

Ministry of Transportation and Norwegian Natural Hazards Mitigation Group



BRITISH
COLUMBIA

Ministry of Transportation



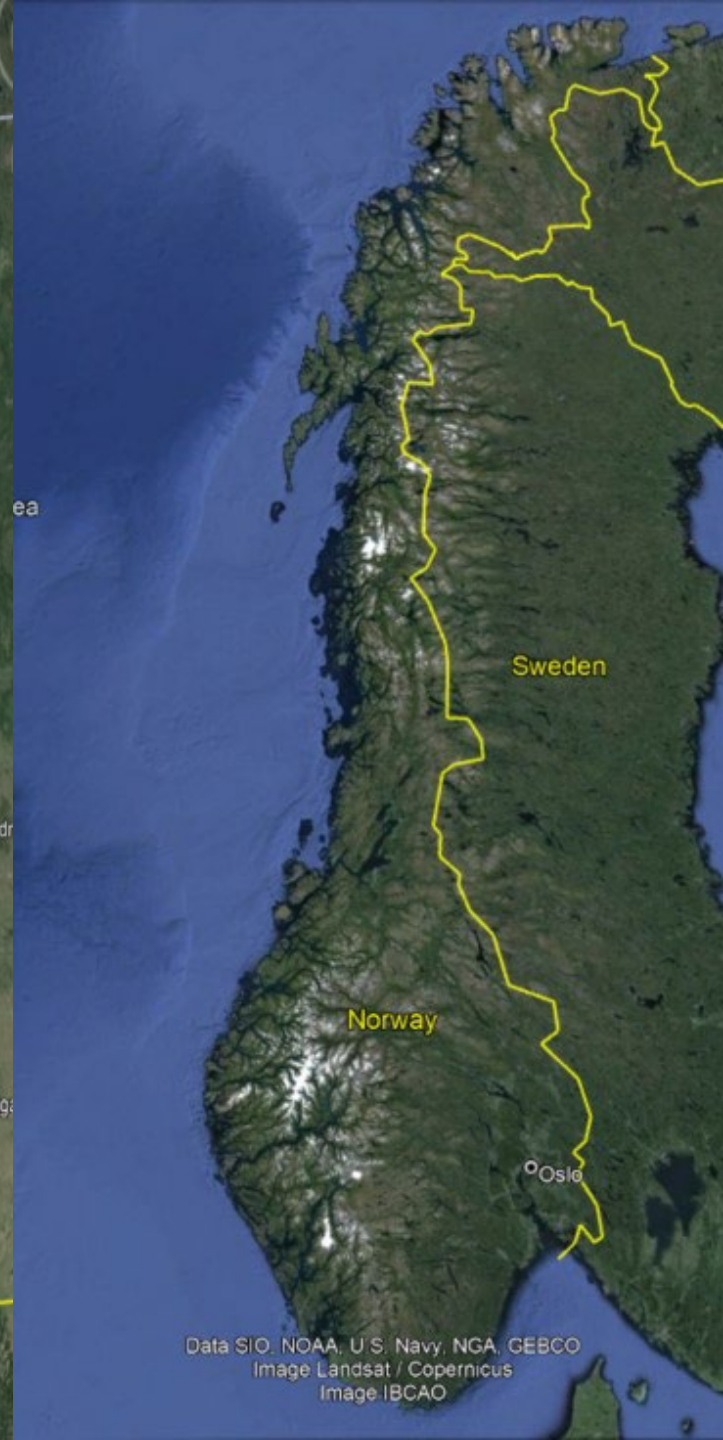
British Columbia

- 944,735km²
- 1200km North to South
- Population (2024)
 - 5.6 Million



Norway

- 385,000km²
- 1750km North to South
- Population (2024)
 - 5.5 Million





AVALANCHE AND WEATHER PROGRAMS

MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE

MOTI Avalanche Safety Program Overview and Operational Risk Management
Presentation
May 27, 2024



