BLM National Fluid Conference

Cheyenne, Wyoming

June 24, 2004

Soil and Vegetation Recovery Rates from Historic Seismic Operations:

Emphasis on Identification and Aging of Historic Geophysical Lines

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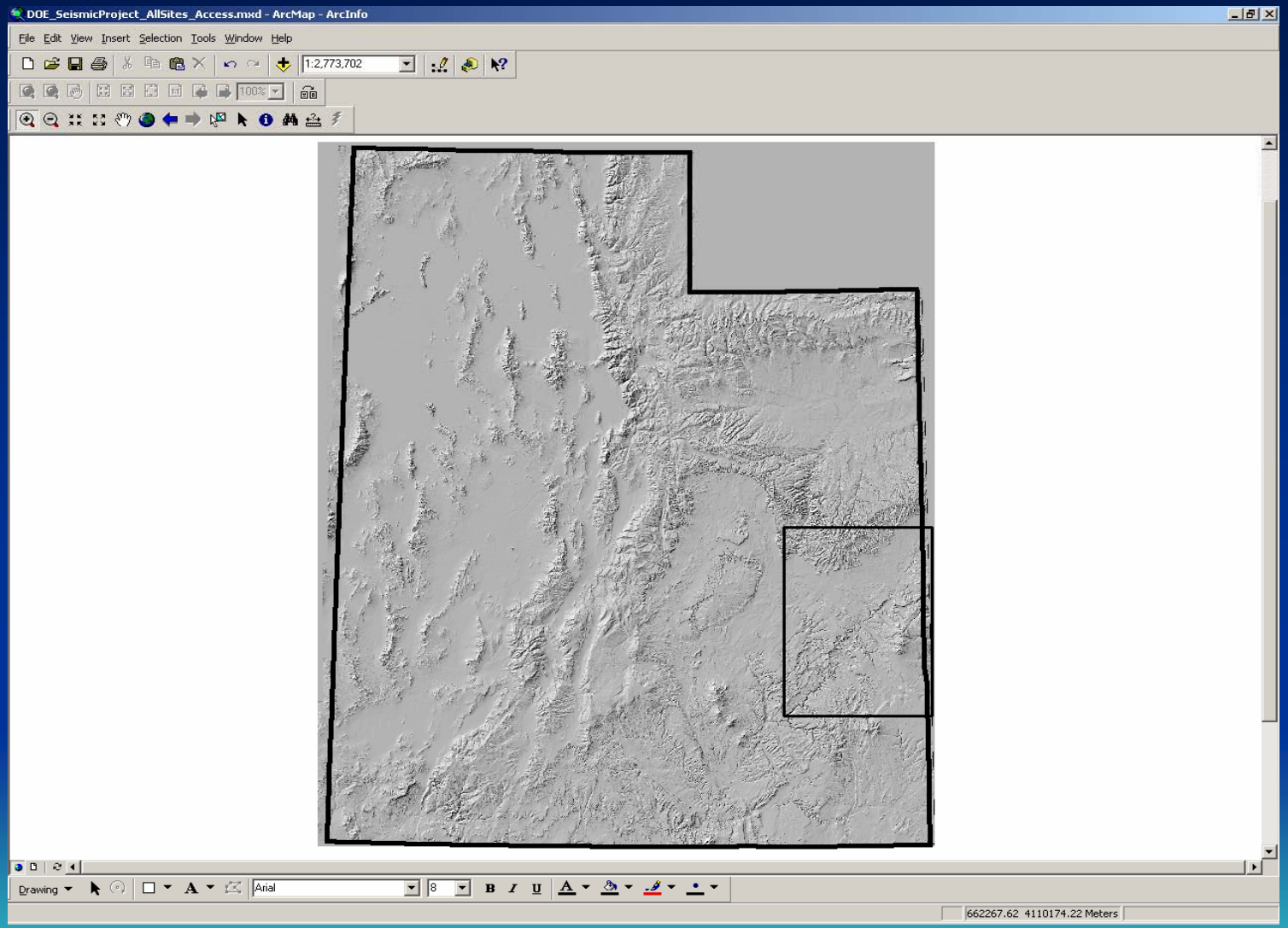
Project Collaborators

- U. S. Department of Energy
- New Mexico State University
- US Geological Survey, Canyonlands Field Station
- Bureau of Land Management Washington and Moab Field Offices
- International Association of Geophysical Contractors

Project Concept

- Locate and age historic seismic lines
- Select sample sites across an array of age dates (20 and 40 year age classes)
- Select samples on similar soil and vegetative types
- Sample and analyze soils and vegetation within old track and adjacent undisturbed lands
- Assess status of recovery rates for soils and vegetation on each sample site

Project Location



Research Questions

- Determine how water retention capacity has recovered over time
- Degree to which soils have re-stabilized and can resist wind and water erosion
- How vegetative communities have responded
- How many years for physical, cyanobacterial and moss/lichen-dominated biotic crusts to re-form
- Information on the recovery of nutrient cycles

Key Data Measurements

Soils

- Depth
- Compaction
- Texture
- Stability
- Geochemistry
- Surface roughness
- % ground cover (vegetation, rocks, litter and cryptobiotic crusts by species)
- Biotic crust chlorophyll content
- Nitrogen fixation capability

Key Data Measurements

Vegetation

- Frequency
- Cover
- Volume (height x width)
- Leaf area
- Leaf nutrient content
- Leaf and soil N and C isotopic ratios
- Ratio of dead/live branches
- Number of flower heads per stem

GIS Component

- Utilizing geospatial data and ARCMAP to identify potential sample areas.

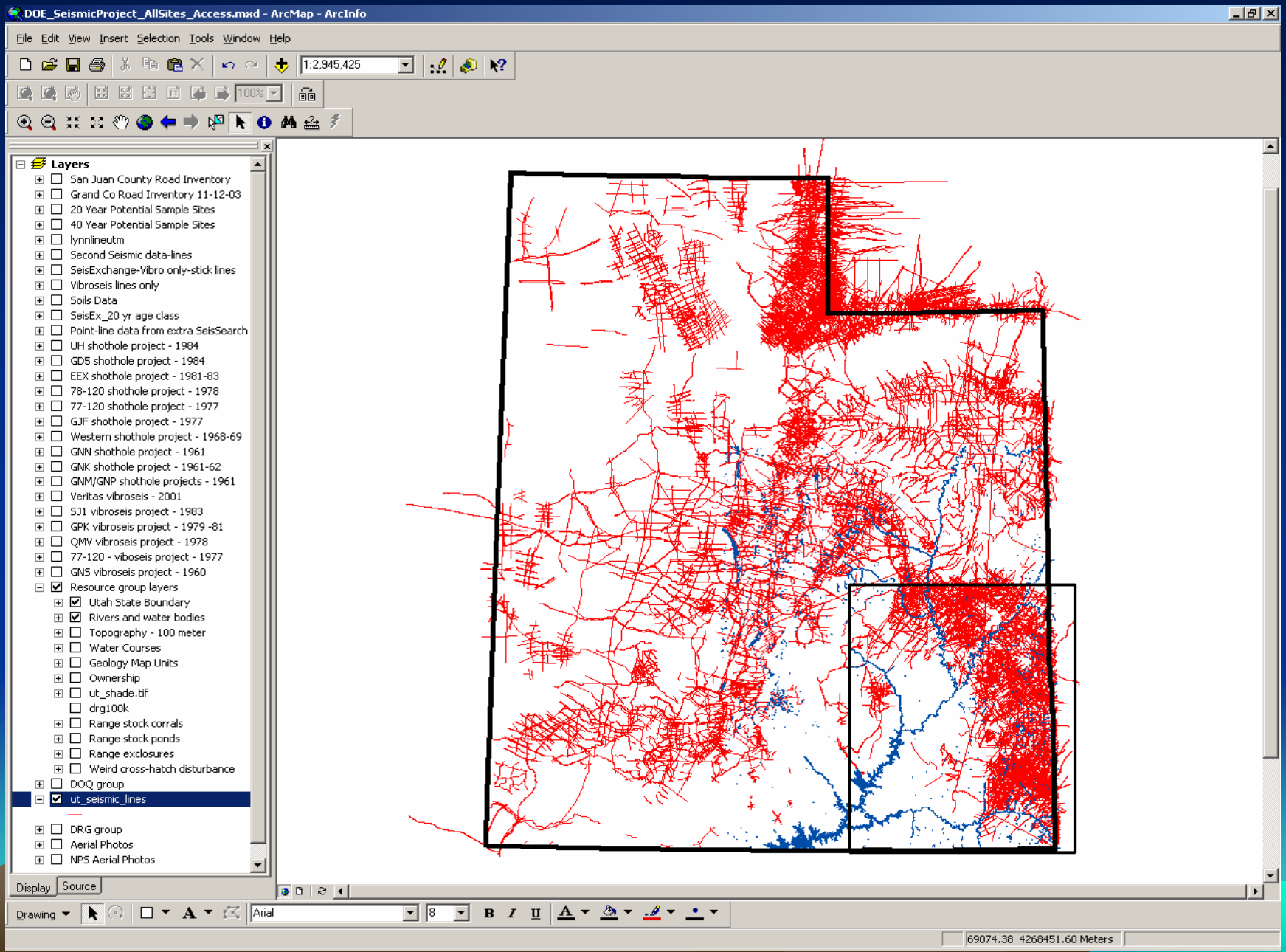
- Looking for areas where project lines are:
  - Of known age and methodology (energy source)
  - High confidence level in accurate line access disturbance location
  - Free from post project disturbance (OHV's, livestock, erosion, etc).

