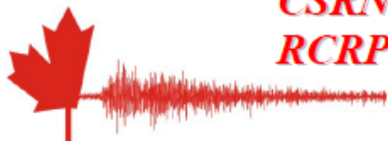




*info@sciencemedia.ca*



Canadian Seismic Research Network  
Réseau canadien pour la recherche parasismique

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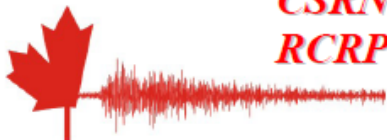
# Canadian Seismic Research Network



Network Leader:

Professor Denis Mitchell  
McGill University

James McGill Professor



**CSRN**  
**RCRP**

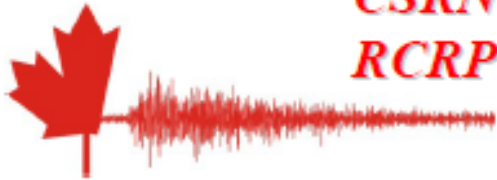
Canadian Seismic Research Network  
Réseau canadien pour la recherche parasismique

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**McGill**



**CSRN**  
**RCRP**

Canadian Seismic Research Network  
Réseau canadien pour la recherche parasismique

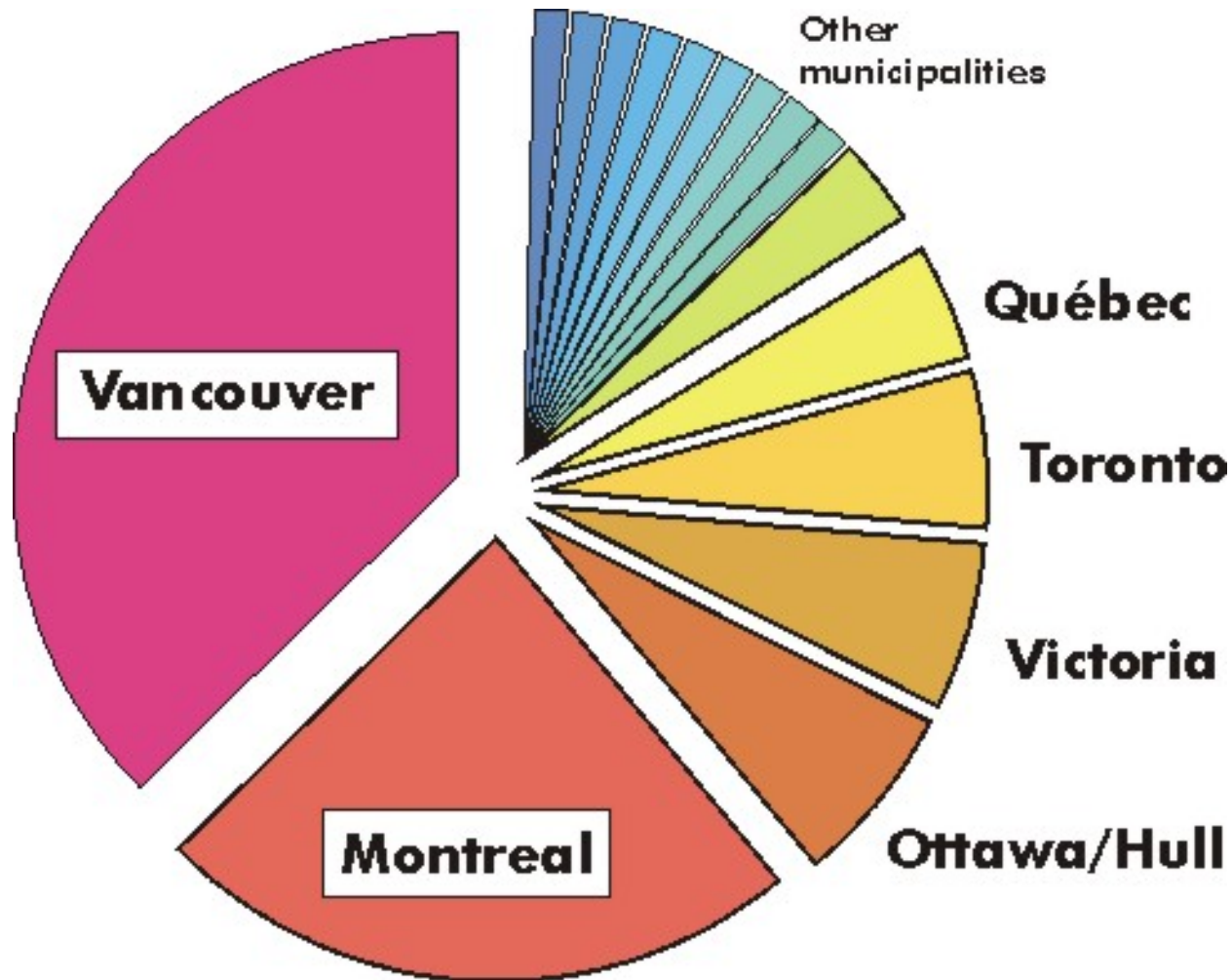
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- A significant earthquake is probably Canada's greatest potential natural disaster
- High percentage of urban infrastructure was constructed prior to the introduction of modern seismic design provisions
- Vulnerability of critical infrastructure such as hospitals, schools and bridges
- **Goal is to reduce urban seismic risk**

# ***Seismic Risk in Canada***

## ***Geological Survey of Canada (GSC)***





# Researchers

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- 26 investigators from eight universities
- Multi-disciplinary research team
- Over 100 graduate students participating in the Network
- Collaboration with government agencies, industry, design engineers, insurance industry, emergency preparedness agencies

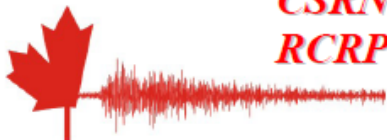
# Canadian Seismic Research Network



Theme 1 Leader (Hazard  
Assessment):

