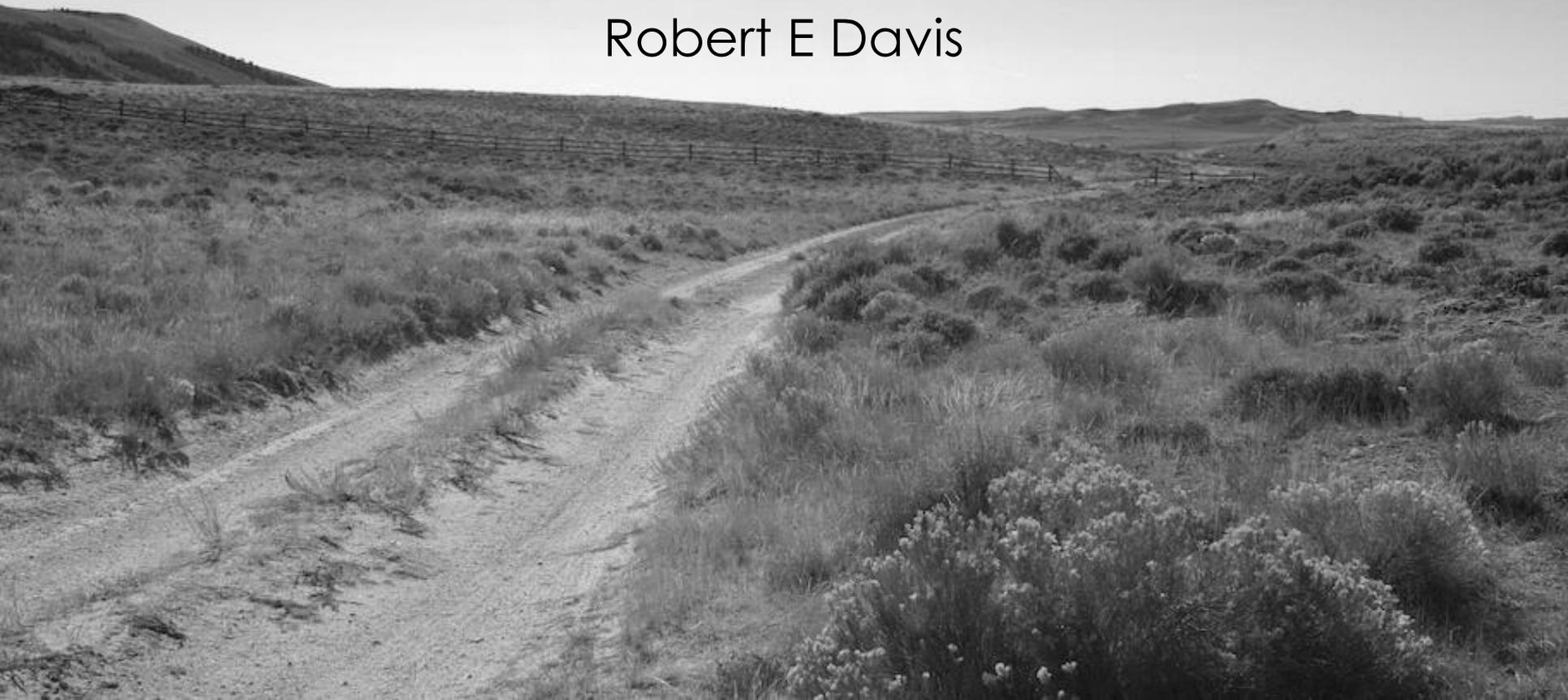


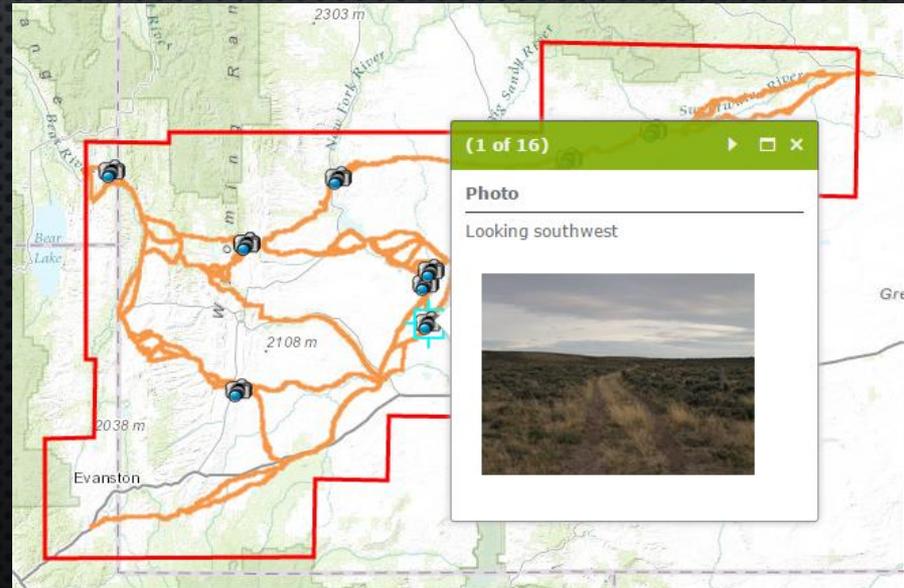
SOUTHWEST WYOMING NINETEENTH CENTURY EMIGRANT TRAILS

Robert E Davis

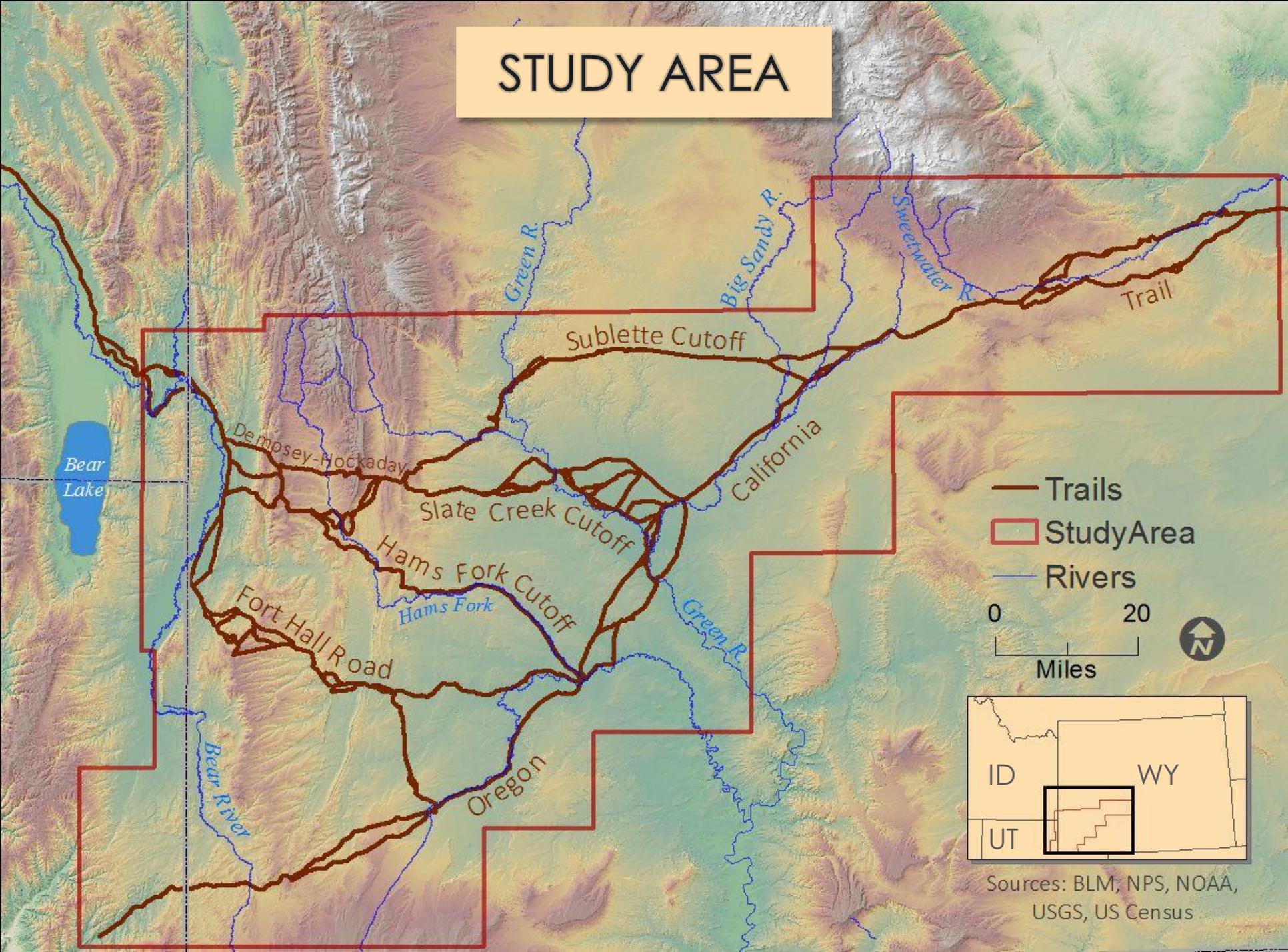


THE WAY FORWARD

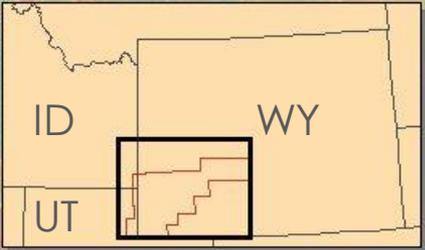
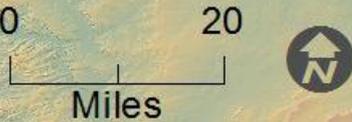
- INTRODUCTION — TIME AND PLACE
- LEAST-COST CORRIDORS AND PATHS
- NETWORK ANALYSIS
- ELEVATION PROFILES
- INCORPORATION INTO A WEBSITE
- CONCLUSIONS