- GIS coverages required:
  - Date, line location and energy source for geophysical projects
  - Recent color aerial photographs (1:24,000)
  - Digital soils data (Order 3 Survey)
  - Recent GPS inventory of all roads and trails
  - Standard base data such as land ownership, coordinate system, hydrography, elevation, DOQ's, etc.

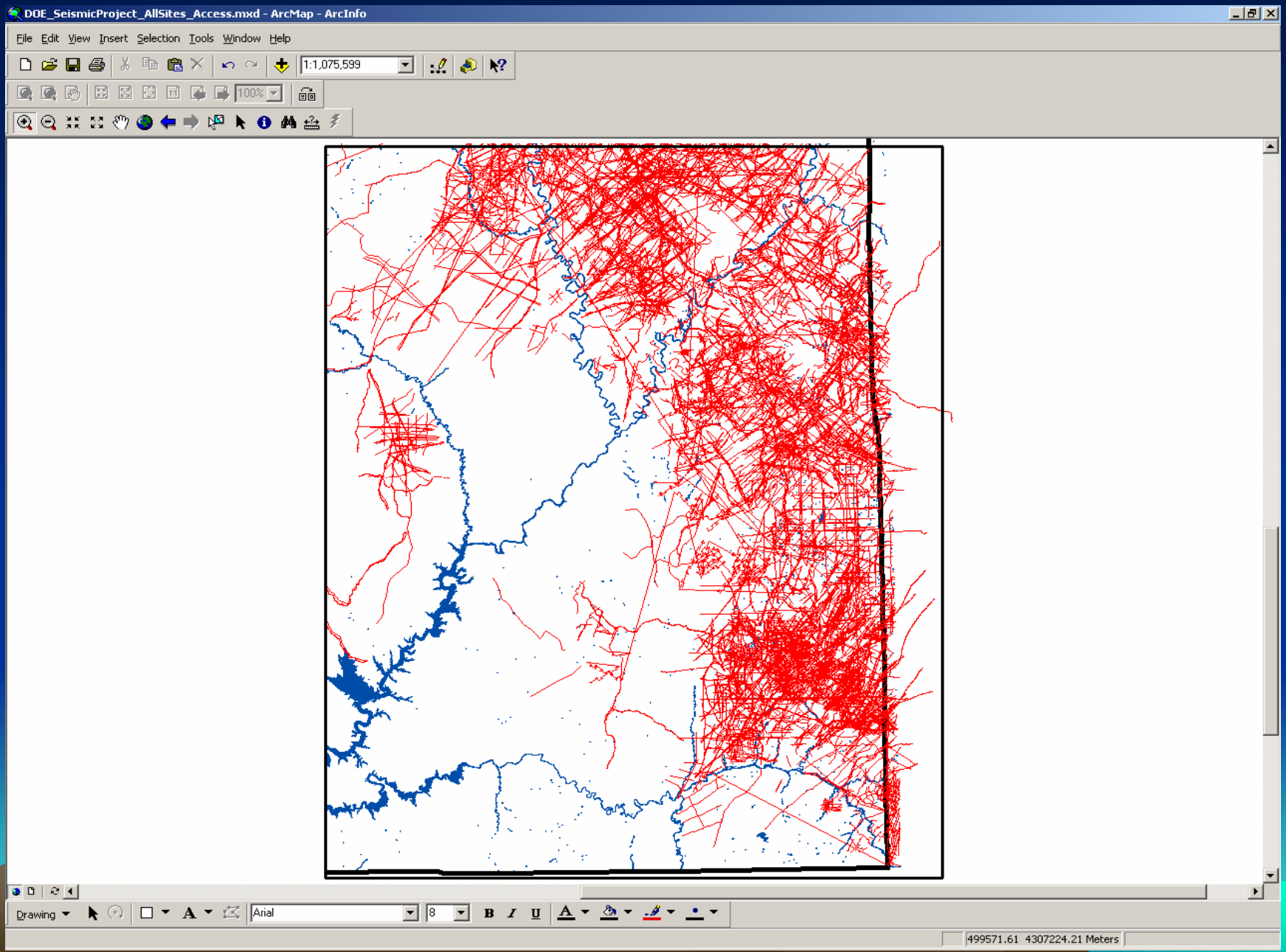
Geophysical Data

- Two data sets from Seismic Exchange Inc. (SEI)
  - All seismic lines in Utah for which Seismic Exchange (SEI) has spatial data. Metadata for lines available through agreements between SEI and various data holders on request from SEI
    - 10,864 project lines
    - Line location and line number data only (no age or method data)
  - SEI data for lines within latitude 37’00” to 39’00” and longitude 109’00” to 111’00” (southeastern Utah) for which SEI has spatial and metadata in house
    - 1,206 project lines
    - Line number
    - Energy source method (dynamite vs. vibroseis)
    - Date of geophysical data collection

