

Automated Avalanche Detection System

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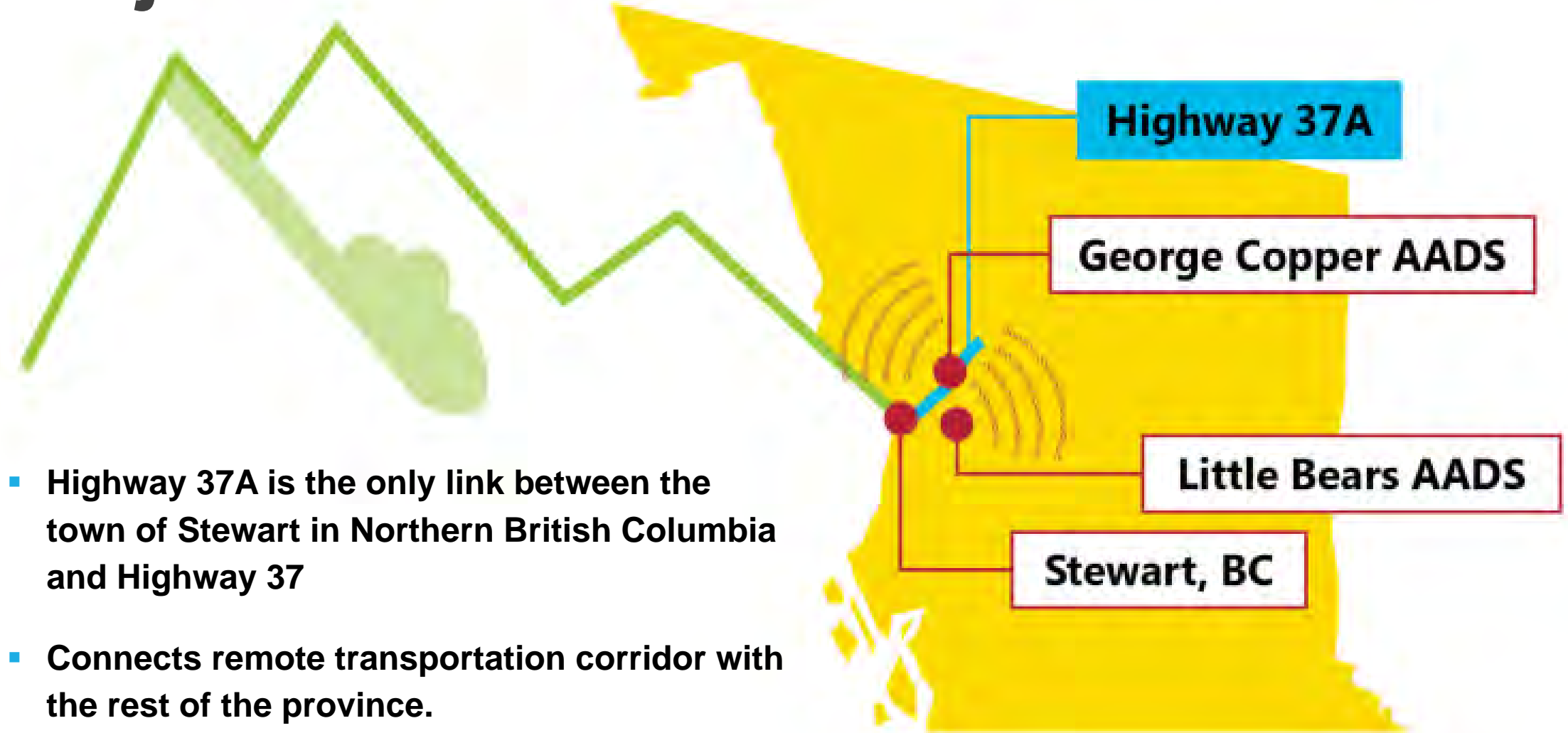
2023 CEA Transportation Conference

25
years
1997
2022

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Project Location



- Highway 37A is the only link between the town of Stewart in Northern British Columbia and Highway 37
- Connects remote transportation corridor with the rest of the province.

