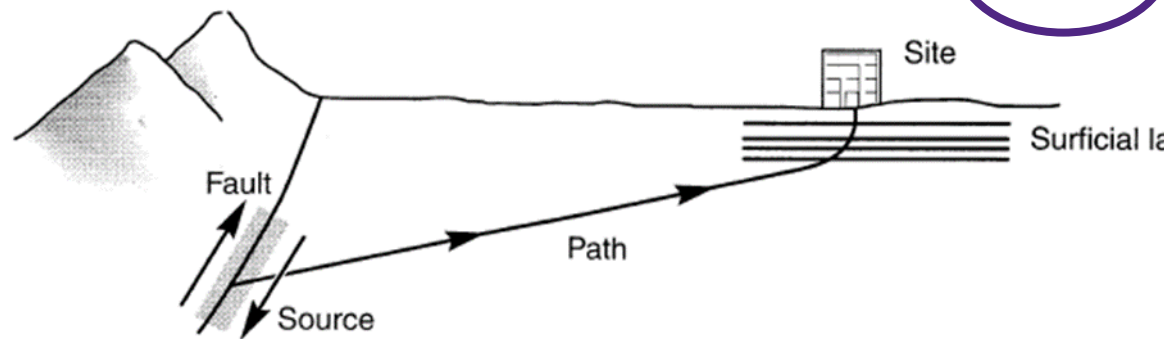


# Seismic hazard assessment

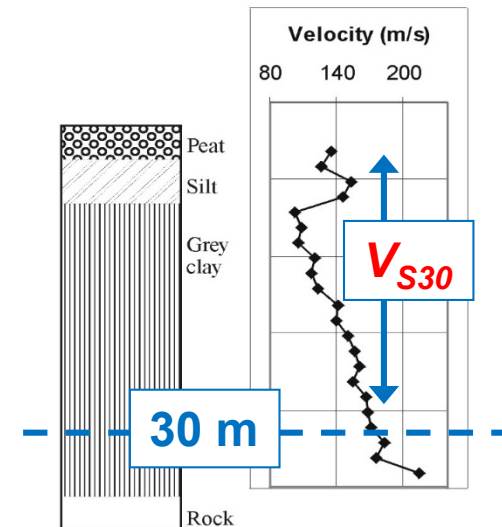
- Hazard due to earthquake shaking; earthquake ground motion prediction

$$\text{Motion} = \text{source} + \text{path} + \text{site}$$



**Greatest uncertainty**  
Constraining the site conditions and their impact to shaking will provide the greatest benefit in shaking prediction

- **Source:** Magnitude, stress drop, rupture characteristics
- **Path:** source-to-site distance
- **Site:** subsurface ground conditions,  $V_{s30}$ ,  $Z_{1.0}$





# Seismic Microzonation Mapping

Urban scale  
seismic hazard  
mapping of:  
Site & Basin  
effects  
Secondary  
shaking hazards

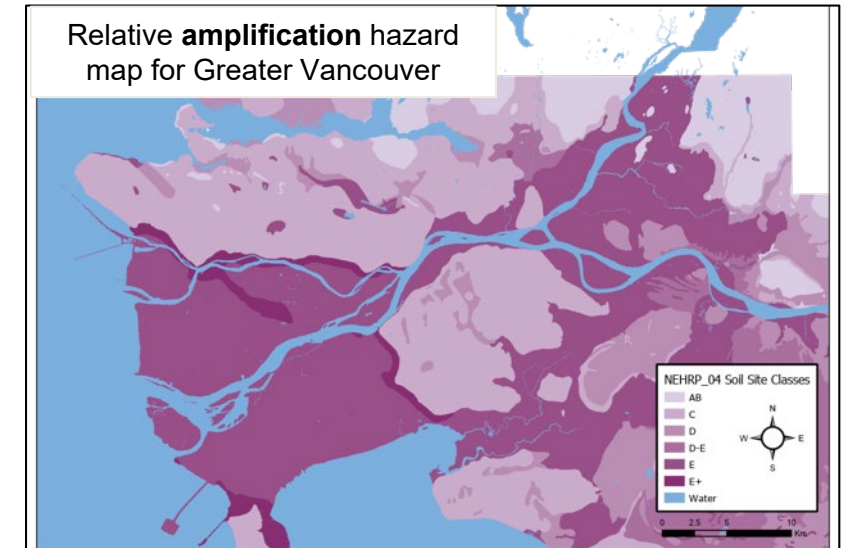
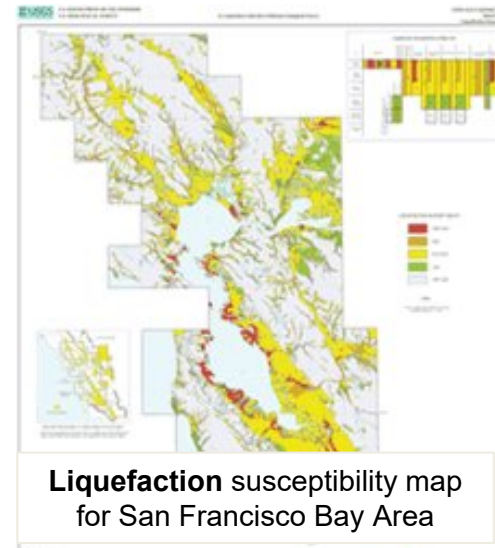
Shaking is not  
uniform due to  
variation in local  
site conditions

