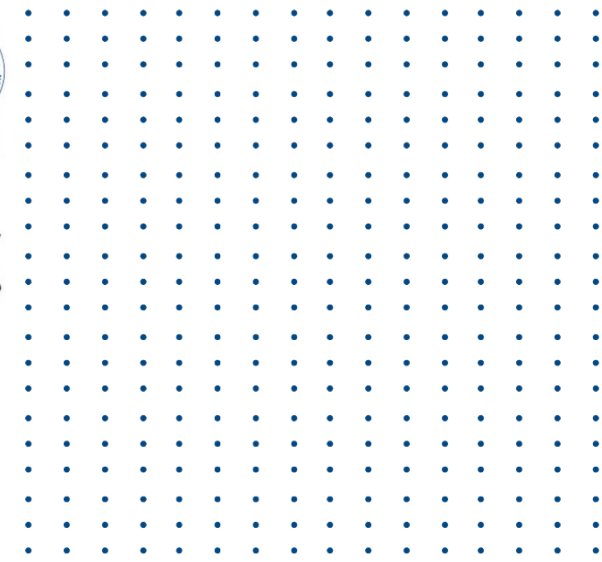*From Reconnaissance to Asset Management: Rethinking Workflow, Project Delivery, and System Performance in the Digital Age*
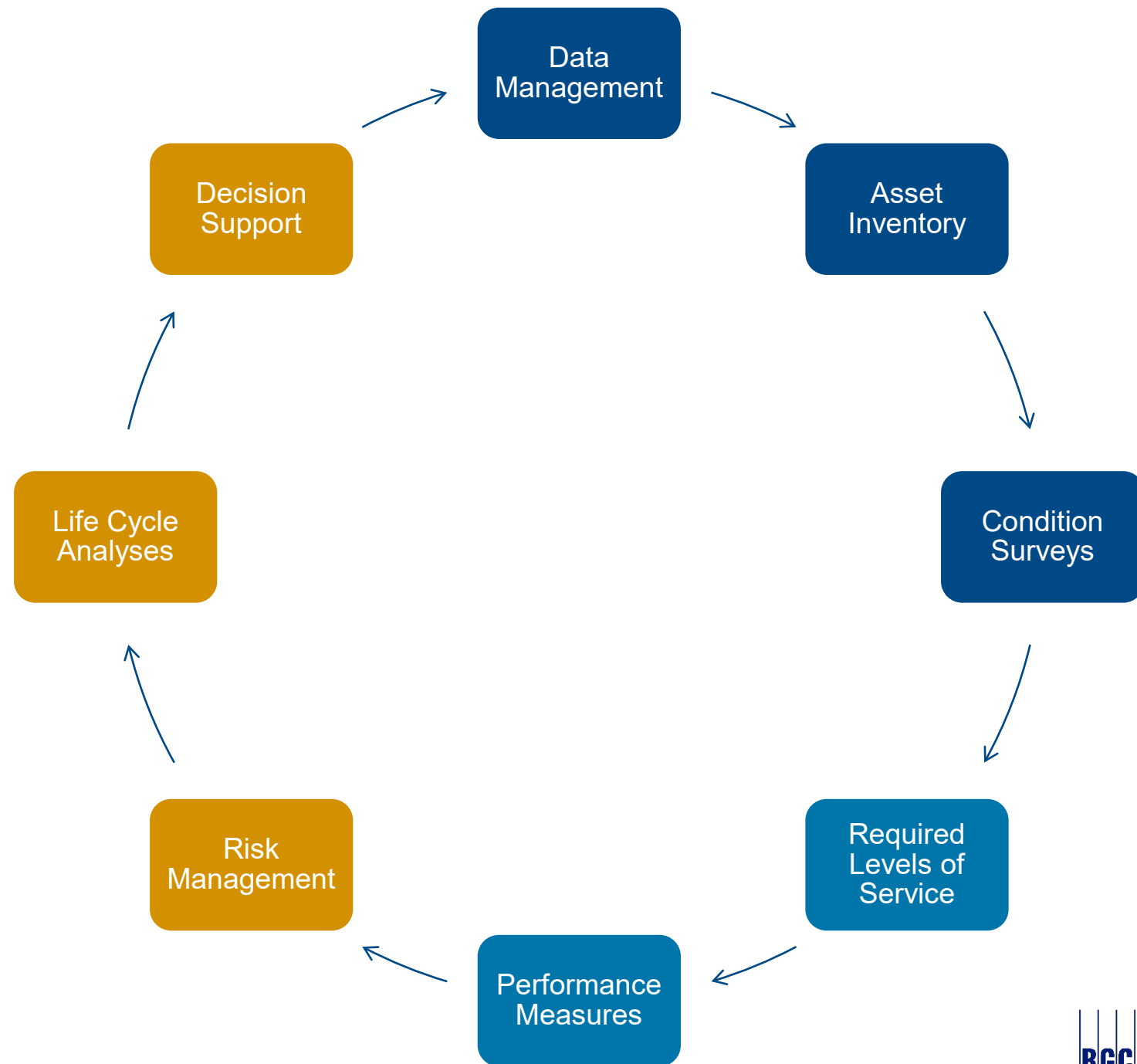
Tech Tools to Improve GAM System Performance

Scott A. Anderson, Ph.D., PE, and Nathan Thompson, PE
BGC Engineering, Inc.
November 2, 2023

