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BUILDING A **SAFE** AND **RESILIENT CANADA**

Data and Science in Emergency Management: Answering Risk Questions to Support Policy and Operations

CIROH Developers Conference 2026
Salt Lake City, Utah
May 29, 2026

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Canada

Introduction

Objective:

To share Canada's recent work building data, science and engineering into Emergency Management and federal Public Safety programs.

Public Safety Canada: Data, Science and Engineering in EM

What is the current state of data, science and engineering in Federal Emergency Management?

- Canada is / was behind many of our G7 partners
- Government Operations Centre (GOC)
- Prime Minister Trudeau 2021 Mandate Letter:

"incorporate the use of data and science in all aspects of Emergency Management"

- Chief Science Officer Report 2024:

Strengthening the Use of Science for Emergency Management in Canada

Public Safety Canada Programs

The Government of Canada is advancing several flood risk reduction initiatives, to increase flood resilience across Canada. Four main hazard risk management initiatives were funded as components of integrated flood risk management in Budget 2023 and 2024:

1. Implement a **modernized Disaster Financial Assistance Arrangements (DFAA) Program**, which would incentivize mitigation efforts
2. Stand up a low-cost **Flood Insurance Program** aimed at protecting high-risk households
3. Identify **Federally Identified Flood Risk Areas (FIFRA)** for federal government purposes
4. Create a publicly accessible online Flood Risk Awareness Digital Resource for Canadians (**Canada's Flood Risk Finder**)

In addition, Public Safety houses the Government Operations Centre (GOC) and coordinates with many other federal departments and agencies.

Answering Risk Questions

At Public Safety, our Data Science and Engineering Team works with a network of government, NGO, academic, and private sector partners to answer specific Risk Questions.

Hazard – Exposure – Vulnerability – Risk

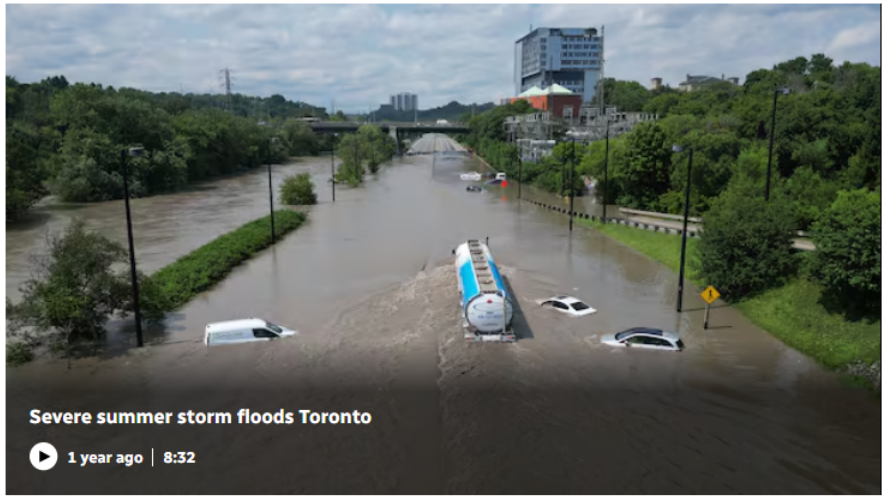
We can define risk in an almost infinite number of ways, depending on the specific use case, decision point, or outcome. Our work focuses on multidisciplinary collaboration to define and answer specific risk questions supporting real-world decision-making.

A Brief History of Flood Risk Management In Canada

Severe Toronto storm causes flooding, major power outages

Storms from London to Toronto lined up 'like jumbo jets on the airport tarmac': climatologist

Rochelle Raveendran, Lucas Powers · CBC News ·
Posted: Jul 16, 2024 10:29 AM EDT | Last Updated: July 16, 2024



A severe storm dumped more than 10 centimetres of water on Toronto, causing flash floods, closing highways, and knocking out power for thousands. Experts say Toronto and other communities need to expect more severe weather because of climate change.