Display predicted  
variation in site  
effects using  
geological,  
geophysical &  
geotechnical  
information

Technical site  
classification  
metrics  
( $V_{s30}$ ,  $T_0$ )

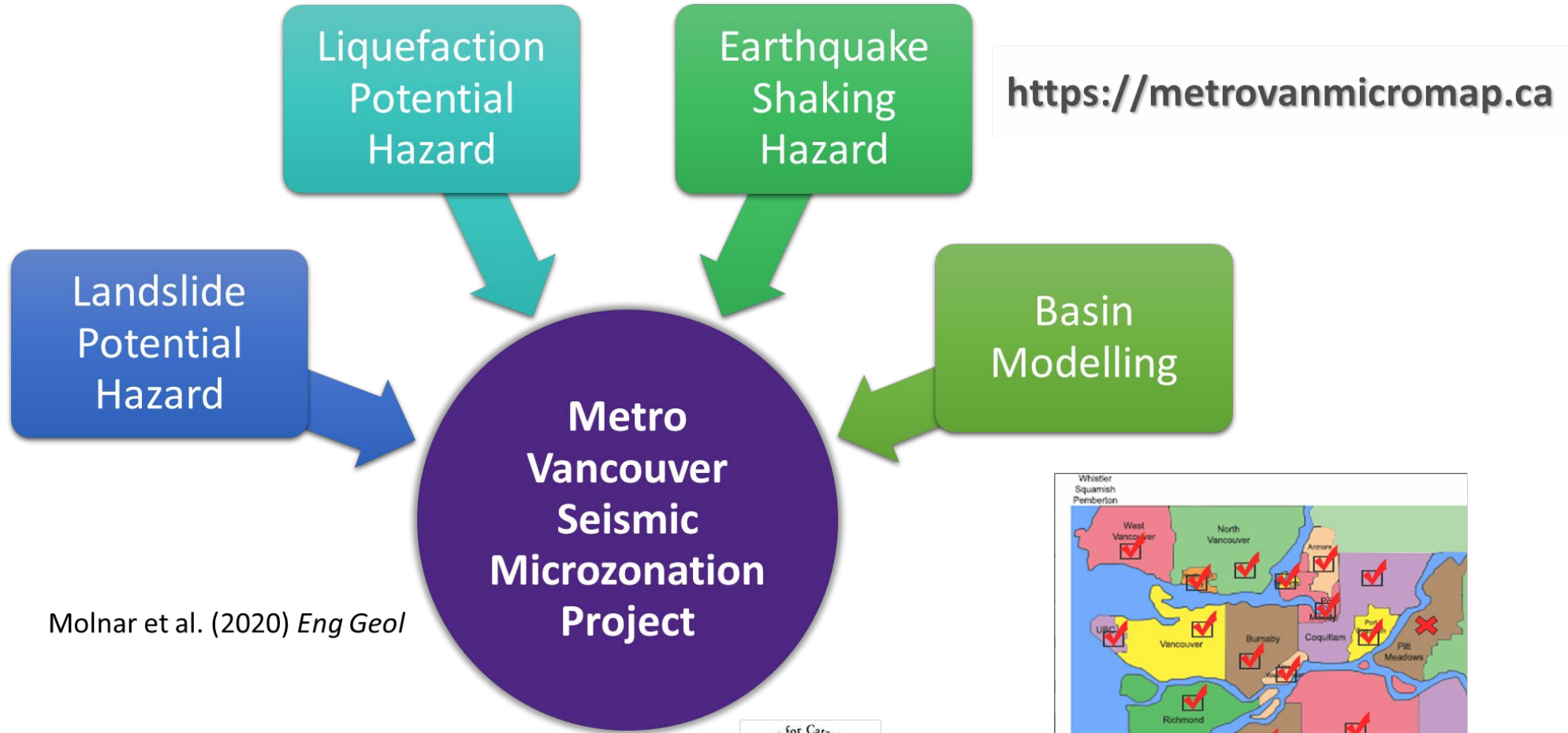
## Benefits:

- Improved understanding of earthquake hazards in the area
- Key input for seismic hazard & risk analyses
- Used by local authorities, practitioners of all types, and the general public
  - e.g., Land use planning; emergency response planning; catastrophe modelling; insurance; prioritize seismic retrofits
- Used to support mitigation and adaptation planning at local and regional scales





