

Developing a *Climate and Infrastructure Forensic Analysis System* for the northern transportation sector

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RISK SCIENCES INTERNATIONAL

Project Team

Risk Sciences International: Simon Eng, Heather Auld, Neil Comer, Erik Sparling, Adam Irawan & Derek Tsui

Northern Climate ExChange: Alison Perrin, John Streicker & Lacia Kinnear

University of Ottawa: Alex Bevington & Toni Lewkowicz

NWT Transportation: Darren Locke, Rob Thom & Greg Cousineau

OCCIAR/Mirarco: Al Douglas & Caroline Rodgers



Outline

- Project objectives
- Methodology
- Information gaps
- Climate & Infrastructure Forensic Analysis System (CIFAS)
- Case study: Yellowknife's climate & linkages to permafrost
- Gaps
- Next steps



Project objectives

- Assess existing information and identify information needs
- Engage with practitioners and decision-makers
- Develop knowledge products and dissemination strategy
- Recommend future actions
- Document the process



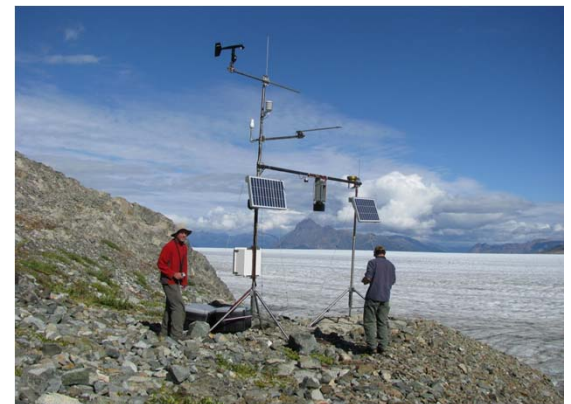
Methodology

- Establish a Project Advisory Committee
- Identify and characterize information needs
 - Literature review
 - Interviews with industry practitioners
 - Webinar
 - Outcome: identification of priority needs
- Prepare draft knowledge product & dissemination strategy
- Test and refine knowledge product
 - Webinar
- Presentation and dissemination of knowledge product



Information gaps

- Case studies of infrastructure failures and adaptations: “real/practical examples”
- Accessible and available climate-related data
- Guidance on complex interplay of climate elements (e.g. snow and permafrost, rain on snow, snowmelt and rain)
- Practical and user-friendly climate change guidance and tools
- Accessible training for practitioners