- Hurricane Hazel 1954
- Provincial Flood Risk Management
- Federal Roles: PS, NRCan, ECCC, ISC / CIRNAC
- Flood Damage Reduction Program (FDRP)
- 2013 Calgary Floods
- National Disaster Mitigation Program (NDMP)
- Flood Hazard Identification and Mapping Program (FHIMP)
- First Nations Adapt
- Current State

Answering Risk Questions: Financial Risk Use Case

A federally-backed Flood Insurance Program in Canada will necessarily be using some big financial levers, and different program designs will ultimately have different answers to the big question: **who pays for what?**

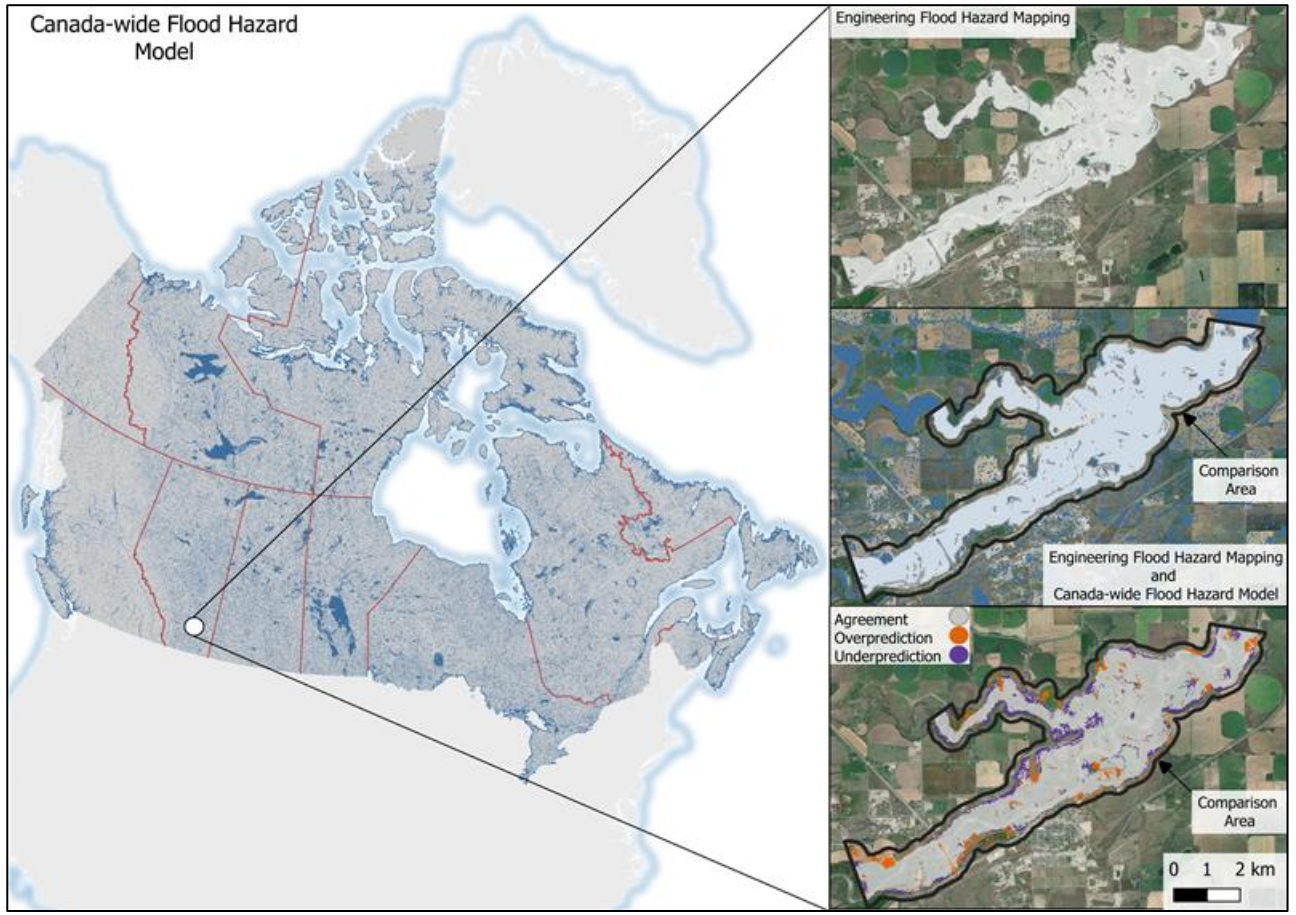
In addition, there's a 'short blanket' issue with different goals of incentivizing risk reduction, and offering financial protection to homeowners.

