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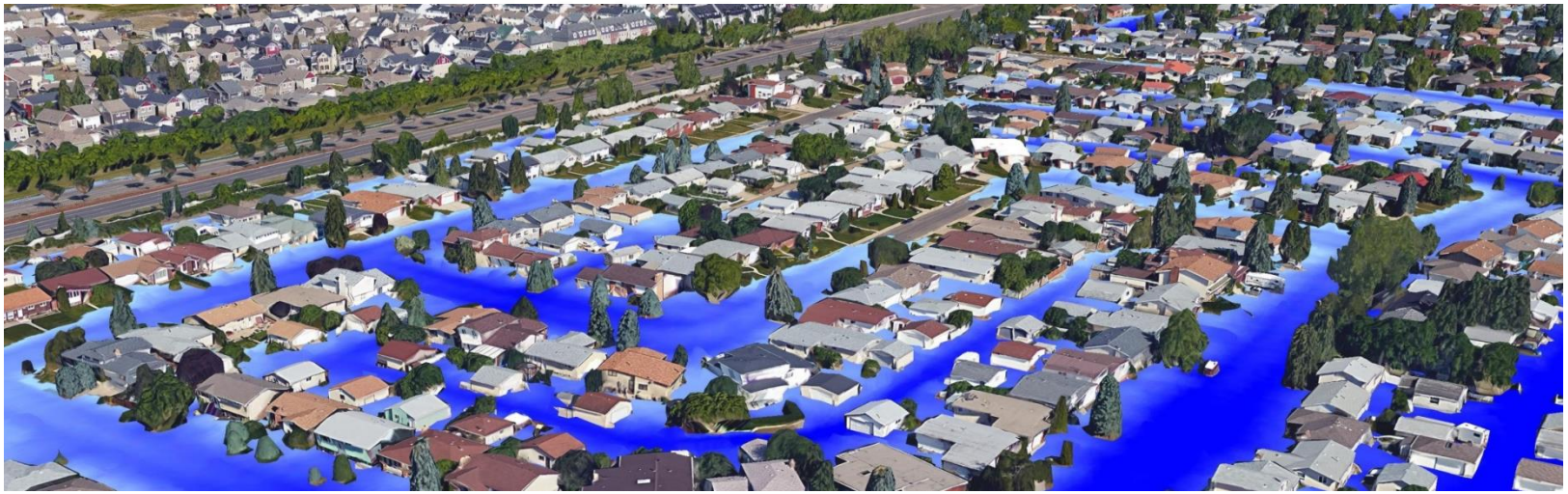
GLOBAL PERSPECTIVE.
LOCAL FOCUS.

Climate Change Adaptation: Moving from Risk to Resilience



John van der Eerden, M.Eng., P.Eng.

CPAA, Red Deer, Alberta, May 3rd, 2016

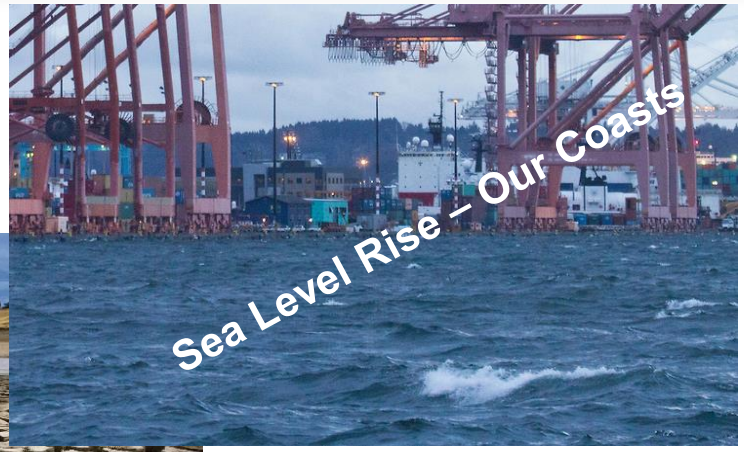
CANADA'S BEST MANAGED COMPANIES
Platinum member

Adaptation

- *Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities (IPCC, 2001a).*

Photo: Pacific Institute for Climate Solutions: Climate Insights 101

Impacts of Climate Change



Climate Change Adaptation: From Risk to Resilience

- Changing Climate
- Identifying Risk
- Assessing Risk
- Managing Risk: Building Resiliency