Professor Gail Atkinson  
University of Western  
Ontario

Canada Research Chair in  
Earthquake Hazards and  
Ground Motions



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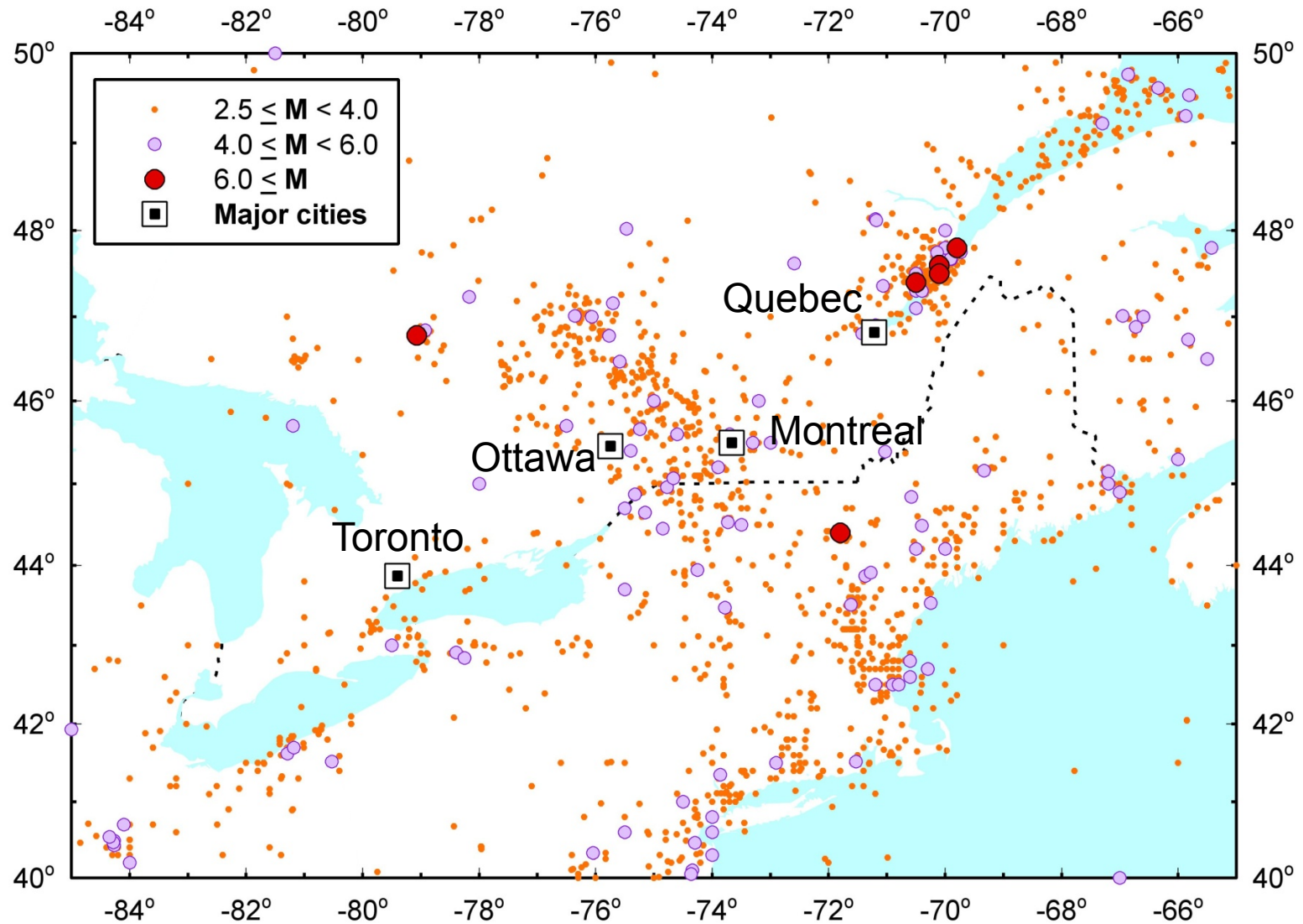
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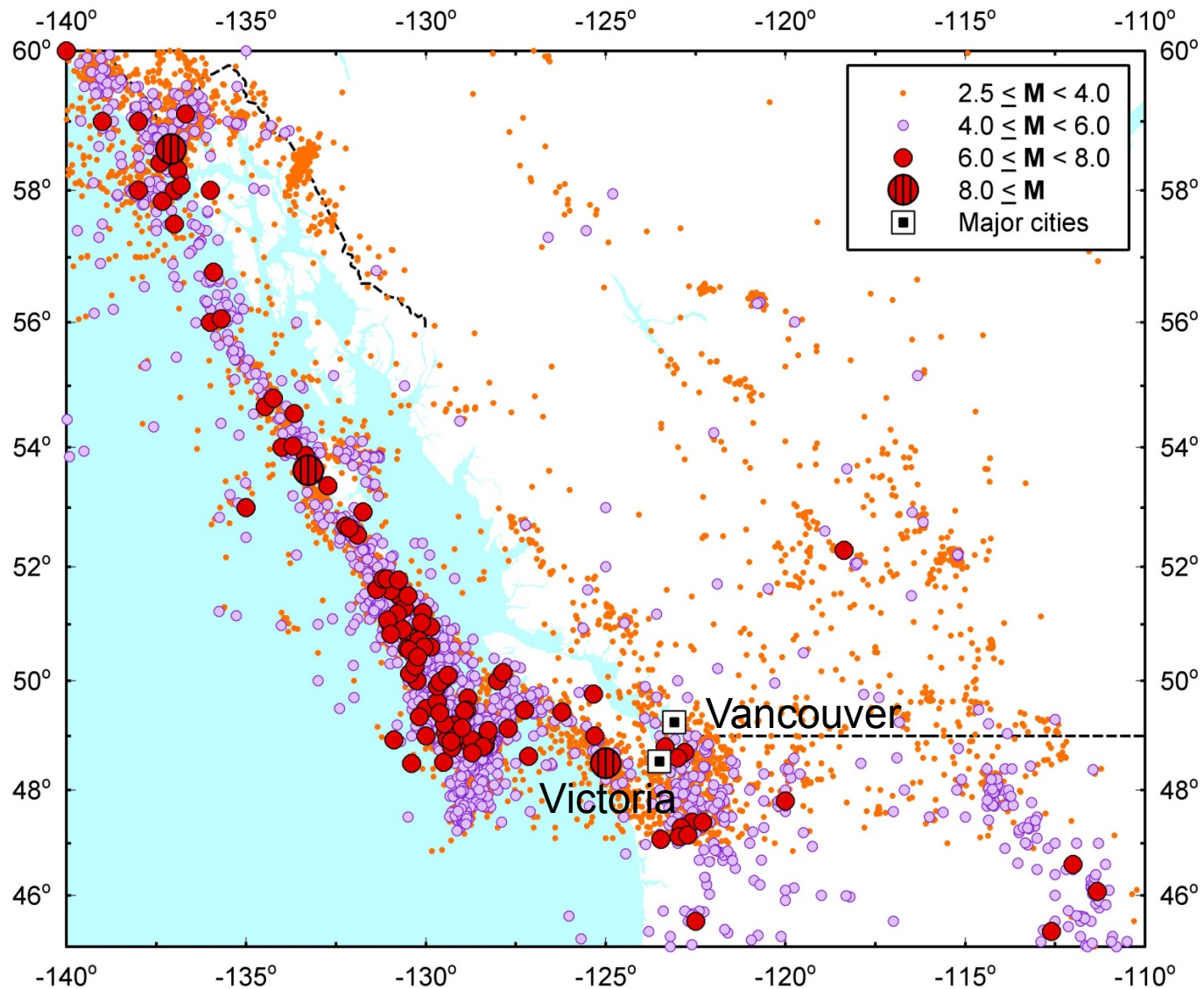
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# Earthquake catalogue for eastern Canada

