



# National Trails Office (NTIR) OCTA Mapping Workshop LiDAR

OCTA Mapping Workshop

September 9-11, 2021

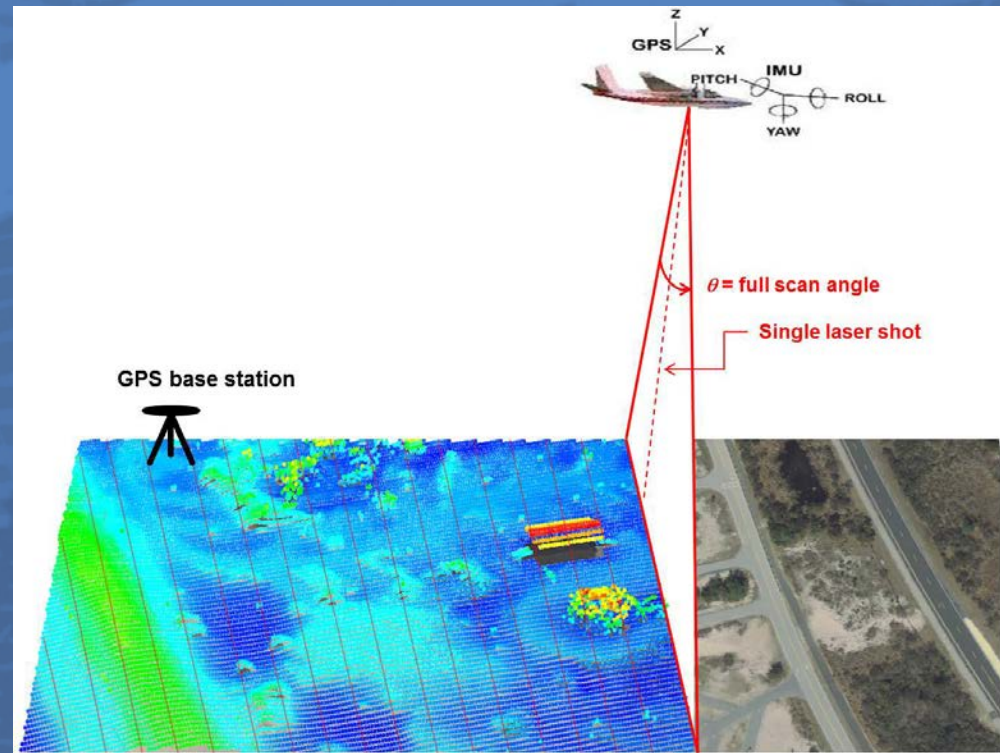
National Park Service – National Trails

Brian Deaton – GIS Specialist



# Light Detection and Ranging (LiDAR)

- Remote Sensing Technique
- Uses Laser Light Pulses (>150K pulses per second)
- Product is a Point Cloud
- See through Vegetation