Avalanche Traffic Impact on Hwy 37A



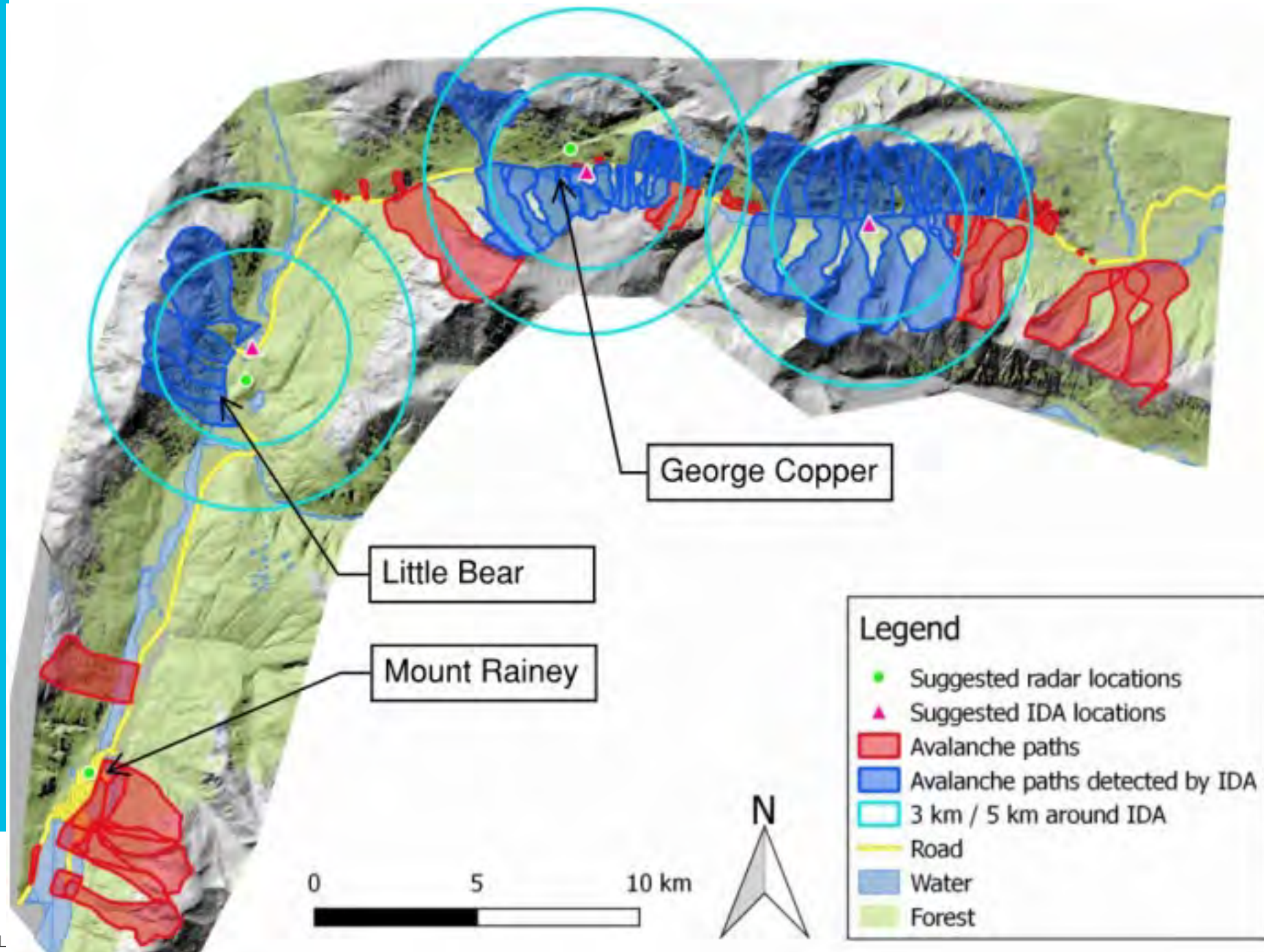
- Approx. 72 avalanche paths ranging from 0m to 2400m above sea level, some spanning several kilometers across
- Bear Pass is closed for apx 100 hours each year and operates at a considerable avalanche hazard level
- Closures and delays due to avalanche

▶ **Potential to close Bear Pass**

▶ **600-900 hours of high-hazard conditions every winter**

▶ **Result in significantly deleterious impacts on commercial traffic and the travelling public.**

