



# AVALANCHE AND WEATHER PROGRAMS

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MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE

Avalanche Mapping, The Avalanche Hazard Index and Prioritization of  
Avalanche Mitigation Funding

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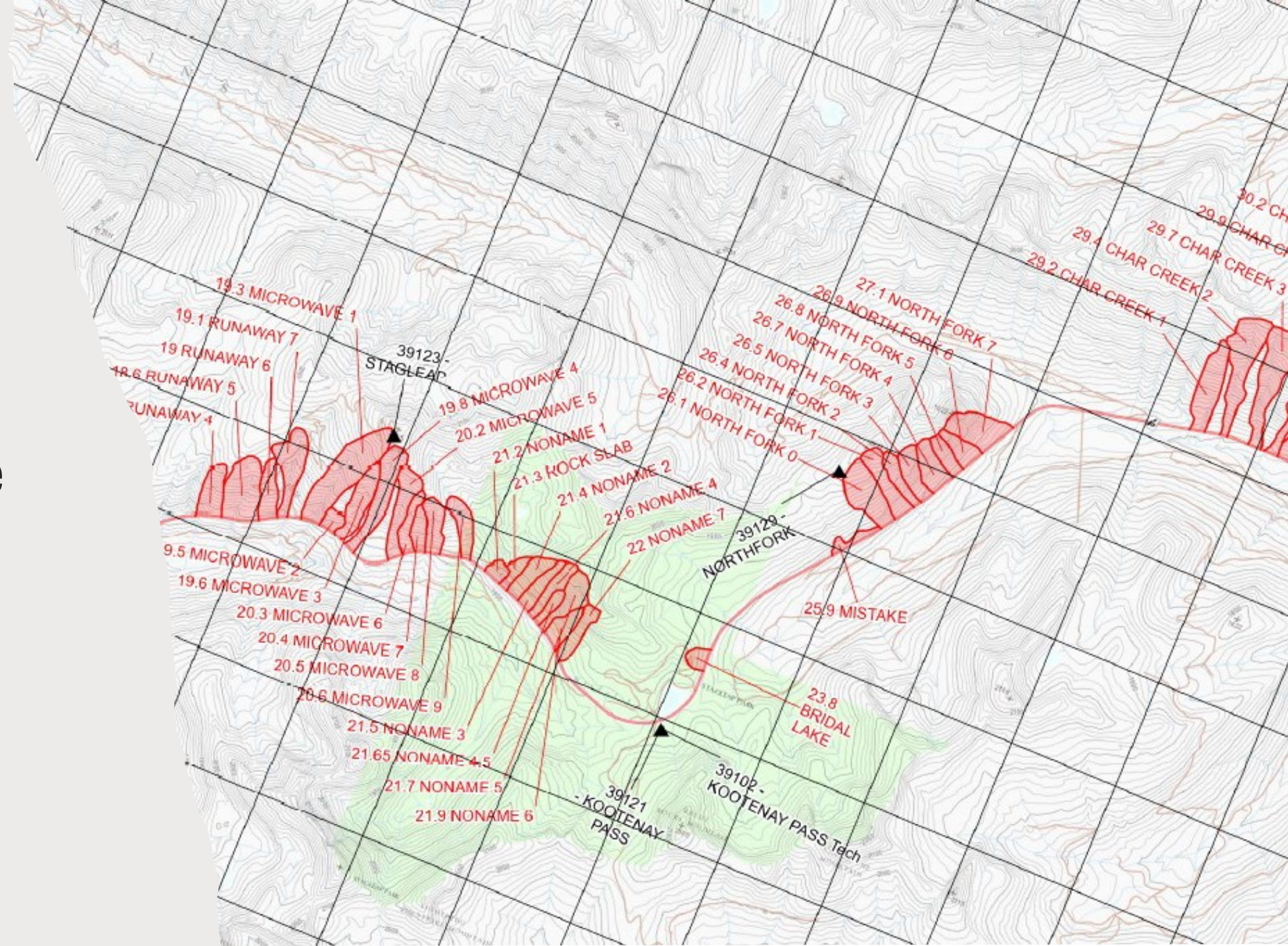
## Avalanche Mapping

- Strip Maps
- Avalanche Atlas
- Avalanche Hazard

Index and Interactive  
Dashboard



# Avalanche Strip Map, Kootenay Pass



# Avalanche Atlas General Path Information Page

## 3 VALLEY GAP MOTEL 1 PATH SUMMARY

Path Name: 3 VALLEY GAP MOTEL 1

Path Number: 19.1

Active Path: Yes

Potential Path: No

Location:

Directly across the highway from the Three Valley Gap Motel.

