

An aerial photograph of a river valley. A wide river flows through the center, surrounded by steep, forested slopes. The trees show autumn colors of yellow and orange. A bridge crosses the river on the left side. The background shows more mountains under a cloudy sky.

# Unstable Slope Management Program for FLMA's

6/23/2017

Not for Distribution, for Personal Use by Attendee Only

1



# Unstable Slope Management Program for FLMA's



*Paul D. Thompson*

Not for Distribution, for Personal Use by Attendee Only



# Welcome



6/23/2017

Not for Distribution, for Personal Use by Attendee Only





6/23/2017

Not for Distribution, for Personal Use by Attendee Only

7





6/23/2017

Not for Distribution, for Personal Use by Attendee Only

8

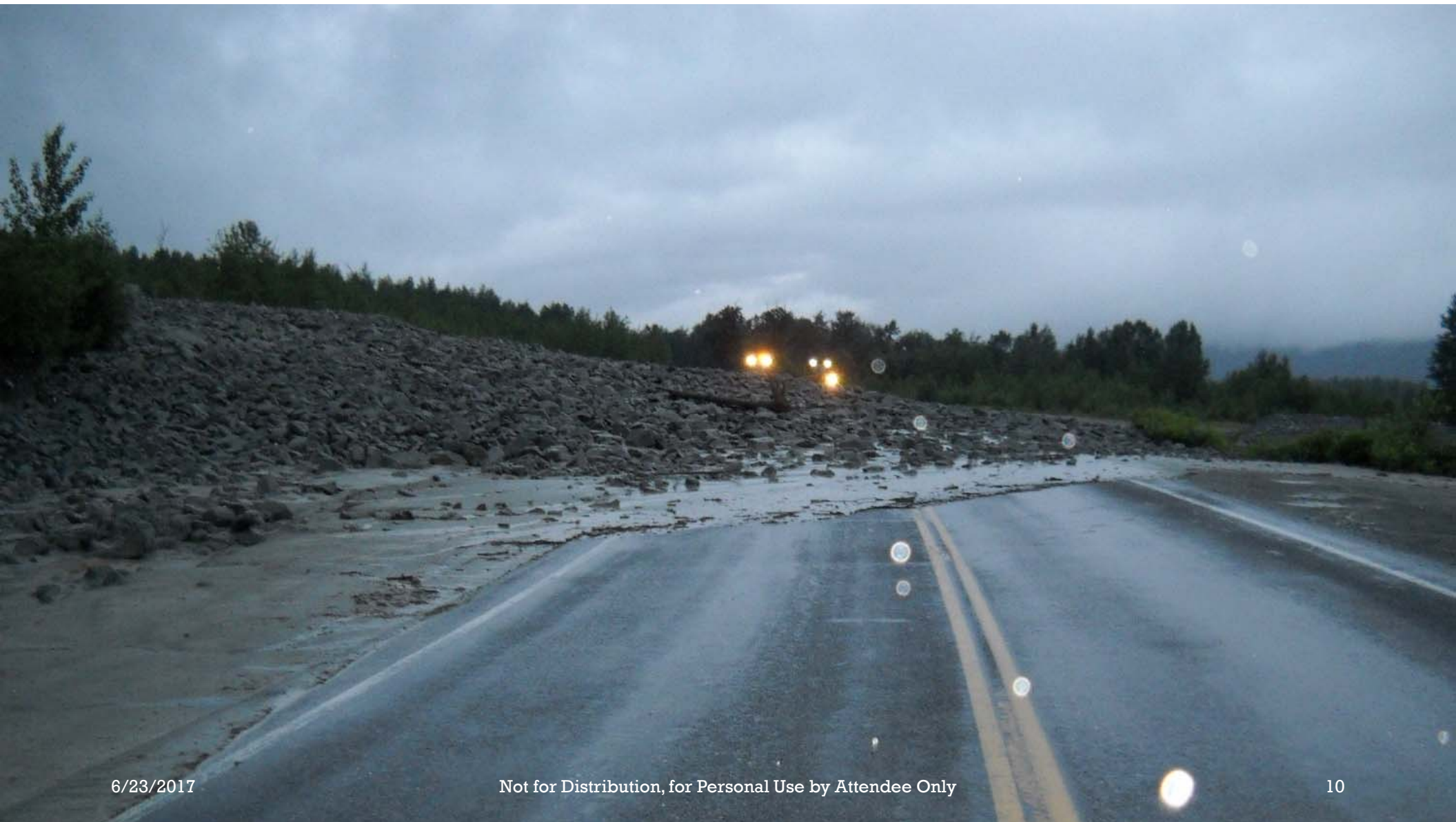