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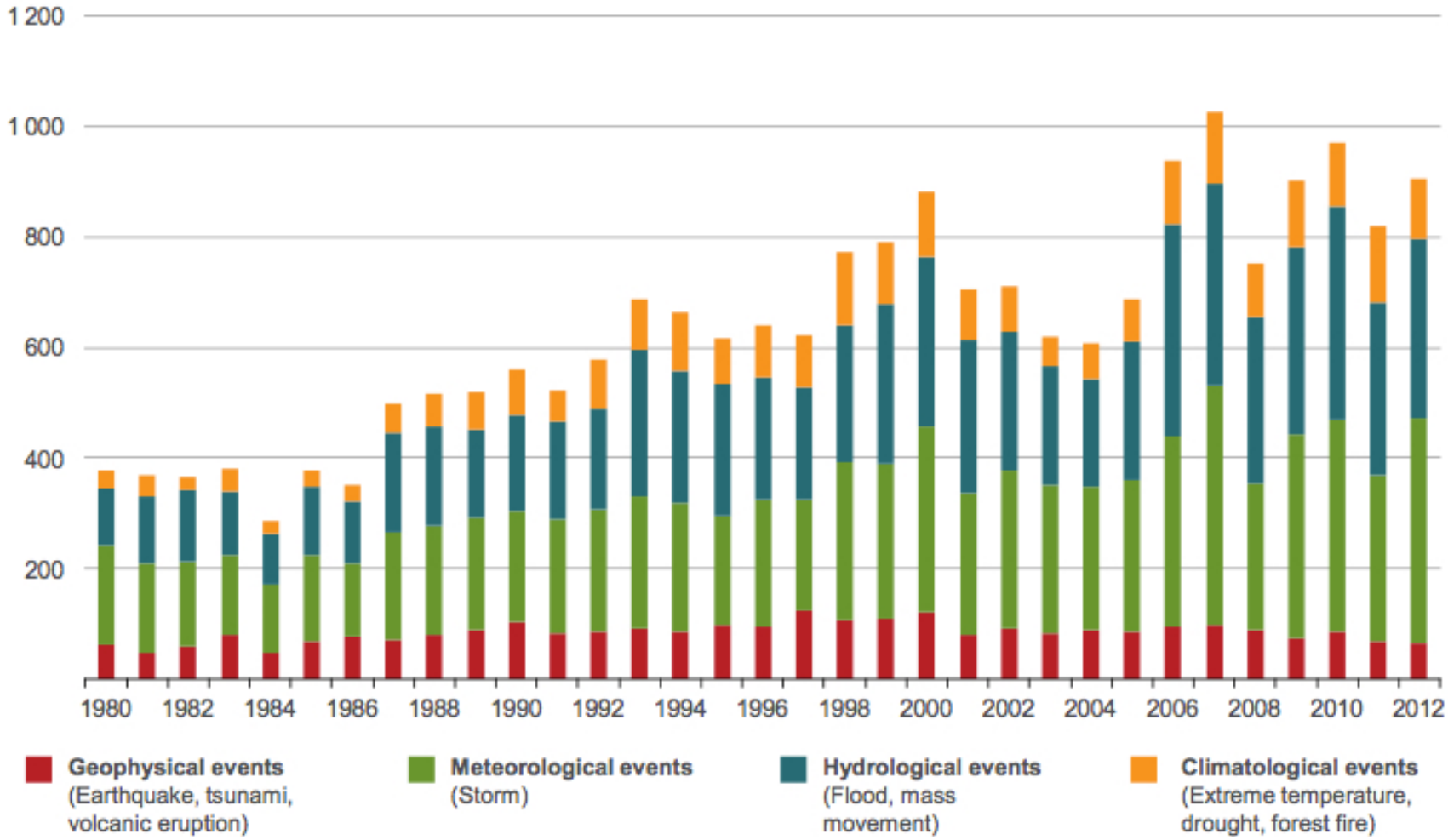
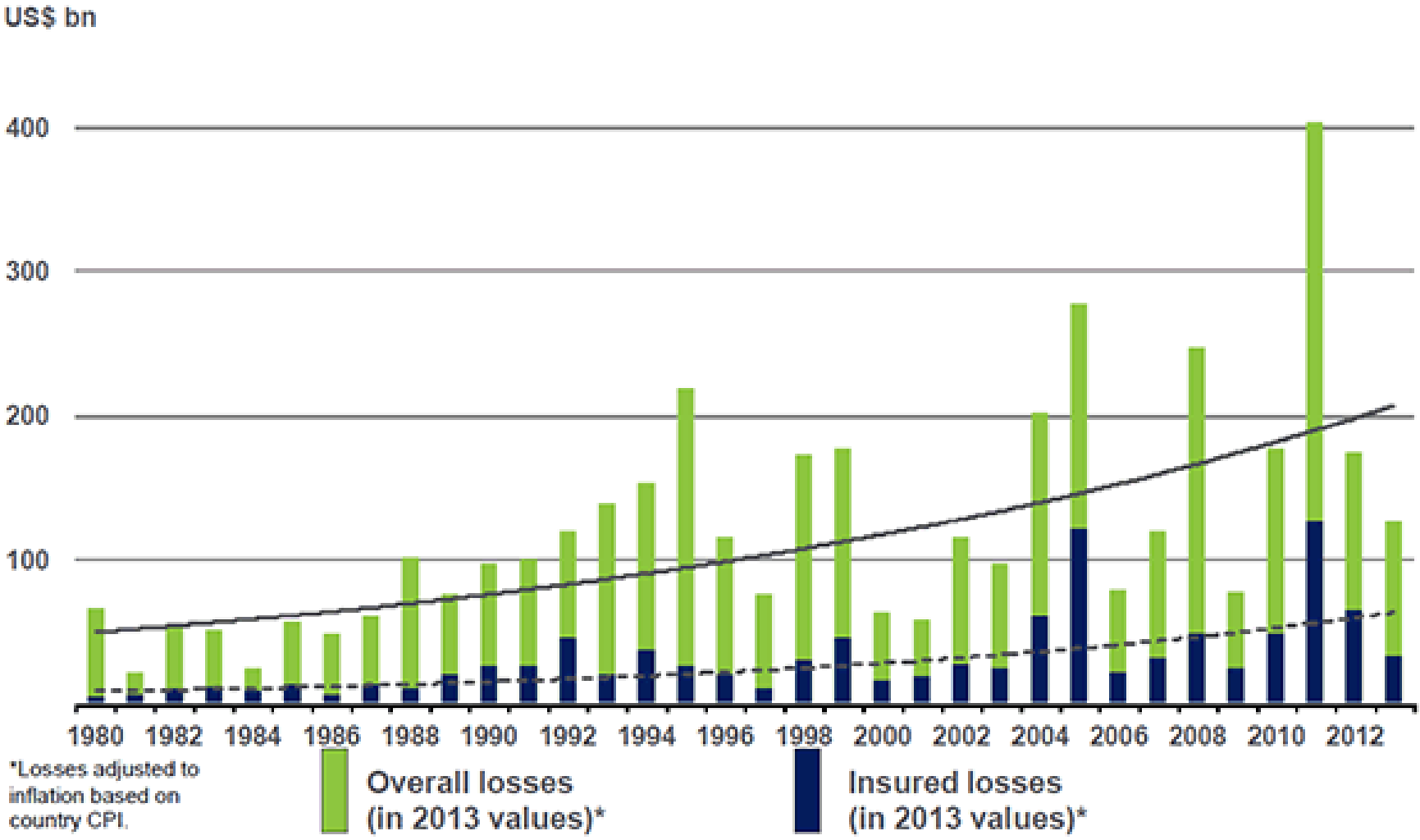
Natural Catastrophes Worldwide 1980-2012