STUDY AREA



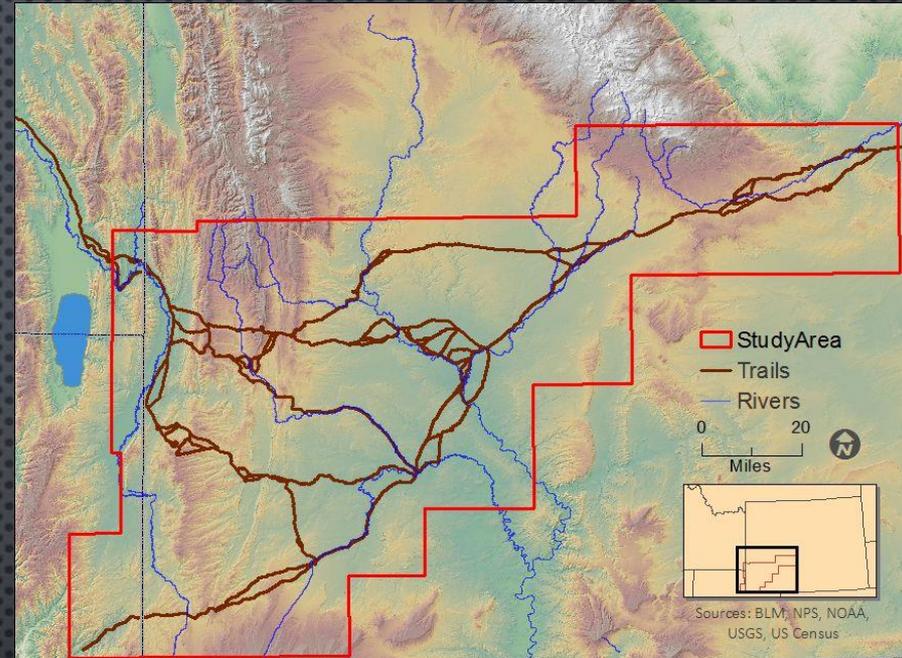
- Trails
- ▭ Study Area
- Rivers



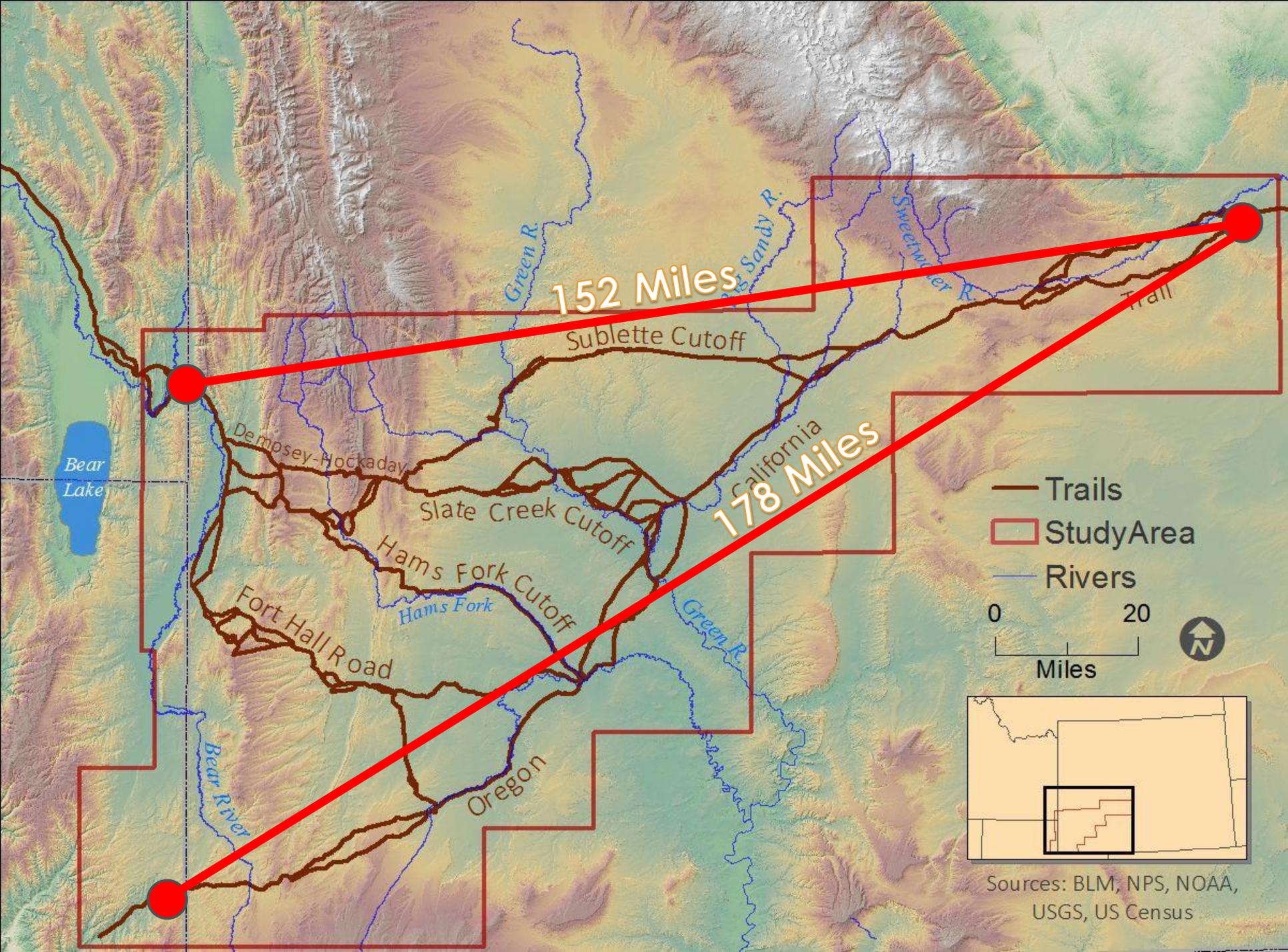
Sources: BLM, NPS, NOAA, USGS, US Census

INTRODUCTION

- MID 19TH CENTURY
- AMERICANS ARE MIGRATING TO THE WEST, MANY BY WAGON
- THE WAGON TRAIL TOOK SEVERAL ROUTES IN THE SOUTHWEST CORNER OF WYOMING
 - OREGON OR CALIFORNIA
 - THE MOST DIRECT ROUTE ACROSS THE TERRAIN
 - RESOURCE NEEDS OF WAGON TRAVEL: GRASS, WATER, FIREWOOD
 - EMIGRANTS CREATE OR USE 949 MILES OF TRAIL TO CROSS ROUGHLY 150 MILES OF TERRAIN



Green River

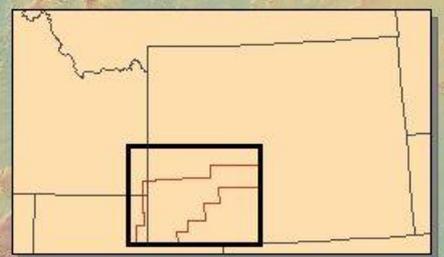


152 Miles

178 Miles

— Trails
▭ Study Area
— Rivers

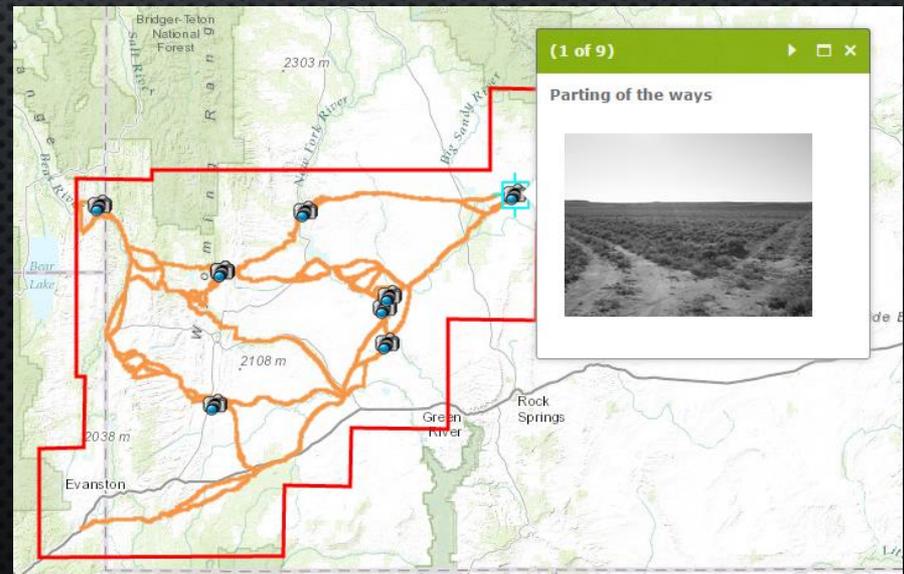
0 20
Miles



Sources: BLM, NPS, NOAA,
USGS, US Census

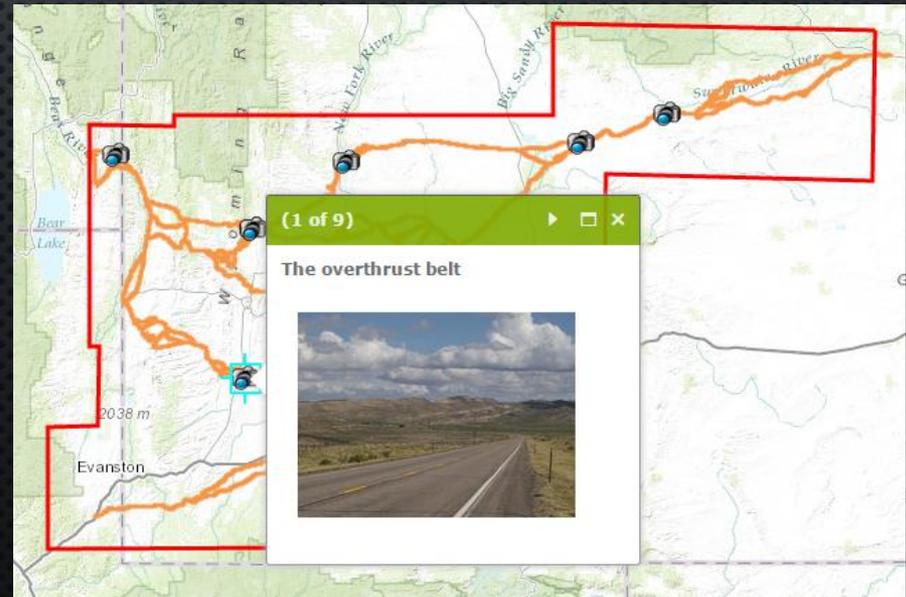
INTRODUCTION

- CONSIDERING:
 - THE STUDY AREA
 - THE SHORT ROUTE, OR THE RESOURCE ROUTE
 - AND THE TERRAIN
- WHICH WERE THE BEST ROUTES ACROSS THE STUDY AREA?
- DID THE EMIGRANTS TAKE THESE ROUTES?
- CAN THIS INFORMATION FIT ON THE WEB? (IN SHORT, YES)

