Alaska's Geotechnical Asset Management Program - Program Update

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- Paul Thompson – Consultant
- Bob Kimmerling – Pangeo
- Mark Vessely – S&W
- Ad Hoc GAM committee

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Connecticut
Rhode Island
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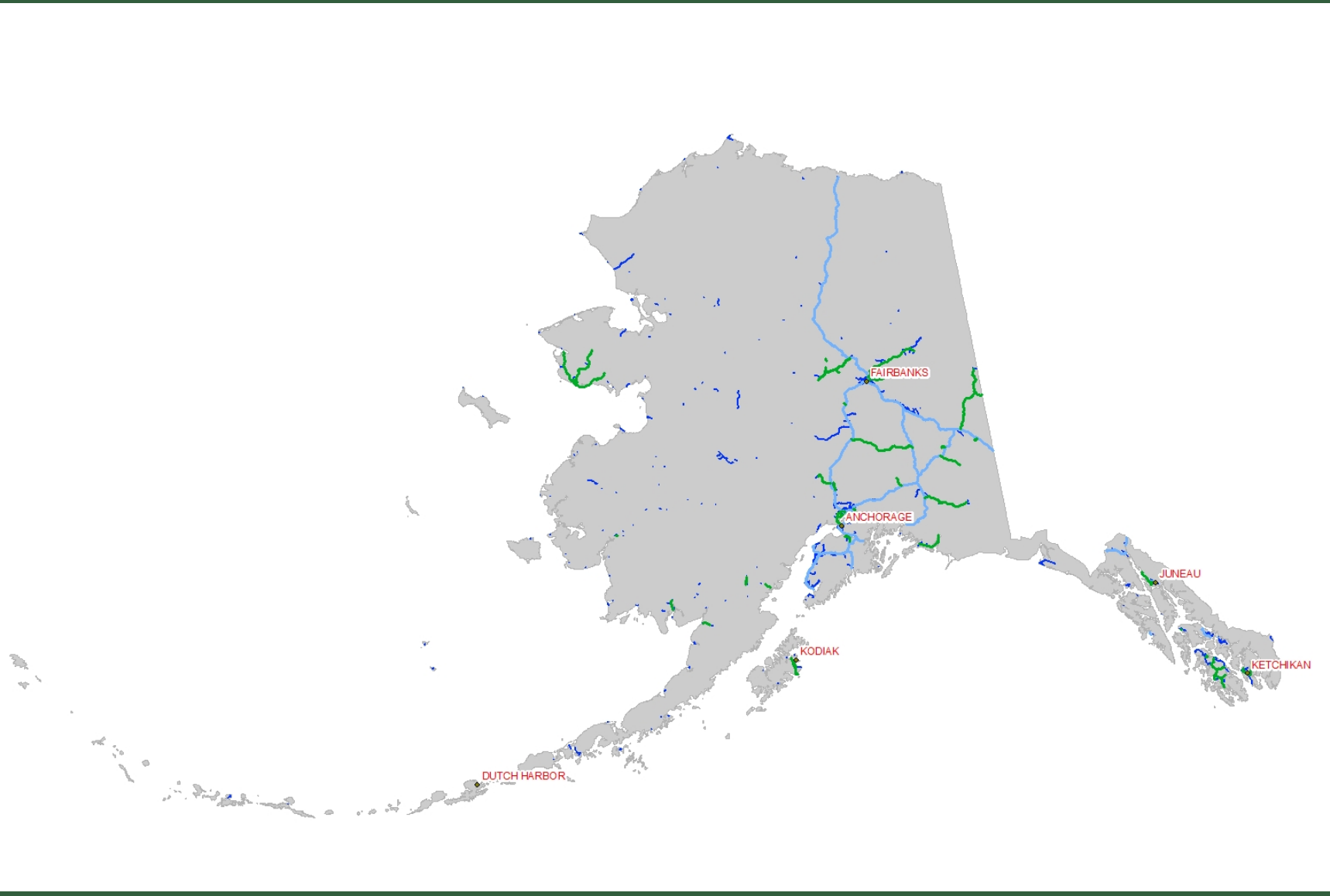
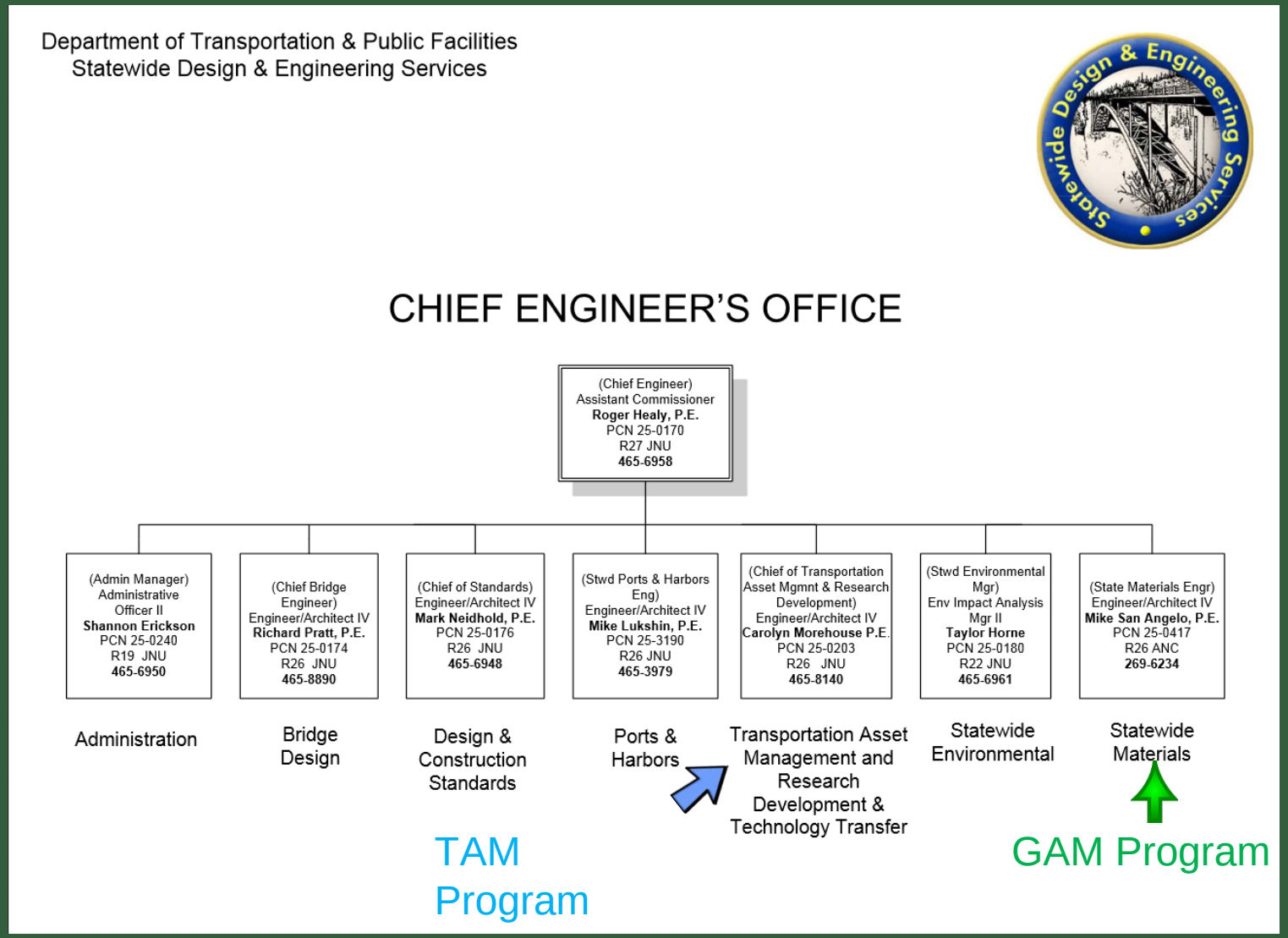
Vermont
New Hampshire
Maine
Washington, D.C.
Alaska
Hawaii

AKDOT&PF Transportation Network

- Low public road centerline mileage(16,301)…
- Low number of bridges (1,196)…
- Vast areas with limited or no connected road system…
- Air travel reliance– 255 airports managed by the agency.
- Extensive marine transportation network: 25 harbors, 33 terminals, 11 ferry vessels



AKDOT&PF asset management programs



AKDOT&PF GAM PROGRAM

Agency Staff:

- Chief Eng Geologist
- Engineering Intern

Research Projects:

- GAM Plan (PDT)
- GAM Development &Implementation (LT)
- Risk Management Framework (S&W)
- Tongass Highway Corridor GAM (LT)

AKDOT&PF GAM PROGRAM

Targeted Asset Classes:

- Rock Slopes
- Unstable Soil Slopes and Embankments
- Earth Retaining Walls
- Material Sites

AKDOT&PF GAM Progress Report 2015

Current Geotech Asset Inventory Census:

- Roughly 1,600 sites in the USMP database [rock slopes, unstable soil slopes and embankments]
- Approx. 1,200 retaining walls
- Approx. 2,900 material sites

AKDOT&PF GAM R&D in 2015

- Methods for determining geotechnical asset condition states
- Cost models to maintain and improve assets
- Asset deterioration rate estimation
- Methods for quantifying asset life cycle cost and risk
- Draft GAM Plan

Prospects in 2016

- Commitment at the division level to support **implementation of GAM Plan**
- Applications for STIP line items for geotechnical asset preservation activities
- Agency emphasis on pursuing increased level of transition to GIS-based data systems that will foster GAM data and tool use.
- Uh…a return to $100+/barrel oil, please!

GAM Outline (Condensed)

1. Inventory
2. Condition State Assessment
3. Cost Modeling *(TRB Paper 16-4286)*
4. Deterioration Modeling & Life Cycle Cost Analysis *(TRB Paper 16-2764)*
5. Alternative Actions focused on Condition State Improvement
6. Database Interface
7. Event Tracking
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Unstable Slopes Management Program

Summary of Inventory Work Completed Through 2015

	Total Inventoried Slopes	Assessed Rock Slopes Number/ft²	Assessed Soil Slopes Number/ln ft	Assessed Retaining Walls Number/ft²
Northern Region	770	290 10,421,107	480 520,143	0
Central Region	363	286 7,124,501	77 59,957	94 181,400
Southern Region	503	427 6,373,882	76 53,681	116 130,844
Statewide	1,636	1,003 23,919,491	633 633,781	210 312,244

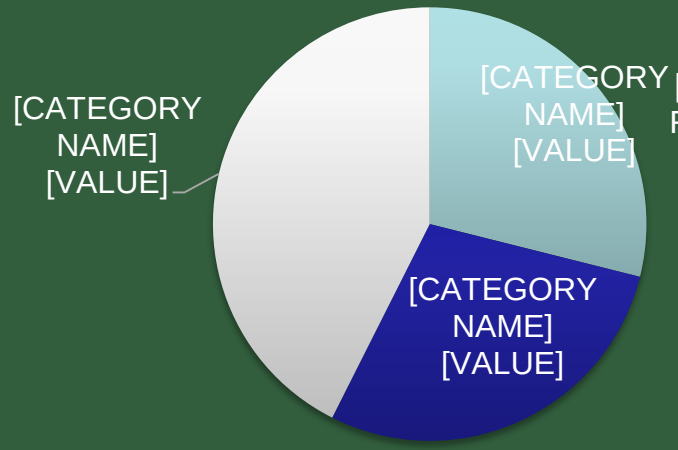
- 1,636 unstable soil and rock slopes rated and inventoried
- 210 retaining walls inventoried
- For unstable slopes, evaluated 45% of AKDOT road miles (NHS routes)
- For retaining walls, evaluated 4% of AKDOT road miles (select locations)
- **Inventoried walls (not field assessed): 1,261**
- **Material Sites: 2,900 (~10 yr. project)**

