NATURAL RESOURCES CANADA - INVENTIVE BY NATURE

Using GIS for assessing risks from earthquakes

Nicky Hastings
Natural Resources Canada

URISA BC Chapter
November 20th 2014
Burnaby, BC

National Scale Geohazard Risk Project Public Safety Geoscience Program

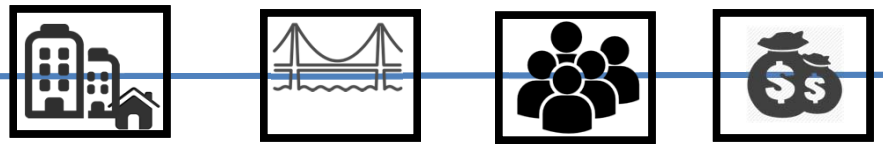
2014/15 — 2015/16 — 2016/17 — 2017/18 — 2018/19

Rapid Risk Tool

Develop, apply & validate Risk Assessment Methodology

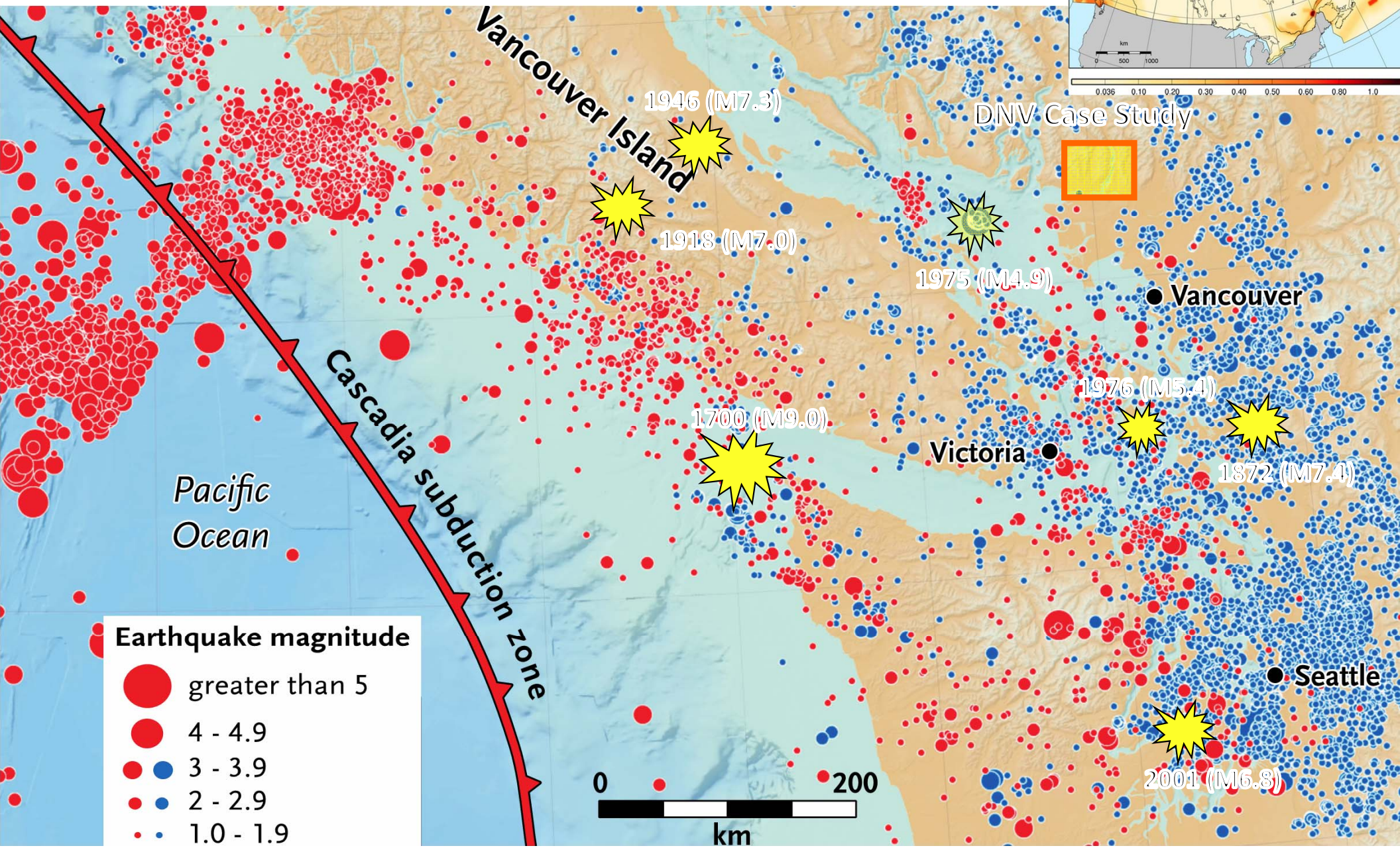
Data distribution

Engage priority end users

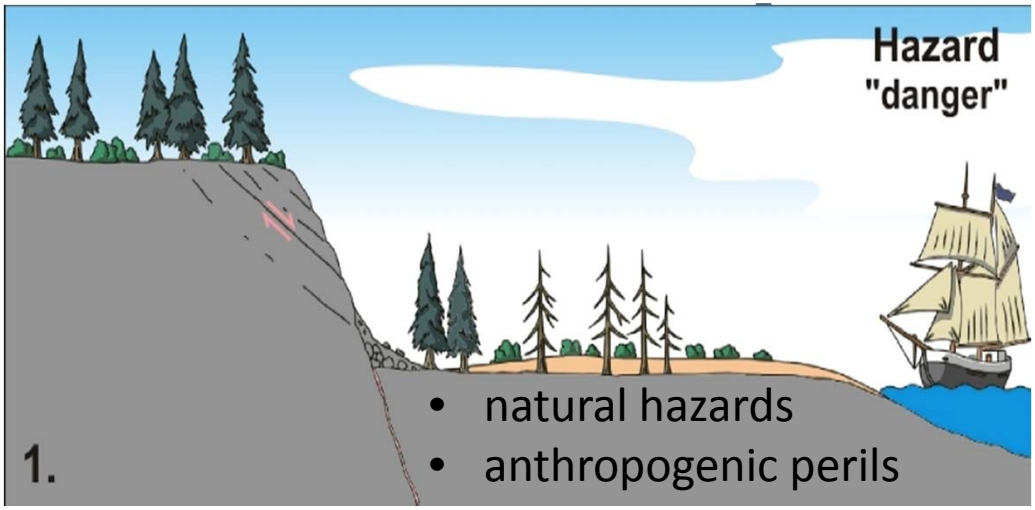


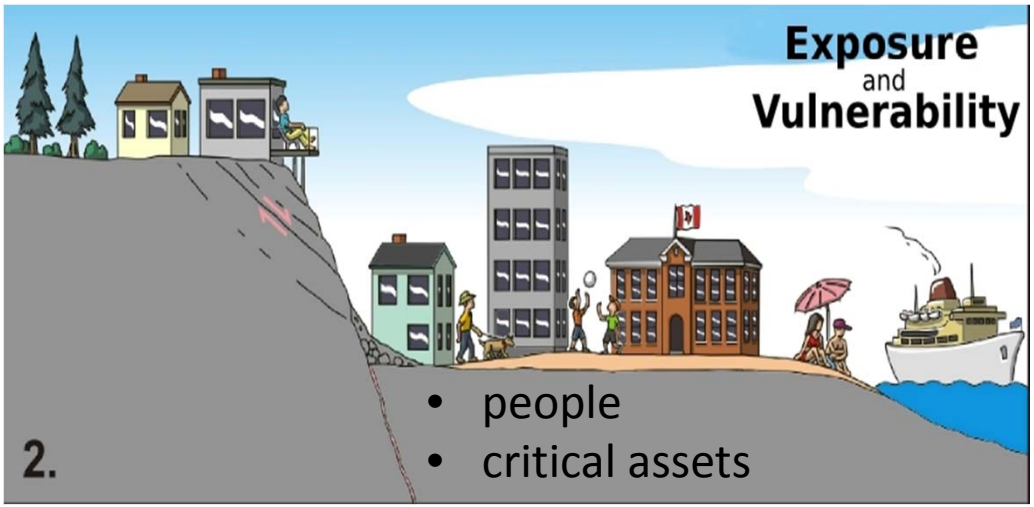
Long term outcome: *Economic, social and environmental losses resulting from geohazards in Canada are reduced*
Intermediate outcome: *The resilience of the built environment to geohazards is increased*
Immediate outcome: *geohazard knowledge outputs are used by govt regulators and decision makers & informs EM orgs.*