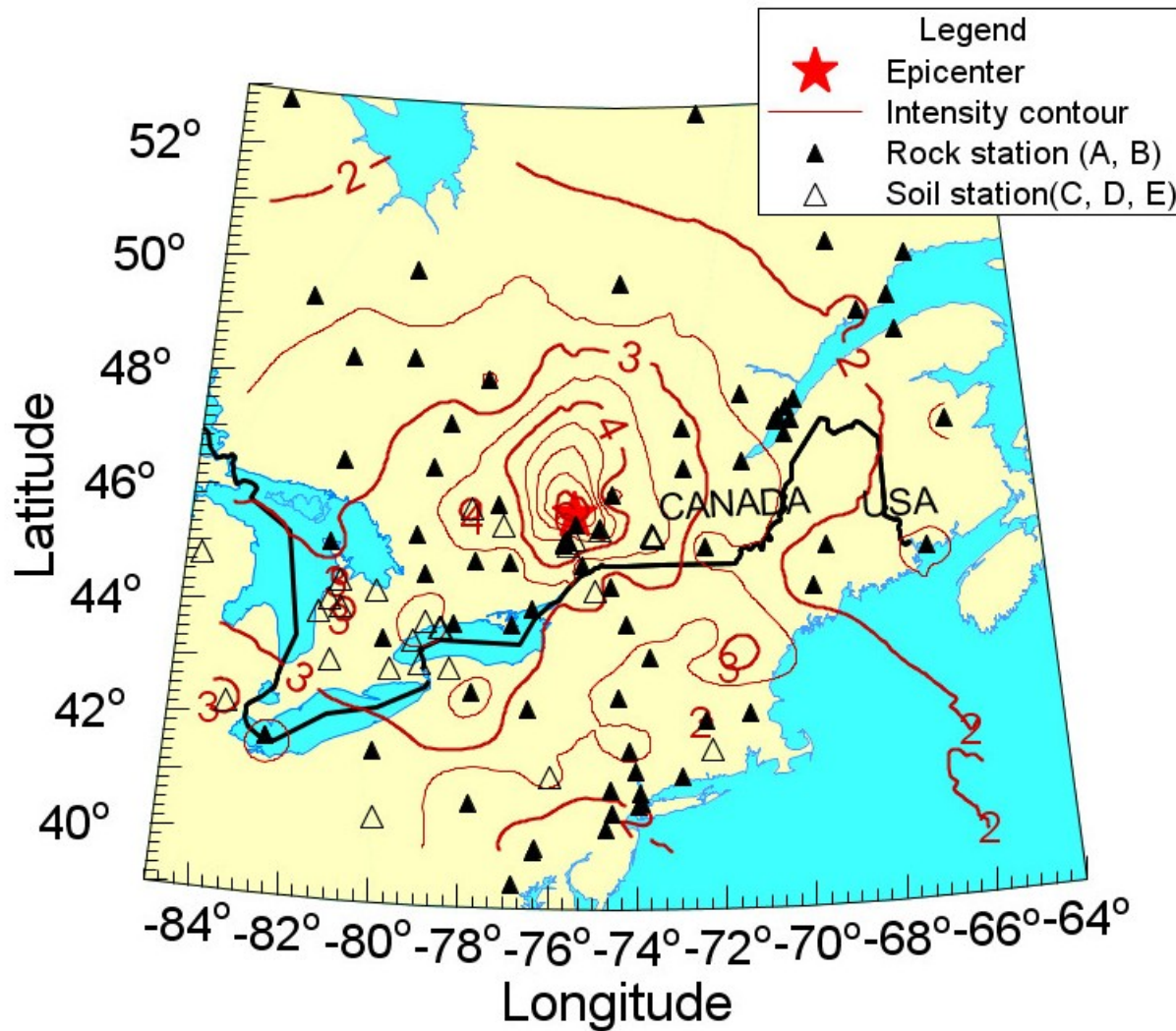


# Earthquake catalogue for western Canada

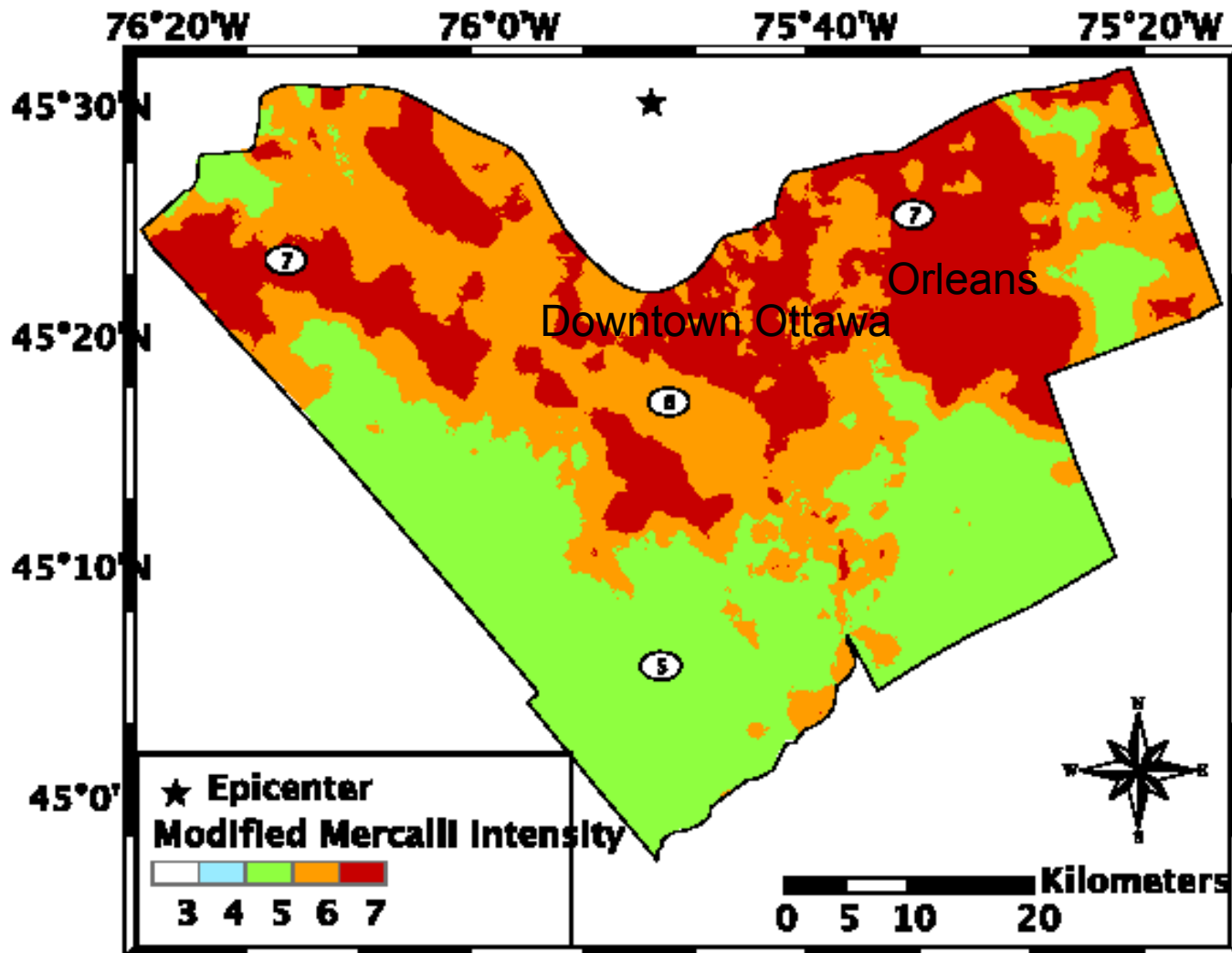




## Instrumental Intensity: June 23, 2010 M5.0 Earthquake



*Overview of ground motions from the 2010 M5.0 earthquake near Ottawa. Symbols show locations of recording stations. Contours show intensity as calculated from the recorded ground motion values.*