# Urban / Regional Seismic Hazard Assessment / Mapping



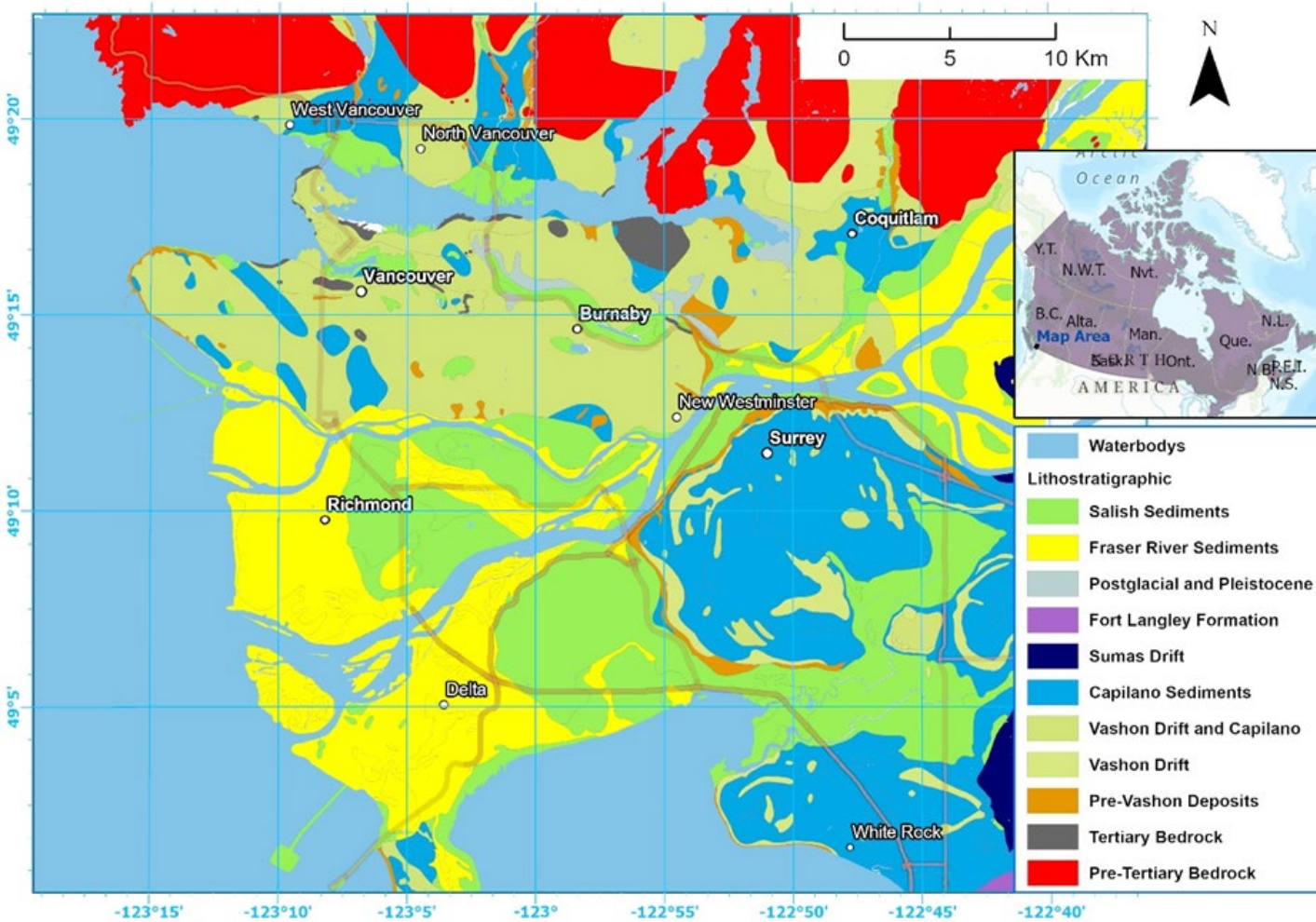
Molnar et al. (2020) *Eng Geol*



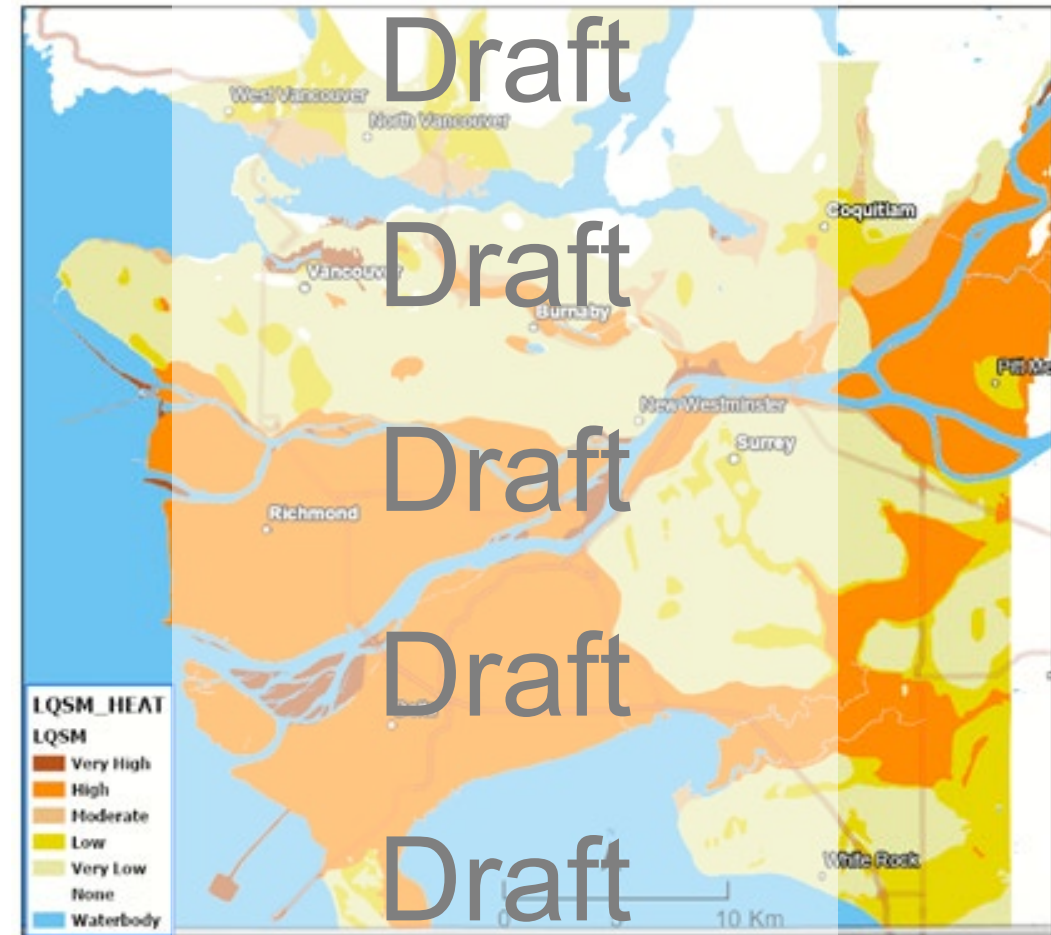


# Metro Vancouver seismic microzonation mapping

- Quaternary Geology

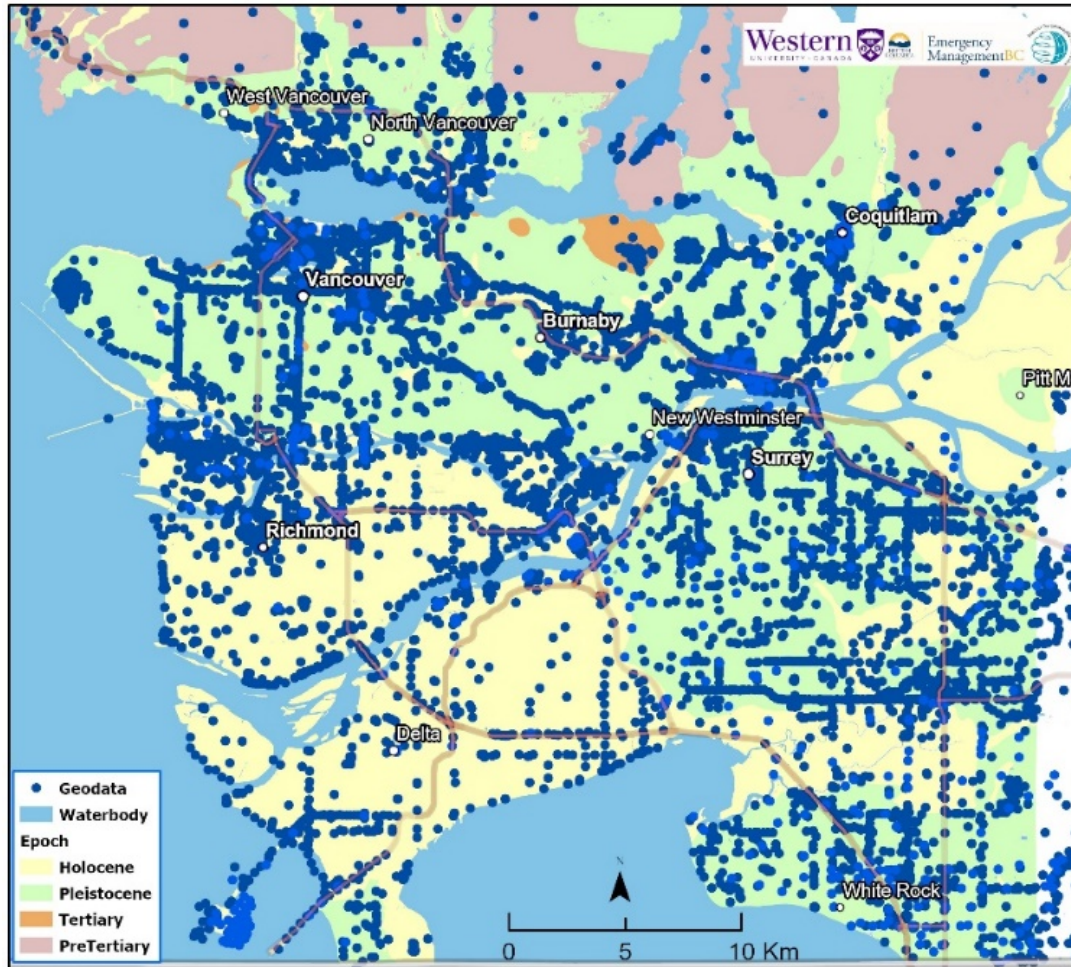