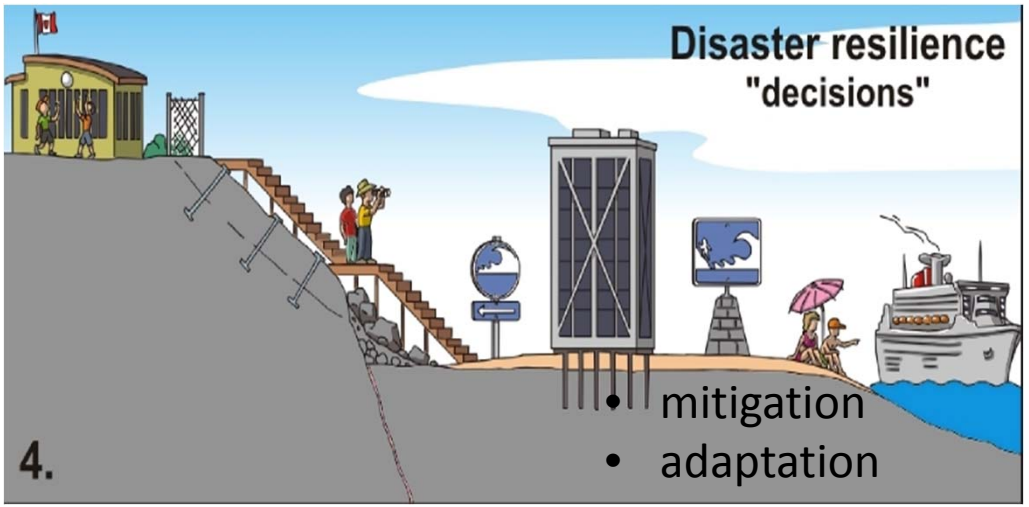
We live in earthquake country



Coming to terms with earthquake risk

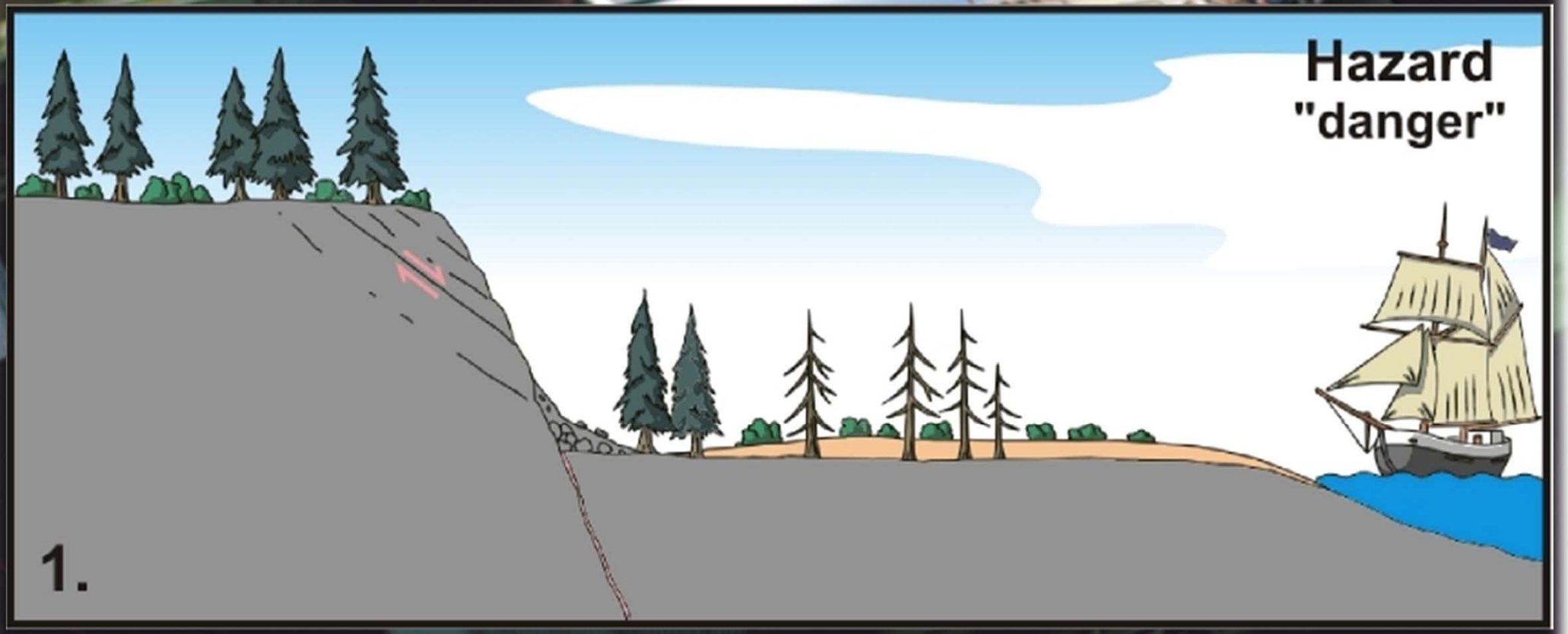






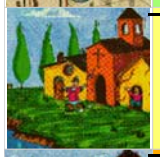
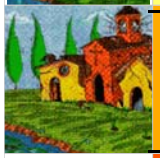
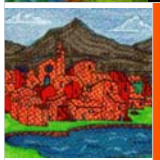
Part I

1) What are the earthquake hazards in the area?

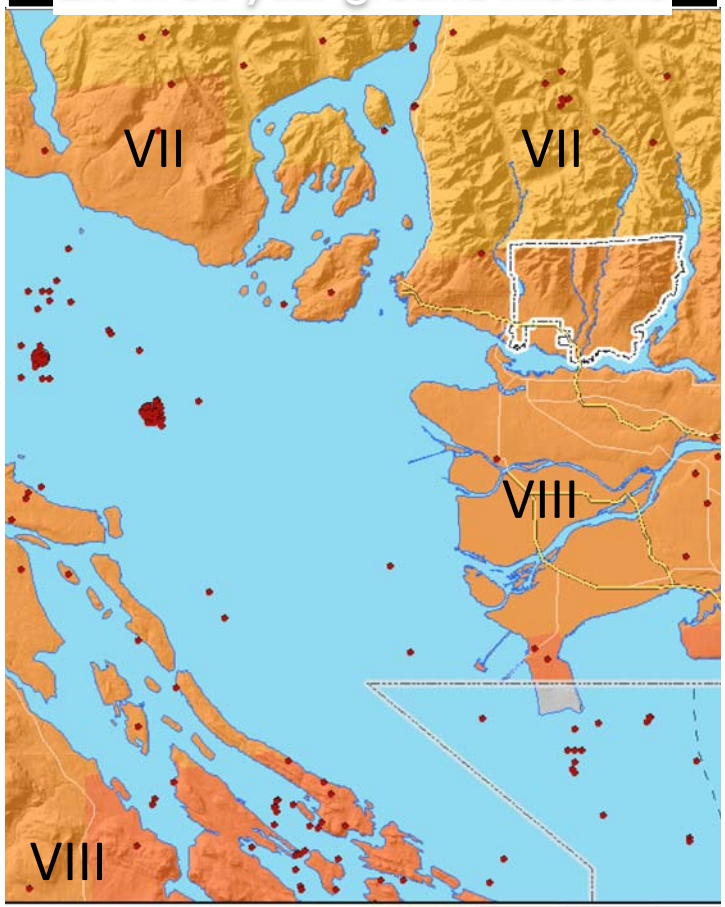


Seismic hazard potential - shaking

Probabilistic — Deterministic

MMI Scale		Perceived Shaking	Damage Potential
	V	Light felt by some	Pictures move
	VI	Moderate *felt by all*	Objects fall to ground
	VII	Strong *difficulty standing*	Non-structural damage
	VIII	Very strong *difficulty driving*	Moderate structural damage
	IX	Violent *general panic*	Heavy structural damage
	X	Very violent *general panic*	Extreme structural damage

2% in 50-year ground motions



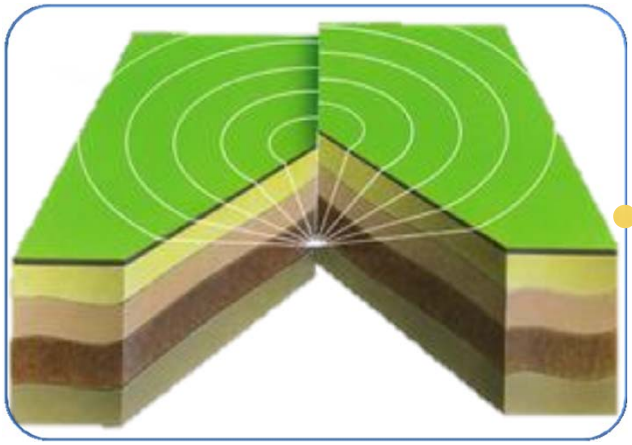
Who and what are vulnerable to known earthquake hazards in the region?

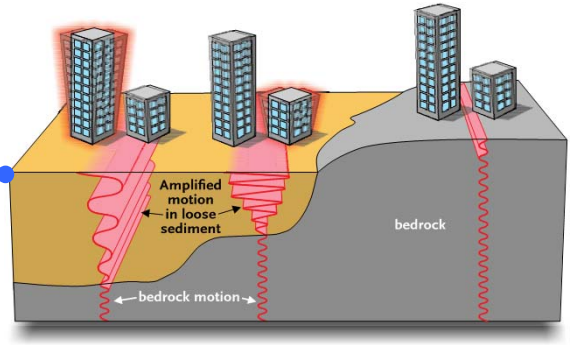
M7.3 scenario earthquake

What are the likely consequences of a major earthquake in the region?