### TERRAIN CHARACTERISTICS

Vertical Fall: 700 m

Slope Length to Road:

Starting Zone Area:

Site Angle to Road:

Runout Area:

Aspect: North North West

Road Width: 7 m

Length of Highway Affected: m

### ELEVATIONS

Starting Zone: 1220 — 855 m

Runout Zone: 520 — 520 m

### INCLINES

Starting Zone: 47 °

Track: 34 °

Runout Zone: 0 °

### GENERAL DESCRIPTIONS

#### **Starting Zone:**

Consists of three narrow deep steep-sided gullies below rock bluffs. The gullies are separated by ridges covered with mature coniferous vegetation.

#### **Track:**

Begins as three gullies which converge, forming one shallow gully which then separates again. The western, main, portion of the track is a narrow creek gully bordered by dense coniferous and deciduous vegetation. The eastern portion is a narrow channel through the dense vegetation.

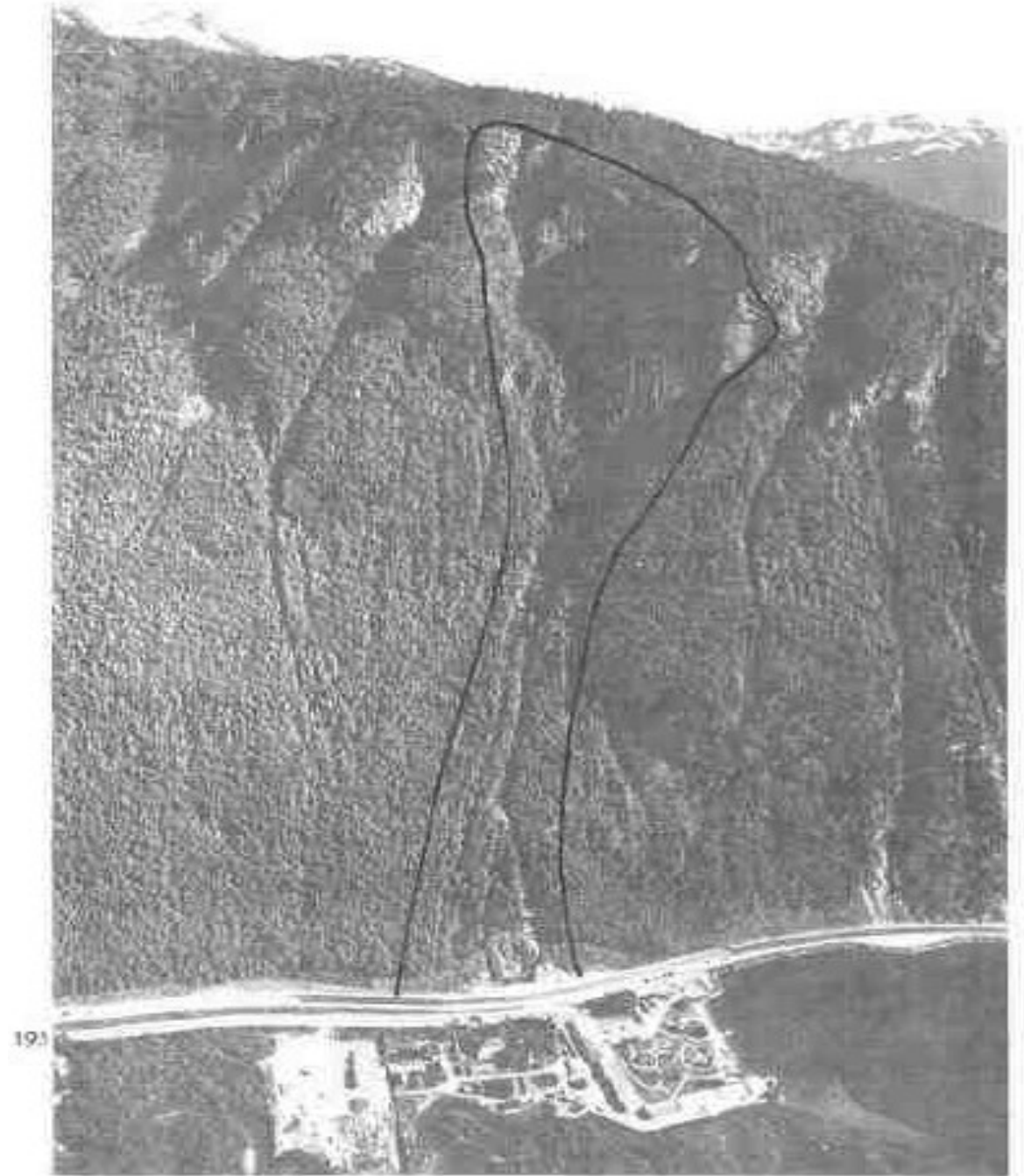
#### **Runout Zone:**

Begins at the highway and extends across it to the Three Valley Gap Motel.

#### **Technician Description of Path Characteristics**

Length of highway affected by the western gully is approximately 65m. Length of highway affected by the eastern gully is approximately 65m. Sloughing is estimated to affect the highway an average of once per year. Avalanches are estimated to affect the highway an average of once every three years. The toe of the fan below the main gully has been excavated to increase the storage capacity immediately above the highway.

# Avalanche Atlas Photo with path delineation



# Avalanche Atlas occurrence data table

OCCURRENCE SUMMARY Aval. Path: 19.1 3 VALLEY GAP MOTEL 1

Average avalanche activity per season in the last 32 years: 21 avalanche(s)

Average avalanche activity affecting the road per season in the last 32 years: 3.94 avalanche(s)

	Total Avalanches	Avalanches on Highway	Average Depth On Highway (Metres)	Incidents	Dusting	Control Attempts
2020 — 2021	1					5
2019 — 2020	41	5	1.50		2	41
2018 — 2019	18					17
2017 — 2018	30	7	1.18			24
2016 — 2017	29	4	0.69			27
2015 — 2016	11					10
2014 — 2015	18	7	2.43			15
2013 — 2014	52	8	1.04		3	49
