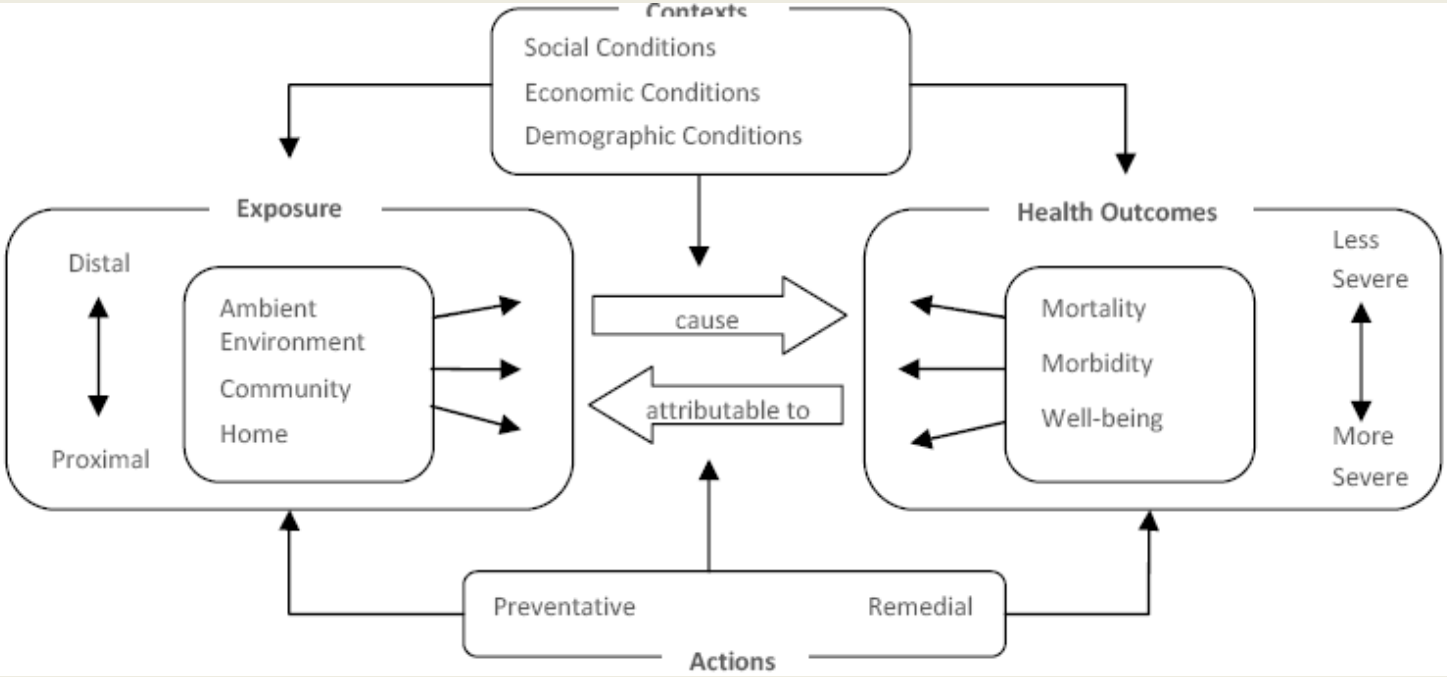

Figure 1. Multiple Exposures, Multiple Effects Framework (WHO, 2002)

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28 May2015

Application of the MEME model to the Health Impacts of Flooding and Extreme Precipitation: Results of Four Ontario Case Examples

Outline

- Climate change and health framework review
- Flood Types
- MEME Model
- Application to Four Case Examples
- Key Themes
- Updated MEME4CC Model

& Environmental

25 Climate Change and Health Models

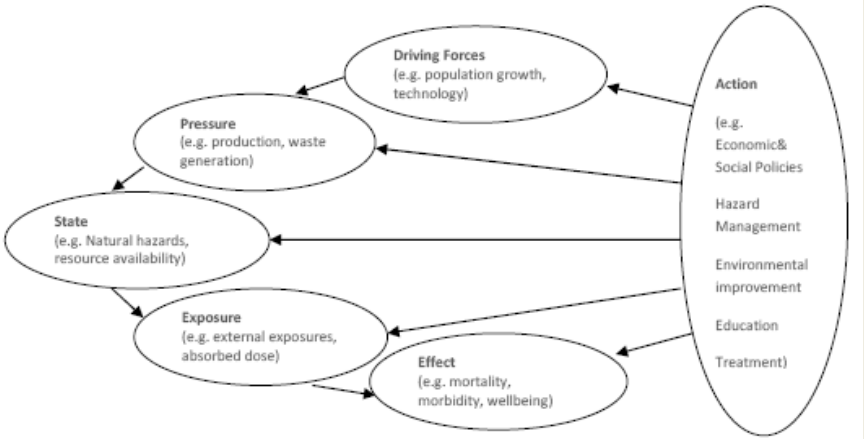


Figure 3. Health and Environment Cause and Effect (DPSEEA) Framework (WHO, 1997)

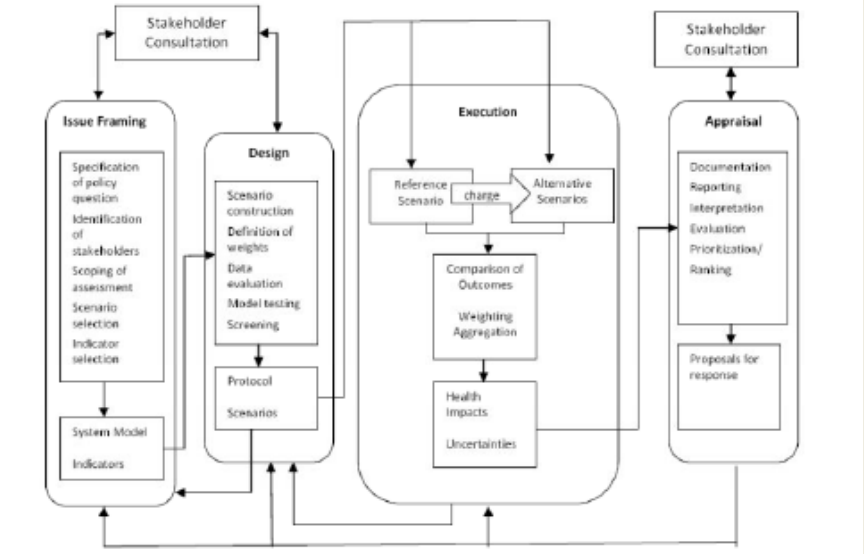


Figure 5. Integrated Environmental Health Impact Assessment Framework (Briggs, 2008)