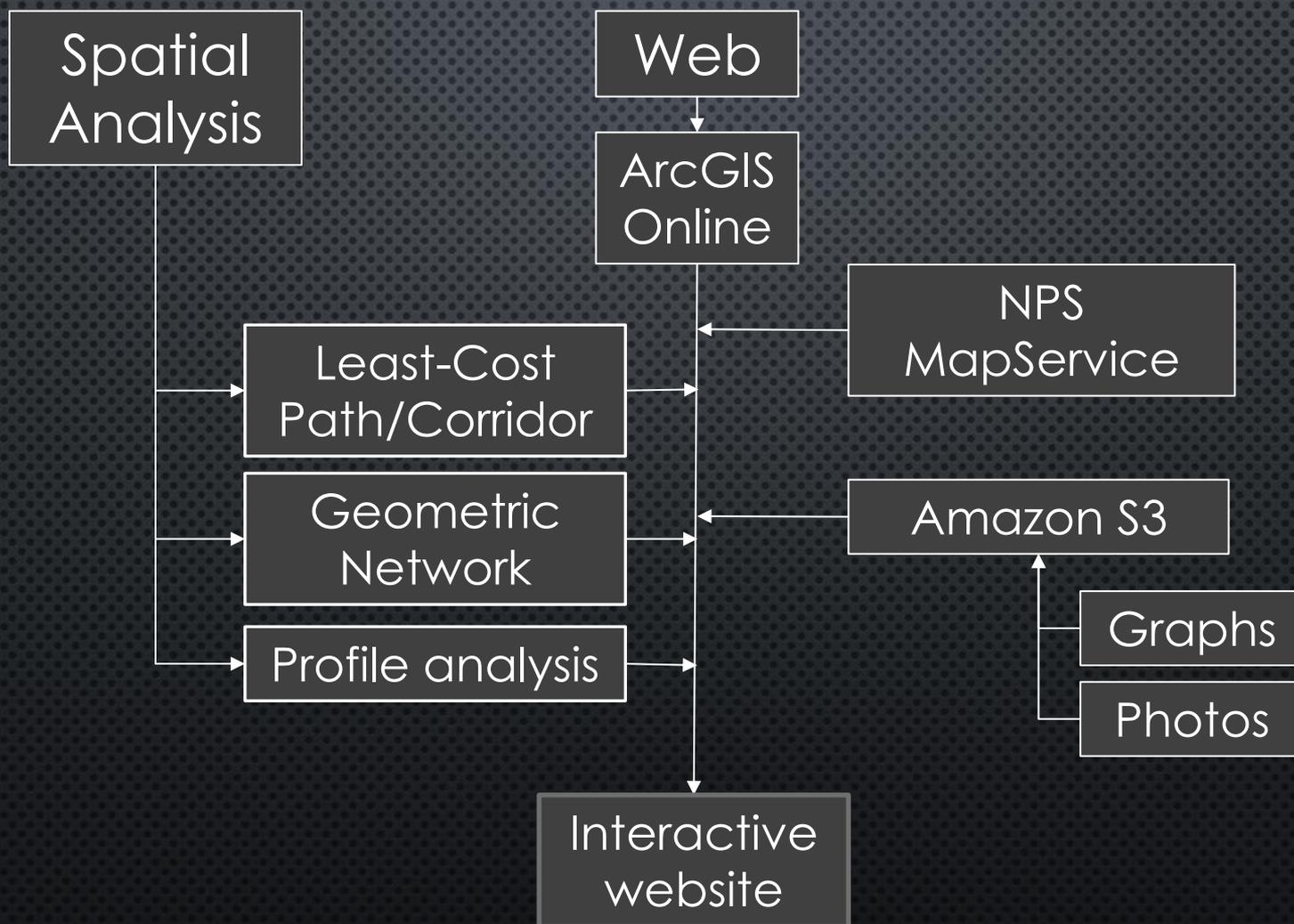


METHOD

- DATA USED:
 - USGS DIGITAL ELEVATION MODELS (10M AND 30M)
 - NOAA RIVER DATA
 - BLM AND NPS TRAIL DATA
- NAD 1983, UTM 12