Hwy 37A Avalanche Paths



Project Scope



- **The BC Ministry of Transportation and Infrastructure's Bear Pass-Stewart Avalanche Program had a well-established and thorough avalanche forecasting process**
 - Avalanche Program works to improve the safety and reliability of the highway by **monitoring, assessing, forecasting, and mitigating avalanche risks**
 - Previous event information **relied on manual reporting** by avalanche technicians, maintenance crews, and the travelling public
 - The program was missing accurate, quantitative, and timely information on actual events

Project Scope

- PBX engaged to plan, design, and oversee the implementation of an Automated Avalanche Detector System (AADS)

- Key objectives:

1 Decreased event response times

2 Decreased road closure durations

3 Increased event forecasting and risk assessment

4 Increased level of safety along Highway 37A

Project Scope



- To fully meet MoTI's requirements, the AADS must provide automated, timely, and accurate information on avalanche event parameters to facilitate:
 - A better and more rapid **understanding of the likely effects** that a given avalanche has had, based on the size of the event
 - An **enhanced ability to predict how far an avalanche has travelled**, and whether it is likely to impact the highway
 - More **rapid response and dispatch** of maintenance crews
 - Monitoring of the **effectiveness of preventive avalanche control** activities
 - **Recording of historical data** to support/improve long term forecasting

Technology Analysis & Solution



- **Extensive jurisdictional review carried out**
 - Similar projects that have been implemented
 - Other proof of concept and pilot projects that have been undertaken
 - Technical publications related to the project scope
- **AADS is a relatively new field**
- **Few projects implemented in North America – most in Europe**

Technology Analysis



- **An automated avalanche detection system primarily consists of the following two technology components:**
 - **Detection:** A sensor technology that is deployed to detect an avalanche event
 - **Analysis/Response:** A software system that ingests the event information from the sensors, assesses the data to determine if an event has occurred, and manages the notification and response functions



Technology Analysis



- **A range of remote sensing technologies have been used for avalanche detection systems and incorporated into operational use at ski resorts and on mountain highways**
 - Long and short-range radar
 - Infrasound
 - Seismic systems such as geophones
 - Mechanical trip lines
 - Buried fibre optic cabling



Technology Analysis



- **Recommendation: conduct proof of concept testing**
- **Based on analysis, the following recommendations were made for the proof-of-concept project:**
 - Focus on long range radar technology
 - Road closure gates should not be installed at this time
 - Deploy cameras (thermal and IR illuminated) to support monitoring (video and still images) calibration/validation
 - Include 2 high priority sites

High Priority Sites

George Copper Area

The George Copper Icefall **poses a hazard year-round irrespective of season** and includes the avalanche paths of Chocolate Bars 1 and 2, Cullen, Disraeli, and Gladstone, where avalanches exhibit plunging characteristics associated with significant powder blasts and routine violent dustings of the highway.

Little Bears Area

The Little Bears Area of avalanche paths encompasses Little Bears 1 to 4, where avalanches also exhibit plunging characteristics with significant powder blasts. These events historically logged more than 85,000m² of forest and **extended more than 300m up valley after impacting the highway.**

Design: Concept of Operations



DETECTION

Radar and camera system integrated into unique software platform, communicating via robust wireless communication network.



NOTIFICATION

Real-time notification of avalanche events via text and email to maintenance and Avalanche Program staff.



VERIFICATION

Event identification on geo-located area map and visual event verification via camera images. Ability to validate an event's likely impact before deploying maintenance crews.



RESPONSE

Faster response and dispatch of maintenance crews.



REPORTING

Historical data to support long term forecasting and assessing the effectiveness of artificially-triggered avalanche mitigation work.

