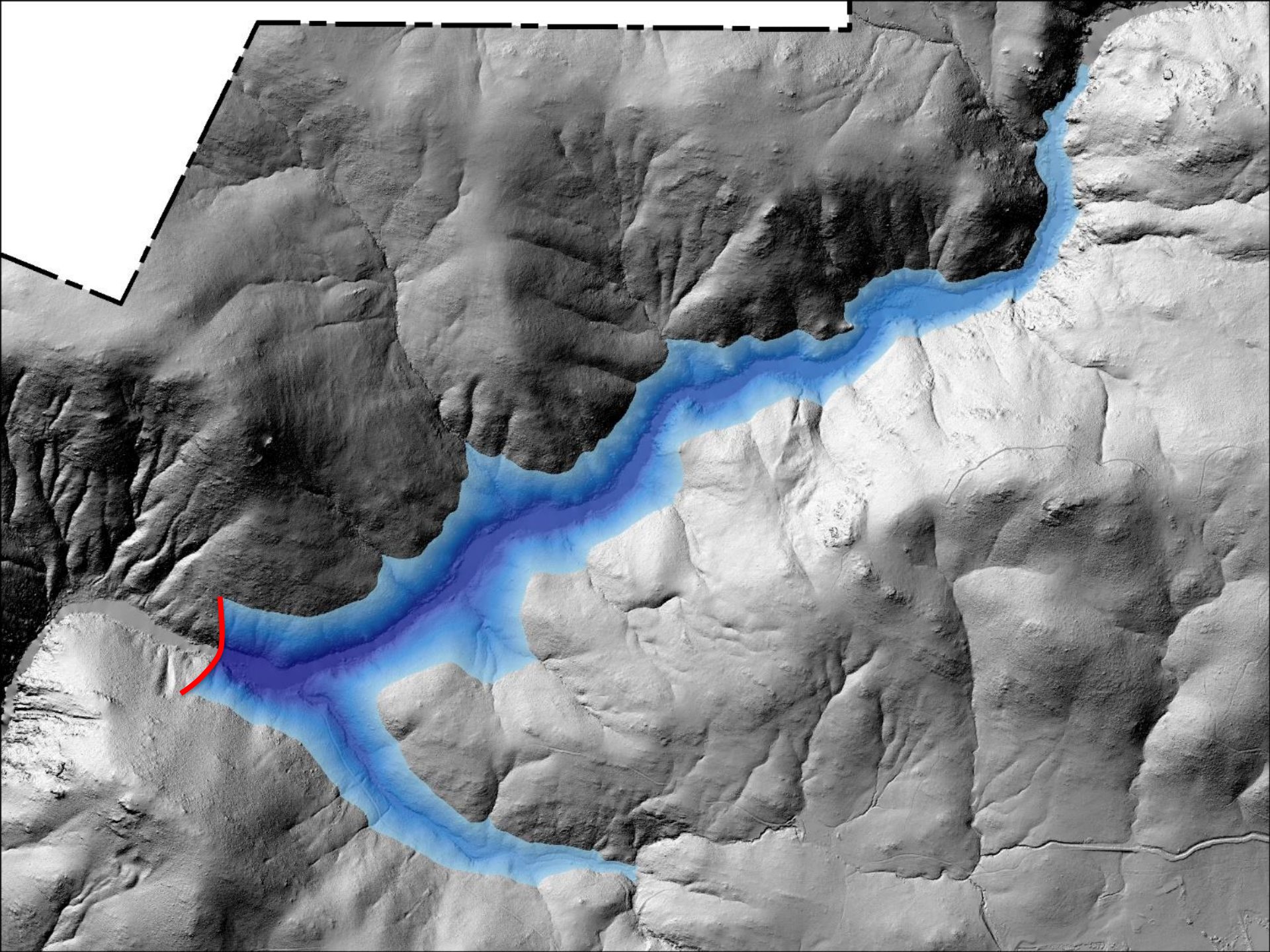
Real World Example #2

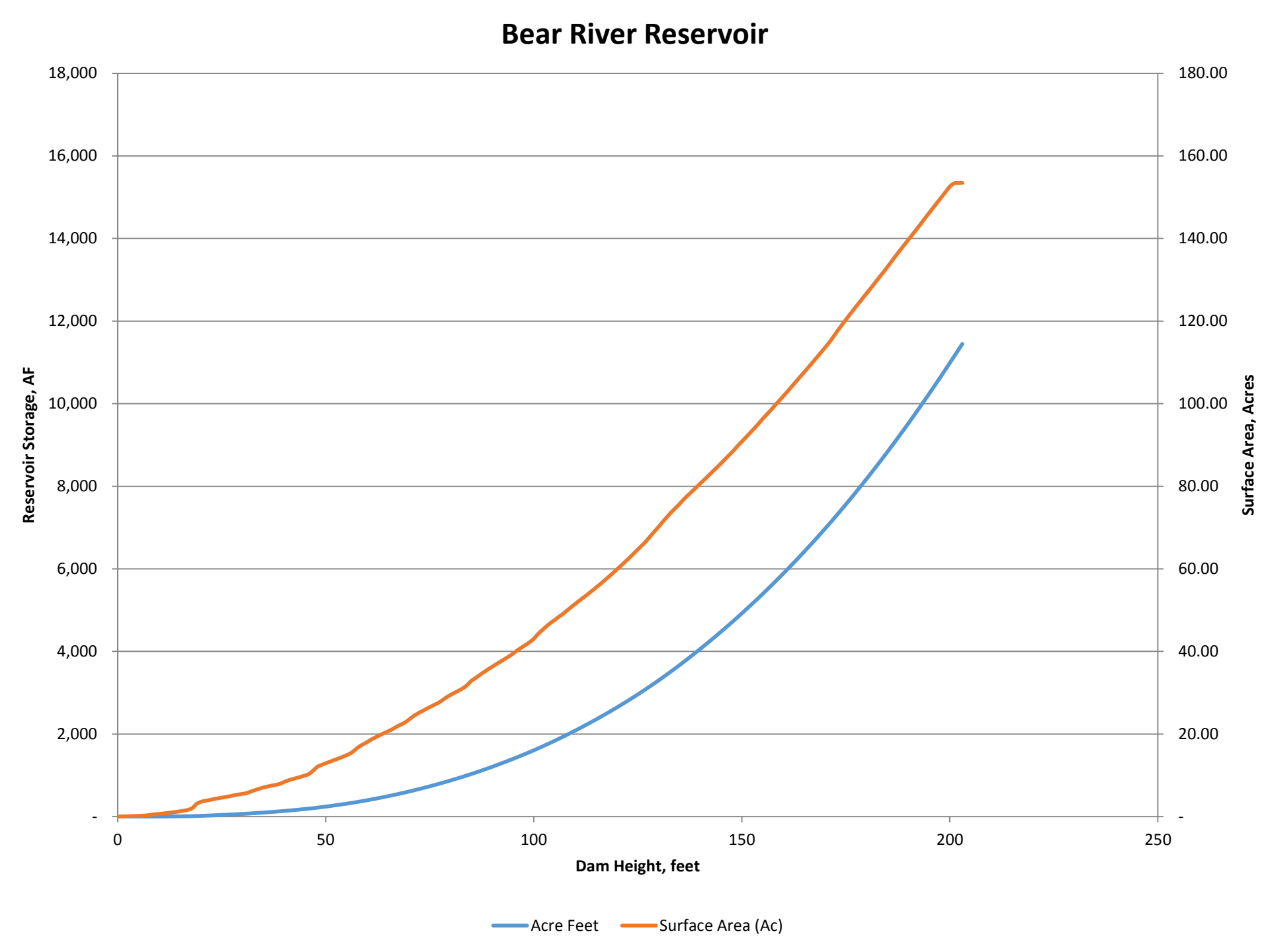
BEAR RIVER RESERVOIR SITING










Bear River Reservoir
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
-
180.00
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
-
Reservoir Storage, AF
Surface Area, Acres
0
50
100
150
200
250
Dam Height, feet
Acre Feet
Surface Area (Ac)

Questions?