Overview

- Background
- Current Response Capability
- Assessing the Risk
- Reducing the Risk & Preparing to Respond
- Assess risks and redundancy in lifelines
- Assess seismic state of public buildings and infrastructure
- Report back with a strategy for seismic improvement of private buildings
- Enhance public preparedness – including drills and exercises
ASSESS RISK
• Assessments of buildings and bridges
• Hazard Risk Vulnerability Assessment

REDUCE RISK
• Seismic upgrades to bridges
• Non-structural retrofit of City buildings
• Enhanced public preparedness education
• Building code improvements

PREPARE TO RESPOND/RECOVER
• Dedicated fire protection system
• Heavy urban search & rescue team
• Consolidated radio & dispatch for fire and police (E-Comm)
• Emergency supply containers
• Emergency operations centre

Earthquake science has evolved
Capacity to model earthquakes has advanced

Learnings from CHILE, CHRISTCHURCH, & JAPAN

Development of the Earthquake Preparedness Strategy
Concurrent implementation of Quick Win initiatives

1990-2010
2011
2012-2013
The Strategy: 56 Actions Over 5 years

12 Primary Actions + 44 Supporting Actions

ASSESS RISK → REDUCE RISK → PREPARE TO RESPOND → RESPOND & RECOVER

Earthquake

Increased efforts to REDUCE RISK lead to faster RECOVERY
Partners and Organizing Structure

**TECHNICAL ADVISORY GROUP:**
- UBC Engineering,
- NRCan, Geological Survey of Canada

**WORKING GROUPS**

**EARTHQUAKE PREPAREDNESS STEERING COMMITTEE**
- SPONSOR:
  - Director of Emergency Management

**CHAMPION:**
- CMO

**EXTERNAL LIAISONS**
- EMBC - IPREM
- Metro Vancouver
- BC Hydro
- Fortis BC
- Translink
- CP Rail
- Port Metro
- Health Authorities
- Vancouver Board of Trade & EPICC
Partners and Organizing Structure

**EXTERNAL LIAISONS**
- EMBC - IPREM
- Metro Vancouver
- BC Hydro
- Fortis BC
- Translink
- CP Rail
- Port Metro
- Health Authorities
- Vancouver Board of Trade & EPICC

**TECHNICAL ADVISORY GROUP:**
UBC Engineering, NRCan, Geological Survey of Canada

**WORKING GROUPS**

**EARTHQUAKE PREPAREDNESS STEERING COMMITTEE**

**SPONSOR:**
Director of Emergency Management

**CHAMPION:**
CMO

**IMPLEMENTATION**
- COV Emergency Management Steering Committee
- Emergency Planning Team
- Working Groups
- Business Units
RESPONSE AND RECOVERY

ASSESS RISK -> REDUCE RISK -> PREPARE TO RESPOND -> RESPOND & RECOVER

Current activities and assets to ensure an effective response and rapid recovery
Disaster Response and Recovery Timeline

**Preparedness**
- Risk Reduction
- Risk Assessment

**Earthquake**
- Initial Response Guideline (IRG)
- City Field Staff respond to Disaster Staging Areas (DSAs)
- Mayor, Corporate Management Team, and EOC staff proceed to Emergency Operations Centre (EOC)
- HUSAR conducts initial reconnaissance and begins rescue efforts
- Vancouver Fire and BCAS respond to fires and critical medical calls
- Vancouver Volunteer Corps (VVC) support response activities
- Reception Centres are established
- Emergency Shelters are set-up
- Emergency repair to critical utilities begins
- Some residents in damaged homes setup tents in their yards, others stay with friends and family. Some seek assistance from the government and NGOs.