2012 — 2013	25	2	1.00			18
2011 — 2012	46	9	1.06			37
2010 — 2011	47	15	0.94		2	38
2009 — 2010	18					15
2008 — 2009	35	8	0.73		4	23
2007 — 2008	45	13	0.88		5	37
2006 — 2007	46	13	0.85		3	35
2005 — 2006	17	1	0.50			12
2004 — 2005	22	1	0.20		1	19
2003 — 2004	38	13	0.98		5	36
2002 — 2003	14				1	12
2001 — 2002	26	2	1.00	1		10
2000 — 2001	15	3	0.67			
1999 — 2000	18	2	0.70			
1998 — 1999	16					
1997 — 1998	3					
1996 — 1997	11	4	0.85			
1995 — 1996	6					
1994 — 1995	4					
1993 — 1994	5	1	0.70			
1992 — 1993	3					
1991 — 1992	7	2	1.00			
1990 — 1991	12	4	0.33			
1989 — 1990	8	2	0.55			

Occurrence Summary data is for period from 1989/09/01 to 2021/08/31

# What is an Avalanche Hazard Index

AHI is defined as “a numerical expression of damage and loss as the result of the interaction between snow avalanches and vehicles on a road.” (Schaerer, 1989). Although it is technically not considered a Quantitative Risk Analysis, it is intended to provide a measurement of risk to the traveling public along a highway segment that can be evaluated and compared to other highway segments.

Why,

The AHI can help with identifying our highest hazard areas.

The AHI is used in combination with other factors/inputs and Ministry priorities to aid in infrastructure planning and avalanche risk management investments.

Such as;

- Primary interprovincial highway corridors that are critical for the movement of goods and services.
- Limited alternative routes (impacts to traffic)
- Isolated communities

## Key AHI Inputs

- Historical avalanche occurrence records as maintained by the Ministry 173,869 avalanche records.
- British Columbia digital road atlas – data for 196 highway corridor sections (e.g. speed limits, number of lanes).
- Ministry Traffic Data Program database – traffic volumes.
- Ministry digital avalanche path mapping – widths and locations for approximately 1400 avalanche paths.
- Ministry avalanche path atlases – general data for the paths.
- Historical aerial photographs – analysis of hundreds of aerial photographs dating back to 1937 was used to refine avalanche path dimensions.