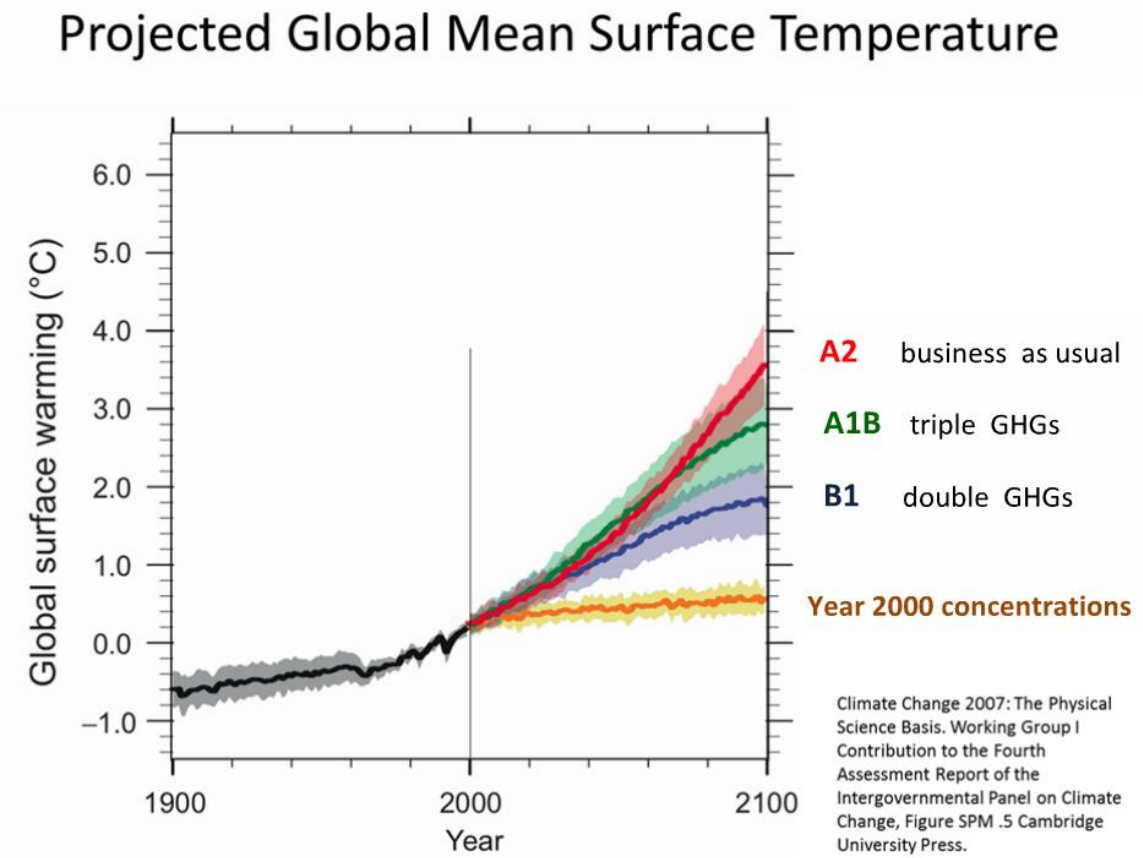
Number of Events



Cost to Society



SRES Emission Scenarios



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Climate Risk

Credit:: Pacific Institute for Climate Solutions: Climate Insights 101

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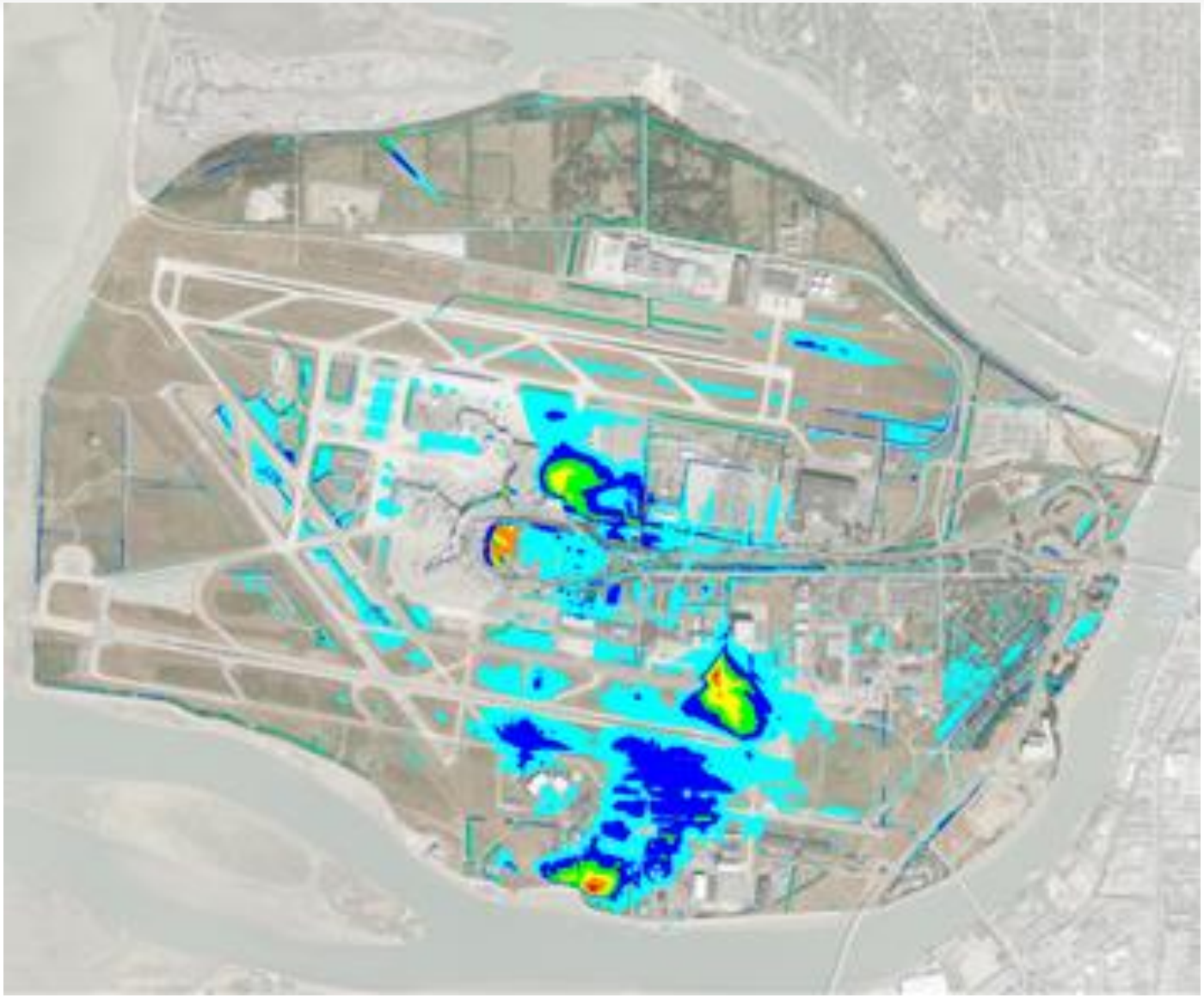
How do we identify flood risk?

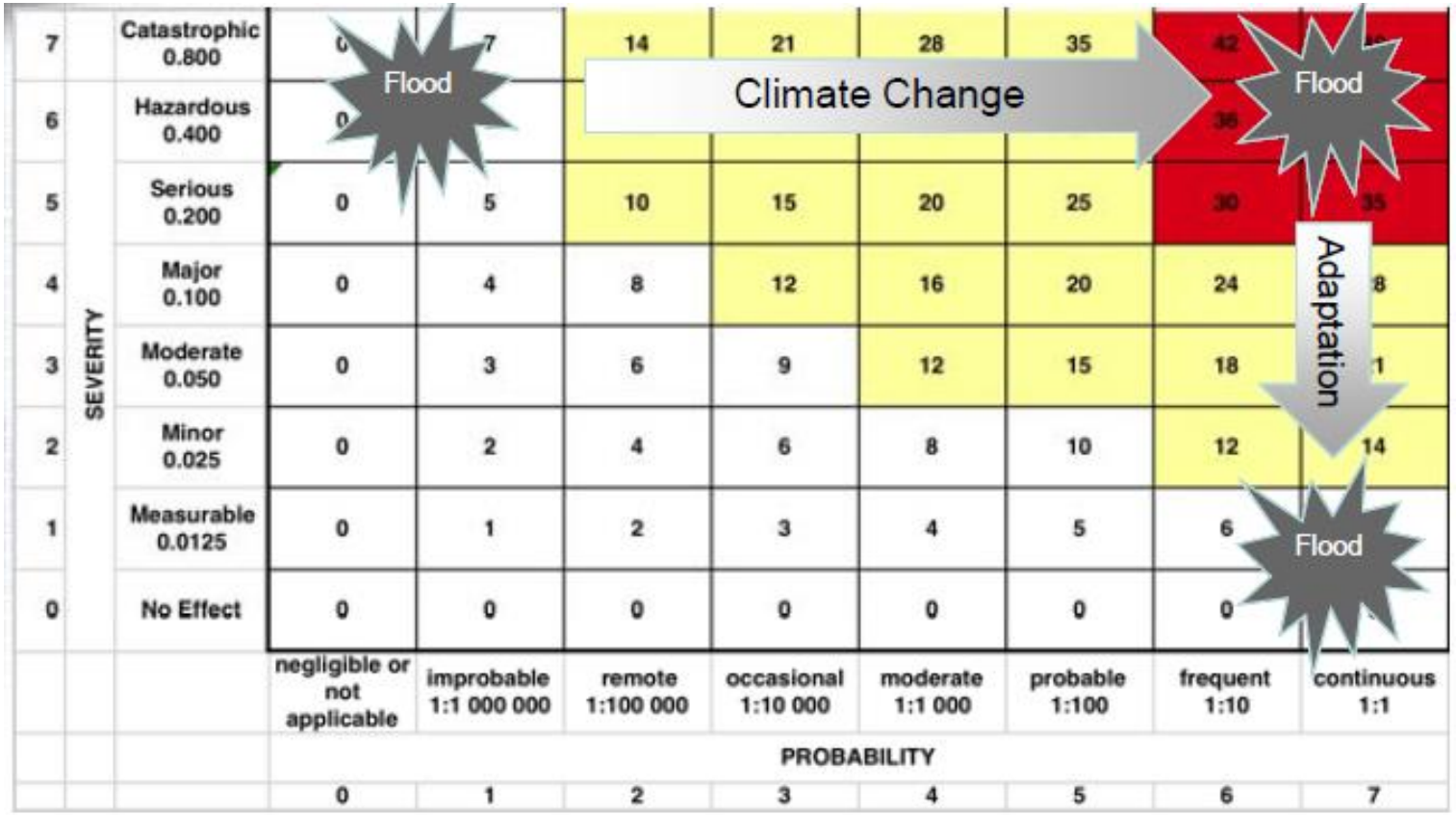


Planning Tools

- PIEVC Protocol
- The Public Infrastructure Engineering Vulnerability Committee's - Climate Change Vulnerability Tool.
- Engineers Canada (regulates the practice of engineering in Canada)/NRCAN
- To ensure that professional engineers and geoscientists always consider climate change impacts as an integral part of all projects.