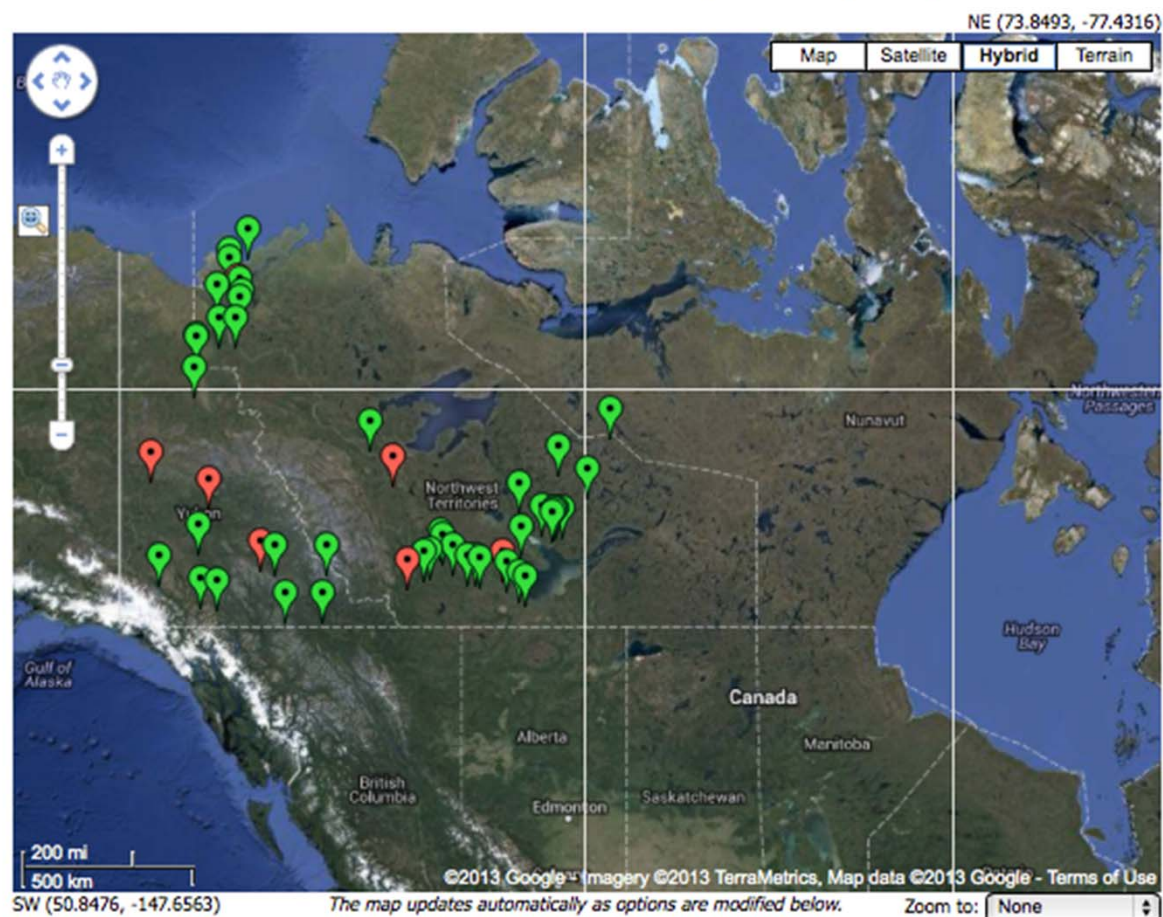
Climate and Infrastructure Forensic Analysis System (CIFAS)



Acknowledgements and the **background** for this project are available.

Proceed to the online system.

Climate and Infrastructure Forensic Analysis System (CIFAS)



Date(s) of Occurrence

Date of incidents (DD/MM/YYYY): 1900-01-01 to 2014-01-01 ☐ is on-going

+ Event Type

+ Infrastructure/System Element

Date(s) of OccurrenceDate of incidents (DD/MM/YYYY): to ☐ is on-going**- Event Type**

- ☐ N/A or blank
- ☐ Permafrost melt
- ☐ Active layer thaw
- ☐ Spring runoff
- ☐ Rain-on-snow
- ☐ Blowing snow
- ☐ Heavy snowfall
- ☐ Snow accumulations
- ☐ Flooding
- ☐ Avalanche
- ☐ Loose snow
- ☐ Totals
- ☐ Additional factors