Source: <https://coast.noaa.gov/data/digitalcoast/pdf/lidar-101.pdf>





## LiDAR Platforms

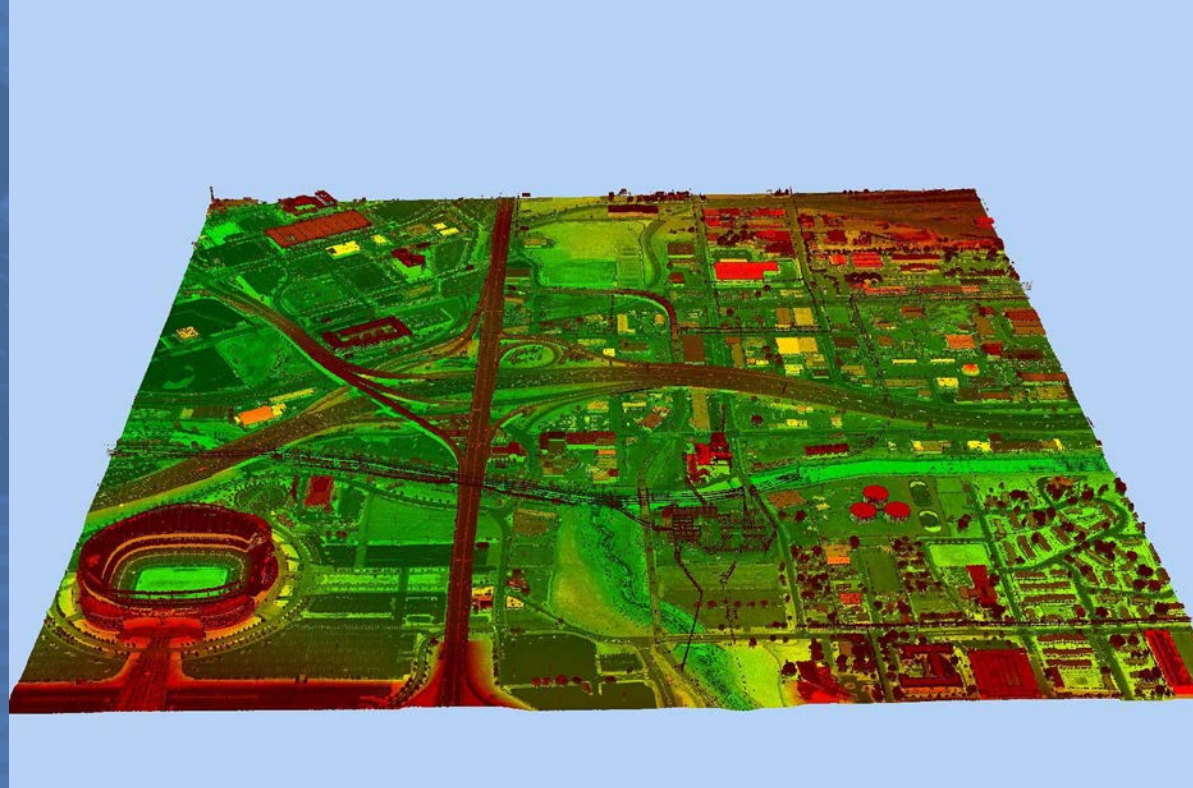
- Airborne
- Fixed Position Terrestrial





## LiDAR Data

- LAS – Laser File Format
- Classification
- Point Spacing



Source: [https://prd-wret.s3.us-west-2.amazonaws.com/assets/palladium/production/s3fs-public/thumbnails/image/Denver\\_Pointcloud.JPG](https://prd-wret.s3.us-west-2.amazonaws.com/assets/palladium/production/s3fs-public/thumbnails/image/Denver_Pointcloud.JPG)





# USGS LiDAR Base Specifications

- LiDAR Quality Level
  - QL0
  - QL1
  - QL2
  - QL3

Table 1. Aggregate nominal pulse spacing and density.

Quality level	Aggregate nominal pulse spacing (m)	Aggregate nominal pulse density (pls/m <sup>2</sup> )
QL0	≤0.35	≥8.0
QL1	≤0.35	≥8.0
QL2	≤0.71	≥2.0
QL3	≤1.41	≥0.5

Table 2. Relative vertical accuracy for light detection and ranging swath data.

Quality level	Smooth surface repeatability, RMSD <sub>z</sub> (m)	Swath overlap difference, RMSD <sub>z</sub> (m)
QL0	≤0.03	≤0.04
QL1	≤0.06	≤0.08
QL2	≤0.06	≤0.08
QL3	≤0.12	≤0.16

Table 3. Land cover classes.