- CREAT (US EPA)
- Climate Resilience Evaluation and Awareness Tool (CREAT)
- Developed to assess Water and Wastewater facilities

Risk Table



	SEVERITY								
7		Catastrophic 0.800	0	7	14	21	28	35	42
6		Hazardous 0.400	0						36
5		Serious 0.200	0	5	10	15	20	25	30
4		Major 0.100	0	4	8	12	16	20	24
3		Moderate 0.050	0	3	6	9	12	15	18
2		Minor 0.025	0	2	4	6	8	10	12
1		Measurable 0.0125	0	1	2	3	4	5	6
0		No Effect	0	0	0	0	0	0	0
			negligible or not applicable	improbable 1:1 000 000	remote 1:100 000	occasional 1:10 000	moderate 1:1 000	probable 1:100	frequent 1:10
			PROBABILITY						
			0	1	2	3	4	5	6

David Lapp, P.Eng., Professional Practice Engineers Canada
Ontario Centre for Engineering and Public Policy, 2011

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Flood Risk at Varying Scales

- River Flooding
  - Impacted by Climate Change?
- Small Watercourses
  - Impacted by Climate Change
- Urban Drainage
  - Most Impacted by Climate Change

Increasing Flood Likelihood

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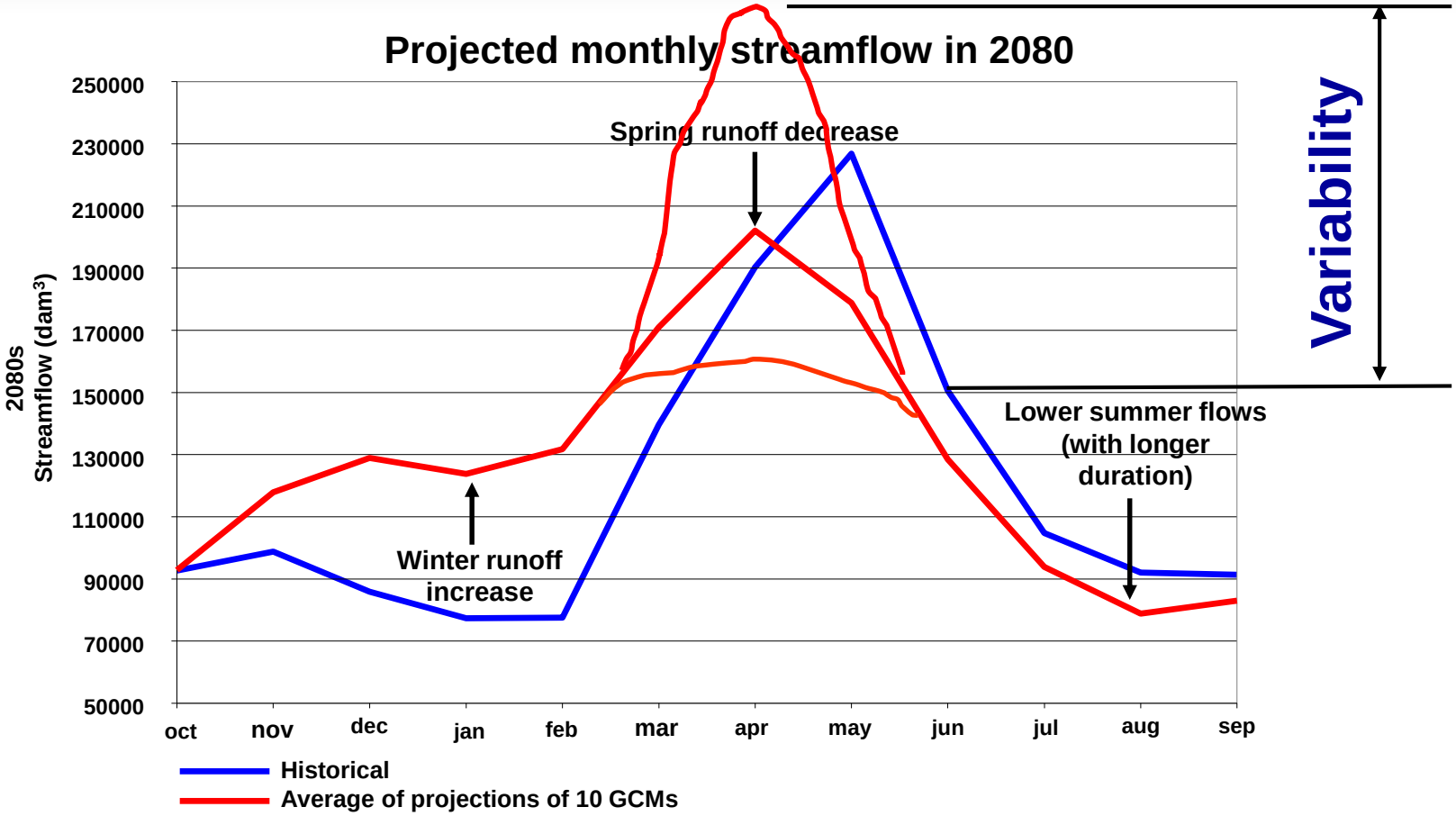
Rivers in Southern Canada

Okanagan River at Oliver



Recreated from Hamlet et al. (2010)