METHOD



METHOD: DETERMINE THE PATH OF LEAST RESISTANCE AND MAXIMUM RESOURCES



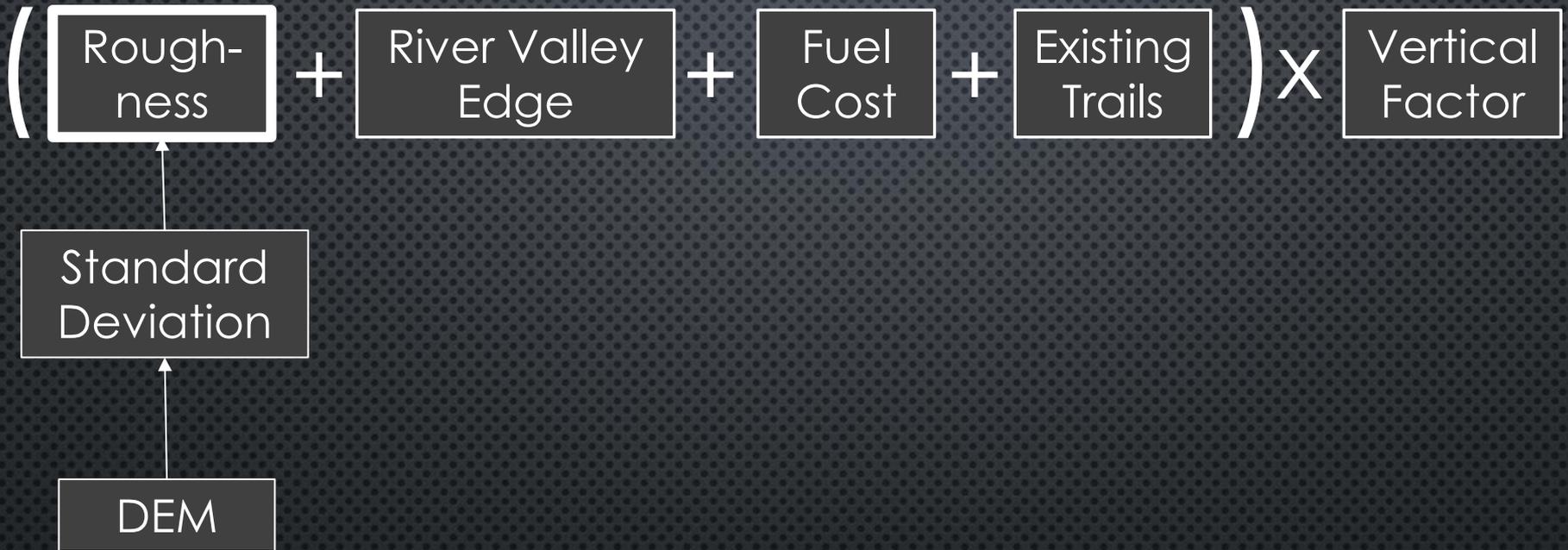
COST PATH
TOOL



CORRIDOR
TOOL



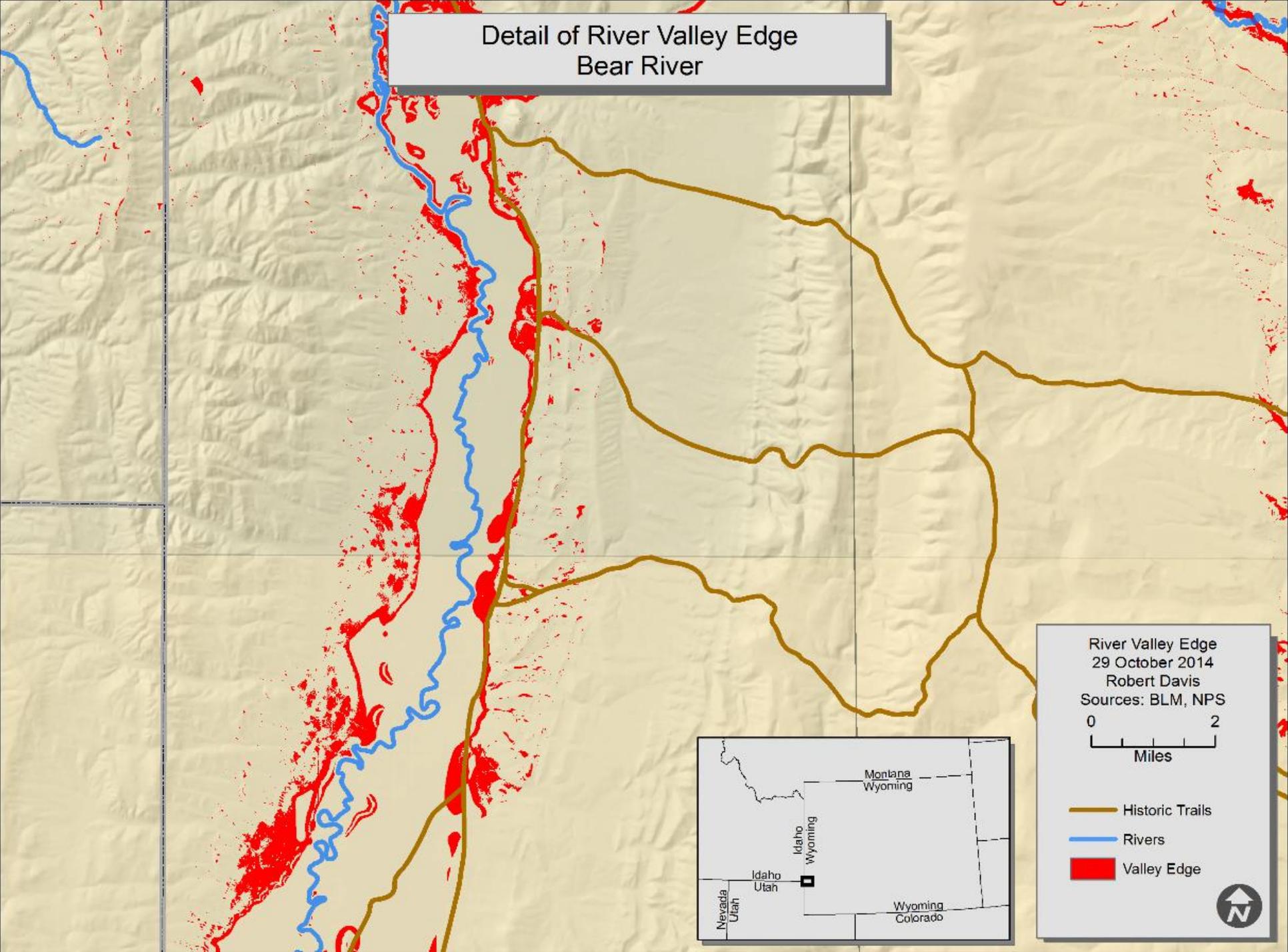
METHOD – COST SURFACE



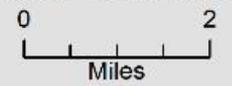
METHOD – COST SURFACE



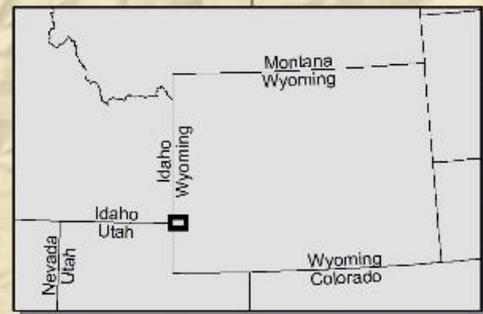
Detail of River Valley Edge Bear River



River Valley Edge
29 October 2014
Robert Davis
Sources: BLM, NPS



- Historic Trails
- Rivers
- Valley Edge



METHOD – COST SURFACE

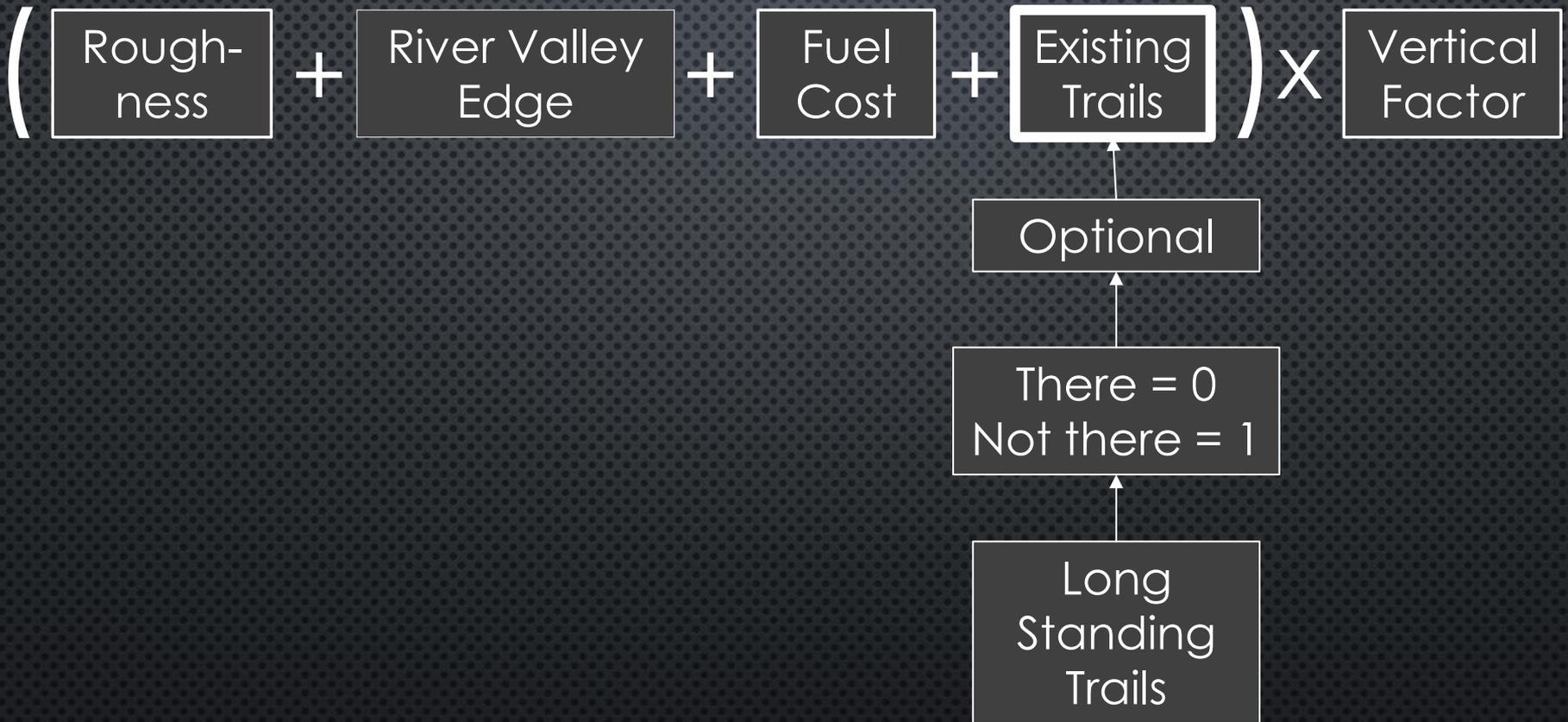
$$\left(\text{Roughness} + \text{River Valley Edge} + \text{Fuel Cost} + \text{Existing Trails} \right) \times \text{Vertical Factor}$$

Areas farther than 1/2 Day's travel (~7 mi) are more costly

Buffer by 7 mi – convert to a raster

Major River

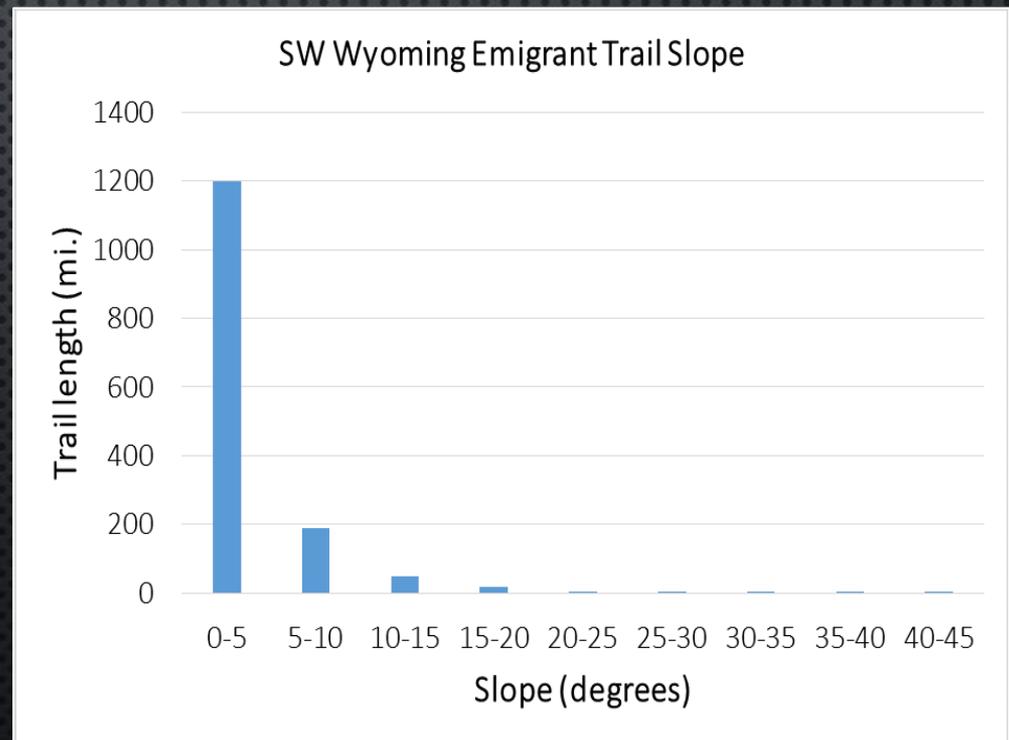
METHOD – COST SURFACE



METHOD – COST PATH

$$\left(\text{Roughness} + \text{River Valley Edge} + \text{Fuel Cost} + \text{Existing Trails} \right) \times \text{Vertical Factor}$$

- A SLOPE RASTER WAS CREATED FROM A DEM
- RECLASSIFIED EVERY FIVE DEGREES
- CONVERTED TO A POLYGON LAYER WITH SLOPE AS AN ATTRIBUTE
- TRAIL LAYER WAS “IDENTIFIED” TO THE POLYGON’S SLOPE



METHOD – COST PATH

$$\left(\text{Roughness} + \text{River Valley Edge} + \text{Fuel Cost} + \text{Existing Trails} \right) \times \text{Vertical Factor}$$

TRAIL (DEG)	LENGTH	COST
0-5	1200 MI.	1
5-10	188 MI.	8
10-15	50 MI.	30
15-20	17 MI.	84
20-25	3 MI.	471
25-45	1 MI.	785

Total length / slope length = Cost

e. g. 1460 / 188 = 8

METHOD – COST PATH

$$\left(\text{Roughness} + \text{River Valley Edge} + \text{Fuel Cost} + \text{Existing Trails} \right) \times \text{Vertical Factor}$$

- A WEIGHT IS ASSIGNED TO BALANCE THE VF TO THE SUM OF THE MAXIMUMS OF THE OTHER FACTORS
- RESULTS IN A TABLE OF VERTICAL FACTORS:

<u>SLOPE</u>	<u>VF</u>
0-5	1.04
5-10	1.4
10-15	2.4
15-20	4.8
20-25	22.3
25-45	36.5

METHOD – COST PATH

$$\left(\text{Roughness} + \text{River Valley Edge} + \text{Fuel Cost} + \text{Existing Trails} \right) \times \text{Vertical Factor}$$

-45	100
-40	10
-35	2
-30	.7
-25	.6
-20	.5
-15	.6
-10	.7
-5	.8
0	1.0
5	1.4
10	2.4
15	4.8
20	22.3
>25	36.5



Vertical factor (optional)

Defines the relationship between the vertical cost factor and the vertical relative moving angle (VRMA).

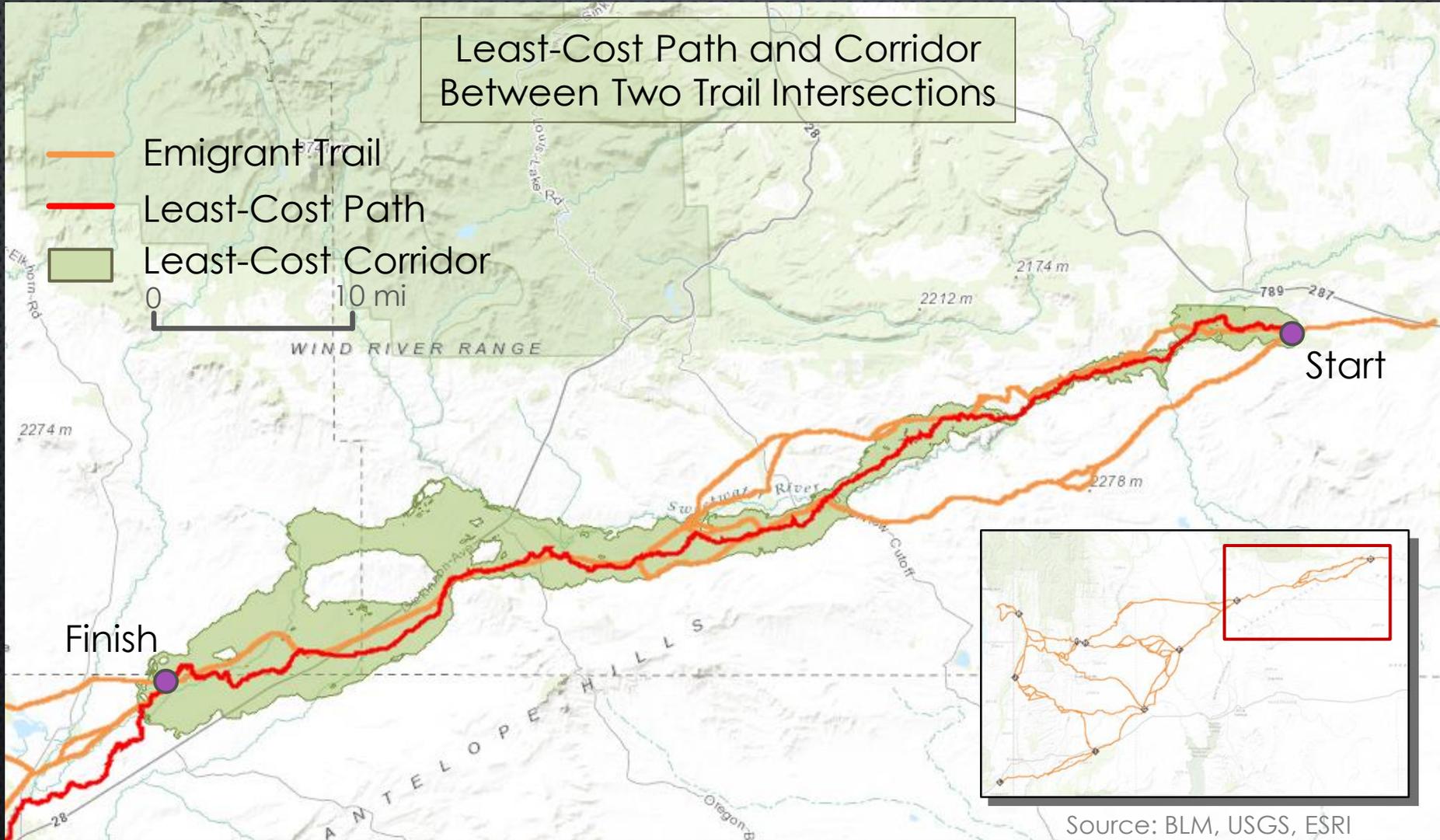
There are several factors with modifiers from which to select that identify a defined vertical factor graph. Additionally, a table can be used to create a custom graph. The graphs are used to identify the vertical factor used in calculating the total cost for moving into a neighboring cell.

In the explanations below, two acronyms are used: 'VF' stands for vertical factor, which defines the vertical difficulty encountered in moving from one cell to the next; and 'VRMA' stands for vertical relative moving angle, which identifies the slope angle between the FROM or processing cell and the TO cell.