Before we hand financial flood risk data to the actuarial teams and political decision makers, there's a whole lot of hydrology, hydraulics, and exposure analysis to do.

Flood Hazard: Global Flood Hazard Models

Another Brief History

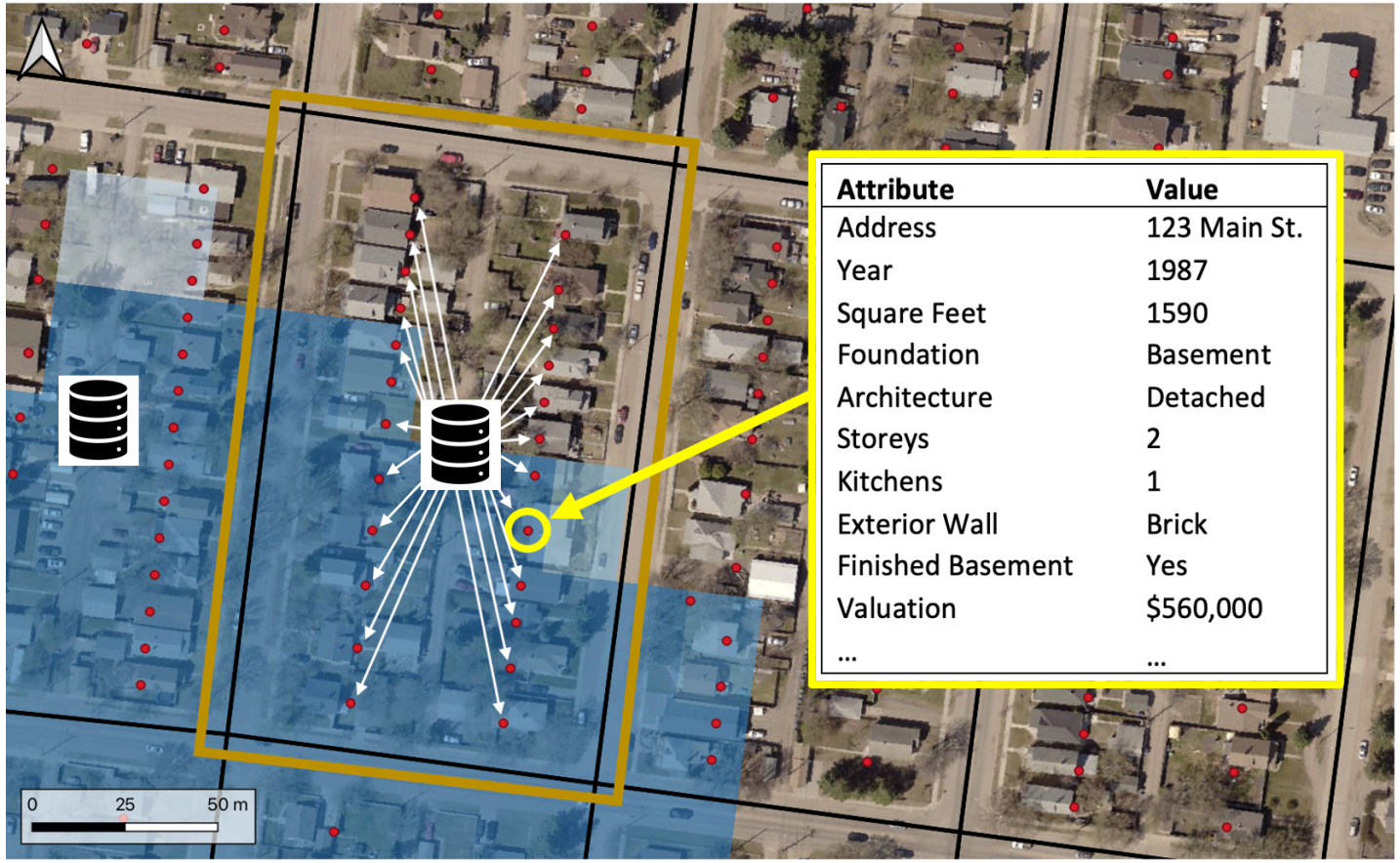
- 2018 Model Assessment
- 2020 Procurement of three Canada-wide Flood Hazard Models
- 2022 First Financial Risk results
- 2024 Open-Tender Procurement