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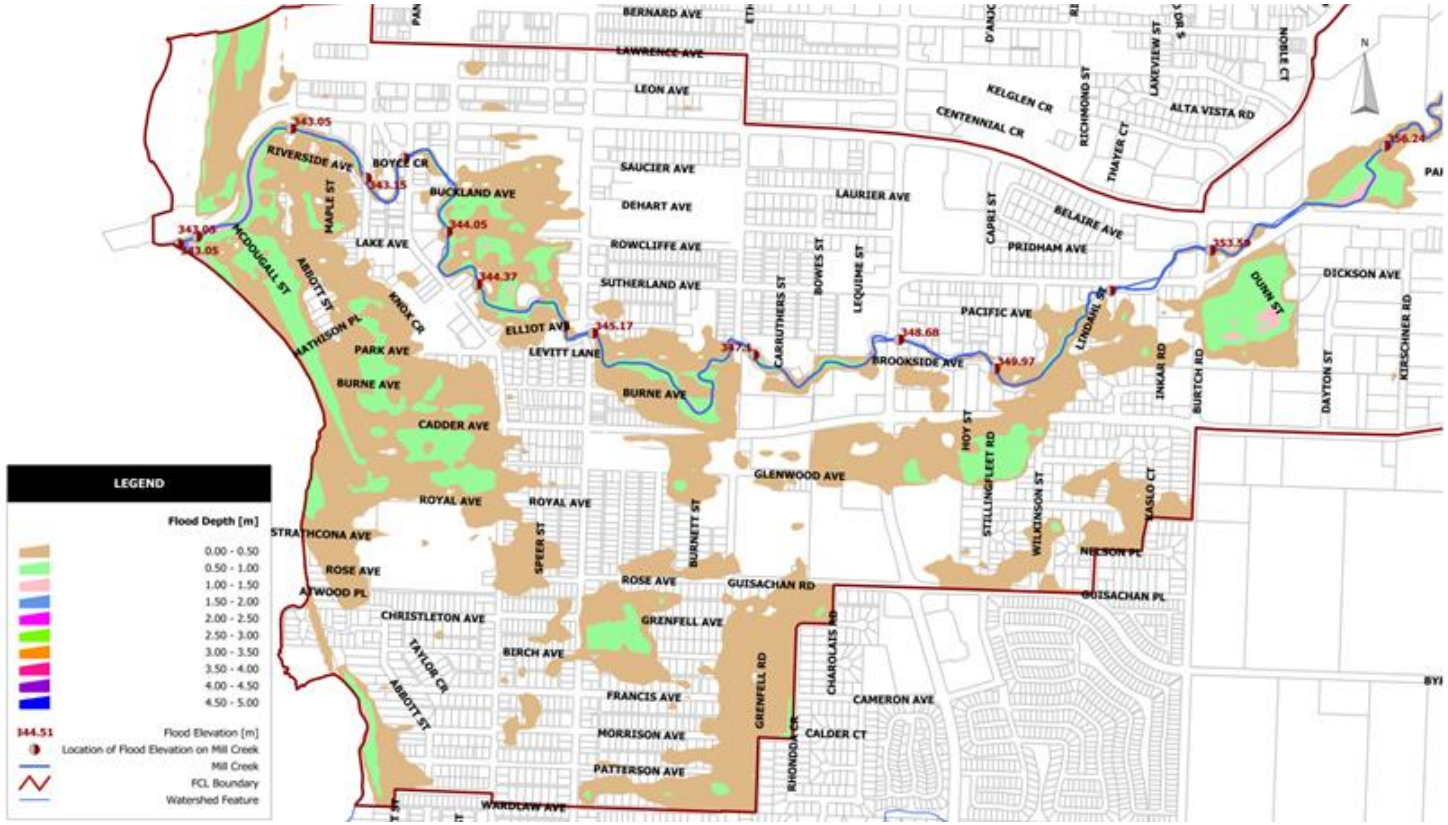
Small Watercourses

- Mill Creek, Kelowna

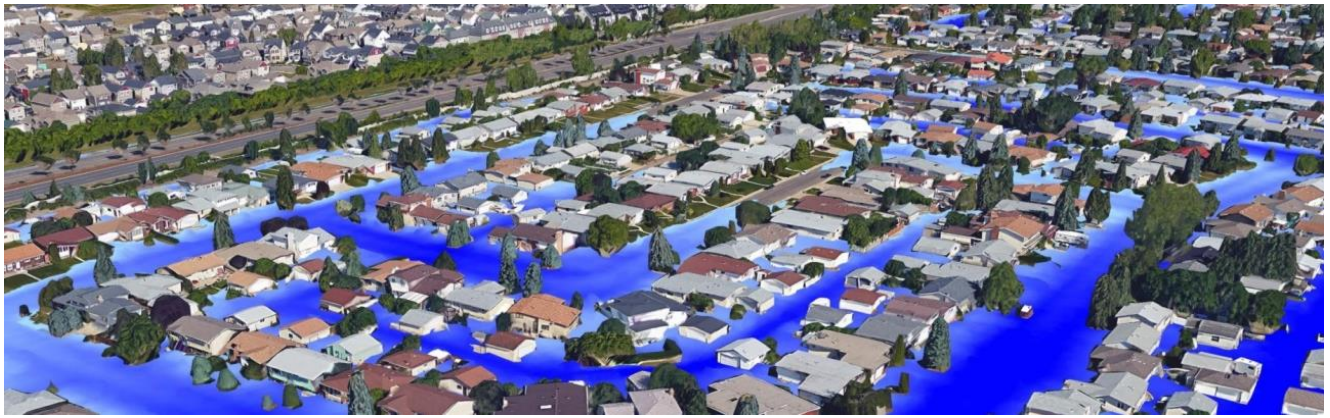


Urban Drainage

Toronto Flooding

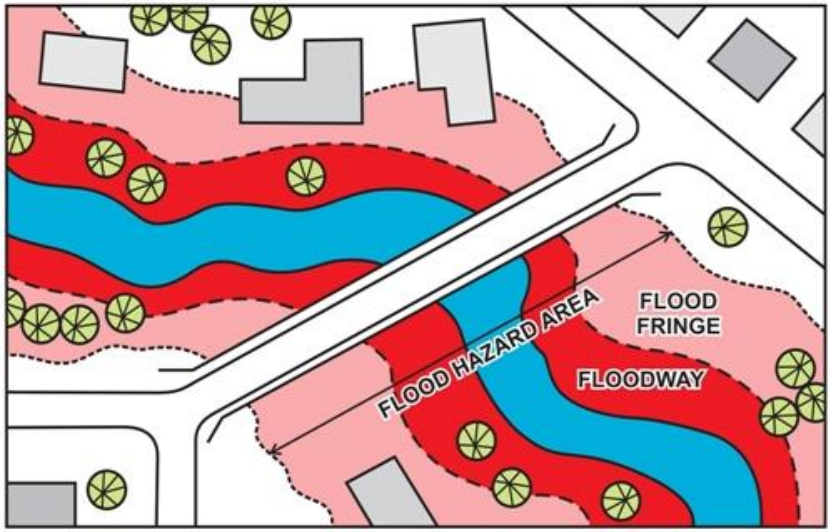
Overland Flood Insurance

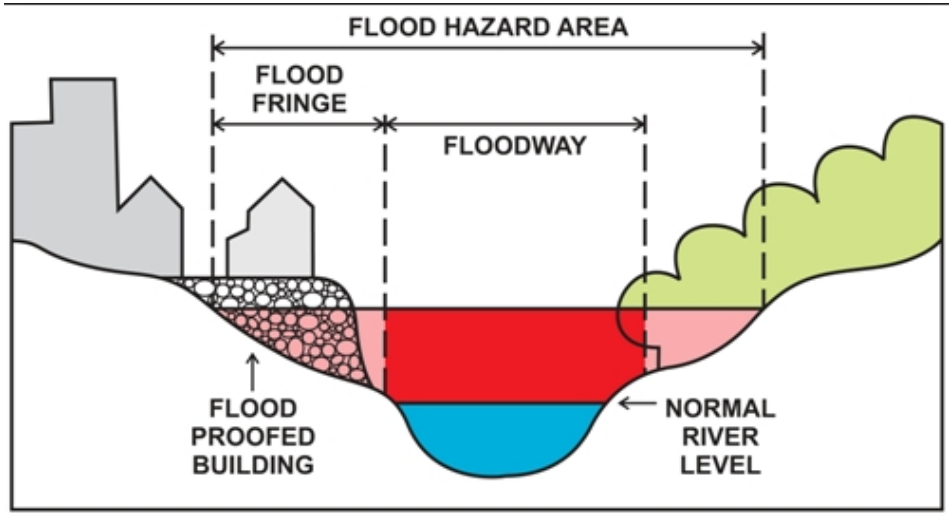
- Canadian Flood Damage Assistance
- Setting Insurance Premiums
  - Probability and exposure?
  - Value of losses?
  - Spread the premiums
- The 19%



Floodplain Mapping

- Federal Government developing a National Floodplain Mapping Guideline
- Water Management is a Provincial responsibility
- Standards across provinces vary





