Associated Engineering

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Climate Change Resiliency and Adaptation considerations in Water System Design

Workshop #17

Associated Engineering

Assembly of First Nations National Water Symposium

February 28, 2019

Workshop Team

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Workshop

Objective

- Outline considerations of climate change risk and mitigation strategies in water system planning and design
- Provide an overview of the new Climate Lens
- Discussion how this applies to your water system in terms of risk evaluation and risk Mitigation and adaptation measures

Challenges

- We only have 90 minutes
- It’s Last day of the Symposium
- We need your help to assess your water system vulnerabilities

Discussion

What are the challenges affecting your water system?

10 minutes

Challenges

- Lack of knowledge and training
- Poor water quality
- Loss of power, power surges
- Funding
- Risk of flooding
- Risk of fire
- Heat waves
- Winter storms and cold
- Drought
- Lack of equipment
- Equipment not operating
- Extreme rainfall events
- Changing water quality
- High Winds

Workshop Definitions

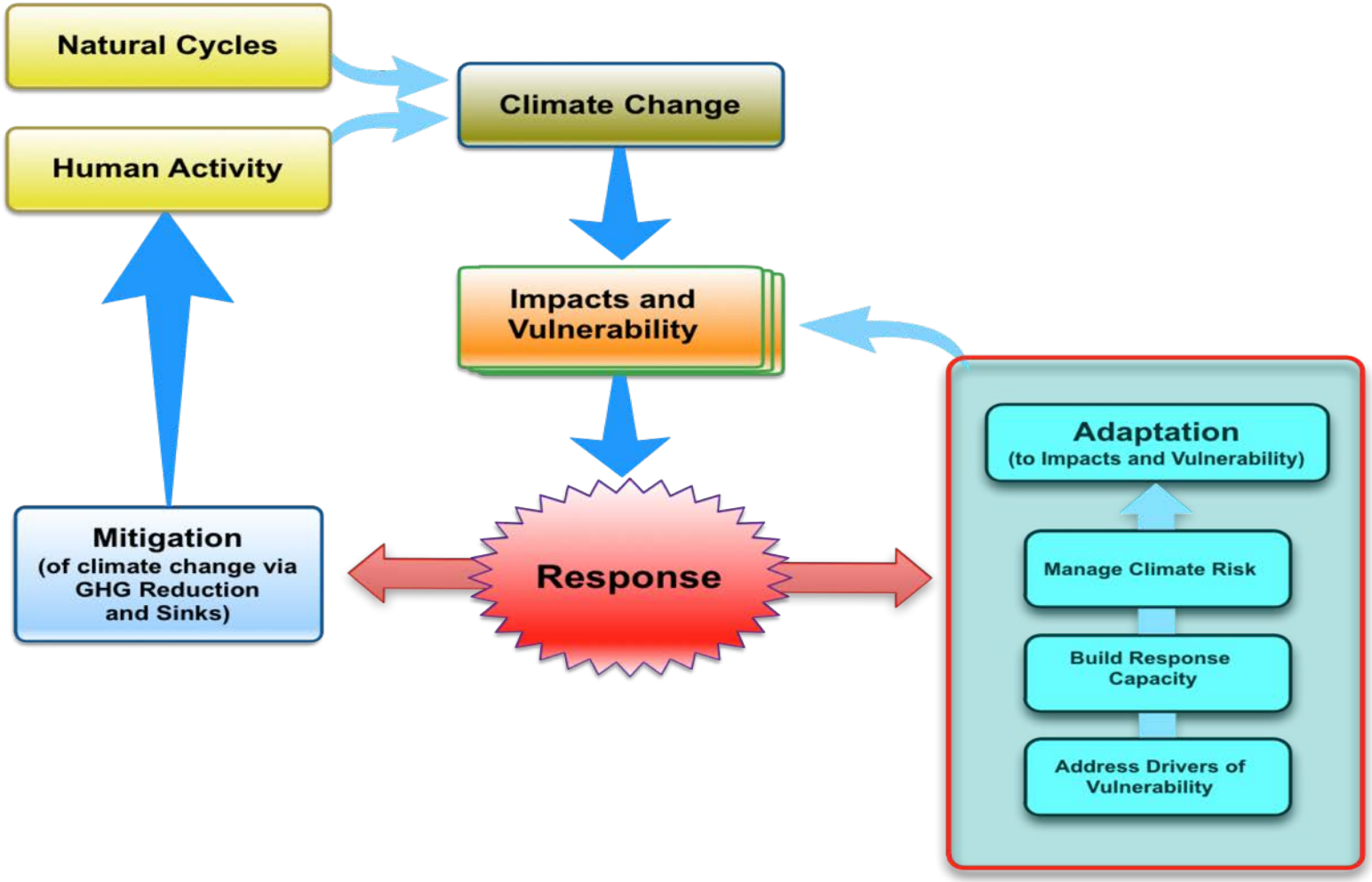
Adaptation - Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.

Mitigation - The reduction of activities causing climate change to slow or reverse the rate of change.

Vulnerability - The degree to which a system is susceptible to, or unable to cope with, adverse effects of changing climate.

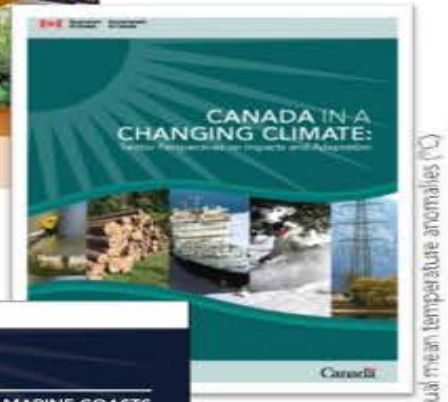
Resiliency - The ability of an infrastructure, or infrastructure component, to absorb a projected weather event or climate condition and still maintain a level of service within design or operational tolerances.