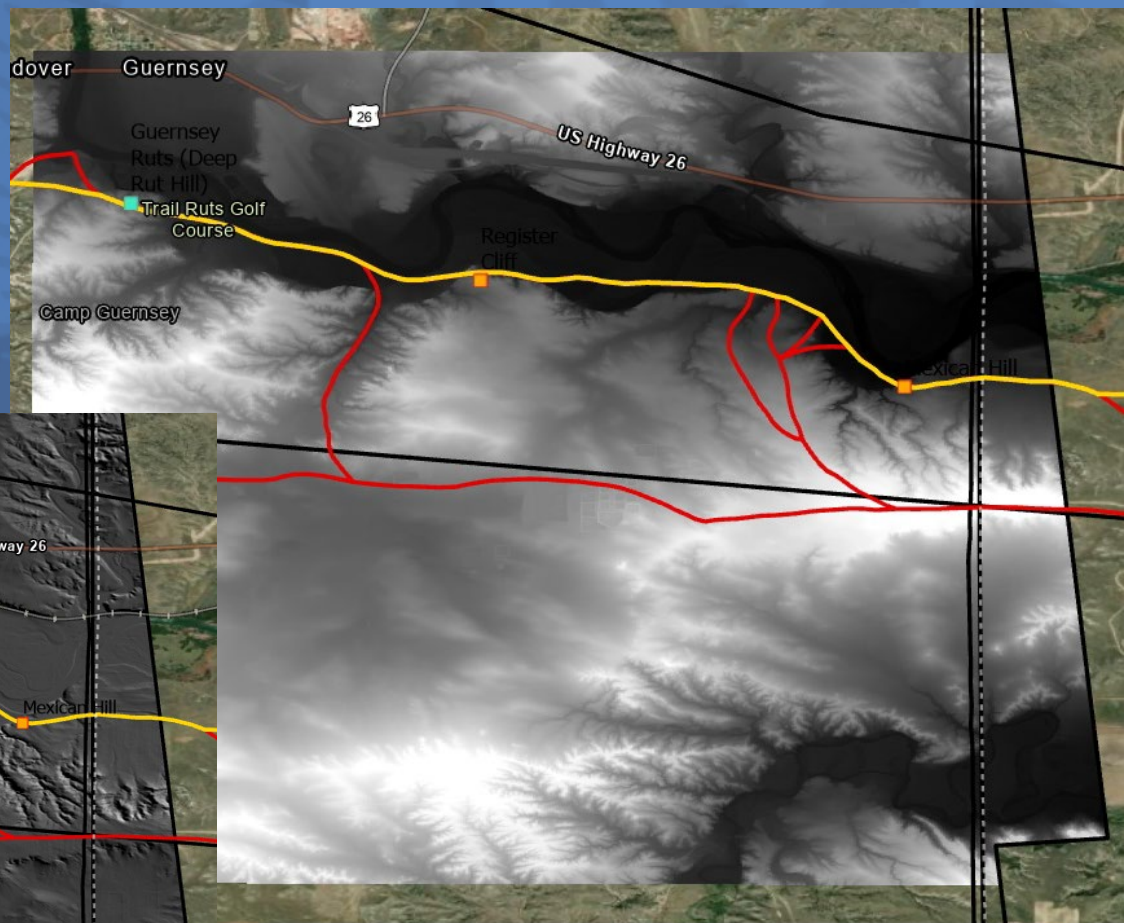
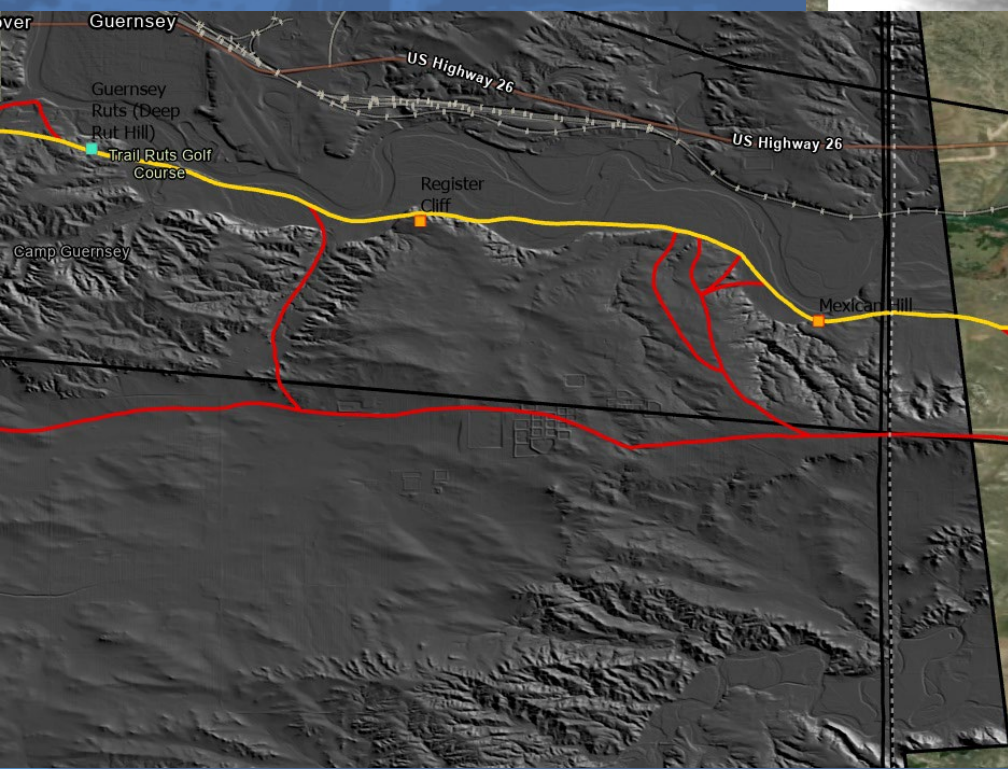
Class number	Land cover class or description	Previous reporting group	Current reporting group
1	Clear or open, bare earth, low grass; for example, sand, rock, dirt, plowed fields, lawns, golf courses	FVA	NVA
2	Urban areas; for example, tall, dense man-made structures	SVA	NVA
3	Tall grass, tall weeds, and grasses for	SVA	NVA

Source: <https://prd-wret.s3.us-west-2.amazonaws.com/assets/palladium/production/atoms/files/Lidar-Base-Specification-2021-rev-A.pdf>