AHI values representing avalanche risk for the Ministry avalanche hazard forecast areas.

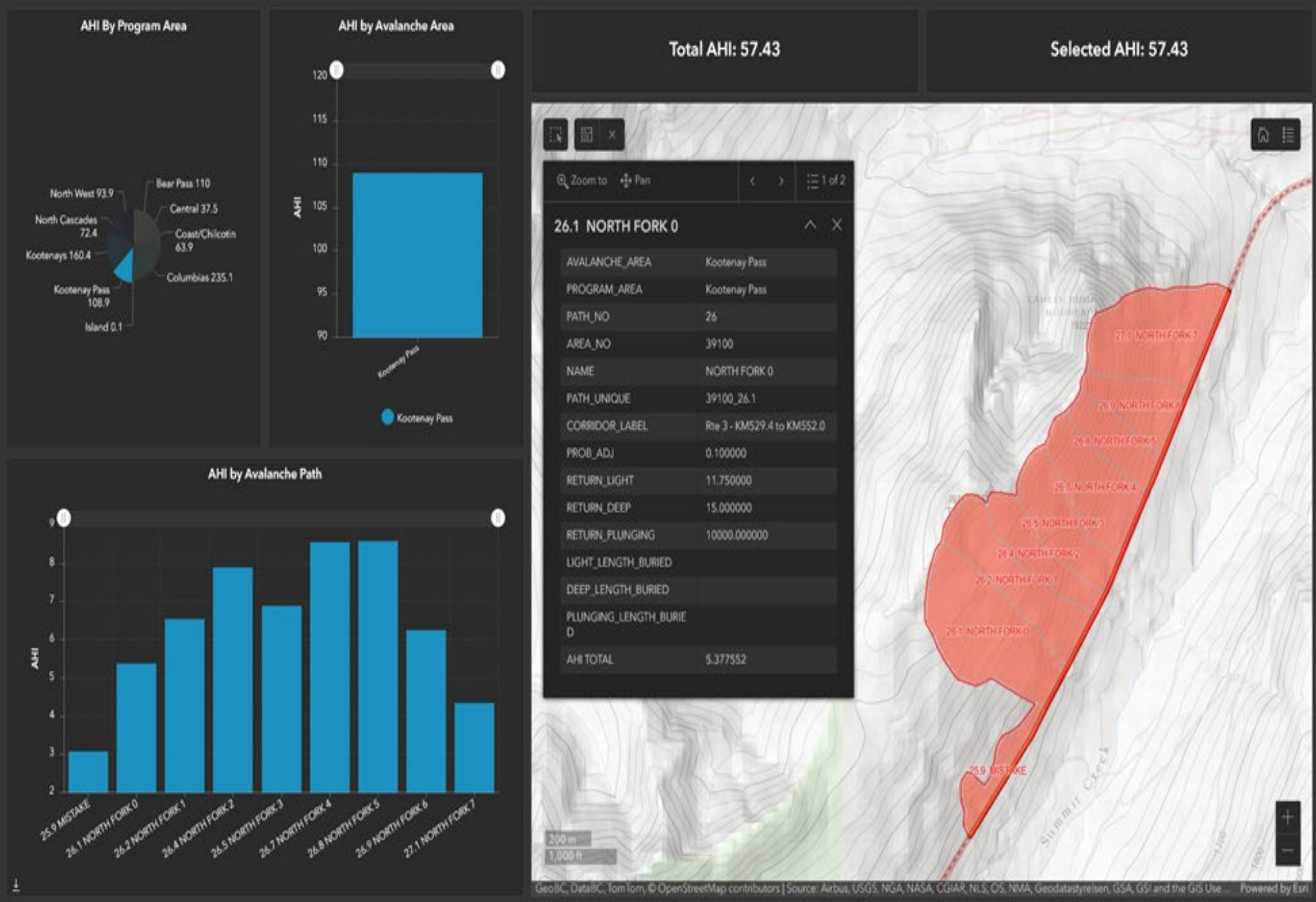
These AHI values represent the risk situation after considering all existing mitigation measures (e.g. hazard forecasting and road closures, explosives control, catchment ditches).