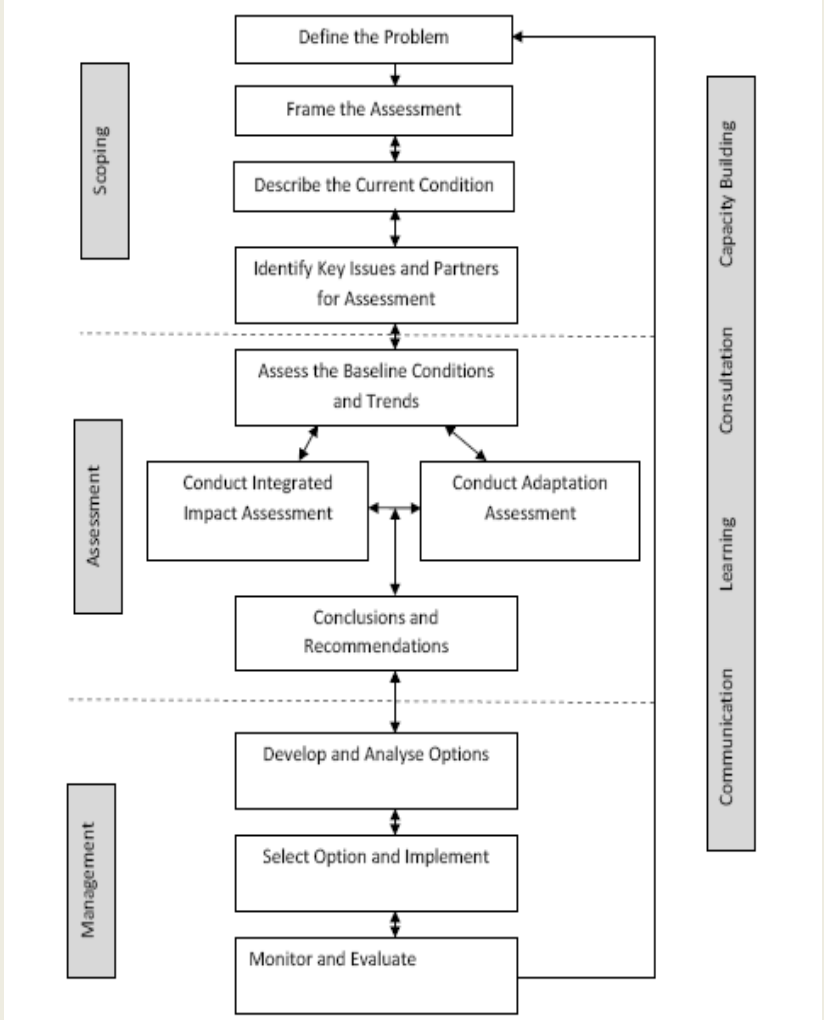


Figure 12. WHO-Health Canada National Health Impact and Adaptation Assessment Framework (as cited in Fussel and Klein, 2004)

5 Common Themes in Models

- Scoping
- Assessment
- Management
- Stakeholder Engagement
- Scenarios

Multiple Exposures, Multiple Effects

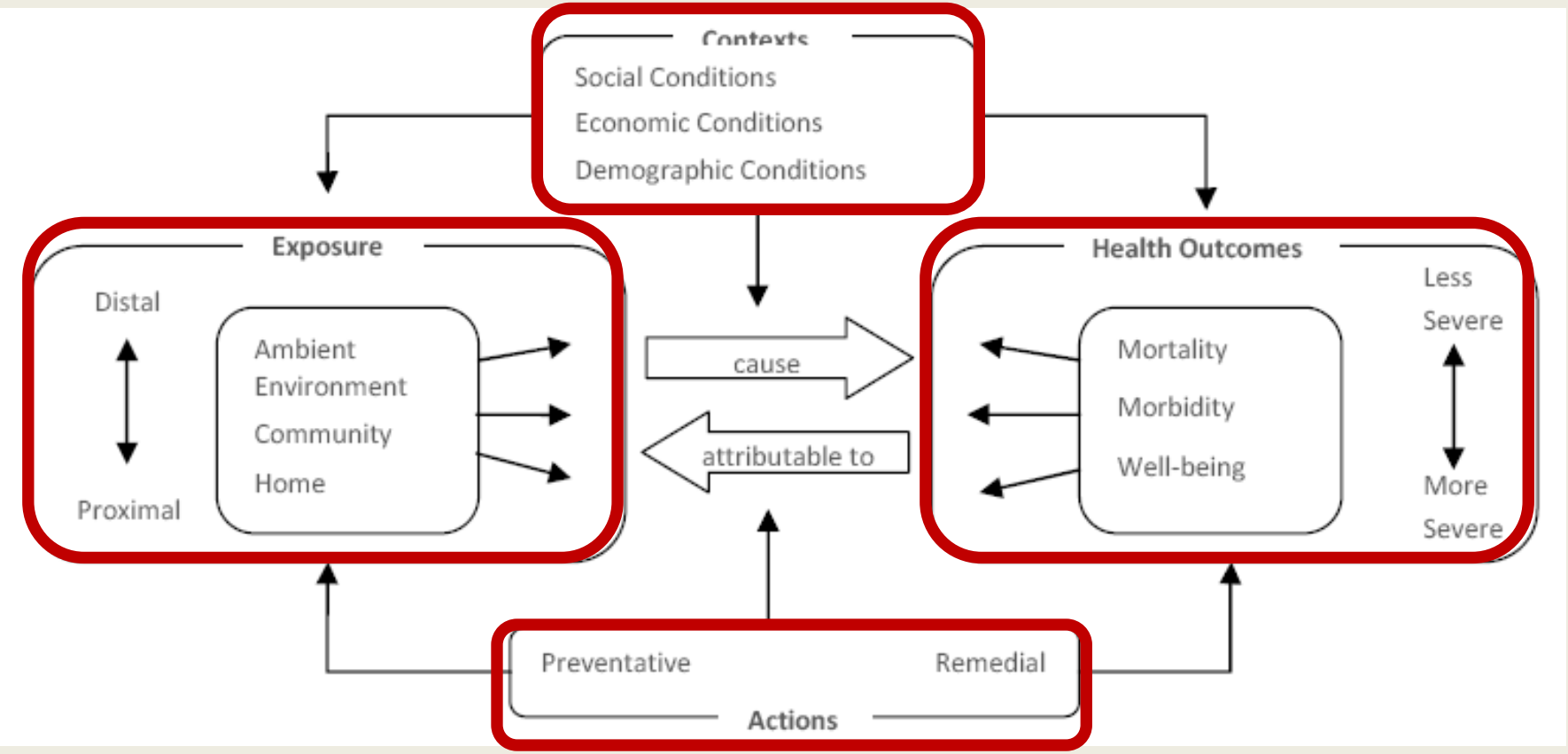
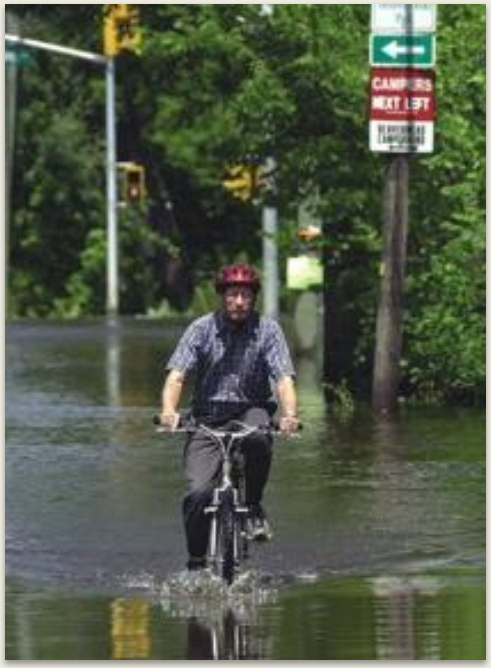


Figure 4. Multiple Exposures, Multiple Effects Framework (WHO, 2002)

Pluvial flooding: Rainfall-generated overland flow and ponding *before* the runoff enters a watercourse.