## Liquefaction susceptibility





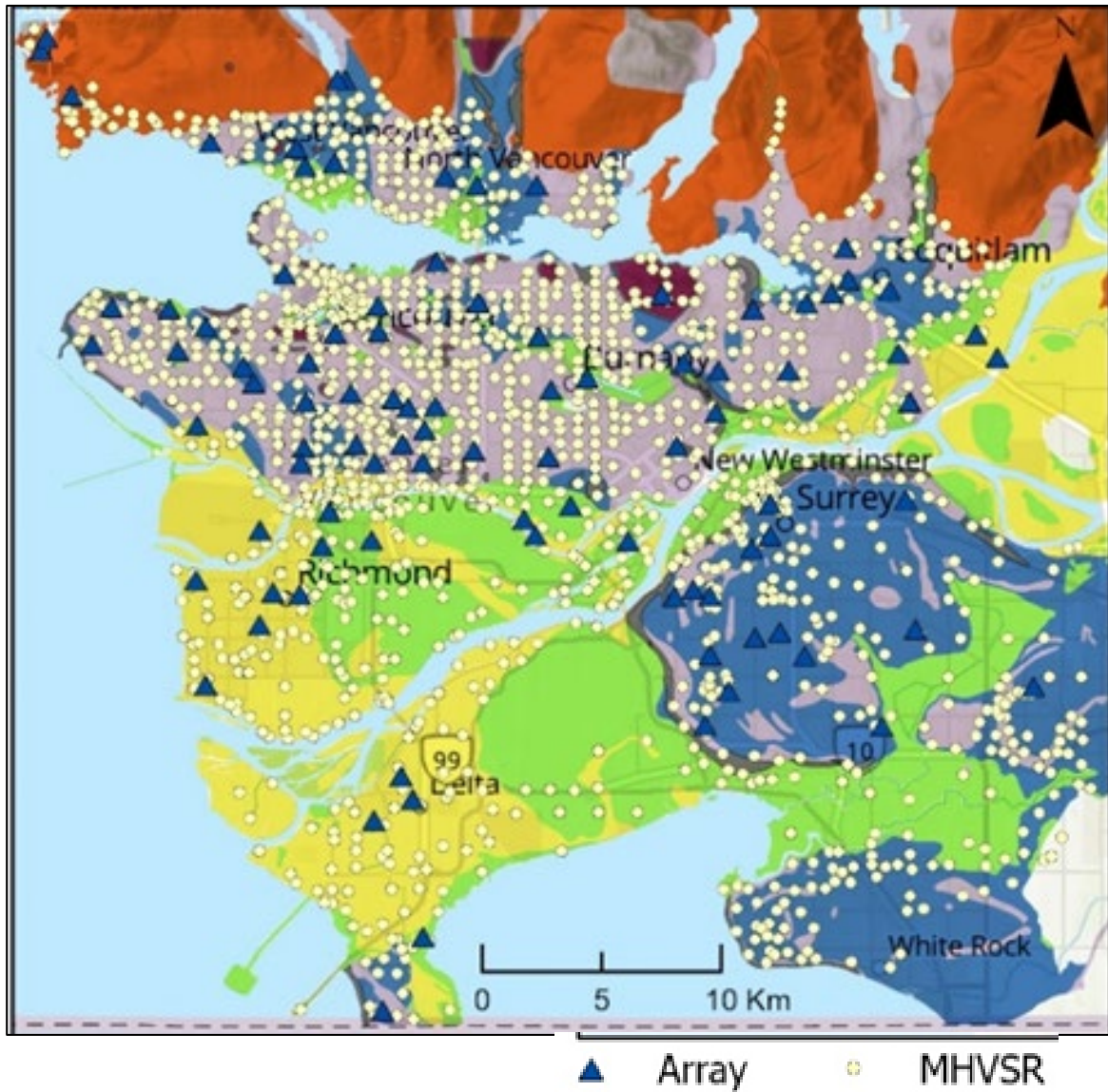
# Metro Vancouver seismic microzonation mapping



- Quaternary Geology
- Request access to previous/available “geo” data (geology, geophysics, geotechnical)
  - Contacted a variety of agencies, organizations, and consultants