AVALANCHE AND WEATHER PROGRAMS

MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE

50 Years Ago
North Route Café Accident
Jan 22, 1974

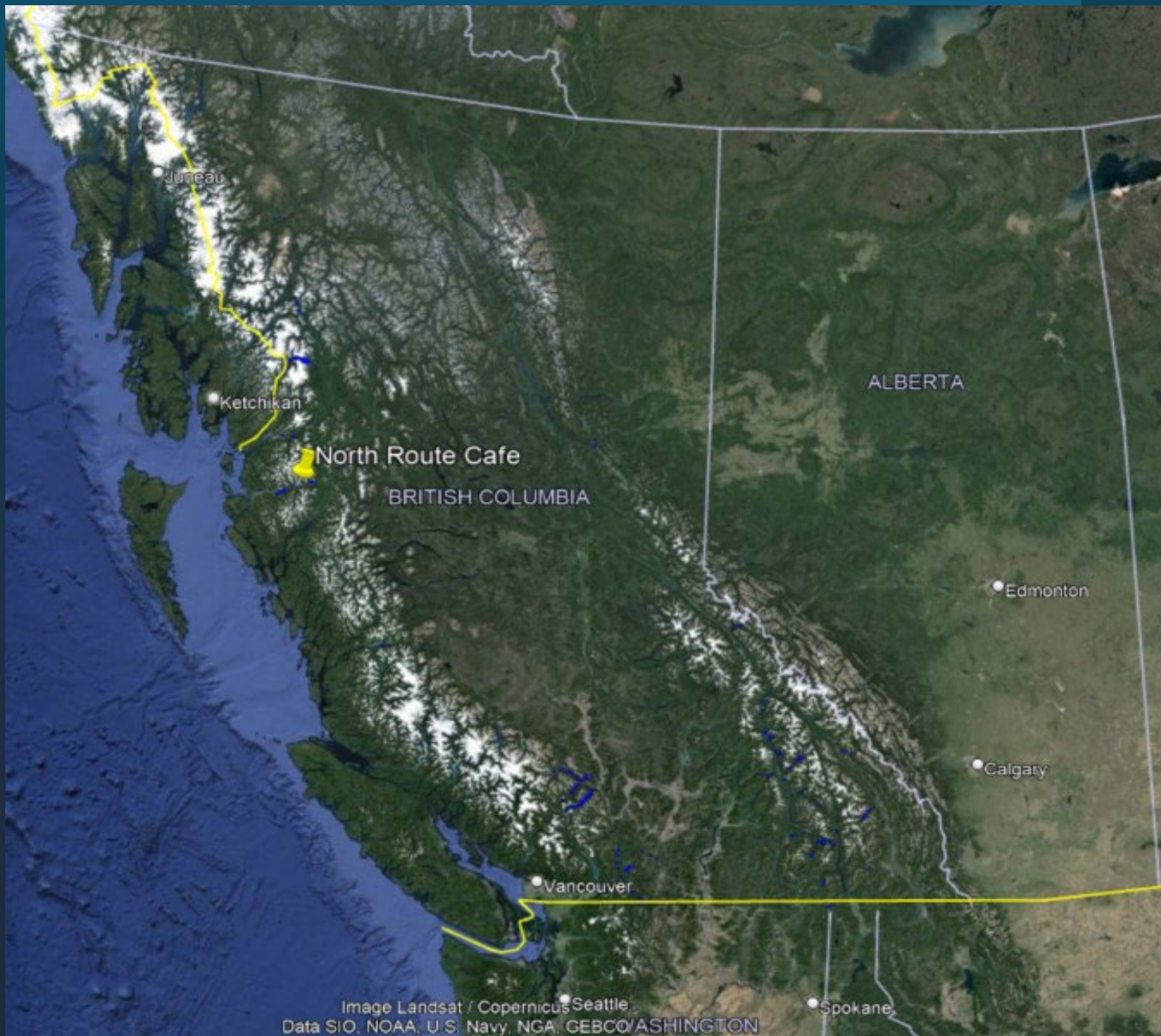


Image Landsat / Copernicus Seattle
Data SIO, NOAA, U.S. Navy, NGA, GEBCO/ASHINGTON