Flood Protection Adaptation

- Non-Structural
  - Room for the River
  - Managed Retreat
  - FCL Controls/MBE Bylaws
- Structural
  - Dyking (Flood boxes and Pump Stations)
  - Diversion
  - Storage

Room For the River

- Phrase coined by the Dutch
- Recognizes that rivers infrequently spill over their banks
- Floodways provide conveyance
- Flood fringe provides storage and natural landscape

Managed Retreat

- Usually higher risk, lightly developed areas
- Relocate floodplain encroachments
- May be more cost effective to relocate assets
- Alberta example

Dyking

- Dykes encroach on the floodplain
- Increased water levels
- Pump Stations and floodboxes
- Erosion protection and seepage control

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FCL's/MBE's

- Flood Construction Level
- Minimum Building Elevation

Images: Pacific Institute for Climate Solutions: Climate Insights 101

Watershed-Based

- Diversion
- Storage

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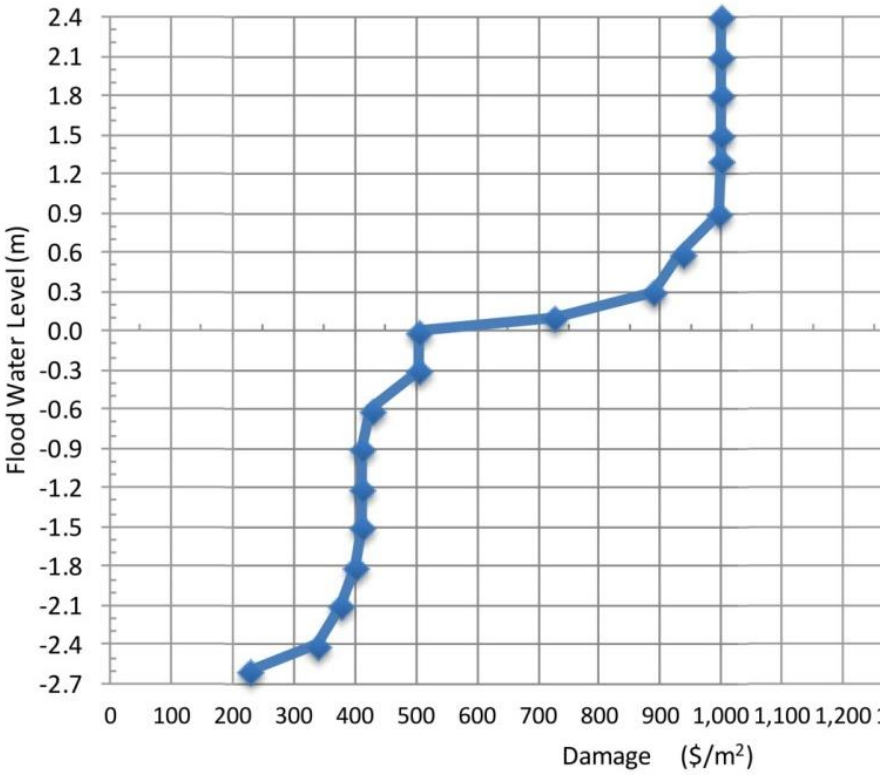
Flood Risk Mapping

Modeling Building Damage

- Depth-Damage Curves



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Modeling Building Damage

Type of Buildings

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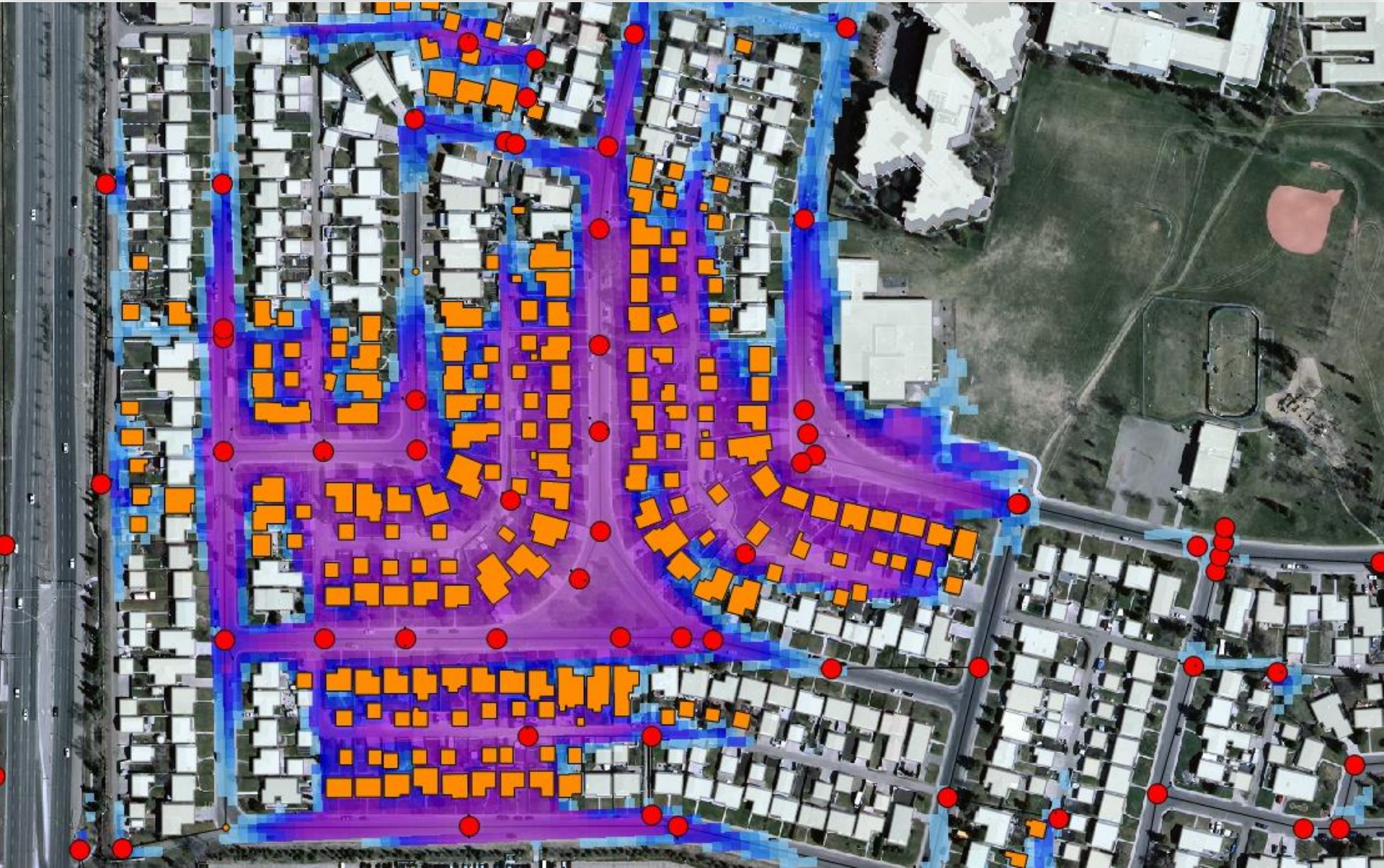
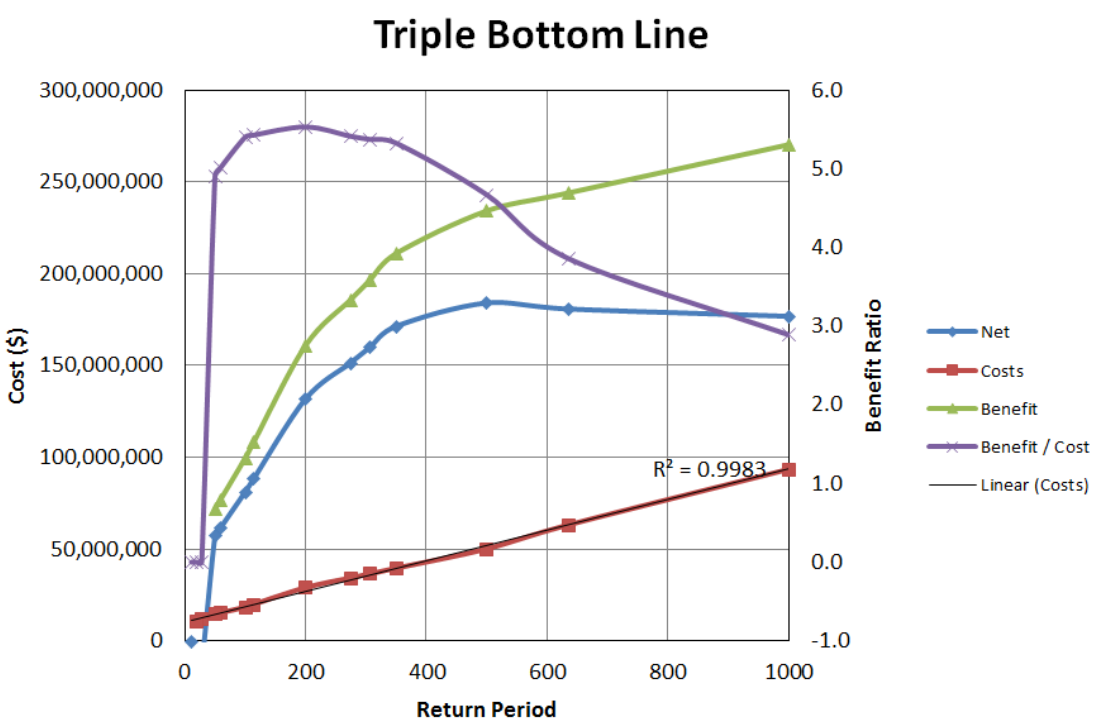
Flood Damage/Averted Flood Damage