Location of Inventoried Assets

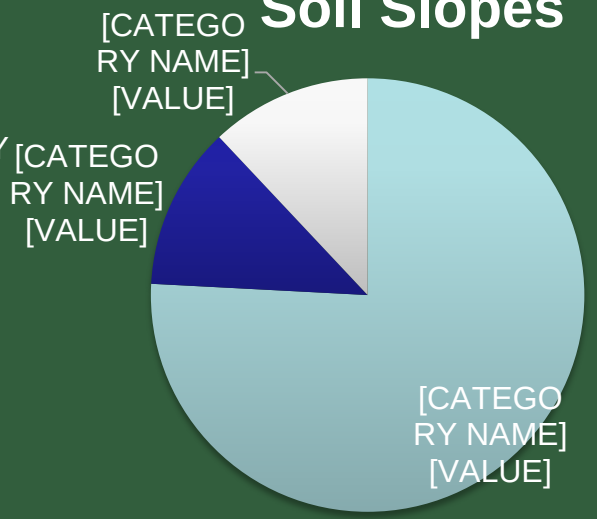
Summary of Inventory Work Completed Through 2015

- Sites sorted by maintenance region (northern, central, and southern)
- For unstable slopes, inventory is complete for NHS routes (45% of AKDOT road miles)
- For retaining walls, inventory covers select areas (4% of AKDOT road miles to date)

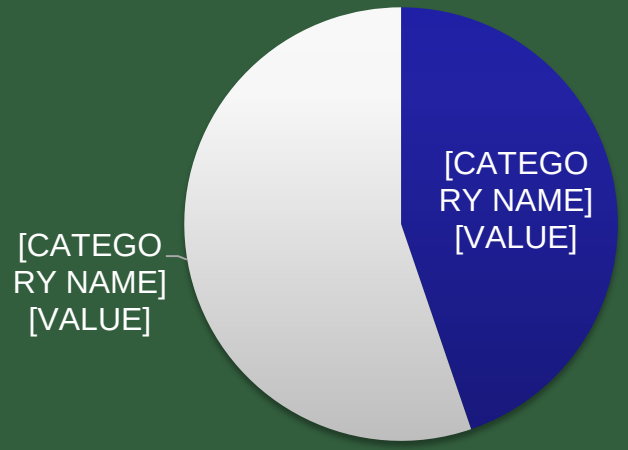
Inventoried Rock Slopes



Inventoried Soil Slopes



Inventoried Retaining Walls



Condition Assessment (Rock Slopes)

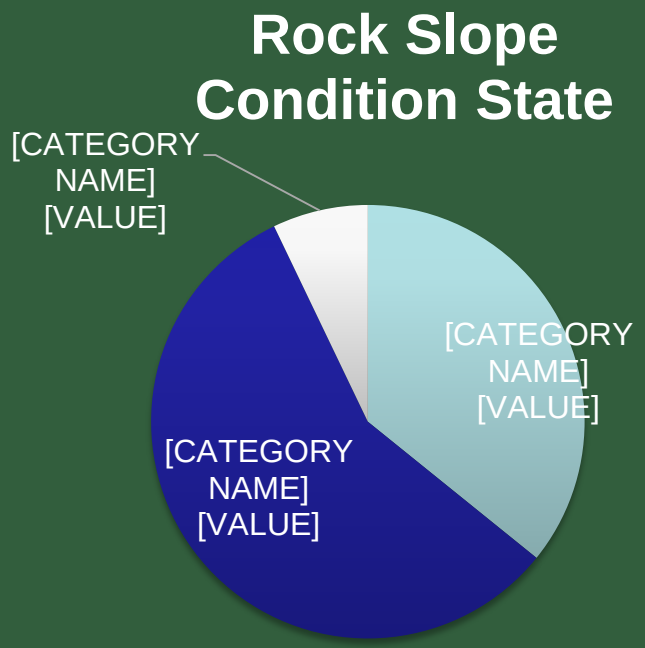
Summarized in TRB Paper 16-4286

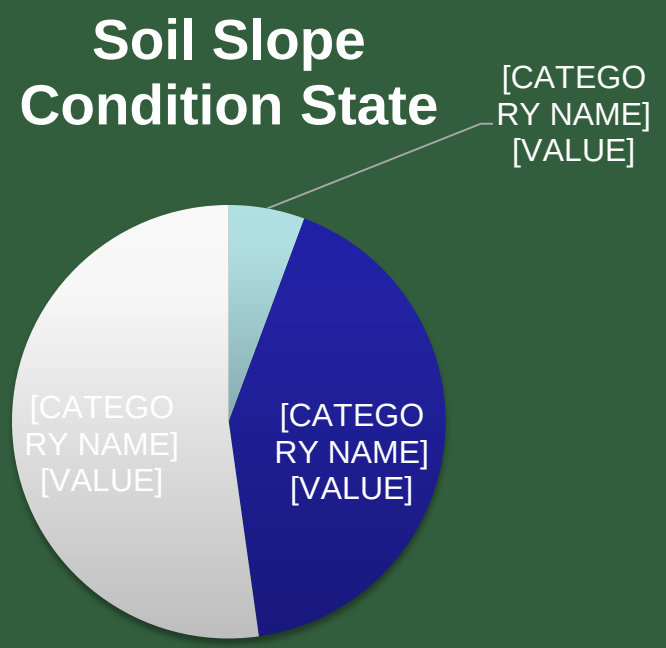
Condition State, Condition Index and Action Level	Description
1- Good (80-100) No action needed	Rock slope produces little to no rockfall and no history of rock reaching the road. Little to no maintenance needs to be performed due to rockfall activity. Mitigation measures, if present, are in new or like new condition.
2 – Fair (60-79.99) Review status at 5-year intervals	Rock slope produces occasional rockfall with a rock rarely reaching the road. Some maintenance needs to be performed due to rockfall activity to maintain safety. Mitigation measures, if present, are in generally good condition, with only surficial rust or minor apparent damage.
3 – Fair (40-59.99) Inspect at bi-annual intervals. Consider mitigation efforts.	Rock slope produces many rockfalls with a rock occasionally reaching the road. Maintenance is required bi-annually or annually to maintain safety. Mitigation measures, if present, appear to have more significant corrosion or damaged minor elements. Preventative maintenance or replacement of minor mitigation components is warranted.
4 – Poor (20-39.99) Inspect annually. Perform major rehab and repair efforts.	Rock slope produces constant rockfall with rocks frequently reaching the road. Maintenance is required annually or more often to maintain ditch. Mitigation measures, if present, are generally ineffective due to significant damage to major components or deep apparent corrosion.
5 – Poor (0-19.99) Perform major mitigation or reconstruction efforts	Rock slope produces constant rockfall and nearly all rockfall reaches the road. Virtually no rockfall catchment exists. Maintenance is cleaning rock off the site regularly, possibly daily during poor weather. If present, nearly all mitigation measures are ineffectual either due to deferred maintenance, significant damage, or

Asset Condition by Region - Northern

Summary of Inventory Work Completed Through 2015

- Majority of rock slope face square footage in region in Fair condition
- Majority of unstable soil slope/embankment footage in Poor condition, with many thaw unstable slopes
- No retaining walls inventoried in Northern Region



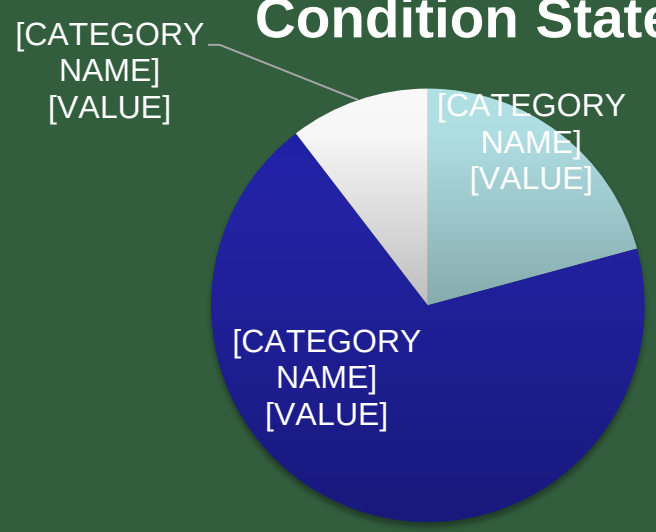


Asset Condition by Region - Central

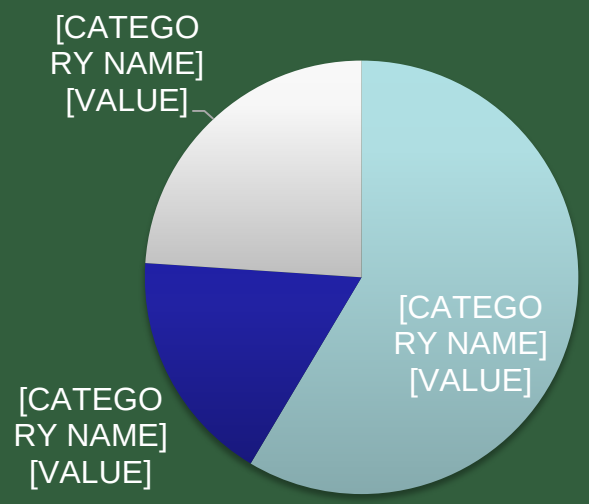
Summary of Inventory Work Completed Through 2015

- Majority of rock slope face square footage in region in fair condition
- Majority of unstable soil slope/embankment footage in Good condition (B-slope)
- Majority of retaining walls square footage inventoried on Seward Highway and in Anchorage Metropolitan Area in Good condition

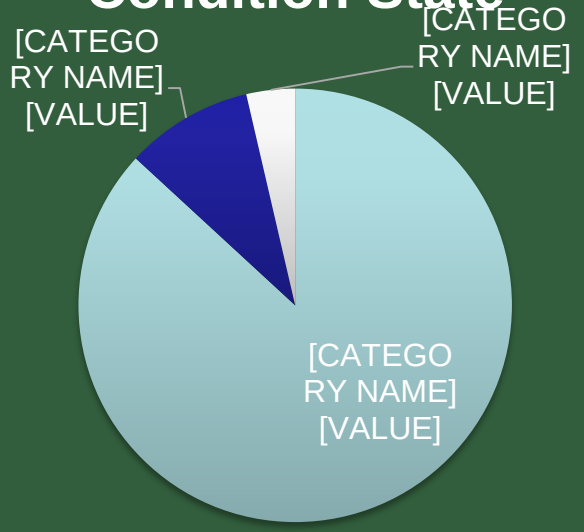
Rock Slope Condition State



Soil Slope Condition State



Retaining Wall Condition State

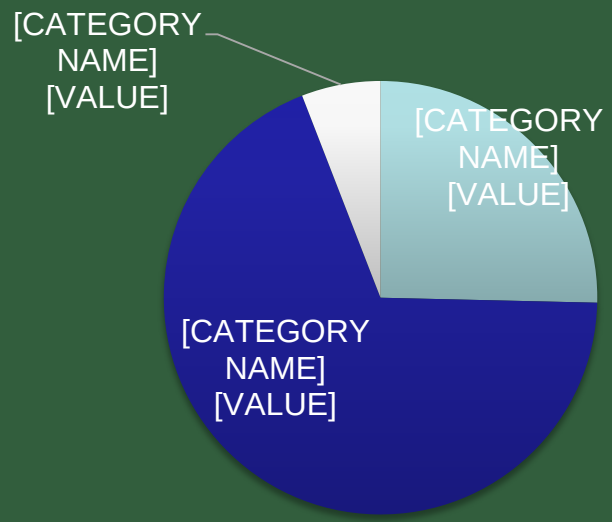


Asset Condition by Region - Southcoast

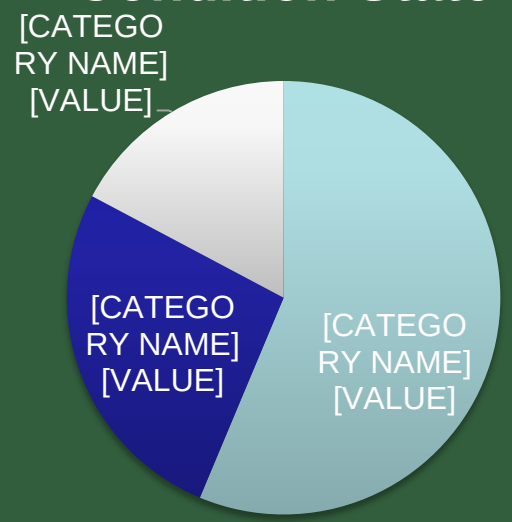
Summary of Inventory Work Completed Through 2015

- Majority of inventoried rock slope square footage in Fair condition
- Majority of inventoried soil slope/embankment footage in Good condition
- Retaining walls inventoried in Ketchikan, Juneau, and Sitka largely in Good condition