Site Design

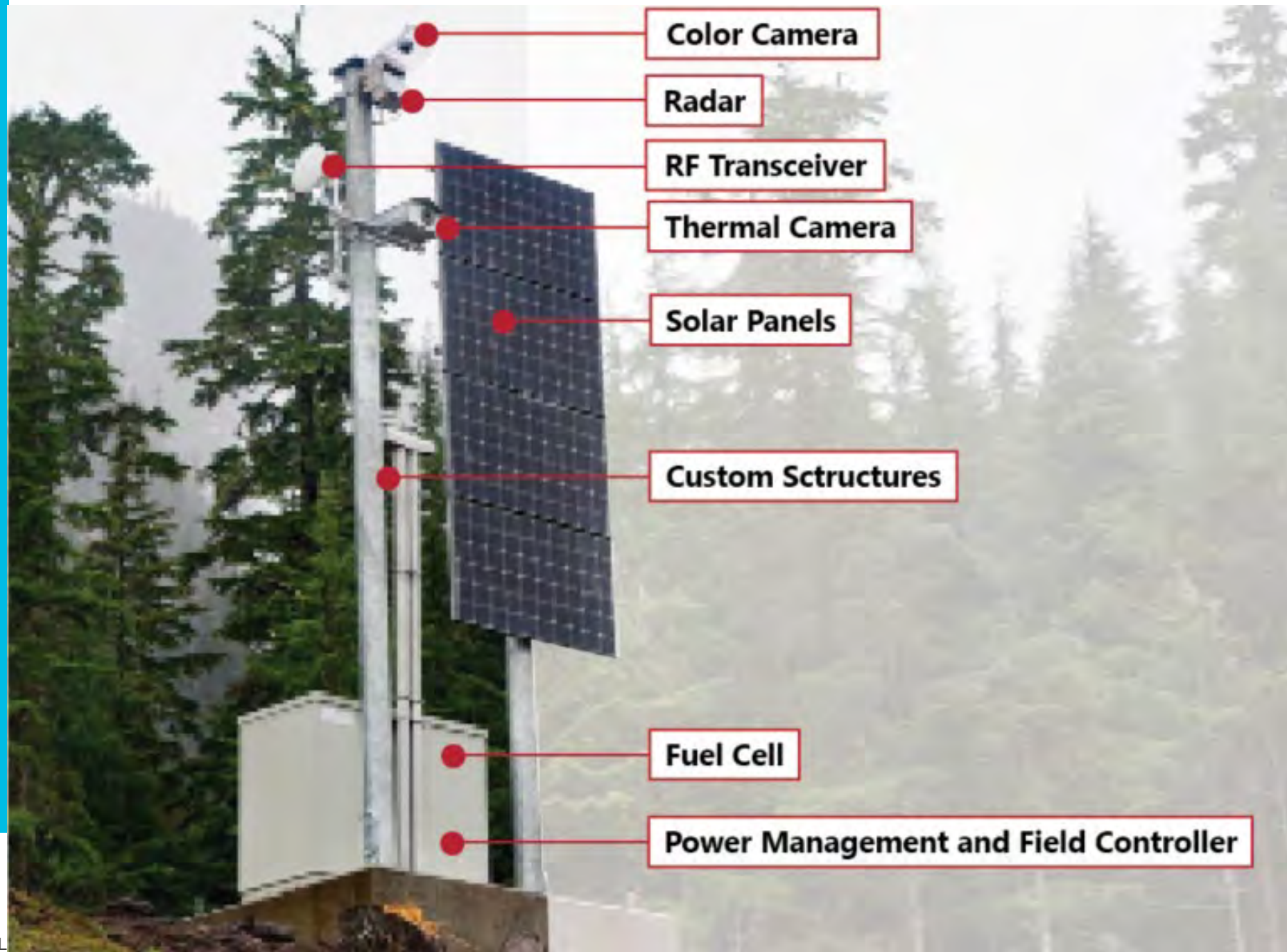
▪ Infrastructure includes:



- ✓ Detection technology
- ✓ Custom mounting structure
- ✓ Concrete foundation
- ✓ Control equipment enclosure
- ✓ Communications equipment
- ✓ Independent power sources
- ✓ Helicopter landing pad