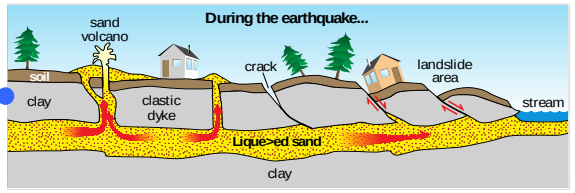
Earthquake Hazards

✓ Ground Shaking

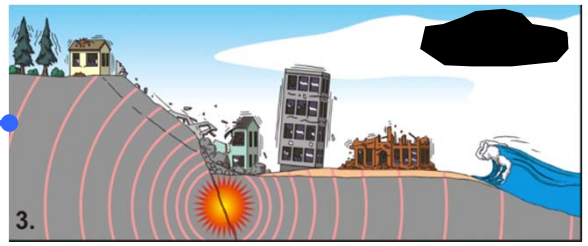




✓ Site amplification



✓ Liquefaction



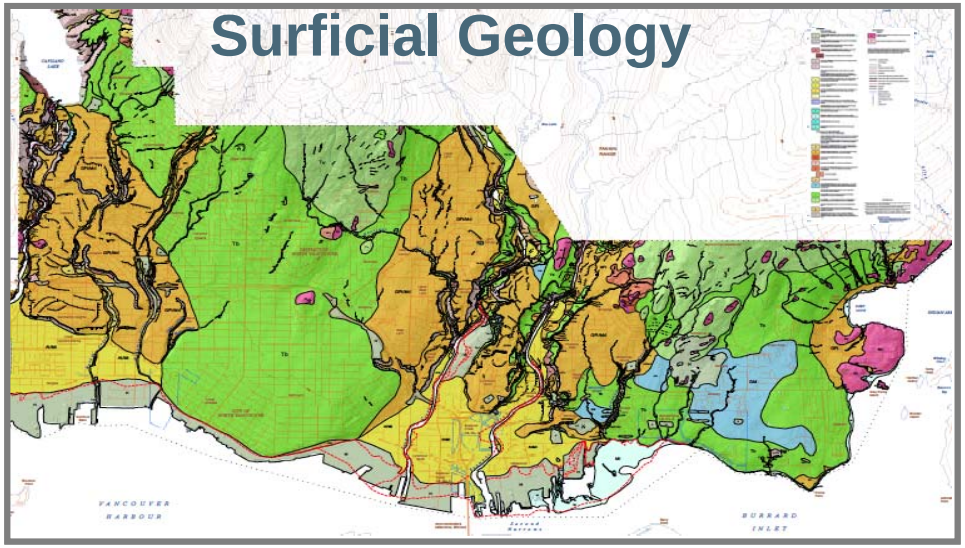
✓ Landslides

✓ Fire Following

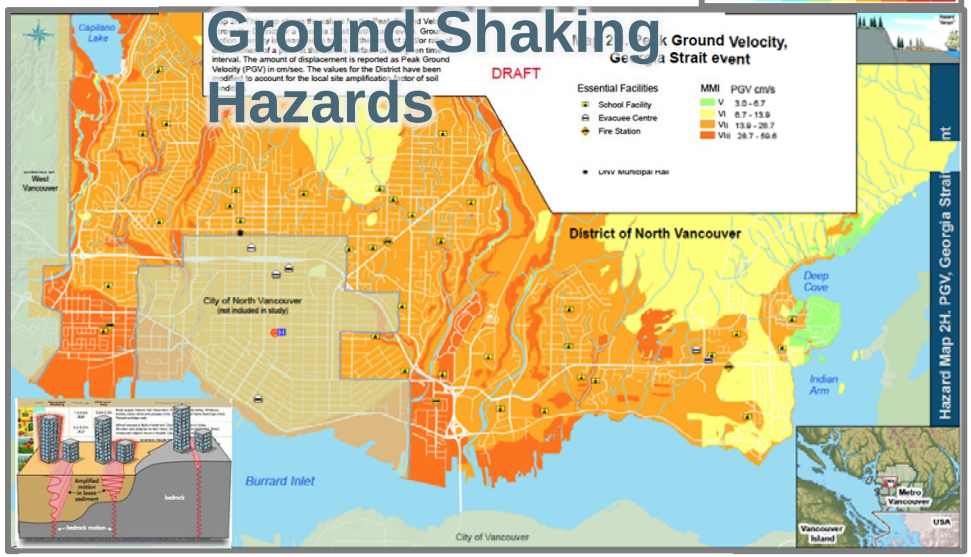
Hazard Maps

based on a Georgia Strait M7.3 scenario earthquake

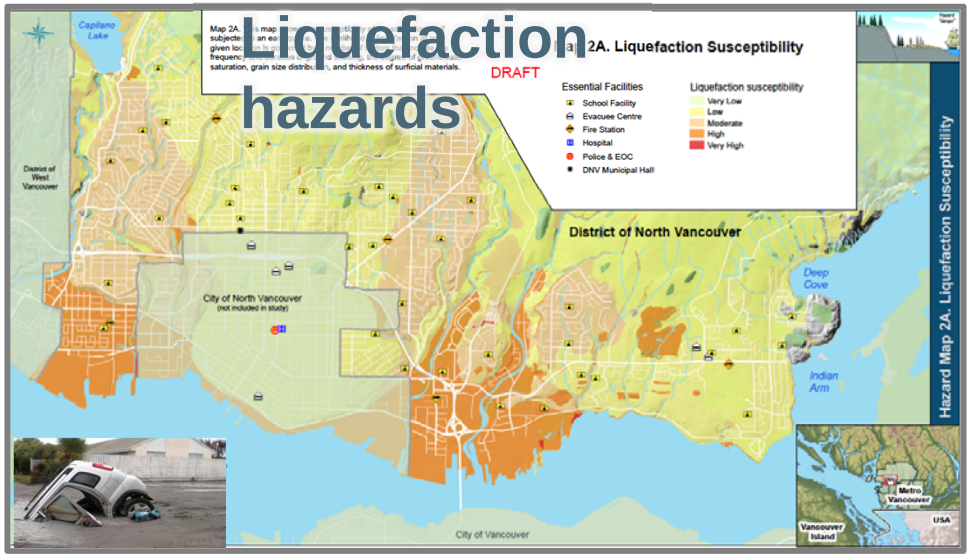
Surficial Geology



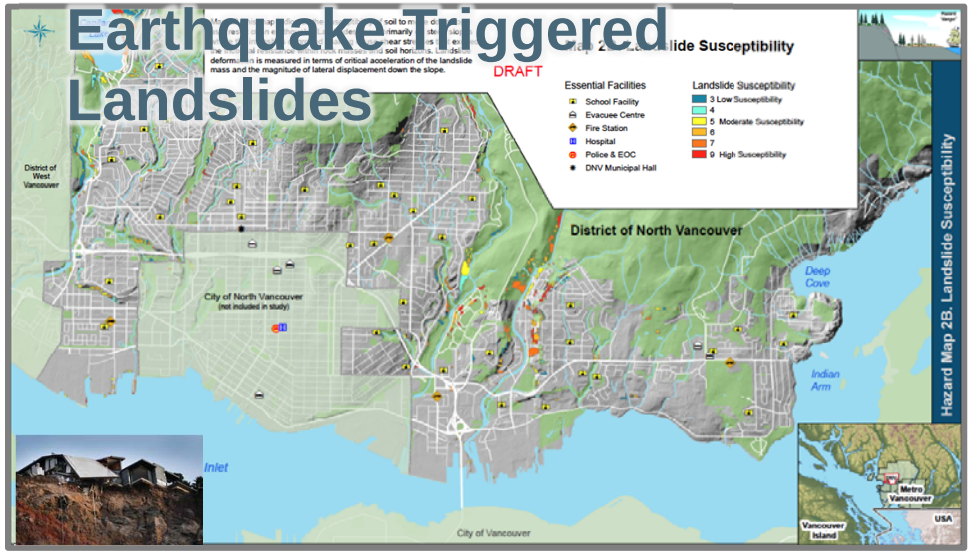
Ground Shaking Hazards



Liquefaction hazards