GAM Workflows

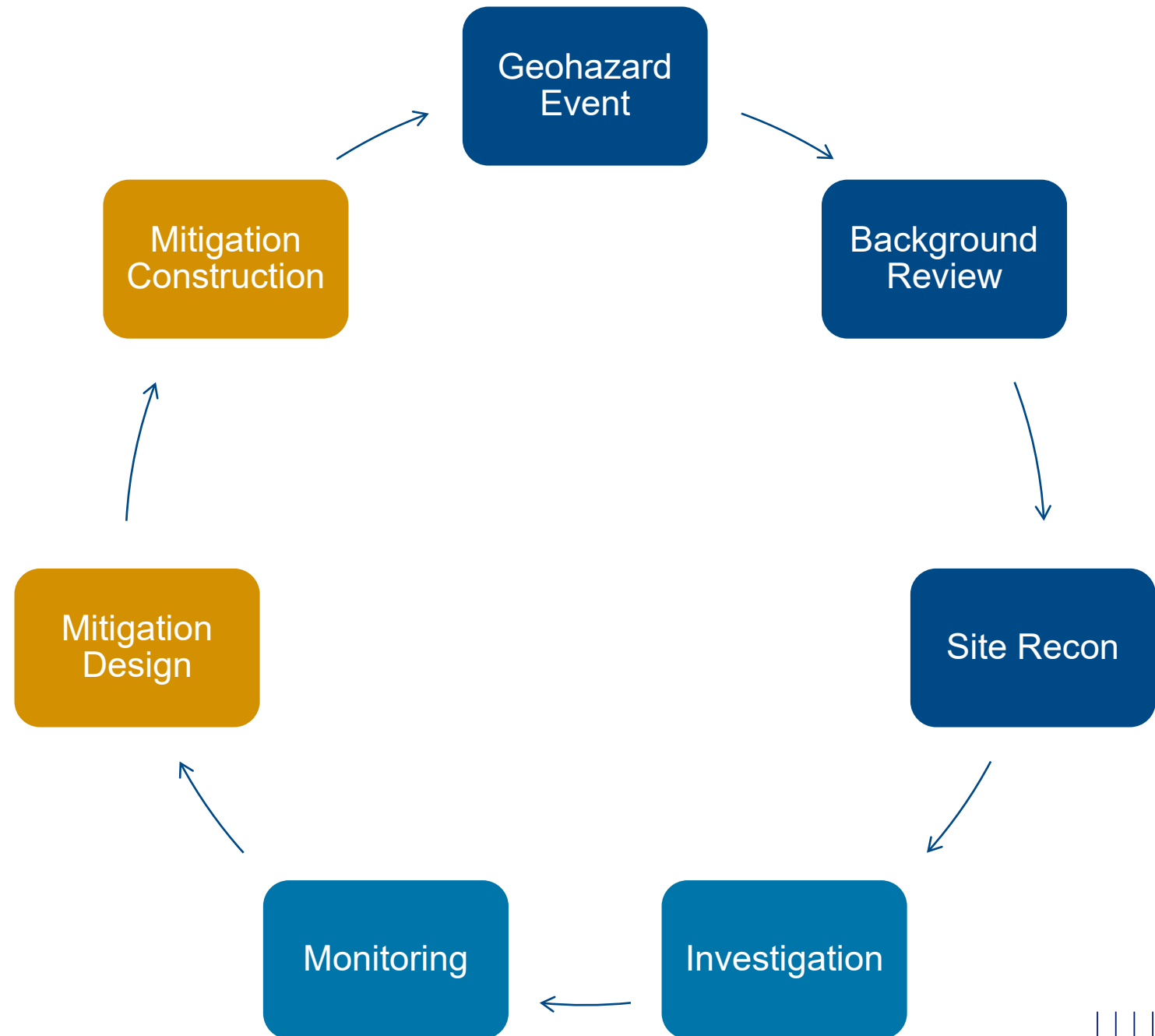How tech tools are improving GAM system performance by:

1) Accelerating the implementation of Risk-Informed GAM; and

2) Improving the efficiency of reactive response to geohazard events.

Data Management

Asset Inventory

Condition Surveys

Required Levels of Service

Performance Measures

Risk Management

Life Cycle Analyses

Decision Support

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# GAM Workflows

How tech tools are improving GAM system performance by:

1) Accelerating the implementation of Risk-Informed GAM; and

2) Improving the efficiency of reactive response to geohazard events.

Geohazard Event

Background Review

Site Recon

Investigation

Monitoring

Mitigation Design
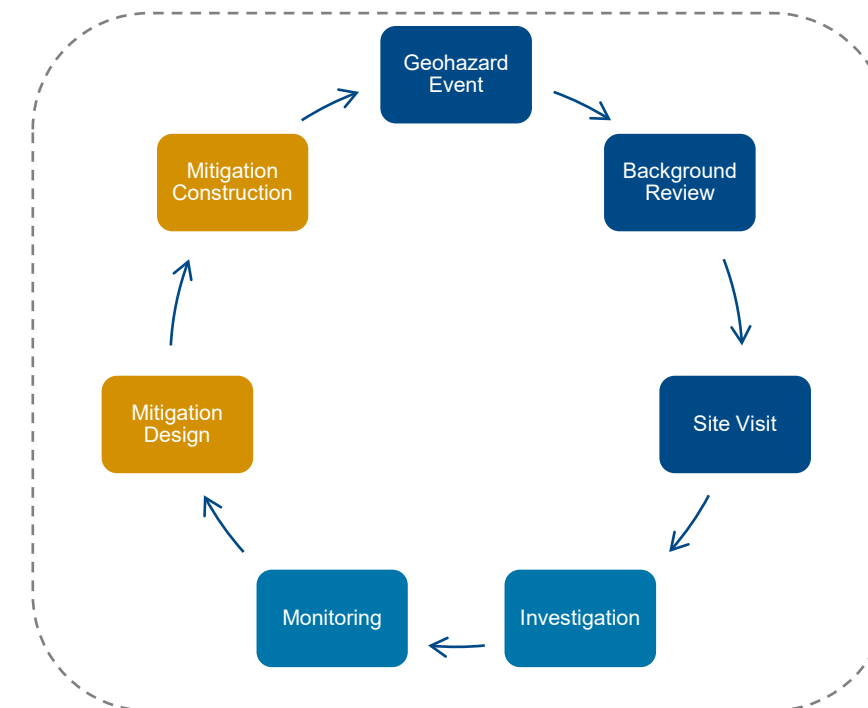
Mitigation Construction

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Tech Tools Highlighted

Tools highlighted:

- Change Detection w/ Remote Sensing

- Algorithmic Asset Identification

- Digital Data Management in GAM Platform

- 3D/4D Data Visualization

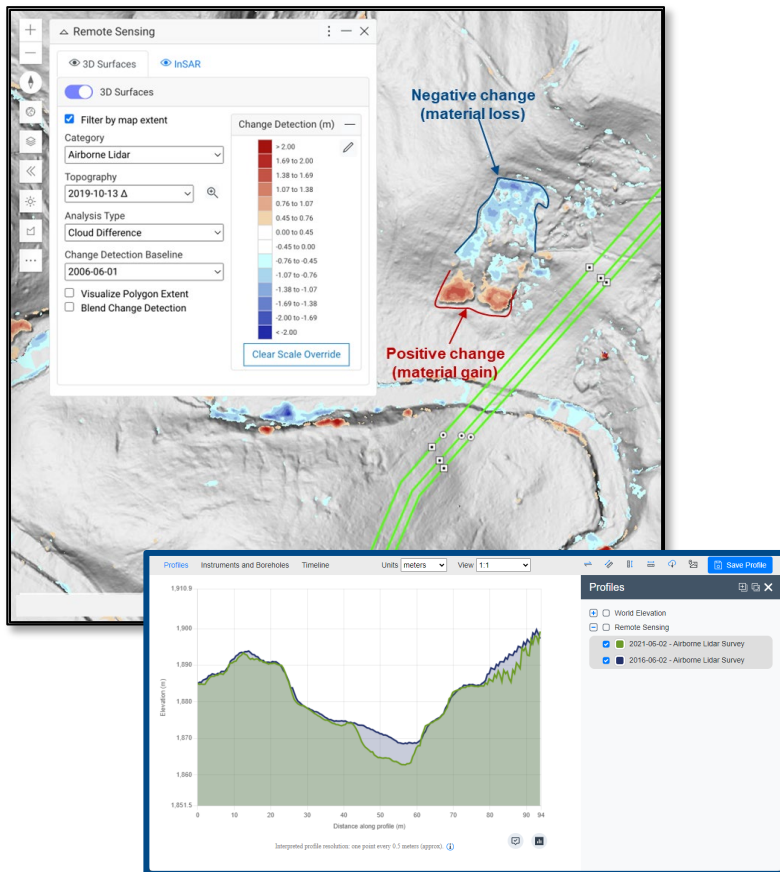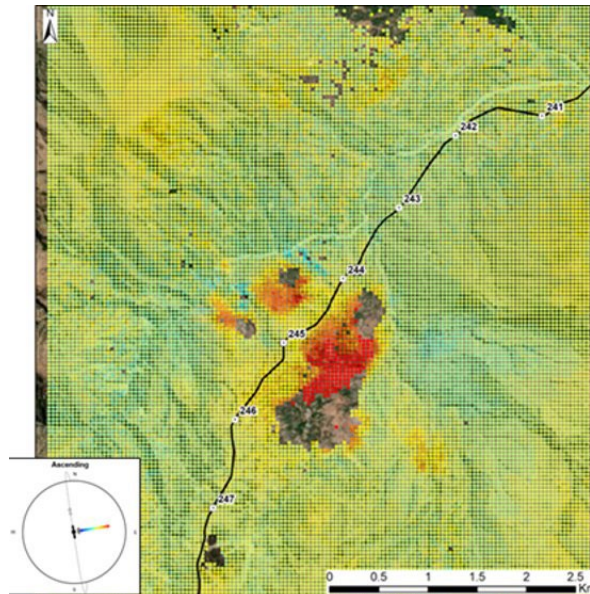- Near Real-time Monitoring
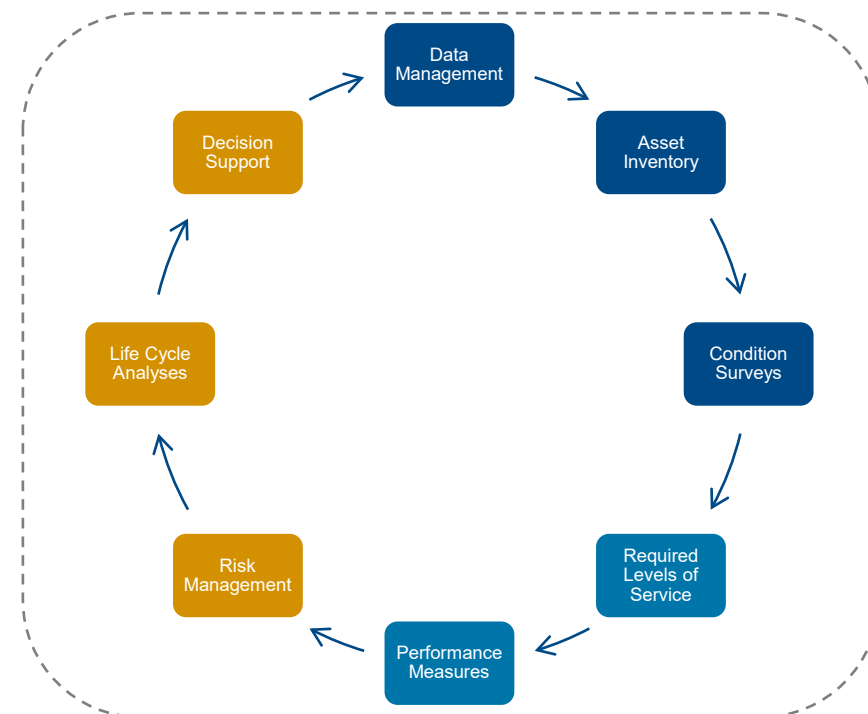
Risk-Informed GAM

Event Response

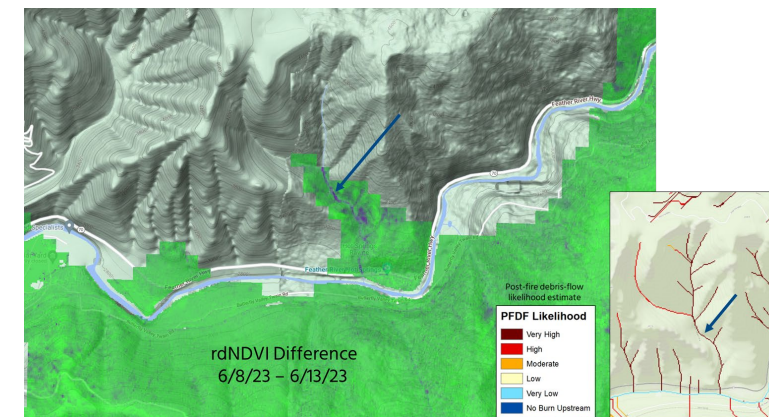# Change Detection
Remote Sensing Techniques