Vertical factor types:

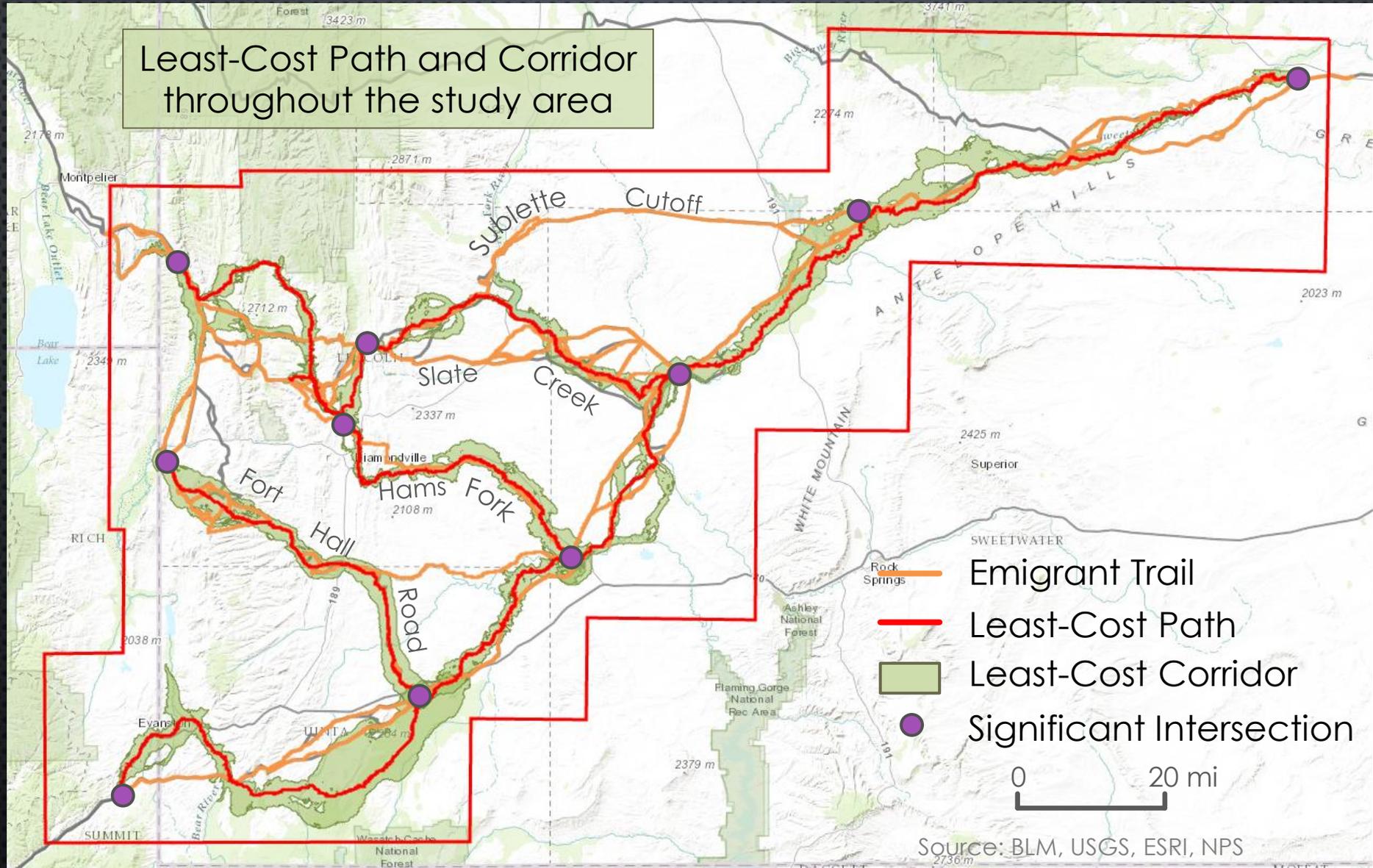
- **Binary**—Specifies that if the VRMA is greater than the low-cut angle and less than the high-cut angle, the VF is set to the value associated with the zero factor; otherwise, it is infinity.
- **Linear**—Indicates that the VF is a linear function of the VRMA.
- **Symmetric Linear**—Specifies that the VF is a linear function of the VRMA in either the negative or positive side of the VRMA, respectively, and the two linear