  - Data provided in a wide variety of ways, sometimes requiring data sharing agreements
  - Multi-personnel and multi-year effort to convert reports into digital geodatabase



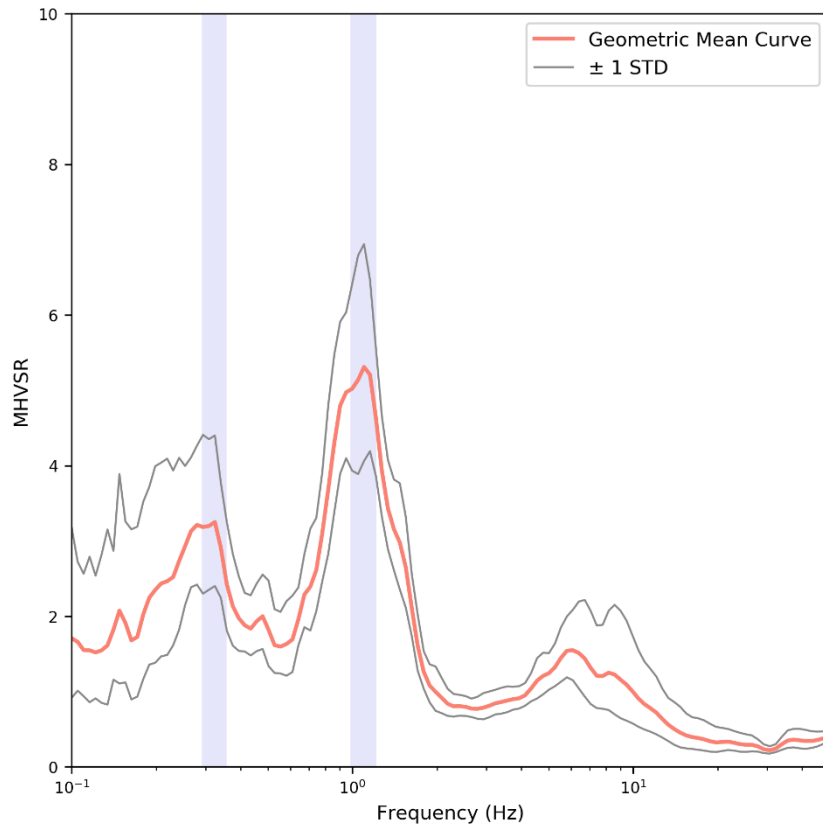
# Metro Vancouver seismic microzonation mapping



