Flood Risk and Resilience in a Rapidly Changing Canada



*R.W. Sandford EPCOR Chair, Canadian Partnership Initiative United Nations Water for Life Decade* 





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Cougar Creek, Canmore, Alberta Thursday, June 20<sup>th</sup>, 2013





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What We Knew: Three Years Before the Flood

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Follow the water; but start with polar ice.













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Arctic Sea Ice





6.70 million square kilometers (2.59 million square miles) Alaska (U.S.A) HadIS

HadISST: September sea ice extent

201

3.41 million square kilometers

(1.32 million square miles)



**The loss of Arctic Sea Ice** 

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#### **The Jet Stream**





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Our weather is all over the place.







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Connecting the Dots: Hydro-climatic change in the Arctic and in the Mackenzie River Basin.





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**Canadian Prairies 2011** 

**Connecting the Dots: The Central Great Plains** 





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The map shows the percentage increases in the average number of days with very heavy precipitation (defined as the heaviest I percent of all events) from 1958 to 2007 for each region. There are clear trends toward more days with very heavy precipitation for the nation as a whole, and particularly in the Northeast and Midwest.

Increased rainfall days in the **Red River Basin** 











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The frequency of major flooding events in the basin is increasing





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Some 18% of samples from 41% of lakes World Health Organization Standards Source: Orihel et al.





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OROL

entered the Lake Winnipeg Basin

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Connecting the Dots: The post-glacial hydrological wealth of Canada is changing form.

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The real urgency resides in recognizing that our nation's hydrology is changing.







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Connecting the Dots: The Great Lakes





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Connecting the Dots: Flooding of the Don Valley Parkway in Toronto, May, 2013

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Rudolf Clausius

**Benoit Clapeyron** 

The Clausius – Clapeyron Relation

*The water-holding capacity of the Earth's atmosphere increases by 7 per cent per degree Celsius* 

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UNITED NATIONS INTERNATIONAL DECASE WATER FOR LIFE TRAF-2012 CANADA



*"Continuing to use the assumption of stationarity in designing water management systems is, in fact, no longer practical or even defensible."* 

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#### **Atmospheric Rivers**







































**Despite heroic efforts to dredge Cougar Creek the flooding begins** 





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#### Cougar Creek breeches the Trans-Canada Highway





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Provincial flood warnings had yet to be issued





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**Stranded police and truckers airlifted from the Trans-Canada** 

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#### **Saving the Canmore Hospital**





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The flood pulse moves downstream into the City of Calgary





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The Highwood River floods High River





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High River is almost completely submerged





















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#### Day 4: The Army Arrives

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#### Lesson 1. Our flood prediction systems are inadequate





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#### Lesson 2. Our flood maps are outdated and irrelevant





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Lesson 3. Adaptation to the New Normal is going to be expensive socially, economically & politically

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Lesson 4. We are not ready for the variability that exists now let alone what we might expect in the future..





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Lesson 5. Governments can't solve problems of this scale on their own

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A month after Alberta's floods: firestorms & floods in Russia





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Storms in the future may be different in character than what we have experienced.





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Three months after Alberta's floods: fires & floods in Colorado





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Game Change1. We need to begin to understand and where possible manage the hydrological cycle regionally and globally

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## Game Change 2. What we have seen is what we are going to get.





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Game Change 3. We can't do this ourselves; we need nature to help us

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Game Change 4. Managing water on a basin scale is no longer an option





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Game change 5. Sooner or later we are going to have to take emissions cuts seriously





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#### So, what should do we do now?

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Some people change their ways when they see the light; others when they feel the heat.

Carolyn Schroeder

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The Challenge of Our Generation

1. We are not without means or solutions





- 2. We have leading-edge technology & know how to employ it
- 3. We know what we can & have to do to adapt.

All we need is the will to work together.

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Can we manage water and what it does so as to preserve the quality of life in Canada?

Yes.





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Summary Findings: **Final Report** March 10, 2014



We need to inform & move the Canadian public.





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