Lidar Change Detection

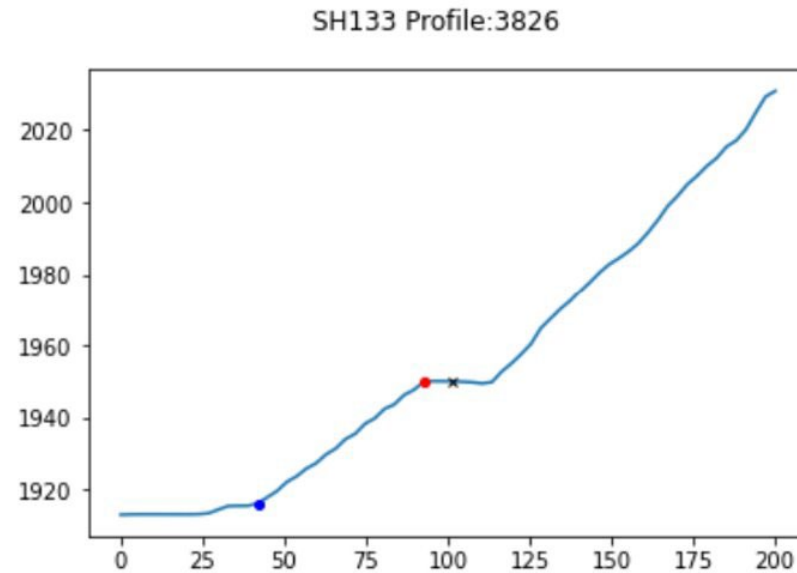**InSAR-on-Demand**

Post-Wildfire Debris Flow

Algorithmic Asset Identification

Embankments, Slopes and Retaining Walls

SH133 Profile:3826
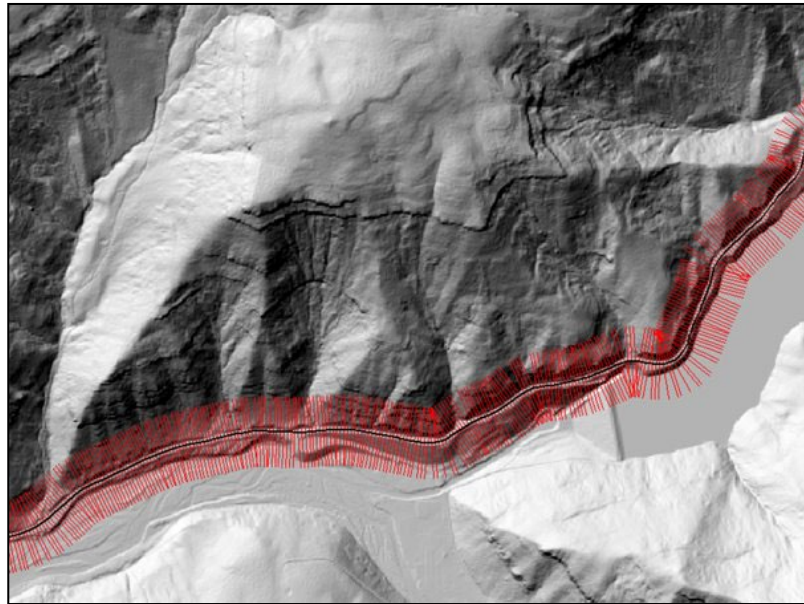
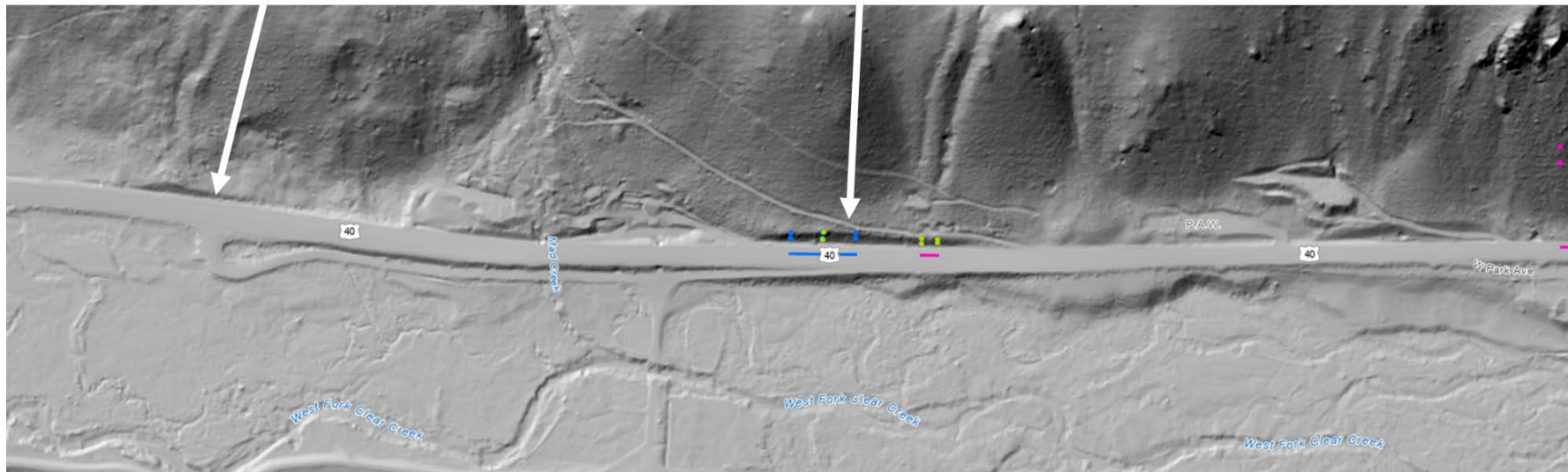(1) Draw elevation profiles perpendicular to the roadway

(2) Identify continuous slopes over a specified gradient, height and distance to the roadway

(3) Outputs include polygons representing the credible geoasset or natural feature

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Algorithmic Asset Identification
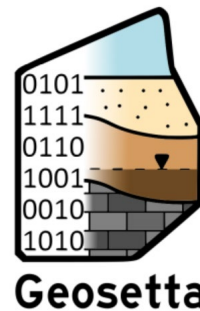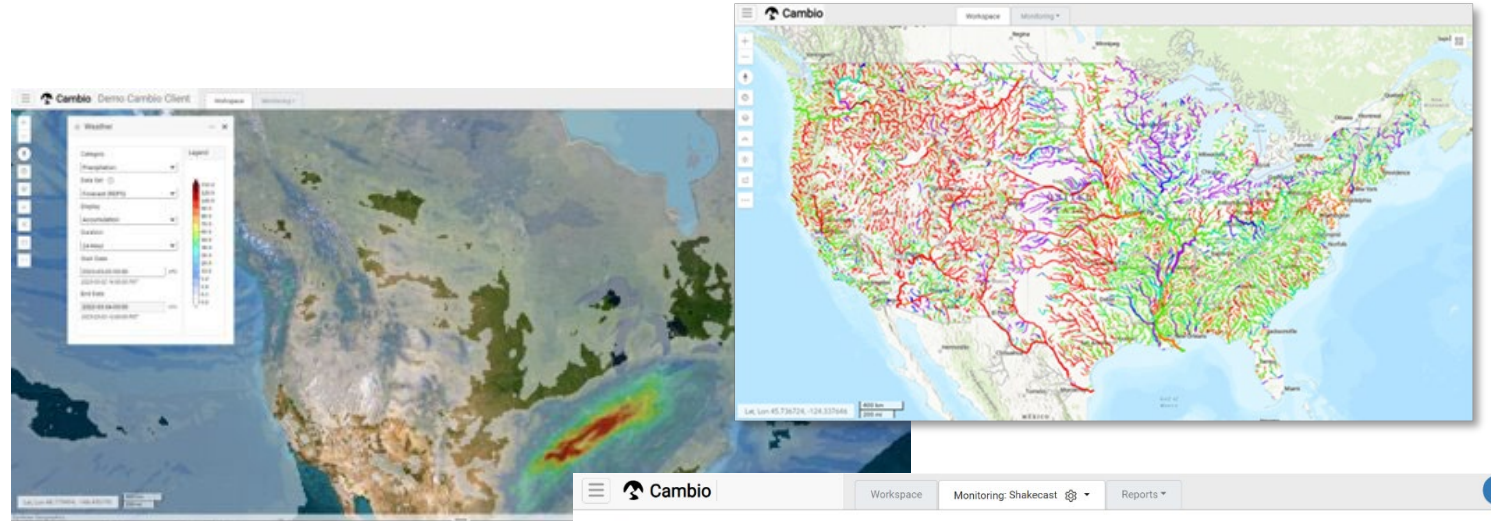## Embankments, Slopes and Retaining Walls

Gaining Insights from GAM Platform

Public Data Integration

Examples:

- Multiple base map & imagery options (including highway network)