- Infrastructure/System Element**Category:**

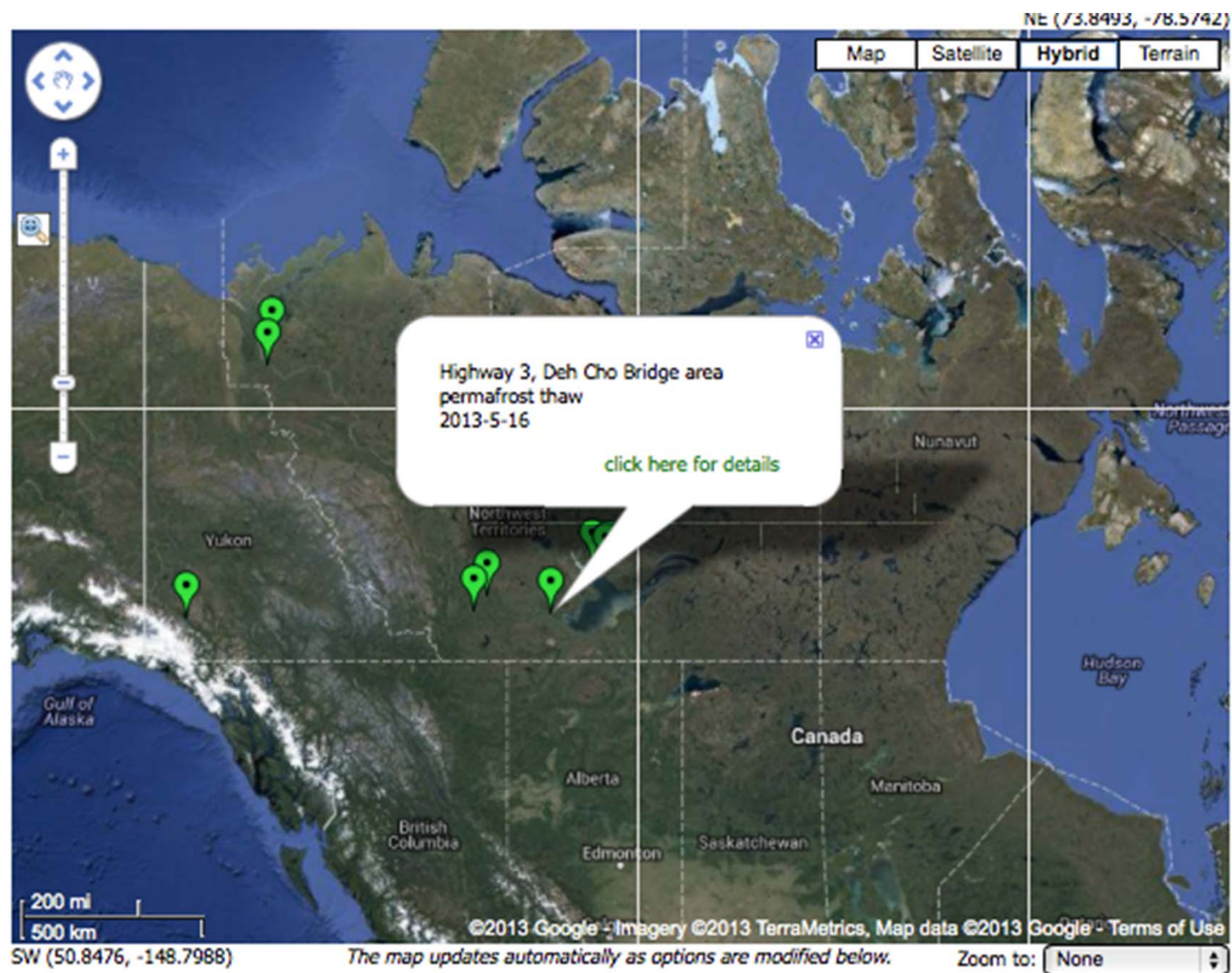
- ☐ N/A or blank
- ☐ Highway (any)
 - ☐ Highway - paved
 - ☐ Highway - gravel
- ☐ Municipal road (any)
 - ☐ Municipal - paved
 - ☐ Municipal - gravel
 - ☐ Municipal - dirt
- ☐ Winter road (any)
 - ☐ Land
 - ☐ Ice bridge
 - ☐ General (for closures)
- ☐ Access road - mining
- ☐ Access road - community
- ☐ Bridge
- ☐ Waterway crossing
- ☐ Building (e.g., garage, supply storage)
- ☐ Ferry crossing
- ☐ Other

Ownership/Jurisdiction:

- ☐ N/A or blank
- ☐ Territorial, YT
- ☐ Territorial, NWT
- ☐ Municipal
- ☐ Private
- ☐ Joint Venture

Performance Response:

- ☐ N/A or blank
- ☐ Engineering Design
- ☐ Operations and Maintenance
- ☐ Emergency Management
- ☐ Maintenance