6/23/2017

Not for Distribution, for Personal Use by Attendee Only





6/23/2017

Not for Distribution, for Personal Use by Attendee Only

10



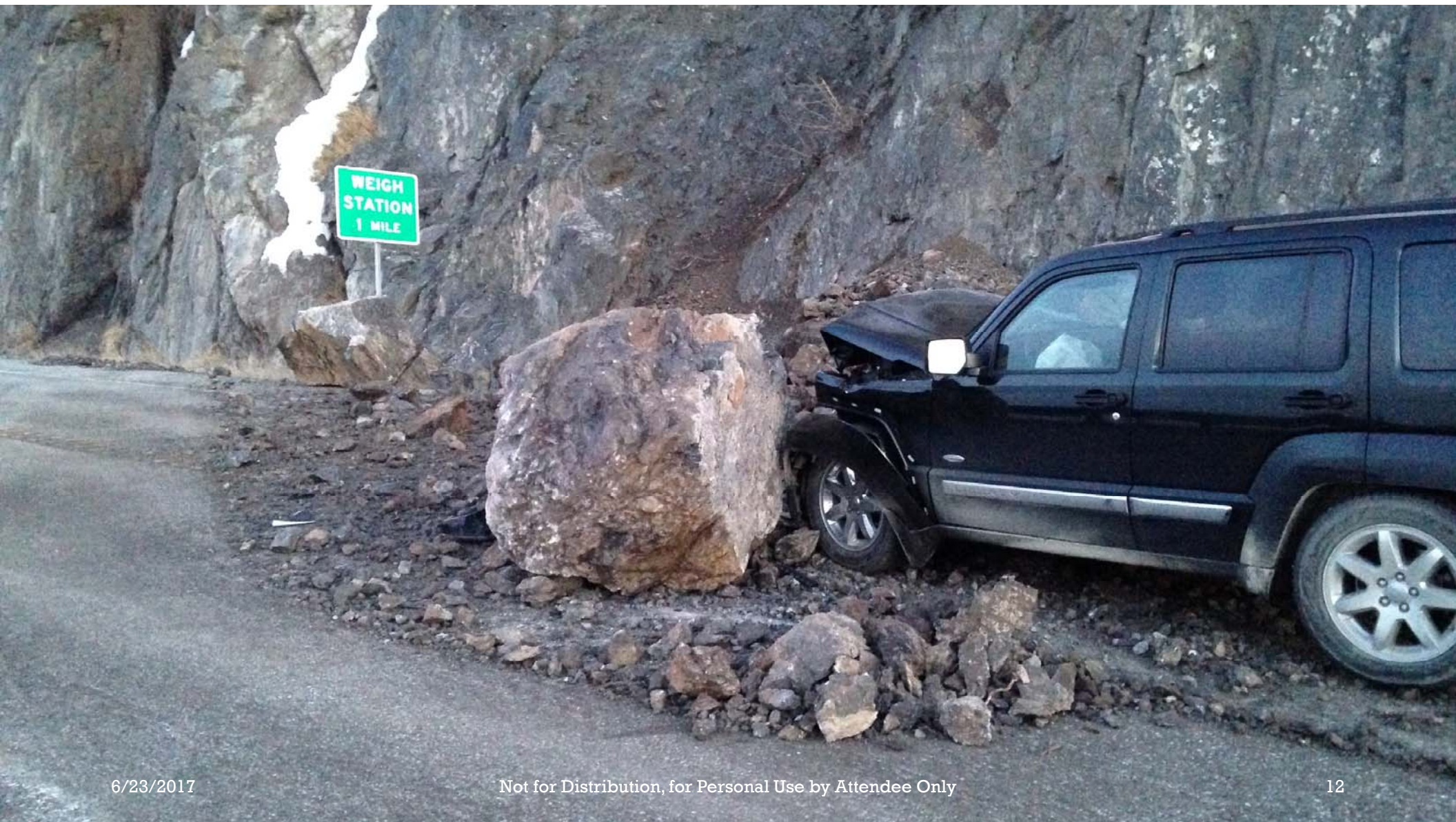


6/23/2017

Not for Distribution, for Personal Use by Attendee Only

11





6/23/2017

Not for Distribution, for Personal Use by Attendee Only

12





6/23/2017

Not for Distribution, for Personal Use by Attendee Only

13





6/23/2017

Not for Distribution, for Personal Use by Attendee Only

14





6/23/2017

Not for Distribution, for Personal Use by Attendee Only

15





6/23/2017

Not for Distribution, for Personal Use by Attendee Only

16



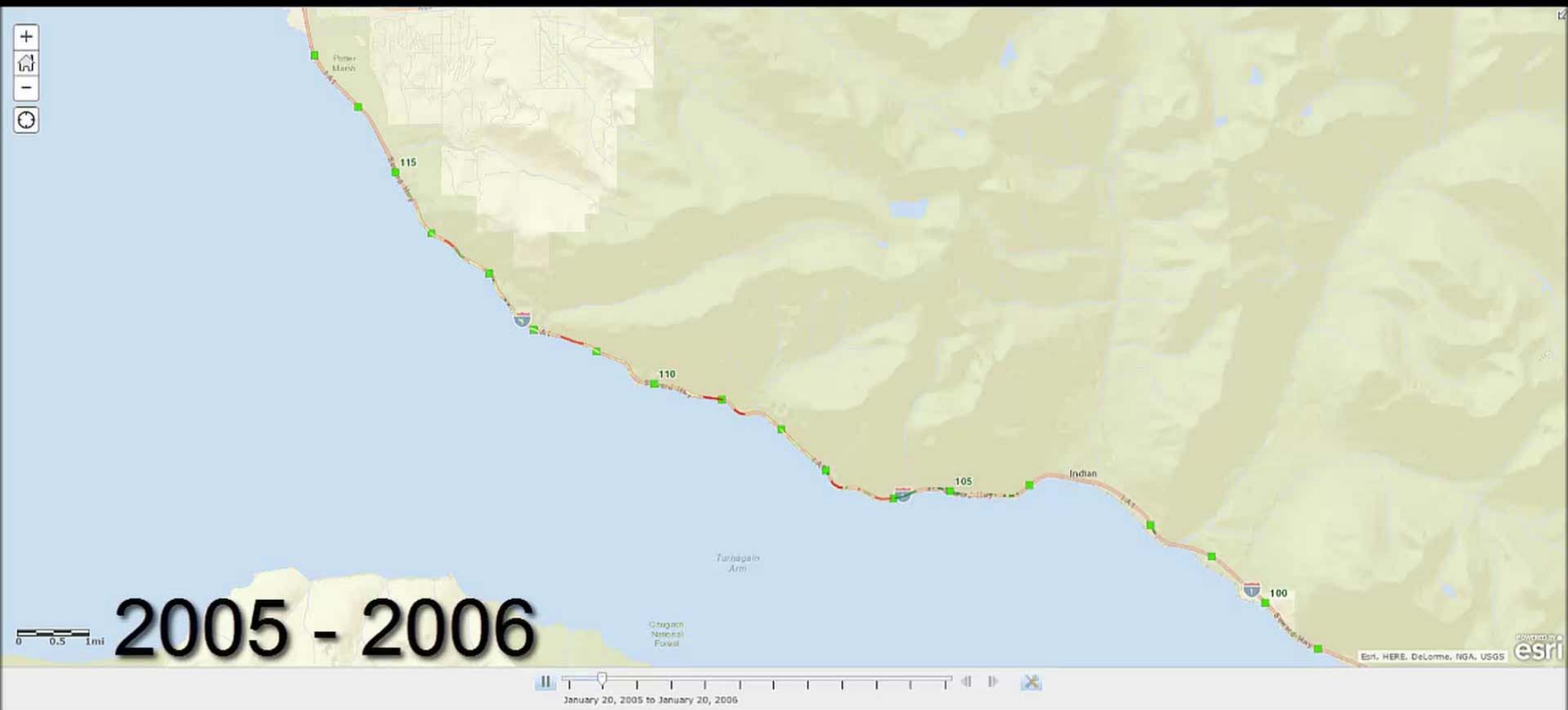


6/23/2017

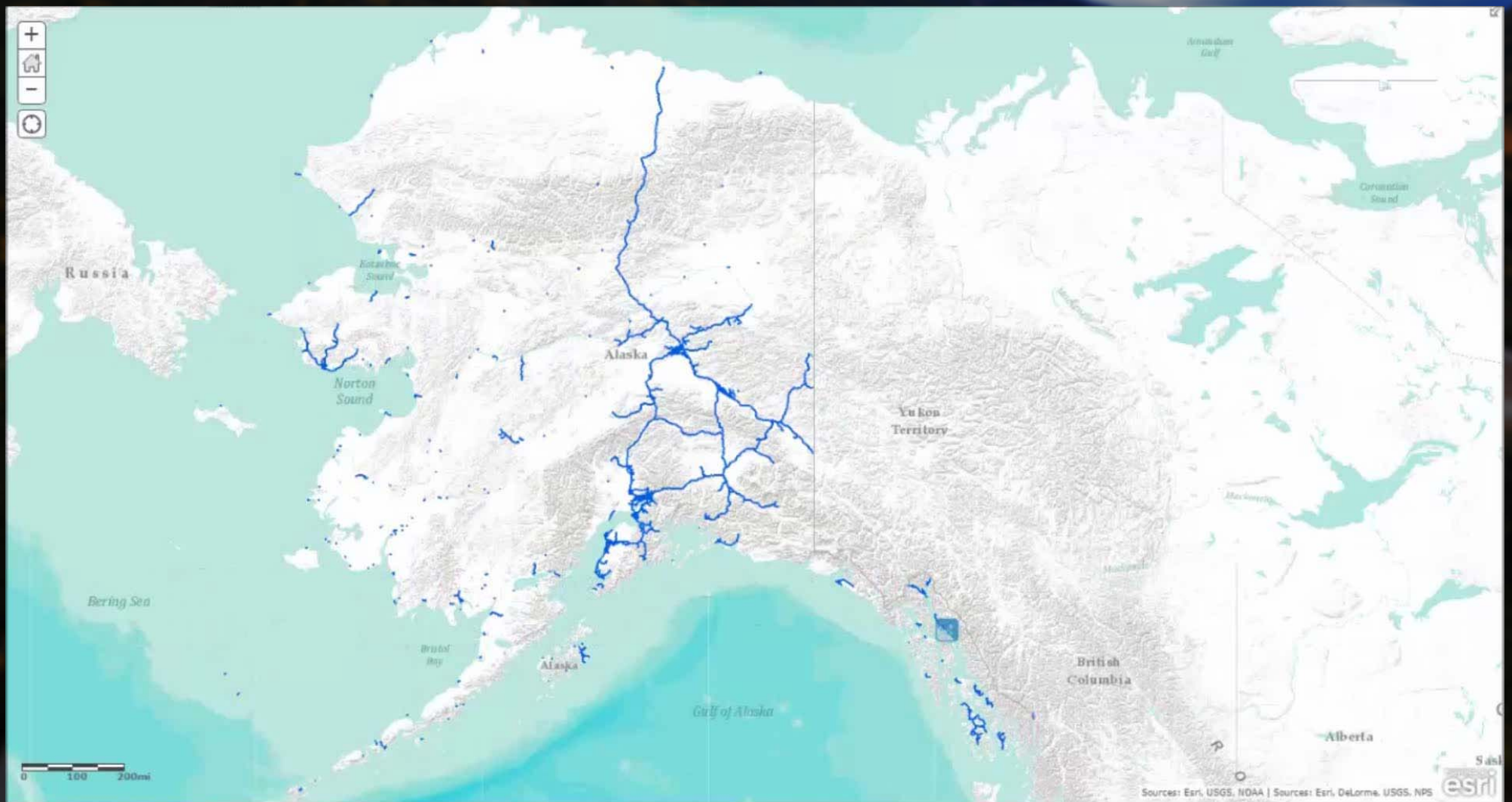
Not for Distribution, for Personal Use by Attendee Only