In relative terms, the higher the AHI, the more hazardous the area is. AHI values are correlated with winter average daily traffic volumes (WADT) which are also shown in Table 1.

Avalanche Area	AHI <sub>R</sub> Total	WADT	AHI <sub>R</sub> Class
TCH West of Revelstoke	150.6	5877	<b>VERY HIGH</b>
Bear Pass	109.4	210	<b>HIGH</b>
Kootenay Pass	108.9	1109	<b>HIGH</b>
Exstew to Rainbow Summit	85.9	945	<b>HIGH</b>
Fraser Canyon	48.6	1676	<b>HIGH</b>
TCH East of Revelstoke	45.9	4823	<b>HIGH</b>
Blueberry Paulson	41.9	2496	<b>HIGH</b>
Bridge River	31.4	250	<b>MODERATE</b>
Lardeau	31.0	597	<b>MODERATE</b>
Red Pass	24.6	2260	<b>MODERATE</b>
New Denver - Kaslo	21.7	685	<b>MODERATE</b>
Duffey Lake	20.5	1124	<b>MODERATE</b>
Golden East	20.4	4973	<b>MODERATE</b>
Grand Forks North	18.5	590	<b>MODERATE</b>
HWY 23 North	18.0	719	<b>MODERATE</b>
Coquihalla	13.7	8444	<b>MODERATE</b>
Cape Horn Bluffs	11.5	626	<b>MODERATE</b>
Whitewater	11.2	1800	<b>MODERATE</b>
Coffee Creek	9.3	1354	<b>LOW</b>
Alison Pass	7.1	2090	<b>LOW</b>
Toby Creek	5.5	500	<b>LOW</b>
Bella Coola	5.3	160	<b>LOW</b>
Telegraph Creek	5.2	45	<b>LOW</b>
Sea to Sky	4.3	7690	<b>LOW</b>
Big Slide	4.1	975	<b>LOW</b>
Fernie	3.4	4218	<b>LOW</b>
Highline	2.4	75	<b>LOW</b>
Castlegar Bluffs	2.1	1425	<b>LOW</b>
Highway 5a	1.9	803	<b>LOW</b>
Chase	1.8	6265	<b>LOW</b>
Galena Pass	1.7	50	<b>LOW</b>
Mt.Cheams Floods	1.6	10937	<b>LOW</b>
Barrière	1.5	2278	<b>LOW</b>
Marble Canyon	1.1	581	<b>LOW</b>

Rating	Avalanche Hazard Index
Very Low	<1
Low	1 - 10
Moderate	10 - 40
High	40 - 150
Very High	>150

# Avalanche Hazard Index Dashboard data example.



# Avalanche Hazard Index Map

## Revelstoke Area





# Long Term Avalanche Infrastructure Investment Plan and Prioritization

## Ministry Governance Structure.

### HQ

- Policy and Procedures
- Support avalanche project, rehabilitation and maintenance funding
- One of 8 avalanche programs reports to HQ
- Database SAWSX
- Quality Assurance
- Regulatory Compliance