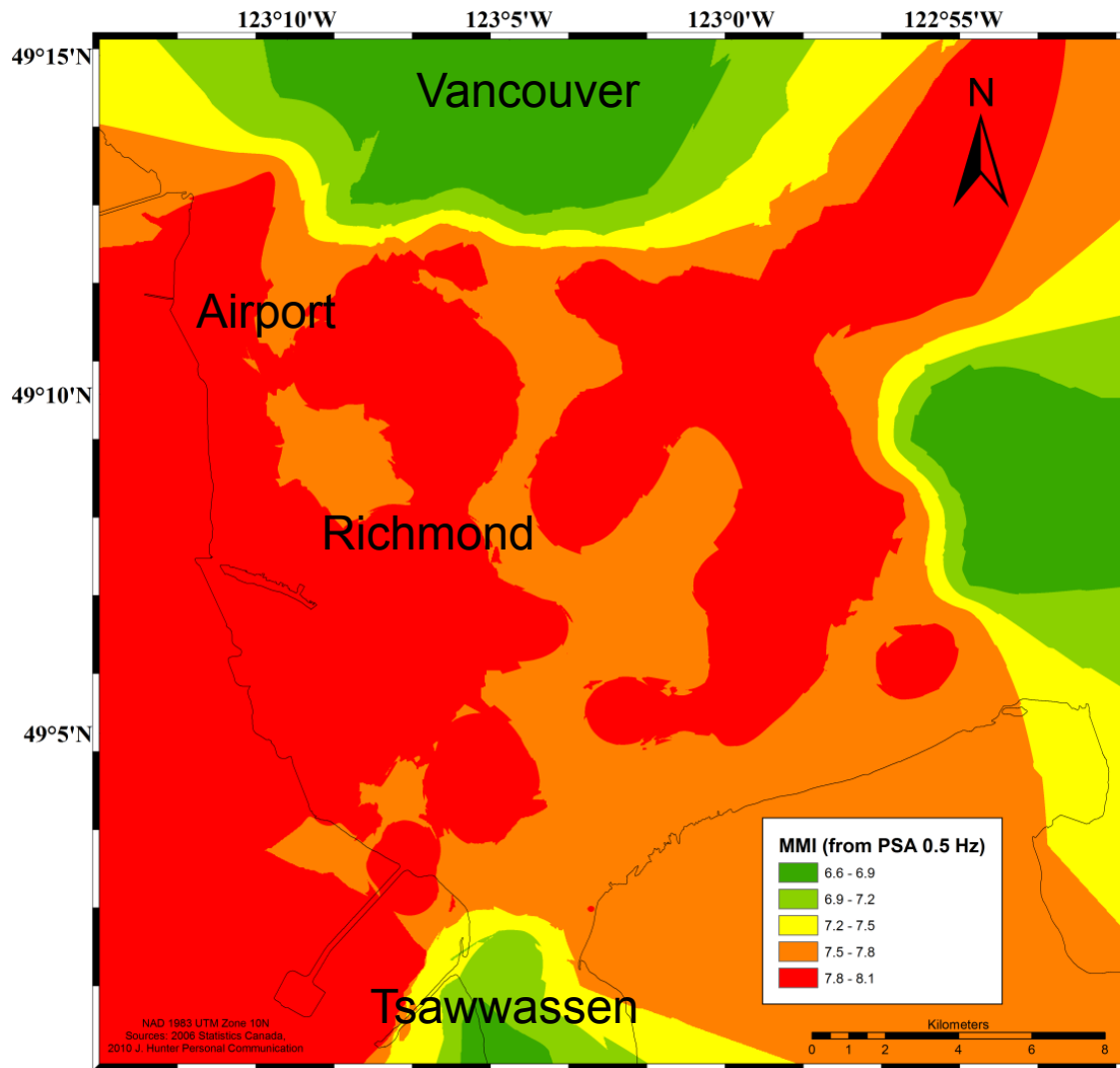


*Predicted intensities for hypothetical M6 event north of Ottawa (star). Motions are code-level for design.*

*Max. MMI=7:  
Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures*

**Scenario ShakeMap for Ottawa  
(soils range from hard to soft)**





*Map of expected intensity (MMI), for an M9 Cascadia subduction zone. Max. MMI=8: Damage slight in properly designed structures; considerable damage in substandard buildings with partial collapse. Damage great in poorly built structures.*

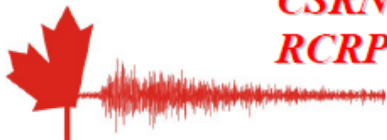
**Scenario ShakeMap for Fraser Delta, south of Vancouver (on deep soil deposits)**

# Canadian Seismic Research Network



Project Leader :  
“Microzonation”  
“From Hazard to Risk”