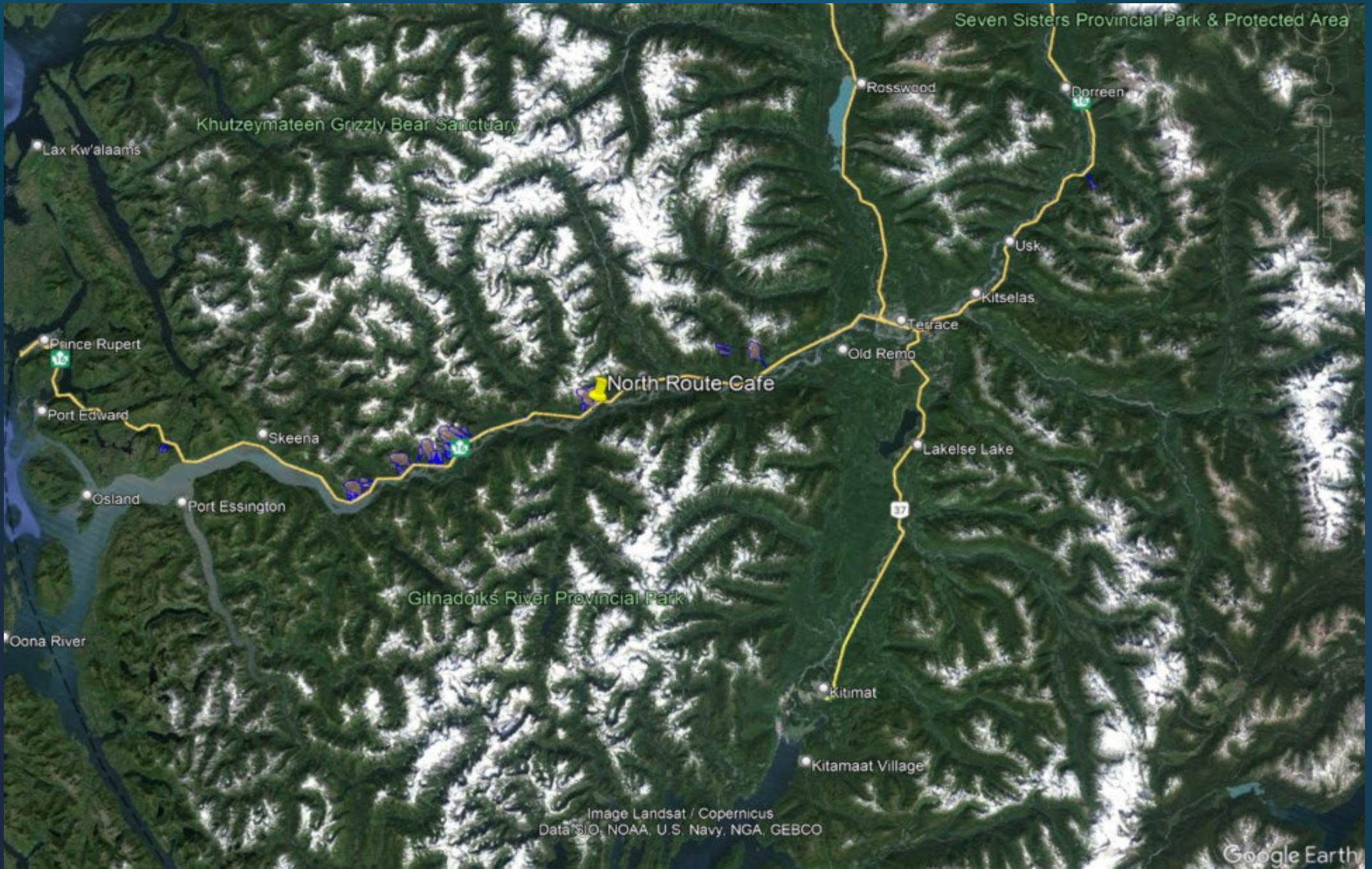
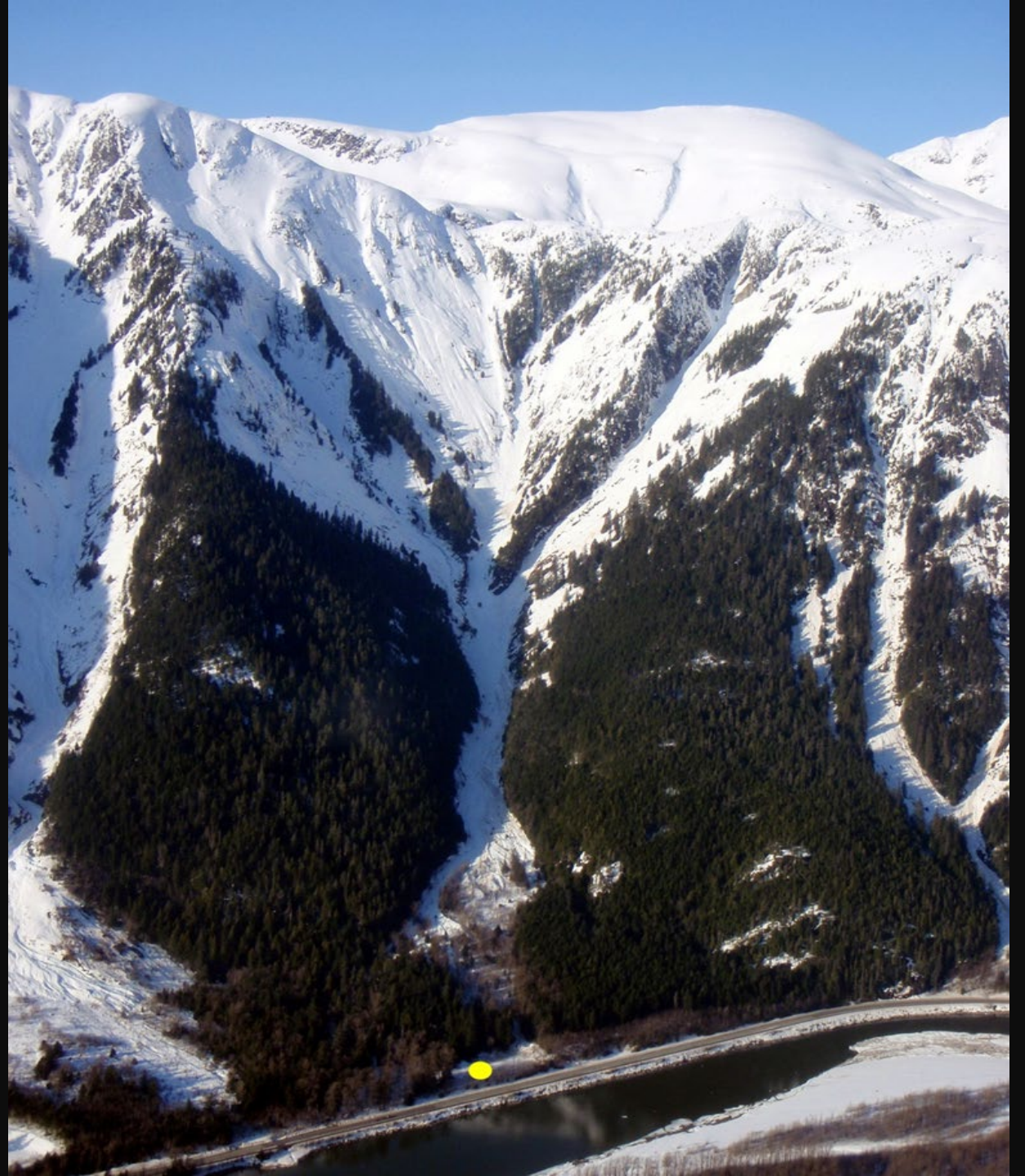