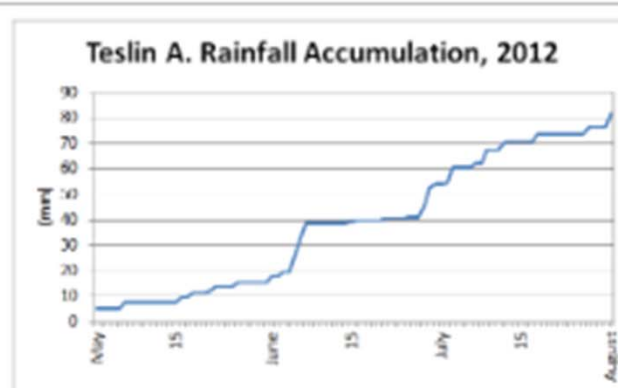
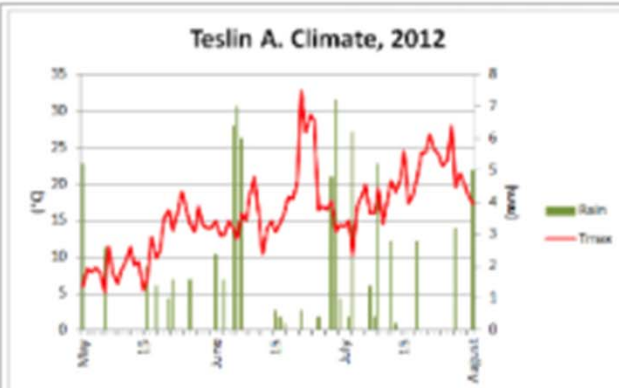
location	Highway 3, Deh Cho Bridge area
latitude	61.2646° N
longitude	117.5275° W
affected	Highway 1 Junction to Behchoko, NWT, incl. Fort Providence & Rae-Edzo, NWT
type	permafrost thaw
start	2013-5-16
end	
ongoing	N
description	<p>May 16 2013: Weight restrictions implemented due to conditions at Deh Cho bridge and along Hwy 3. Conditions were due to increased truck traffic from lack of delays crossing MacKenzie River, in combination with melt water also saturating ground under road. Trucks travelling between the Hwy 1 junction and Behchoko to be restricted to 75% full weight.</p> <p>This was the first ever weight restriction placed on Hwy 3, leading to increases in prices of goods and supplies. The Yellowknife Co-Op, for example, paid 34% more for groceries load. "This is the first time there has been a weight restriction on Highway 3. However, they are common at spring time in every jurisdiction in Canada," [Earl Blacklock, DoT spokesperson] said. It was never an issue on Highway 3 because breakup prevented traffic from crossing the river</p>
category	
component	
design	
jurisdiction	Territorial, NWT
age	
lifetime	
usage	
response	
codes	
elements	
measurements	
projections	
timeframe	
source	
implications	
adaptation	Weight restrictions implemented to prevent further increased damage to road. First ever case of such a measure taken for Highway 3.
effectiveness	While weight reductions reduce damage to the road, transportation efficiency is significantly reduced and causes increases in overall transportation costs. Impacts clearly exasperated by presence of bridge, which increased traffic efficiency at the cost of wear and damage to adjacent infrastructure under certain conditions.
casualties	
injuries	
loss	
notes	
references	NNSL.com: Laura Busch. 2013. Highway 3 truck traffic restricted. http://www.nnsl.com/frames/newspapers/2013-05/may20_13hwy.html

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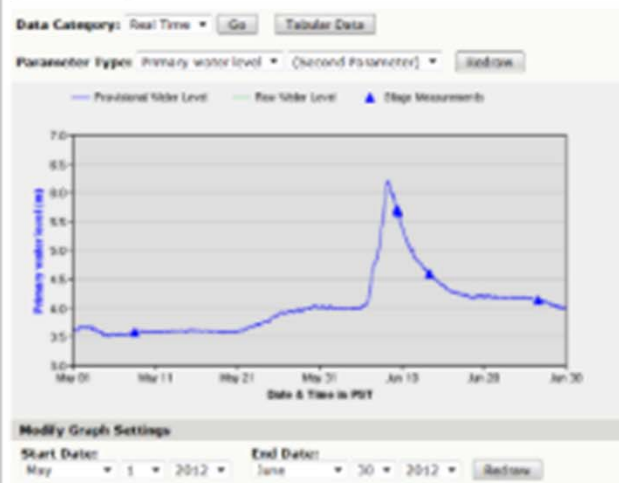
location	Alaska Highway, between Highway 37 Junction and Teslin, YT
latitude	60.0788° N
longitude	130.8278° W
affected	Teslin, YT
type	rain-on-snow, spring runoff, flooding
start	2012-6-12
end	
ongoing	
description	One of four major washouts in southern YT reported; Detour constructed by June 14th to allow traffic along route
category	
component	
design	
jurisdiction	
age	
lifetime	
usage	
response	
codes	
elements	