Exposure Data: Synthesis

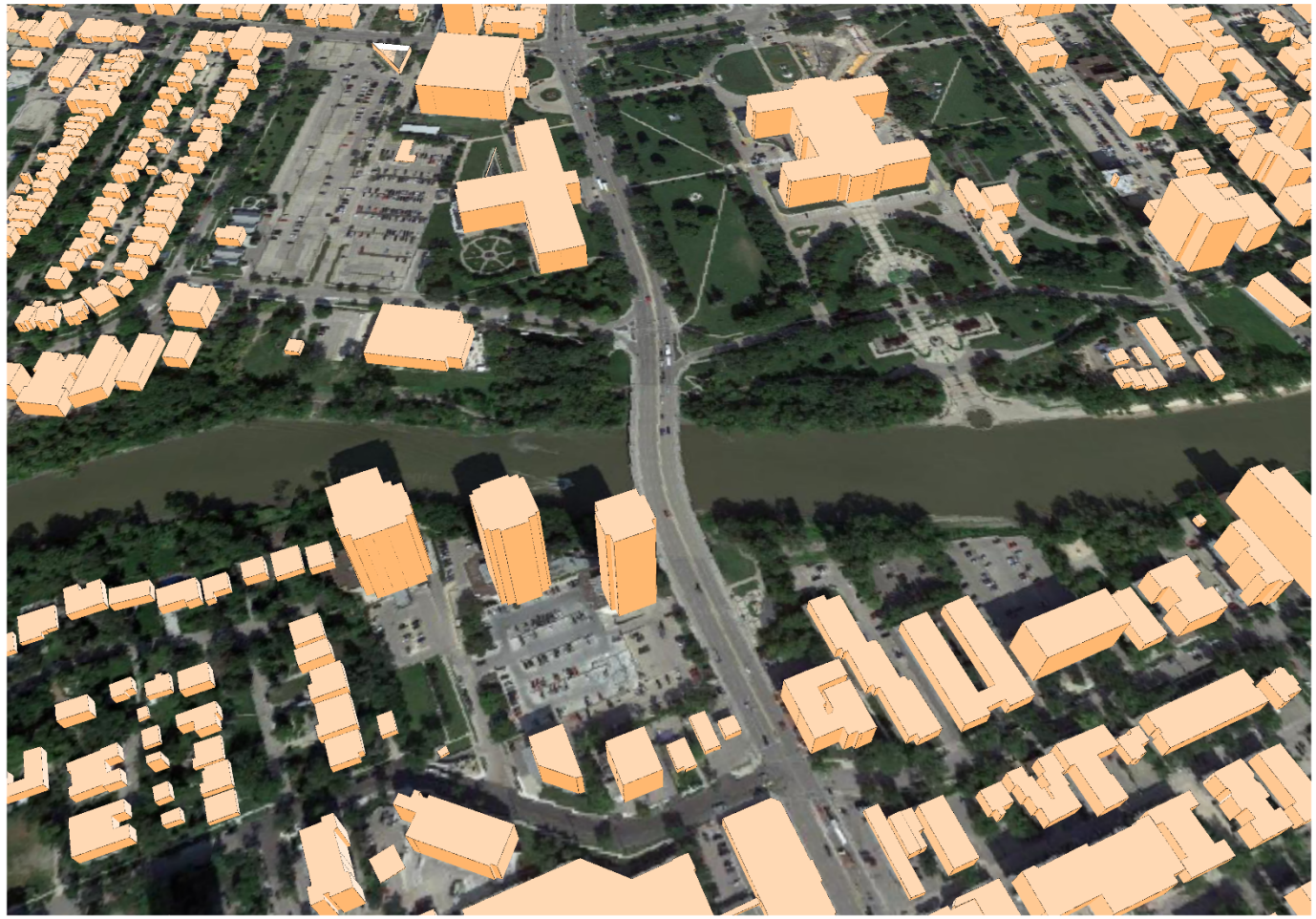
Exposure Data

- Opta – Verisk
- DMTI
- Open Street Maps
- Microsoft Buildings
- Statistics Canada
- Internal analysis and data synthesis