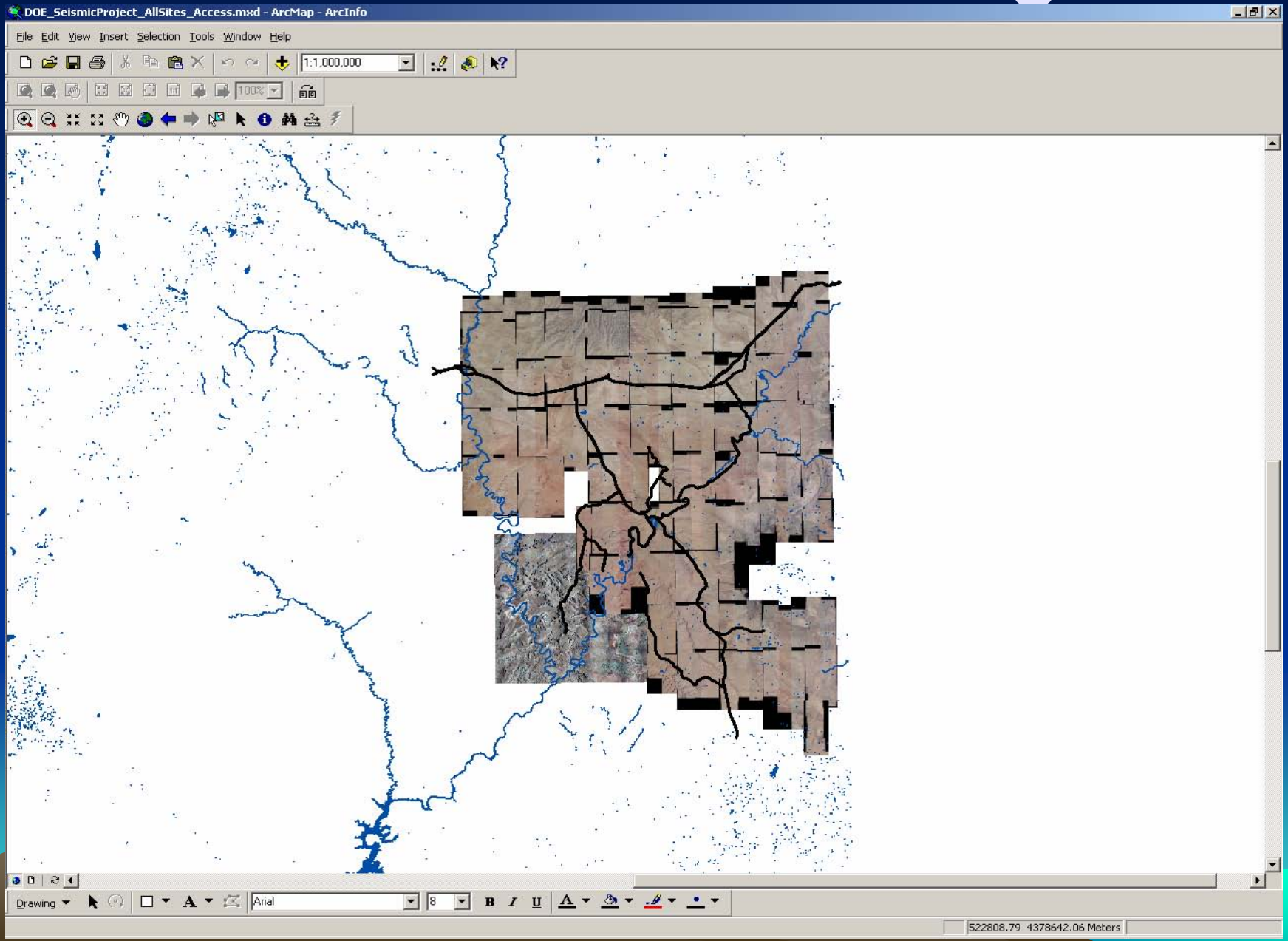
Total Utah Seismic Data Set



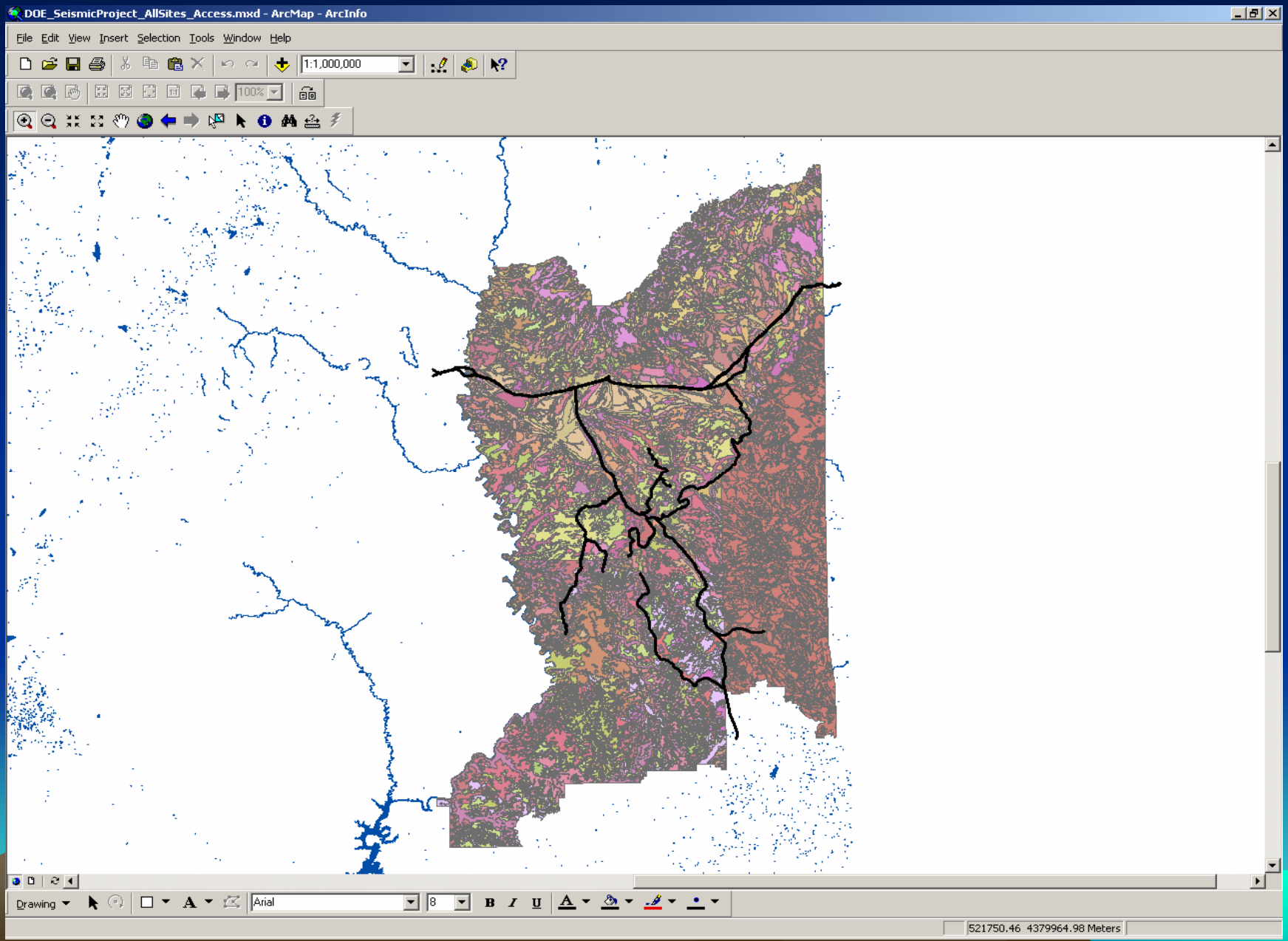
Total SE Utah Seismic Dataset



Aerial Photo Coverage



Digital Soil Coverage



Projects Analyzed

- 20 Year Age Class (1977-1981)
  - 3 projects, all dynamite
- 40 Year Age Class (1961- 1962)
  - 4 projects, all dynamite

Could find no 40 year old vibroseis projects. 20 year vibroseis done primarily on existing roads. Subsequently analysis is strictly for large dynamite shothole projects

Line Analysis Summary

- 20 Year Age Class (1976-1985)
  - 6 projects analyzed, 3 utilized

EEX	36 lines
	193 miles
	11/81-3/86
77-120	7 lines
	92 miles
	1/77
78-120	16 lines
	77 miles
	1/78

- 40 Year Age Class (1957-1962)
  - 4 projects analyzed, all utilized

GNK	95 lines
	386 miles
	1/61
GNM	40 lines
	151 miles
	1/61 – 2/61
GNP	60 lines
	154 miles
	2/60 – 2/62
GNN	80 lines
	237 miles
	1/61 – 2/61

Potential Sample Summary

Potential sample sites identified:

- 20 year age class 74
- 40 year age class 115

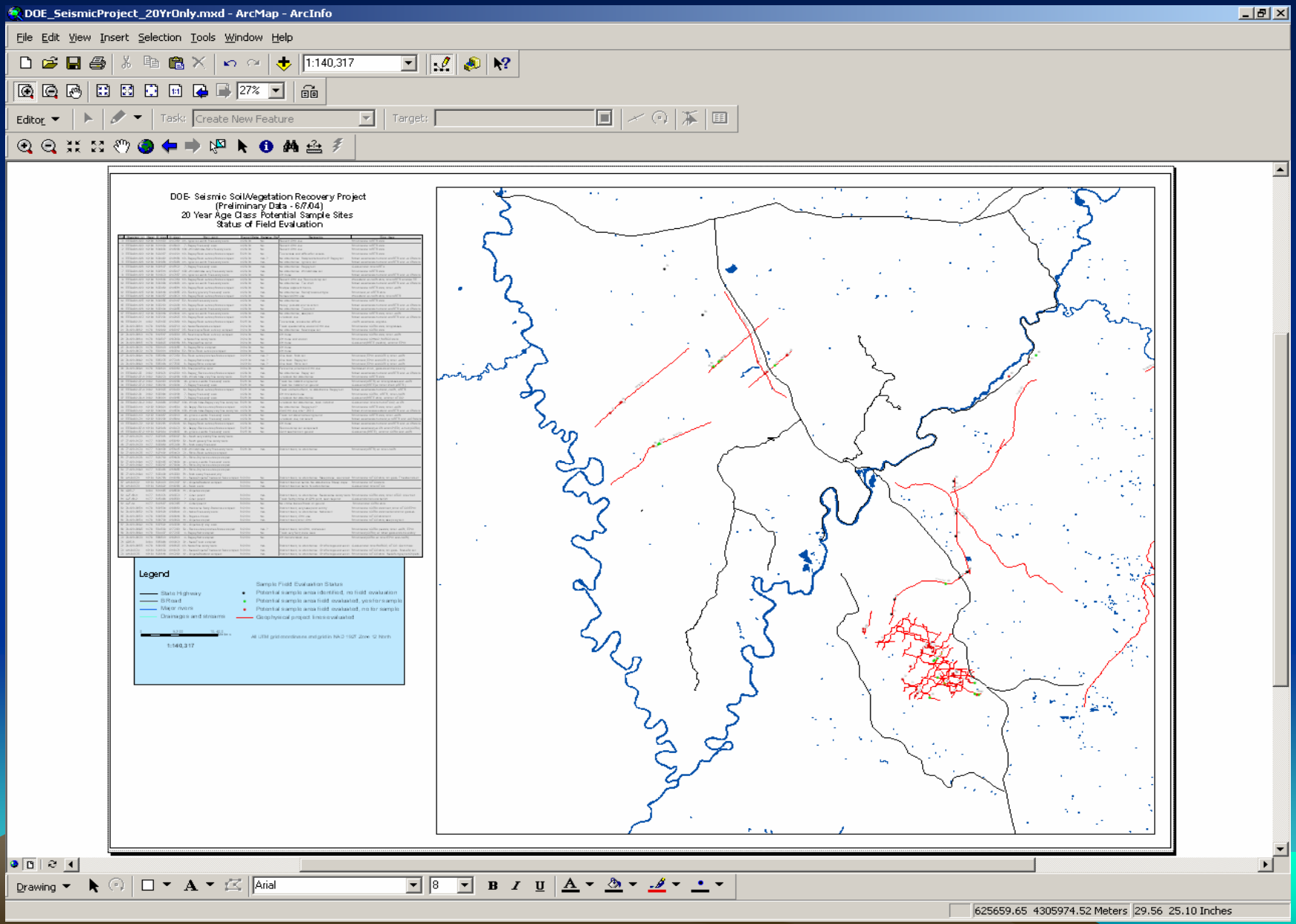
Sites field evaluated:

- 20 year age class 62 (84%)
- 40 year age class 51 (44%)

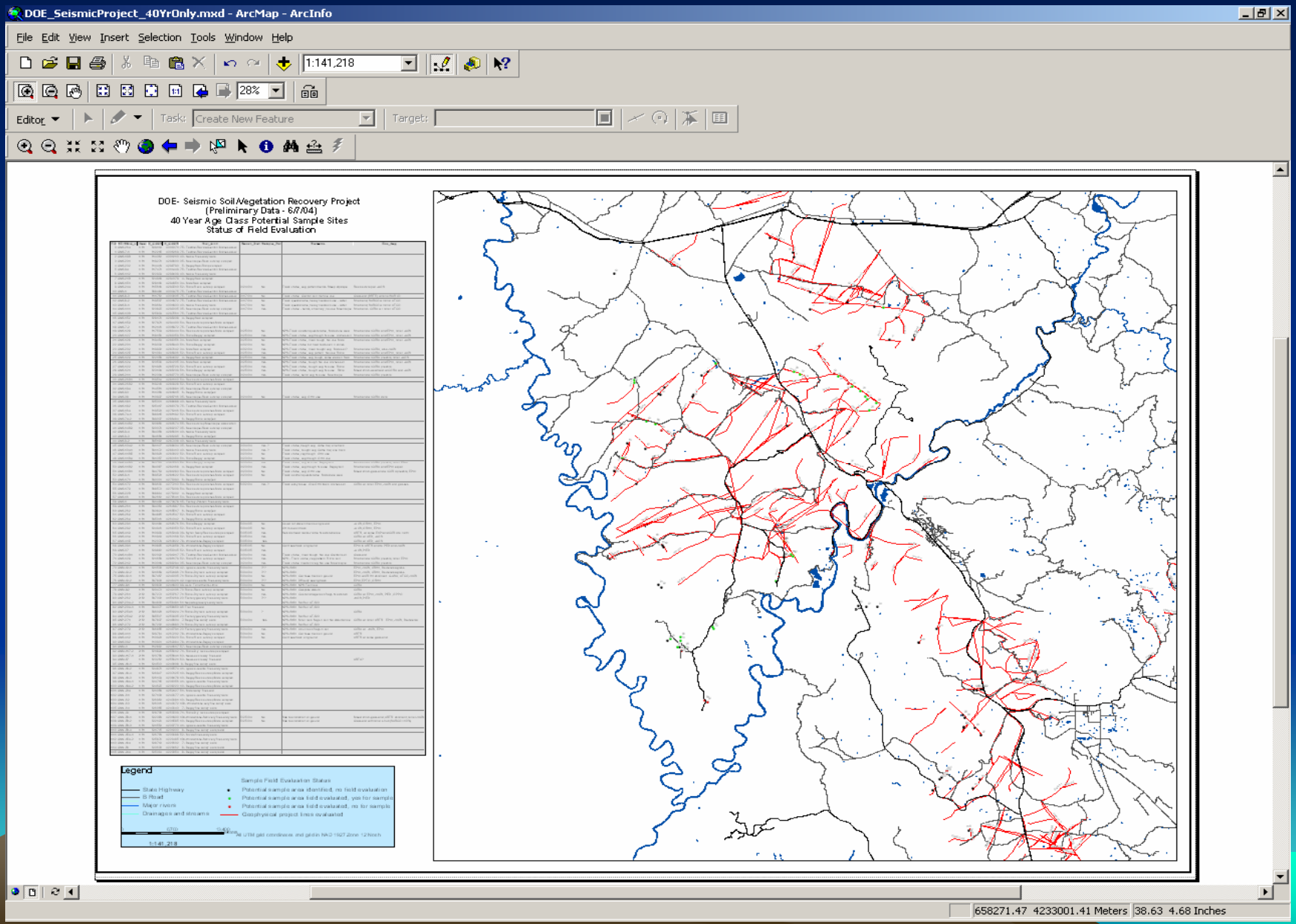
Sites suitable for sampling:

- 20 year age class 22 (35% of sites visited)
- 40 year age class 24 (47% of sites visited)