17







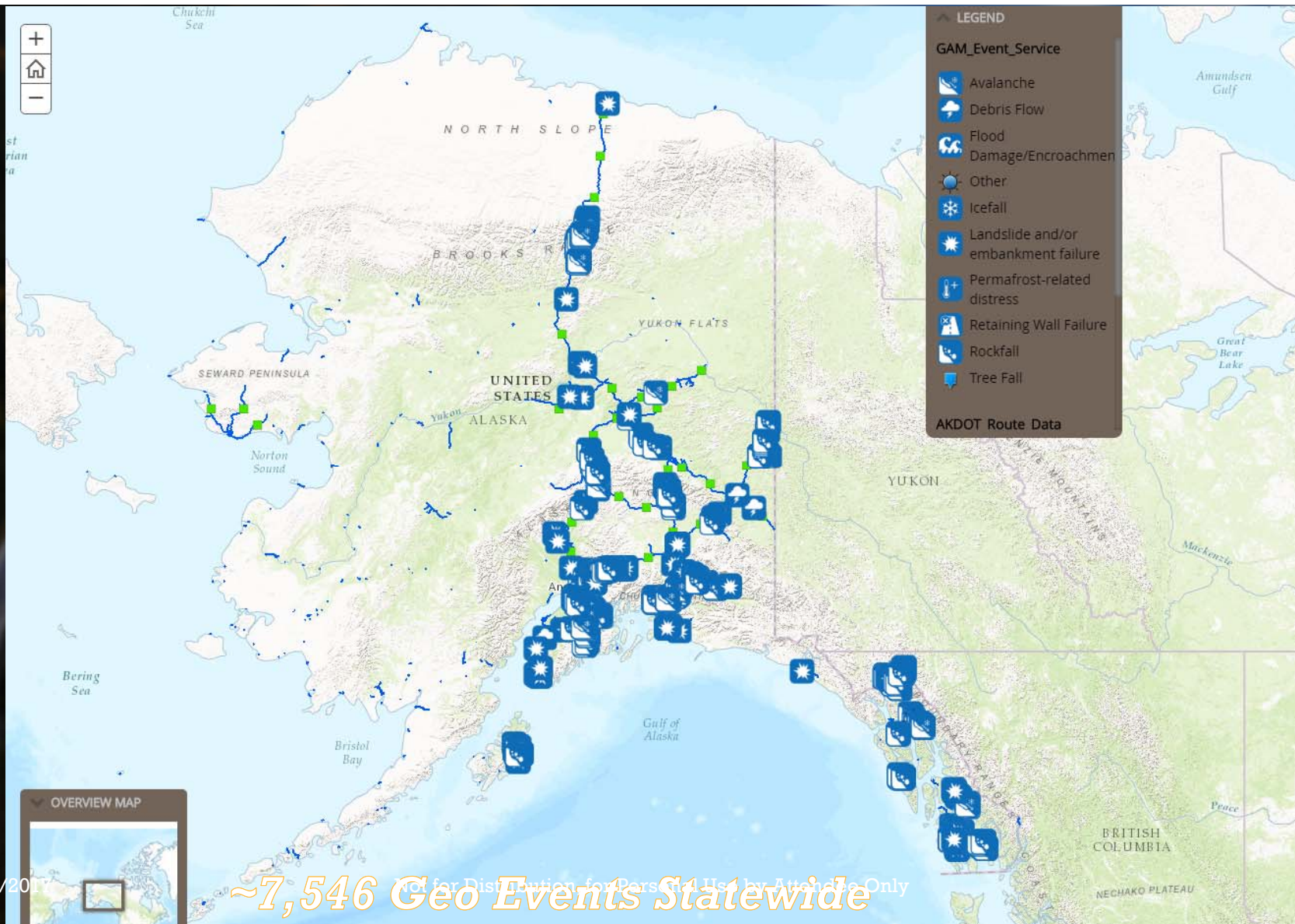


6/23/2017

Not for Distribution, for Personal Use by Attendee Only

19









6/23/2017

Not for Distribution, for Personal Use by Attendee Only

21





6/23/2017

Not for Distribution, for Personal Use by Attendee Only

22





2014/07/22 13:08





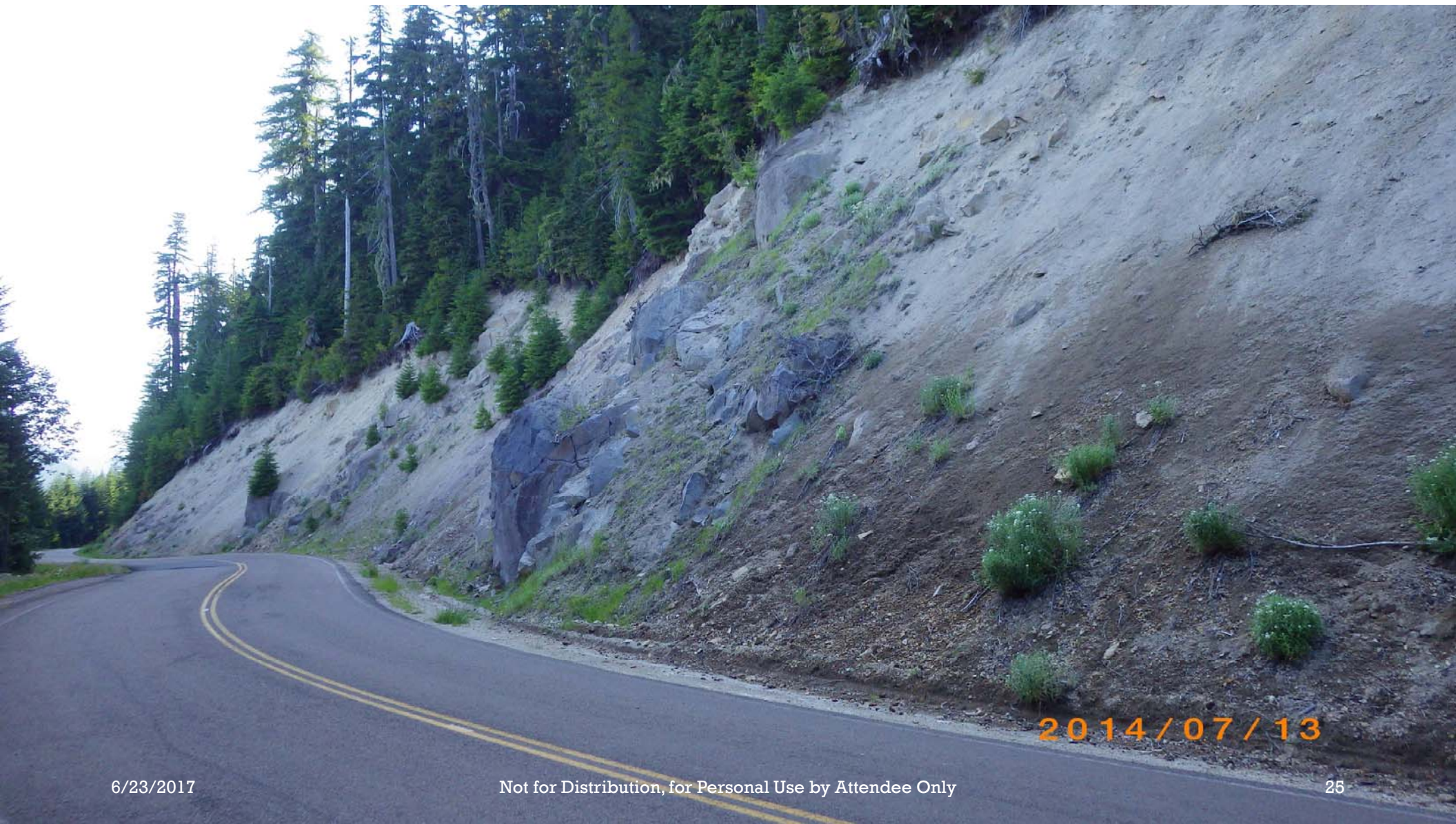
2014/07/22 14:21

6/23/2017

Not for Distribution, for Personal Use by Attendee Only

24





6/23/2017

Not for Distribution, for Personal Use by Attendee Only

2014/07/13

25





6/23/2017

Not for Distribution, for Personal Use by Attendee Only

26





6/23/2017

Not for Distribution, for Personal Use by Attendee Only

27





6/23/2017

Not for Distribution, for Personal Use by Attendee Only

2014/07/13

28



# History of Slope Assessments & Project History

- 1970's Railroad rock slopes following wrecks: A, B, C, D, E system
- 1980's Developed rating categories
- 1984 Oregon DOT began to develop Rockfall Hazard Rating System (RHRS)