## Data Derivatives

- DEM  
(Digital Elevation Model)
- Hillshades



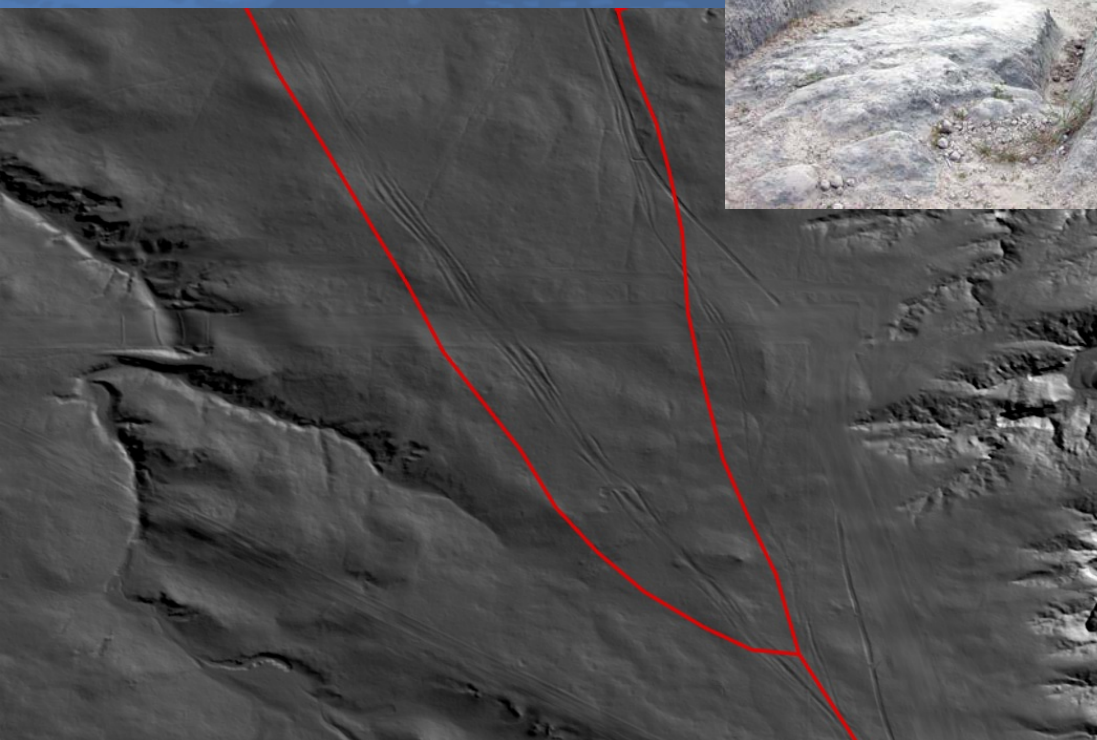
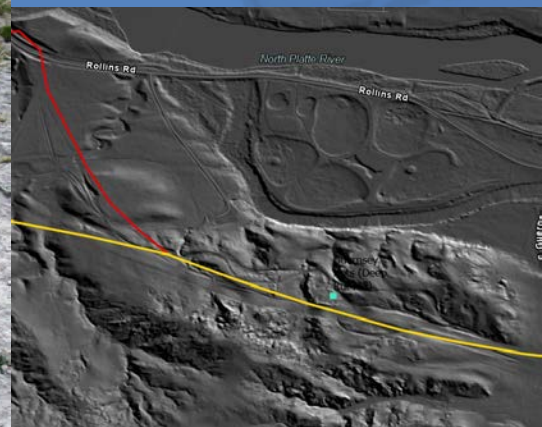




# Application to Historic Trail Trace

DEM  
(Digital Elevation Model)