- Geologic Maps – USGS

- Precipitation – NOAA

- River Network

- Flood (Streamflow) – USGS, National Water Model

- Seismic – USGS/Shakecast

- Wildfire – USGS

- Snowpack – SNODAS, Copernicus

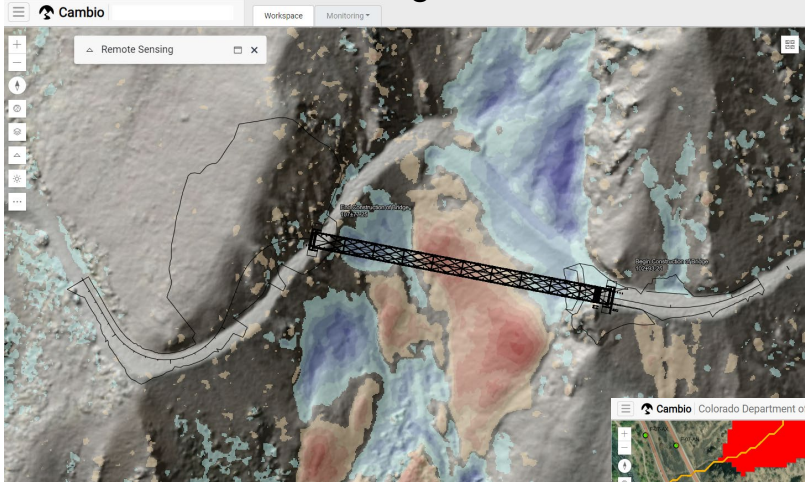- Publicly funded geotechnical data – Geosetta
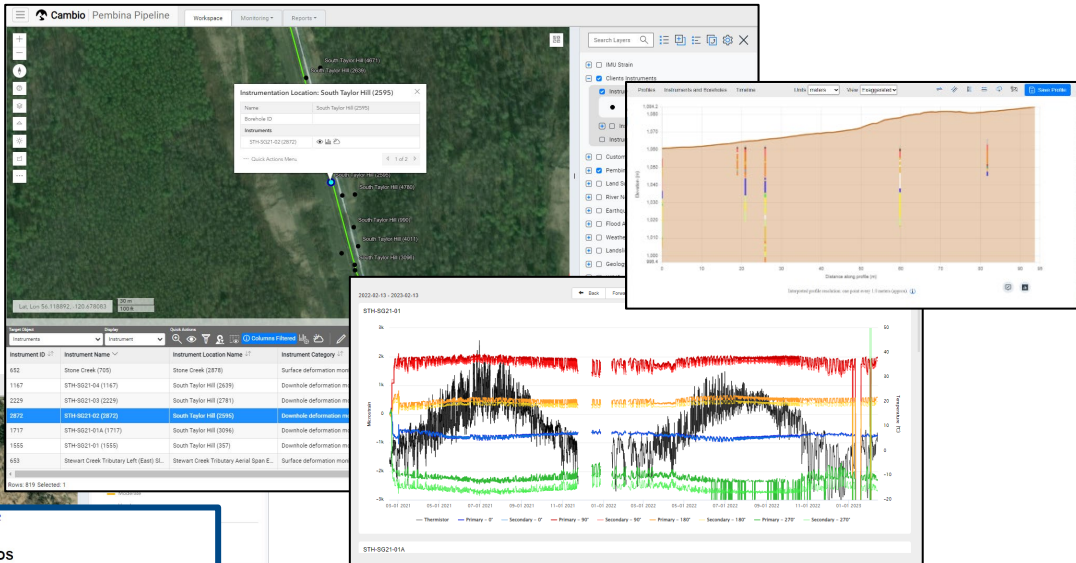

Geosetta

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Gaining Insights from GAM Platform

Site Data Integration

Lidar, LCD, design files

Boring logs and instrumentation

Asset inventory, photos, and inspections

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Site Recon and Investigation

Digital Data Management
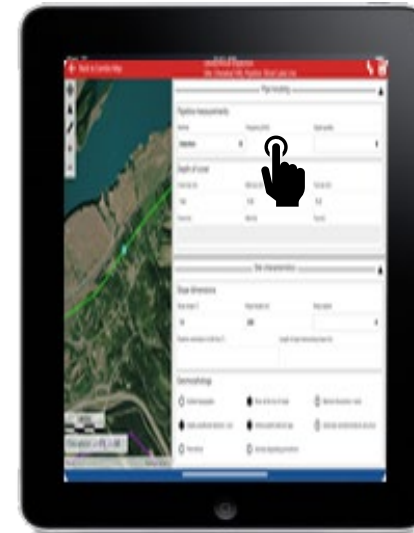
Mobile

Web
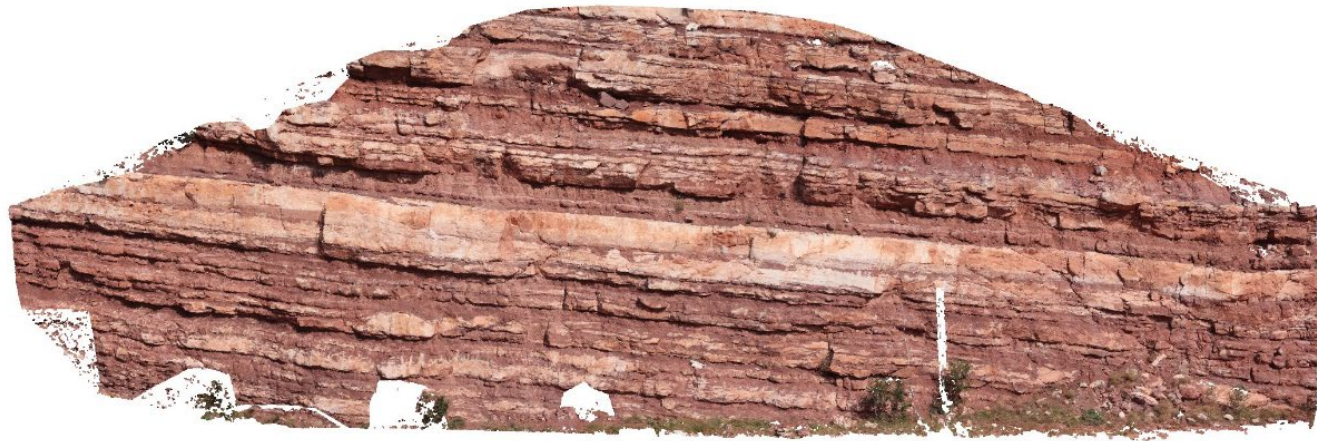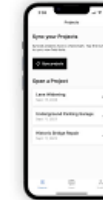
Site Investigation