Image Landsat / Copernicus
Data SIO, NOAA, U.S. Navy, NGA, GEBCO

Google Earth

-
- Path number 45.6
 - Yellow dot approx. location of North Route Café
-





BC Government forms The Avalanche Task Force

- Following the North Route avalanche, an Avalanche Task Force was formed, consisting of a five-member group of engineers and avalanche technicians.
- The task force was charged by the Minister of Highways to report on “measures to be taken to identify and control avalanche hazards from snow and mud as they may endanger highways and facilities adjacent to highways in British Columbia”.
- The recommendations of the Avalanche Task Force have influenced avalanche programs in B.C. and elsewhere over the past 50 years. A Hazard Index (later known as the Avalanche Hazard Index) was developed to assess the relative seriousness of the problem in various avalanche areas.
- Using this method, avalanche prone areas on B.C. Highways were grouped as High, Moderate, Low and Very Low Hazard with recommendations for management of the risk.

Key Task Force Recommendations

- A program of preventative closures during periods of high avalanche hazard
- An avalanche control program using artillery.
- Hiring avalanche coordinators for the three areas identified as High Hazard routes including Terrace, Hope, and Kootenay Pass, as well as hiring a senior avalanche coordinator in Victoria
- Avalanche training programs for Department of Highways staff in the maintenance, management and planning groups
- Safety measures for highways maintenance crews
- Avalanche warning signs for all avalanche areas
- Installation of weather stations and exchange of weather data through cooperation with Environment Canada
- A public information program (Avalanche Canada)
- Investigation of the effect of structures including barriers, dams and other earthworks, as well as snowsheds at various locations
- An assessment of the adequacy of snow removal equipment.