Mitigation and Adaptation

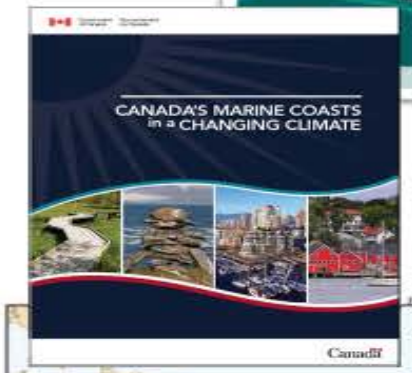


Canada's climate is changing and further changes are inevitable

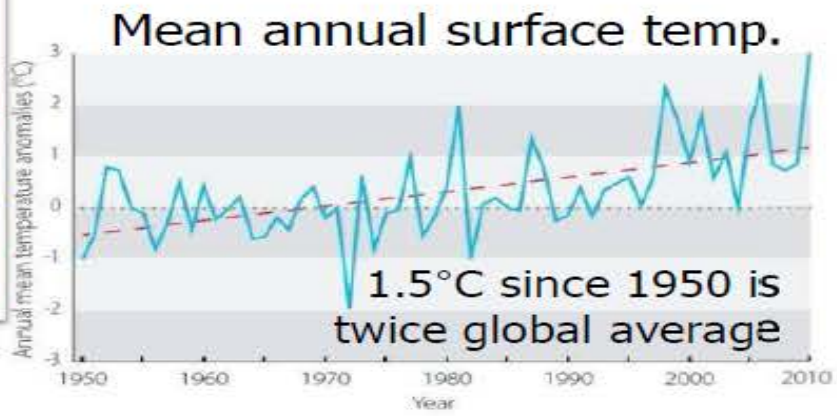
2008

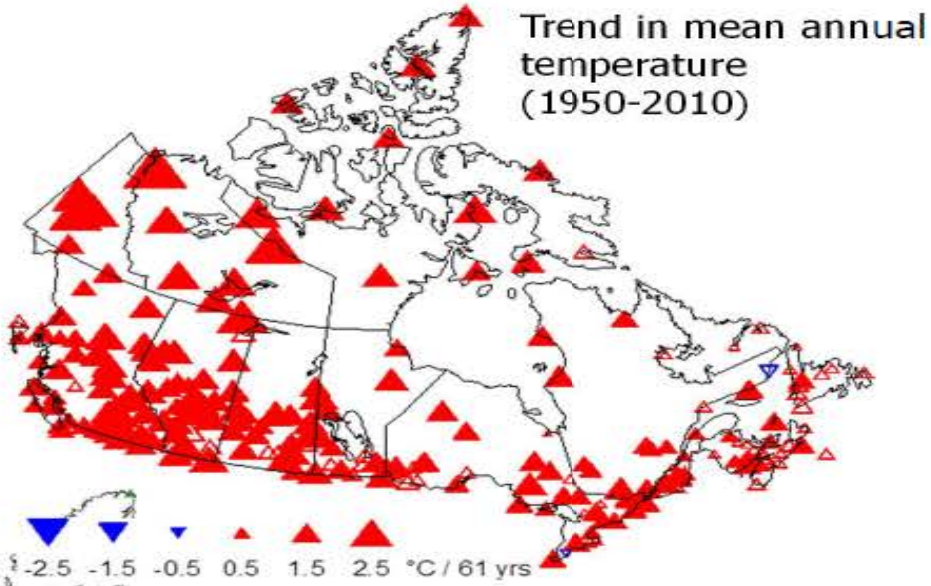


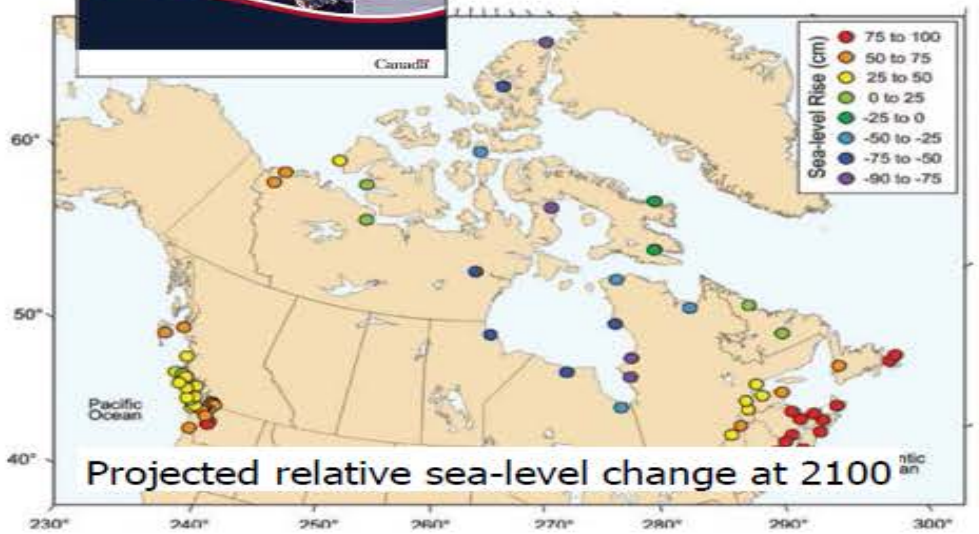
2014

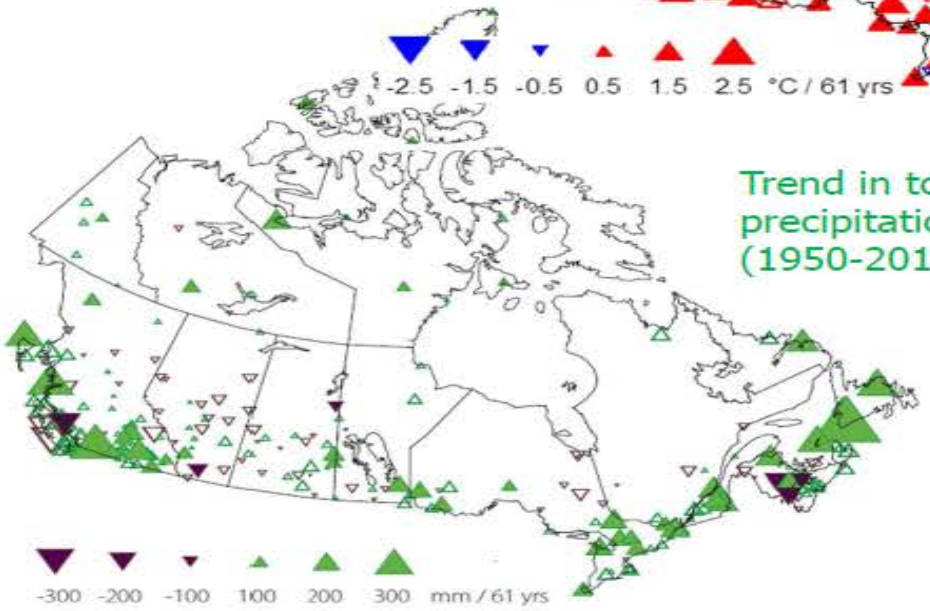


2016

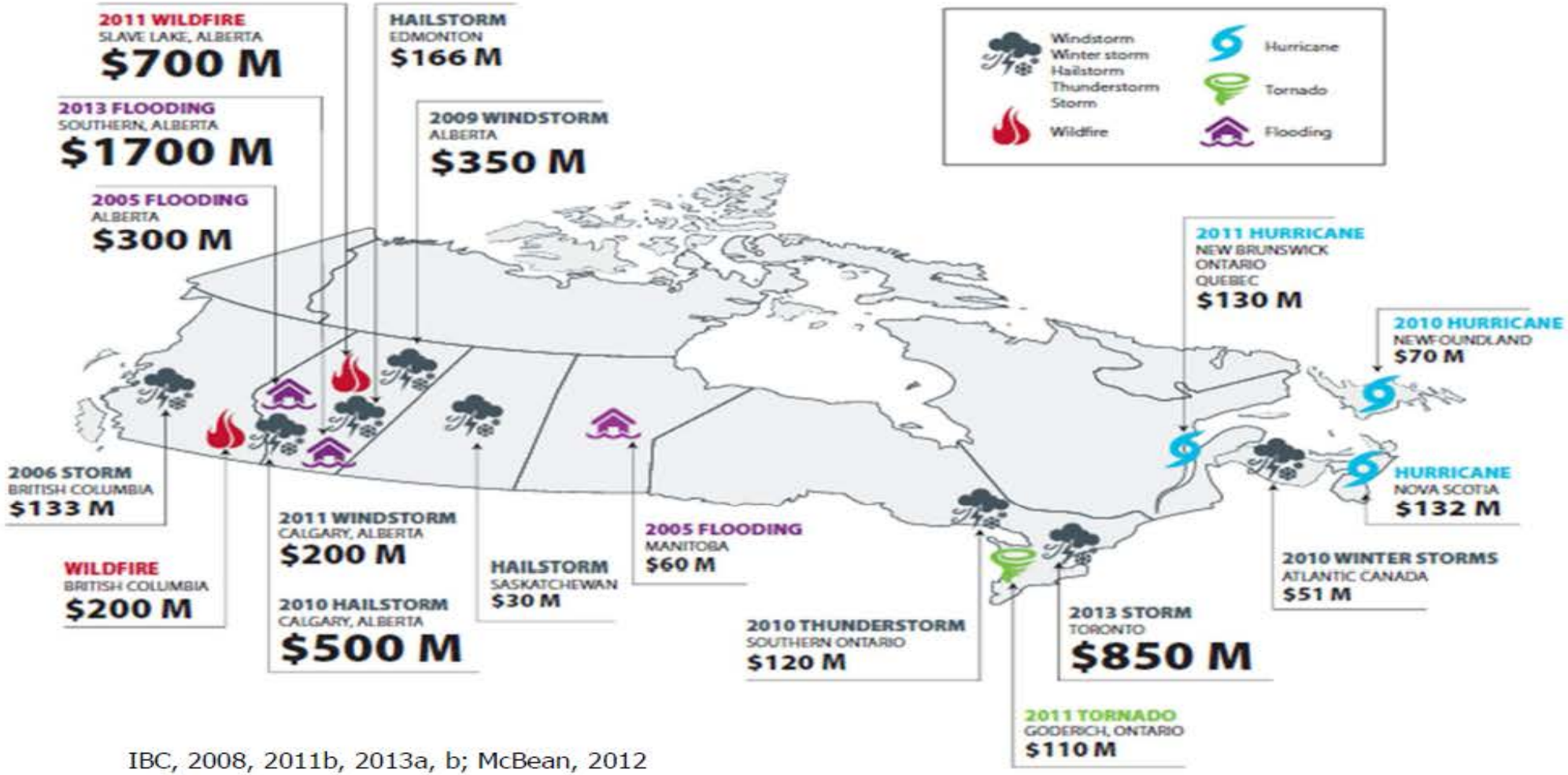






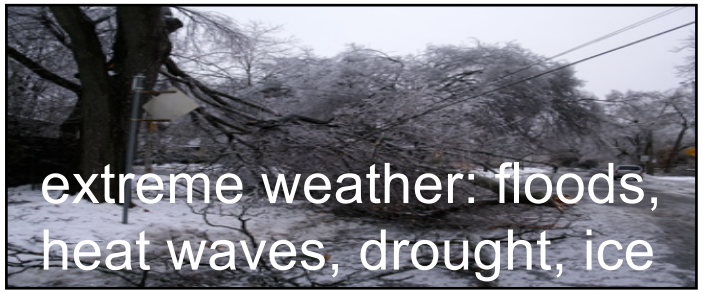


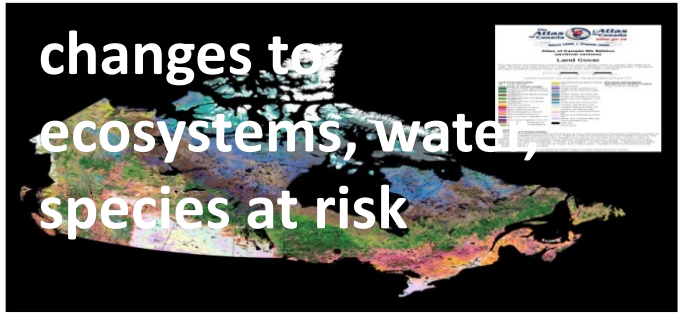
Damage of Extreme Weather



IBC, 2008, 2011b, 2013a, b; McBean, 2012

Current/Future Impacts of Climate Change in Canada





Combination of events can increase the vulnerability

- Events can occur in rapid succession
- Events can add together
  - Extreme rainfall + hail
- Management or maintenance practices can intensify impacts
  - Infrequent culvert clearing + severe rain
- Change of use can intensify impacts
  - Urbanization → changes in drainage regime → increased drainage flow