Professor Luc Chouinard  
McGill University



Canadian Seismic Research Network  
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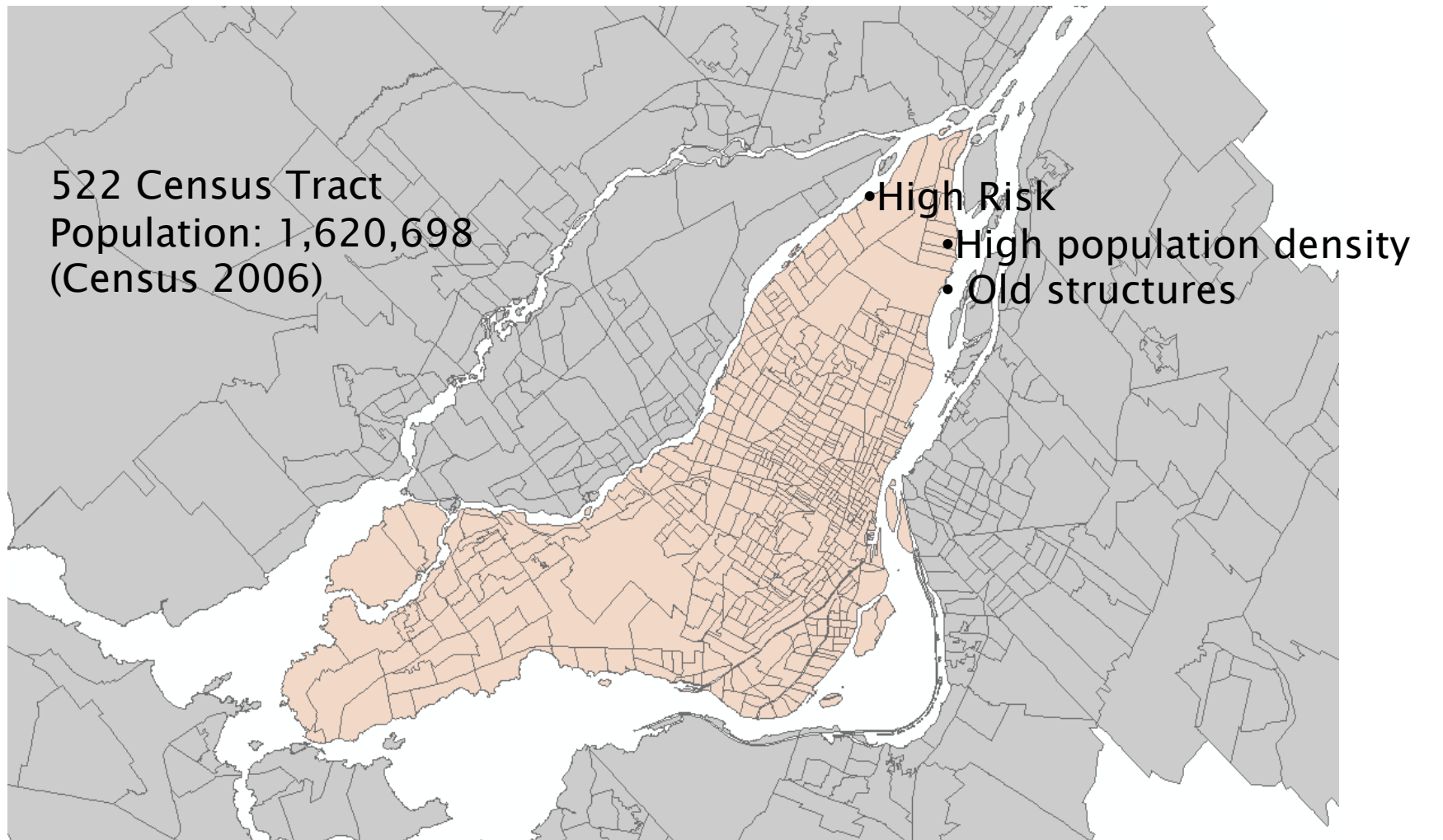
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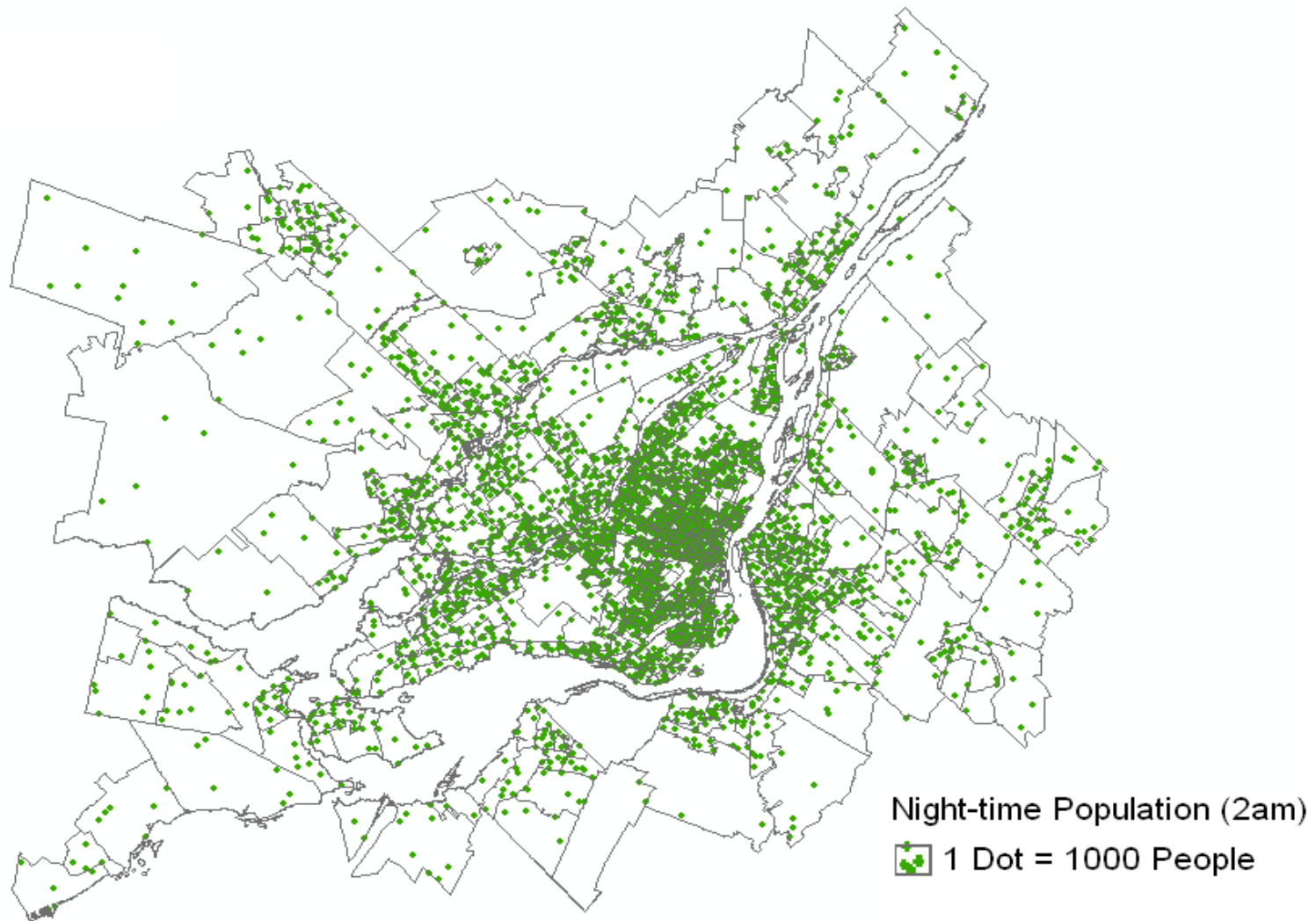
**McGill**