4D Data Visualization

Hwy 101 – Last Chance Grade
A Leapfrog™ model

- Hwy 101 – critical corridor

- ~3mi landslide complex

- Alternative alignments

- ID critical sections

- Support stability analysis

● InSAR reflectors

◄ Inflections from inclinometer plot

Blue / red color overlays: lidar change detection

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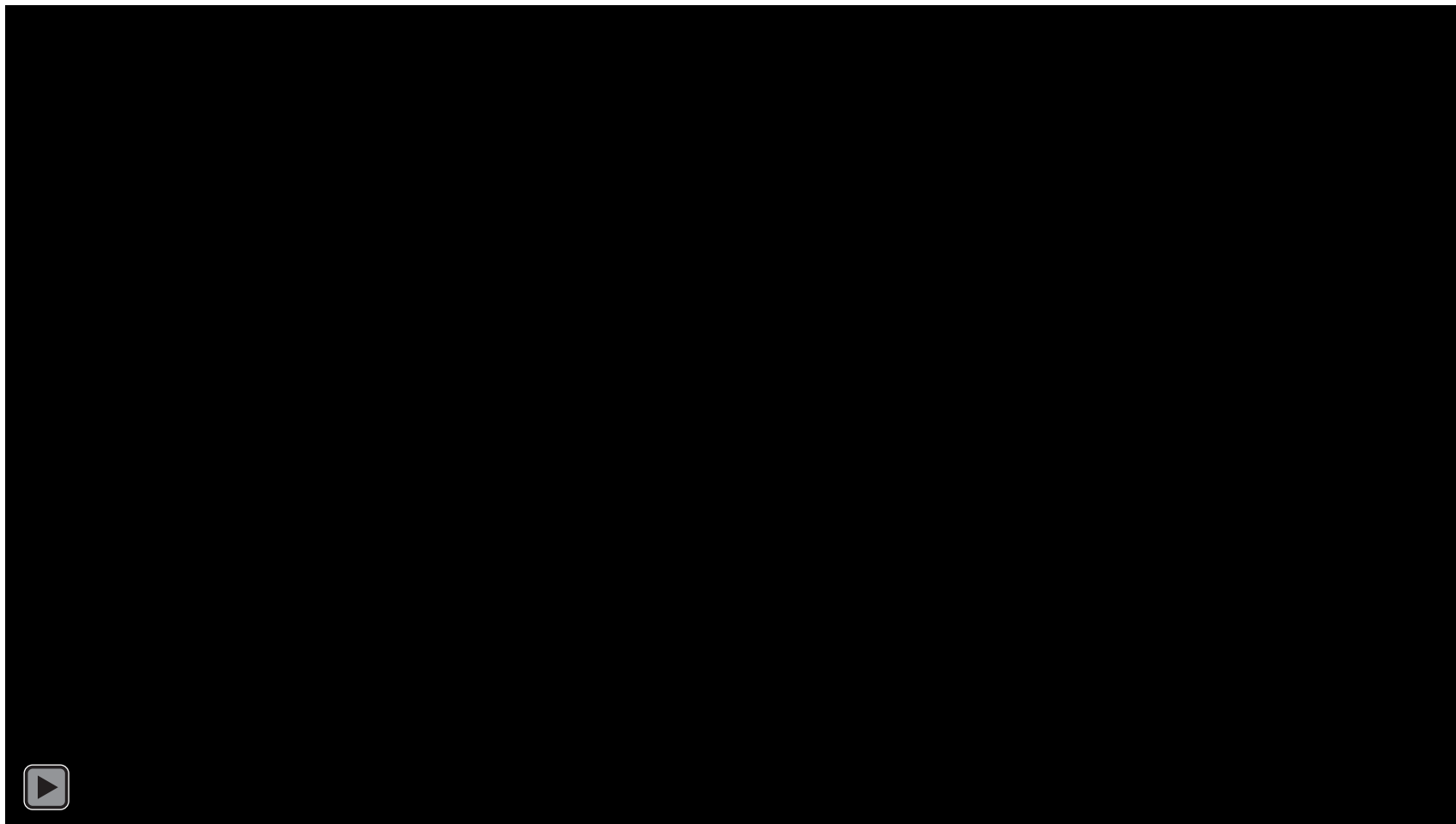
Site Investigation

4D Data Visualization

Hwy 101 – Last Chance Grade
A Leapfrog™ model

- Static model, but

- Time dimension preserved

- Select design section(s)
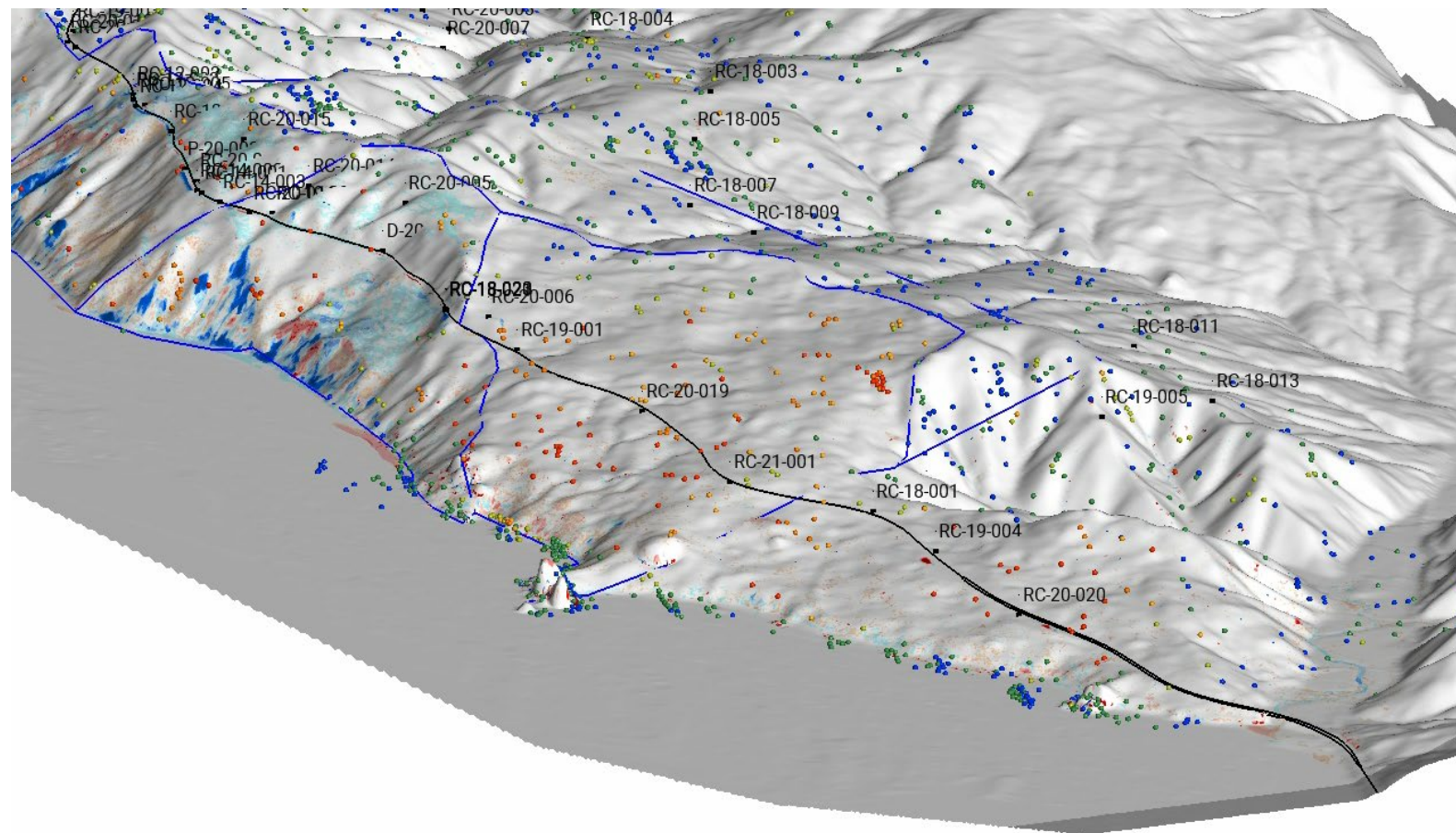
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Site Investigation