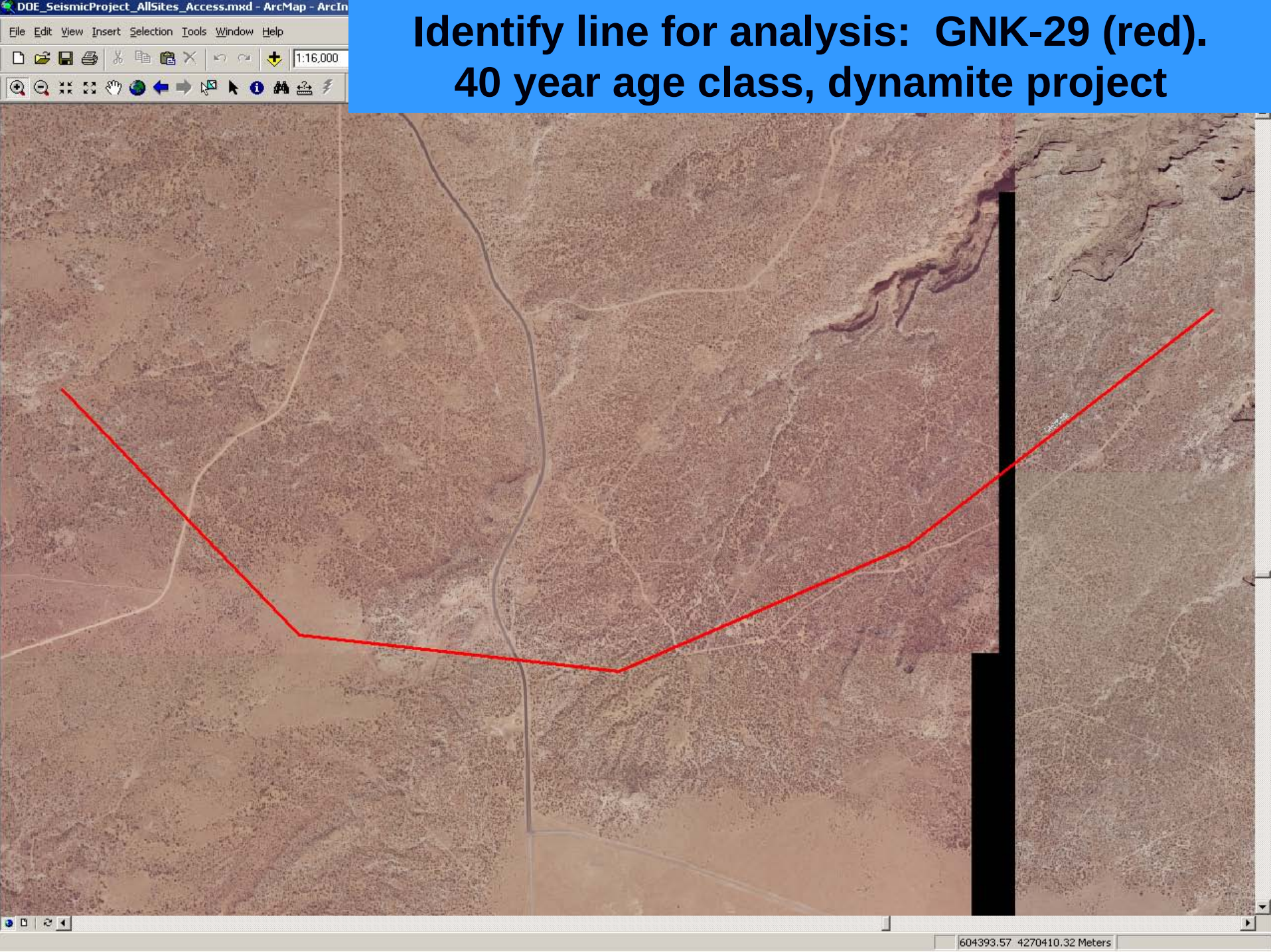
20 Year Age Class Projects Analyzed



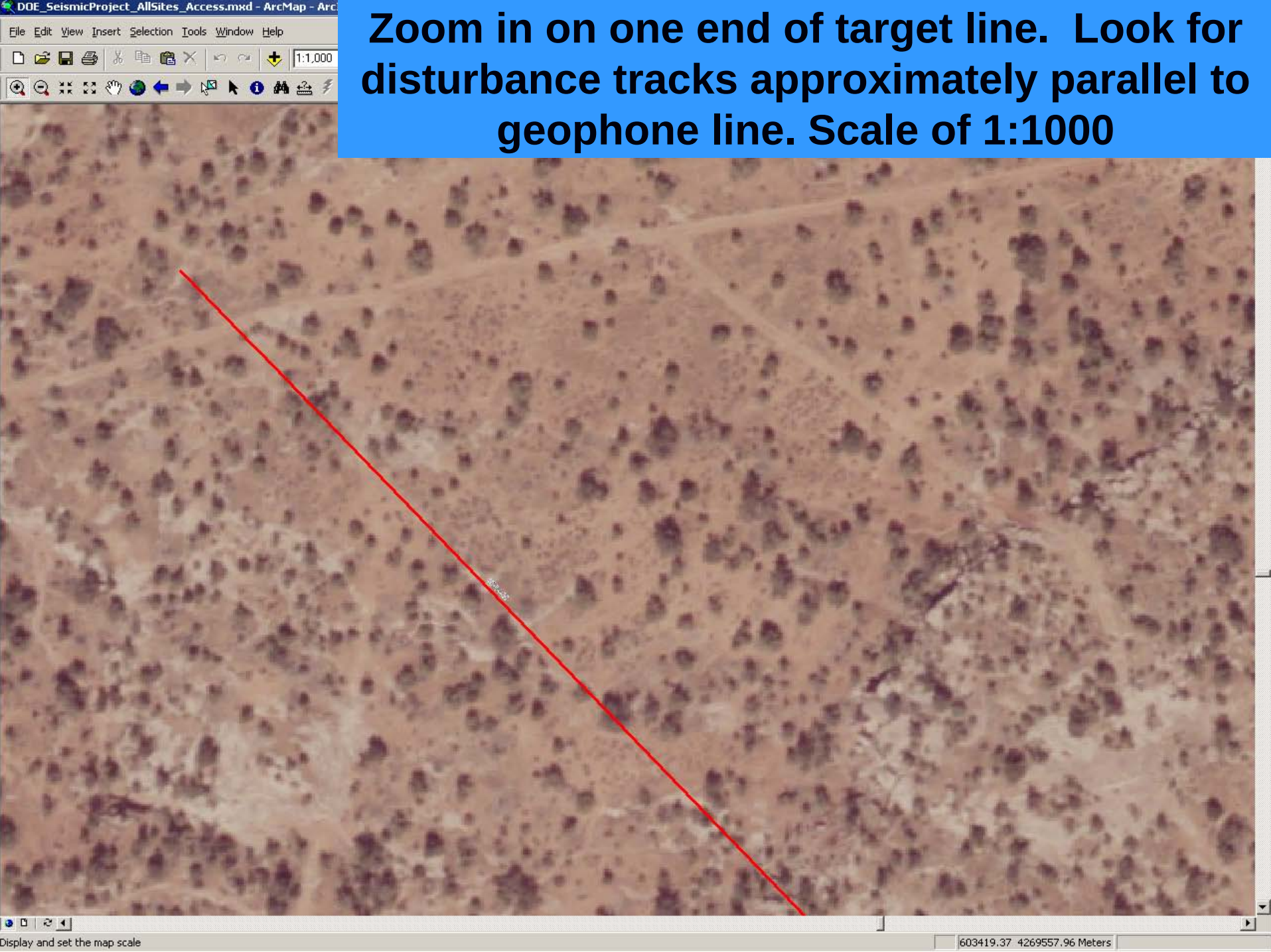
40 Year Age Class Projects Analyzed



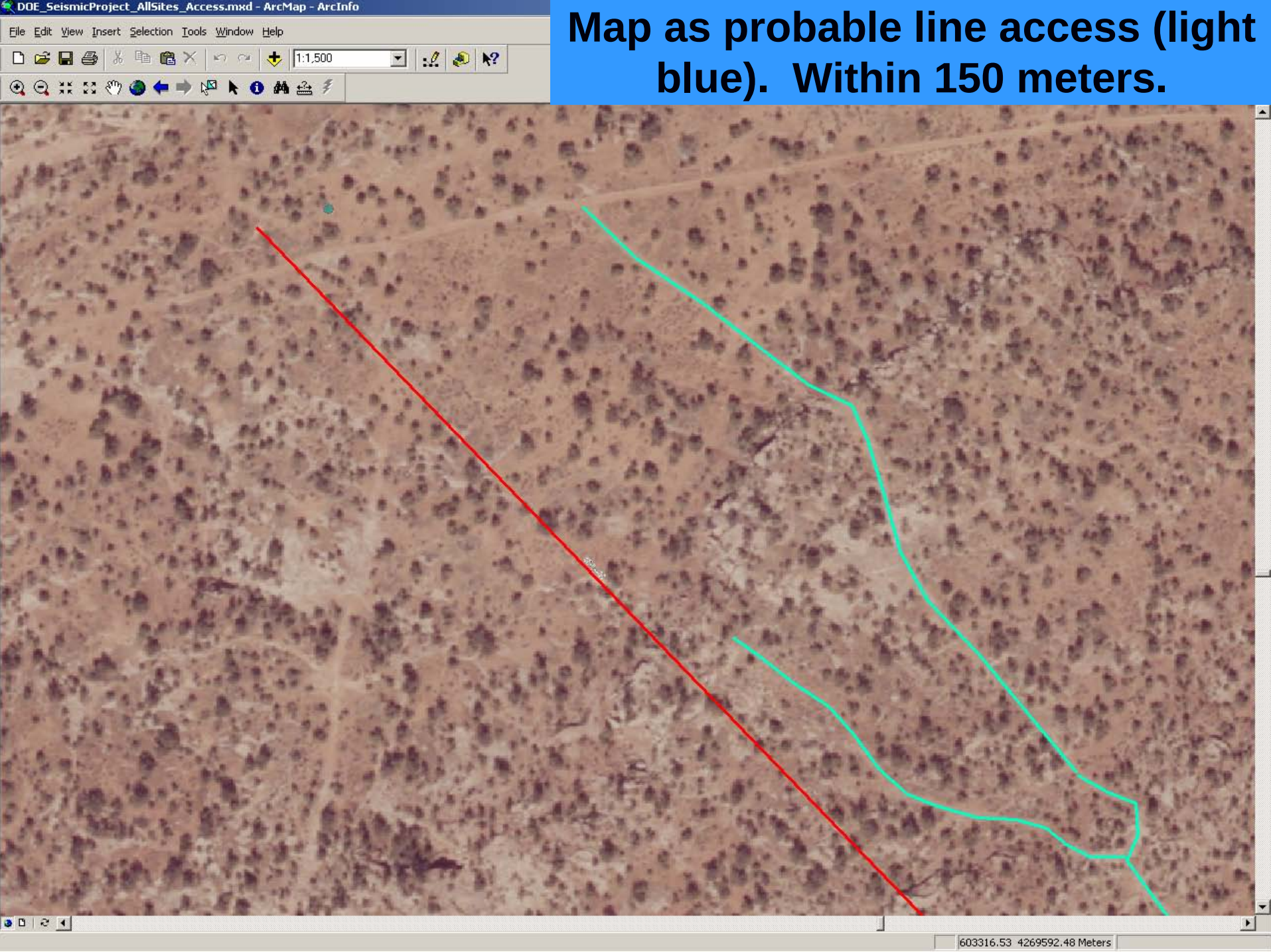
Identify line for analysis: GNK-29 (red). 40 year age class, dynamite project



Zoom in on one end of target line. Look for disturbance tracks approximately parallel to geophone line. Scale of 1:1000



Map as probable line access (light blue). Within 150 meters.