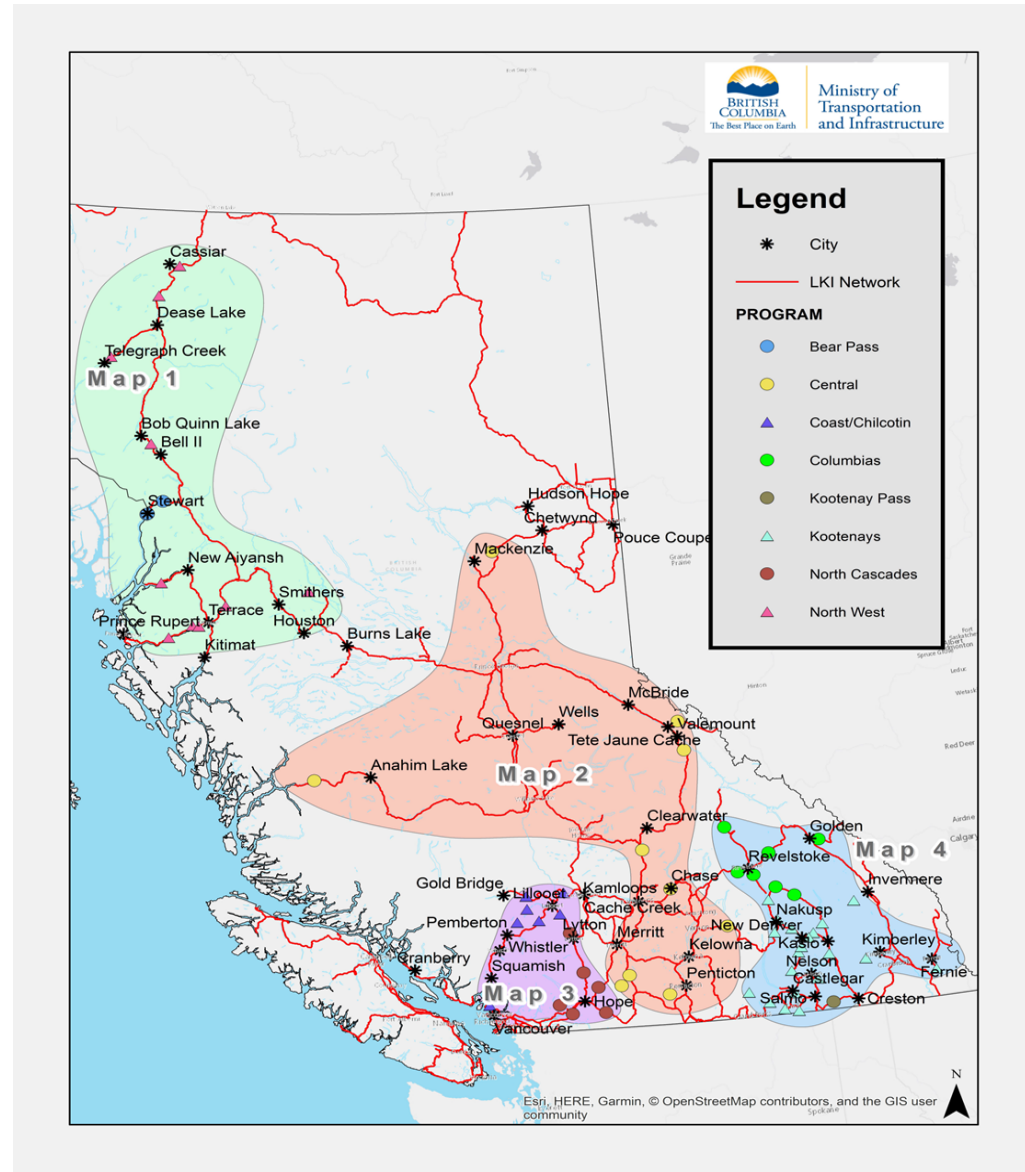
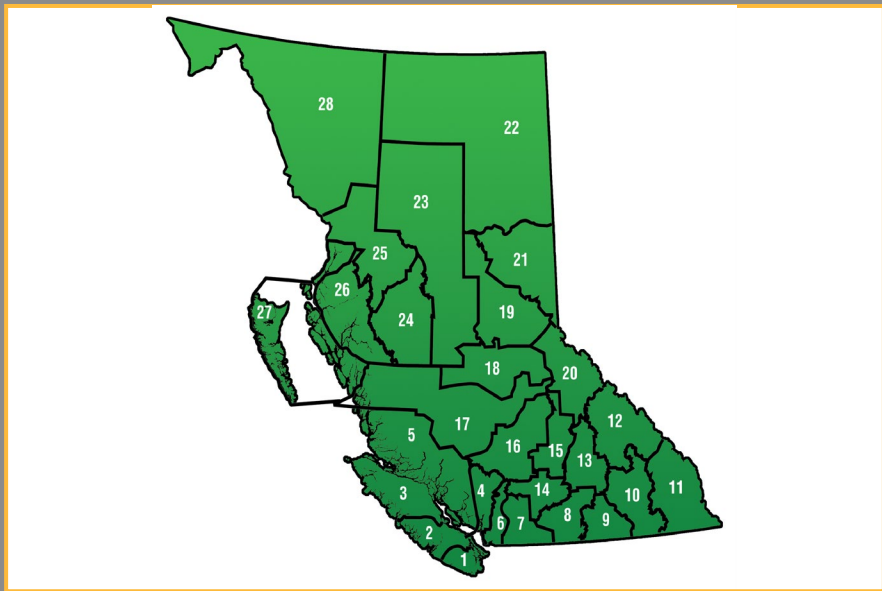
### Regions