Exposure Data: Canada Structures

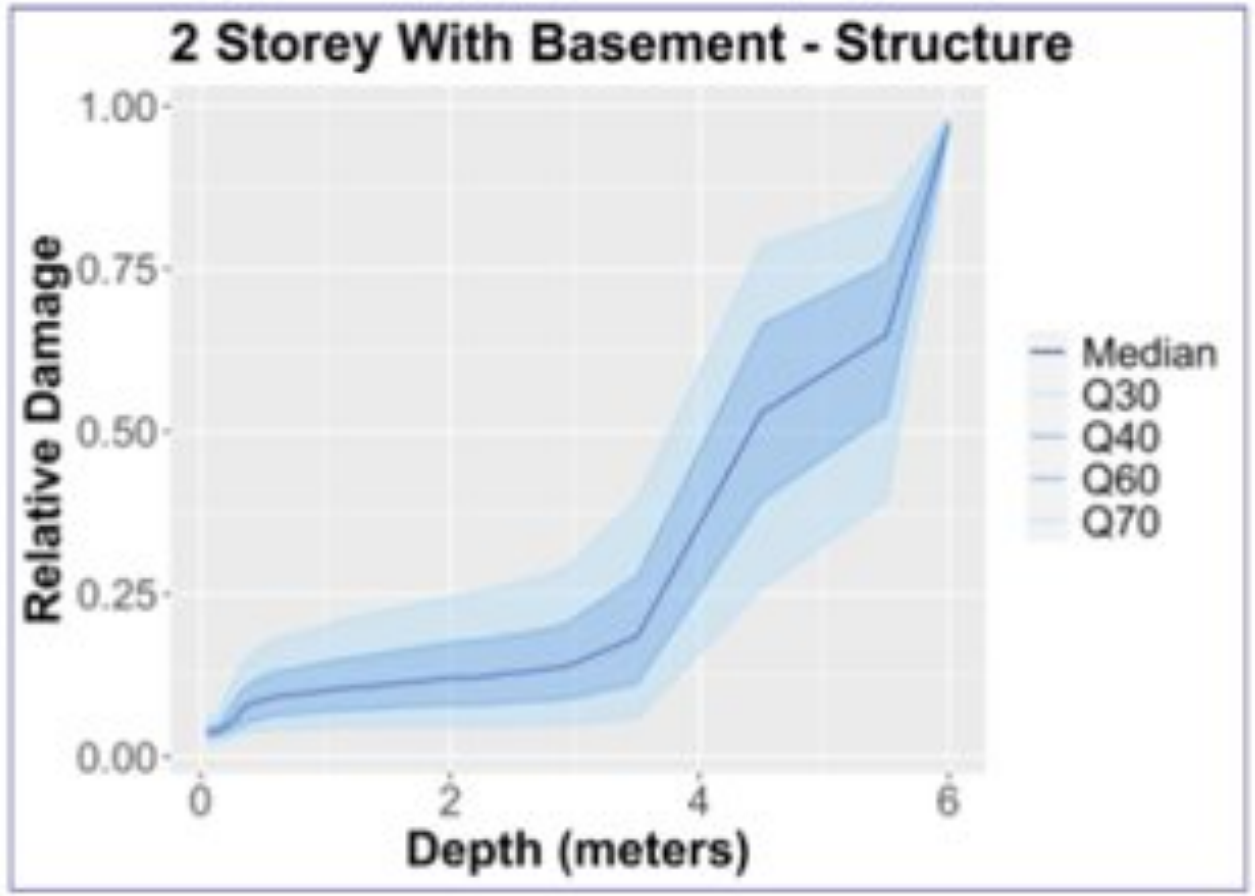
Current Attributes
Building Footprints (shapefile) (from OSM, ODB, MCBF)
Building Centroid (csv) (from building footprints)
Building Name (from OSM)
Building Use (residential, commercial) (estimated from OSM landuse)
Building Area (estimated from building footprint)
Building Height (from High Resolution Digital Elevation Model)
Number of Stories (estimated from height)
Number of Units (estimated from area and height)