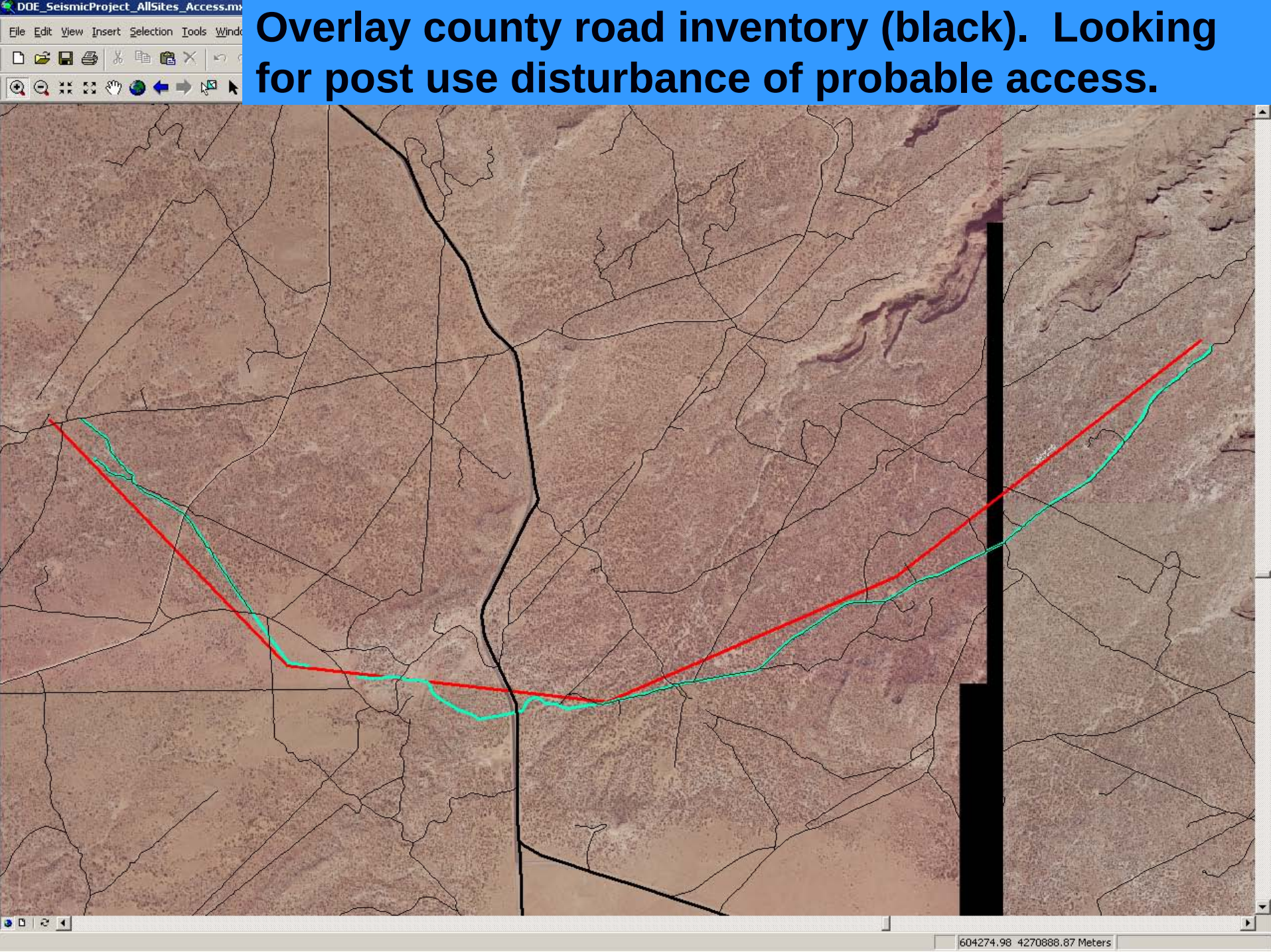
DOE_SeismicProjec

File Edit View Insert

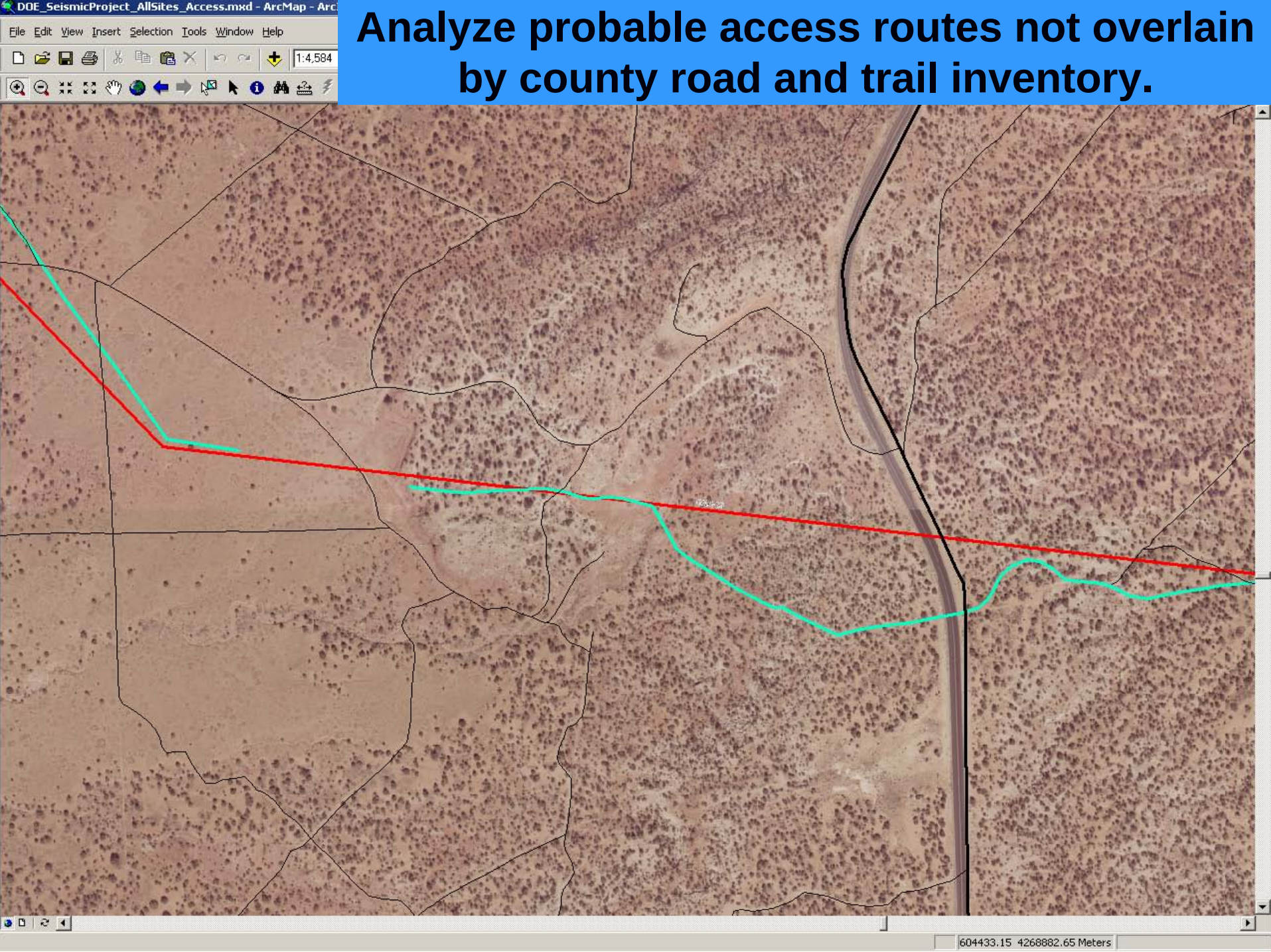
Continue moving along line, mapping probable access where disturbance track can be seen. Note odd disturbance pattern in photo. Seismic related?

606785.35 4268978.25 Meters

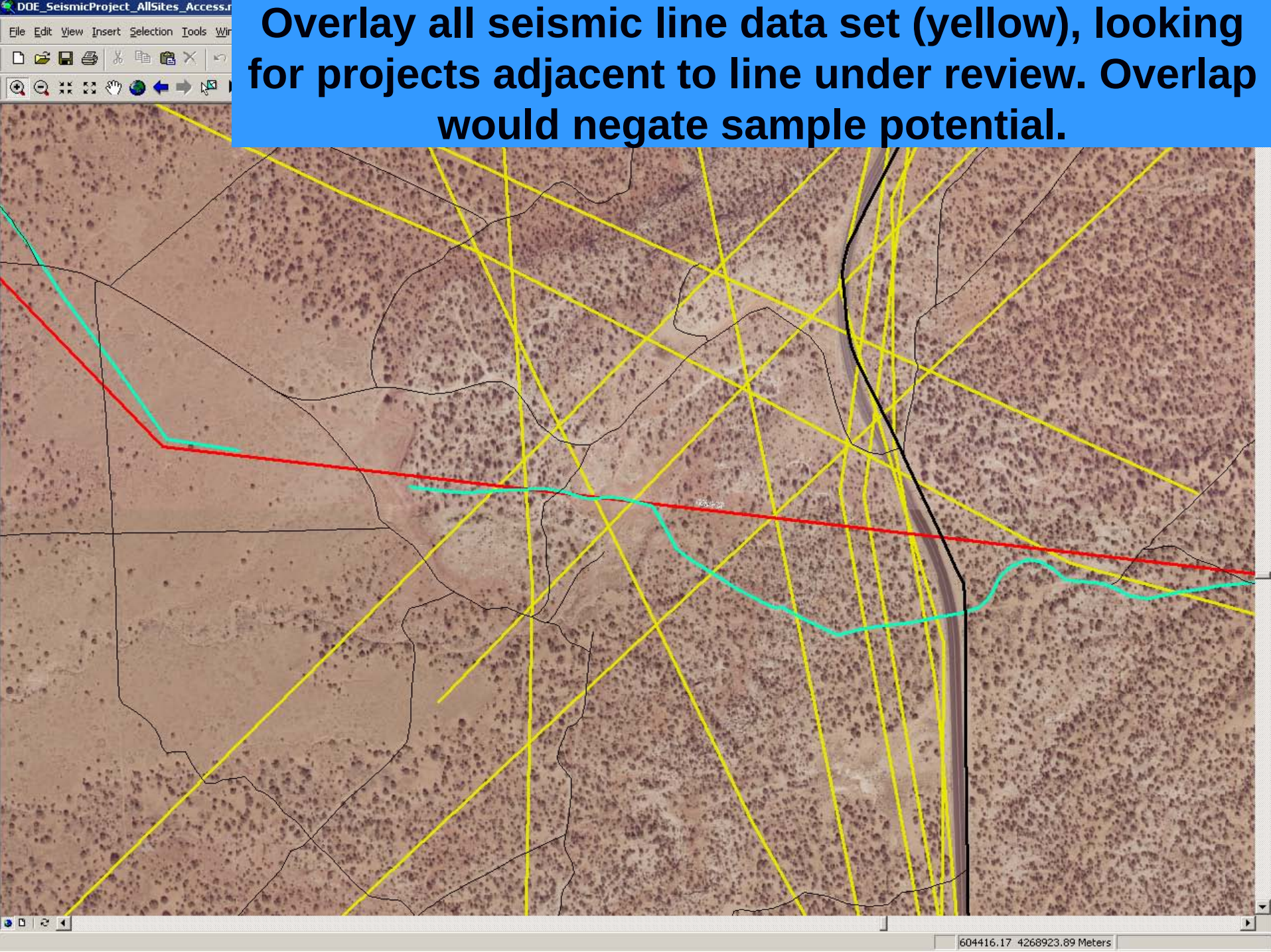
Overlay county road inventory (black). Looking for post use disturbance of probable access.