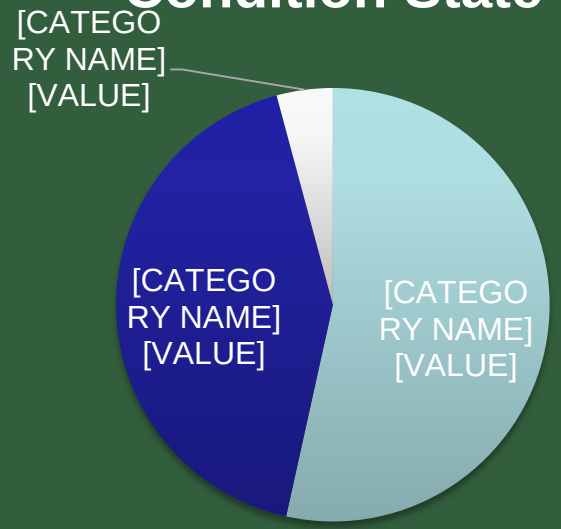
Rock Slope Condition State



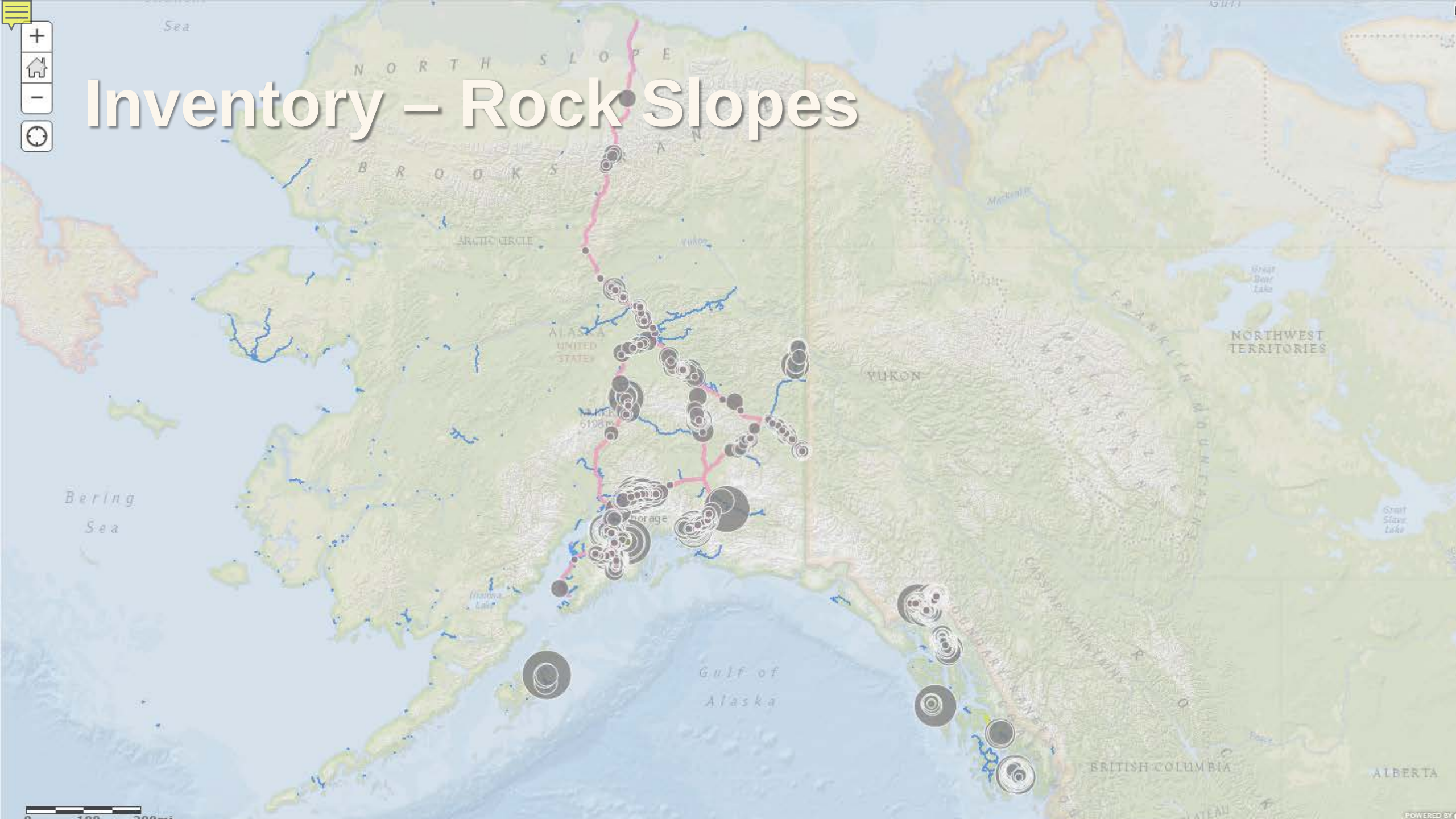
Soil Slope Condition State



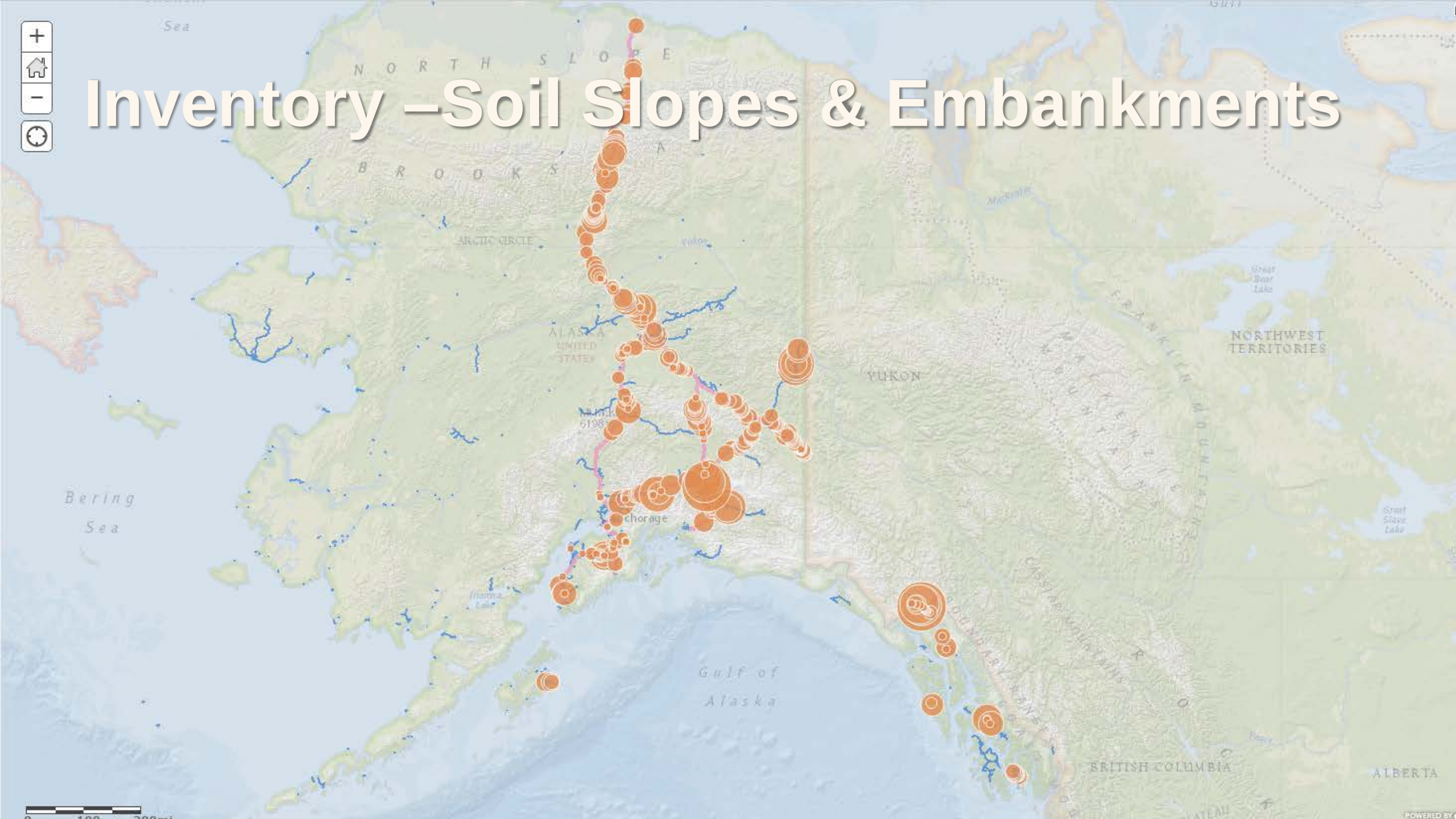
Retaining Wall Condition State



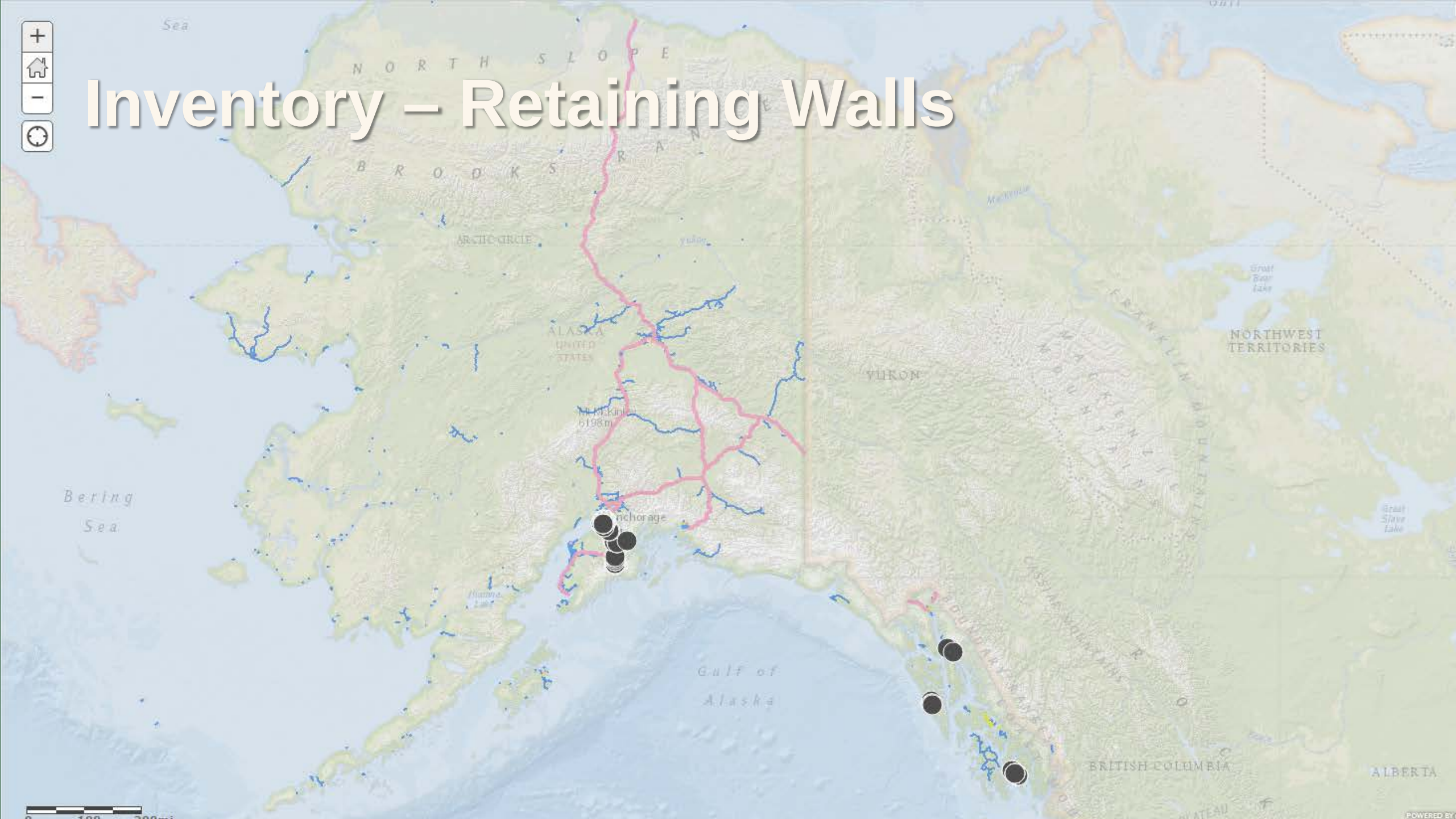
Inventory – Rock Slopes



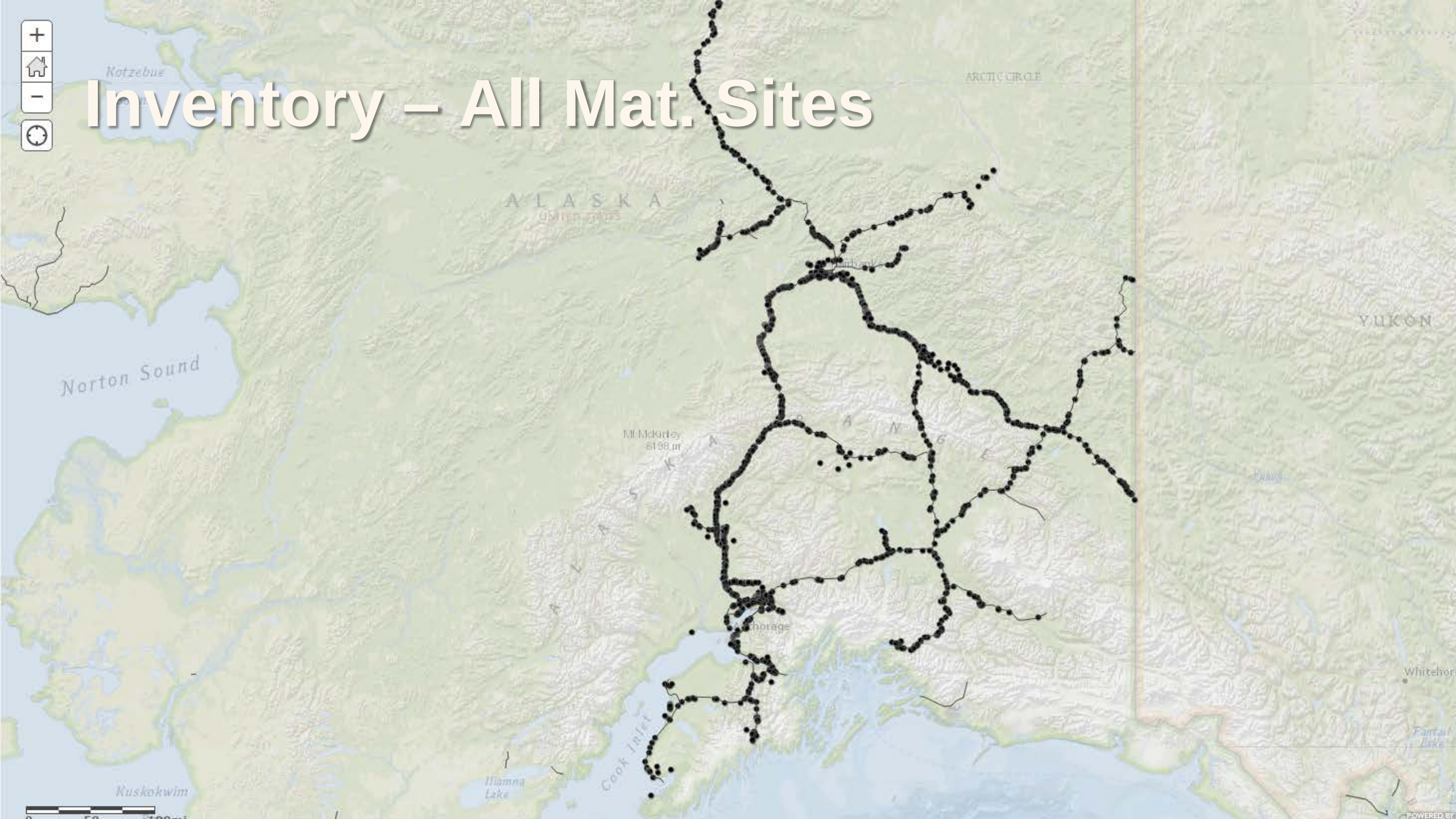
Inventory –Soil Slopes & Embankments

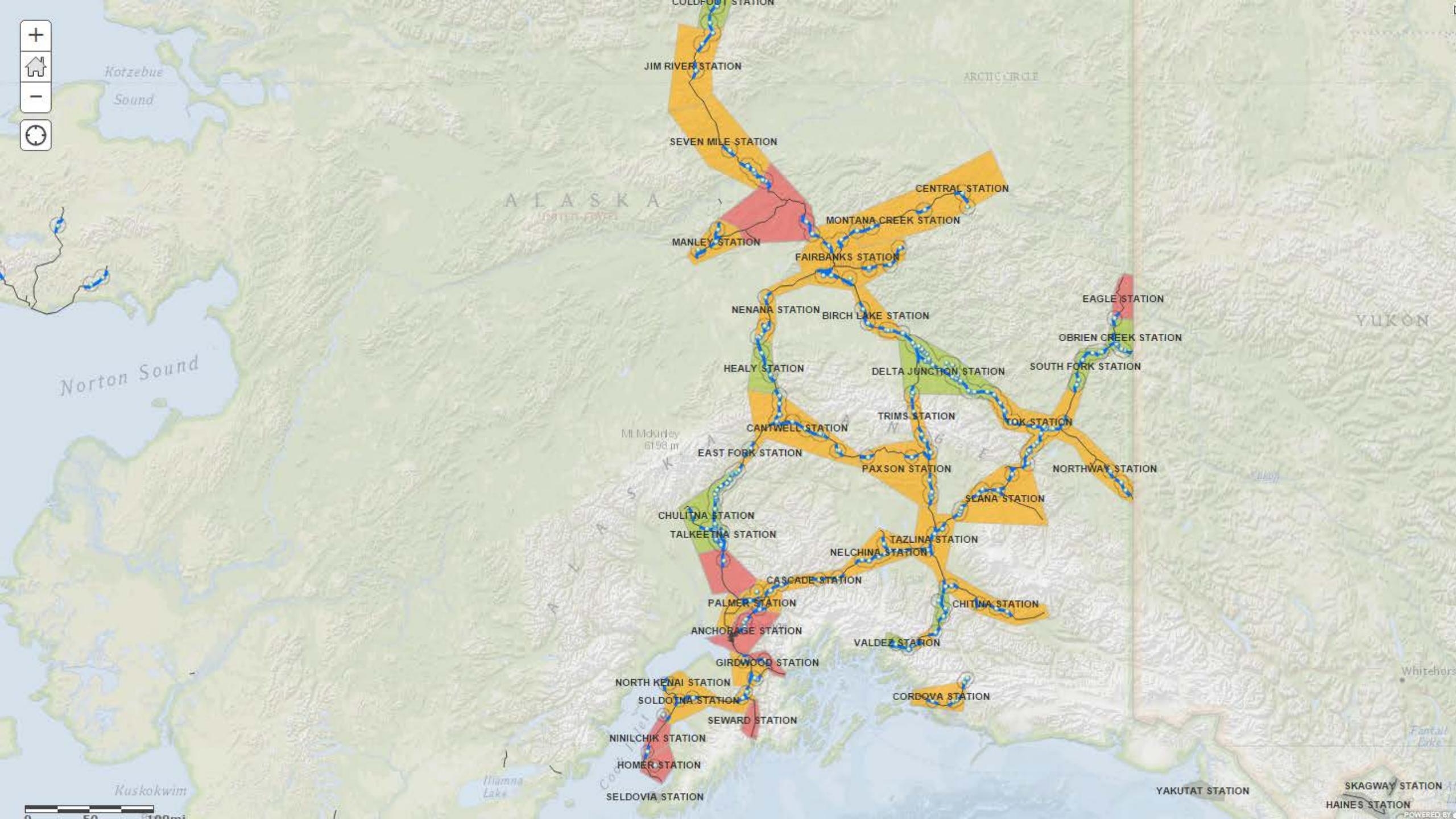


Inventory – Retaining Walls



Inventory – All Mat. Sites




COLDFOOT STATION
JIM RIVER STATION
SEVEN MILE STATION
CENTRAL STATION
MONTANA CREEK STATION
MANLEY STATION
FAIRBANKS STATION
NENANA STATION
BIRCH LAKE STATION
EAGLE STATION
OBRIEN CREEK STATION
HEALY STATION
DELTA JUNCTION STATION
SOUTH FORK STATION
TRIMS STATION
TOK STATION
CANTWELL STATION
EAST FORK STATION
PAXSON STATION
NORTHWAY STATION