4D Data Visualization

Hwy 101 – Last Chance Grade
A Leapfrog™ model
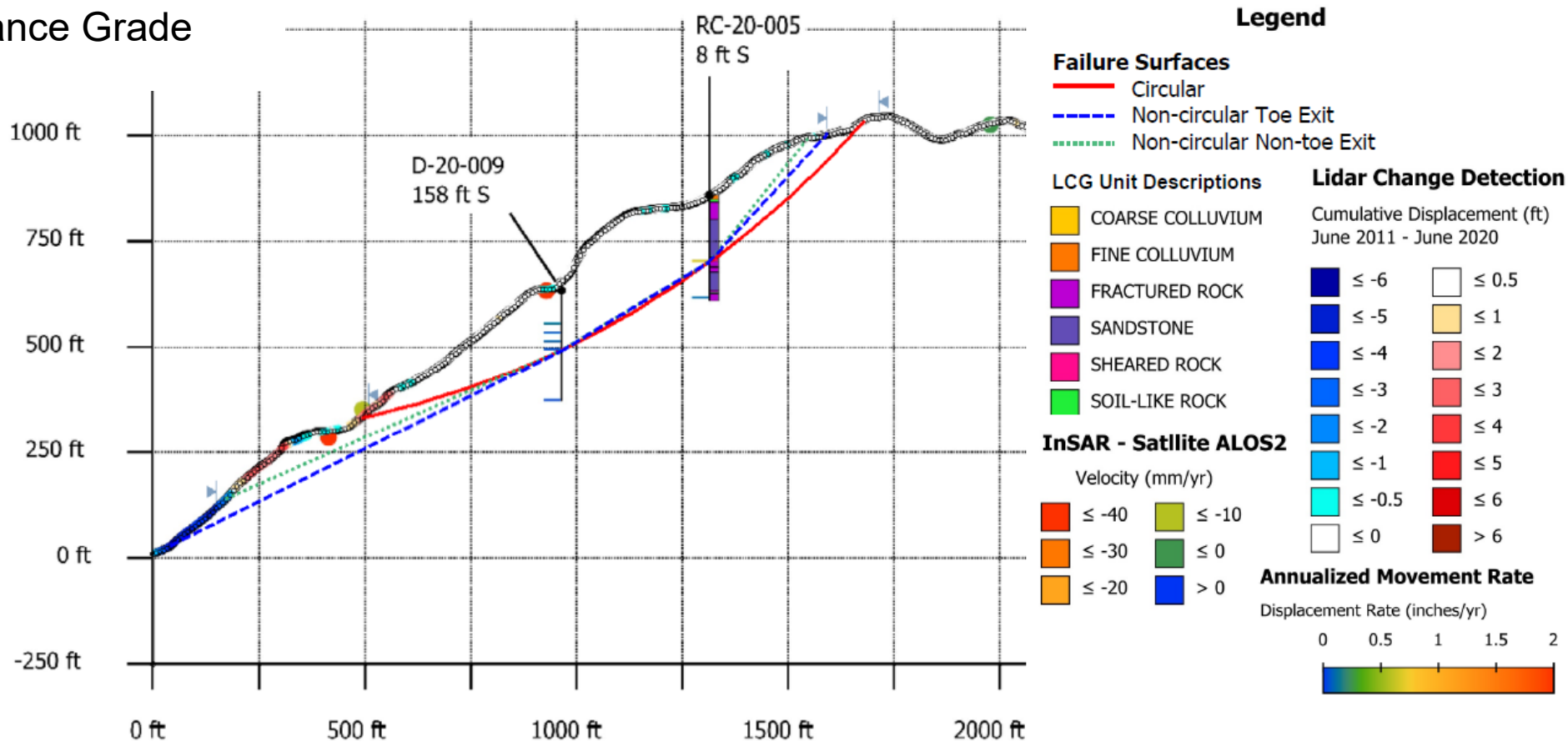
Site Investigation