RESULTS OF LEAST-COST ANALYSIS



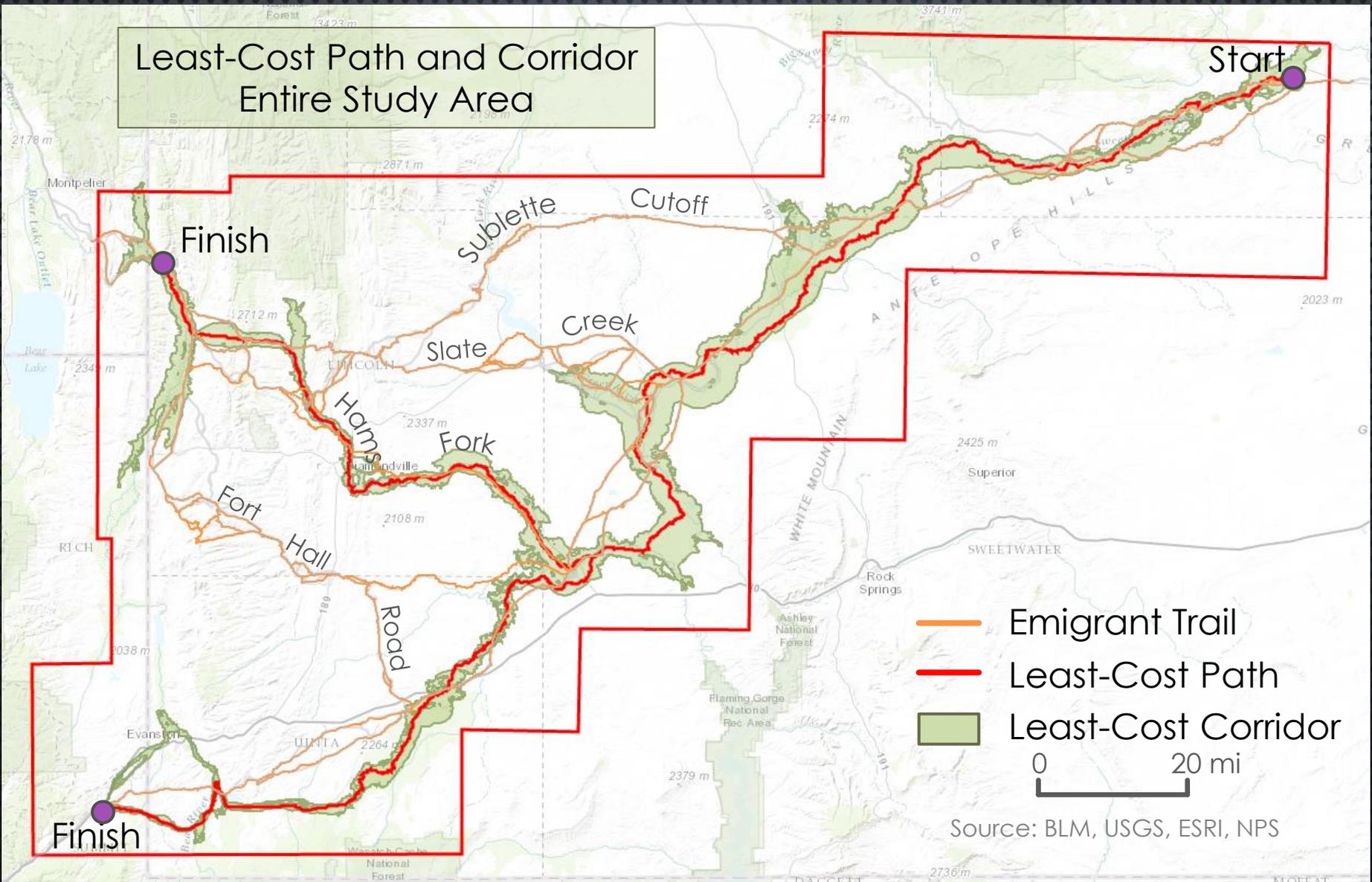
RESULTS OF LEAST-COST ANALYSIS

Least-Cost Path and Corridor throughout the study area

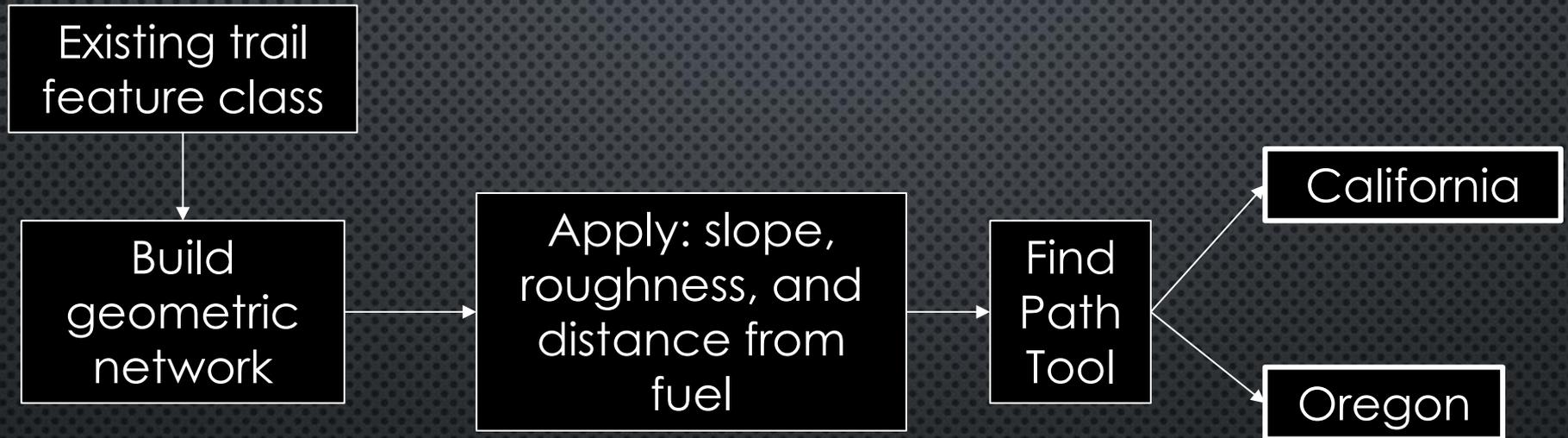


ENTIRE STUDY AREA LEAST-COST

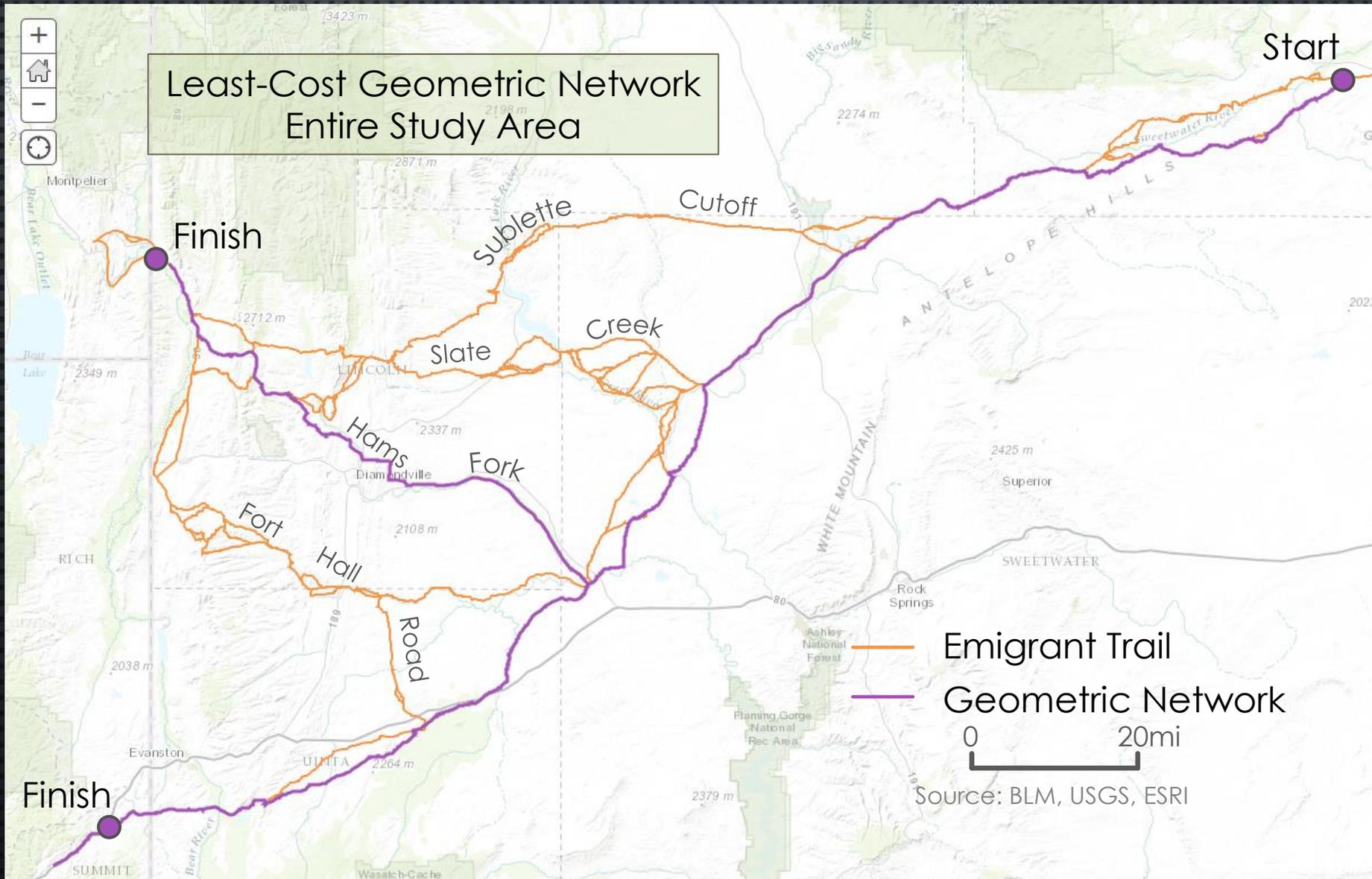
Least-Cost Path and Corridor
Entire Study Area