SLANA STATION
CHULITNA STATION
TALKEETNA STATION
TAZLINA STATION
NELCHINA STATION
CASCADE STATION
PALMER STATION
CHITINA STATION
ANCHORAGE STATION
VALDEZ STATION
GIRDWOOD STATION
NORTH KENAI STATION
CORDOVA STATION
SOLDOTNA STATION
SEWARD STATION
NINILCHIK STATION
HOMER STATION
SELDOVIA STATION
YAKUTAT STATION
SKAGWAY STATION
HAINES STATION
ALASKA
YUKON
Norton Sound
Kotzebue Sound
Kuskokwim
ARCTIC CIRCLE
Mt McKinley 6198 m
Whitehorse

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Cost Modeling

- Who has a database of GAM Condition States and long-term costs associated with maintenance and mitigation?

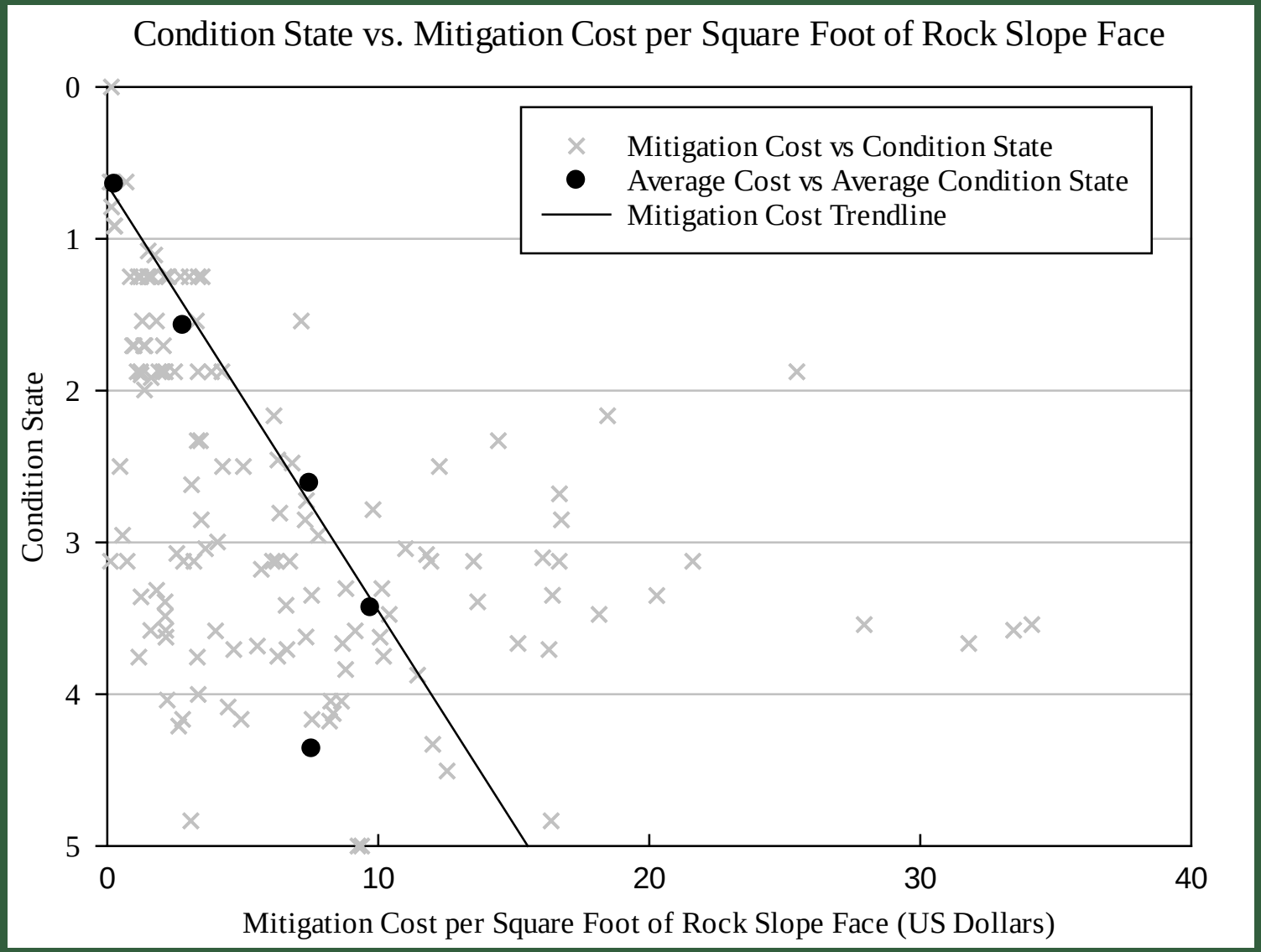
Cost Modeling

- Who has a database of GAM Condition States and long-term costs associated with maintenance and mitigation?
  - NOBODY! Creativity needed!