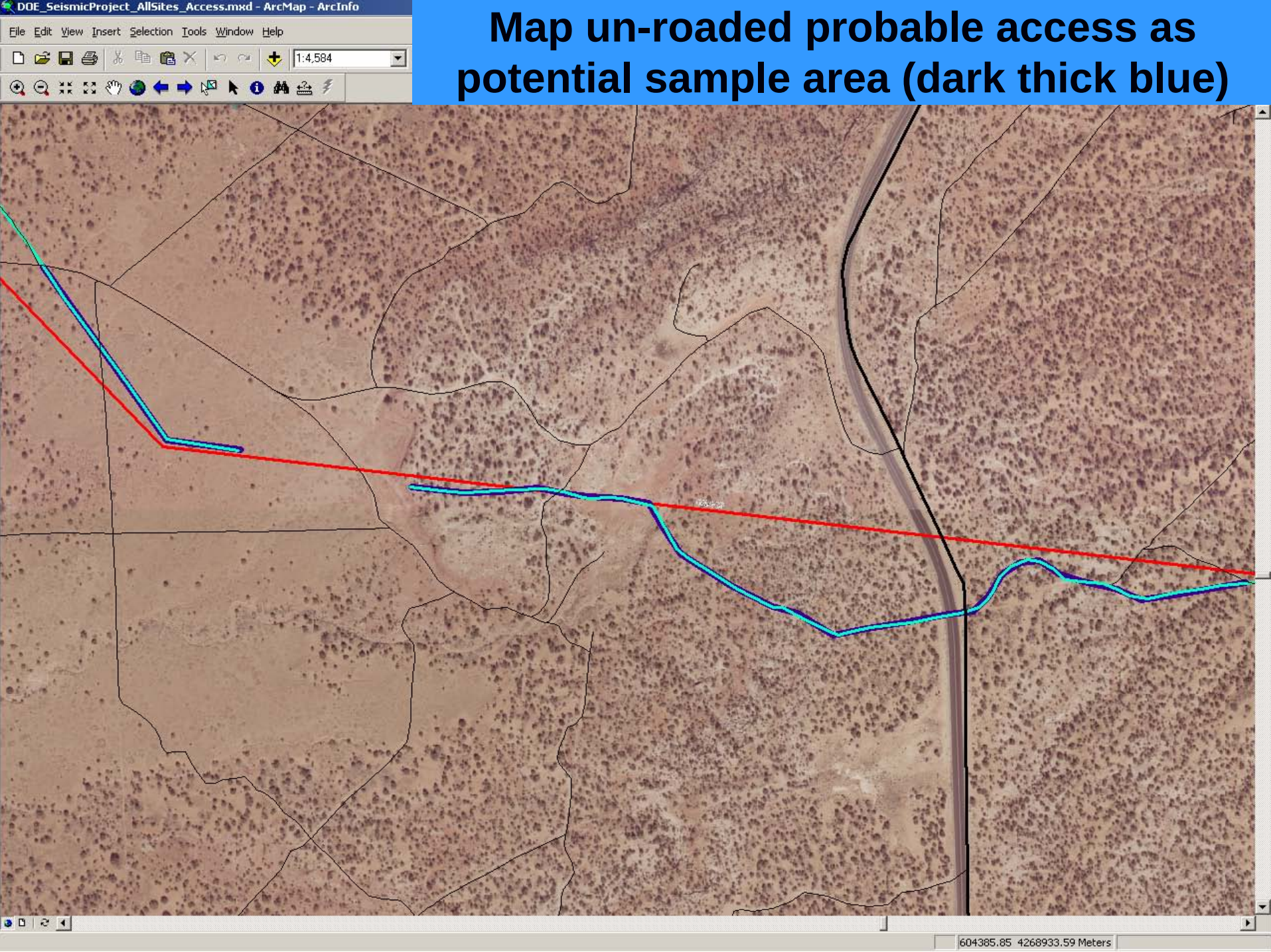
Analyze probable access routes not overlain by county road and trail inventory.



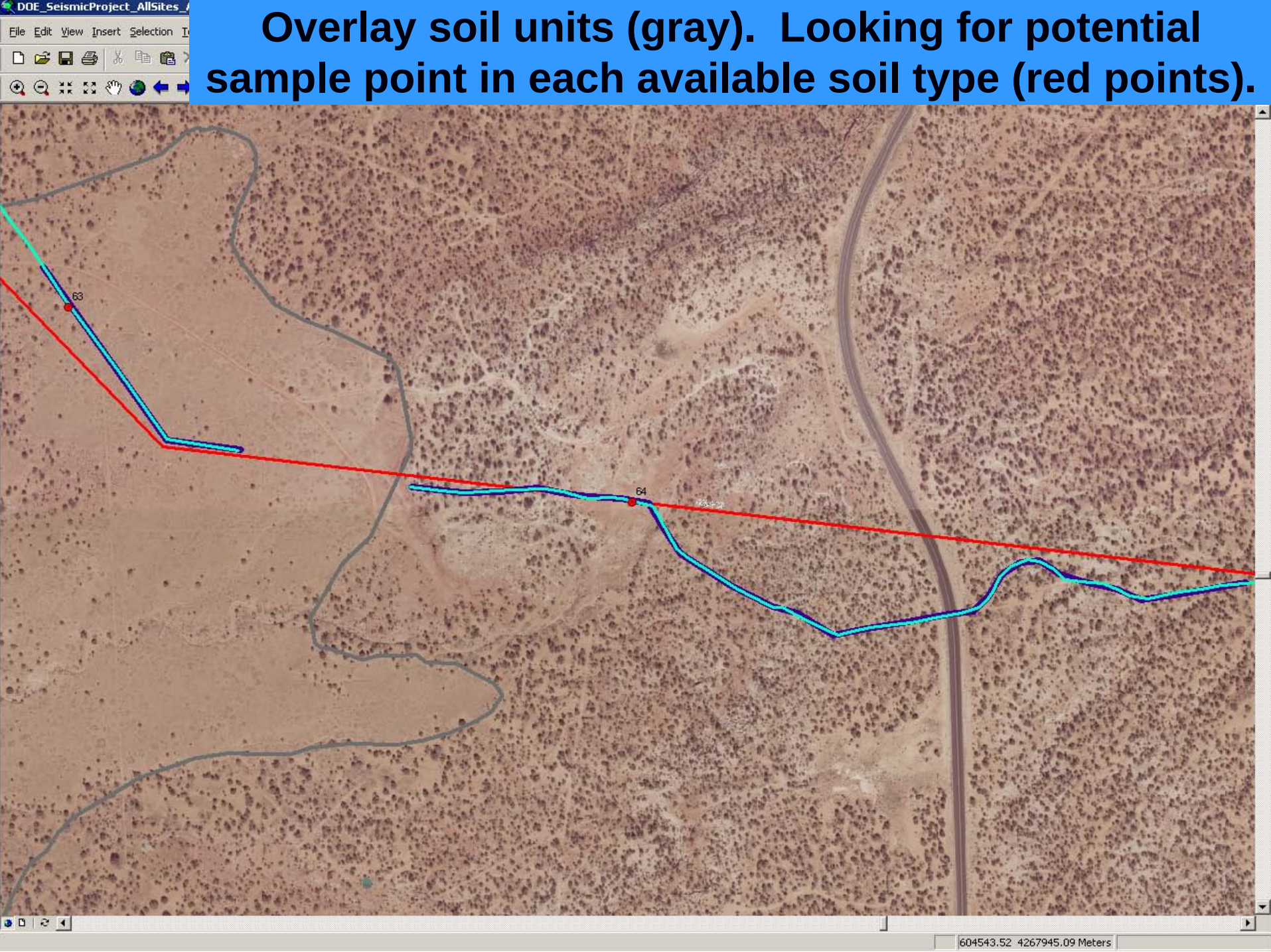
Overlay all seismic line data set (yellow), looking for projects adjacent to line under review. Overlap would negate sample potential.