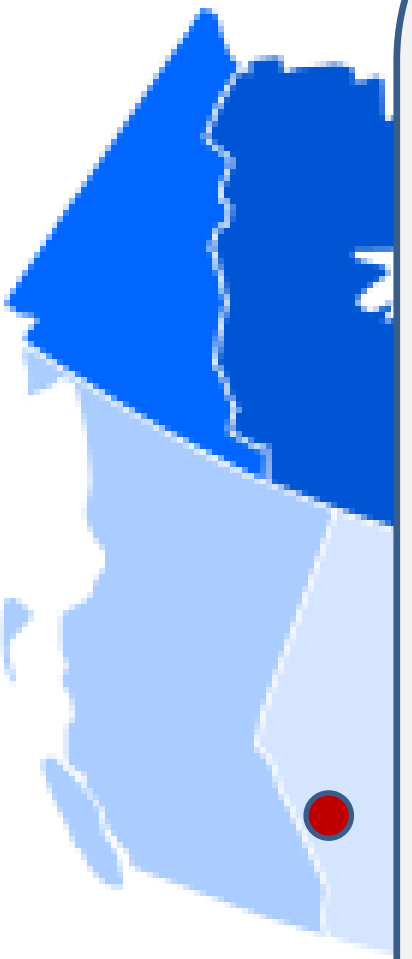


Surface water or urban flooding Combined flooding in urban areas during heavy rainfall. It includes **pluvial**, sewer, small open-channel, culverted urban watercourses and overland flows from groundwater springs.

Fluvial flooding: Riverine flooding, driven by precipitation events in a watershed. These floods typically last for days or even weeks.

Snowmelt Runoff: The most common type of flood in Canada. Linked to the spring 'freshet', or snowpack melting. When the freshet is combined with rainfall, flooding can occur.

Four Canadian Flood Events



High River, Alberta (pop'n 13,000)

***Fluvial/Snowmelt Runoff Flood**:* 3 days of torrential rain falling on frozen, saturated ground; river flow 10x higher than normal for June

State of Emergency declared at 7:04 am. Entire town evacuated for one week; hospital, hospice, continuing care facilities; rooftop rescues, etc.

Considered to be 'like a war zone'. **Chief Mental Health Officer** position created.

Some surveillance data from 2 Calgary hospitals: 3 fatalities; mental health challenges; sexual assault and violence; physical injuries including lacerations/punctures; cardiac events; eye pain

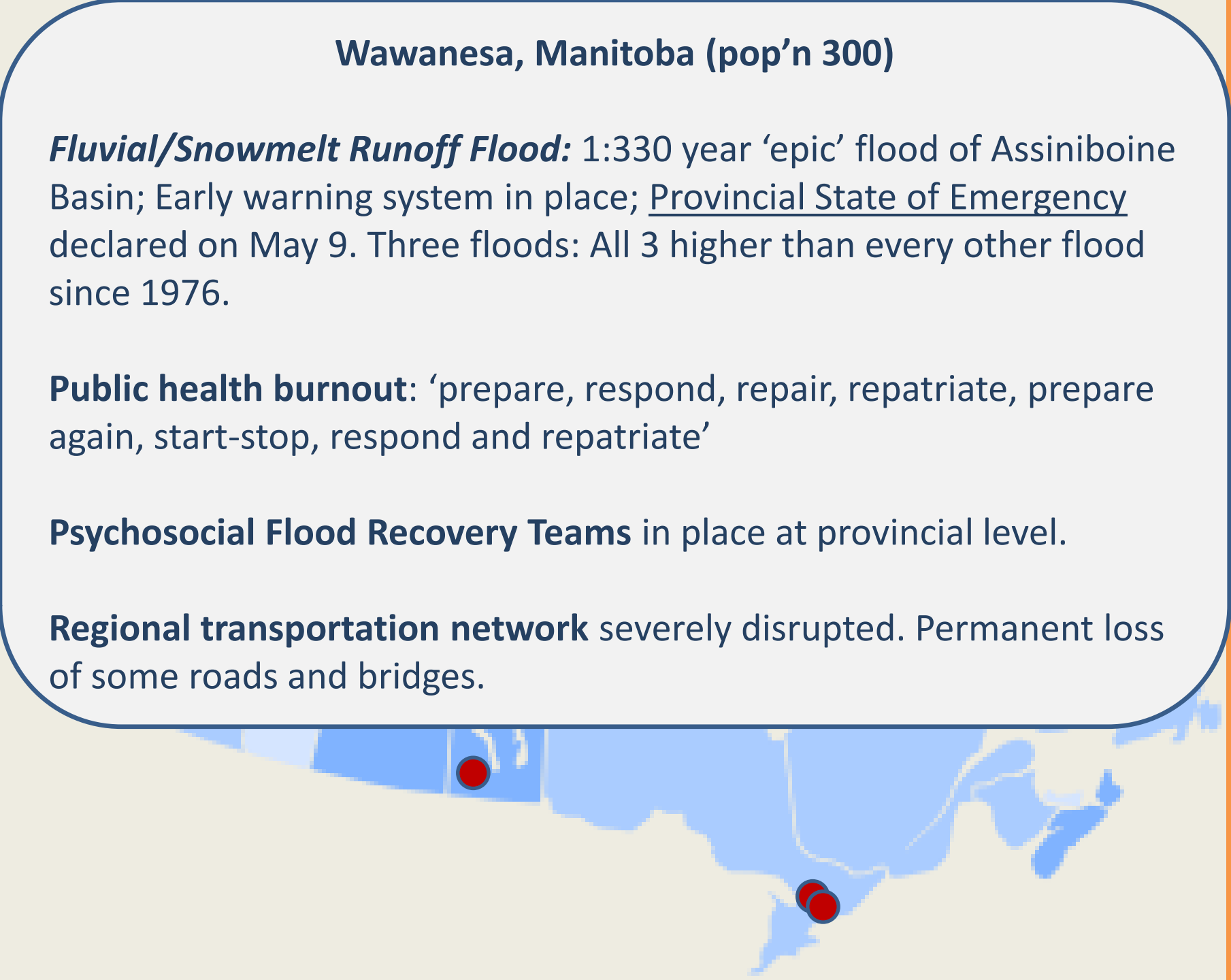
Wawanesa, Manitoba (pop'n 300)

Fluvial/Snowmelt Runoff Flood: 1:330 year 'epic' flood of Assiniboine Basin; Early warning system in place; Provincial State of Emergency declared on May 9. Three floods: All 3 higher than every other flood since 1976.

Public health burnout: 'prepare, respond, repair, repatriate, prepare again, start-stop, respond and repatriate'

Psychosocial Flood Recovery Teams in place at provincial level.

Regional transportation network severely disrupted. Permanent loss of some roads and bridges.