# Study Region: City of Montréal

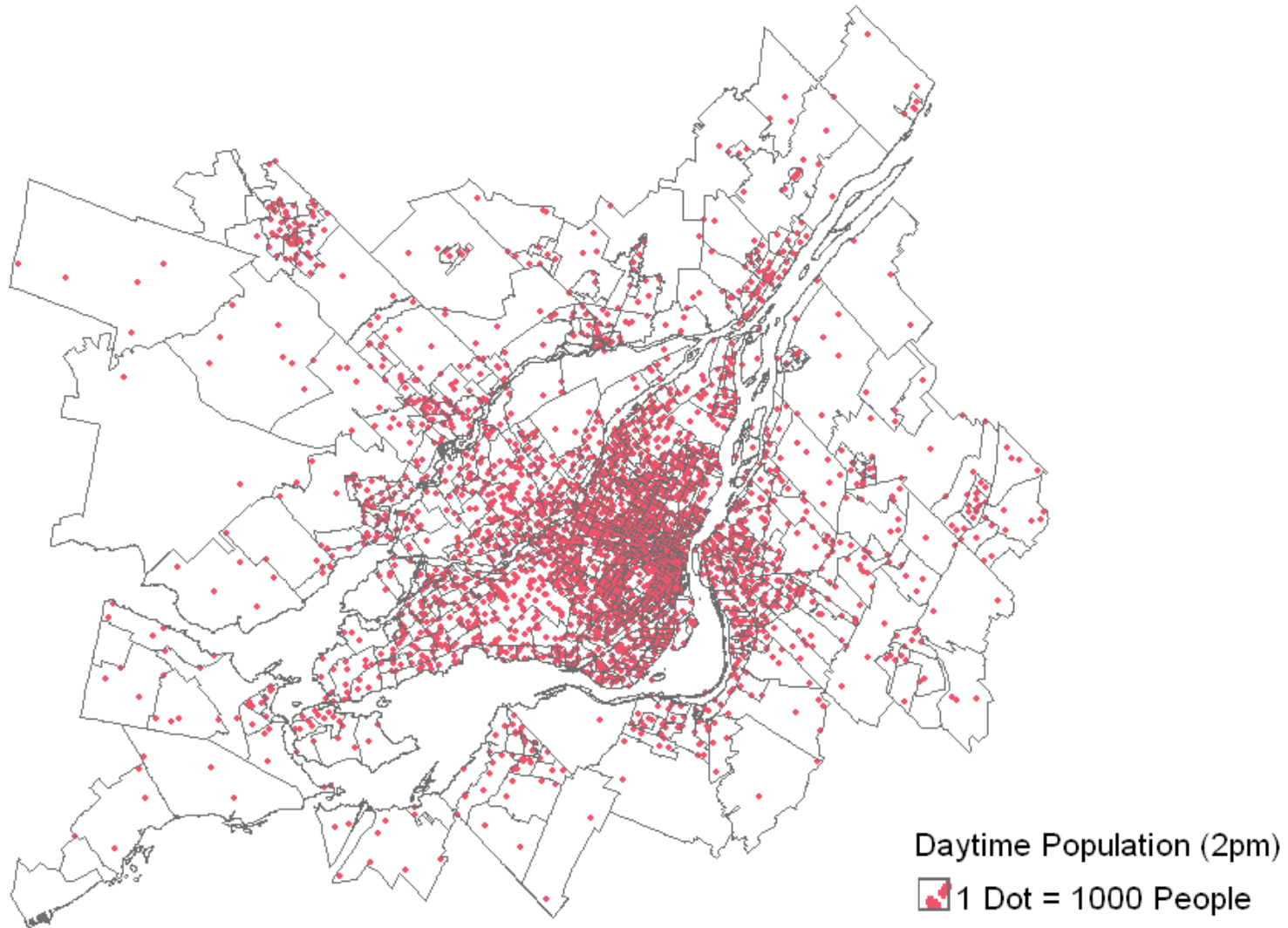


Census 2006 Data

# Night-time Population (2 a.m.)








# Daytime Population (2 p.m.)





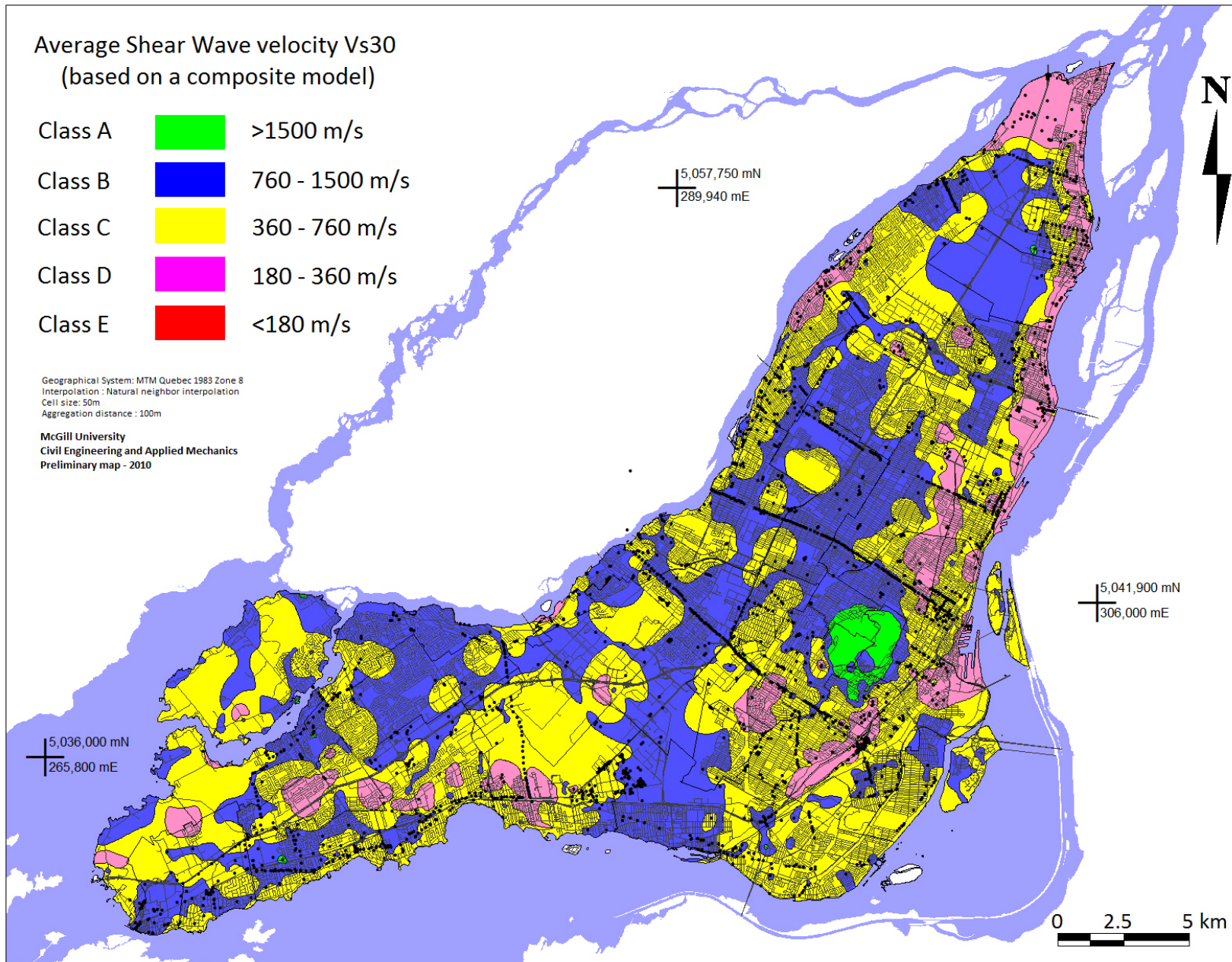
# Preliminary Microzonation for Montréal

Average Shear Wave velocity  $V_{s30}$   
(based on a composite model)

Class A		>1500 m/s
Class B		760 - 1500 m/s
Class C		360 - 760 m/s
Class D		180 - 360 m/s
Class E		<180 m/s

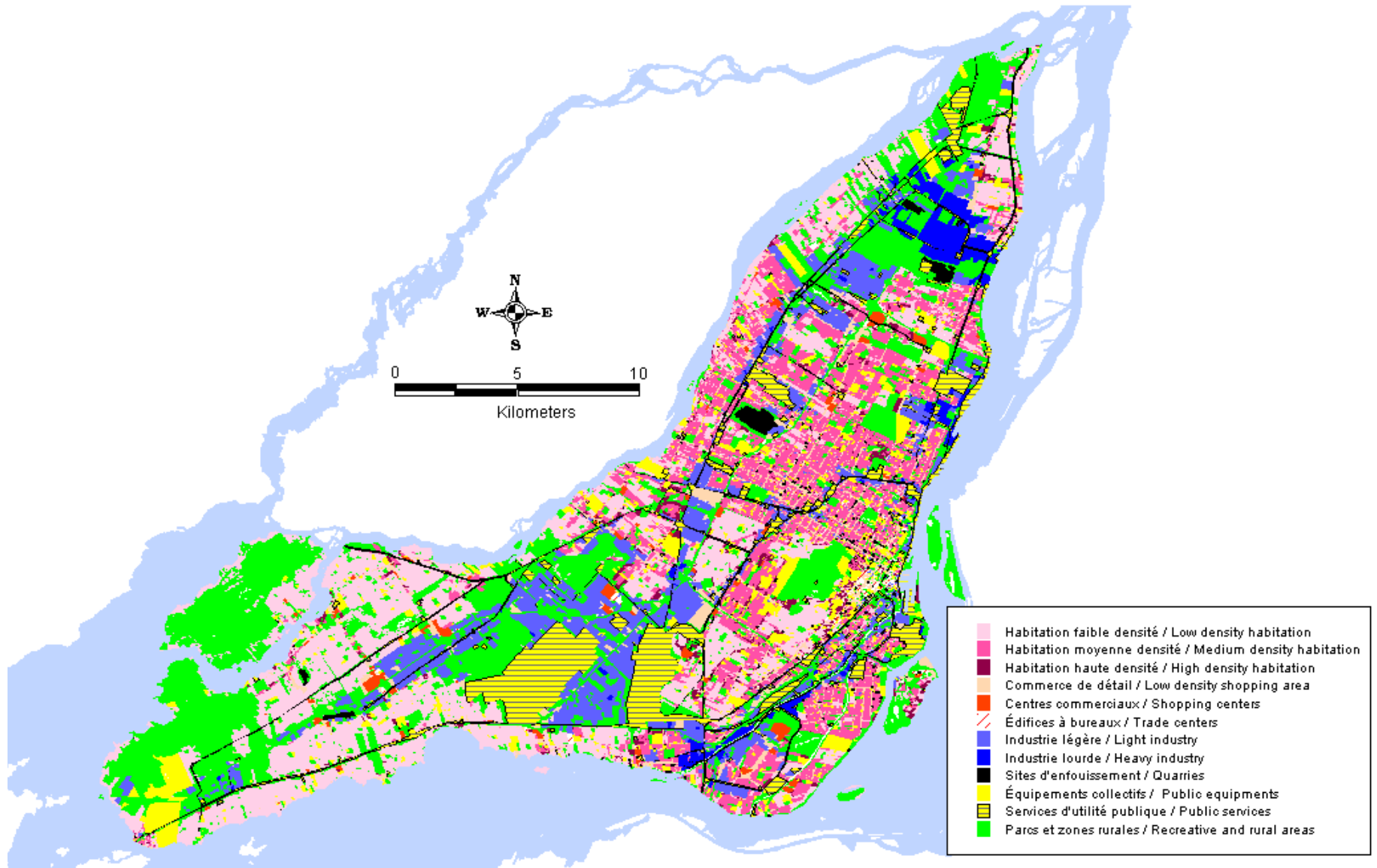
Geographical System: MTM Quebec 1983 Zone 8  
Interpolation: Natural neighbor interpolation  
Cell size: 50m  
Aggregation distance: 100m