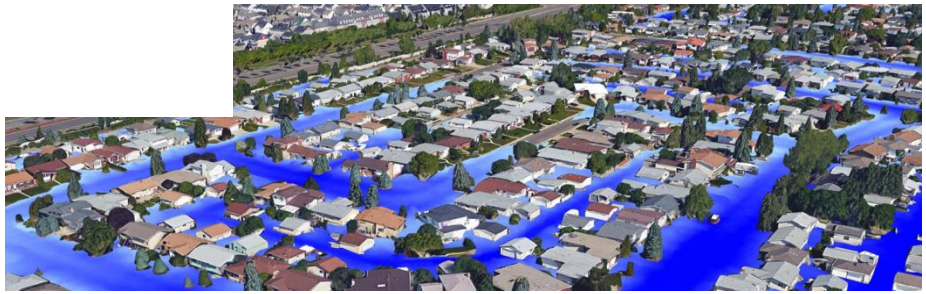


Urban Networks

- Adaptation Strategies:
  - Source Controls
  - BMPs
  - Bigger Pipes
  - Floodproof (grading bylaws, MBE, backflow preventers)
  - Purchase flood prone properties
  - Accept risk

Urban Flooding TBL Example





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Questions?

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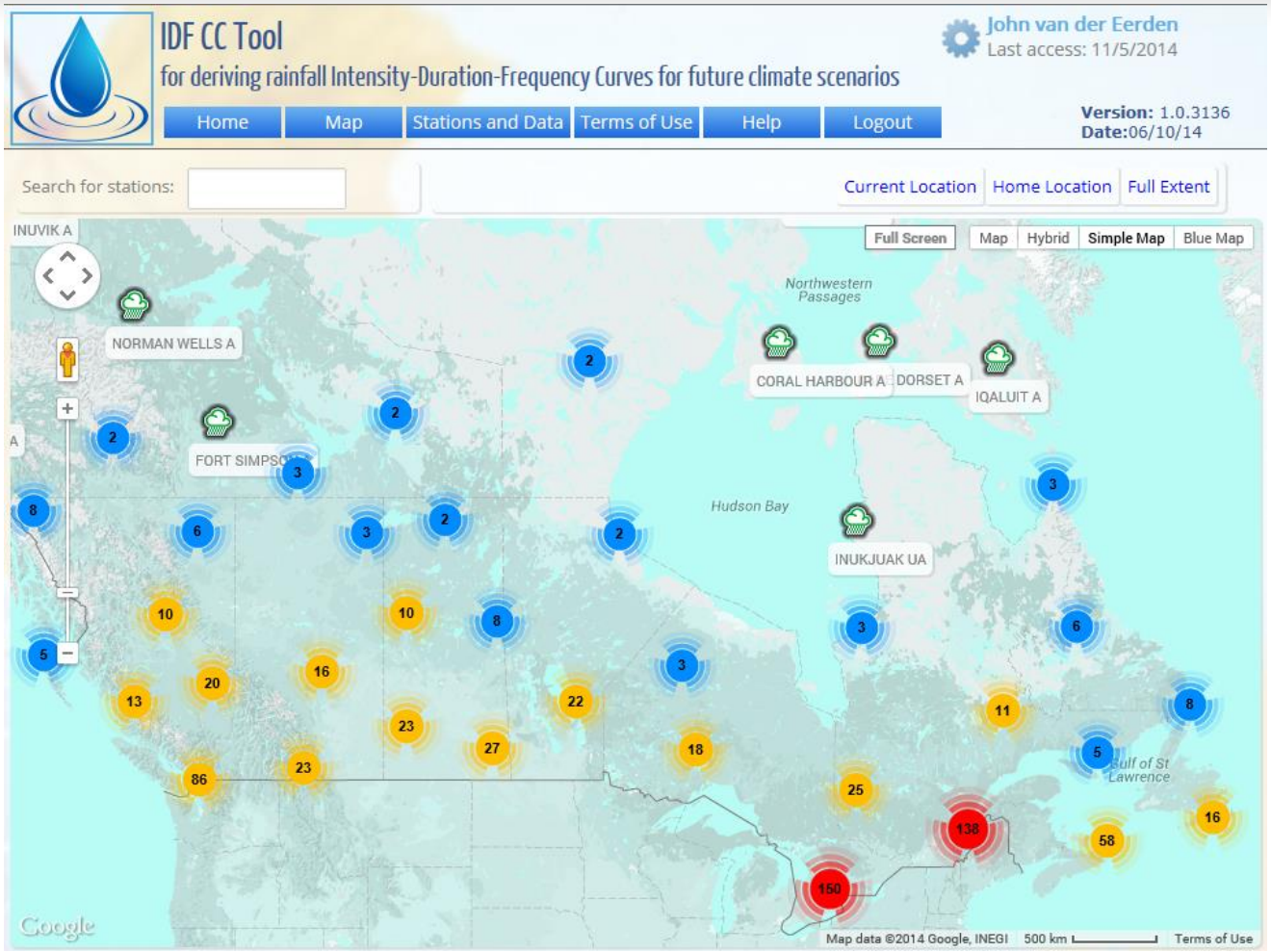
IDF Climate Change Calculator