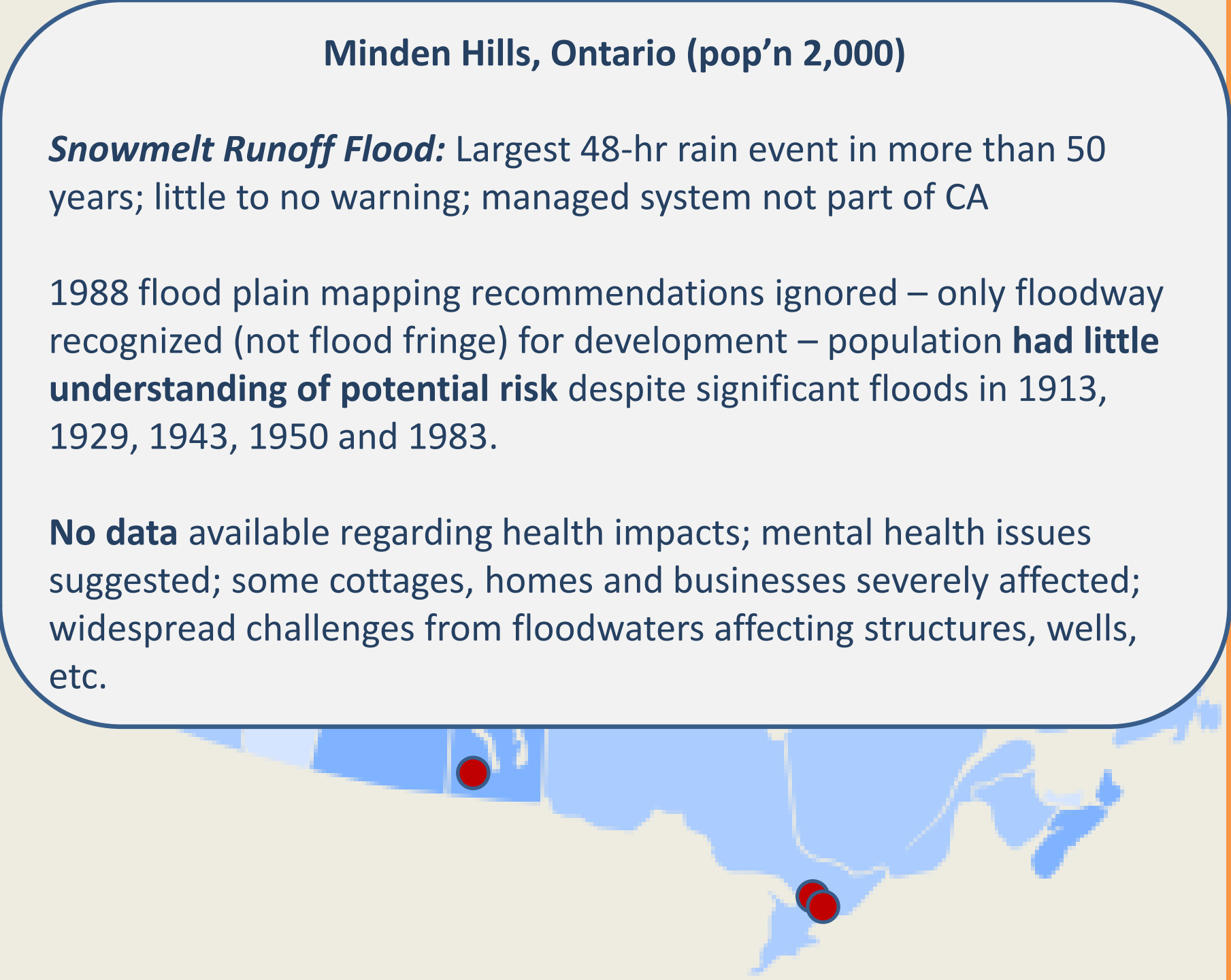


Minden Hills, Ontario (pop'n 2,000)

Snowmelt Runoff Flood: Largest 48-hr rain event in more than 50 years; little to no warning; managed system not part of CA

1988 flood plain mapping recommendations ignored – only floodway recognized (not flood fringe) for development – population **had little understanding of potential risk** despite significant floods in 1913, 1929, 1943, 1950 and 1983.

No data available regarding health impacts; mental health issues suggested; some cottages, homes and businesses severely affected; widespread challenges from floodwaters affecting structures, wells, etc.



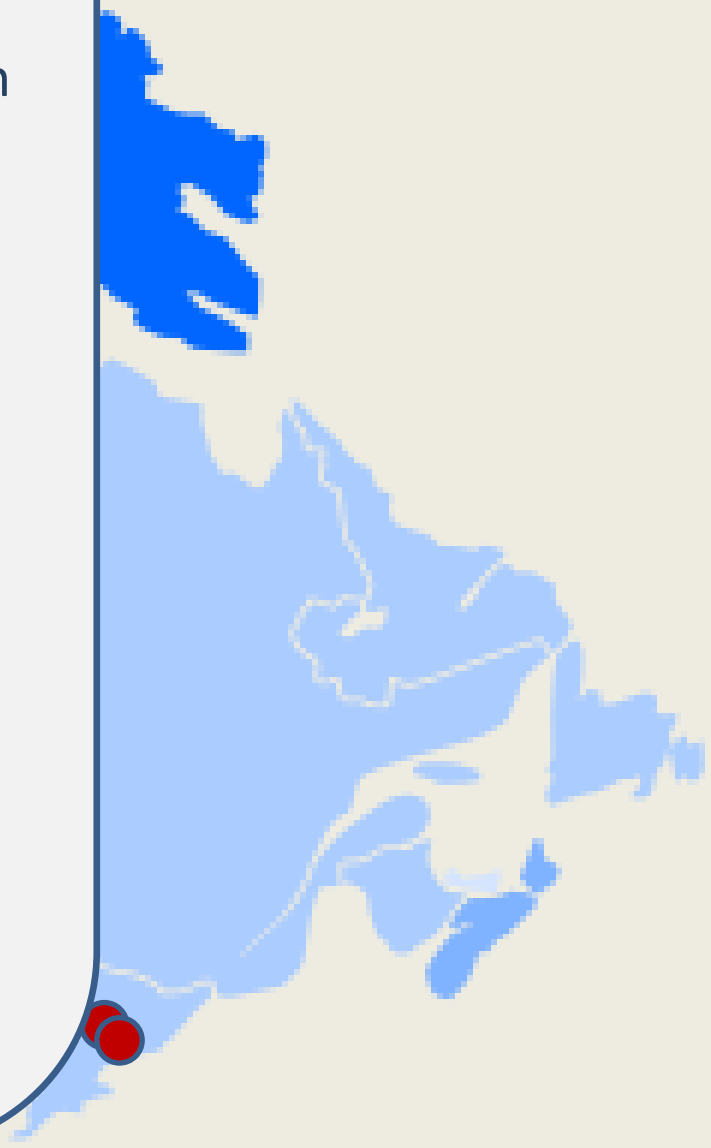
Peterborough, Ontario (pop'n 75,000)

Pluvial/Urban Flood: Largest 24-hr total rainfall depth ever recorded in S. Ontario; Largest instantaneous peak flow in Jackson Creek; rainfall occurred overnight.

Roof collapse at nursing home. **State of Emergency** declared at 7:00 am. Extensive basement flooding, concerns about infrastructure: water, sanitation, gas, buildings and roads.

Low-income populations particularly affected by basement flooding.