Wildfire

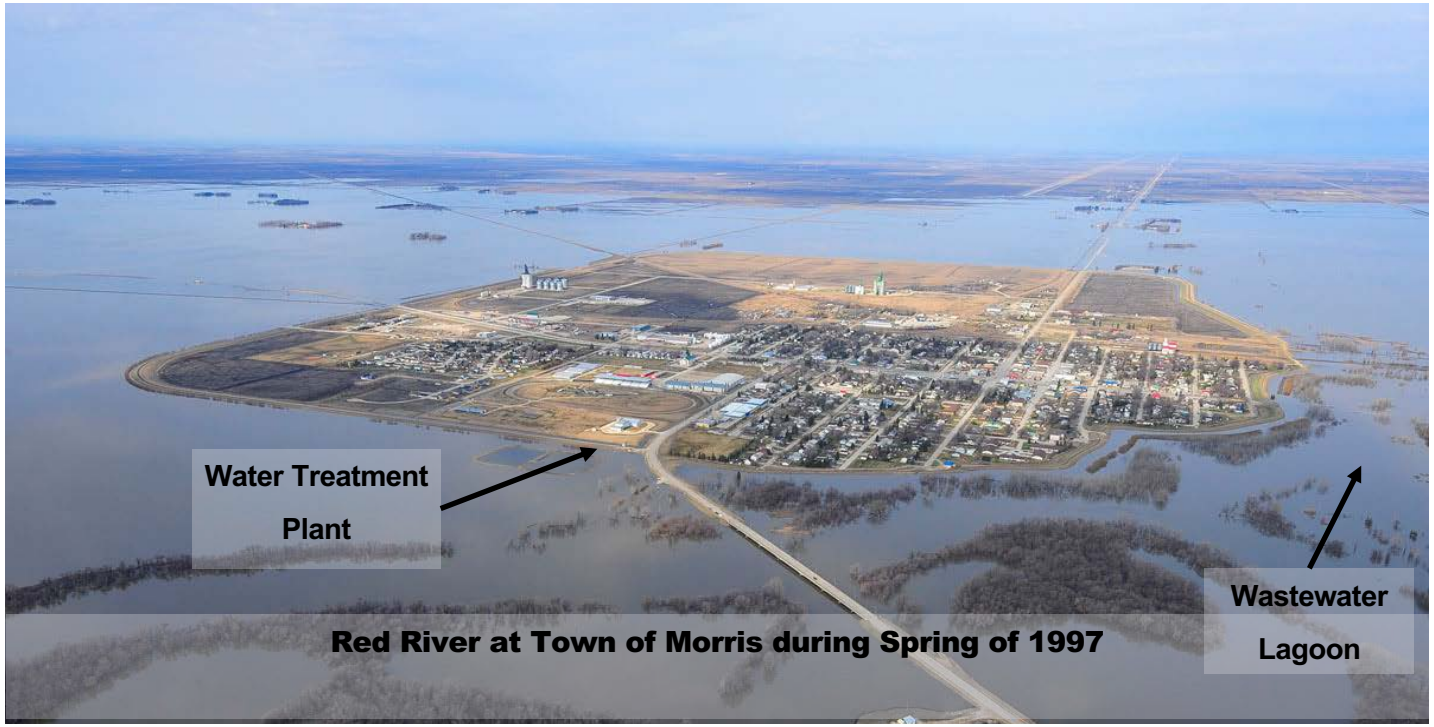
Drought, Algae Blooms

Wind Storm Gusts

Drought

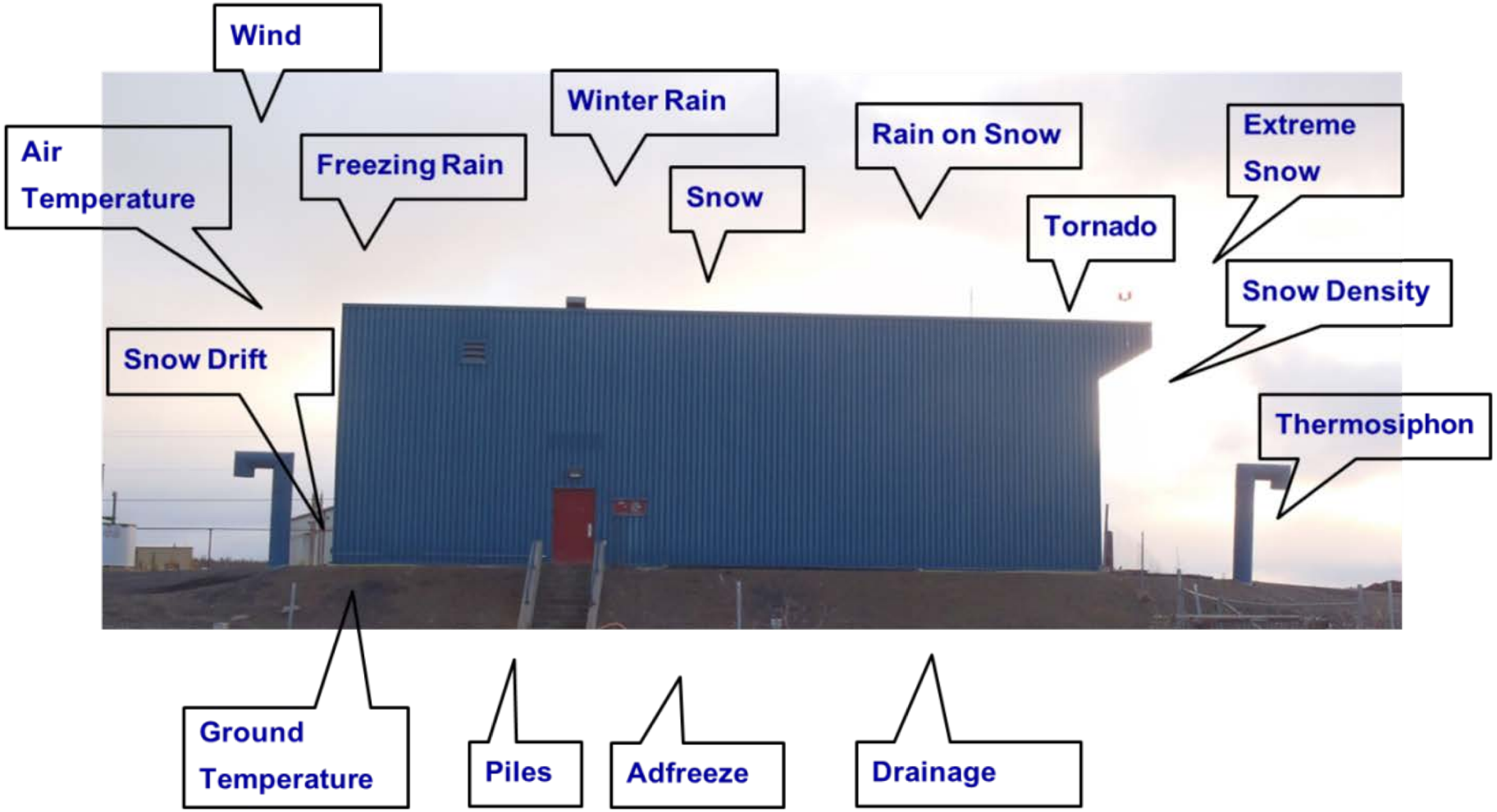
Red River in Fargo during Summer of 1936