Damage Estimation

Depth-Damage Curves

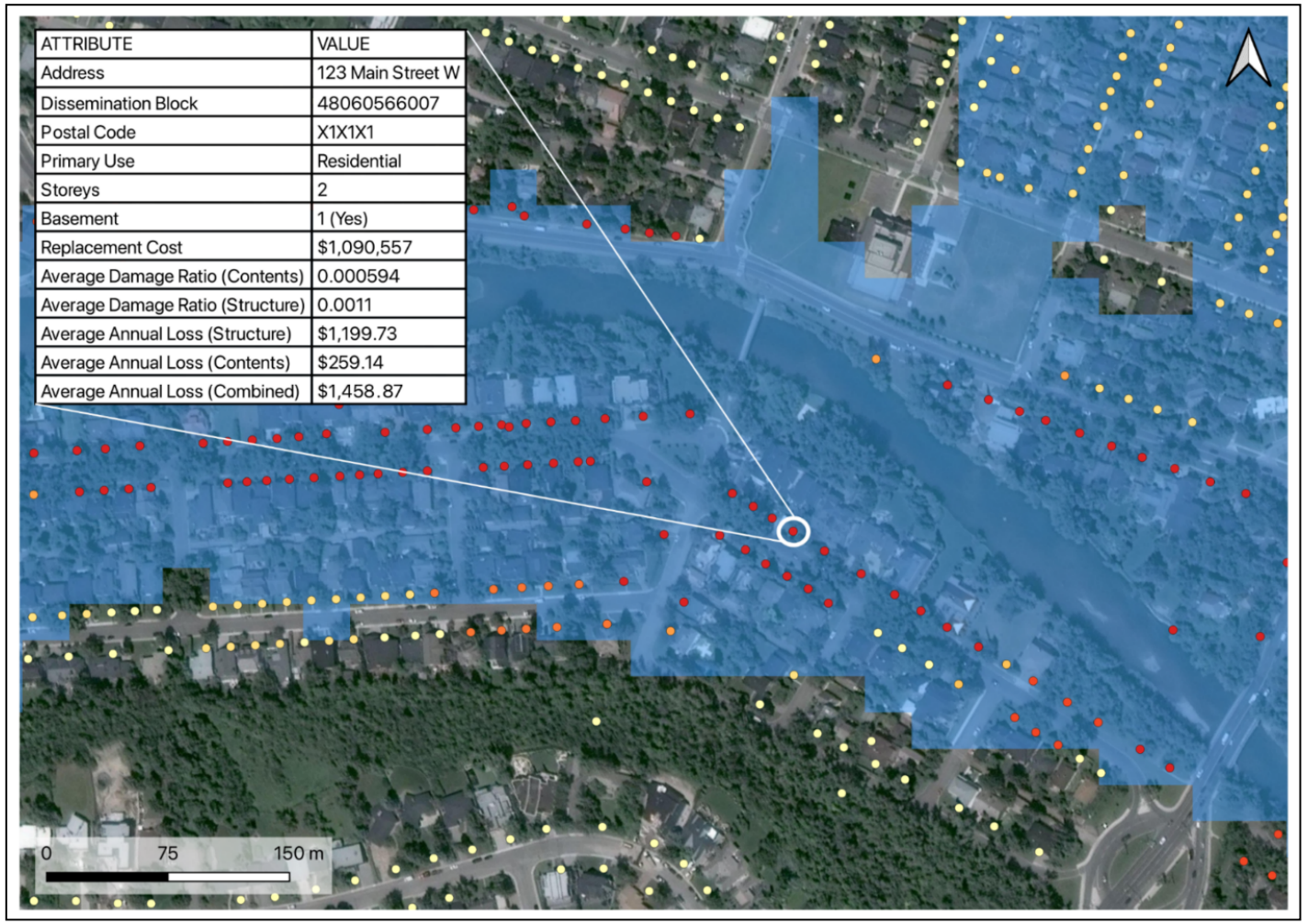
- Four different damage estimation methodologies have been used for previous analyses, giving a range of six different AAL estimates
- Current model runs use curves developed by Fathom, which are close to the mean model estimate