Disaster assistance provided quickly; challenge to end services such as emergency housing



Key Findings (1)

- Needs of **vulnerable populations** not systematically addressed
  - Populations not clearly identified
  - Case-file approach seems appropriate
  - No evidence of any gendered approaches/thinking
  - Complete lack of consideration in post-flood reviews

Post-Flood Risk Factors and Vulnerable Populations Well-Known

- Factors increasing vulnerability:
  - Gender
  - Age
  - Socio-economic status
  - Perceived impact on finances
  - Personality traits
  - Existing health problems
  - Evacuation
  - Access to health care
  - **Warning time**
  - **Housing tenure**
  - **Previous flood experience/awareness**
  - **Problems receiving assistance**

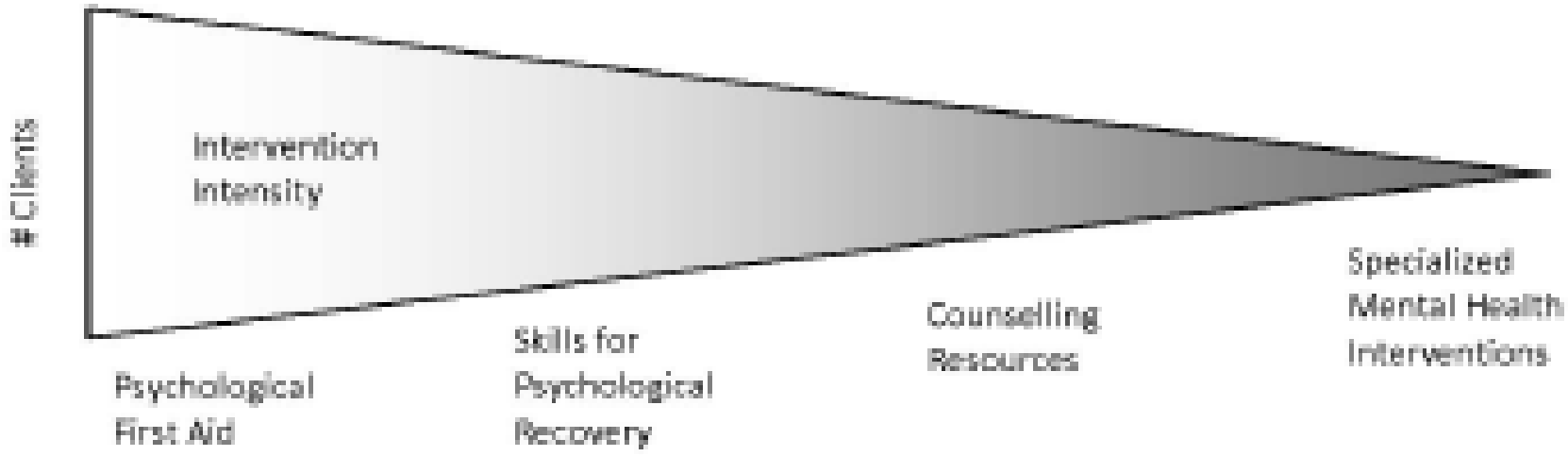
Vulnerable Populations

- Children
- Elderly
- First Nations
- People with: Chronic Illnesses and/or Physical, Cognitive or Sensory Impairments;
- Gender
- Pregnant Women
- Tourists
- Homeless
- People with Cultural or Language Vulnerability
- Housing
- Insurance
- Others

Key Findings (2)

- **Mental health** problems are key
  - Addressed very differently in 4 examples
  - Lack of categorization of different kinds of problems to assist in follow-up; little formal follow-up
  - Public may avoid programs using mental health language ...

Varying Levels of Psychosocial Support



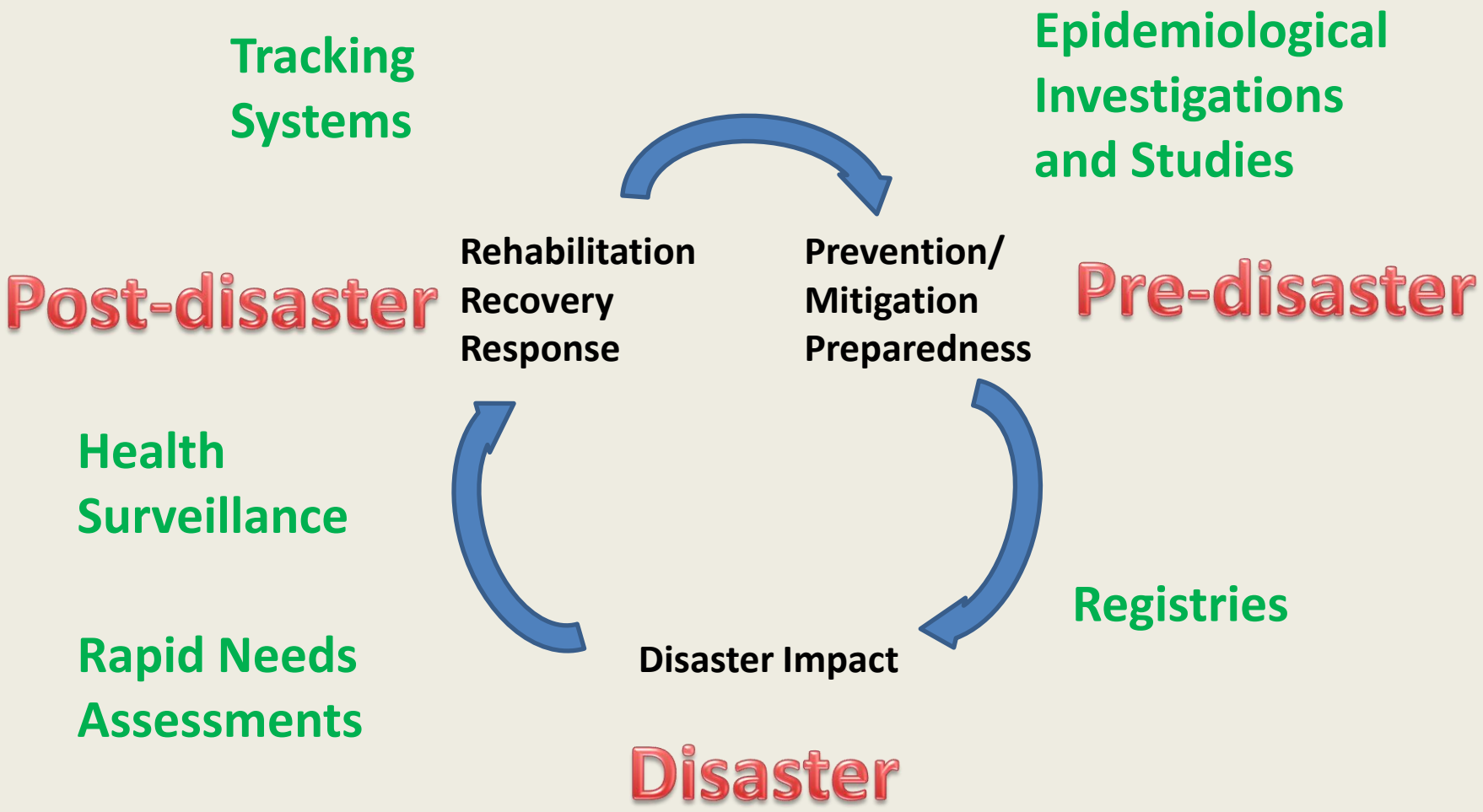
(Source: Adapted from Morris-Oswald, 2015)