Hillshades





# Why Use LiDAR Derivatives?

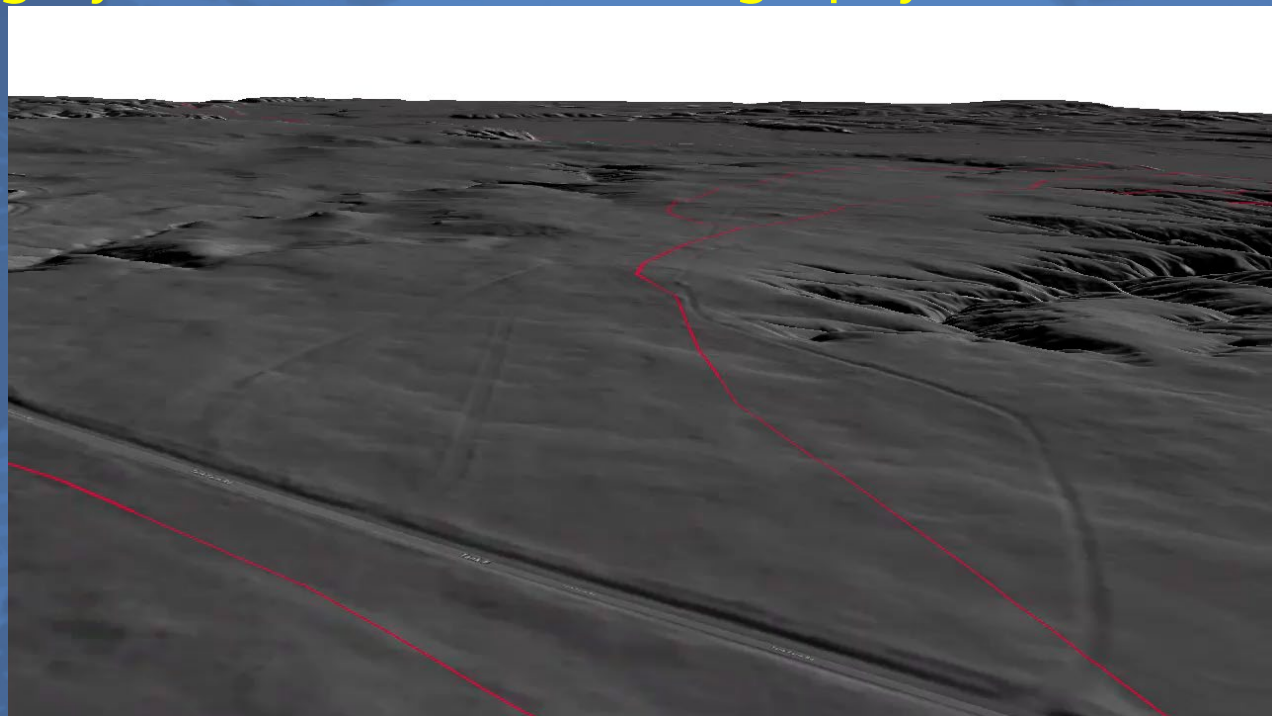
Detect Features that May Not be Discernable From:

- High Resolution Imagery - Historic Aerial Photography
- Pedestrian Survey

Bare Earth  
Removes Vegetation

High Accuracy  
Georeferenced Data

- Allows for Trail Digitization
- Classification in the Field







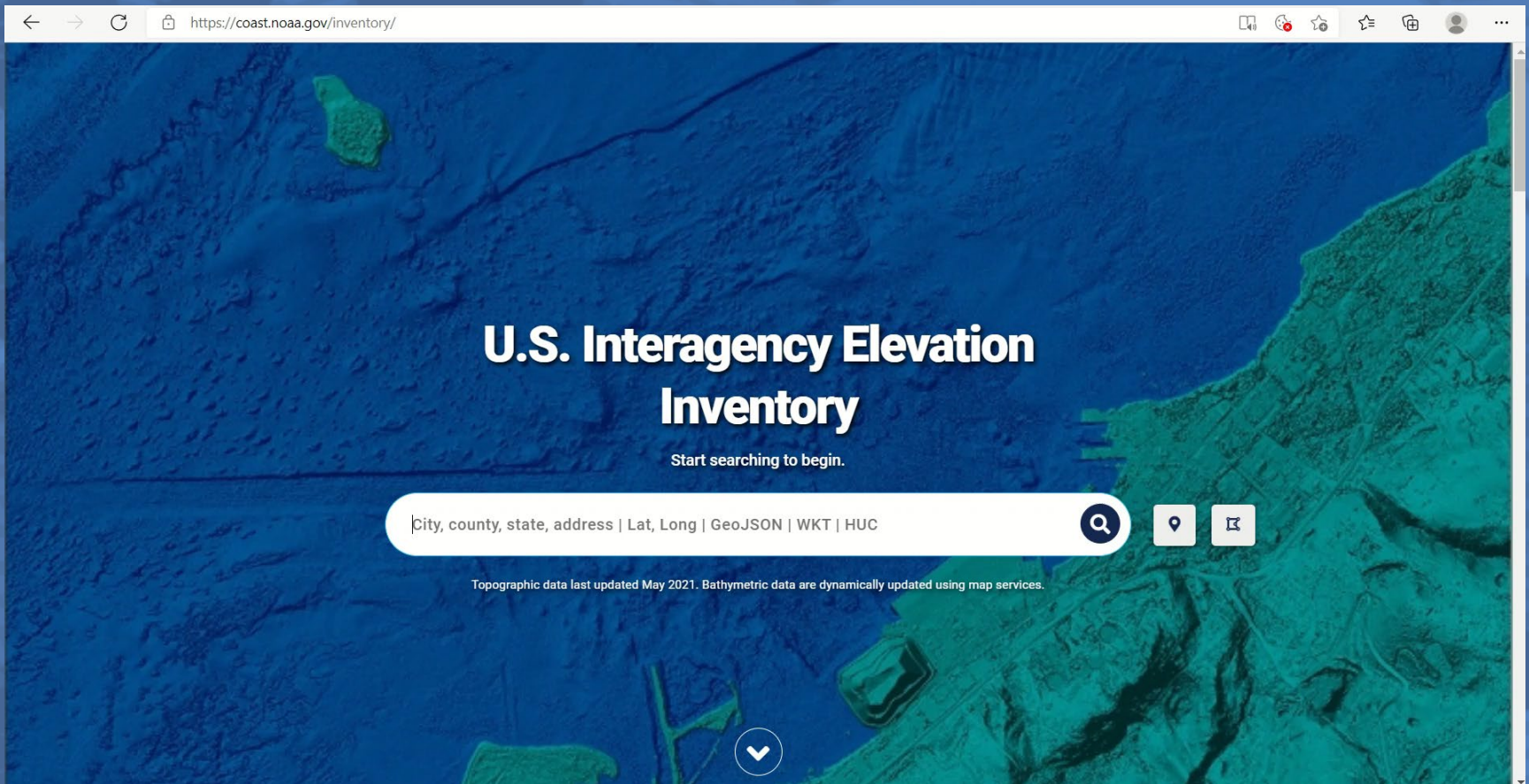
# Application to MET Mapping

- LiDAR Hillshades are Another Type of Evidence to Support Verifying Trail
  - May help focus mapping efforts in areas where the trail is unknown
  - Display physical linear features that may represent:
    - Historic trail trace
    - Swales
    - Ruts
  - Used in conjunction with other evidence, LiDAR Hillshade data can be ground truthed and verified.



# LiDAR Coverage

<https://coast.noaa.gov/inventory/>







# USGS TNM Downloader

<https://apps.nationalmap.gov/downloader/#/>

← → ↻ 🔒 <https://apps.nationalmap.gov/downloader/#/> ★ ☆ 📁 👤 ...

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Datasets Products **Cart**

Select products below and then hit "Search Products"

**Area of Interest:** Map Extent/Geometry ▾

Extent 📏 Polygon 📐 Point 📍 Enter Coords 📄 Clear Geometry 🗑️

**Advanced Search**

🔍 Search Products Reset Map 🔄 Upload shapefile 📁

**Map**

☐ US Topo

☐ Historical Topographic Maps

**Data**

☐ Boundaries - National Boundary Dataset

☐ Elevation Products (3DEP)

☐ Elevation Source Data (3DEP) - Lidar, IfSAR

☐ Hydrography (NHDPlus HR, NHD, WBD)

☐ Imagery - NAIP Plus (1 meter to 1 foot)

☐ Map Indices

☐ Names - Geographic Names Information System (GNIS)

☐ Small-scale Datasets

☐ Structures - National Structures Dataset

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# 3DEP LiDAR Explorer

<https://prd-tnm.s3.amazonaws.com/LidarExplorer/index.html#/>



≡ 3DEP LidarExplorer

[Search](#) [Process](#) [About](#)

Locate a Place

BASE MAP



Which product are you interested in?

LIDAR

DEM

OTHER

☐ Show where Lidar is available.