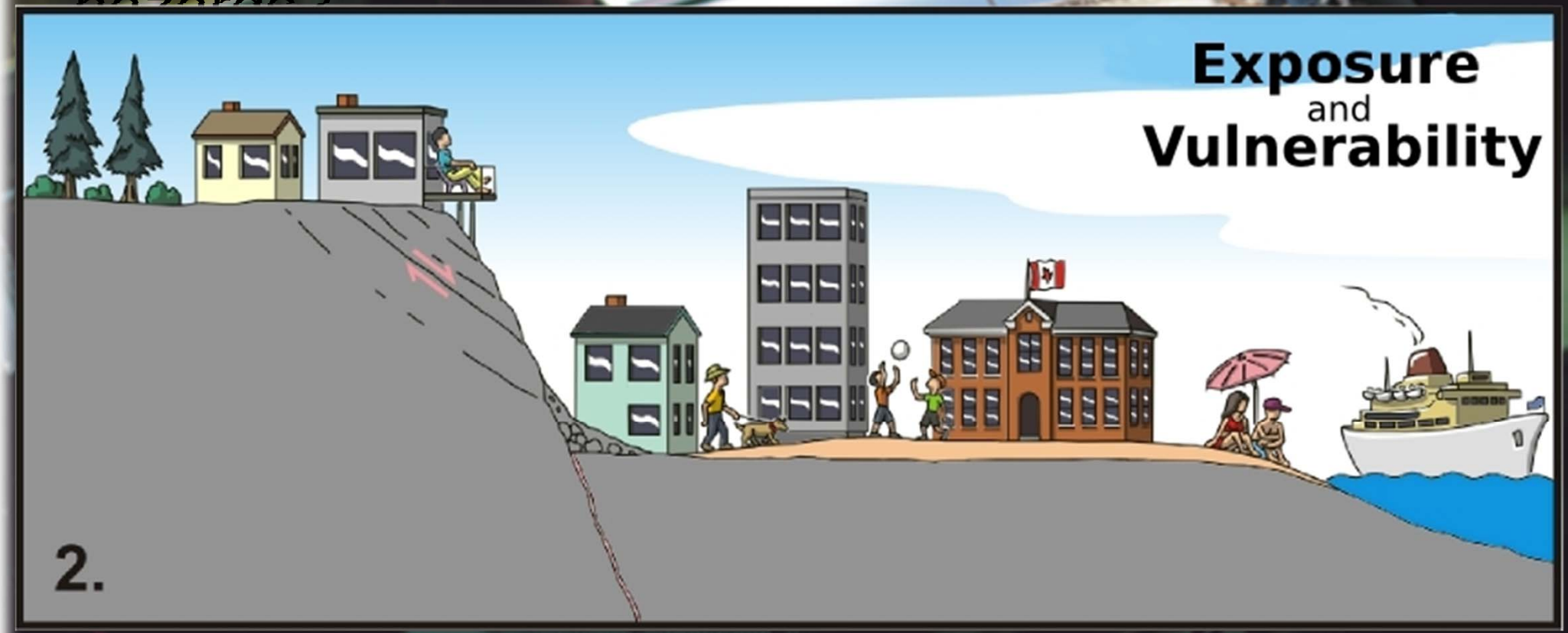


Earthquake Triggered Landslides



Part II

2) Who and what are vulnerable to earthquake hazards?

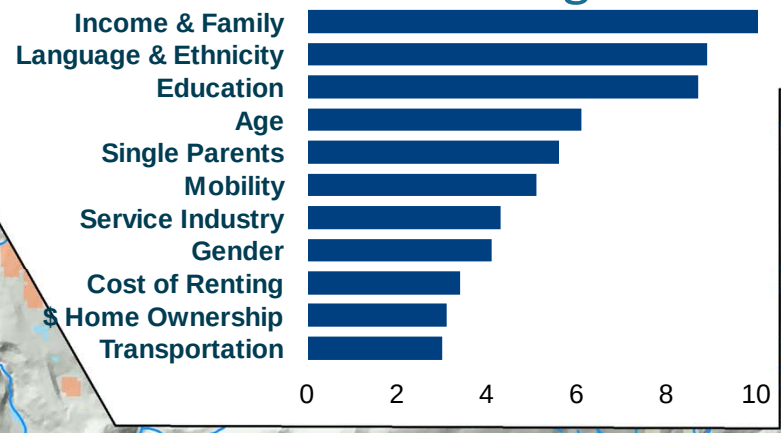


Who is vulnerable? – people

social vulnerability index

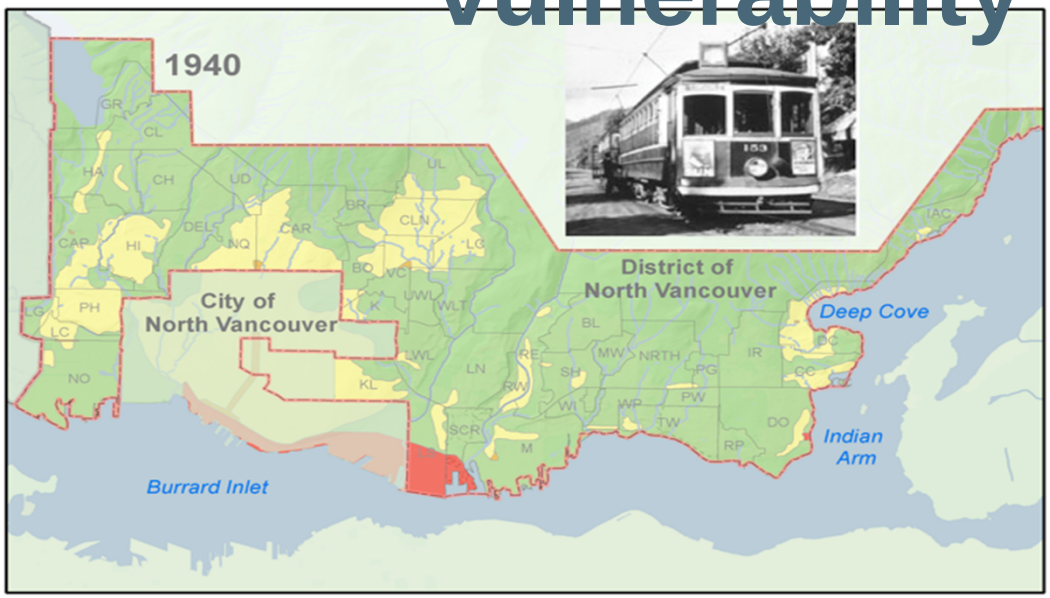
high
moderate
low

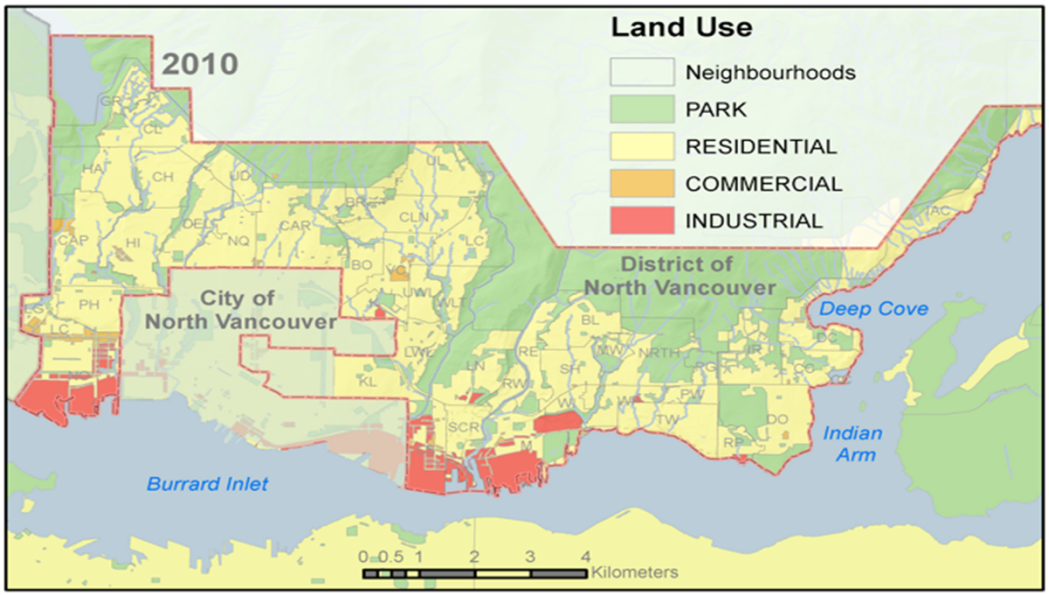
contributing factors

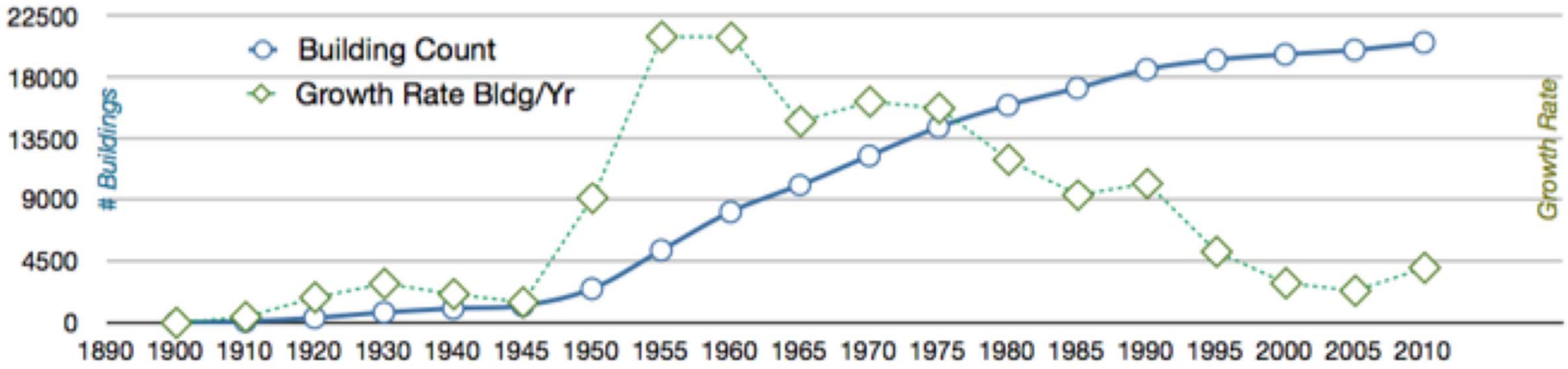


Capilano Lake
District of North Vancouver
City of North Vancouver
Deep Cove
Indian Arm
Burrard Inlet
City of Vancouver
1
2
3
4