Figure 4. Psychological Support Interventions by Demand, Intensity and Distribution

Key Findings (3)

- State of Emergency should trigger formal, but temporary and flexible, **expansion of list of reportable diseases** to local authorities
  - Otherwise no data for public health, particularly regarding causes of illnesses and **potential emerging pathogens**
  - Low morbidity may privilege doctor over hospital surveillance
  - Alternatively, many other models of disaster epidemiology

Disaster Epidemiology



Source: Malilay et al. 2014

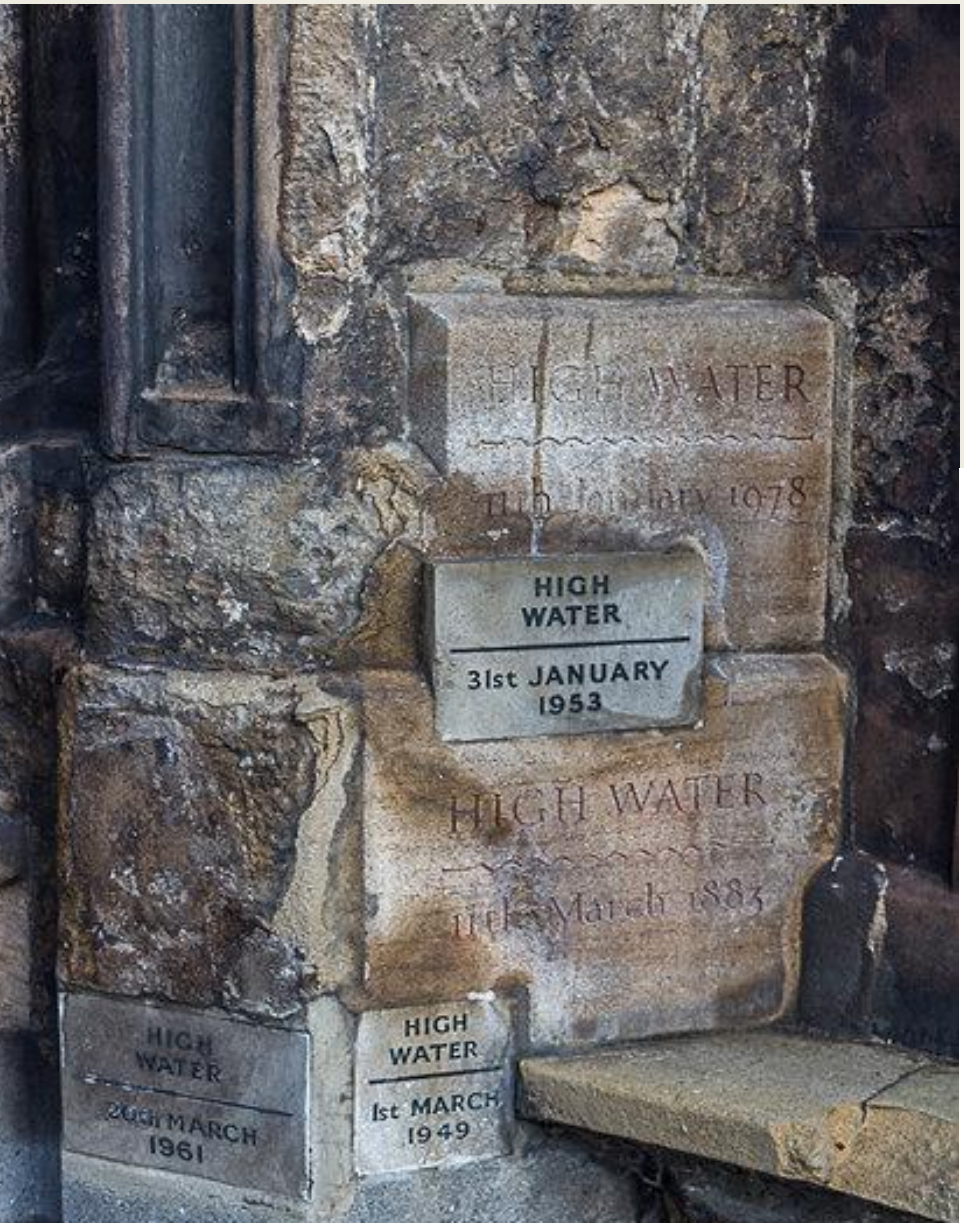
Key Findings(4)

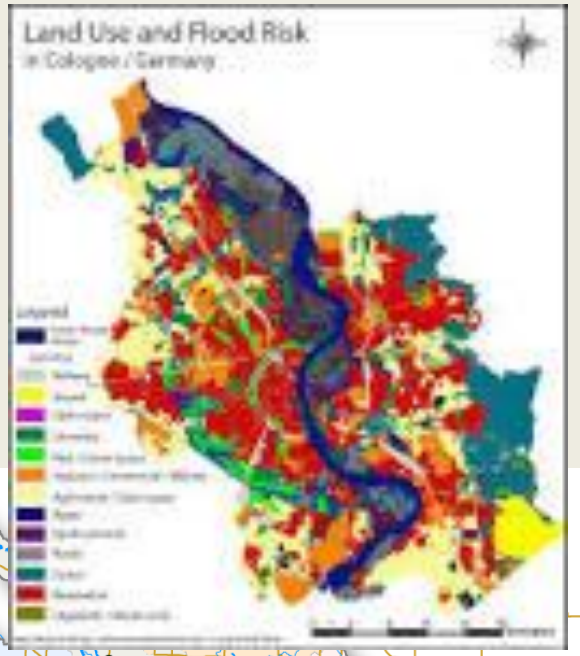
- **Limited evidence of mortality and morbidity**
- Fatalities tend to be behavioural
  - Not ‘fixable’ through enhanced flood protection
- Professional, focused responses to core threats
  - drinking water, garbage, structural integrity, etc.
- Dampness and mould an on-going challenge

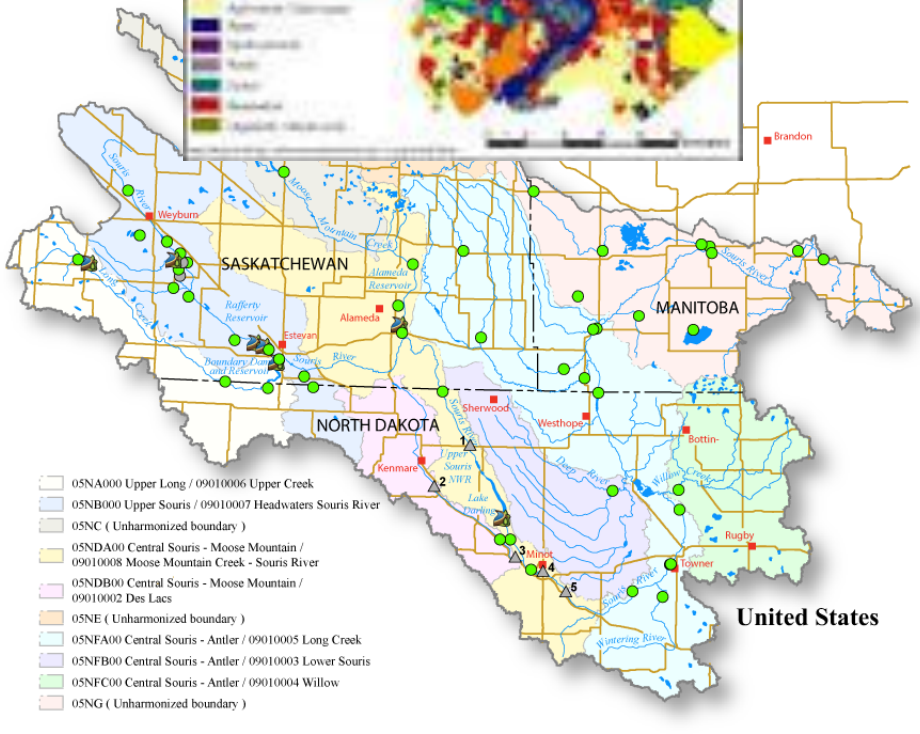
Key Findings (5)