Map un-roaded probable access as potential sample area (dark thick blue)



Overlay soil units (gray). Looking for potential sample point in each available soil type (red points).



Populate database in attribute file with relevant information for each potential sample site.

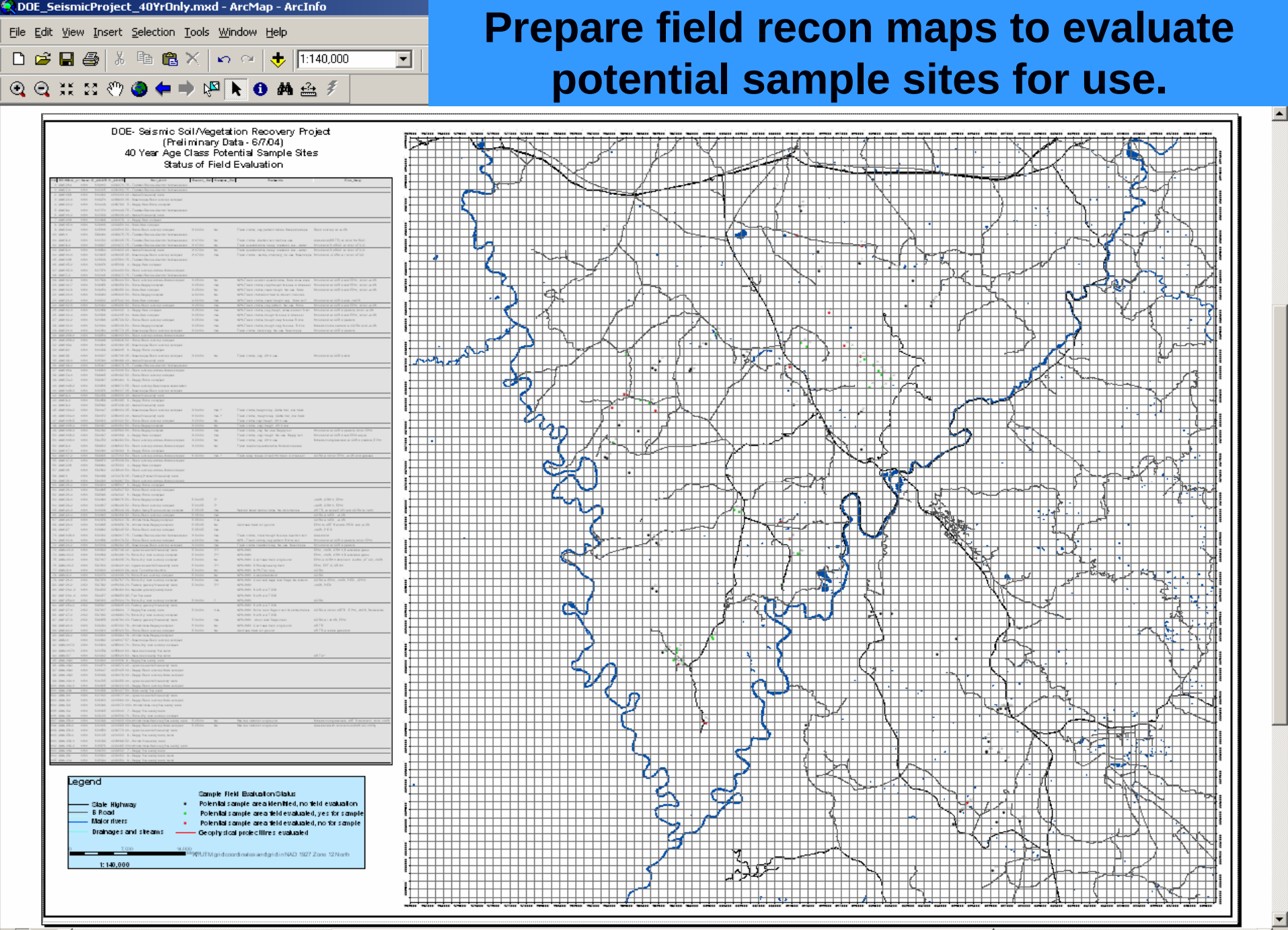
Attributes of 40 Year Potential Sample Sites

FID	SEISMIC_LI	Meth	Year	X_COOR	Y_COOR	Soil_Unit	Recon_Dat	Sample_Pot	Remarks	Eco_Veg
63	GNK-29-1	Dyno	1/61	604181	4268676	51 - Rizno-Begay complex	5/04/05	??		JUOS, ORHY, EPVI
64	GNK-29-2	Dyno	1/61	604867	4268428	52 - Rizno-Rock outcrop complex	5/04/05	??		JUOS, ORHY, EPVI
65	GNK-41-3	Dyno	1/61	610908	4265049	39 - Myton family-Rock outcrop complex	5/05/05	Yes	Seismic tread marks visible. No disturbance.	ARTR, w/some EVPI and CORA to north
66	GNK-41-4	Dyno	1/61	611910	4263168	52 - Rizno-Rock outcrop complex	5/05/04	Yes		CORA w/AED, JUOS
67	GNK-41-5	Dyno	1/61	612079	4263022	78 - Windwhistle-Begay complex	5/05/04	Yes		CORA w/AED, JUOS
68	GNK-39-1	Dyno	1/61	610895	4262858	78 - Windwhistle-Begay complex	5/05/05	No	Can't see track on ground	EPVI to ARTR and to PEID and JUOS
69	GNK-37	Dyno	1/61	609882	4259345	52 - Rizno-Rock outcrop complex	5/05/05	Yes		JUOS, PIED
70	GNK-14B-1	Dyno	1/61	602022	4291017	75 - Toddler-Ravola-Glenton families assoc	3/04/04	Yes	Track visible, linear trough. No use. Glenton soil	Grassland
71	GNK-12-9	Dyno	1/61	621658	4286179	52 - Rizno-Rock outcrop complex	4/02/04	Yes	NPS - Track visible, veg pattern. Rizno soil	Shrubland w/CORA predom, minor EPVI
72	GNK-21-2	Dyno	1/61	613019	4289294	35 - Moenkopie-Rock outcrop complex	3/24/04	Yes	Track visible lineation/veg. No use. Moenkopie	Shrubland w/CORA predom
73	GNM-13-1	Dyno	1/61	601533	4252748	42 - Ignacio-Leanto fine sandy loam	5/04/04	???	NPS-ISKY.	EPVI, JVOS, ORHY, Boutelema grass
74	GNM-13-2	Dyno	1/61	601669	4252496	71- Rizno-Dry rock outcrop complex	5/04/04	???	NPS-ISKY.	EPVI, JVOS, ORHY, Boutelema grass
75	GNM-10-1	Dyno	1/61	597467	4249305	71- Rizno-Dry rock outcrop complex	5/04/04	No	NPS-ISKY. Can't see track on ground	EPVI w/ORHY dominant. GUSA, ATCO, JVOS
76	GNM-10-2	Dyno	1/61	597833	4249421	42- Ingancio-Leanto fine sandy loam	5/04/04	???	NPS-ISKY. Difficulty seeing track	EPVI, EPTO, ORHY
77	GNM-8-1	Dyno	1/61	600833	4241933	99- Ustic Torriorthents-Lithic	5/04/04	No	NPS-ISKY. NPS Trail now	CORA

Record: 64 Show: All Selected Records (0 out of 116 Selected.) Options

604678.15 4268681.31 Meters

Prepare field recon maps to evaluate potential sample sites for use.



Field Evaluation

Line No. GNK-29
Potential Sample point 1

Locate sites from GPS coordinates

Evaluate for post disturbance use

Photos, vegetation types, soil units and texture, use, etc

This site was determined to not be acceptable for use as sample point due to OHV use.

Field Evaluation

Line No. GNK-29

Potential Sample Point 1

Field evaluation indicated tracks could not be seen from the ground.

This site not used for sampling.

Additional Field Evaluation Photos

Sites could not be used due to erosion

78-120-006: 20 year site

GNK-12-3: 40 year site

Additional Field Evaluation Photos

Tracks through dune areas were difficult to see on the ground. Not utilized for sampling.

78-120-008-4: 20 year line

GNK-12-8: 40 year line

Additional Field Evaluation Photos

A fair number of tracks turned into livestock trails. Could not be used.

78-120-007-3: 20 year line

EEX-U82-36: 20 year line

Additional Field Evaluation Photos

Consistently difficult to see tracks through grasslands. Sites could not be used.

EEX-U81-106-3: 20 year line

GNN-5B-1: 40 year line

Additional Work

- Will likely do additional sampling this fall on different soil types.
- Possibly add additional vegetation types for sampling next spring.
- Conduct all lab work on samples.
- Prepare final report – due Dec 2005

Summary

- While difficult and time consuming, it is possible to accurately locate and date old geophysical lines if the appropriate databases are available.
- This appears to be a viable method for research on recovery rates over time for soils and vegetation from this type of disturbance.