measurements	<p>Teslin A, Climate, 2012</p> <p>Teslin A, Rainfall Accumulation, 2012</p> <p>RIO CREEK AT KM 1084.8 ALASKA HIGHWAY (YT) (10AA095)</p> <p>Base Category: Real Time • [Data] [Station Data]</p> <p>Measurement Type: Precipitation (mm) • [Observation] [Station Data]</p> <p>Monthly Graph Settings:</p> <p>Open Date: 1 • 2012 • End Date: 30 • 2012 • [Station Data]</p>
projections	<p>GISS, 10.62W AOS Ensemble Spring Precipitation (mm)</p> <p>GISS, 10.62W AOS Ensemble Spring Snow (°C)</p>

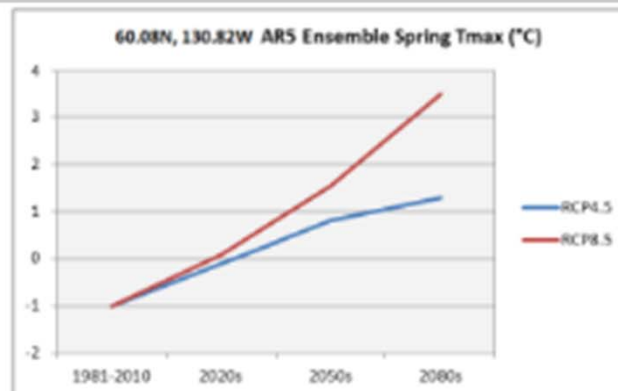
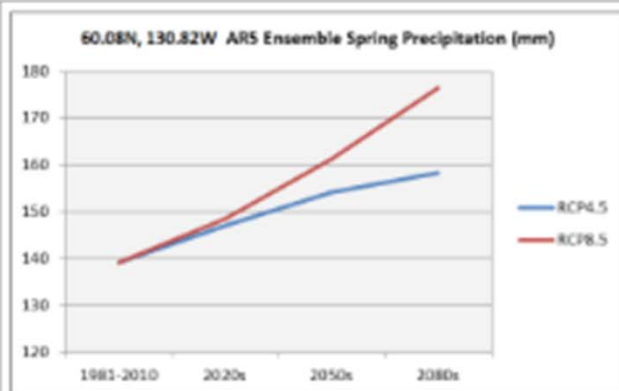
measurements



BIG CREEK AT KM 1084.8 ALASKA HIGHWAY [YT] (10AA005)



projections



Why?

September 20th, 2007: Dempster Hwy Caribou Creek
Culvert Failure (Morin 2007; NNSL)

“opinions were mixed”

“...it might be related to permafrost”

“Most likely it’s metal fatigue...”