Flood



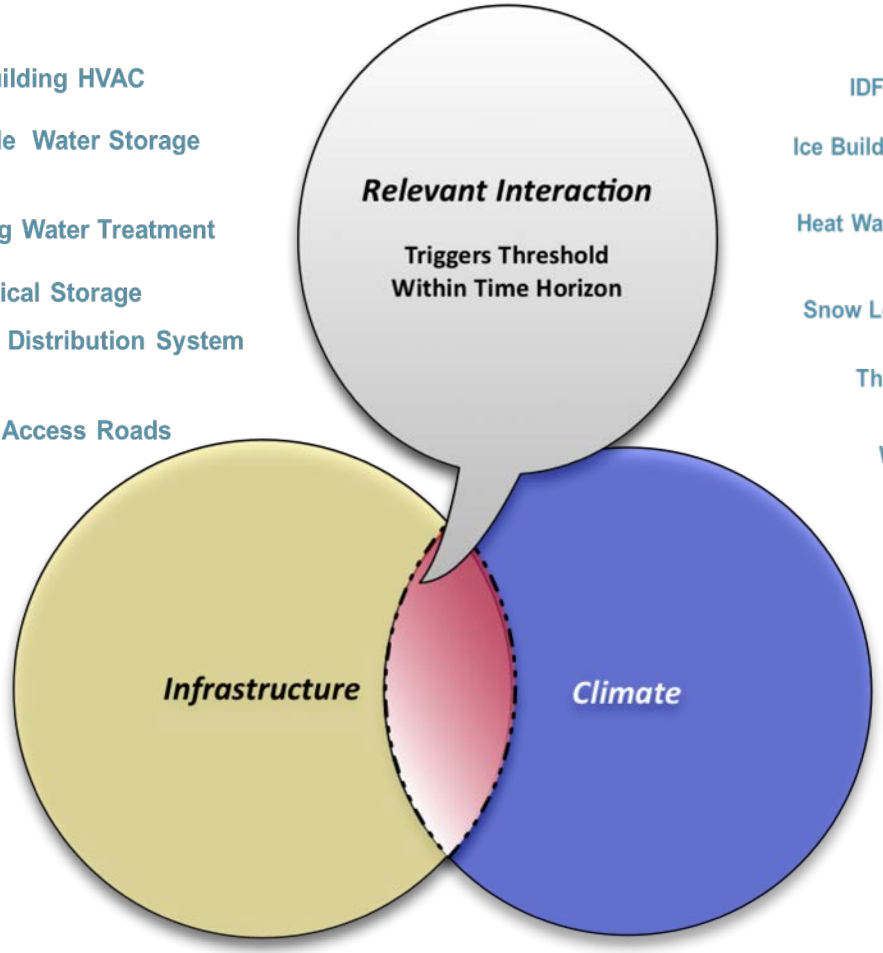
Red River at Town of Morris during Spring of 1997

Infrastructure and Climate



Infrastructure and Climate

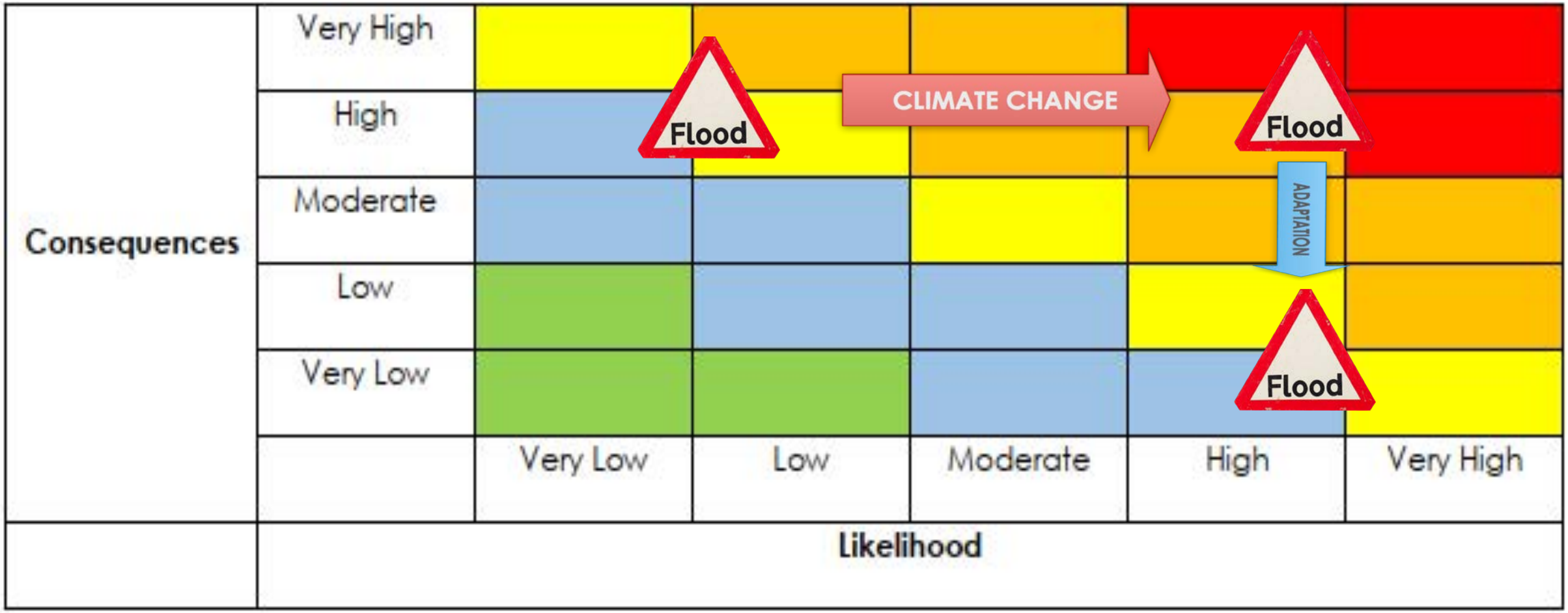
Treated Water Conveyance
Power Supply
Raw Water Storage
Structures
Building HVAC
Control and Communication
Potable Water Storage
Residuals Treatment Systems
Intakes
Drinking Water Treatment
Raw Water Conveyance
Flood Protection
Chemical Storage
Distribution System
Surface Water
Access Roads
Ground Water