- Lack of **public awareness** of potential consequences of living in a flood plain or being part of a **social-ecological system**
  - Has consequences for post-disaster mental health
  - Role for public health in improving connections through websites and pre- and post-flooding resources
  - Linked to ecological determinants of health (and ecohealth!)
  - Conservation Authorities a good resource
  - Public health could encourage the expansion of flood marking systems

Flood Markers, Watershed and Flood Maps







For another day ...

- Use of social media
- Pan-Canadian networking among public health professionals
- Perverse disaster-relief programs
- Pre- and post-flood information packages
- Public health staff burnout
- Post-flood reviews that are entirely focused on the ‘hard path’ for water ...
  - Leave out ‘soft paths’ AND social/institutional responses
  - Reduce learning and adaptation and hence resilience

MEME4CC

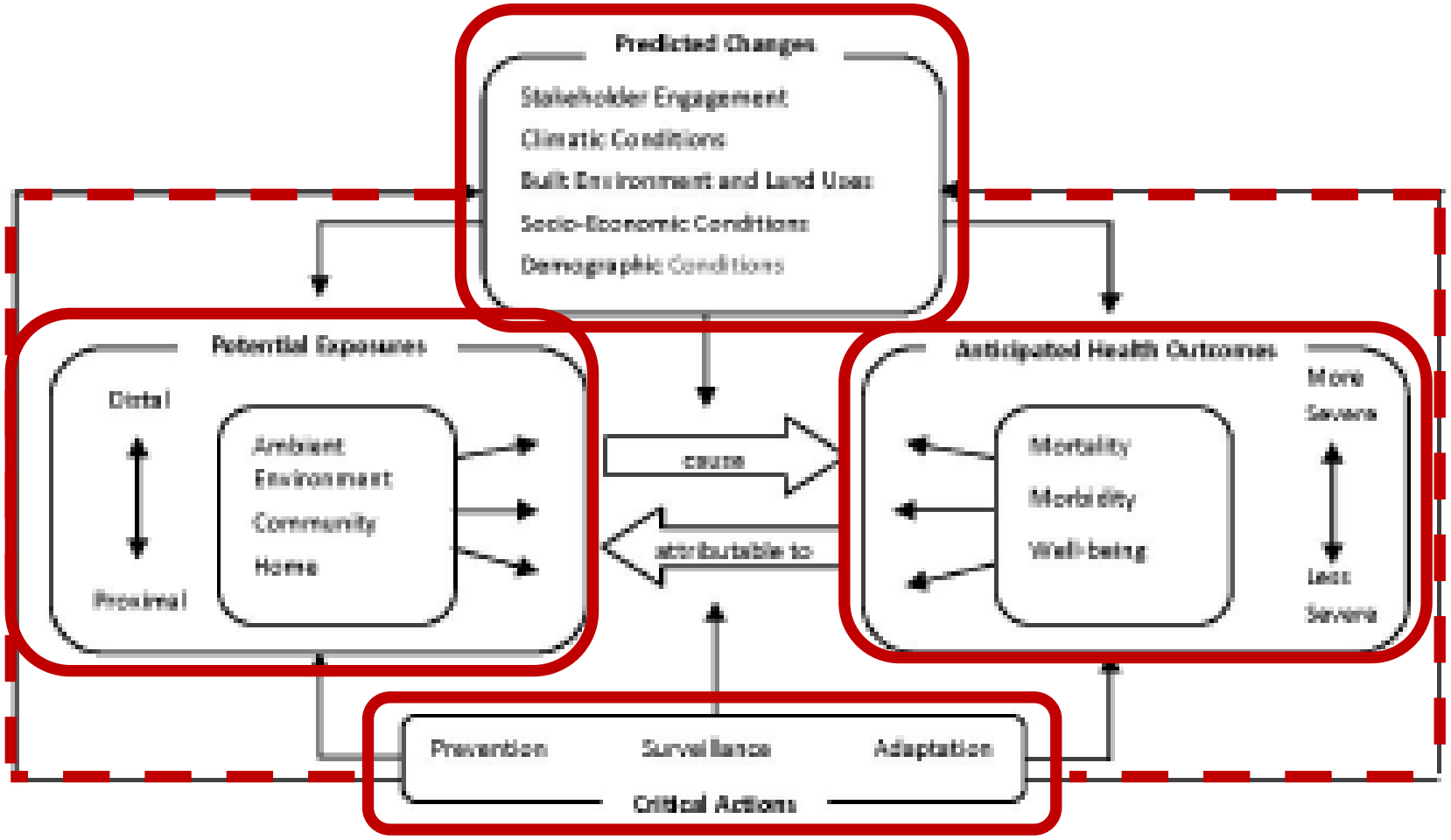
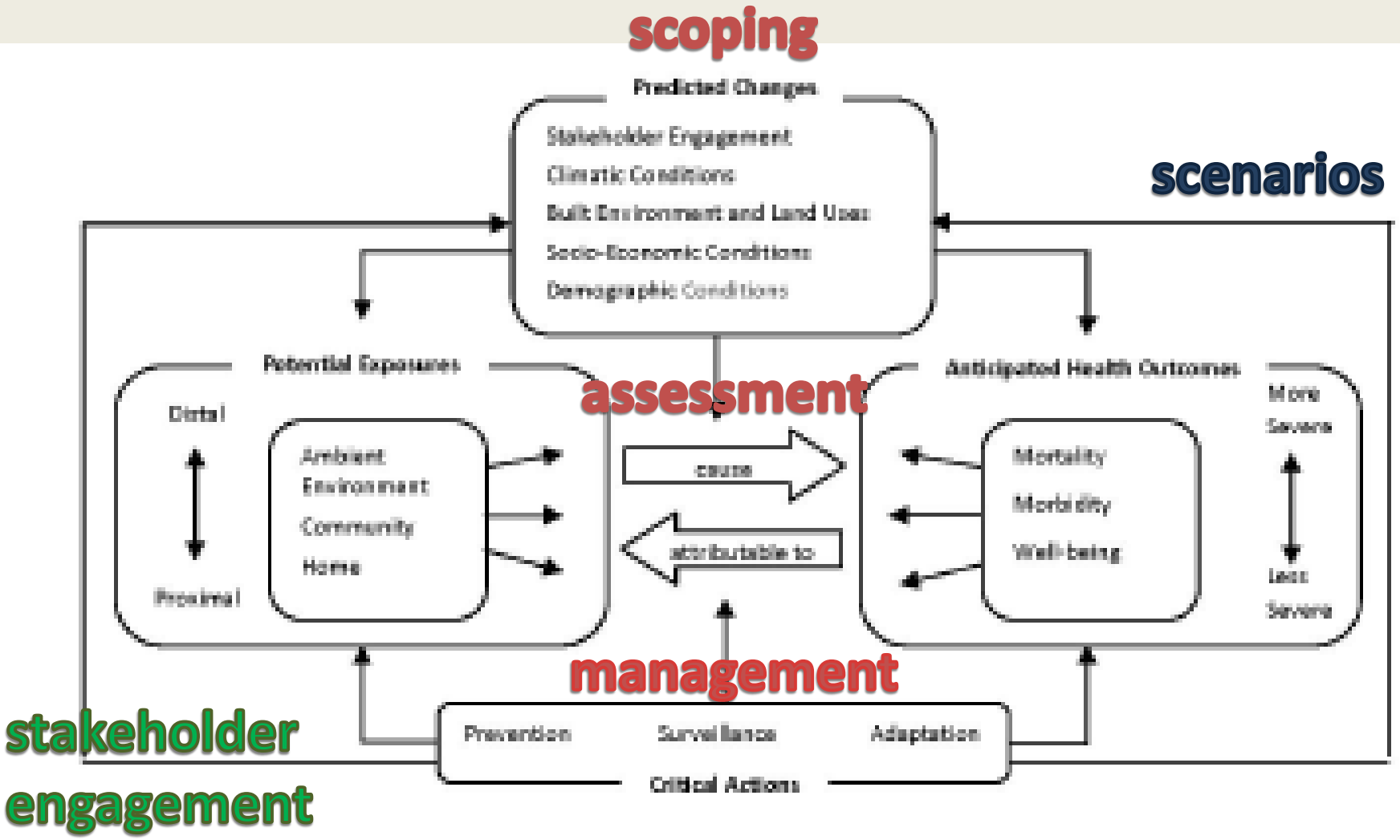