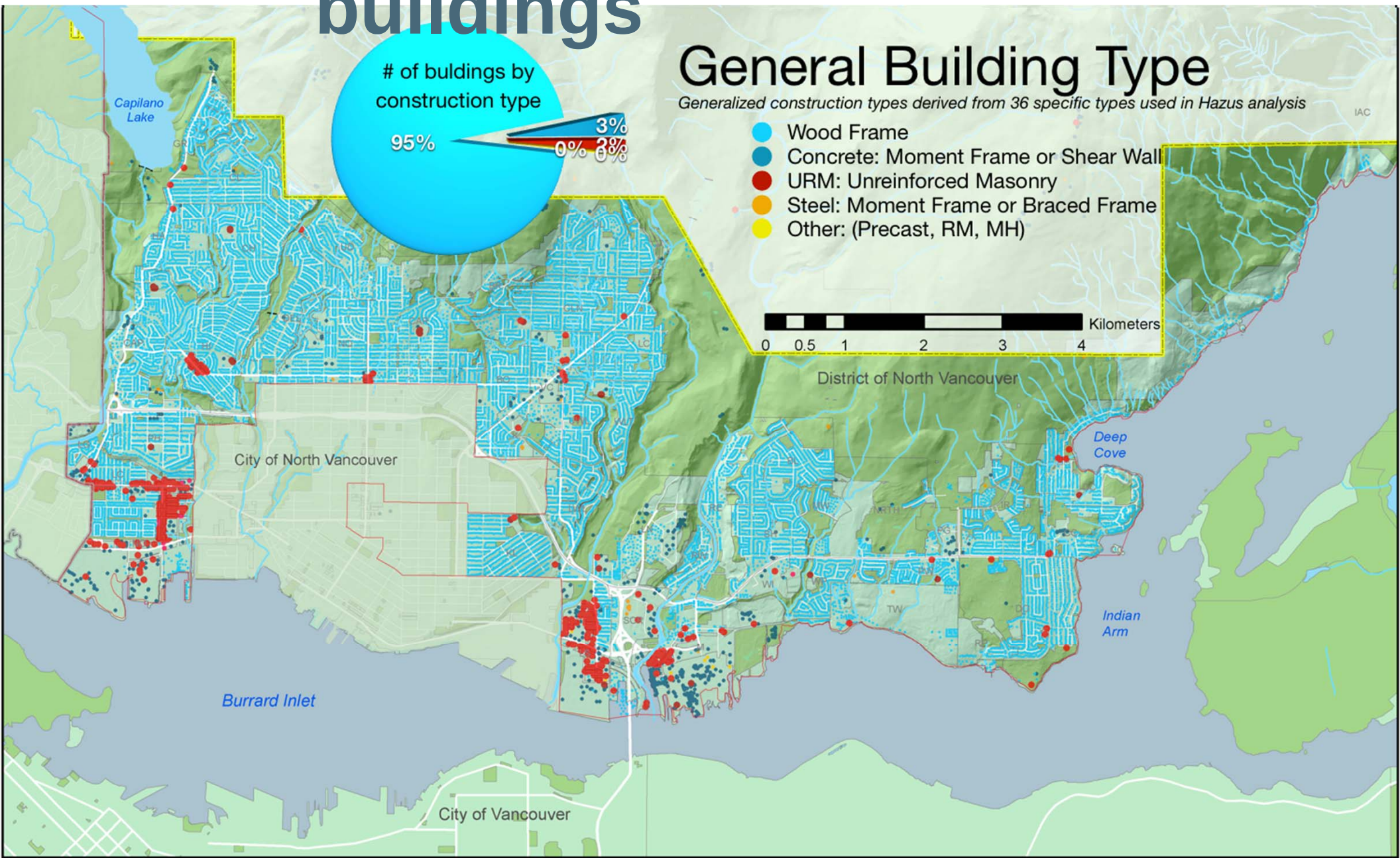
An evolving pattern of vulnerability





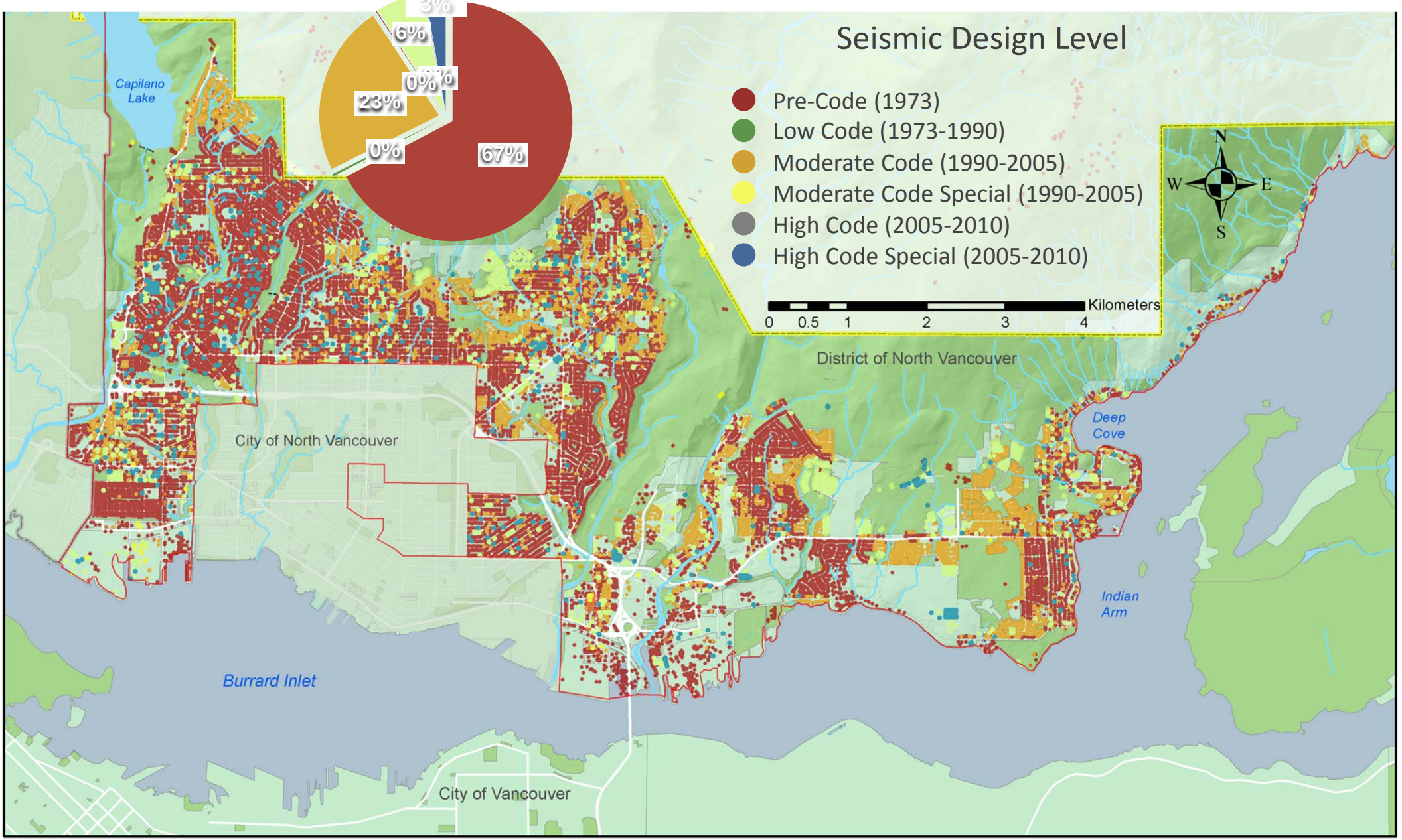


What is vulnerable? - buildings



Development history & vulnerability

Design Code



Part III

3) What are the likely impacts & consequences of a major earthquake?

Disaster Risk Reduction - *Performance Measures*

Georgia Strait M7.3 scenario earthquake

MMI Scale	Perceived Shaking	Damage Potential
V	Light felt by some	Pictures move
VI	Moderate *felt by all*	Objects fall to ground
VII	Strong *difficulty standing*	Non-structural damage
VIII	Very strong *difficulty driving*	Moderate structural damage
IX	Violent *general panic*	Heavy structural damage
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Building Damage