AADS Site



Technology & Notification

Site Access



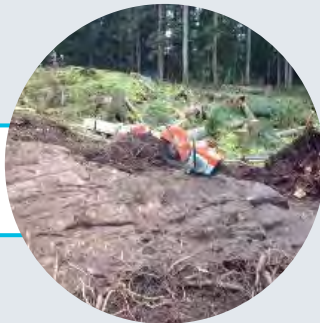
Crews & Materials



Weather conditions



Dense Forest



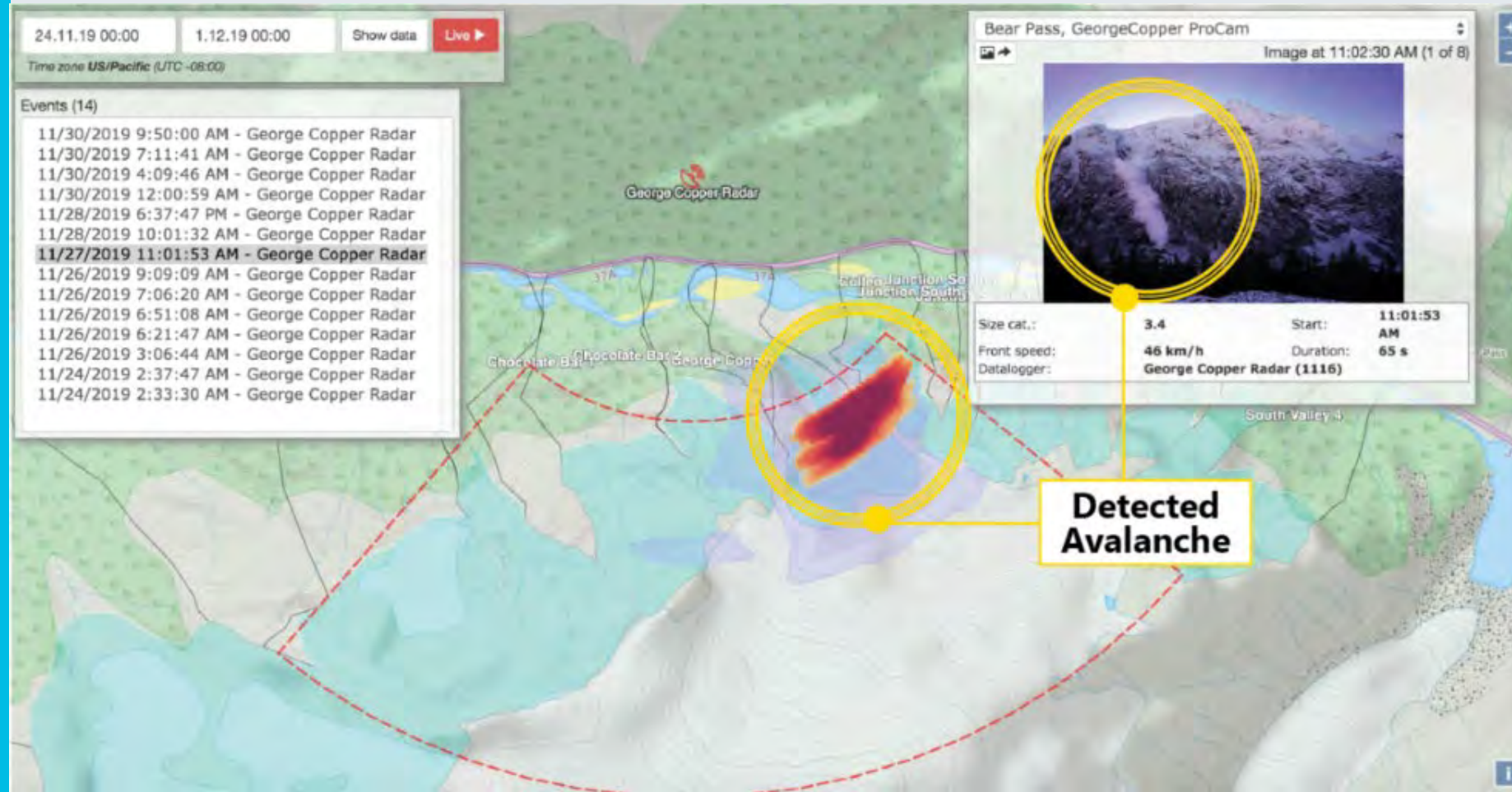
Steep inclines



Difficult Testing



AADS Live



AADS Proof of Concept Results



- The system has proven highly effective
- System validates that there are far more avalanches than originally known
- MoTI is planning to expand the system to monitor other high-activity terrain along the corridor
- Future system will include automated road gate closure capability



Thank you.

25

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2023 FEB 28

QUESTIONS?

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