**Risk Assessment**
- Buildings and infrastructure are damaged
- Gas lines rupture – fires start
- Power goes out
- Phone system overloaded
- People flood to the streets and begin making their way from the areas of major damage

**Time**
- Hours
- Days
- Weeks
- Months
- Years
Disaster Response and Recovery Timeline

**RECOVERY**

- Building damage assessments
- Medium-term and long-term housing
- Redevelopment planning of heavily damaged areas
- Rebuilding of critical utilities (water, sewer, power, telecommunications)
- Some businesses look for temporary alternate facilities, others seek permanent alternate facilities
Assets and Tools: Initial Response Guidelines, Plans and Checklists
Assets and Tools: Heavy Urban Search and Rescue

- Multi-purpose team, critical in responding to trapped people in damaged buildings and structures and can support a wide range of other disaster response activities

- 125 trained members, including:
  - Rescue technicians
  - Engineers
  - Paramedics
  - Doctors
  - Search dogs

- Simulated earthquake site for training

- Lost Federal funding, now supported by City and Provincial funding
Assets and Tools: Vancouver Volunteer Corps

• Christchurch demonstrated importance of trained volunteer response

• Vancouver Volunteer Corps (VVC) launched in 2012. Over 800 members, comprised of:
  ✓ 300 general VVC members
  ✓ 400 Emergency Social Services volunteers
  ✓ 100 Neighbourhood Emergency Assistance Team (NEAT) volunteers

• 150 VECTOR emergency communications volunteers

• Annual exercises and drills
Assets and Tools: Training, Exercises, and Deployments

Exercises

• Monthly tabletop exercises with CMT
• Regular activation of emergency operations centre for planned events

Response deployments

• Hurricane Katrina 2005 (HUSAR)
• Christchurch Earthquake 2011 (Staff)
• Johnson’s Landing Landslide 2012 (HUSAR)
• Calgary Flood 2013 (Staff and HUSAR)
Further Work: Response and Recovery Actions

Significant steps taken to ensure an effective response, however, additional steps to be taken over next five years to improve response.

1. Develop an on-going city-wide emergency training and exercise program, including an annual earthquake drill and opportunities for ongoing staff engagement.

2. Develop memoranda of understanding with other Canadian Cities to support rapid deployment of resources following a disaster.

3. Continue refining earthquake response plans in key areas, including provision of medium-term shelter, provision of potable water, building damage assessment, and community response.
ASSESSING THE RISK

• EARTHQUAKE SCENARIOS
• GENERAL IMPACTS
Earthquake Scenarios

1. Cascadia Subduction Zone: (‘megathrust’) earthquake - M 9+
2. Georgia Strait: shallow crustal earthquake - M 7.3
3. Kendall fault: intraslab, deep earthquake - M 6.8
Earthquakes

Liquefaction
When silty and sandy soils temporarily act as a liquid due to ground shaking, bringing silt up to the surface and damaging infrastructure and buildings. Underground pipes can “float up”.

Lifelines
Networked utility systems that provide critical services that residents, businesses, and industry rely on.

Examples:
- Water and sewer systems
- Telephone system
- Road and rail systems
- Power and gas systems
Ground Shaking

Shake Map

Georgia Strait M 7.3
Planning Scenario

Peak Ground Velocity data provided by Natural Resources Canada
Liquefaction Susceptibility data provided by Natural Resources Canada.
Tsunami Run-up Potential

Highlighted area shows 2 m above high tide.

Opportunities for alignment with climate change adaptation efforts related to sea level rise.

Key City Infrastructure
- Hospitals
- DFPS Pump Stations
- City Hall Campus
- EOC
- Police
- Community Centres
- Fire Halls
- City Works Yards
- Bridges & Structures
- Disaster Response Routes

Tsunami hazard area generated by City of Vancouver
Further Work: Assess Risk Actions

Assess Risk Actions

4. Analyze weak links in our supply chain for critical supplies and services required in earthquake response

5. Enhance inputs to the earthquake impact estimation model
   - Maintain a digital inventory of buildings & lifelines
   - Improve earthquake hazard maps