Natural and/or human contributing factors

- Don’t know until investigated
- Usually *both*



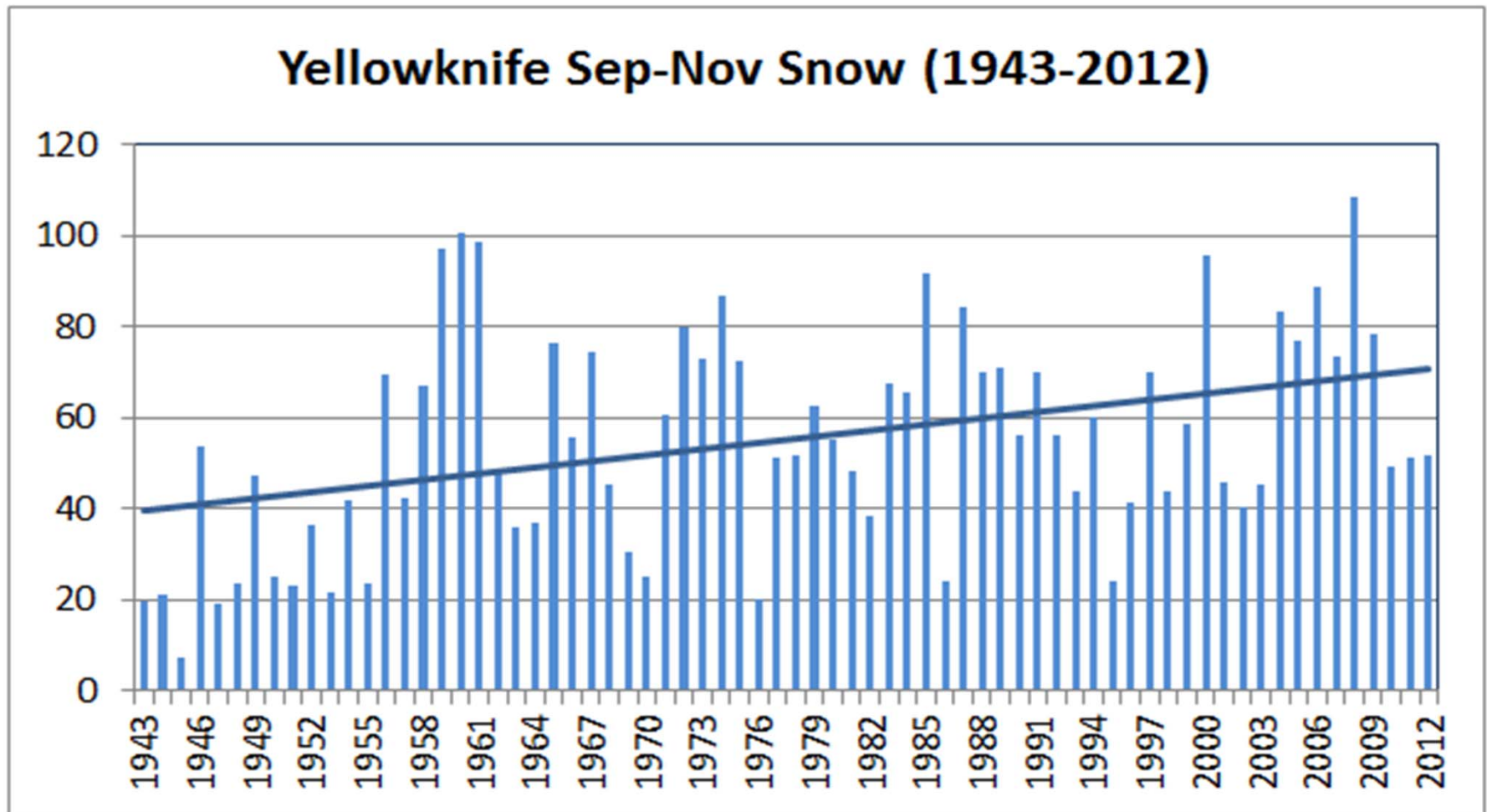
How?



- Multidisciplinary treatment
 - Engineering and management
 - Historical and future climate
- Automated reports and guidance
 - Individual and cross-incidence
 - Forensic analysis guidance
 - Examples
- Ultimate goal: *adaptation options*