- Quaternary Geology
- Request access to previous/available “geo” data (geology, geophysics, geotechnical)
  - Contacted a variety of agencies, organizations, and consultants
  - Data provided in a wide variety of ways, sometimes requiring data sharing agreements
  - Multi-personnel and multi-year effort to convert reports into digital geodatabase
- Supplement with four field campaigns of non-invasive seismic testing
  - Regional coverage for less expense
  - MHVSR for  $f_{0HV}$
  - AVA + MASW for dc
  - Joint inversion of  $f_{0HV}$  + dc  $\rightarrow$  Vs profile



# Metro Vancouver seismic microzonation mapping

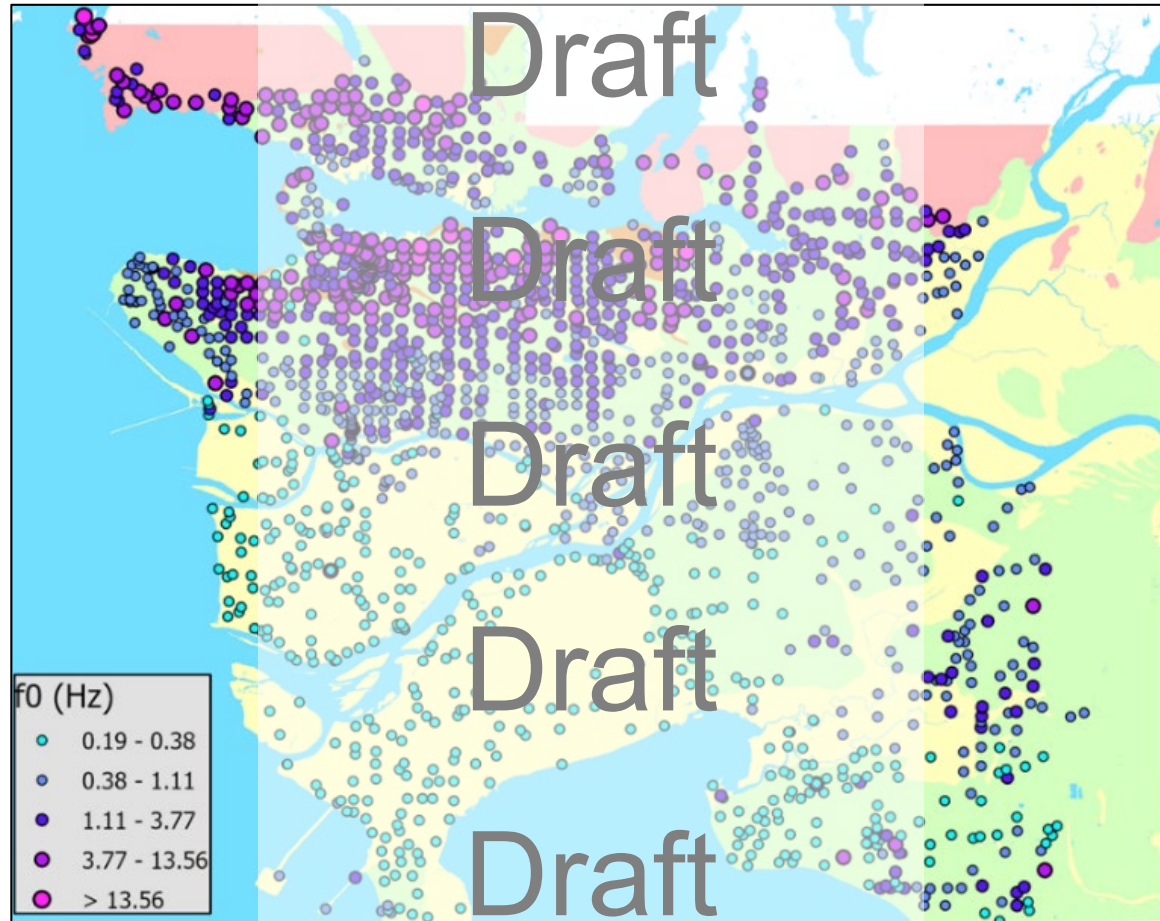


- Quaternary Geology
- Request access to previous/available “geo” data (geology, geophysics, geotechnical)
  - Contacted a variety of agencies, organizations, and consultants
  - Data provided in a wide variety of ways, sometimes requiring data sharing agreements
  - Multi-personnel and multi-year effort to convert reports into digital geodatabase
- Supplement with four field campaigns of non-invasive seismic testing
  - Regional coverage for less expense
  - MHVSR for  $f_{0HV}$
  - AVA + MASW for dc
  - Joint inversion of  $f_{0HV}$  + dc → Vs profile