Casualties

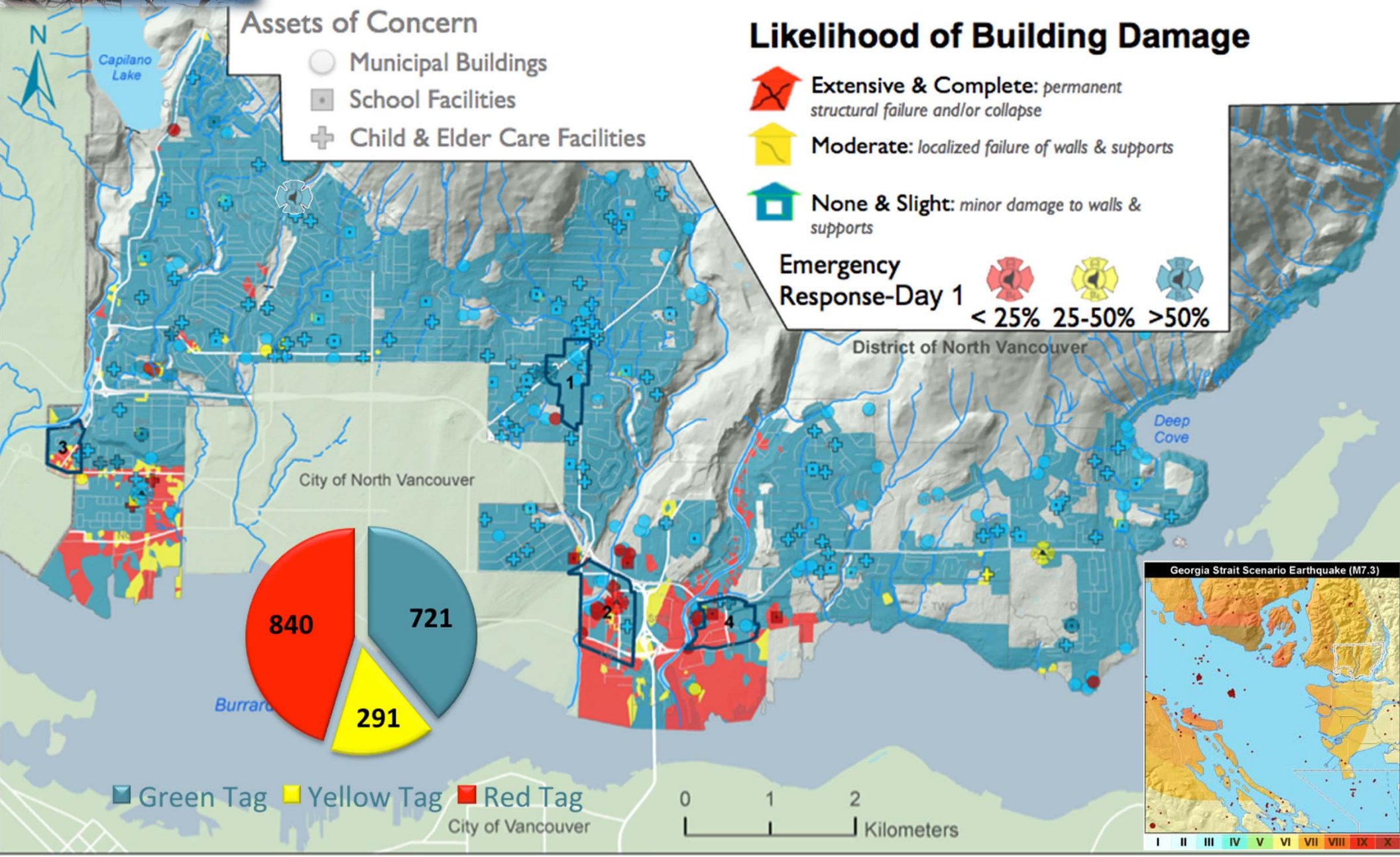

Lifelines


Economic Loss

What are the likely consequences of a major earthquake in the region?