☐ Define Area of Interest

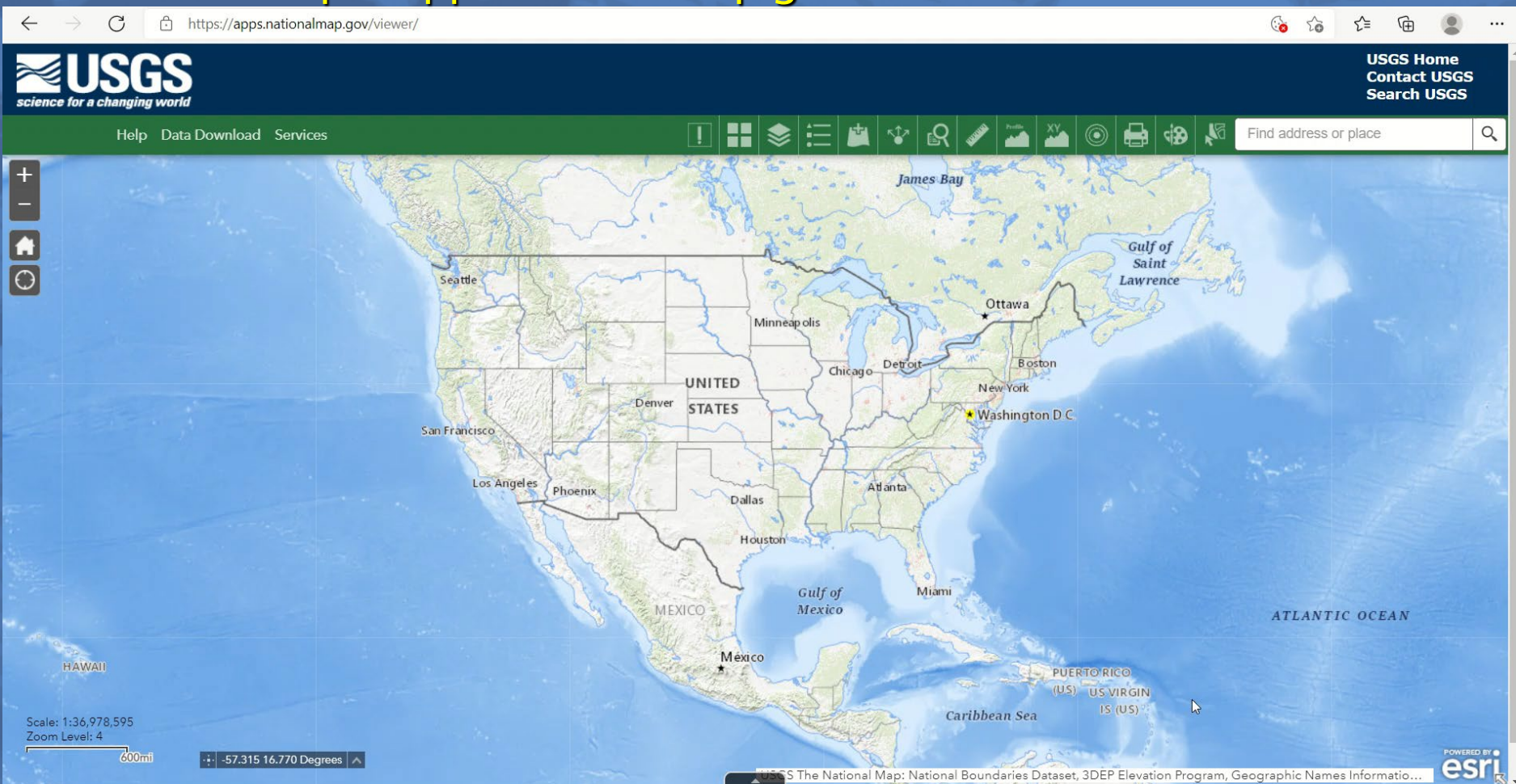






# USGS HillShade Viewers

<https://apps.nationalmap.gov/viewer/>





# Some Other Ways to View Hillshade Services

← → ↻ 🔒 https://apps.nationalmap.gov/viewer/

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USGS Home  
Contact USGS  
Search USGS

Help Data Download Services

Find address or place

Layer List

- ☐ 1 arc-second
- ☐ 2 arc-second
- ☐ Source Data Index - Lidar, Ifsar, DEM
- ☐ Topobathymetric Data Index
- ☒ Query
- ☐ 3DEP Elevation - Hillshade
- ☐ 3DEP Elevation - Multi-Directional Hillshade
- ☐ 3DEP Elevation - Elevation Tinted Hillshade
- ☐ 3DEP Elevation - Slope Map
- ☐ 3DEP Elevation - Aspect Map
- ☒ 3DEP Elevation - Hillshade Stretched
- ☐ 3DEP Elevation - Auto Contours
- ☐ Geologic Map of North America (GMNA)
- ☐ Imagery (NAIP Plus)

Scale: 1:9,028  
Zoom Level: 10  
600ft  
-106.453 42.769 Degrees


USGS National Map 3D Elevation Program (3DEP) | U. S. Geological Survey











# Other Sources



<https://gis.dogami.oregon.gov/maps/lidarviewer/>

 **DOGAMI Lidar Viewer** Oregon Department of Geology and Mineral Industries Oregon Lidar Consortium

Find address

**Layers Currently Shown** 

**Layers**  

- ☐ Downloadable Lidar Data ...
- ☐ Project Areas ...
- ☐ Canopy Height Hillshade ...
- ☐ Bare Earth Slope (degrees) ...
- ☐ Highest Hit Lidar Hillshade ...
- ☐ Bare Earth Lidar Hillshade ...

100mi 41.734 -131.012 Degrees

County of Crook, State of Oregon GEO, Esri, HERE, Garmin, FAO, NOAA, USGS, EPA | County of



# National Trails NHT Viewer



## National Park Service - National Trails

National Historic Trails Viewer

[NPS Home](#) [Integrated Resource Management Applications](#) [NPS ArcGIS OpenData Portal](#)

[About](#) [Legend](#)