Cost Modeling

- Who has a database of GAM Condition States and long-term costs associated with maintenance and mitigation?
  - NOBODY! Creativity needed!
- Rock Slopes – Statewide MDT RHRS data from 2005
- Unstable Soil Slopes and Embankments – WSDOT Landslide Database and Cost Estimates
- Retaining Walls – AKDOT Bid Tabs for new construction

Results


Condition State vs. Mitigation Cost per Square Foot of Rock Slope Face
Mitigation Cost vs Condition State
Average Cost vs Average Condition State
Mitigation Cost Trendline
Condition State
0
1
2
3
4
5
0
10
20
30
40
Mitigation Cost per Square Foot of Rock Slope Face (US Dollars)

Results

Number of Condition States Improved by Mitigation Activities	Rock Slopes – Average Mitigation Costs per sq. ft. of Rock Slope Face	
	Geotechnical Component Cost	Incorporating Overhead Costs (105%)
1	$3.56	$7.30
2	$7.12	$14.60
3	$10.68	$21.90
4	$14.24	$29.20

Implications

Number of Condition States Improved by Mitigation Activities	Rock Slopes – Average Mitigation Costs per sq. ft. of Rock Slope Face	
	Geotechnical Component Cost	Incorporating Overhead Costs (105%)
1	$3.56	$7.30
2	$7.12	$14.60
3	$10.68	$21.90
4	$14.24	$29.20

- Example: 20,000 sf CS 3 slope improved to CS 1 (like new) = 20,000 x $14.60 = $292k
- Permits Programmatic Cost Estimation and Asset Valuation
  - *Does not replace corridor specific studies or site specific cost estimates.*

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Deterioration Model

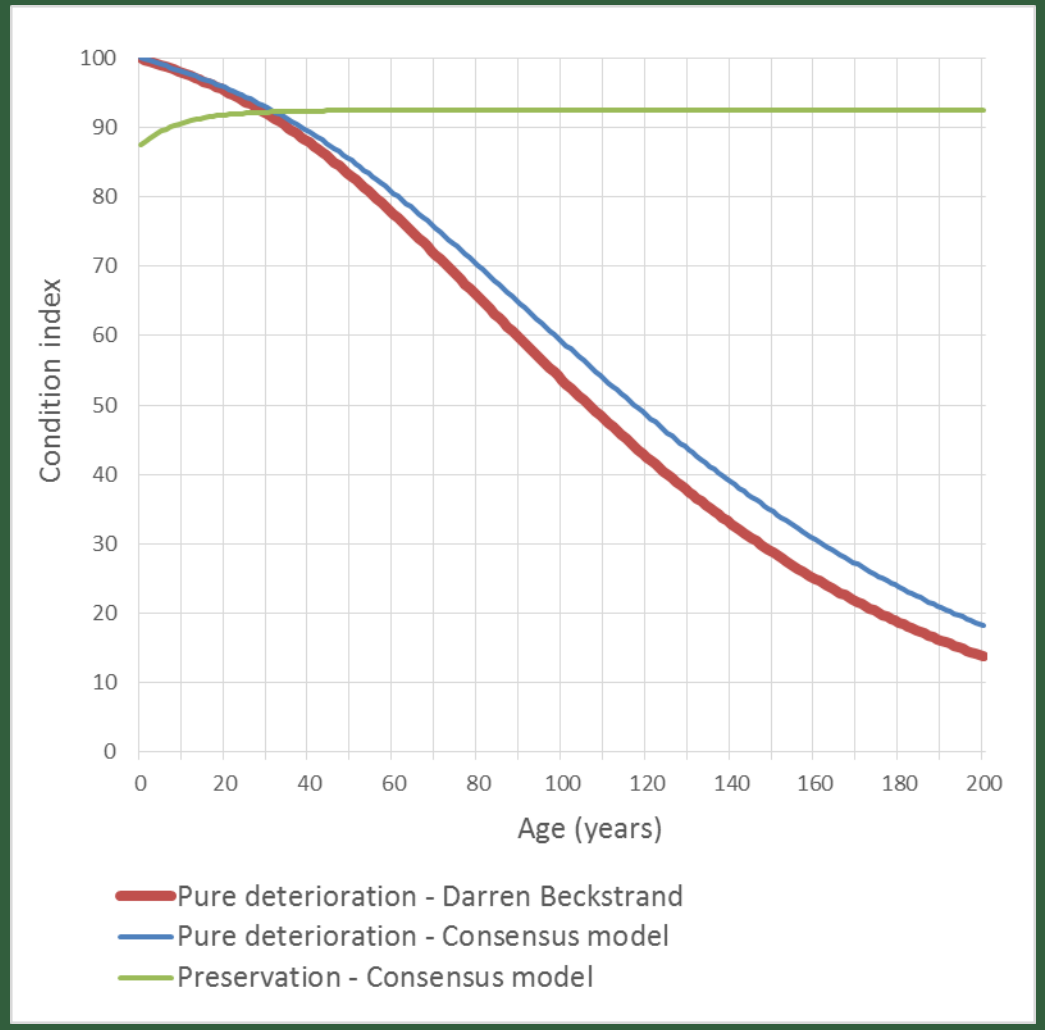
- Who has a database of GAM Condition States and long-term deterioration rates in the absence of maintenance activities?
  - NOBODY!

- Expert Elicitation performed

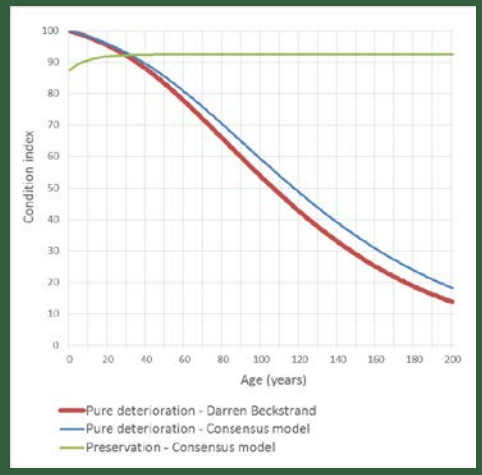
Expert Elicitation

- You have 100 Condition State 1 slopes. How many years until 50 of them have deteriorated to CS 2?
  - 35, 20, 75, 45, 30, 25 years…Consensus of 38.3 yrs
- Same question for CS 2 deteriorating to CS 3 and so on.

Elicitation Results

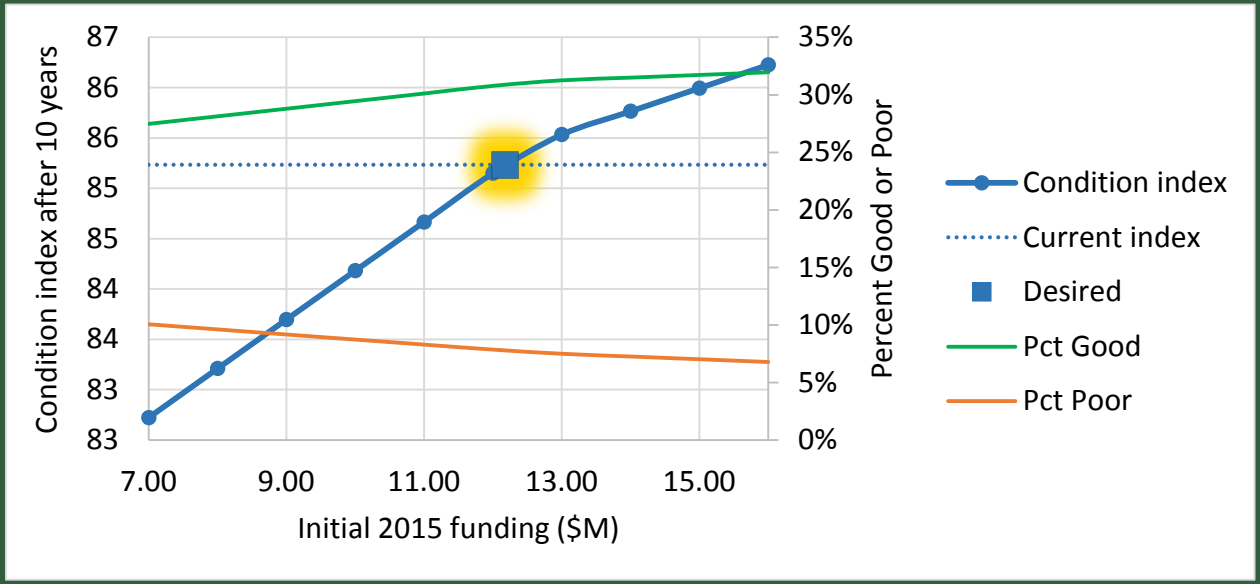


Investment Levels & LCCA



Treatment frequency and cost						$/sq.ft	OH%
					Unit cost per state improved:	3.56	105%
	% acted upon per year					Cost	Cost
Treatment	State 1	State 2	State 3	State 4	State 5	$/sq.ft	$k/year
Maintain same state	10.00%	15.00%	20.00%	75.00%	75.00%	0.46	4296.9
Improve by 1 state		0.00%	2.00%	1.00%	25.00%	3.56	650.4
Improve by 2 states			8.00%	2.00%		7.12	4660.4
Improve by 3 states				15.00%		10.68	6108.5
Improve by 4 states						14.24	0.0
Total acted upon	10.00%	15.00%	30.00%	93.00%	100.00%		15716.3

Funding vs performance



For example, funding of $12.2 M/year is expected to yield 31% Good and 8% Poor

- More funding gives better condition (as expected)
- 10-year fiscally-constrained condition targets based on expected funding allocated to slopes
- Computed from current condition, deterioration and cost models