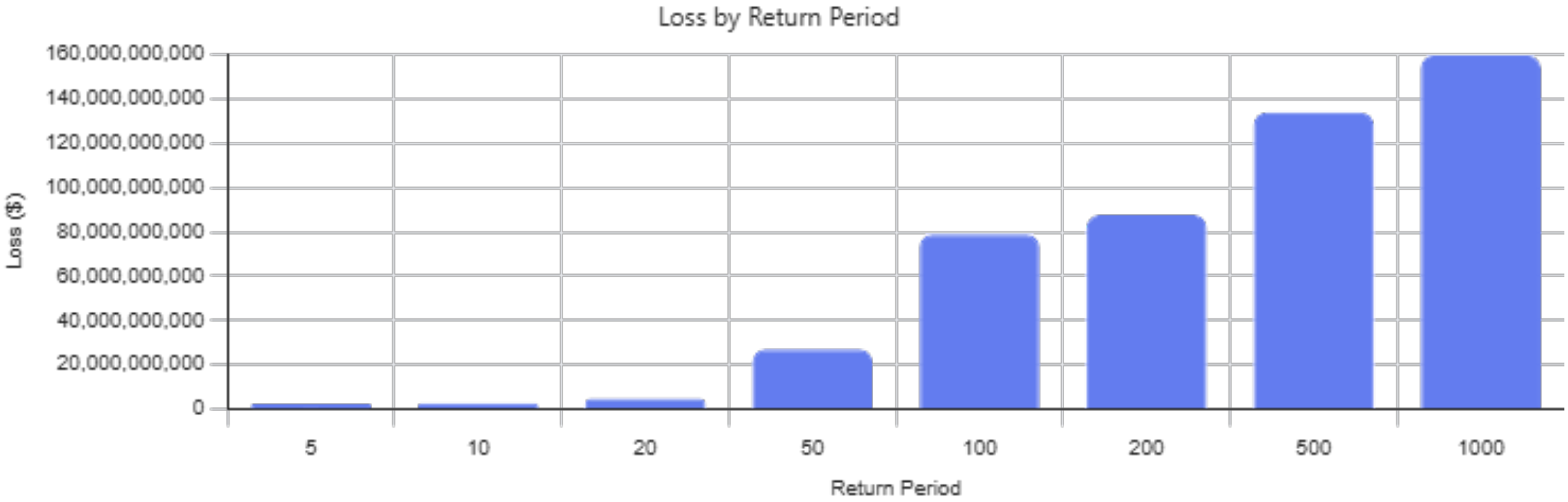
Financial Risk

Financial Risk Results

- Different ways of looking at financial risk
- Primary analysis used Average Annual Loss
- We can also look at loss at the event level
- Loss information is rolled up for actuarial teams looking at Flood Insurance program design