- Northern Region
- Southern Interior Region
- South Coast Region

### Districts

- 11 Districts
- 28 Service Areas
- 7 Avalanche Programs report to 5 Districts
- Operational funding
- Project funding





# Ministry of Transportation and Infrastructure's Vision and Mission

- Our Vision,  
Moving and connecting British Columbia for a strong and sustainable future.
- Our Mission,  
Plan, design, build and operate a safe and reliable integrated transportation network, offering accessible, seamless mobility for people and goods.

## Avalanche Safety Program Mandate

- Ensure the safety of all highway users.
- Minimize the frequency and duration of avalanche-related road closures.



## MINISTRY OF TRANSPORTATION & INFRASTRUCTURE

Avalanche Safety Program Infrastructure Investment Plan  
September 2023

# Key Investment Planning Considerations

- The Ministry's Avalanche Hazard Index.
- Input from Ministry of Transportation District, Regional and Headquarters staff.
- The Avalanche Safety Program's 10 Year Maintenance and Rehabilitation Plan.
- Avalanche mitigation strategies are developed by HQ and Senior District Avalanche staff and contracted Avalanche Consultants.





# Key Investment Planning Considerations

- Trans-provincial highways.
- Trans Canada Highway, 60 Billion in Goods and Services per year.
- Economic impacts
- Alternative routes or lack of.
- Isolated Communities.





## Avalanche Infrastructure Funding Sources

- HQ
  - Maintenance and Rehab
  - Climate Adaptation
  - Capital Funding
  - Safety Fund
  - Innovative Technologies Fund (ITS)
- Regional Funding
- District Funding

# Avalanche infrastructure investments 2020-2024 highlights (Estimated)

## Avalanche Radar

- \$5 Million

## Remote Avalanche Control Systems (New, Upgrades and Maintenance)

- \$3.5 Million

## SAWSX Database (Complete 2027)

- \$4 Million

## Lock Block Walls / Catchments

- \$6 Million



# Highway 37A – Automated Avalanche Detection System

## Challenge:

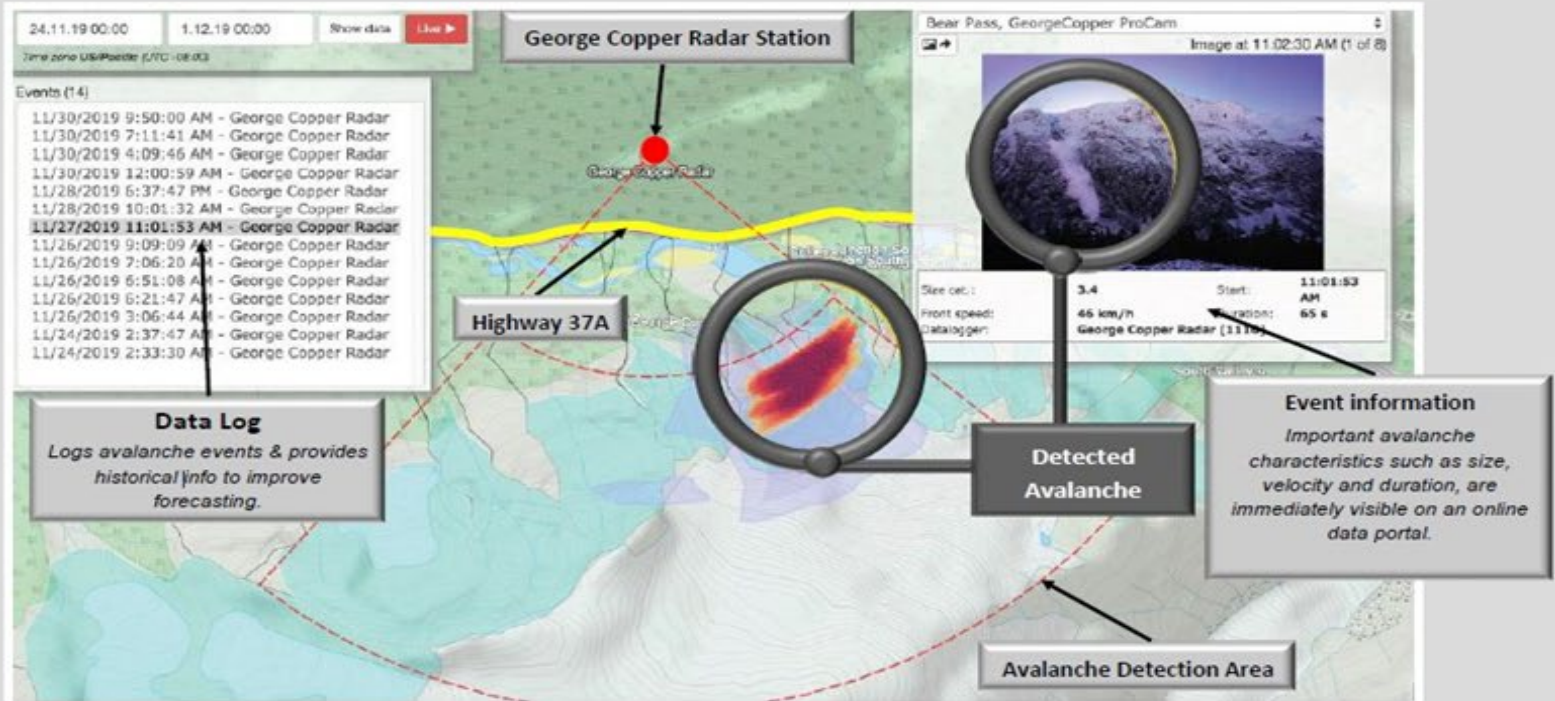
- The Bear Pass is a 62km section of Highway 37A that has 72 avalanche paths.
- The annual average avalanche related closure time is 105hrs but can be as high 360hrs.
- The highway operates at a considerable hazard level for 600-900hrs each year.
- No alternate land transportation route in & out of Port of Stewart.