# History of Slope Assessments & Project History



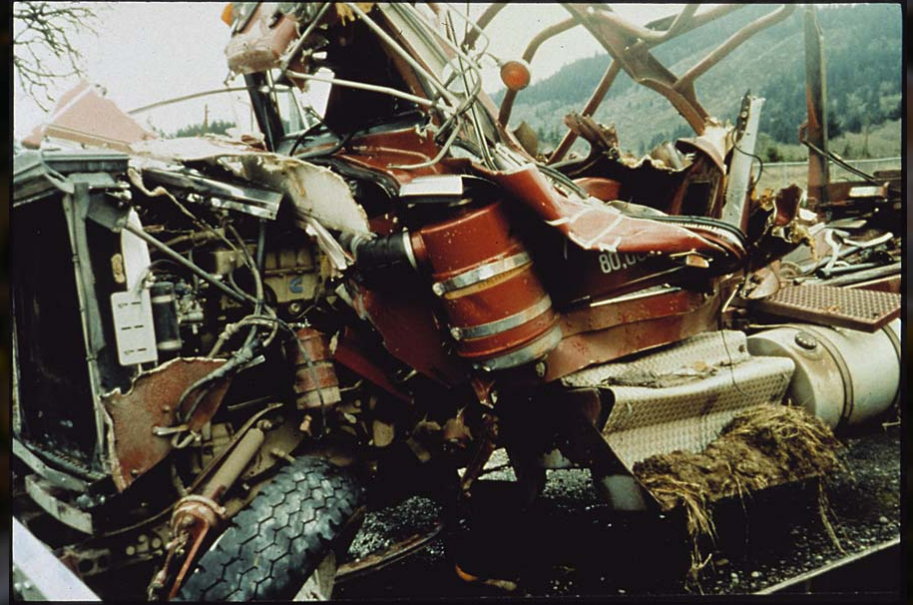
6/23/2017

Not for Distribution, for Personal Use by Attendee Only

30



# History of Slope Assessments & Project History





# History of Slope Assessments & Project History





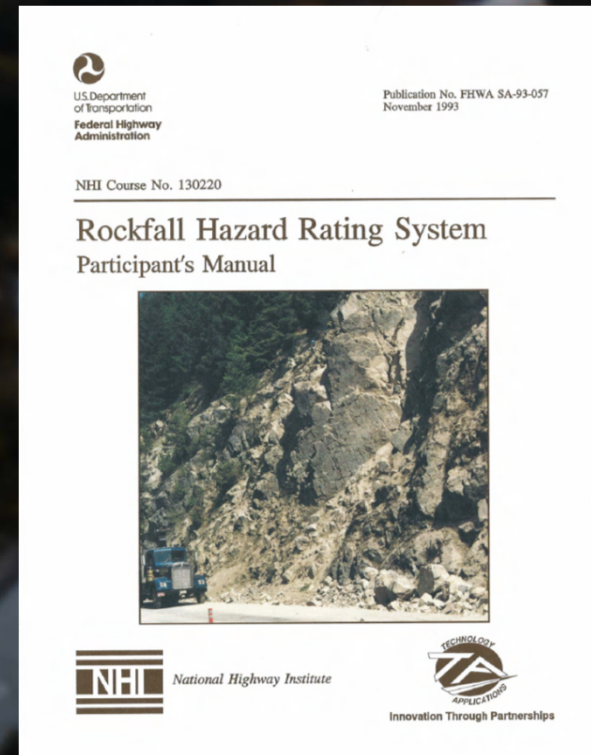
# History of Slope Assessments & Project History





# History of Slope Assessments & Project History

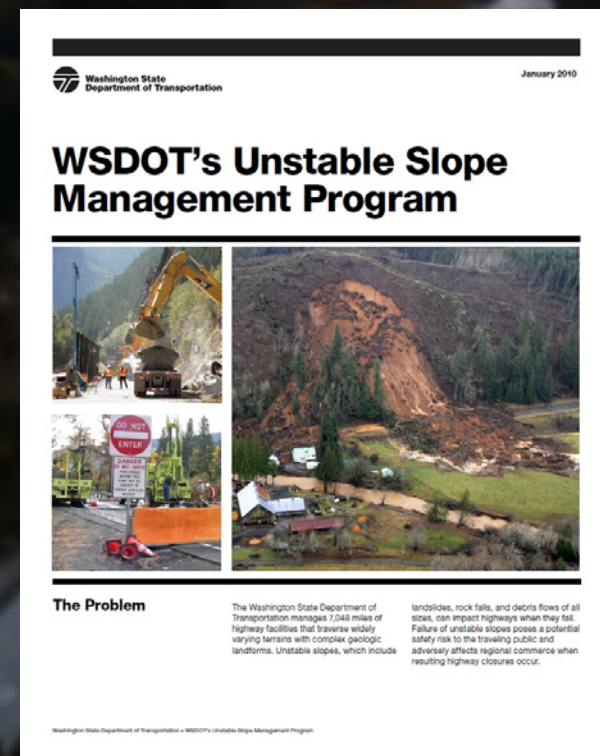
- 1993 – RHRS System published, National Highway Institute (NHI) course developed
- Remaining 1990s: Some states advance RHRS





# History of Slope Assessments & Project History

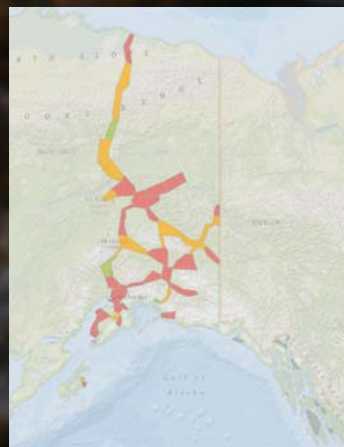
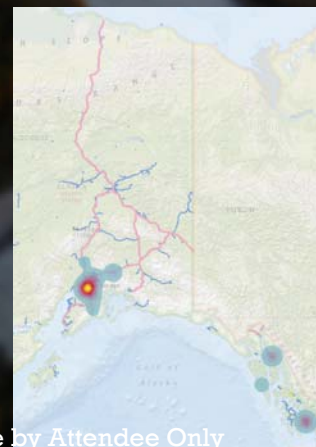
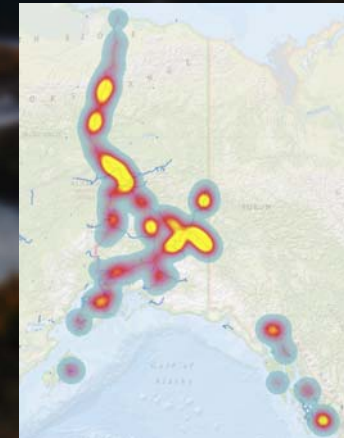
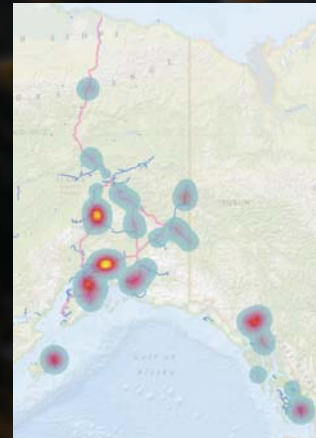
- Mid- to Late-1990's: WSDOT develops & implements a USMP that includes slides
- At the same time, Transportation Asset Management Programs for Bridges and Pavements develop in their own silo