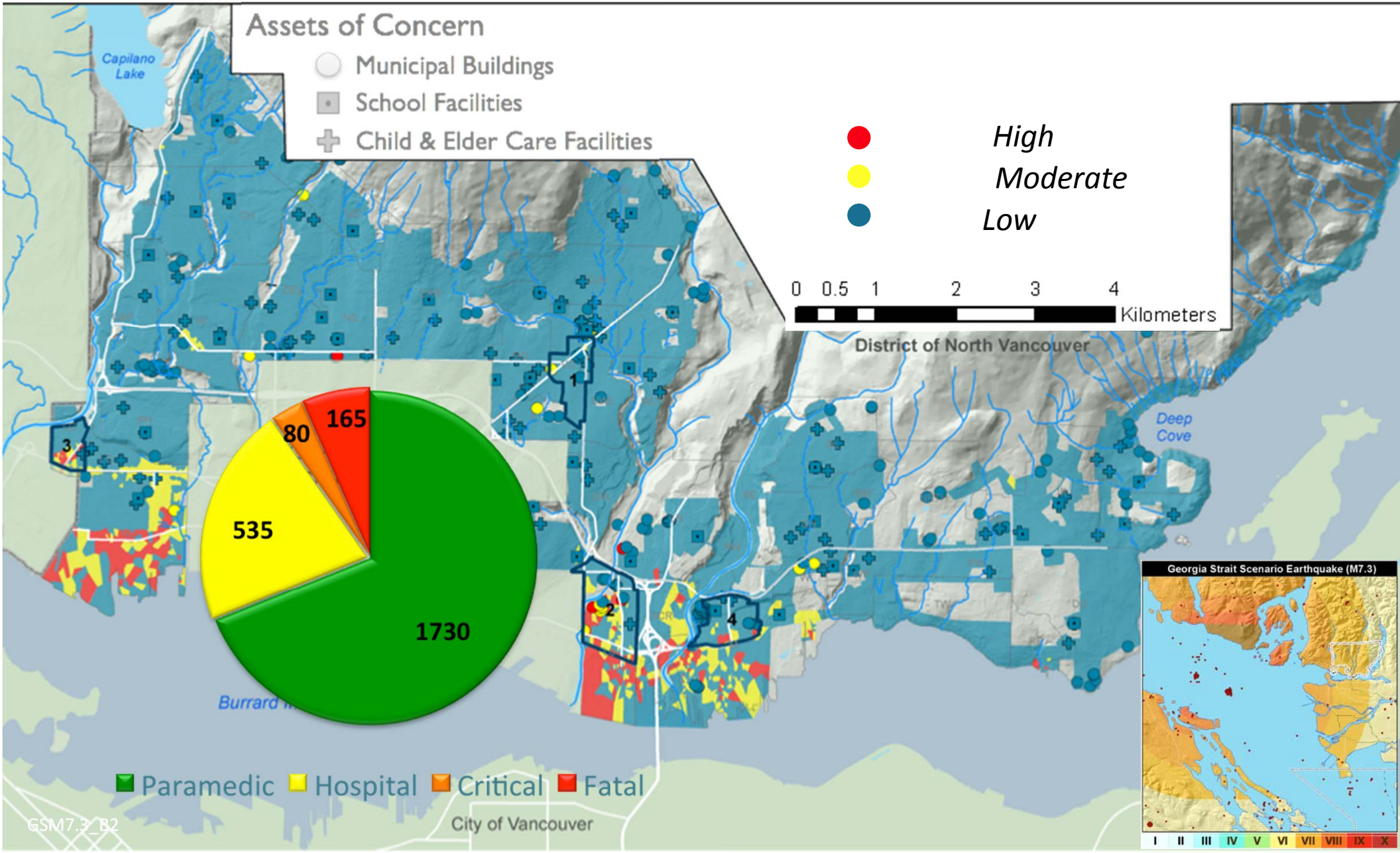
Buildings – *likelihood of damage*

estimates based on M7.3 Georgia Strait earthquake scenario



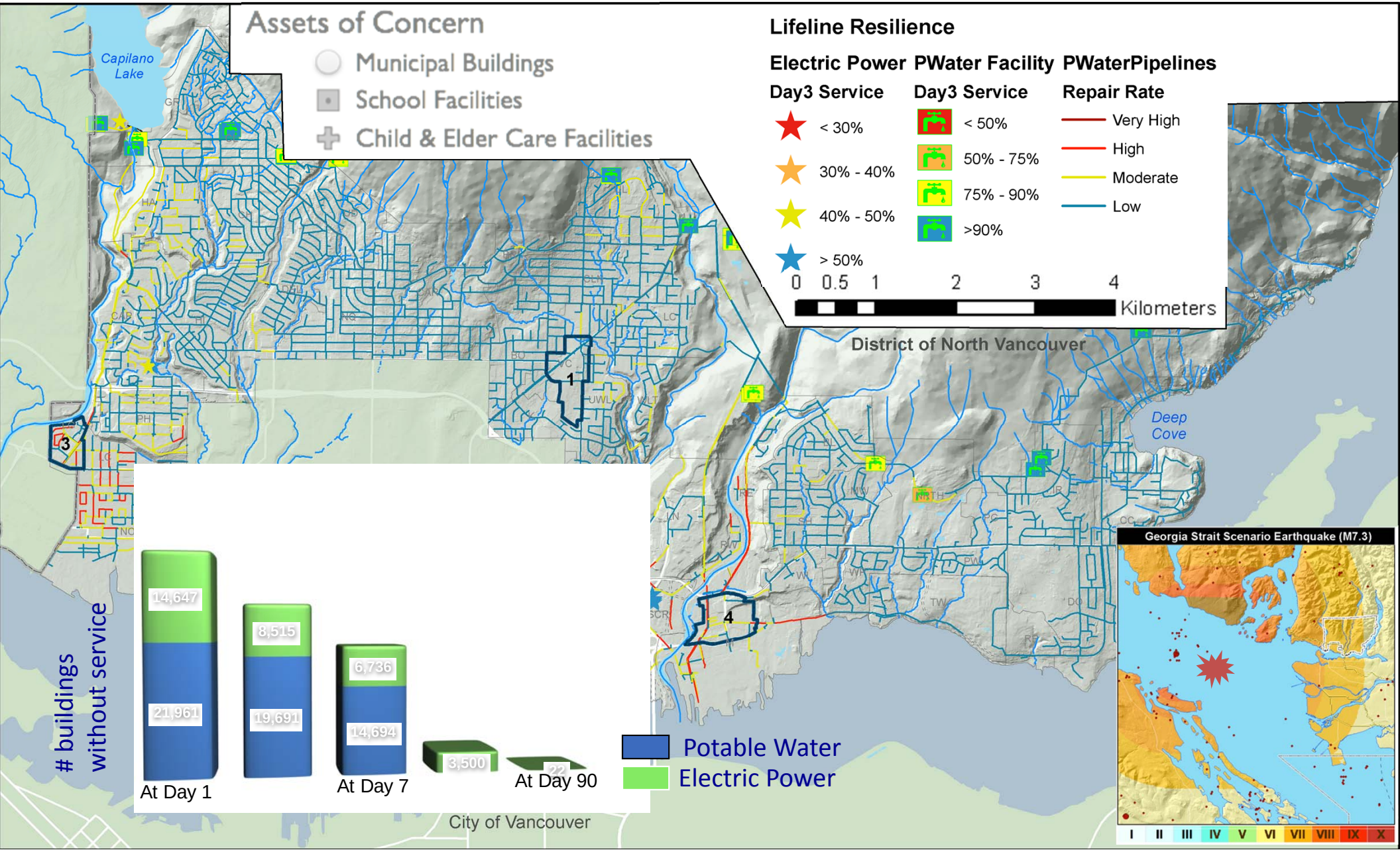
Injuries – *daytime scenario*

estimates based on Georgia Strait M7.3 scenario earthquake



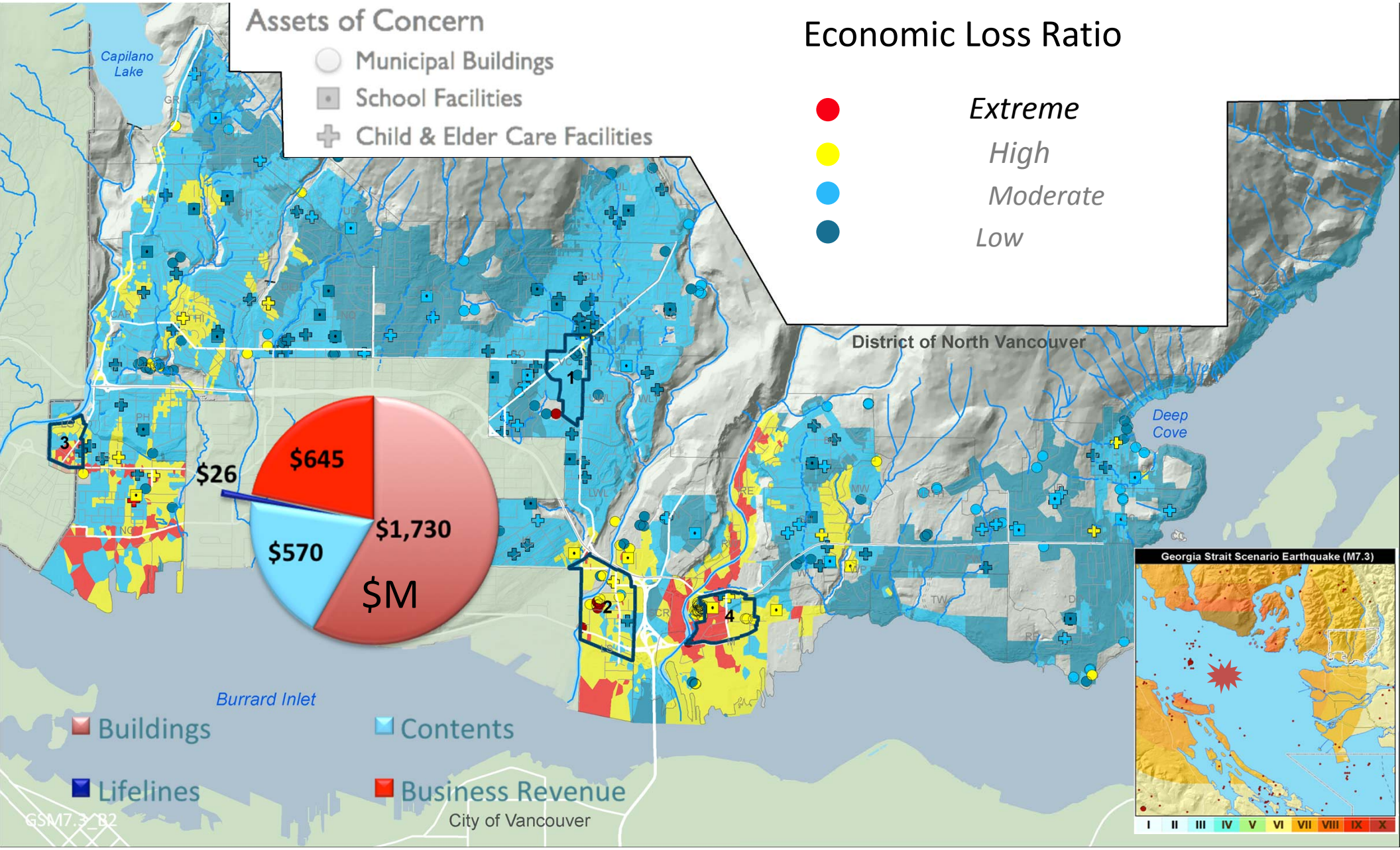
Lifeline Functionality - *Utilities*

estimates based on Georgia Strait M7.3 scenario earthquake



Economic Losses

estimates based on Georgia Strait M7.3 scenario earthquake



What can we expect from a major quake?

hazards:

- ~ 20 seconds of severe ground shaking
- liquefaction along river valleys and waterfront
- landslides along steep/unstable slopes

building damage:

- ~ 300 with significant damage, but repairable
- ~ 850 damaged beyond repair

casualties:

- ~ 2,350 people injured ; ~80 are life-threatening
- ~165 fatalities

lifelines:

- ~14,000 homes without potable water @ 7 days
- ~6,700 homes without power @ 7 days
- ~11,000 truckloads of disaster debris

economic losses:

- ~ $2.9 Billion capital stock losses
- ~ $4.4M per day of business-related losses