3D Data Visualization

Pretty Rocks Landslide, Denali NP
A Leapfrog™ model

- ~Middle of park access road

- Slide active since <'60s

- <2014: inches/year

- 2017: inches/month

- 2018: inches/week

- 2019: inches/day

- 2021: inches/hour

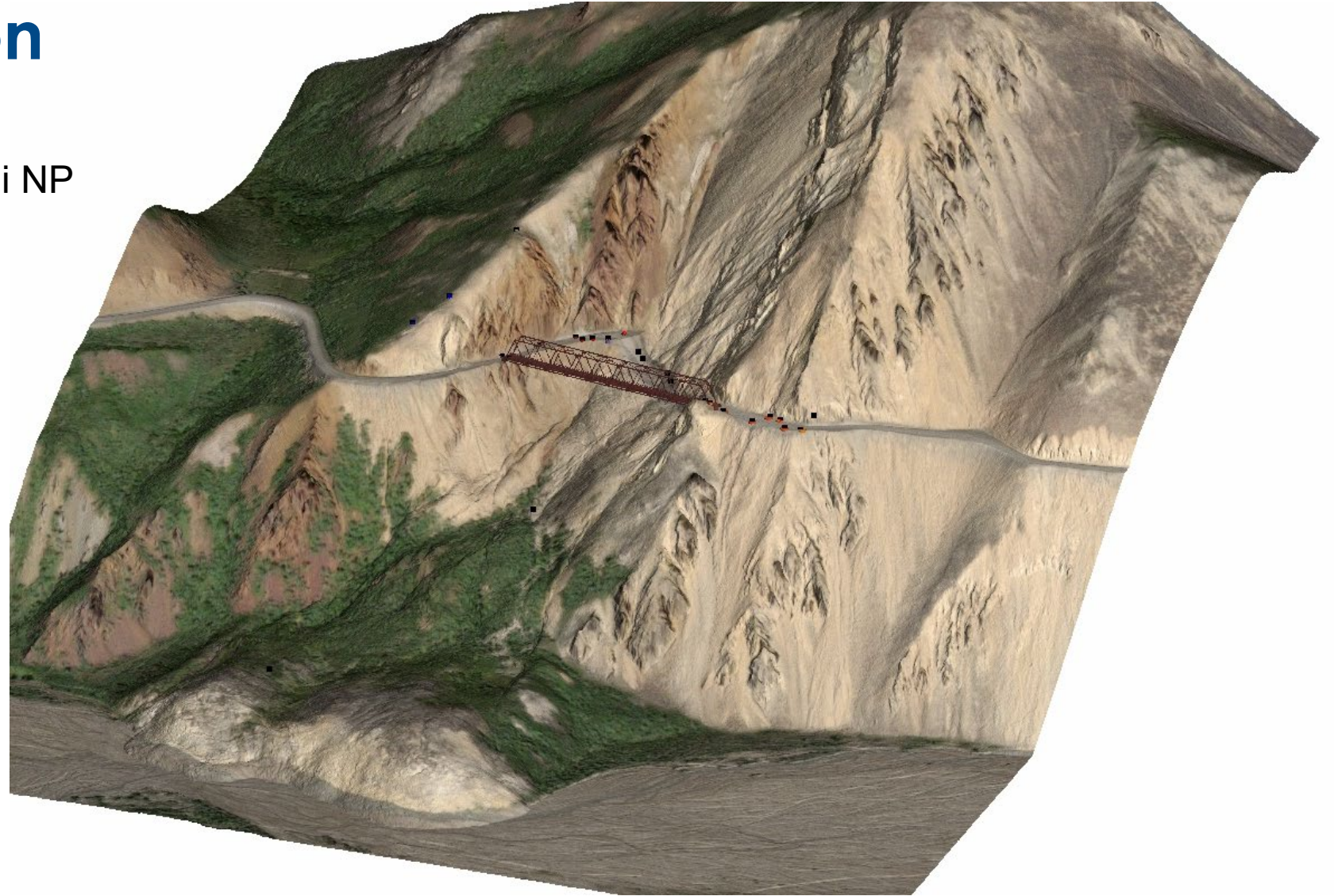*(NPS Photo)*

Site Investigation

3D Data Visualization

Pretty Rocks Landslide, Denali NP
A Leapfrog™ model

Site Investigation

3D Data Visualization

Tech Tools to Improve GAM System Performance
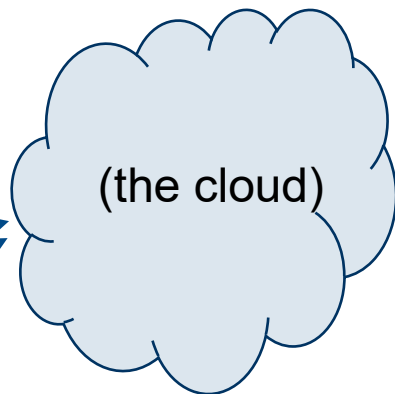
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Site Monitoring
Near Real-Time

Site Monitoring
Near Real-Time

ALDOT US 231 Slide

Daily, automated groundwater + slope
movement readings into digital twin

US 231 Landslide

Automated
groundwater
readings

Underground
slope
inclinometers

(the cloud)

US 231 Landslide
Digital Twin

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Site Monitoring
Near Real-Time

ALDOT US 231 Slide
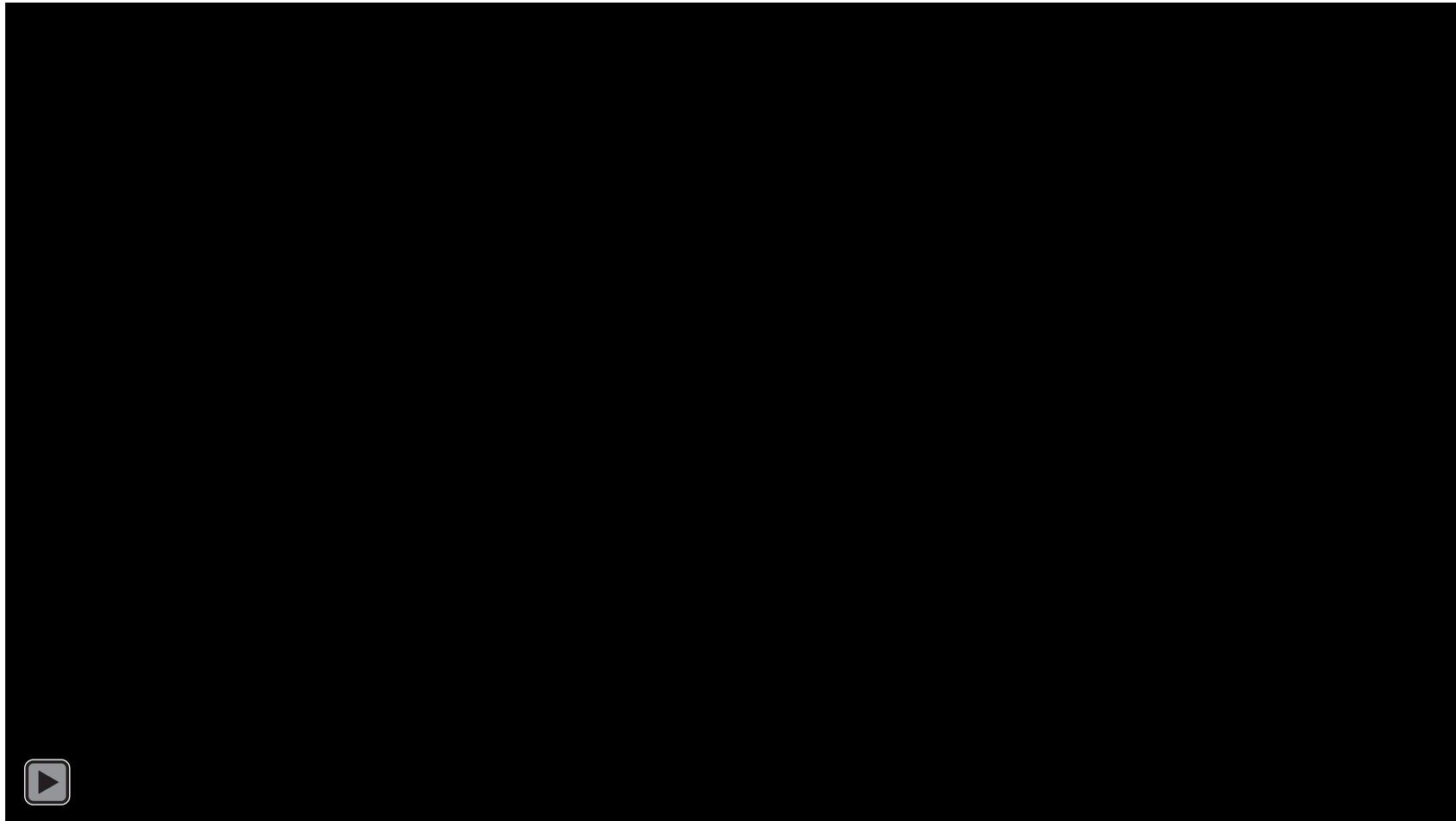(Green and skinny = good)

Mitigation Plans

3D Data Visualization – Communicating Design Elements in Augmented Reality

Pretty Rocks Landslide, Denali NP
A Leapfrog™ model

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Contact us

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www.bgcengineering.ca

BGC Locations

CANADA			USA	DOMINICAN REPUBLIC
VICTORIA	CALGARY	KINGSTON	GOLDEN	SANTO DOMINGO
VANCOUVER	EDMONTON	OTTAWA	NASHVILLE	
KELOWNA	TORONTO	HALIFAX	CHILE	AUSTRALIA
KAMLOOPS	SUDBURY	FREDERICTON	SANTIAGO	BRISBANE