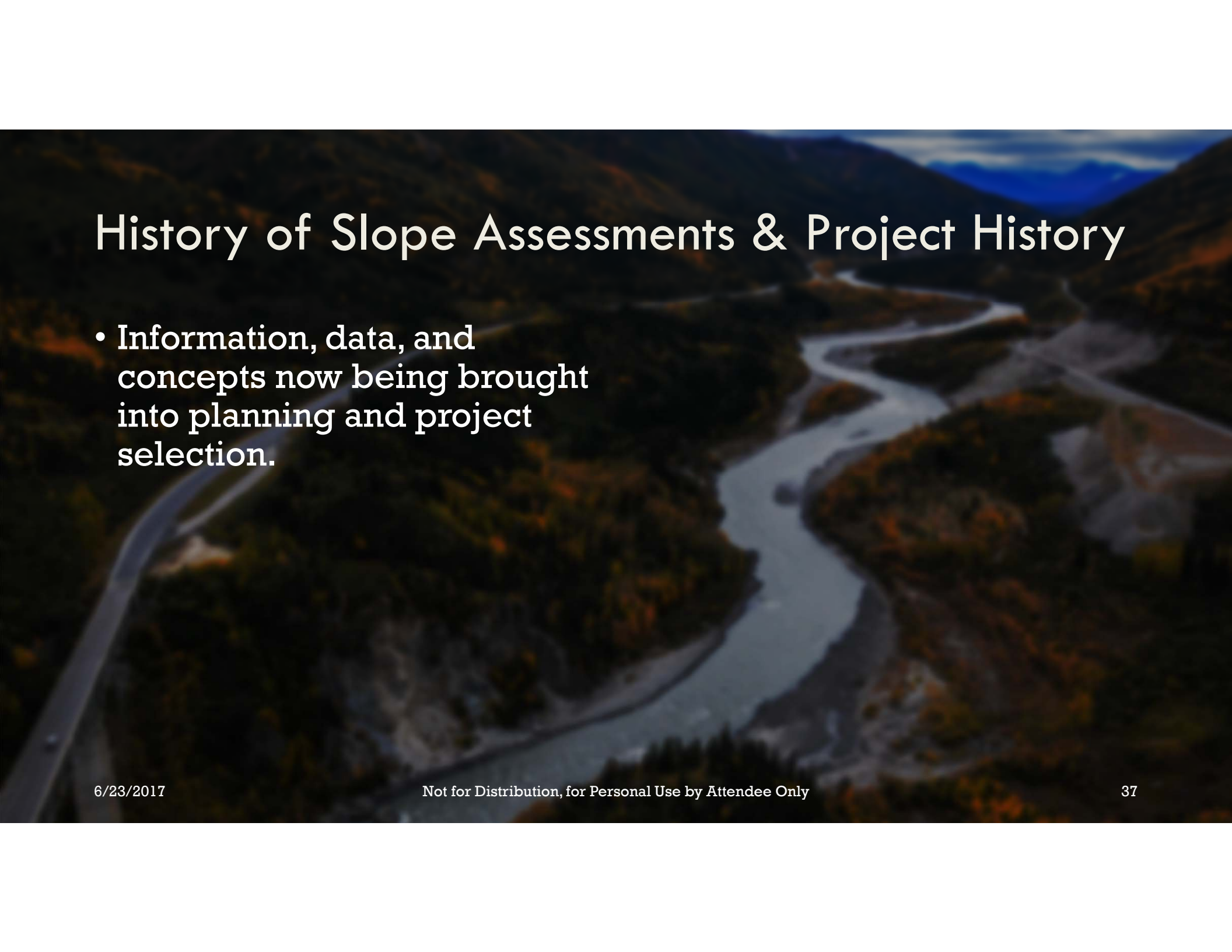


# History of Slope Assessments & Project History

- 2009 – Alaska DOT begins the nation's first Geotechnical Asset Management Program, starting with unstable slopes, retaining walls, and material sources (quarries, gravel pits) and finishes with a complete program.





An aerial photograph of a river winding through a valley. The river is light-colored, possibly due to sediment, and meanders through a landscape of dark green and brown forested hills. In the background, blue mountains are visible under a clear sky.

# History of Slope Assessments & Project History

- Information, data, and concepts now being brought into planning and project selection.



## Task 5 - Determine Critical Sections

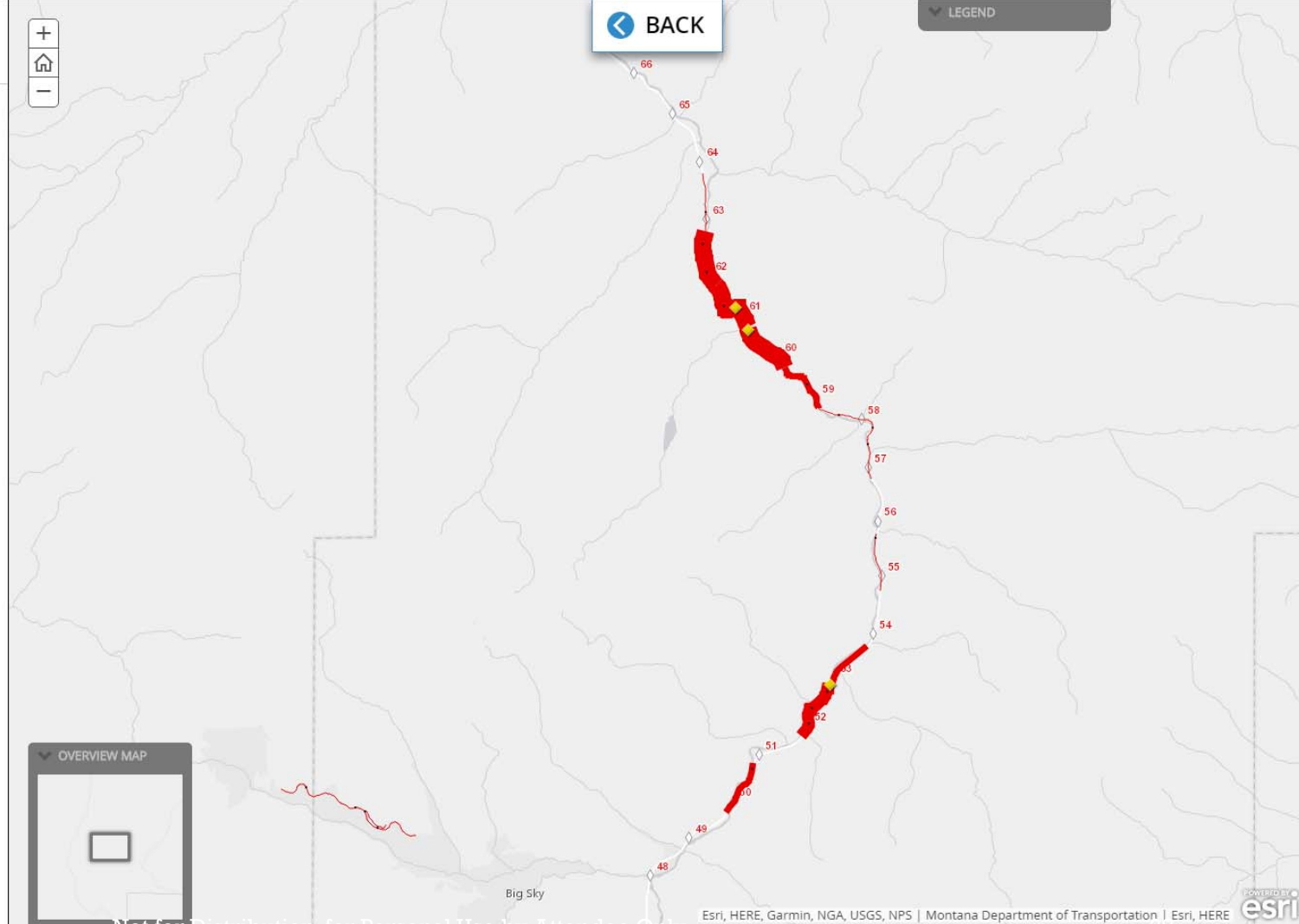
### Lowest Performing Sites & 30 yr Risk

Map illustrating where poor performing rockfall sites correlate with higher risk corridors and STIP locations (where applicable).