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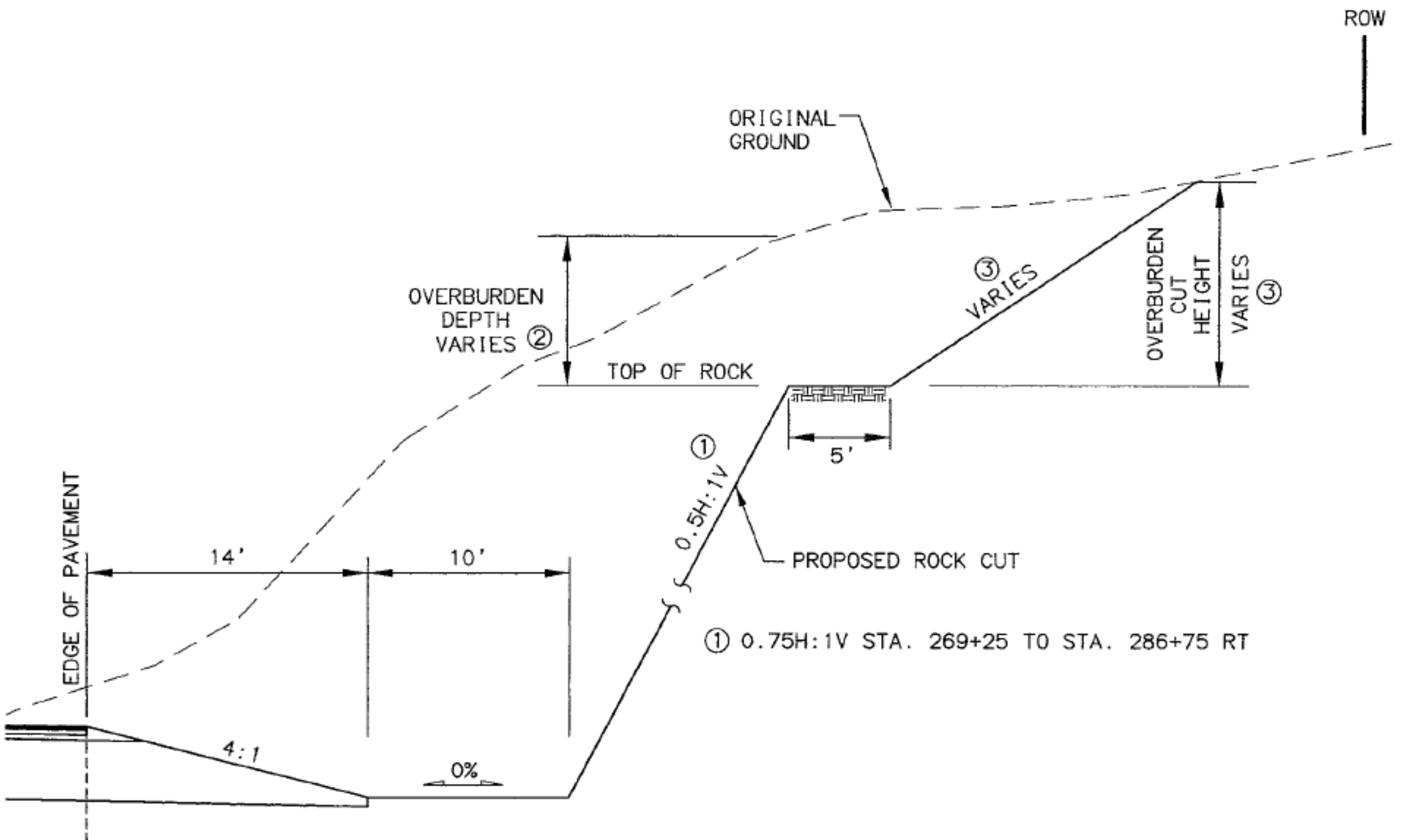
Alternative Actions

- Rock
  - Maintain (Same CS)
    - Ditch Cleaning - Mitigation Maintenance
  - Minor Improvement (Improve CS)
    - Ditch Improvement (concrete barrier) - Scaling
  - Major Improvement (Improve CS)
    - Bolts – Mesh – Attenuator – Barrier – Shotcrete
  - Realignment / Reconstruction
- Soil
  - Maintain (Same CS)
    - AC Patch – Ditch Cleaning
  - Minor Improvement (Improve CS)
    - Reinforced AC Section – Rock Inlay – Rip Rap – Small Buttress
  - Major Improvement (Improve CS)
    - Full Stabilization – Debris Flow Barriers – Tie Back Anchor
  - Realignment / Reconstruction

Alternative Actions

- Walls
  - Maintain (Same CS)
    - Vegetation Removal – Coating Application – Facing Repair
  - Minor Improvement (Improve CS)
    - Repair Failing Elements – Reinforce Displaced Sections
  - Major Improvement (Improve CS)
    - Major Repairs
  - Realignment / Reconstruction
- District Material Scarcity
  - Maintain (Same CS)
    - Prevent Sites from Closing - Expand when Reserves Drop
  - Minor Improvement (Improve CS)
    - Open new sites – Expand Existing
  - Major Improvement (Improve CS)
    - Open more until full coverage

Alternative Actions


ROW
ORIGINAL GROUND
OVERBURDEN DEPTH VARIES ②
TOP OF ROCK
③ VARIES
OVERBURDEN CUT HEIGHT VARIES ③
5'
① 0.5H:1V
PROPOSED ROCK CUT
EDGE OF PAVEMENT
14'
10'
4:1
0%
① 0.75H:1V STA. 269+25 TO STA. 286+75 RT

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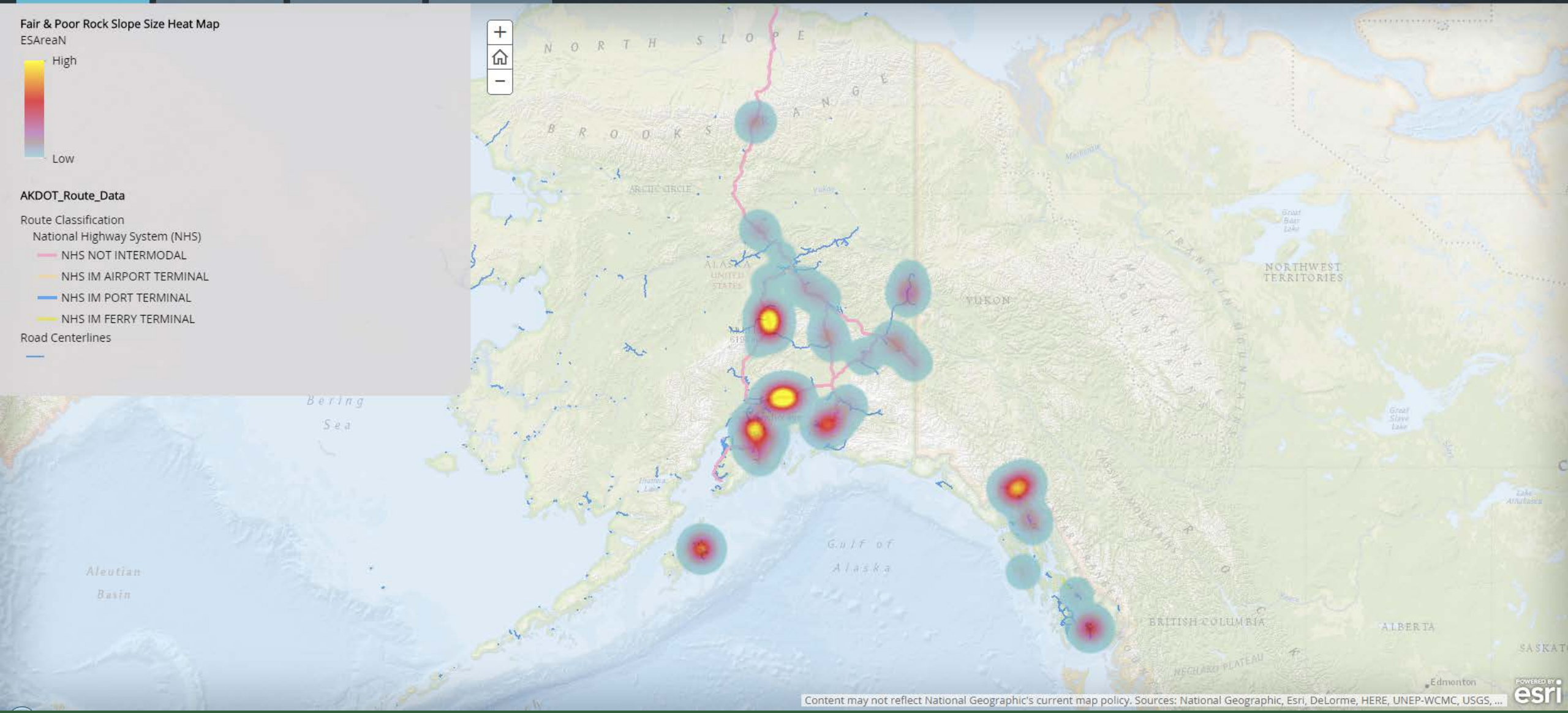
Geotechnical Asset Management Progam

Fix issues in your story | Edit | A story map

Unstable Rock Slopes | Unstable Soil Slopes | Retaining Wall Assets | Material Site Assets



Geotechnical Asset Management Progam

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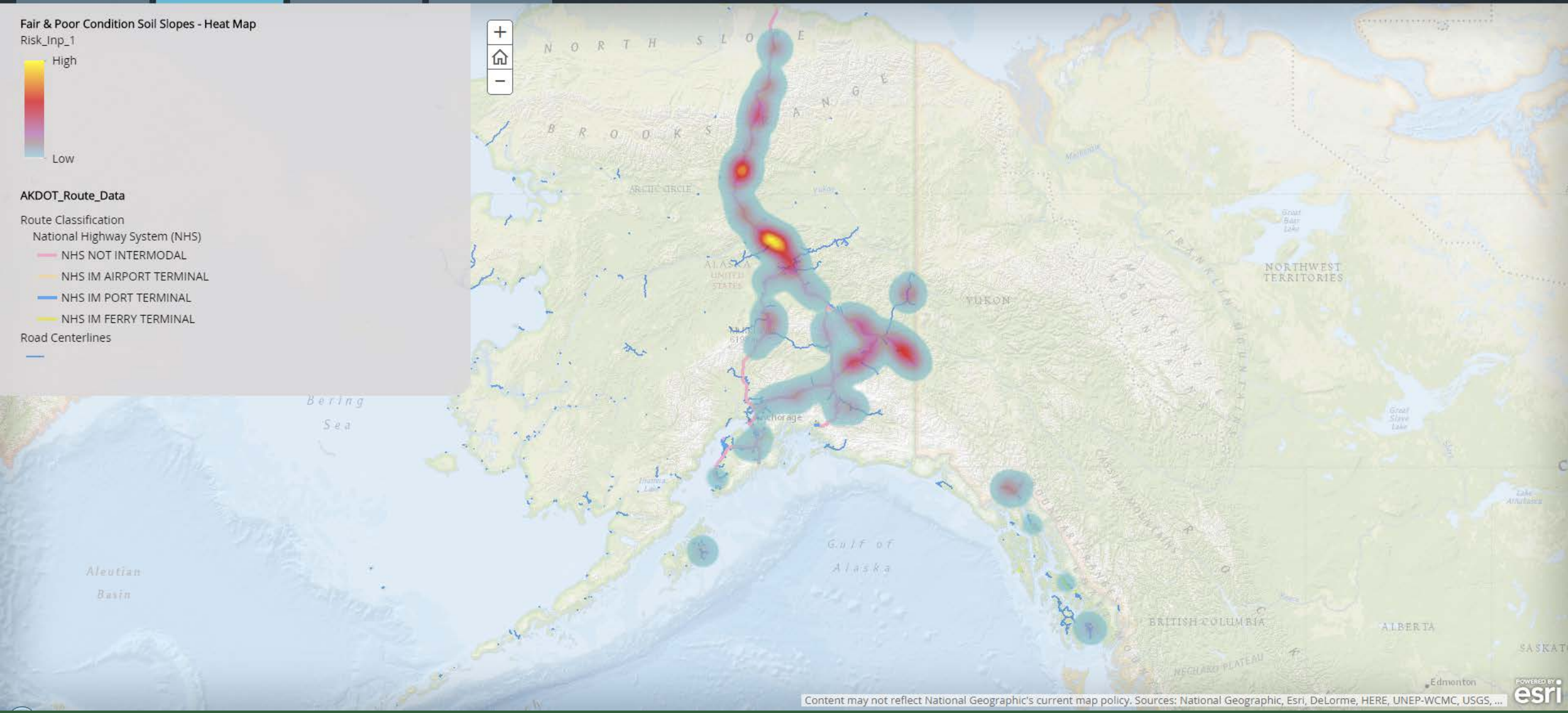