Storm Surge
Rain on Snow
Freeze Thaw Cycles
IDF Curves
Salt Water Intrusion
Ice Storms
Drought
Ice Build-up
100 year Flood Elevation
Water Temperature
Hurricanes
Heat Waves
Frazil Ice
Flood
Hail
Dry Ground
Fog
Intense Rain
Snow Load
Thunderstorm
Tropical Storms
Wild Fires
Water Quality

Consequence **Likelihood**

Infrastructure and Climate



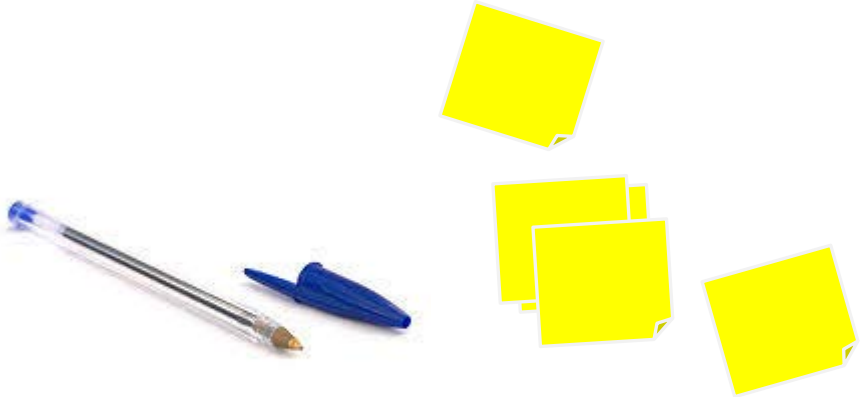
Infrastructure and Climate

Structures	Expected Lifecycle
Dams/ Water Supply	Base system 50-100 yrs Refurbishment 20-30 yrs Reconstruction 50 yrs
Storm/Sanitary Sewer	Base system 100 yrs Major upgrade 50 yrs Components 25 – 50 yrs
Roads & Bridges	Road surface 10 - 20 yrs Bridges 50 - 100 yrs Maintenance annually Resurface concrete 20-25 yrs Reconstruction 50-100 yrs
Houses/ Buildings	Retrofit/alterations 15-20 yrs Demolition 50-100 yrs

Discussion

What are the climate change impacts affecting on your water system?

10 minutes



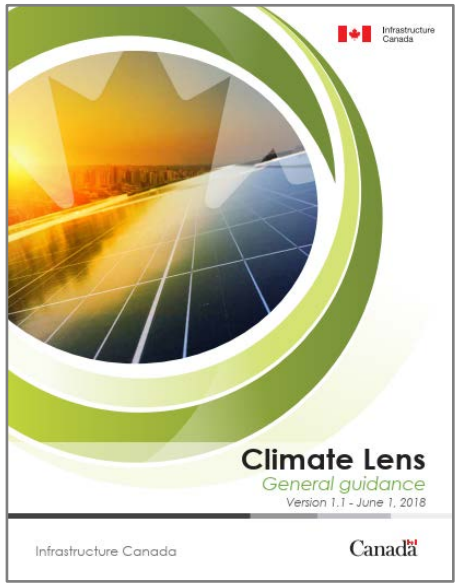
Workshop

Climate Lens

Infrastructure Canada recently published a guidance document on GHG mitigation and climate change resilience assessments called Climate Lens.