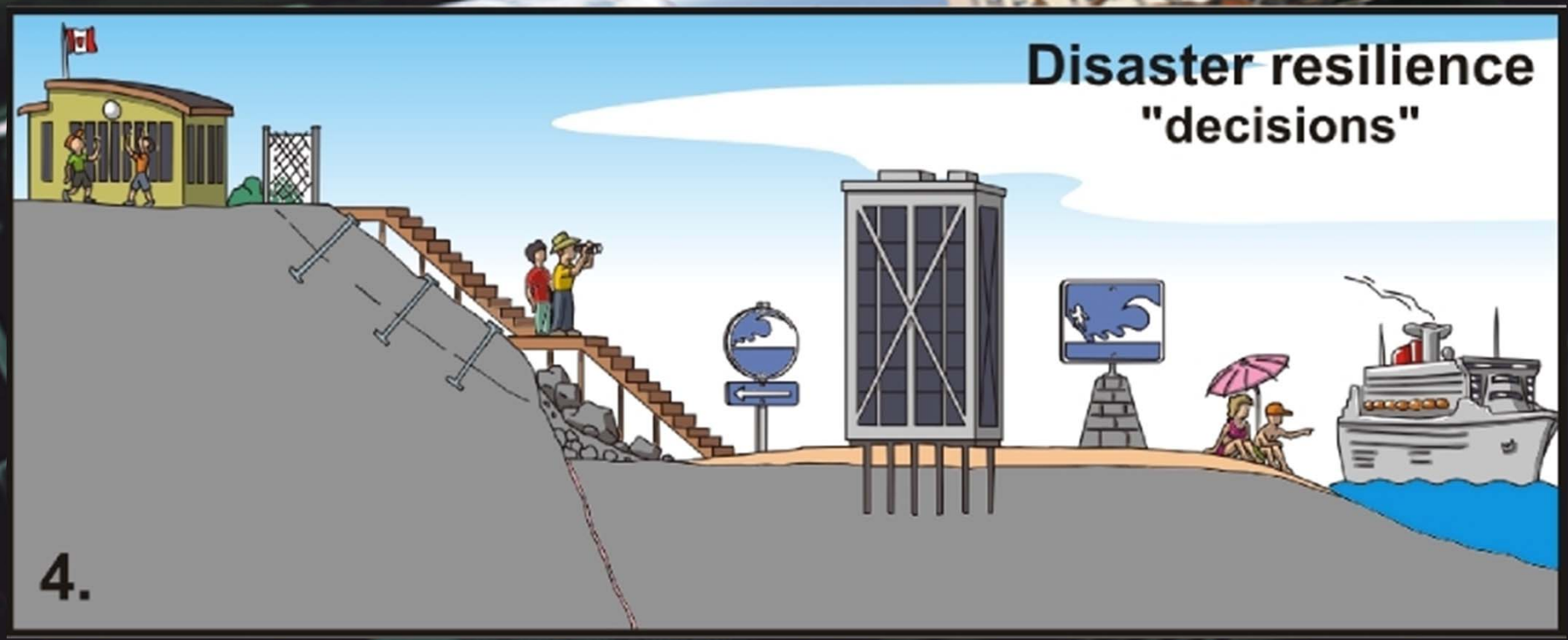
The 2011 Christchurch earthquake

M6.3 Earthquake Event and Related Aftershocks

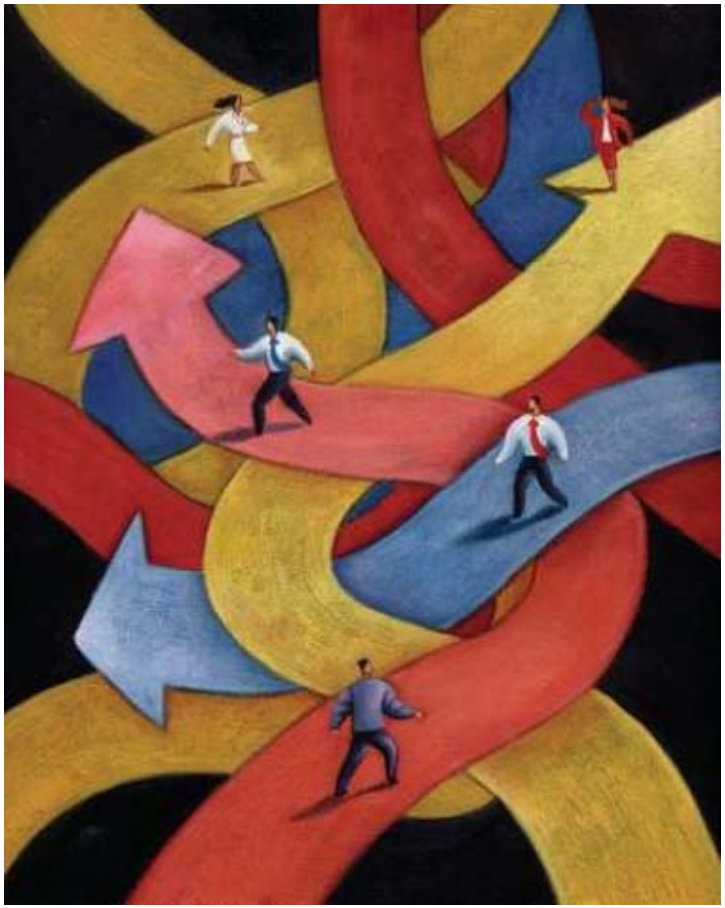
24 seconds of violent ground shaking which triggered liquefaction and landslides
837 buildings have so far been demolished
7000 buildings classified as being in suburban red zone, -not economically viable to repair
1200+ police officers from Christchurch and nationwide on duty 7 days following quake
185 died as a result of the earthquake
11310 people uprooted two weeks after February quake
300km of sewer pipes and about **124km** of water pipes are being fixed
4 million tonnes (~160,000 trucks) of rubble carted away from commercial and residential areas
$2 billion- Christchurch City Council's predicted cost to rebuild city infrastructure
$30 billion- Reserve Bank's estimated total cost of earthquake claims

from knowledge to action

4) How might knowledge about earthquake risk be used to reduce future losses and increase disaster resilience in your community?

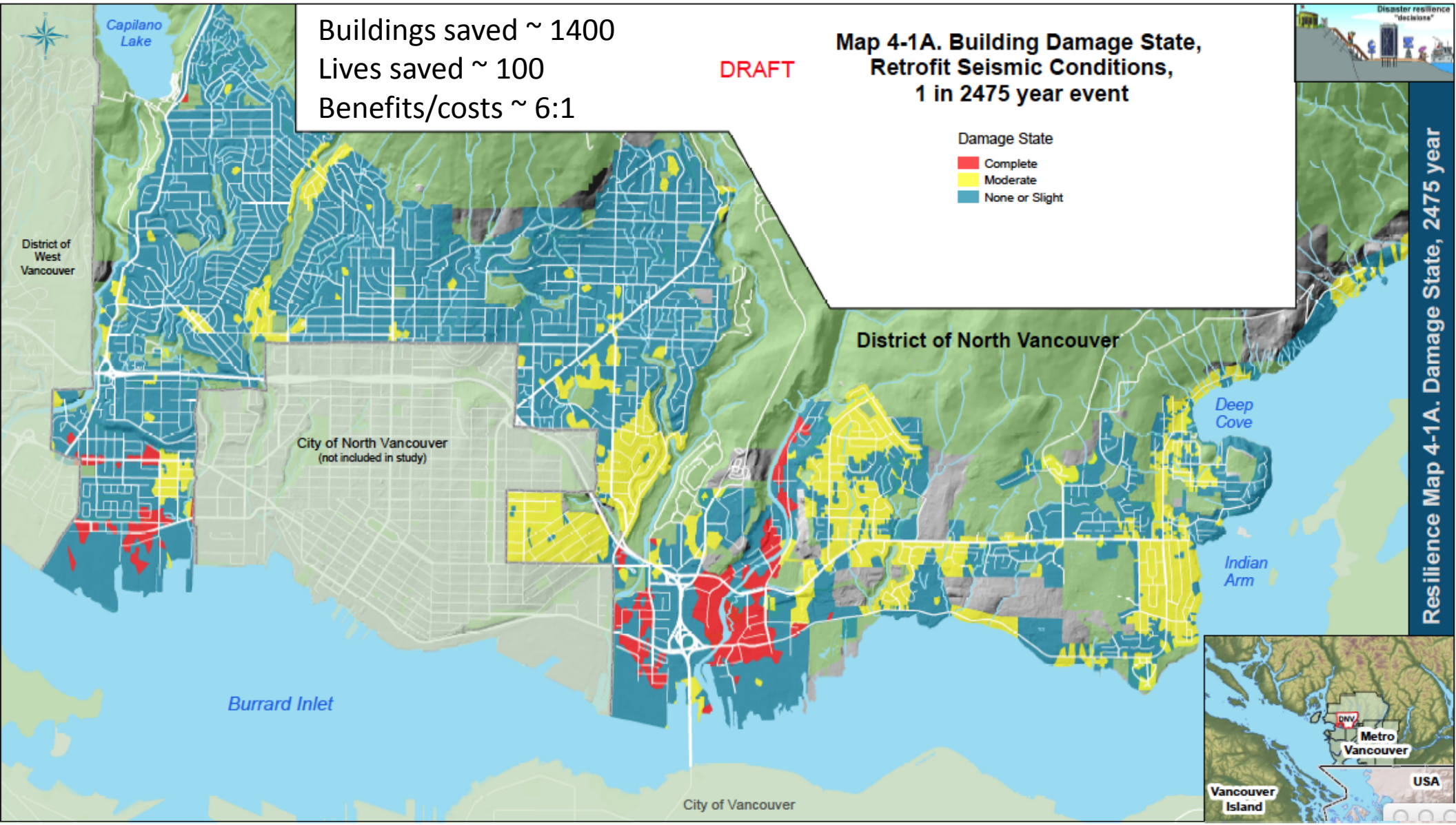


Land Use Planning

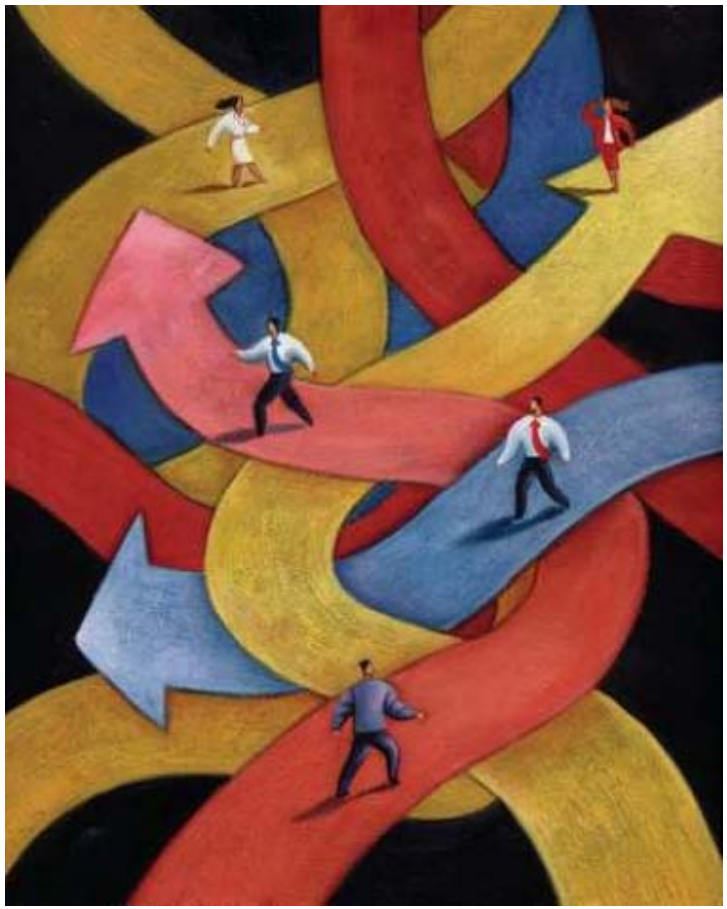


- Performance measures - disaster resilience:
  - ✓ *societal risk*
  - ❑ *building safety*
  - ❑ *economic security*
  - ❑ *lifeline functionality*
- Incorporate disaster resilience measures into development process
- Seismic retrofits of most vulnerable buildings

Potential Benefits of Seismic Retrofits



Emergency Management



- Emergency Plans
  - *earthquake response plan*
  - *business continuity plan*
  - *recovery plan*
- Strengthen capabilities for response and recovery
- Community outreach and engagement to promote a culture of disaster resilience

Reaching out to you STAKEHOLDERS...

- How can you make Canada more disaster resilient to earthquakes?

Continuing the conversation:

- Email: Nicky.Hastings@nrcan.gc.ca
- Input to www.hazuscanada.ca forum
- CanHUG workshops