# Metro Vancouver seismic microzonation mapping

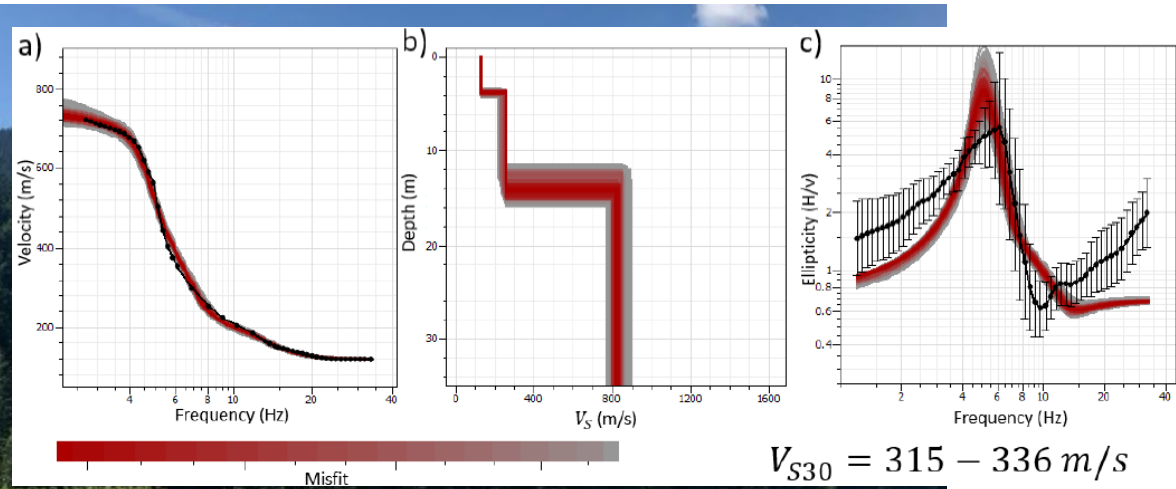


- Quaternary Geology
- Request access to previous/available “geo” data (geology, geophysics, geotechnical)
  - Contacted a variety of agencies, organizations, and consultants
  - Data provided in a wide variety of ways, sometimes requiring data sharing agreements
  - Multi-personnel and multi-year effort to convert reports into digital geodatabase
- Supplement with four field campaigns of non-invasive seismic testing
  - Regional coverage for less expense
  - MHVSR for  $f_{0HV}$
  - AVA + MASW for dc
  - Joint inversion of  $f_{0HV}$  + dc → Vs profile