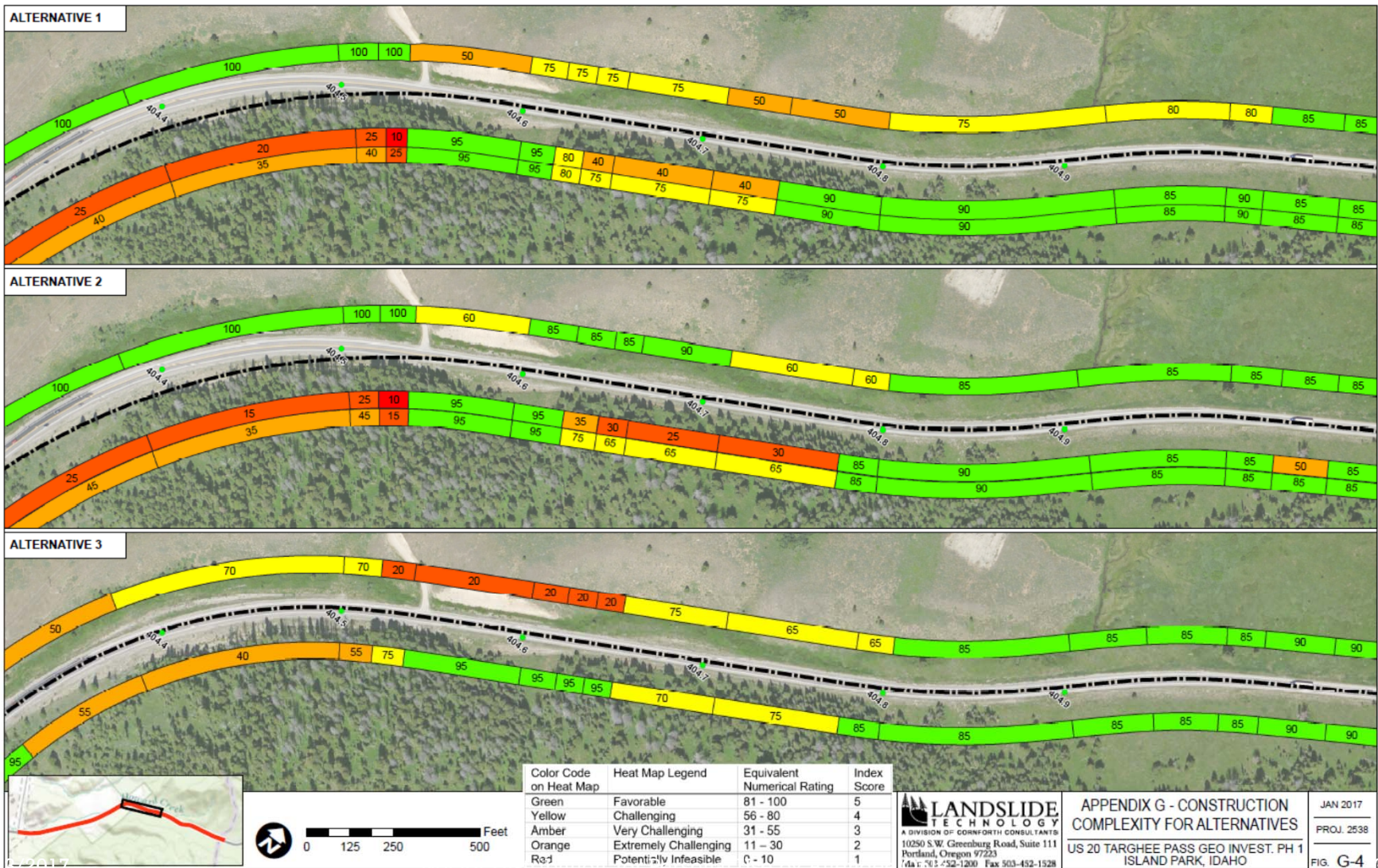
Candidate Rockfall Corridors ( \* indicates an adjacent STIP project).

Click on the links below to zoom in on the map. Sites are listed in no particular order.

- Gallatin Canyon\* - 3 sites not meeting minimum conditions, risk costs of \$5.1M
- Yankee Jim Canyon near Sphinx\* - 3 sites not meeting minimum conditions, risk costs of \$4.4M
- Beartooth Pass\* - 10 sites not meeting minimum conditions. \$2.4m risk over 6 miles.
- I-90 Chestnut Canyon E. of Bozeman. 1 site not meeting minimum condition. \$2.4m risk over 1 mile. \$1.7 m risk at nearby sites to the east.
- Cardwell East to Lewis and Clark Cavern SP. 3 sites not meeting minimum conditions and \$0.6 m risk over two miles.
- Hwy 43 West of Divide. 4 sites not meeting minimum conditions and \$0.9 m risk over three miles.
- I-90 East of Drexel. \$5.0m risk over one mile.
- I-90 East of Saltese. \$5.9m risk over one mile.
- I-90 Near Taft. \* \$3.7m over four miles.
- I-90 Lookout Pass. \* \$0.8m risk at Mile 0.
- MT 200 West of Weeksville. \* 2 sites not meeting minimum conditions and \$0.7 m risk over one mile. RR risk not included.
- Hwy 2 @ Kootenai Falls. \$1.4m risk over one mile.
- Hwy 2 East of West Glacier. 5 sites not meeting minimum conditions and \$0.9 m risk over three miles.









# Unstable Slope Management for FLMA's

- Phase 1: FHWA project contracted to AKDOT
  - Included adaptation of AKDOT's USMP for FLMA's with stakeholder input, test ratings, and criteria definitions.
- Phase 2: FHWA project subcontracted to WTI
  - Consists of 15 tasks
  - Scheduled for completion September 2017

SITE INFORMATION					
Management Area					Date
Road/Trail No.		Road/Trail Class		Rating	
Beginning Mile Marker		Ending Mile Marker		Weather	
Hazard Type		Rockfall Planar   Wedge   Topping   Ravelling/Undermining   Rock Avalanche   Indeterminate Rock Failures   Diff. Erosion		Landslide Above, Below, or Across Route   Translational   Rotational   Debris Flow   Shallow slump   Erosional Failure	
Begin Coord.	Lat.	Long.	End Coord.	Lat.	Long.
Length of Affected Road/Trail			Slope Height (rock) / Axial Length (slide)		Slope Angle
Sight Distance			Roadway/Trail Width		Speed Limit
Ditch Width		Ditch Depth		Ditch Slope	
Annual Rainfall		Sole Access Route <input type="checkbox"/> Yes <input type="checkbox"/> No		Flies Present <input type="checkbox"/> Yes <input type="checkbox"/> No	
Photo # Range		Comments			
PRELIMINARY RATING					
Category Rating	3	9	27	81	Score
A. Landslide - Roadway Width Affected	0-5 Percent	6-25 Percent	26-50 Percent	51-100 Percent	
B. Landslide - Slide/Erosion Effects	Visible crack or slight deposit of material / minor erosion	1 inch offset, or 6-inch deposit of material / major erosion will affect travel in < 5 yrs	2-inch offset or 12-inch deposit / mod. erosion impacting travel annually	4-inch offset or 24-inch deposit / severe erosion impacting travel consistently	
C. Landslide - Roadway Length Affected	25 ft	100 ft	225 ft	400 ft	CALC
D. Rockfall - Ditch Effectiveness (consider launch features)	Good	Moderate	Limited	No Catchment	
E. Rockfall - Rockfall History	Few Falls	Occasional Falls	Many Falls	Constant Falls	
F. Rockfall - Block Size or Volume per Event	1 ft or 3 yd <sup>3</sup>	2 ft or 6 yd <sup>3</sup>	3 ft or 9 yd <sup>3</sup>	4 ft or 12 yd <sup>3</sup>	CALC
G. All - Impact on Use	Full use continues with minor delay	Partial use remains. Use modification required, short (3 mi/30 min.) detour available	Use is blocked - long (1-30 min.) detour available or less than 1 day closure	Use is blocked - no detour available or closure longer than 1 week	
H. All - AADT / Usage / Economic or Recreational Importance (highest rating applies)	50 Rarely Used Insignificant economic / rec. importance	200 Occasionally used Minor economic / rec. importance	450 Frequently used Moderate economic / rec. importance	800 Constantly used Significant economic / rec. importance	CALC FOR AADT ONLY
LANDSLIDES TOTAL (A+B+C+G+H)					CALC
ROCKFALL TOTAL (D+E+F+G+H)					CALC
Preliminary Rating: Low (15-21 pts)   Moderate (22-63 pts)   High (>64 pts) Sites rated as High or Moderate receive detailed evaluation (complete back page).					