## Solution:

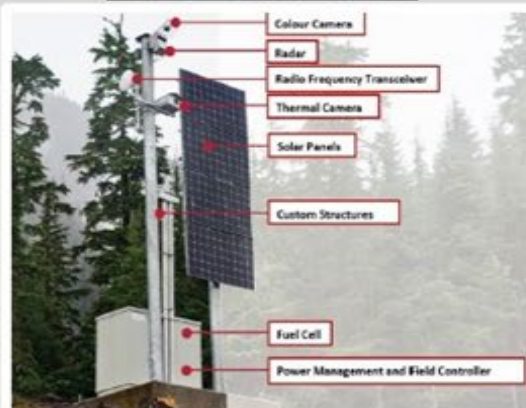
- The AADS includes two radar stations, a communications repeater and software platform.
- The AADS provides real time monitoring and alert notifications (24/7, all weather conditions) for natural avalanche activity.

## Benefits:

- Reduces highway closure times.
- Improves reliability, safety, promotes the Port of Stewart as a reliable entry and exit point for commodities.
- Improves reliability and accuracy of avalanche forecasting.
- In the future this technology could be linked to automated gates that would close the highway to ensure the safety of motorists in case of an avalanche.



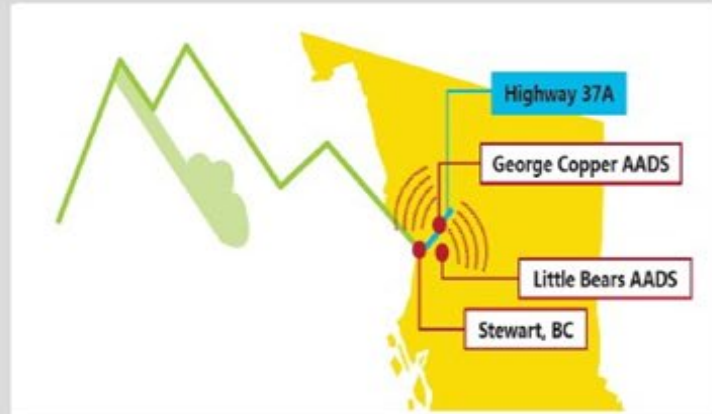
Little Bears Radar Station



George Copper Radar Station



Mount Johnson Repeater





- Remote Avalanche Control Systems
- Walls and Catchments



Short slope / low-cost avalanche problem mitigation solutions



Thank You

Questions ?