Figure 10. Multiple Exposures Multiple Effects Model for Climate Change Adaptation (MEME4CC)

MEME4CC



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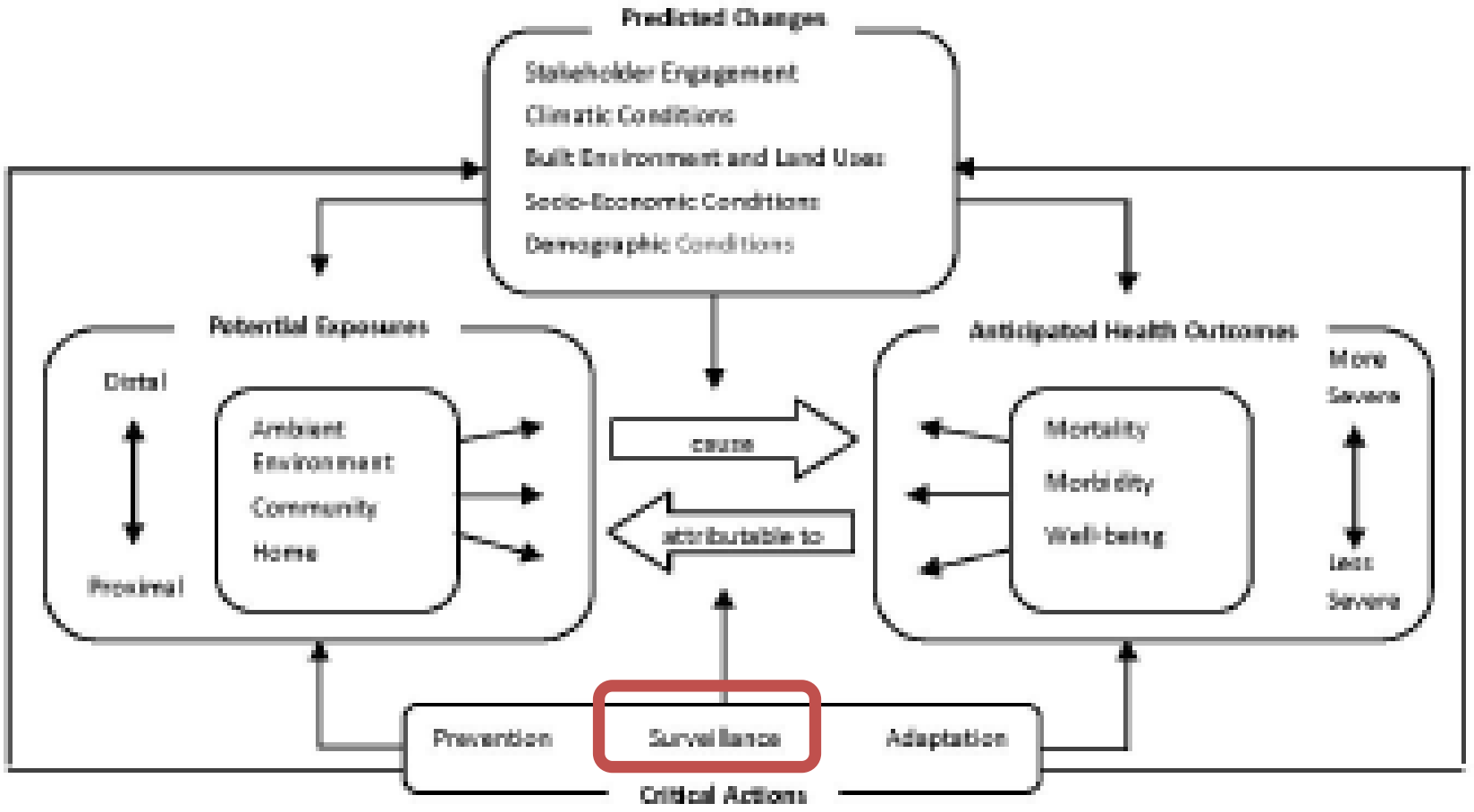

Figure 10. Multiple Exposures Multiple Effects Model for Climate Change Adaptation (MEME4CC)

Questions?

Many thanks to:

- Peterborough: Donna Churipuy, Jodi DeNoble, Melanie Kawalec, Margo Perun and the Climate Change Working Group
- Minden: Richard Ovcharovich
- Manitoba: Toni Morris-Oswald, Steve Geletchuk and Mike Olczyk
- Alberta: Younous Manjoura

Common Themes

Theme/Town	High River	Wawanesa	Minden	Peterborough
Lack of Surveillance/ Health Data	- (P)	√	√	√
Dominant Mental/ Psychosocial Health Issues	√	√	√	√
Lack of Public Awareness of Threat	√	X	√	√
Public Outrage, 3rd Party Reviews	√	√ (P)	√	√
Proactive ID of Vulnerable Populations	X	√	X	X
Explicit consideration of gender	X	X	X	X
Housing Type Important	X	X	√	√
Increased stress from disaster relief processes	√	√	√	X
Watershed-Level Tensions & Communication Challenges	√	√	√	√
Public Health Staff Tensions & Burnout	√	√	√	√
Available Pre- and Post-Flooding Information Packages	X	-	-	-