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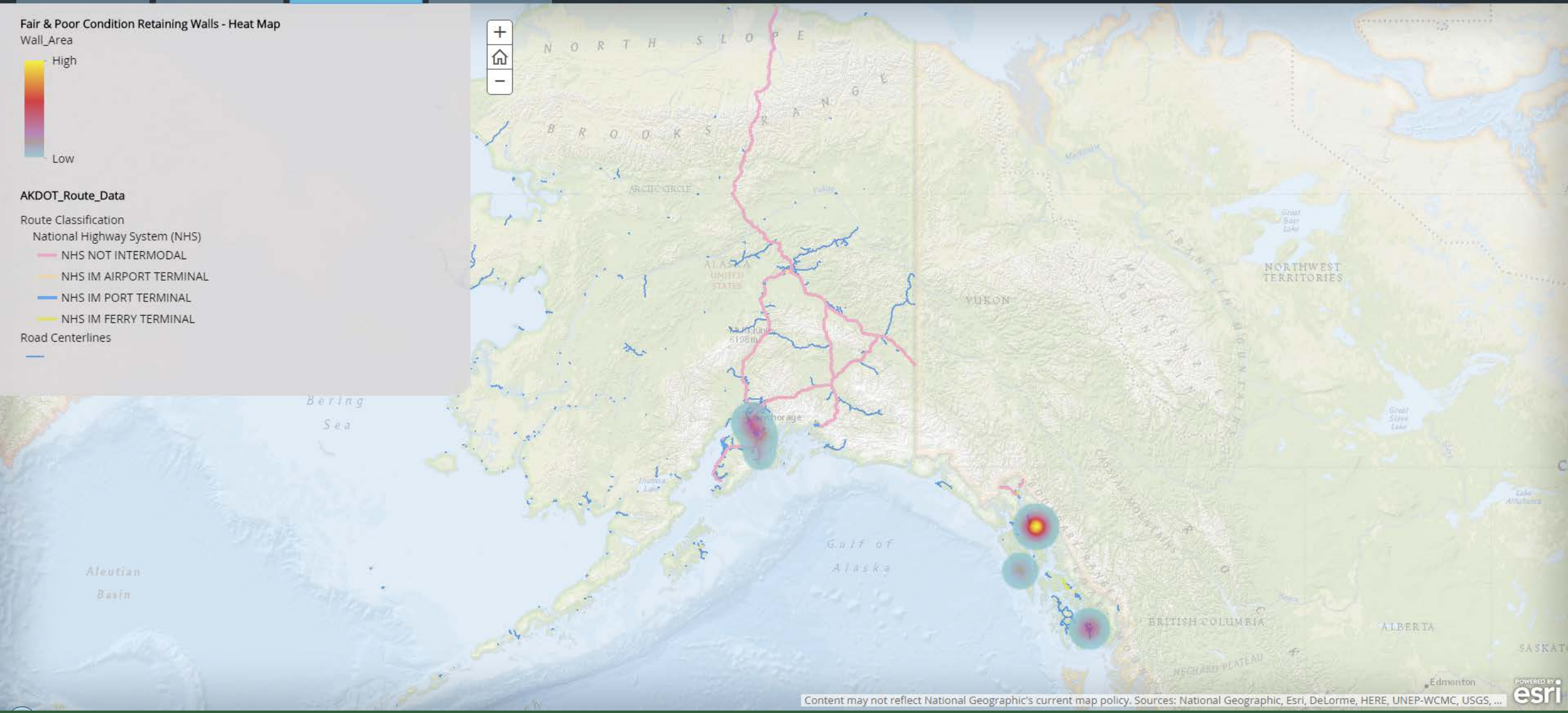

Geotechnical Asset Management Progam

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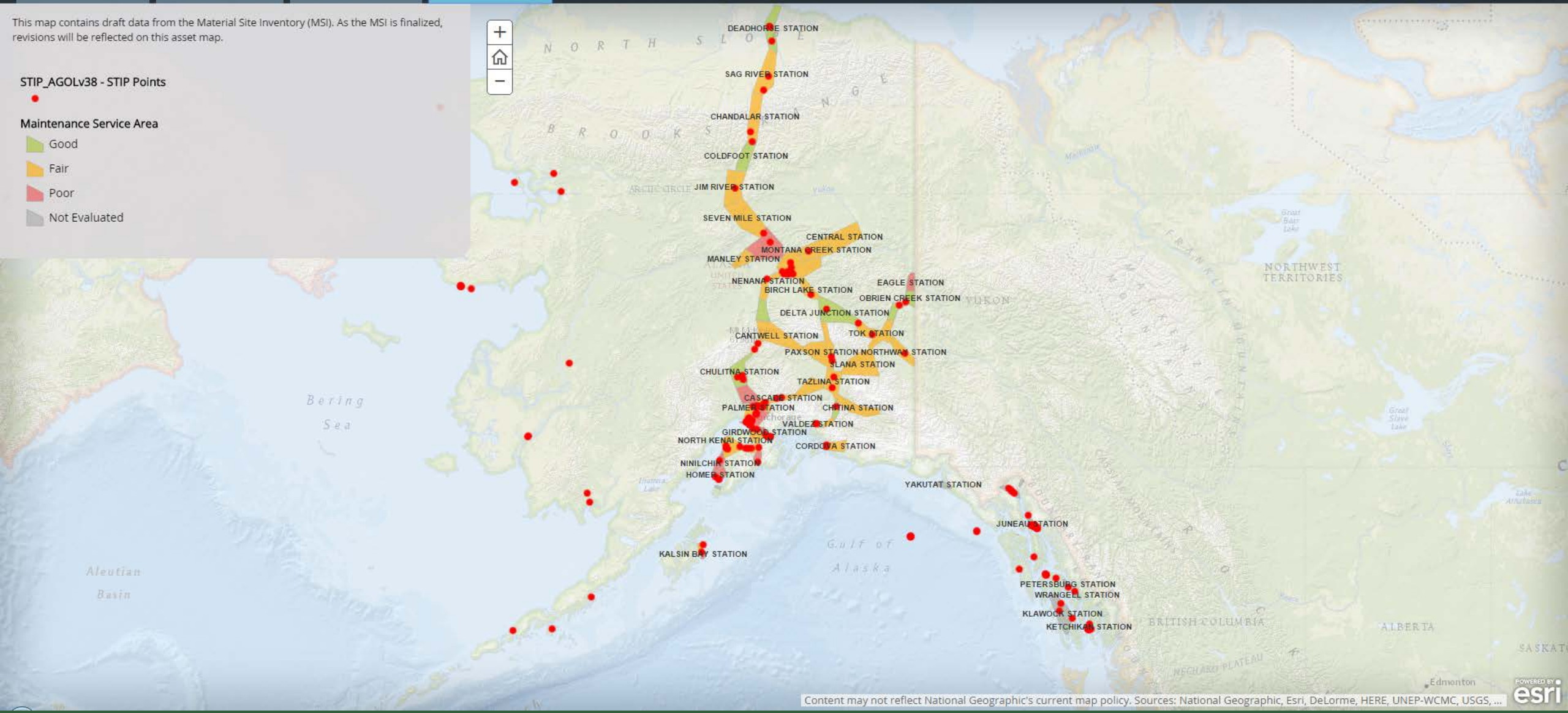
Unstable Rock Slopes | Unstable Soil Slopes | Retaining Wall Assets | Material Site Assets

This map contains draft data from the Material Site Inventory (MSI). As the MSI is finalized, revisions will be reflected on this asset map.

STIP_AGOLv38 - STIP Points

Maintenance Service Area

- Good
- Fair
- Poor
- Not Evaluated

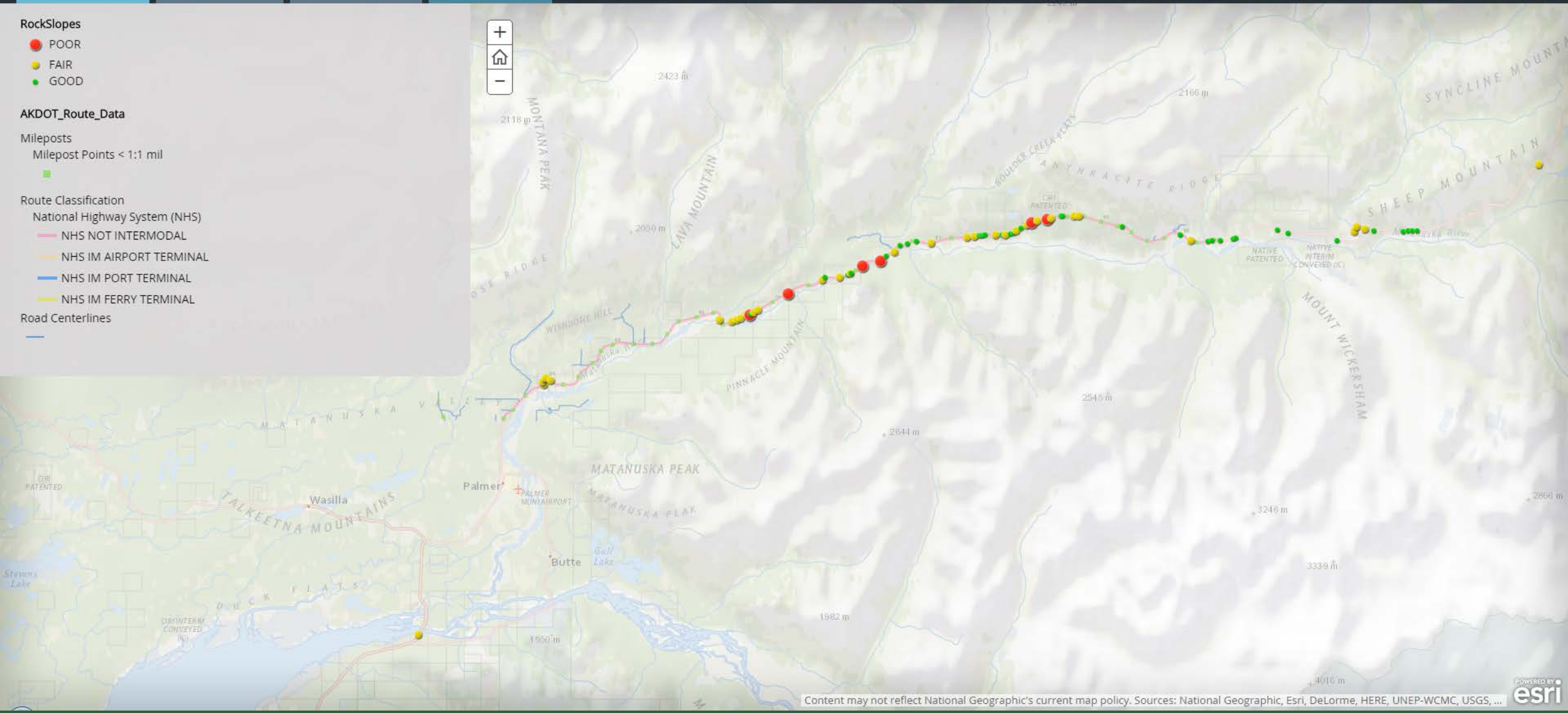


Content may not reflect National Geographic's current map policy. Sources: National Geographic, Esri, DeLorme, HERE, UNEP-WCMC, USGS, ...

Geotechnical Asset Management Progam

Fix issues in your story | Edit | A story map

Unstable Rock Slopes | Unstable Soil Slopes | Retaining Wall Assets | Material Site Assets