# Metro Vancouver seismic microzonation mapping

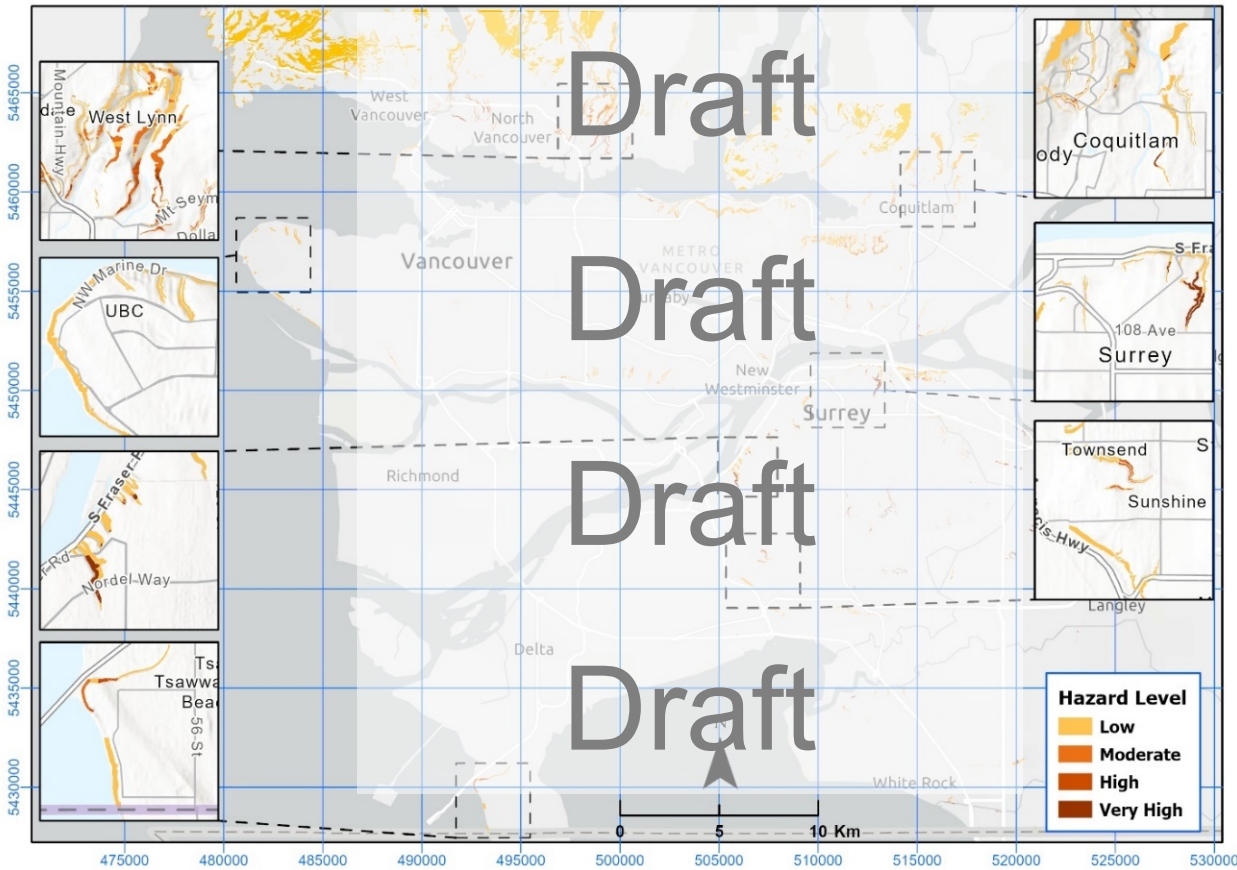


- Quaternary Geology
- Request access to previous/available “geo” data (geology, geophysics, geotechnical)
  - Contacted a variety of agencies, organizations, and consultants
  - Data provided in a wide variety of ways, sometimes requiring data sharing agreements
  - Multi-personnel and multi-year effort to convert reports into digital geodatabase
- Supplement with four field campaigns of non-invasive seismic testing
  - Regional coverage for less expense
  - MHVSR for  $f_{0HV}$
  - AVA + MASW for dc
  - Joint inversion of  $f_{0HV} + dc \rightarrow V_s$  profile

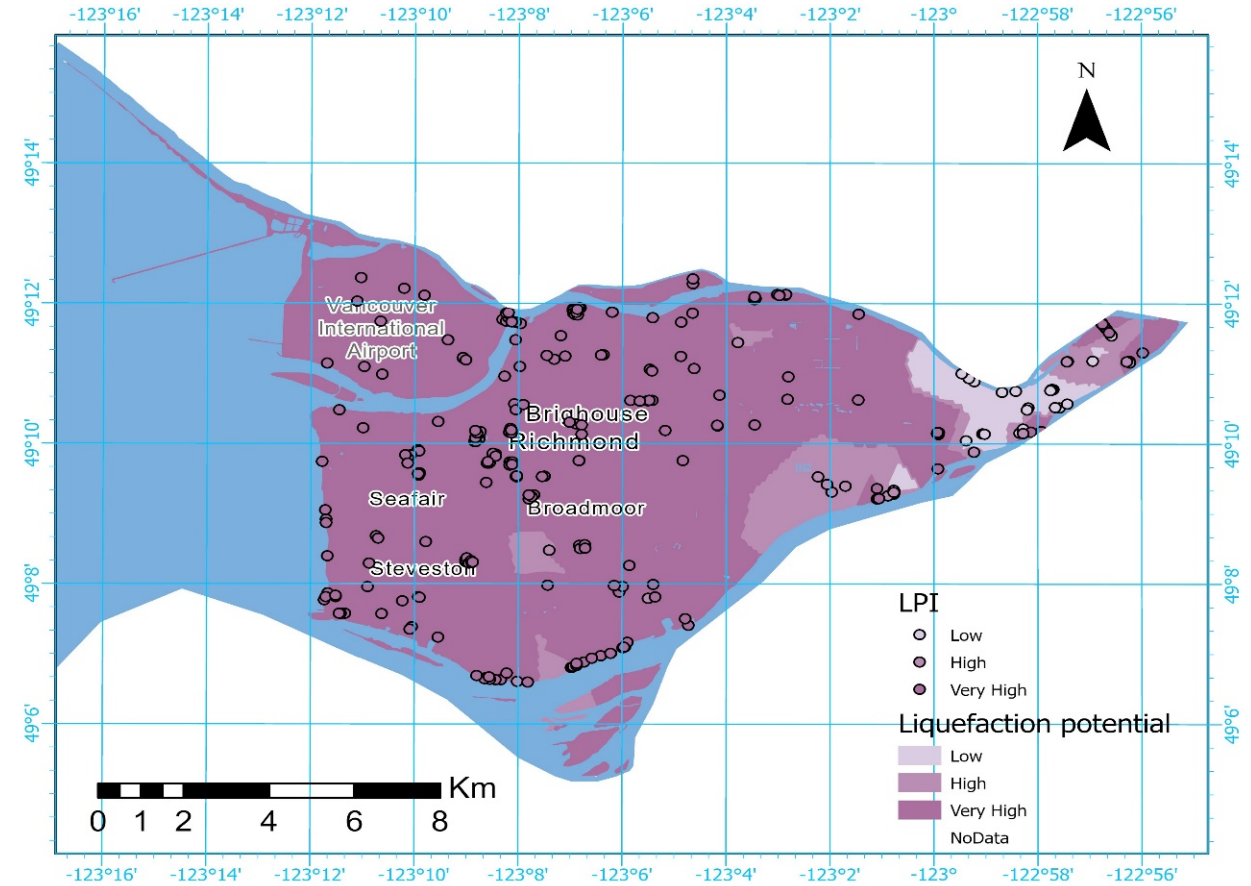


# Metro Vancouver seismic microzonation mapping

## Landslide and Liquefaction potential (2% PE in 50 years) hazard maps



Fallah Yeznabad et al. (2021)



Javanbakht Samani et al. (2021)

# Seismic microzonation maps in Canada