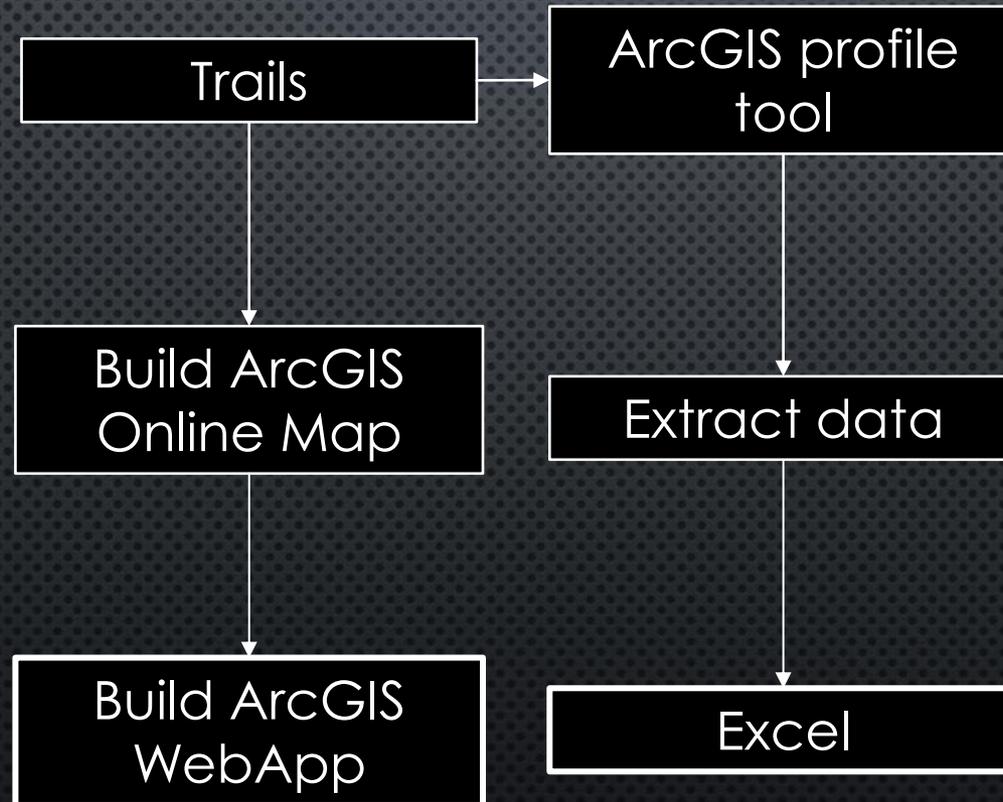
METHOD: GEOMETRIC NETWORK



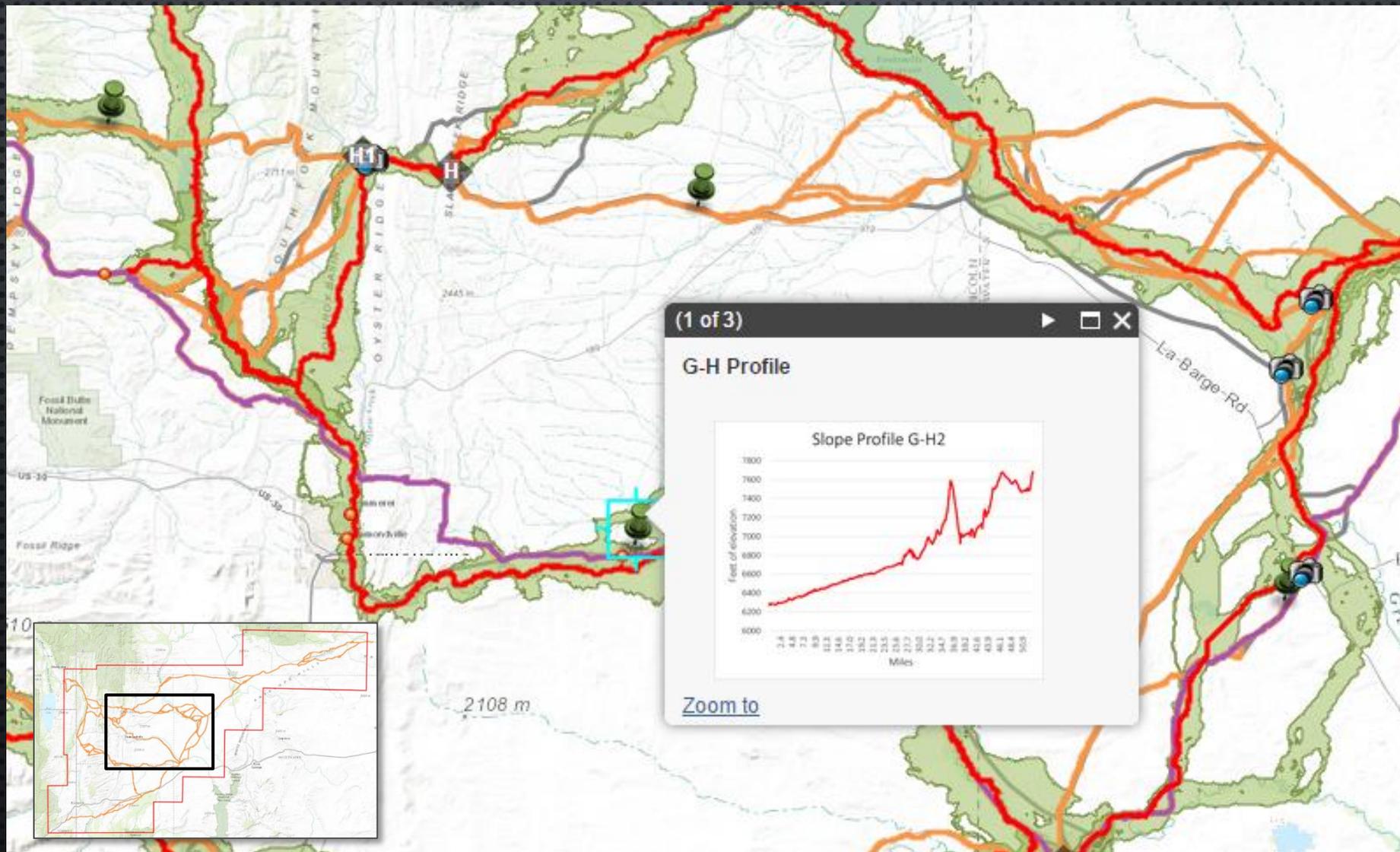
RESULTS: GEOMETRIC NETWORK



METHOD: ELEVATION PROFILES



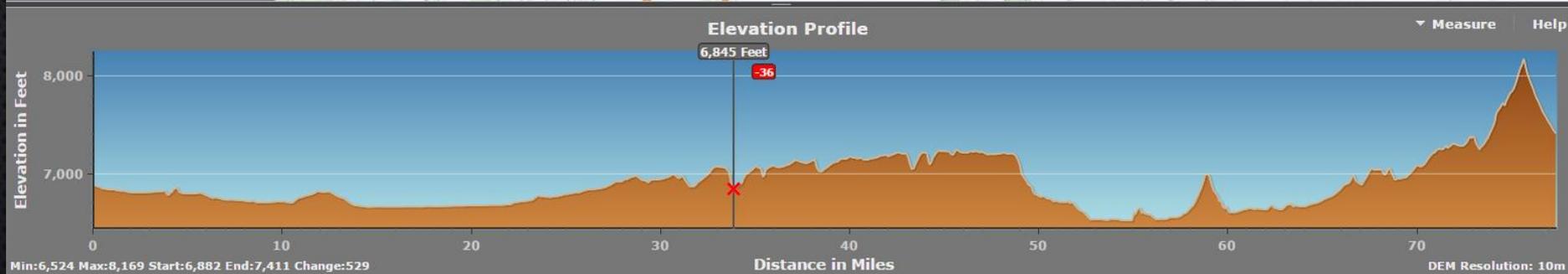
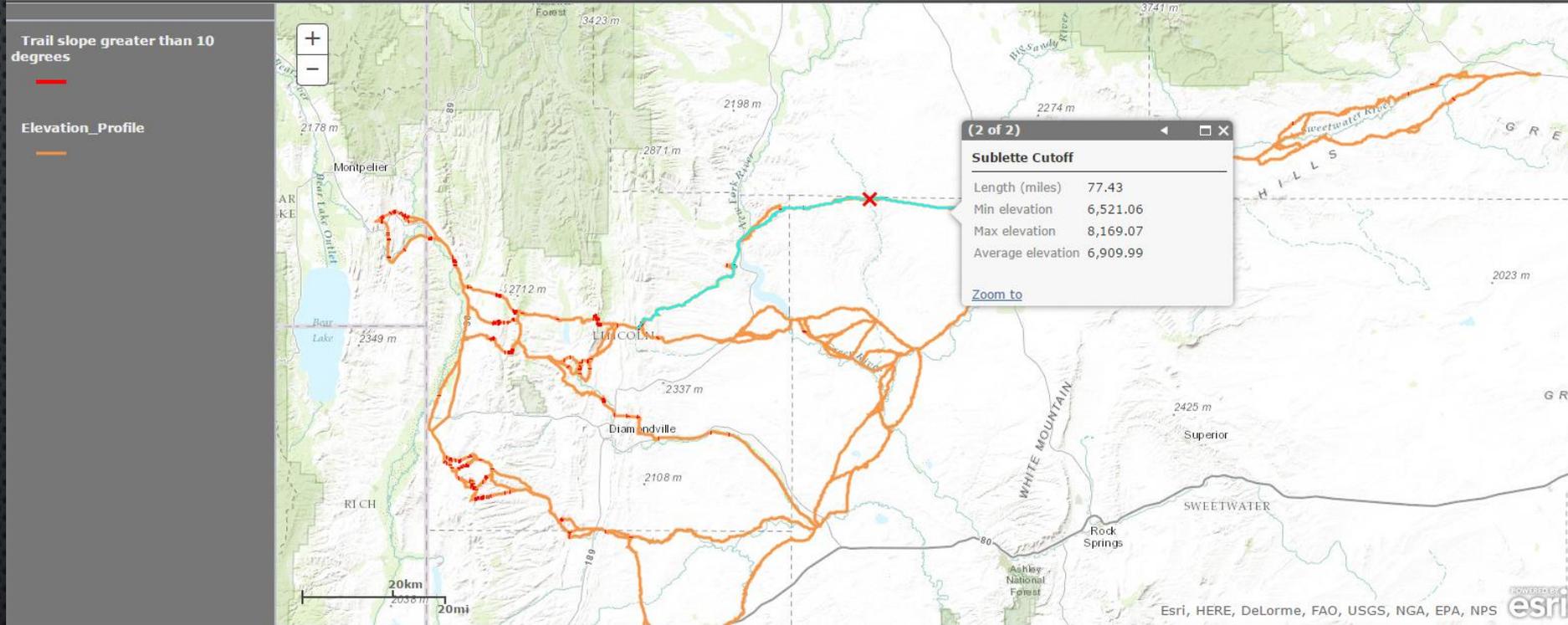
RESULTS: EXCEL ELEVATION PROFILE



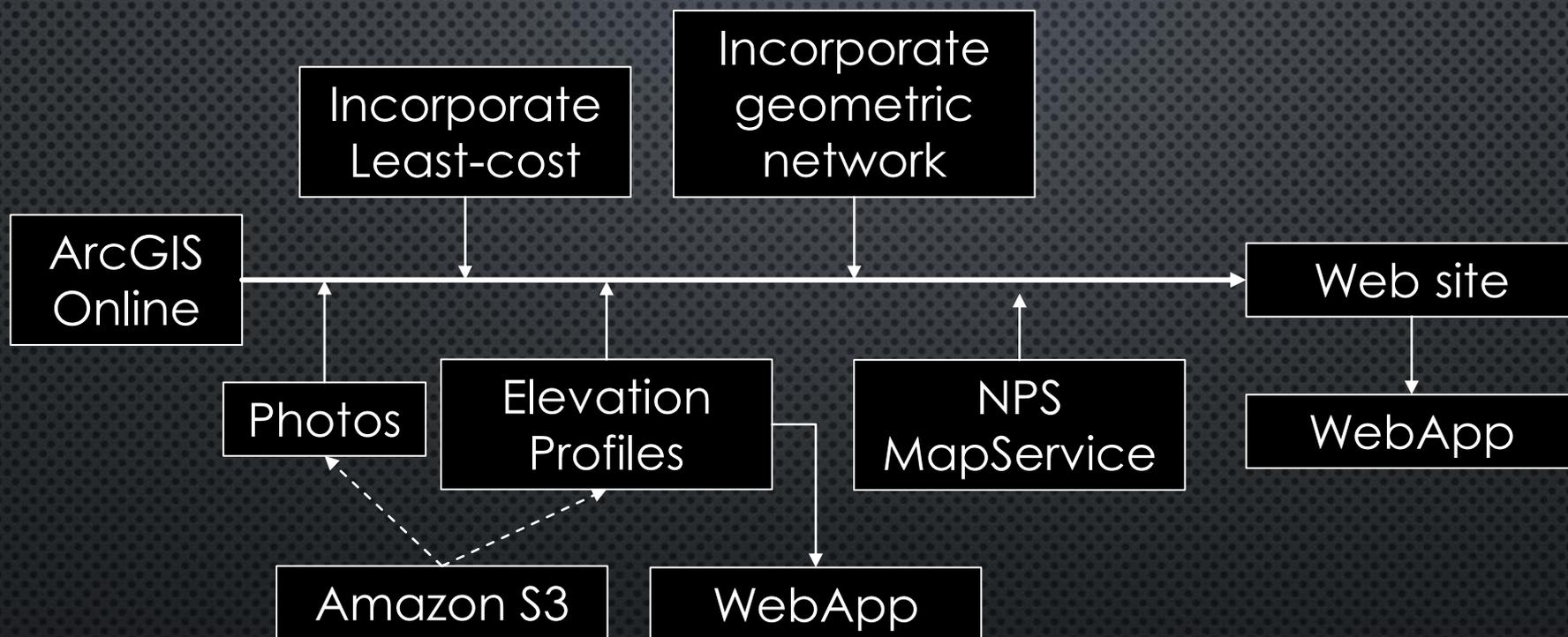
RESULTS: ELEVATION PROFILE WEBAPP

Elevation Profiles SW Wyoming Emigrant Trails

Elevation Profiles SW Wyoming Emigrant Trails



METHOD: INTEGRATION INTO THE WEB



RESULTS: WEBSITE

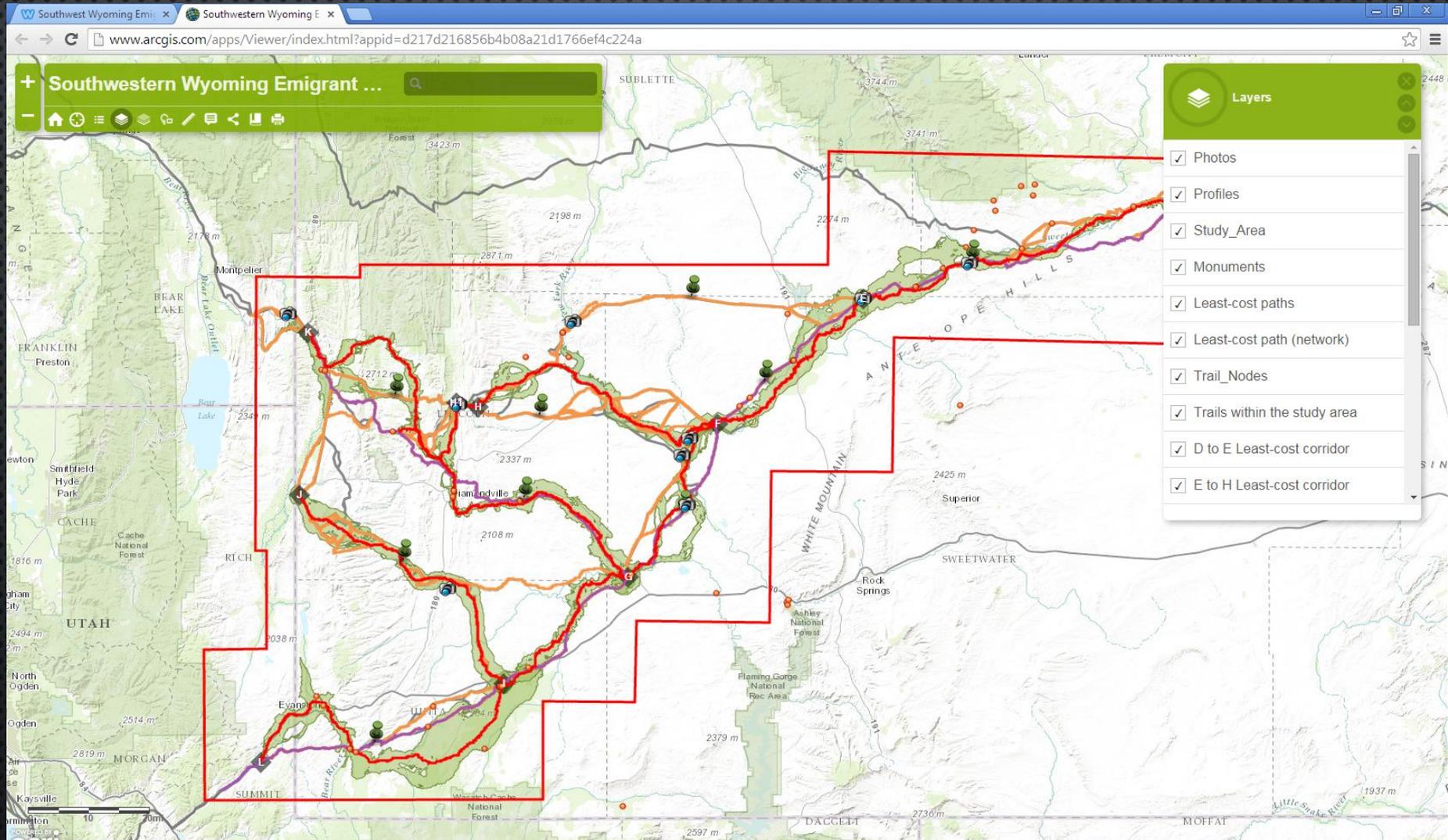
Southwest Wyoming Emig x
southwestwytrails.weebly.com

SOUTHWEST WYOMING EMIGRANT TRAILS

TRAILS ONLY LEAST COST PATHS/CORRIDORS EXPLANATIONS

This is perhaps the most interesting section of emigrant trails along the entire California trail network. From east to west in a distance of about 150 miles almost a thousand miles of trails were created in an effort to find the route with the best grass, most water, least elevation gain, and shortest distance. Below is a collection of geospatial graphics depicting least-cost corridors (the green blob features), least-cost paths (the red lines), least cost route along the existing trails (purple lines), known emigrant trails (the orange lines), elevation profiles (pushpins), photographs (camera graphics), and historic markers (orange dots). Note that the least cost paths are theoretical -- they are computer generated and may or may not correspond with a trail on the ground.