Current Avalanche Risk Management Programs for BC Highways

- As of 2024, the Avalanche and Weather programs for the BC Ministry of Transportation and Infrastructure has grown to 35 full time and seasonal avalanche technicians, managing the avalanche risk from 62 avalanche areas and approximately 1400 avalanche paths.
- The network of weather stations has grown to approximately 320 stations, including 70 remote weather stations that are at elevations similar to avalanche start zones.
- The expertise of this program is recognized internationally.

8 Avalanche Programs

- Map 1 – NW BC
 - Bear Pass – Stewart
 - NW Regional – Terrace
- Map 2 – Central and Southern BC
 - Central Program – Penticton
- Map 3 – Southwest BC
 - Coast/Chilcotin – Pemberton
 - North Cascades – Hope
- Map 4 – Southeast BC
 - Kootenay Pass – Nelson
 - Kootenay Regional – Nelson
 - Columbia – Revelstoke/Golden



Avalanche Risk Management

- Identify avalanche paths and potential level of risk
 - Mapping / Avalanche Atlas / AHI
 - Operational Standards
 - Training
 - Rescue
 - Risk reduction methods and procedures
 - Operational Risk Band
-



*Regulatory Requirement (Worksafe BC)

Key Elements of the Avalanche Safety Plan

Training Requirements for Avalanche Workers

- Ministry Staff
- Maintenance Contractor Staff
- Untrained Workers

Equipment and Infrastructure

- Signs
- Avalanche Rescue Equipment
- Radio Equipment and Weather Station Info
- Avalanche Atlases

Operational Procedures

- Pre-Winter Meetings with Stakeholders
- Avalanche Forecasts and Operational Procedures
- Road Closures – Procedures
- Quality Assurance (Program Audits)



Avalanche Safety Plan

Ministry of Transportation and Infrastructure

Avalanche and Weather Programs

Effective: November 1, 2022

Avalanche Search and Rescue and Incident Response

- Avalanche Incident Response Plan
- Avalanche Plan Updates and Distribution
- Avalanche Rescue Training
- Avalanche Rescue Equipment
- Backcountry Rescue Protocol

Incident Review

- Incident Reporting and Investigation
- Avalanche Incidents
- Regulatory Requirements for Incident Reporting

Fieldwork Sites and Working Alone or in Isolation

- Fieldwork Atlases – Risk identification
- Pre-Trip Planning
- Check in / out procedures

Explosive Use

- Transporting
- Storage
- Explosive Use
- *Specific Blasting Procedures approved by WSBC.



Avalanche Safety Plan

Ministry of Transportation and Infrastructure

Avalanche and Weather Programs

Effective: November 1, 2022

Key Elements of the Snow Avalanche Safety Measures for Highways Manual

- Pre Winter Meetings
- General Training
- Equipment
- Avalanche Search and Rescue
- Avalanche Hazard Forecasts and Operational Procedures
- Avalanche and Weather Observation guidelines
- Avalanche related Road Closures
- Avalanche Rescue Cache
- Avalanche Rescue Training



Snow Avalanche Safety Measures for Highways Manual



British Columbia Ministry of Transportation
and Infrastructure
Avalanche and Weather Programs
November 2022

Previous Revisions: October 2019
March 2018

Key Elements of the Threshold Guidelines for Avalanche Safety Measures

- Avalanche Forecasts
- Avalanche Hazard Levels
- Site-Specific Safety Measures

Primary Avalanche Risk Factors

- Avalanche Termination Point
- Avalanche Size Expectations
- Avalanche Frequency Expectations
- Terrain Features
- Traffic Flow Characteristics



BRITISH COLUMBIA
MINISTRY OF TRANSPORTATION
&
INFRASTRUCTURE

AVALANCHE AND WEATHER PROGRAMS

THRESHOLD GUIDELINES FOR AVALANCHE SAFETY MEASURES

Original:
December 2005
Revisions:
December 2 2008
December 1 2017

At each level, specific operational safety measures are implemented.

LOW

- Remove snow and debris from avalanche catchment areas and defensive structures unless directed not to by the avalanche technician.
- Remove avalanche deposits from Highway.