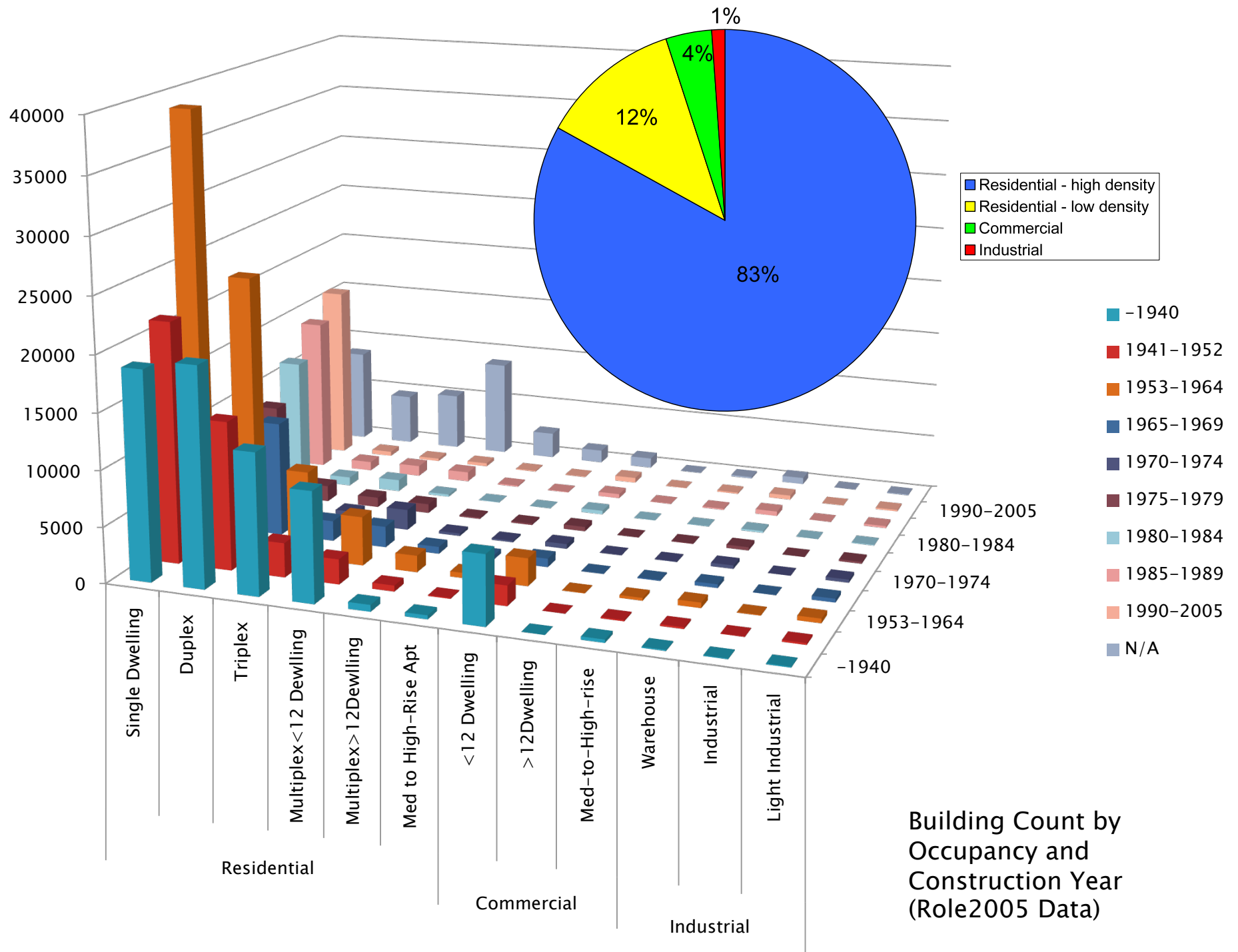
McGill University  
Civil Engineering and Applied Mechanics  
Preliminary map - 2010