Western University
Canadian Water Network

Western
CANADIAN WATER NETWORK
RÉSEAU CANADIEN DE L'EAU

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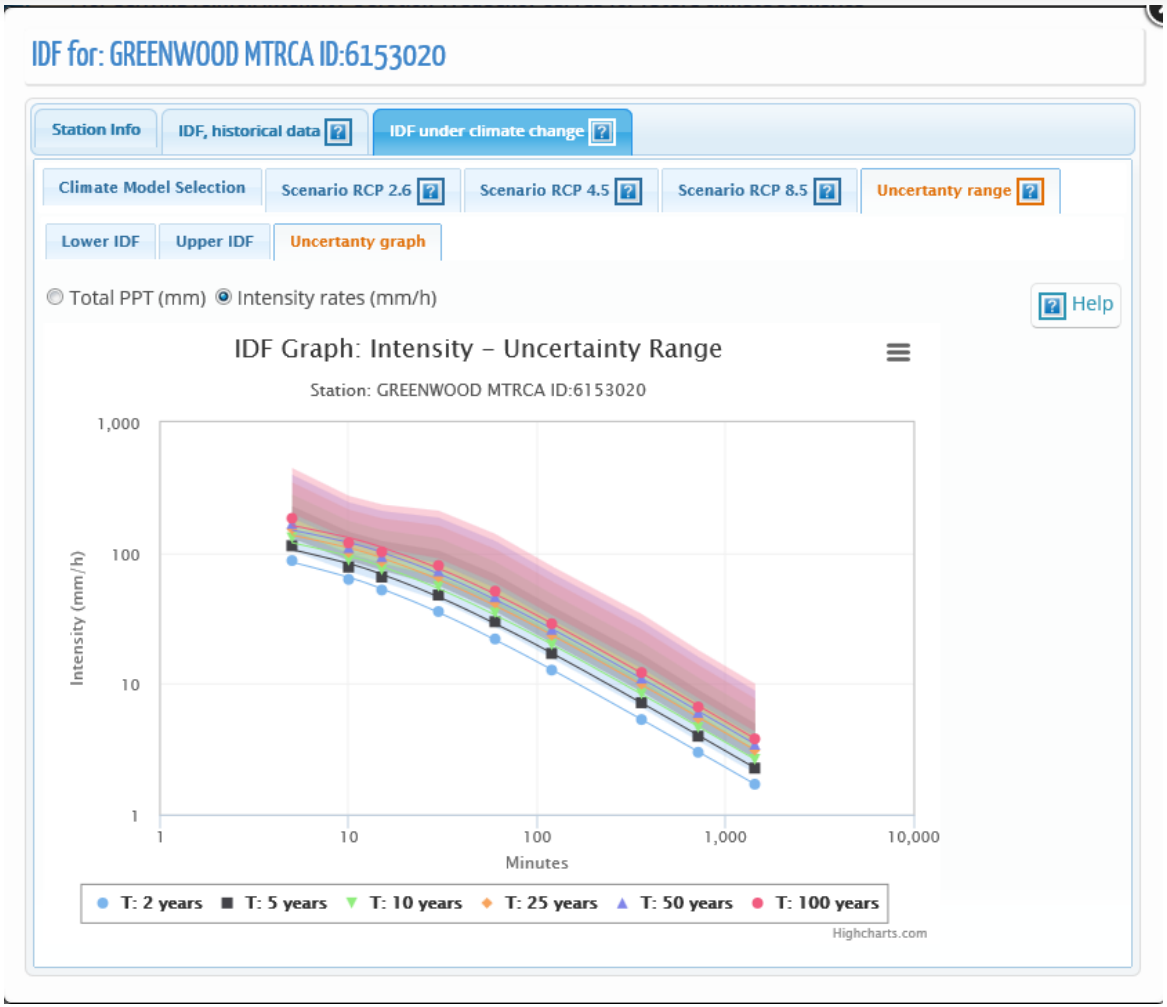
IDF CC (Western University/Canadian Climate Network)



Western

CANADIAN WATER NETWORK
RÉSEAU CANADIEN DE L'EAU

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Risk-Based Flexible Design

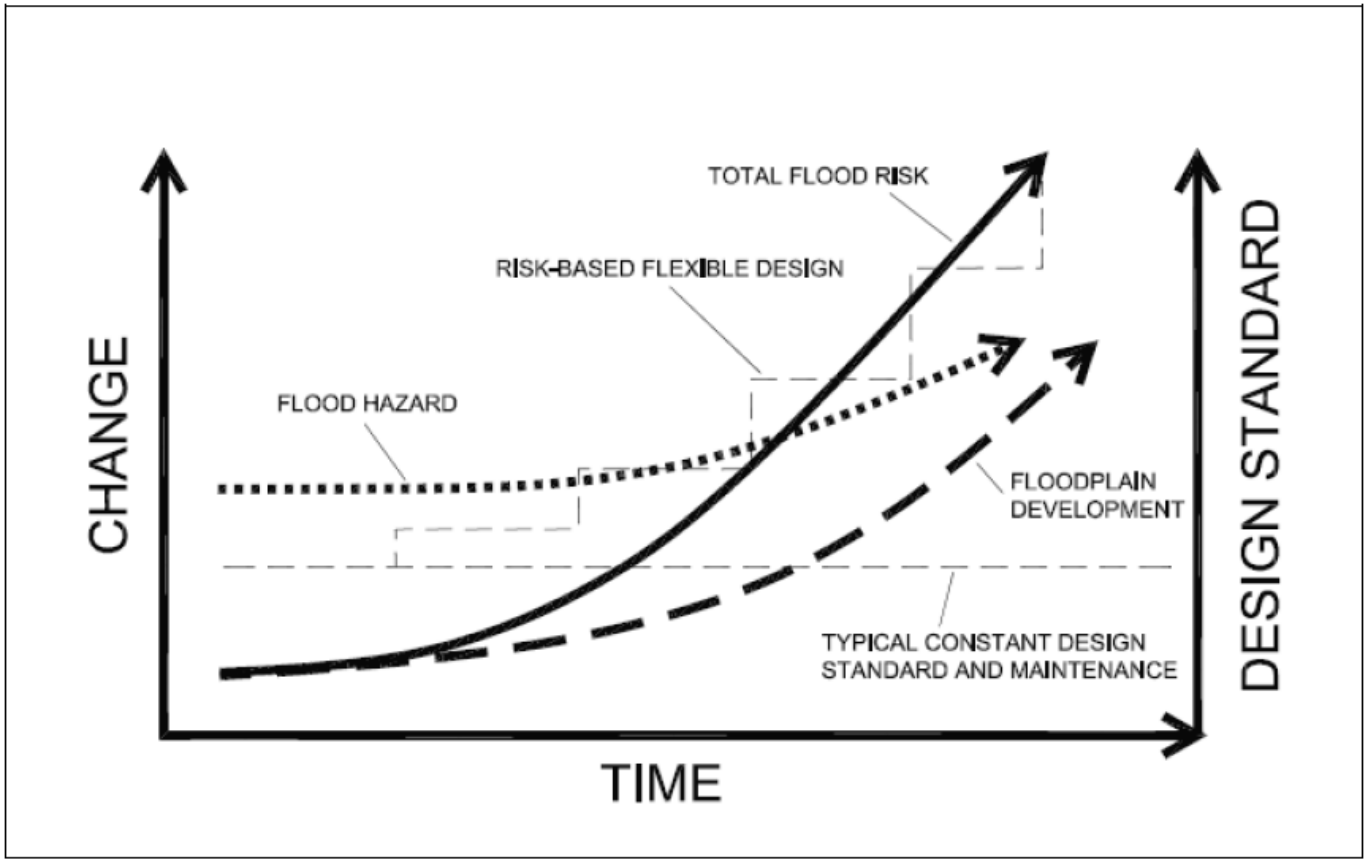

Figure 1-1: Changes in *flood hazard* and *risk* over time (Jakob and Church, 2012).

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