MODERATE

- Notify avalanche technician of any changes in weather such as rising temperatures and heavy snowfall and new avalanche activity.
- No personal working outside of vehicles
- No equipment working outside of travel lanes

CONSIDERABLE

- No stationary equipment working within the avalanche area
- Ensure safety of personal by
 - Radio call when entering and exiting avalanche area
 - Radio call in minimum 30 min intervals
 - Plow in tandem

Appendix F – Avalanche Hazard Levels and Specific Operational Procedures

Ministry of Transportation and Infrastructure - Avalanche and Weather Programs
Avalanche Hazard Levels & Specific Operational Procedures

LOW Avalanches are unlikely OR small avalanches are possible, but are expected to terminate far above the road.

The contractor may proceed with normal winter operations. The contractor will:

- Remove snow and debris from avalanche catchment areas
- Remove snow and debris from static avalanche defense structures, unless directed not to by the District Avalanche Supervisor
- Maintain previously announced road closures to allow for avalanche patrols and for removal of snow and/or deposits from the road

MODERATE Small avalanches are probable but are expected to terminate above the road AND/OR large avalanches are possible, but are expected to terminate far above the road.

The contractor will:

- Notify the District Avalanche Supervisor if there is a change in weather such as increased wind speed, rise in temperature, and/or increased snowfall intensity
- Notify the District Avalanche Supervisor immediately after observing NEW avalanche occurrences
- Ensure there are no personnel working outside of vehicles within avalanche areas, unless approved by the District Avalanche Supervisor
- Ensure there is no equipment working outside of the travel lanes and shoulders of the road within avalanche areas, unless approved by the District Avalanche Supervisor
- Take interval weather and/or avalanche occurrence observations, as requested by the District Avalanche Supervisor
- Be prepared for road closures/delays as a result of unexpected natural avalanche activity on the road or explosives avalanche control, as requested by the District Avalanche Supervisor
- Maintain previously announced road closures to allow for avalanche patrols and the removal of snow and/or deposits from the road

CONSIDERABLE Small avalanches may affect the road; AND/OR large avalanches are probable, but are expected to terminate above the road; AND/OR snow dust events may affect the road

The contractor will:

- Notify the District Avalanche Supervisor if there is a change in weather such as increased wind speed, rise in temperature, and/or increased snowfall intensity
- Notify the District Avalanche Supervisor immediately after observing NEW avalanche occurrences
- Ensure there are no personnel working outside of vehicles within avalanche areas, unless approved by the District Avalanche Supervisor
- Ensure there is no equipment working outside of the travel lanes and shoulders of the road within avalanche areas, unless approved by the District Avalanche Supervisor
- Ensure there is no stationary equipment working within avalanche area unless approved by District Avalanche Supervisor
- Ensure safety of personnel by performing one of the following:
 1. Radio call-in when entering and exiting avalanche areas*
 2. Radio call-in at least every 30 minutes*
 3. Plow in tandem (second vehicle may be a pick-up or another plow truck)

* The person receiving the radio call may or may not be working in avalanche areas, but must be available 100% of the forecast time period
- Take interval weather and/or avalanche occurrence observations, as requested by the District Avalanche Supervisor
- Be prepared for road closures/delays as a result of unexpected natural avalanche activity on the road or explosives avalanche control, as requested by the District Avalanche Supervisor
- Maintain previously announced road closures to allow for avalanche patrols and for removal of snow and/or deposits from the road

HIGH – Highway is closed.

- Close and sweep the road between closure locations
- No equipment or personnel working within the avalanche closure area except for,
 - Sweep vehicles
 - Avalanche program personnel
 - Snow maintenance equipment provided they operate in safe areas as determined by the avalanche technician

EXTREME – Highway is closed.

- Close and sweep the road
- No equipment or personnel working within the avalanche area.

*Avalanche Deposit Removal

- There may be areas within the closure where avalanche deposit removal is deemed appropriate by the avalanche technician. This is because the hazard scale represents the highest potential hazard path within the avalanche area.

HIGH	Numerous small avalanches are expected to affect the road AND/OR one or more large avalanches are expected to affect the road.
<p>The contractor will:</p> <ul style="list-style-type: none"> • Close and sweep the road between standard closure locations (as determined by the District Avalanche Supervisor) using standard closure procedures • Ensure there is no equipment or personnel working within the avalanche closure area except for: <ul style="list-style-type: none"> • Sweep vehicles (continue radio call-ins at increased frequency) • Avalanche program vehicles and personnel • Snow maintenance equipment, provided they operate in safe areas and do not enter avalanche hazard areas (as determined by the District Avalanche Supervisor)* * This is possible because many standard closure locations are located outside of avalanche hazard boundary locations • Take interval weather observations from weather stations with safe access, as requested by the District Avalanche Supervisor 	
EXTREME	Numerous, large avalanches are expected to affect the road.
<p>The contractor will:</p> <ul style="list-style-type: none"> • Close and sweep the road between standard closure locations (as determined by the District Avalanche Supervisor) using standard closure procedures • Ensure there is no equipment or personnel working within the avalanche closure area • Take interval weather observations from weather stations with safe access, as requested by the District Avalanche Supervisor. 	