# Land Use

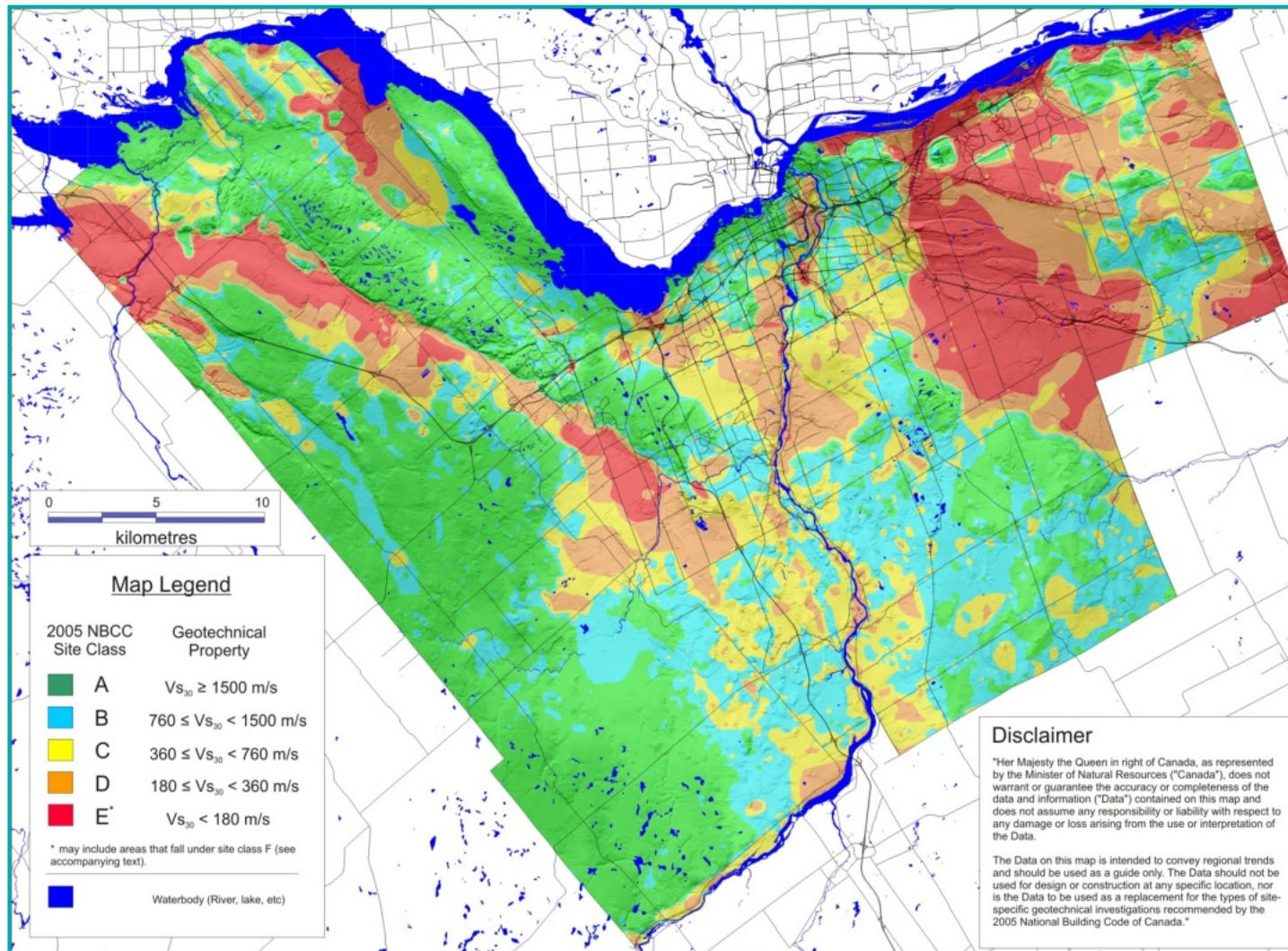




# Microzonation of Ottawa

## GSC & Dariush Motazedian (Carleton U.)

- Final  $V_{s30}$  map for Ottawa





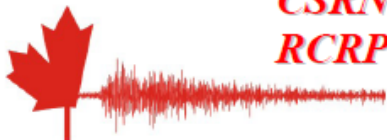
# Canadian Seismic Research Network



Network Leader

Professor Denis Mitchell  
McGill University

James McGill Professor



**CSR/N**  
**RCRP**

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**McGill**

# Montreal East City Hall

## Saguenay Earthquake, 1988

### M5.9

- *Soft soil*
- *Unreinforced masonry*
- *350 km from epicentre*





# ***Evaluation of critical infrastructure***

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- Post-disaster structures (hospitals, schools)
- Other buildings
- Bridges





# ***Reinforced Concrete Buildings***

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- Older codes for design and detailing did not adequately address seismic aspects
- Earthquake engineering is a relatively new science
- Older structures have deficiencies
- Large-scale testing



***Hospital, Mexico City, 1985***



***School, Kobe, 1995***

# ***Steel Structures***

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- Older steel structures have deficiencies
- Large-scale testing of components of steel structures (connections and braces)

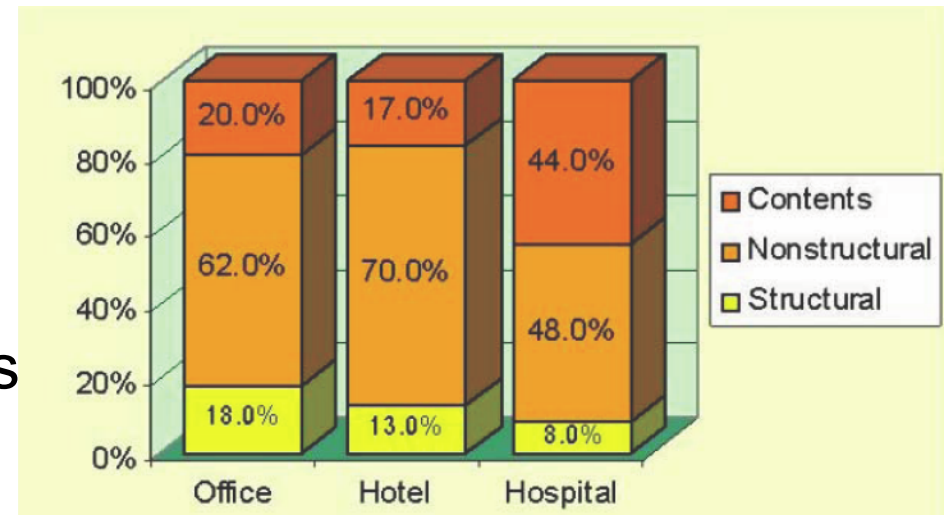


***Mexico City, 1985***

# *Operational and Functional Components*

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- Non-structural components are vital to the operations of facilities
- Critical for post-disaster structures such as hospitals
- Damage to these components forms a significant percentage of total losses



*Importance of Component  
Damage*

# ***Bridges***

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- Developing an inventory of deficiencies for older bridges
- Developing improved seismic design provisions for the Canadian Highway Bridge Design Code.



***Northridge, CA, 1994***



***Tubul, Chile, 2010***

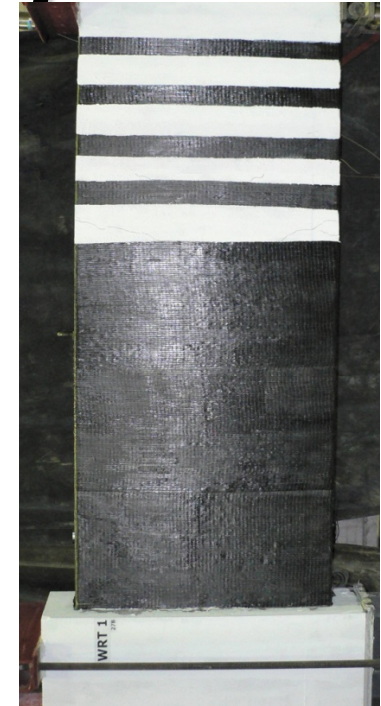


# Full-Scale Testing



# ***Developing Innovative, Cost-Effective Retrofit Techniques***

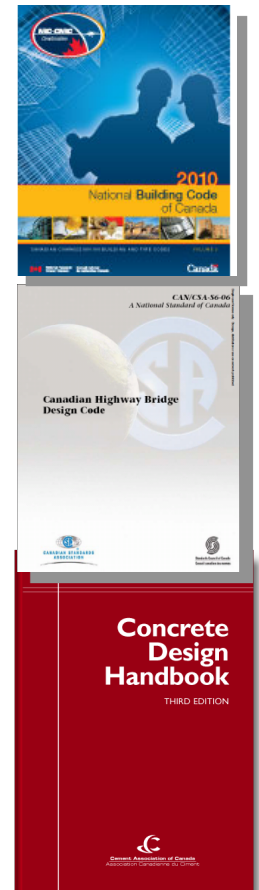
- Energy-Dissipating Braces
- Carbon Fibre Wrap
- Added Steel Braces





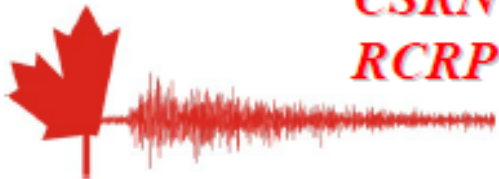
# ***Role of Codes and Standards for New Construction***

- National Building Code of Canada
- Canadian Standards Association
- Legally binding documents
- Primary concern is life safety
- Written by experts (design engineers, researchers, regulatory authorities, producers)
- Current Canadian codes are among the best in the world



# *Assessing Seismic Safety of Existing Structures*

- Guidelines being developed for the seismic evaluation and retrofit of existing older buildings and bridges
- Canadian Seismic Research Network funded by NSERC Strategic Research Network program



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# ***Benefits to Canada***

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- Improved risk assessment
- Identification of deficient infrastructure
- Cost-effective retrofit solutions
- Plans and tools for response and recovery
- Guidelines and policy for reduction of risk
- **Improved safety and security**