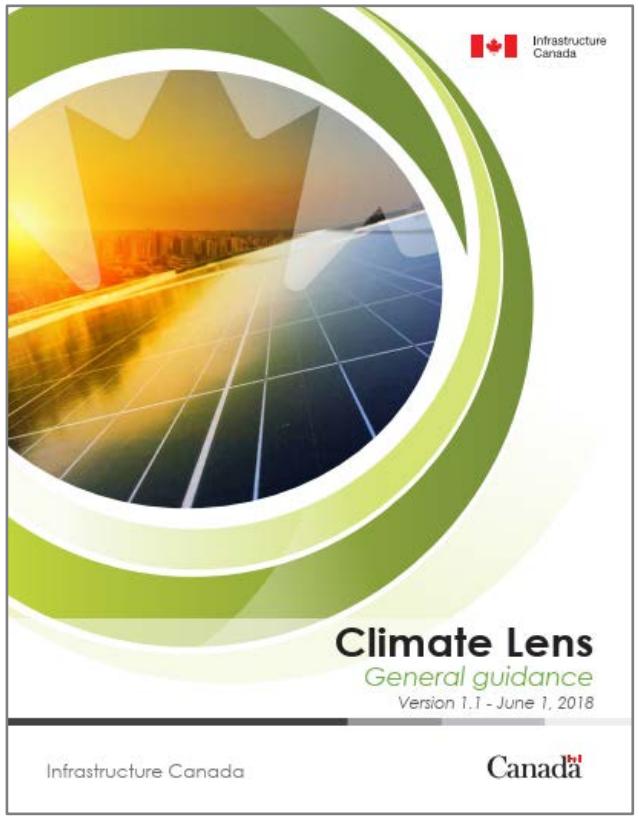
Goal

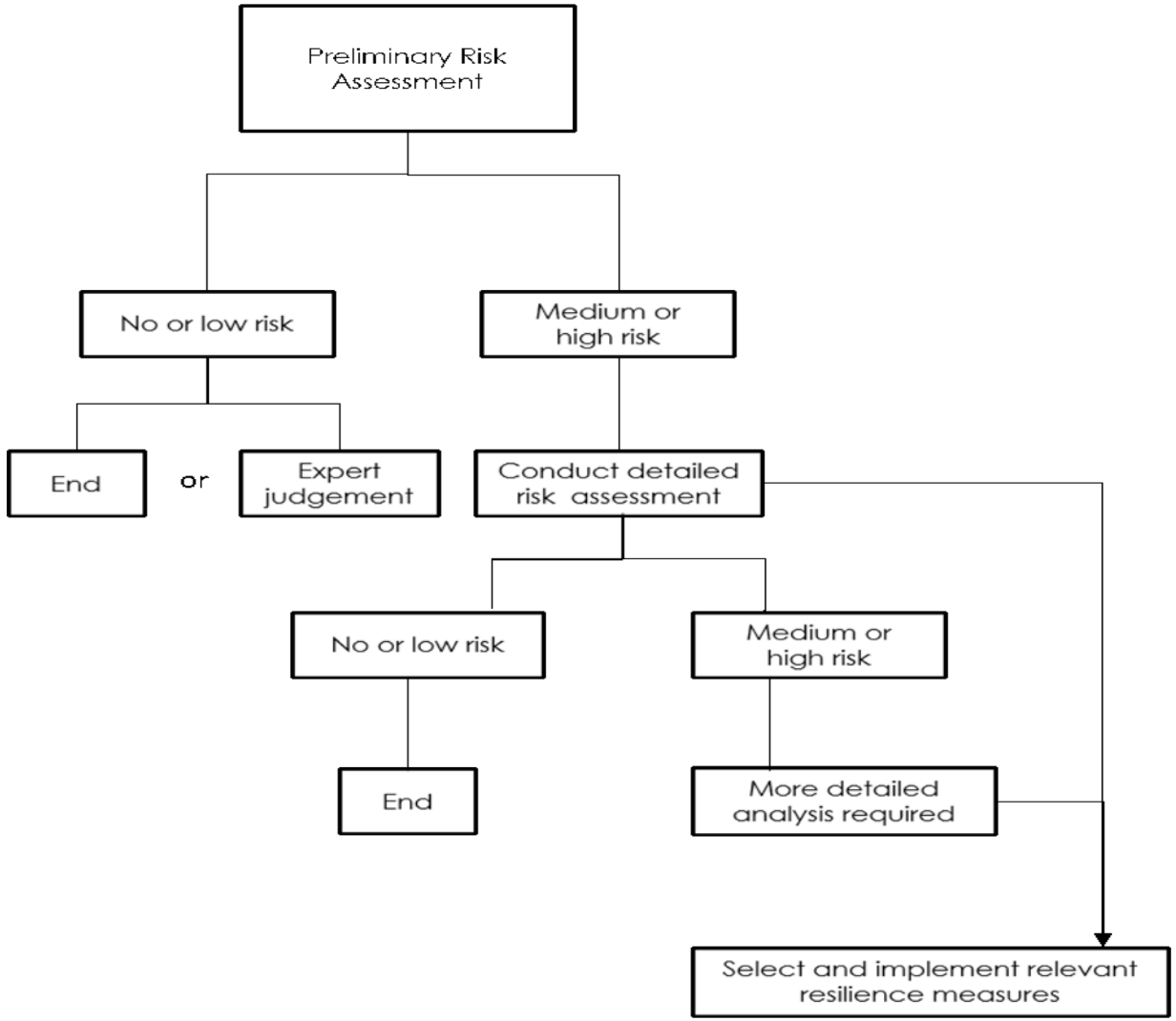
- Facility a climate-focused behavioral change at the project level.
- Greater consideration of risk and mitigation strategies
- Facilitate better decision making in current and future infrastructure projects.



www.infrastructure.gc.ca/pub/other-autre/cl-occ-eng.html

Climate Change Resilience Assessment





Climate Change Resilience Assessment

Establishing the Context (Scope)

- Understanding the climate change projections for the areas of interest and the associated vulnerabilities;
- Ensuring clarity about the objectives, timeframe and resources available for assessment; and
- Development of a work plan.

Risk Identification

- Identifying the specific climate change impacts and the associated potential risk events to the asset, system and surrounding environment and the possible opportunities
- Conducting a preliminary analysis of these risk events to determine in a very general sense their likelihood and possible consequences.
- Considering which events present a minimal level of risk and can be discarded from further consideration.

Climate Change Resilience Assessment

Risk Analysis

- Estimates of likelihood and consequences of risk events and opportunities.
- Presentation of likelihood and consequence estimates in a format that is easy-to-understand by non-experts.
- Estimates of the acceptance by stakeholders of risk, or a record of reasons for non-acceptance, based on a dialogue with the stakeholders and a careful documentation of their perception of the risks.

Risk Evaluation

- Confirming the overall likelihood and consequence rating that was done in Step 3 including costs, benefits and acceptability. The overall rating should also consider any downstream effects identified.
- Identifying unacceptable risks and ranking them for risk reduction or control measures.
- Opportunities have also been rated in Step 3 in a more general way by their likelihood and potential benefits. These should be confirmed in Step 4 and the opportunities ranked in some order of importance for exploitation.

Climate Change Resilience Assessment

Risk

Evaluation

Table 1 – Estimates of Likelihood of Risks

Probability Range Type of Event	Very Low	Low	Moderate	High	Very High
Significant single event; or	Not likely to occur in period	Likely to occur once between 30 and 50 years	Likely to occur once between 10 and 30 years	Likely to occur at least once a decade	Likely to occur once or more annually
On-going / Cumulative Occurrence	Not likely to become critical/beneficial in period	Likely to become critical/beneficial in 30-50 years	Likely to become critical/beneficial in 10-30 years	Likely to become critical/beneficial in a decade	Will become critical/beneficial within several years

Note: Use as many rows as needed to include the selected risk events.

Climate Change Resilience Assessment

Risk Evaluation

Table 2 – Estimates of Consequences of Risks

(Use one table for each risk event)

Factor	People				Economic			Environment			
Degree	Health & Safety	Displacement	Loss of Livelihood	Reputation	Infrastructure Damage	Financial Impact on Proponent	Financial Impact on Stakeholders	Air	Water	Land	Ecosystems
Very Low											
Low											
Moderate											
High											
Very High											

Climate Change Resilience Assessment

Risk Evaluation

Table 3 – Risk Evaluation Matrix

Consequences	Very High					
	High					
	Moderate					
	Low					
	Very Low					
		Very Low	Low	Moderate	High	Very High
	Likelihood					

Extreme Risk: Immediate controls required
High Risk: High priority control measures required
Moderate Risk: Some controls required to reduce risks to lower levels
Low Risk: Controls likely not required
Negligible Risk: Risk events do not require further consideration

Climate Change Resilience Assessment

Risk Mitigation

- Adaptation measures will be identified for reducing unacceptable risks to acceptable levels and examined for feasibility.
- Potential opportunities will be considered further for exploitation, where applicable.
- The effectiveness of the adaptation measures will be evaluated including the costs (both operating and capital), benefits and associated implementation risks.
- Return on Investment will be calculated where possible.
- Optimal adaptation strategies and opportunity exploitation measures will be selected and consideration will be given to the acceptability of residual risks.