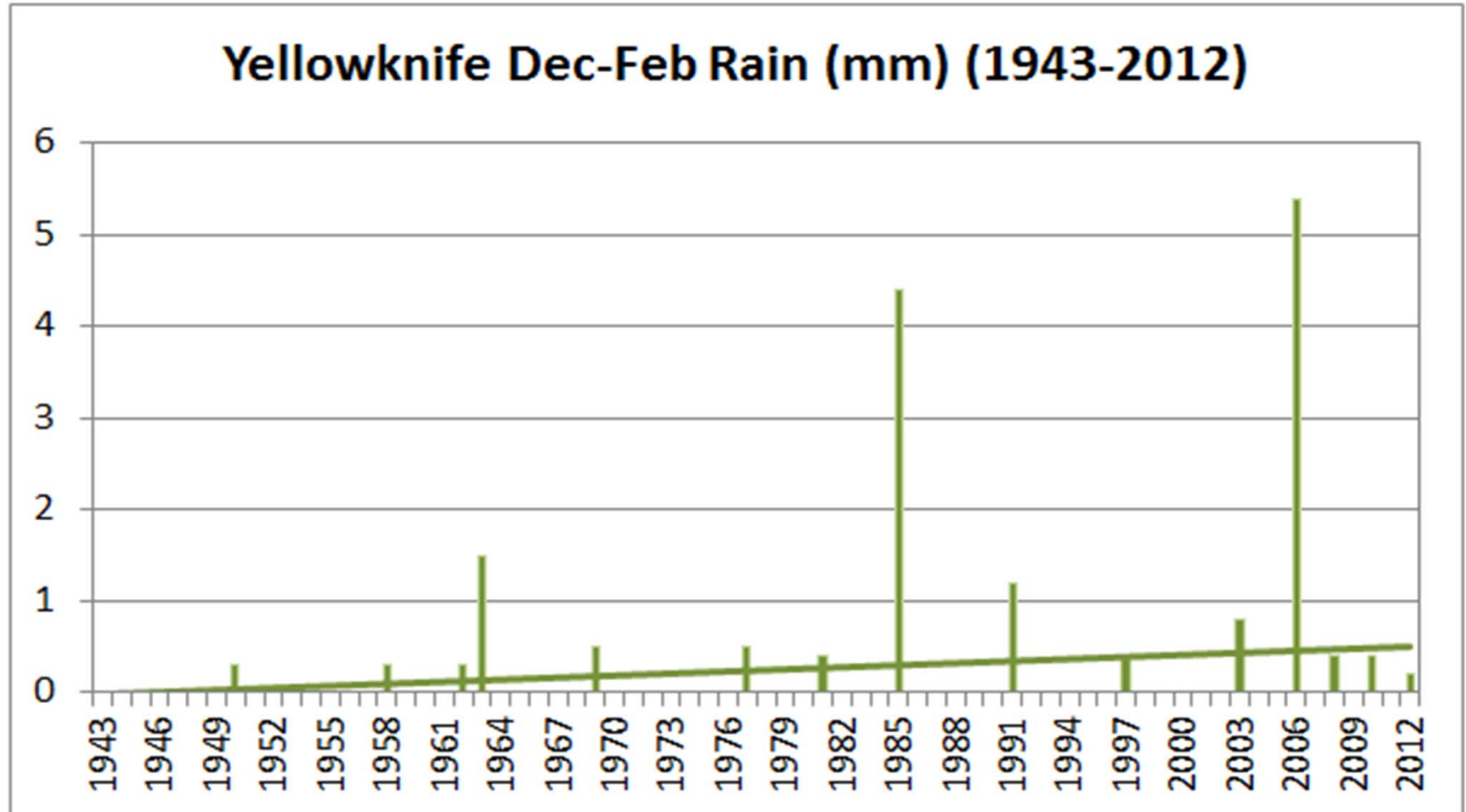


Precipitation and permafrost



Yellowknife's Changing Precipitation Regimes

Precipitation and permafrost



Precipitation changing along with temperature

Gaps



- Data for populating events
 - Engineering content
 - Infrastructure system
 - Timeline
- Observational climate/weather data

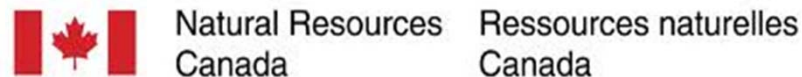


Next steps

- Data population = largest effort
- Expansion:
 - Geographical (NU, Provinces)
 - More hazards
 - New sectors
- Integrate Feedback



Project partners and funder



Funding from Natural Resources Canada in support of Canada's Adaptation Platform Northern Working Group