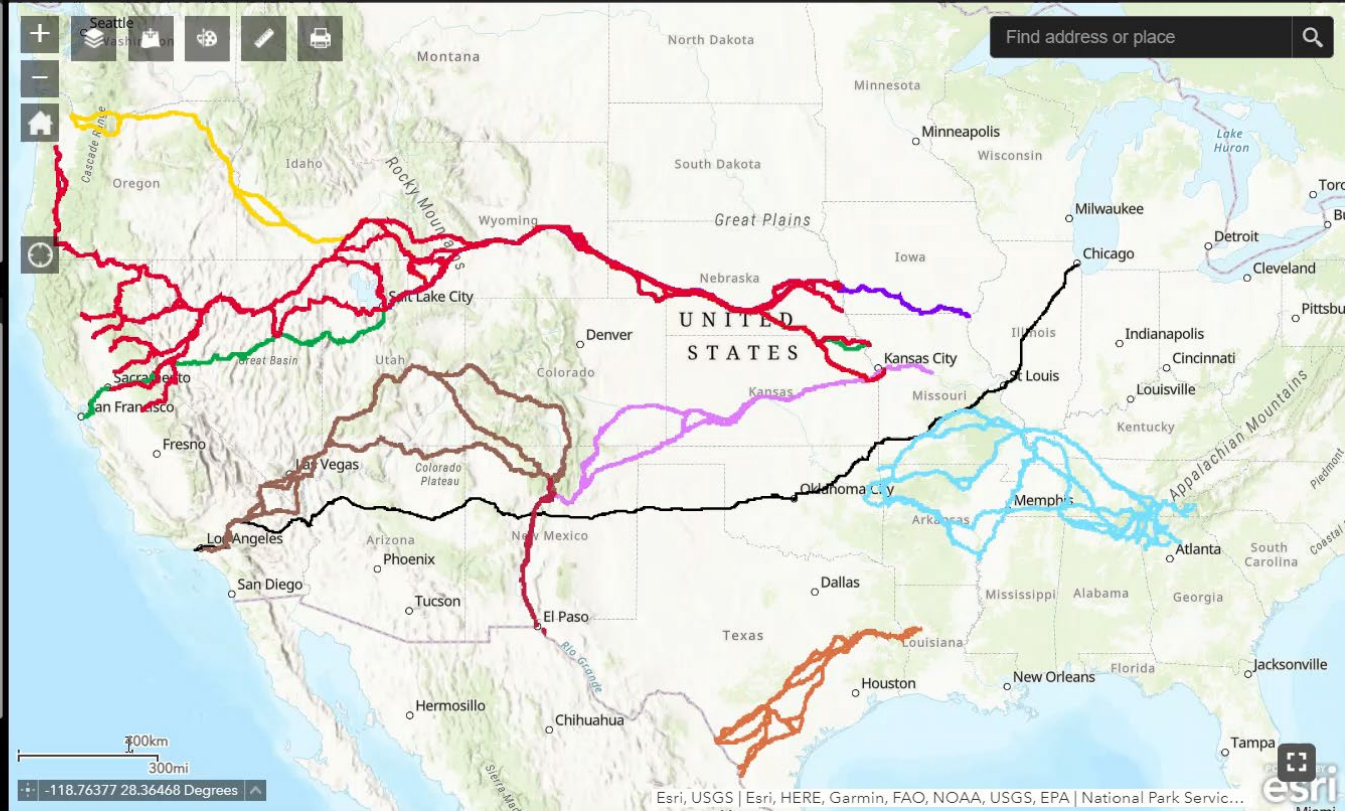
### Explore National Historic Trails

National Historic Trails are designated to protect the remains of significant overland or water routes to reflect the history of the nation. They represent the earliest travels across the continent on El Camino Real de Tierra Adentro National Historic Trail; epic migrations on the Mormon & Oregon Trails and the development of continental commerce on the Santa Fe Trail. They also commemorate the forced displacement and hardships of the Native Americans, on the Trail of Tears. There are currently 19 National Historic Trails in the National Trails System, and the National Trails office administers nine. The National Trails office also includes the Route 66 Corridor Preservation

[Layers](#) [Basemap](#) [Gallery](#)

#### Layers

- ☒ California NHT
- ☒ El Camino Real de Tierra Adentro NHT
- ☒ El Camino Real de los Tejas NHT
- ☒ Mormon Pioneer NHT
- ☒ Old Spanish NHT
- ☒ Oregon NHT
- ☒ Pony Express NHT
- ☒ Santa Fe NHT
- ☒ Trail of Tears NHT







# Hillshade Creation and Digitization

- Hillshade Creation
  - GIS Software Needed but there are open source free options available
  - Potential Historic Trail Trace Digitization
    - A number of GIS software/platform depending on the input data (TNP, ArcGIS, Google Earth, ArcGIS Online, QGIS)



# Why This Matters

- LiDAR Hillshade
  - Allows for identification of potential trail trace before field work
  - Makes field recording potentially faster
  - Identify previously unknown trail trace
- More importantly, LiDAR Hillshades are another way to fulfill the purpose of the National Historic Trails under the National Trails System Act by identifying and protecting for public use and enjoyment.





# Questions

References to non-U.S. Department of the Interior (DOI) products do not constitute an endorsement by the DOI.