Avalanche Deposit Removal: Avalanche Technicians will determine when conditions are appropriate for work such as avalanche deposit removal at specific locations within the avalanche area. An avalanche hazard forecast will be issued to identify these work locations. The overall avalanche hazard forecast for the area may remain at a higher level, indicating that only the specifically identified areas are safe for conducting work such as avalanche deposit removal. The maintenance contractor may be instructed to commence avalanche deposit removal at these specific safe work locations. Specific operational procedures remain in effect throughout the rest of the avalanche area.

August 2017

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- Highway Closures when avalanche hazard exceeds operational risk band.
 - No Stopping signs are located near the boundaries of our avalanche areas. Stopped traffic within an avalanche area increases the avalanche risk.
-



- Avalanche Rescue & Safety Training



Reducing the
Avalanche Risk

Avalanche
Control Methods





Remote Avalanche Control Systems



Helicopter Bombing

Daisy Bell

Similar to the
ObellX



Case Charging

- For short slope avalanche paths



Static Defense Structures

- Walls
- Catchments
- Benches
- Avalanche Fencing

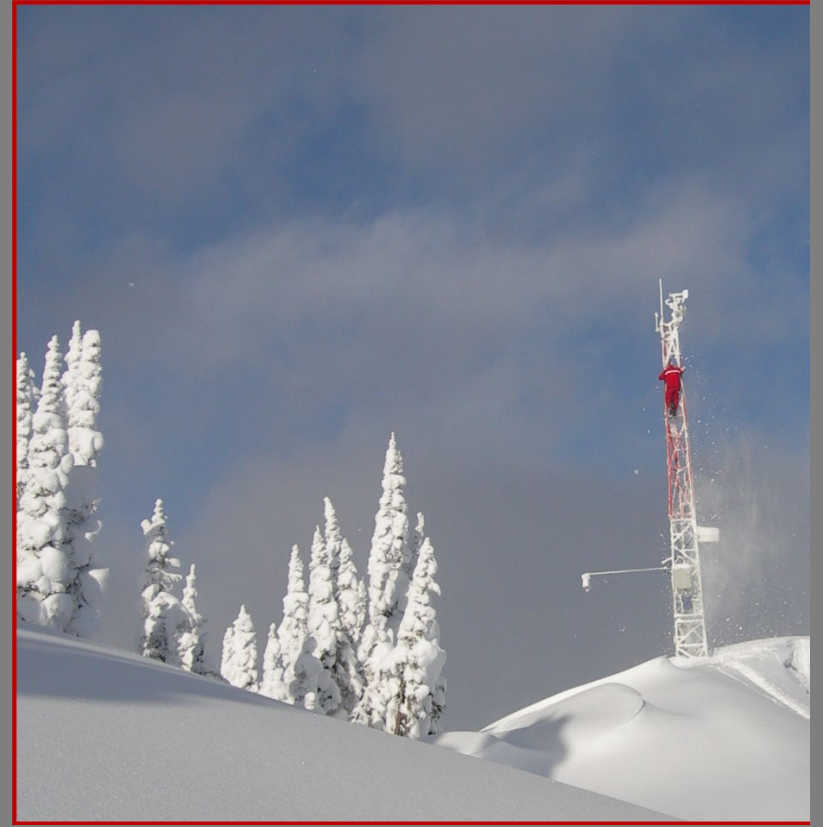


Radars at Ningunsaw Pass NW BC





Avalanche Deposit Removal



Avalanche Weather Stations



The Avalanche Program is a key component of our Ministry's Safety Program

- Geographically BC MOTI is the largest highways avalanche program in North America.
- Team of 35 Avalanche Technicians manage avalanche risks 24/7 during the winter months ensuring safety to all highway users and provide a reliable transportation network.
- Average highway closures time is 700h per year.
- Approximately 1400 active avalanche paths.
- Overall Operational Budget, approximately 4.5 Million per year.

Thank you.

Questions?