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Poor Condition Soil Slopes

Fair Condition Soil Slopes

Good Condition Soil Slopes

AKDOT_Route_Data

Mileposts

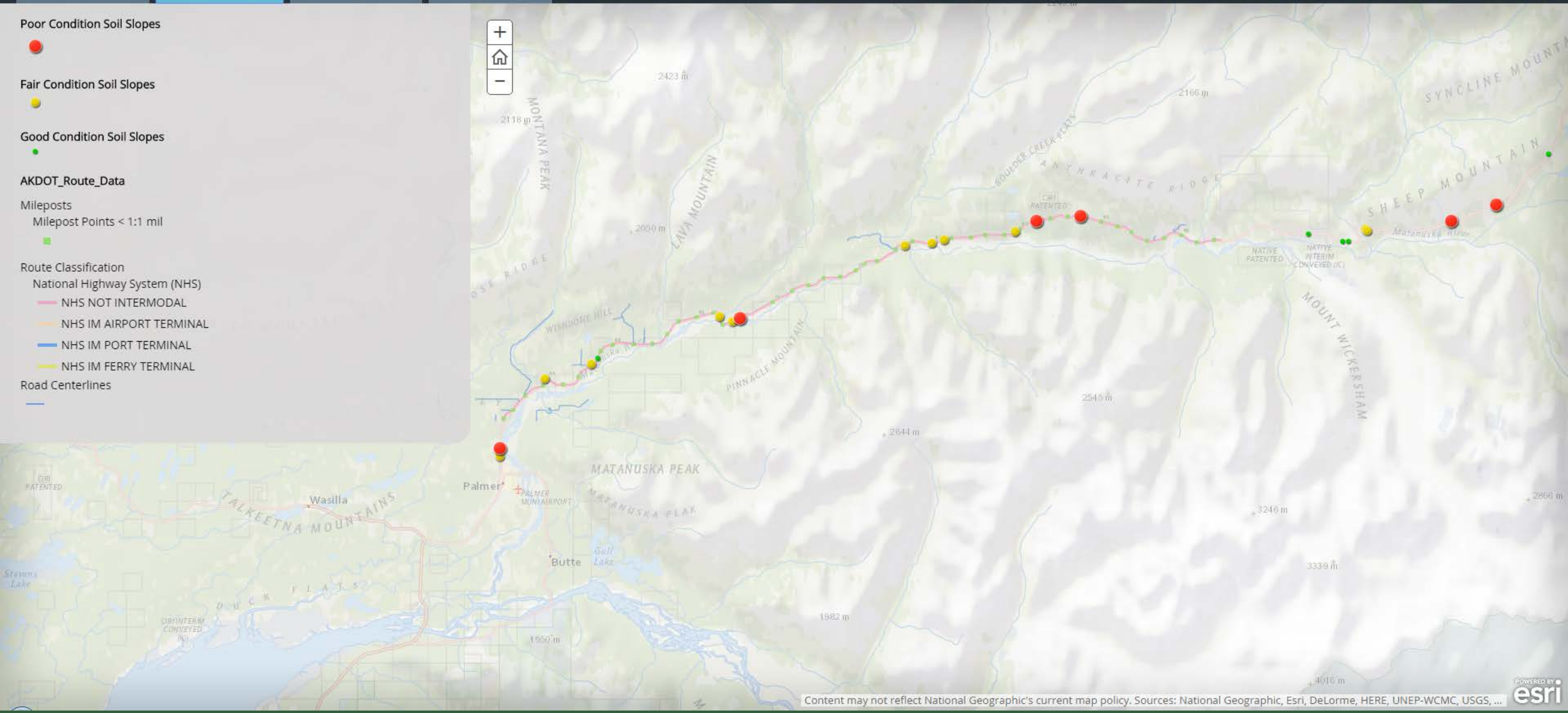
Milepost Points < 1:1 mil

Route Classification

National Highway System (NHS)

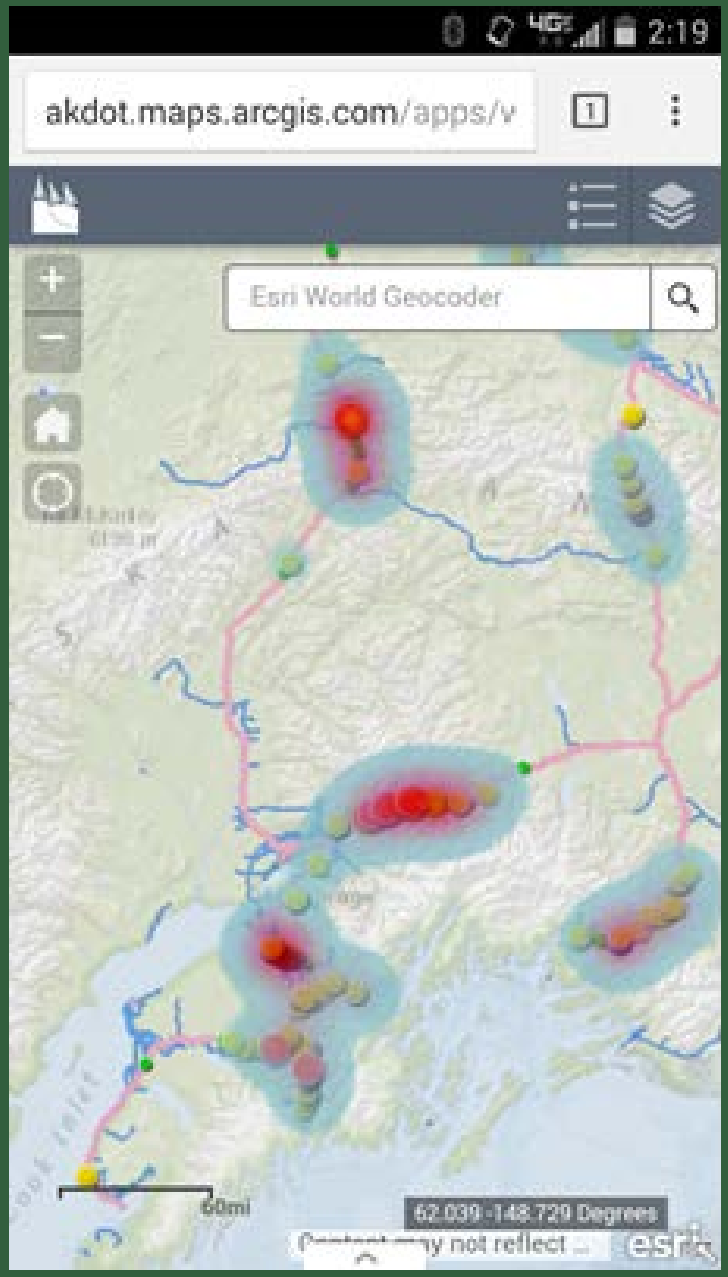
- NHS NOT INTERMODAL
- NHS IM AIRPORT TERMINAL
- NHS IM PORT TERMINAL
- NHS IM FERRY TERMINAL

Road Centerlines



Interactive Maps

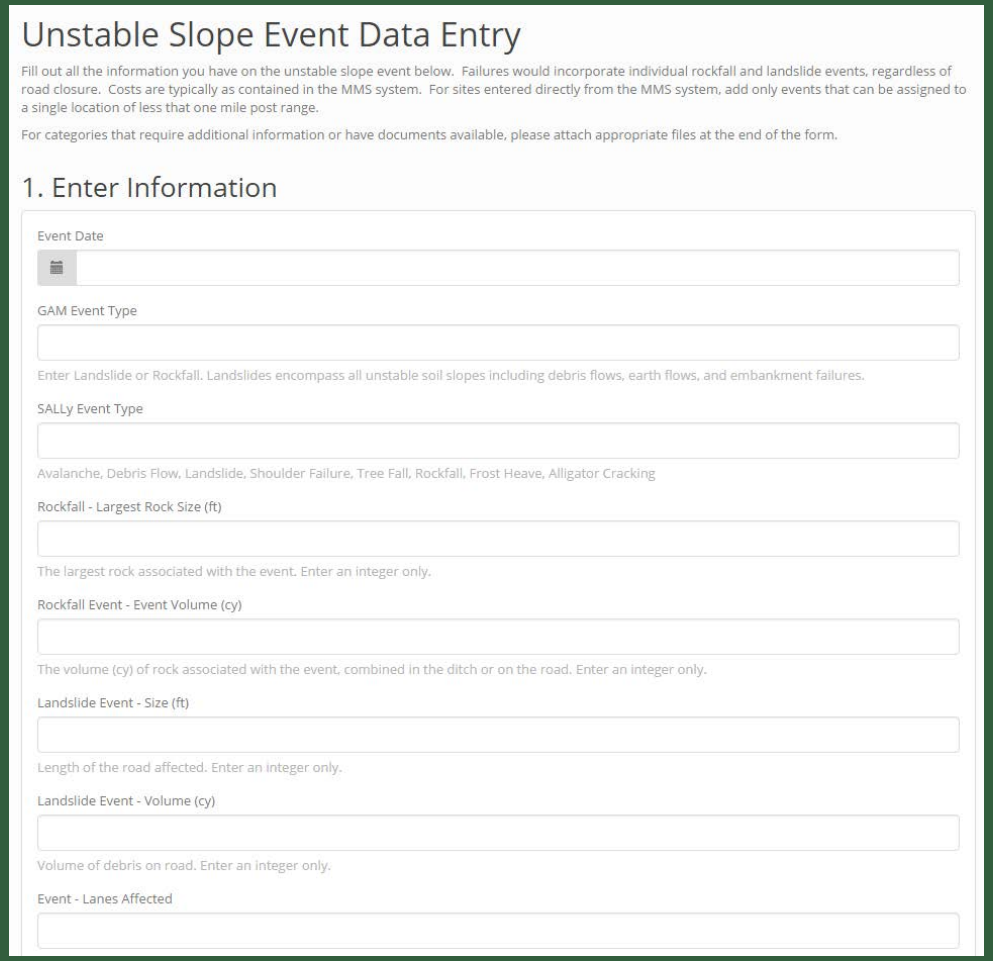
- http://arcg.is/1J46Omp
  - (Unstable Slopes – Interim Interface)
- Mobile Application

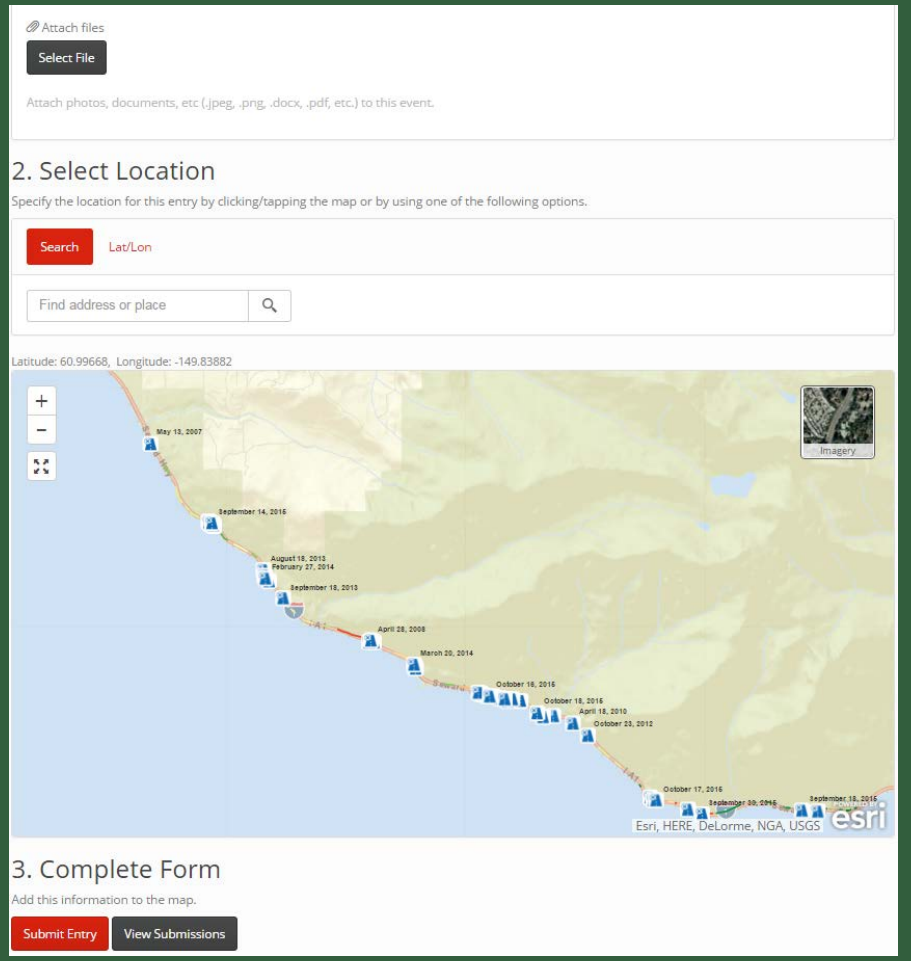


GAM Outline (Condensed)

1. Inventory and Condition Evaluation
2. Condition State Assessment
3. Cost Modeling *(TRB Paper 16-4286)*
4. Deterioration Modeling & Life Cycle Cost Analysis *(TRB Paper 16-2764)*
5. Alternative Actions focused on Condition State Improvement
6. Database Interface
7. **Event Tracking**
8. Decisions, Decisions, Decisions

Data Entry Form





www.landslidetechnology.com/rockfall-GAM-DataTracking.htm

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Future

- AKDOT has committed to GAM Implementation
- Complete Condition Assessments on AHS & NHS
- Trends of HSIP & STIP Projects
- Assets ID’d for inclusion in current & future programs
  - No more 20 yr pavements on 5 yr pavements (Klondike Highway)
  - Improve assets as part of highway & bridge projects (cuts, fills, walls)
  - Stockpile quality excavation spoils in strategic locations
- Training on GAM Use, Available Data, and Future Ratings