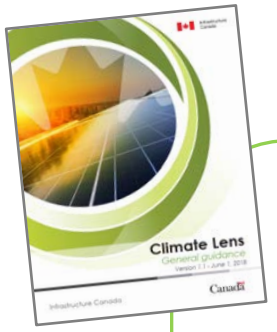
Climate Change Resilience Assessment

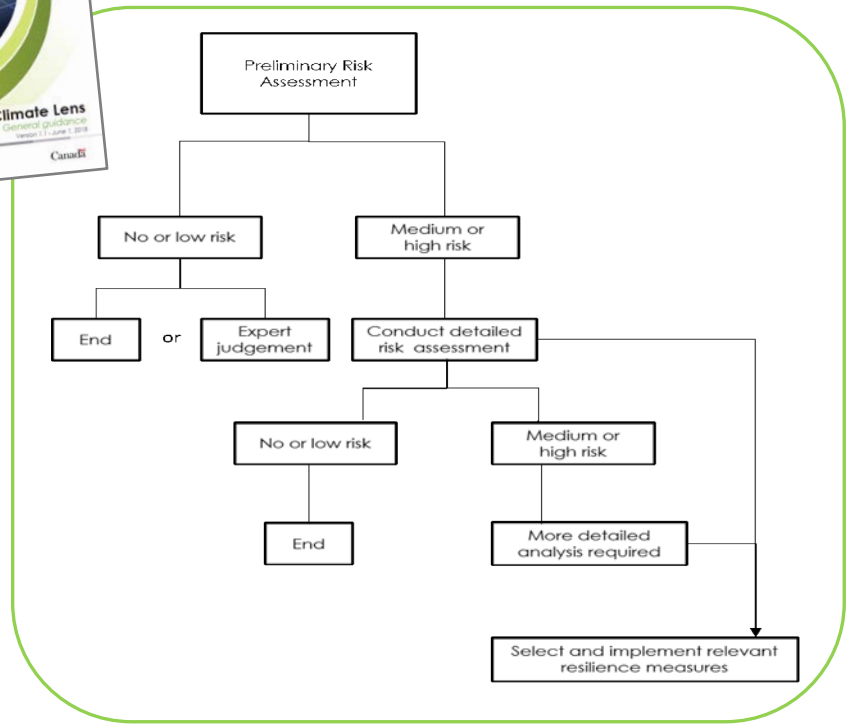
Risk Evaluation

Table 4 – Risk Mitigation and Adaptation Measures

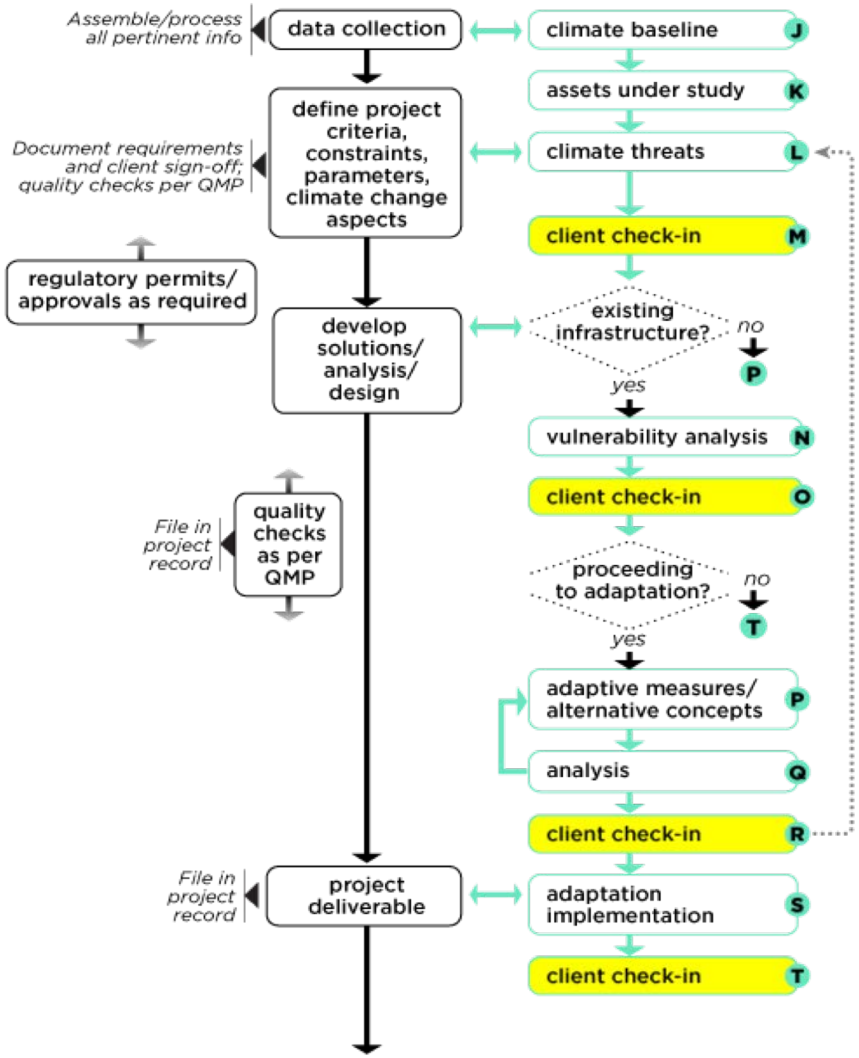
Risk Event	Adaptation Measure or Risk Treatment (use as many rows as needed for each event)	Timeframe	Cost	Effectiveness	Acceptability	Comment/ Evaluation

Design





Project Approval



Detail Design

Discussion

What are the likelihood and consequence of these impacts?

15 minutes

Table 1 – Estimates of Likelihood of Risks

Probability Range / Type of Event	Very Low	Low	Moderate	High	Very High
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Note: Use as many rows as needed to include the selected risk events.

Table 2 – Estimates of Consequences of Risks

(Use one table for each risk event)

Factor	People				Economic			Environment			
Degree	Health & Safety	Displacement	Loss of Livelihood	Reputation	Infrastructure Damage	Financial Impact on Proponent	Financial Impact on Stakeholders	Air	Water	Land	Ecosystems
Very Low											
Low											
Moderate											
High											
Very High											

Table 2 – Estimates of Consequences of Risks

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Moderate											
High											
Very High											

Table 3 – Risk Evaluation Matrix

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Discussion

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Discussion

What are the likelihood and consequence of these impacts?

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High											
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Discussion

15 minutes

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Negligible Risk: Risk events do not require further consideration

Discussion

What mitigation and adaptation measures can be considered?

15 minutes

Table 4 – Risk Mitigation and Adaptation Measures

Risk Event	Adaptation Measure or Risk Treatment (use as many rows as needed for each event)	Timeframe	Cost	Effectiveness	Acceptability	Comment/ Evaluation

Workshop Team

Questions?

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