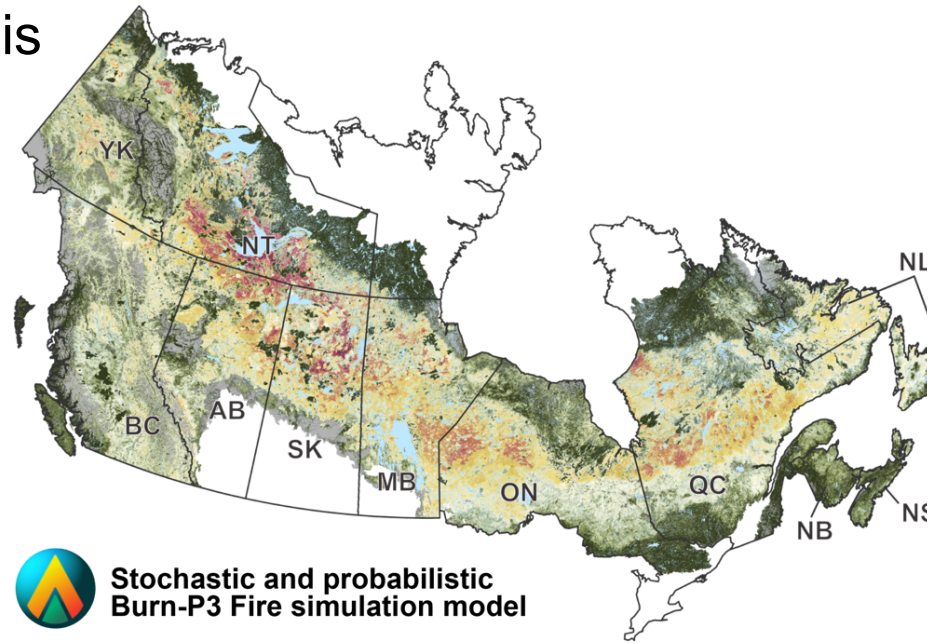


A Few Interesting Results

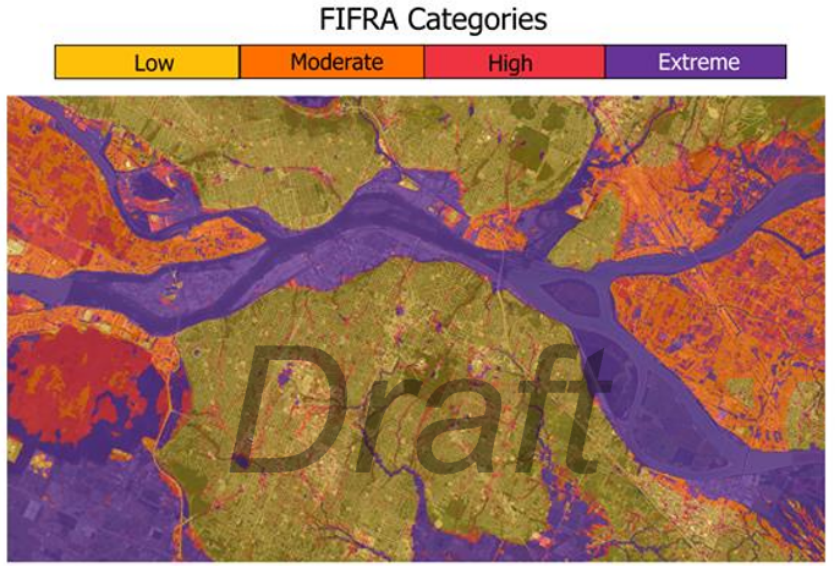


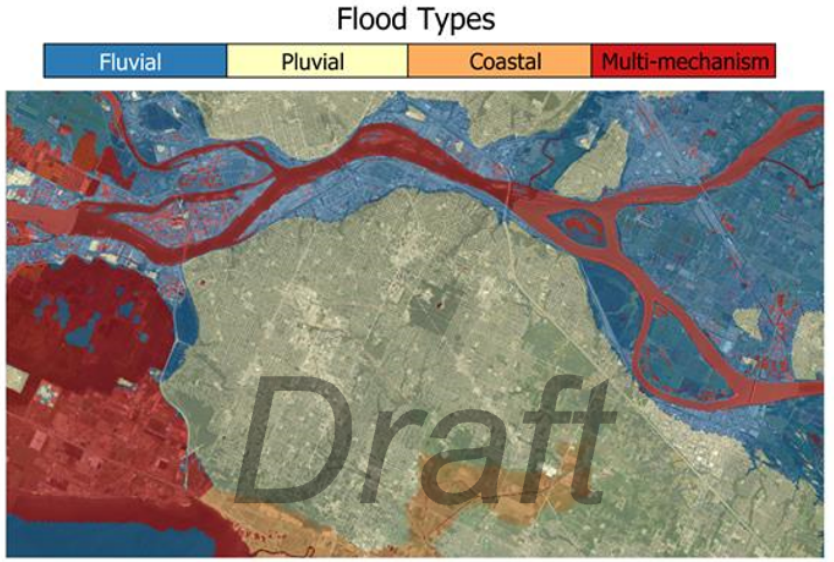
What's Next?

- Federal Emergency Management: Operations Support
- Disaster Financial Assistance Arrangements (DFAA)
- Federally Identified Flood Risk Areas (FIFRA)
- Canada's Flood Risk Finder Public Resource
- Multi-hazard Analysis
- Flood Insurance
- Open-FRANC
- Collaborations!



Stochastic and probabilistic Burn-P3 Fire simulation model





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Disclaimer: you may hear the term ‘floodplain mapping’ used colloquially in Canada, when inundation mapping or flood hazard mapping is more appropriate. It’s a bit like how we use ‘Sea-doo’ to refer to personal watercraft. Also, the original name for ‘Sea-doo’ was ‘Sea-dog’, but the font used was unclear and ‘Sea-doo’ stuck. We are aware of this issue and are working to correct this historical wrong (the floodplain mapping one).

Canada