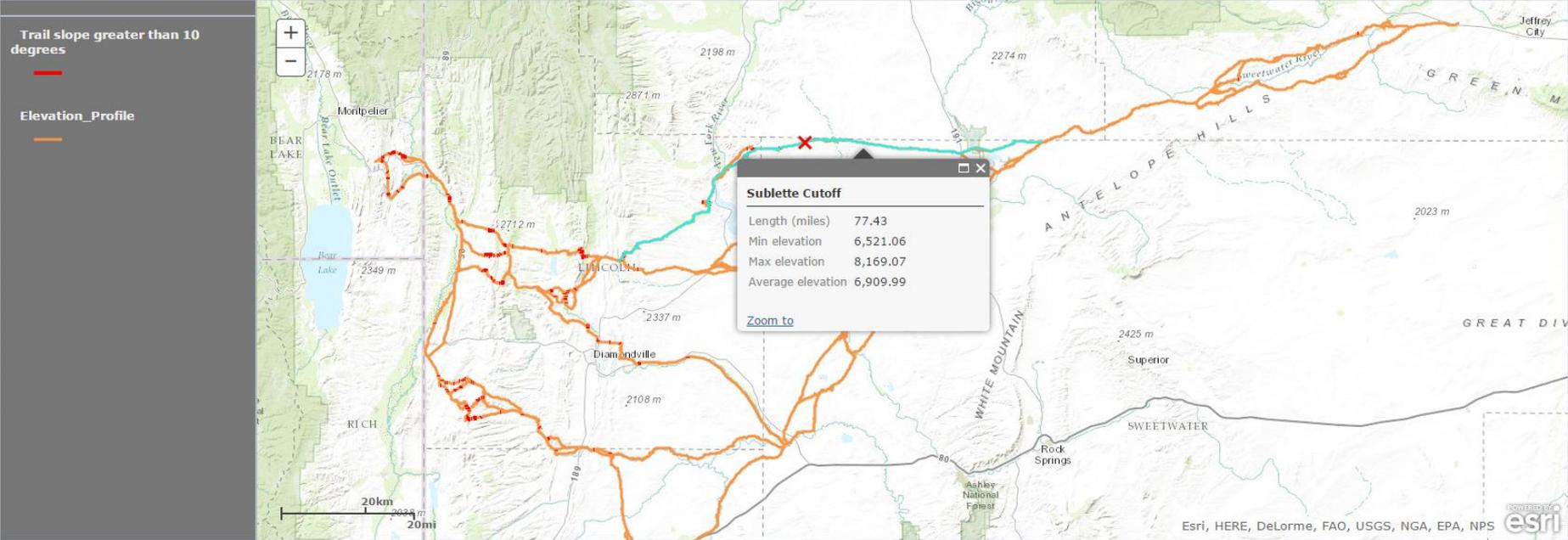
RESULTS: WEBSITE



RESULTS: WEBSITE

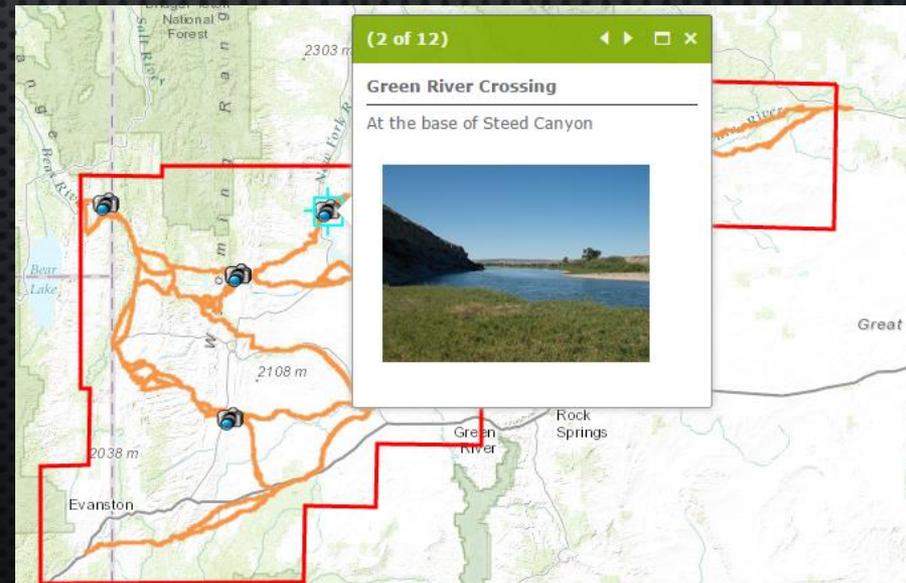
Elevation Profiles SW Wyoming Emigrant Trails

Elevation Profiles SW Wyoming Emigrant Trails



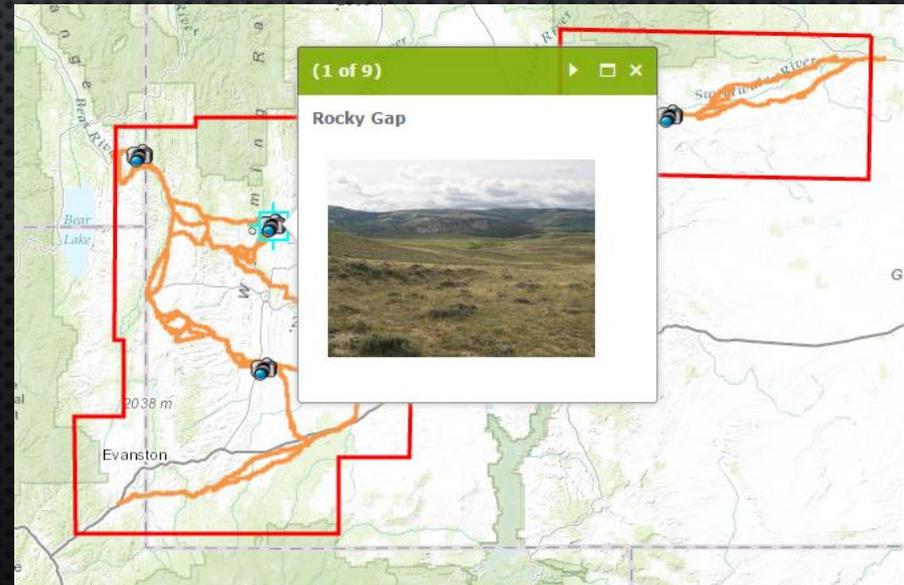
CONCLUSIONS

- GENERALLY, EMIGRANTS DID USE THE LEAST COST PATHS, CORRIDORS, AND NETWORKS
- SIGNIFICANT EXCEPTION
 - SUBLETTE CUTOFF
 - SHORTER AND MORE DIRECT
 - 1850: 9 OF 11 EMIGRANTS TOOK THE SUBLETTE CUTOFF
 - YET WITH THE CRITERIA SELECTED, NEITHER LEAST-COST PATH OR NETWORK PATH CHOSE THIS ROUTE
 - IT'S DRY
 - ROUGH COUNTRY
 - PERHAPS IT IS AN ISSUE OF TIME



REVIEW

- INTRODUCED THE HISTORICAL ASPECTS
- DISCUSSED LEAST-COST CORRIDORS AND PATHS
- NETWORK ANALYSIS
- ELEVATION PROFILES, EXCEL AND WEB BASED
- INCORPORATION INTO A WEBSITE
- CONCLUSIONS – SUBLETTE CUTOFF



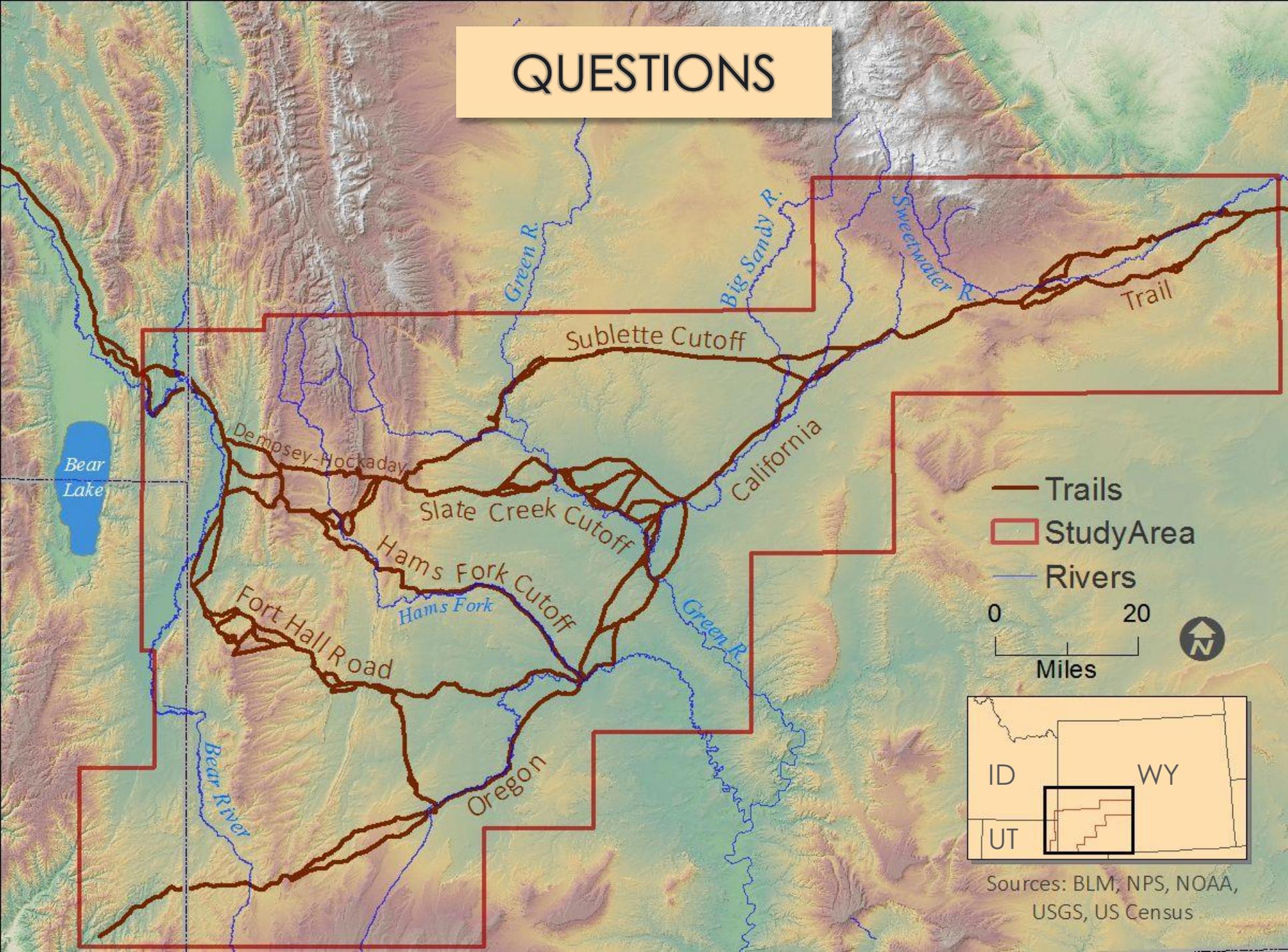
ACKNOWLEDGMENTS

- DR. CHRISTOPHERSON, U OF A
- DR. LUKINBEAL, U OF A
- DR. PATTEN, U OF A
- DR. RICHARD L. RIECK, PHD, UNIVERSITY OF MICHIGAN
- MR. DONALD BUCK, OREGON CALIFORNIA TRAILS ASSOCIATION

SOURCES

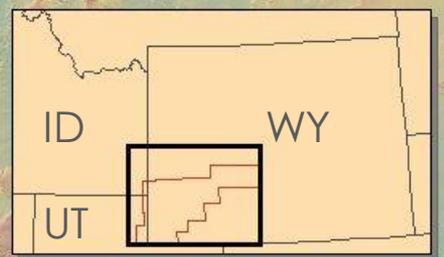
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QUESTIONS



— Trails
▭ Study Area
— Rivers

0 20
Miles



Sources: BLM, NPS, NOAA, USGS, US Census