FLMA - Unstable Slope Management Program Field Rating Form  
Prepared by: Landslide Technology, WFLMD, FLS, BLM, BIA and NPS

Rev 1.0 (October 24, 2014)



# Why are you here...

- How the USMP can help your agency
  - Proactive Project Selection
- Assist in definition of asset significance to agency goals and strategic requirements.
- Identify assets that are in need of repair prior to failure or significant reduction in performance.
- Focus on critical maintenance actions to enhance performance, reduce risk, and optimize cost prior to onset of emergency conditions



# Why are you here...

- How the USMP can help your agency

- Proactive Project Selection
- Funding Transparency

Follow decision making process that adheres to a national framework

Promote public understanding of national standards

Promote understanding that transparent and wise spending contributes to preventing asset failures and deterioration of infrastructure



# Why are you here...

- How the USMP can help your agency
  - Proactive Project Selection
  - Funding Transparency
  - Spending Wisely with Limited Funds

Wise expenditure of funds to support infrastructure health enhances public perception of agencies as good stewards



# Why are you here...

- How the USMP can help your agency
  - Proactive Project Selection
  - Funding Transparency
  - Spending Wisely with Limited Funds
  - Providing Better Liability Control for Public Agencies

State DOT's proactively using an Unstable Slope Asset Management Program have been better protected through "Discretionary Immunity" decisions than those that don't have one.

Proactive asset management program that identifies underperforming sites/corridors and allows for periodic, cost effective maintenance and risk reduction before failure.



# Why are you here...

- How the USMP can help your agency
  - Proactive Project Selection
  - Funding Transparency
  - Spending Wisely with Limited Funds
  - Providing Better Liability Control for Public Agencies
  - Comply with MAP-21 and the FAST Act legislation
- Establish performance-based AM program
- Establishes national performance goals in 7 areas
- Federal Lands Transportation Program (FLTP)
  - Up to 5% of funds for planning, AM, inventory, and condition assessment
- National Federal Lands Transportation Facility (FLTF) Inventory



# USMP Goals

- Utilize an existing USMP system from Alaska DOT that includes cold region issues and has a rural context for hazard and risk ratings. This closely matches many of FLMA units with low to very low usage relative to a typical DOT's volumes.
- Generate one standard set of forms that are simple to use by all Agency personnel with differing mission statements and differing levels of available data to feed calculations.
- Proactively manage unstable slopes on roads, trails (NPS & USFS only), and really any linear asset
- Includes Rockfall, Landslides, Debris Flows, and Thaw-Unstable Slopes



# USMP Goals

- Develop a condition survey of unstable slopes and provide methods to monitor and track deterioration to effectively schedule beneficial, prioritized, preventative maintenance and risk reduction.
- Ultimately to answer the questions:

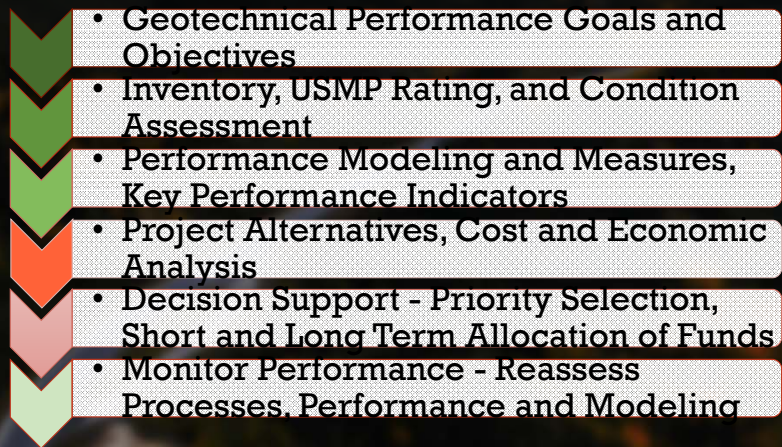
*Do I know where my problems are?*



- The first step in proactively managing unstable slopes is determining where they are and evaluating their condition



# Unstable Slope Management Program

- 
- Geotechnical Performance Goals and Objectives
  - Inventory, USMP Rating, and Condition Assessment
  - Performance Modeling and Measures, Key Performance Indicators
  - Project Alternatives, Cost and Economic Analysis
  - Decision Support - Priority Selection, Short and Long Term Allocation of Funds
  - Monitor Performance - Reassess Processes, Performance and Modeling



# Geotech Assets are a Neglected Asset Class

- With replacement costs higher than proactively managed assets

Rock slopes \$ 3.9 billion	Soil slopes \$ 14.4 billion	Retaining walls \$ 0.7 billion
Good 27%	Good 22%	Good 73%
Fair 65%	Fair 47%	
Poor 8%	Poor 31%	
		Fair 23%
		Poor 4%

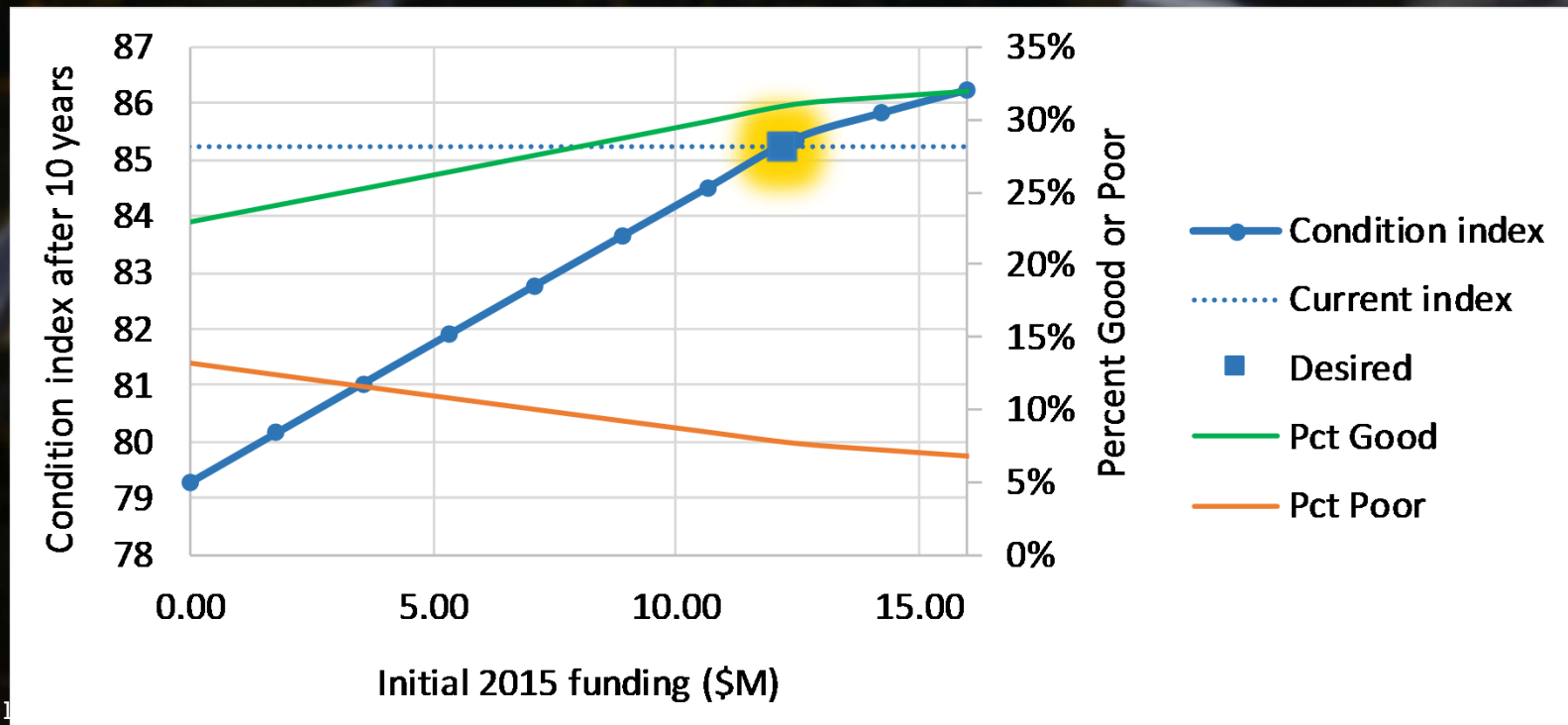
Alaska DOT:

\$19 billion in geotechnical assets – 3 times the value of the bridge inventory



# Manage deterioration...with less \$\$

- Worst first: \$23.5M/YR
- Preservation model: \$9.5M/YR



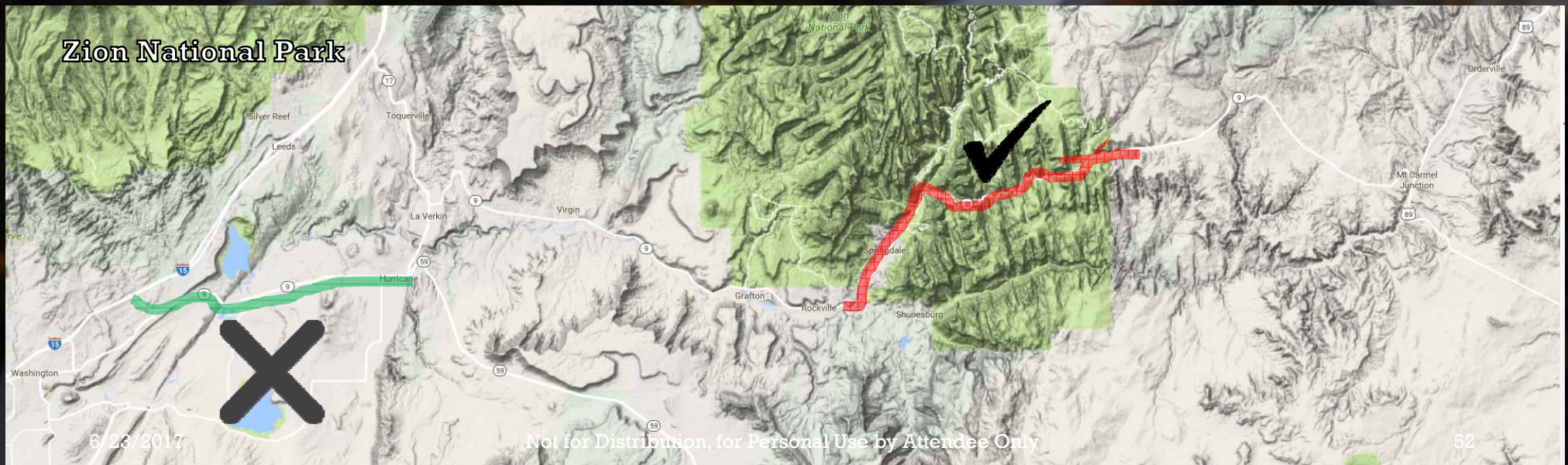
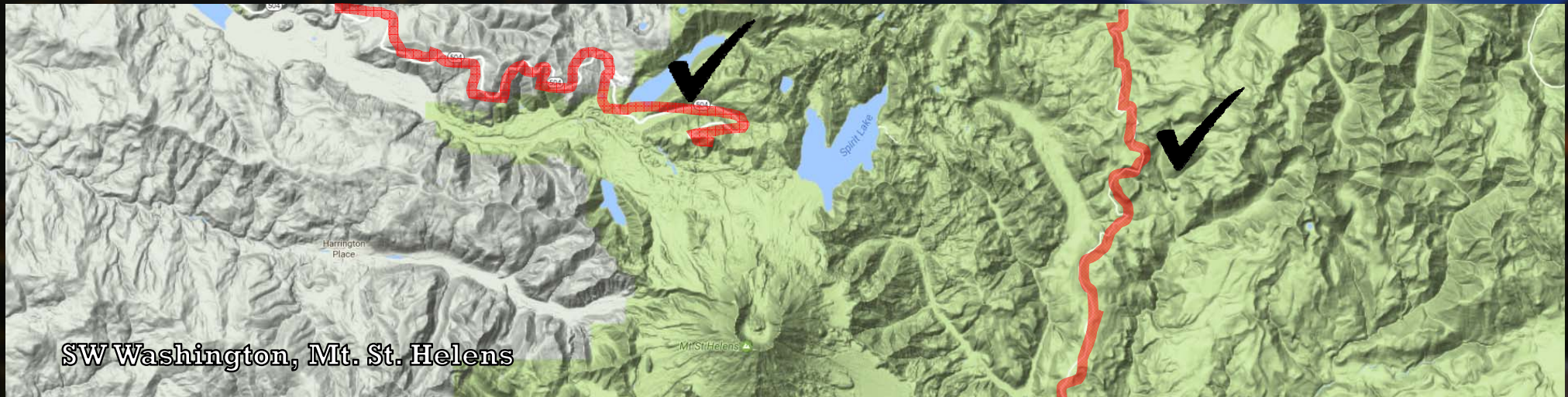


An aerial photograph of a river winding through a valley. The river is light-colored, possibly due to sediment, and flows from the upper right towards the lower left. The surrounding landscape is covered in dense forest with some autumn-colored trees. In the background, there are dark, forested mountains under a blue sky with some clouds.

# Preparing for USMP Ratings

- Develop corridors for study
  - Known unstable terrain – mountains, river banks, weak geology







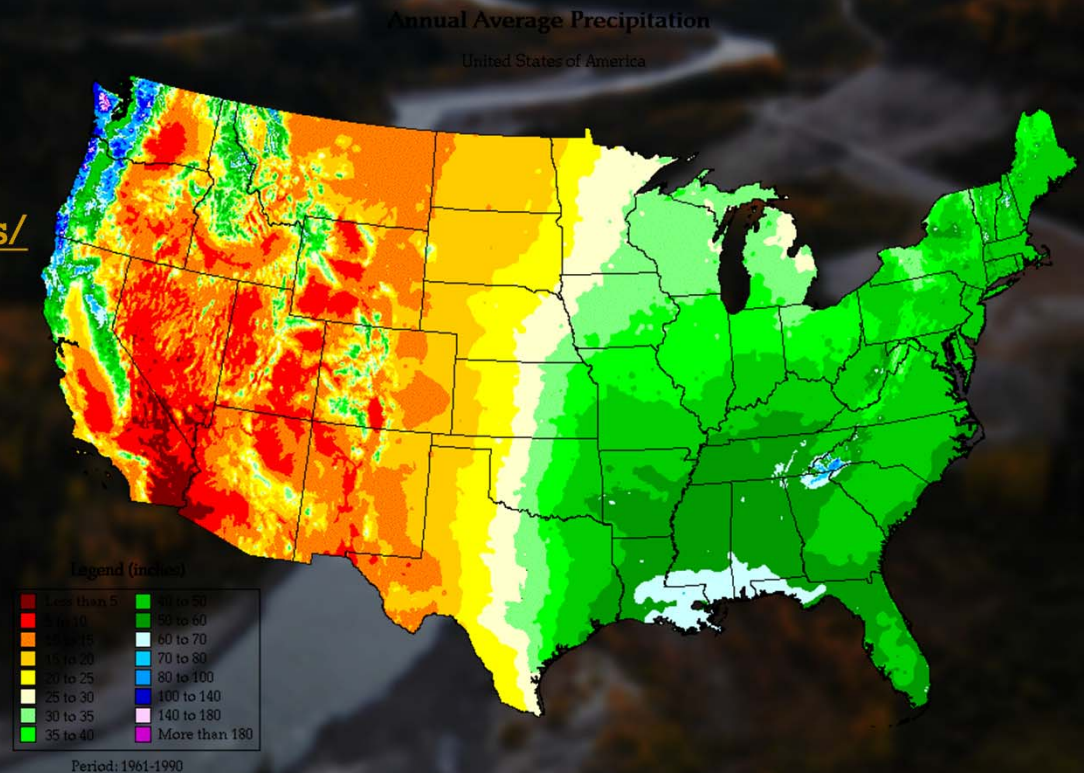
# Preparing for USMP Ratings

- Develop corridors for study
  - Known unstable terrain – mountains, river banks, weak geology
- Policy-driven road prioritization
  - Forest Service – Maintenance Levels
  - NPS – Primary thoroughfares (Blue Ridge Parkway, Going to the Sun, Grand Loop Rd)
  - Corps of Engineers – Roads critical to dam safety and identified PFMs
  - Others?
- Roads of high economic importance



# Preparing for USMP Ratings

- Obtain site information
  - AADT
    - NPS: <https://irma.nps.gov/Stats/>
    - Others?
  - Rainfall Maps





# Preparing for the field

- Talk to maintenance personnel, local engineering staff, & administrative staff (ranger, park superintendent, district engineer)
- Gather maps, review geology
- Prepare field devices





# Field Equipment

- Safety Gear

- High visibility vest
- Hard hat
- Traffic cones
- Signage in high traffic areas, where appropriate



- Field Gear

- Tape Measure / Cloth Tape / Roller Tape / Measuring Wheel
- Laser Rangefinder
- Clinometer
- Calculator
- Geotagging Camera
- Field Notebook
- Field Rating Forms
- Field Manual
- Android, iOS or Laptop

(optional but recommended)