6. Work with regional partners to develop shared models of earthquake risk
REDUCING RISK AND PREPARING TO RESPOND

- IMPACTS ON SYSTEMS
- ASSOCIATED ACTIONS
Impacted Systems

- WATER SYSTEMS
- SEWER SYSTEMS
- ENERGY SYSTEMS
- TRANSPORTATION SYSTEMS
- COMMUNICATIONS SYSTEMS

Buildings
- CITY FACILITIES
- PRIVATE BUILDINGS

Lifelines

Ground Shaking
Liquefaction
Fire
Landslides
Tsunamis

Impacts
Impacted Systems: Lifelines

- Ground Shaking
- Liquefaction
- Fire
- Landslides
- Tsunamis

Buildings
- City Facilities
- Private Buildings

Lifelines
- WATER SYSTEMS
- SEWER SYSTEMS
- ENERGY SYSTEMS
- TRANSPORTATION SYSTEMS
- COMMUNICATIONS SYSTEMS

Impacts

People

Economy
Consequences of Damage

- Service from North Shore reservoirs is interrupted
- Lack of water/pressure for fire fighting
- Hospital operations impacted
- Lack of water for households, businesses, industry
- Localized flooding

Action to Date

- Water Utility Response Plan
- Dedicated Fire Protection System (DFPS)
- Maintain emergency wells
Neighbourhood Portable Showers, Christchurch
## Risk Reduction Actions

7. Harden key components of water system in high risk areas

8. Develop generator deployment and refueling plan for pressure reducing valve stations

9. **Work with Metro Vancouver to increase seismic resilience of reservoirs, water main crossings from the North Shore, and key mains and couplings**

## Preparedness Actions

10. **Enhance post-earthquake access to firefighting water supply**

11. Continue to grow volunteer corps to assist with Dedicated Fire Protection System

12. Develop plan for mass provision of potable water and shower facilities

13. **Continue to work with health authorities to enhance post-earthquake water servicing plans**
Consequences of Damage

- Sewage back-up in neighbourhoods
- Inability to use household toilets
- Raw sewage will likely be discharged into marine environment

Action to Date

- Sewer utility response plan
- Regional plans to upgrade treatment plants
**Impacted System: Sewer System – Further Work**

**Risk Reduction Actions**

14. Change pipe materials and install flexible couplings in high-risk areas

15. Develop generator deployment and refueling plan for pump stations

16. Work with Metro Vancouver to increase resilience of key mains and couplings

**Preparedness Actions**

17. Plan for mass provision of alternate toilet facilities (i.e. porta-potties and chemical toilets)

18. Plan for more frequent testing of water system given potential for contamination from damaged sewer infrastructure.

19. Develop public notification and beach closure plan in conjunction with health authorities
Consequences of Damage

- Power outages and gas leaks impact most critical infrastructure
- Natural gas leaks cause fires and outages
- Above-ground power lines may be downed impacting public space
- Fuel tank leaks cause environmental damage and reduce vehicle fuel supply

Action to Date

- Developed Neighbourhood Energy Utility strategy that helps reduce reliance on elect. grid
- Installed backup power at critical City facilities, such as fire halls and data centres
- Electric grid redundancy as a legacy of the 2010 Winter Olympic Games
**Risk Reduction Actions**

20. Reduce dependence on the electricity and natural gas grids by facilitating local energy generation and reducing energy requirements in buildings

21. Continue to develop post-disaster Neighbourhood Energy Utilities (NEUs) to build community disaster resilience

**Preparedness Actions**

22. Develop plan for backup power needs across City operations (i.e. key facilities, sewer and water pump stations)

23. Enhance public education program to train residents and businesses how to cope with outages

24. Review gasoline and diesel fuel requirements across the City and ensure City-owned fueling stations are earthquake resilient
Consequences of Damage

- Cell/telephone systems overloaded
- People cannot get through to 9-1-1
- People have difficulty connecting with friends and family
- Businesses cannot conduct operations
- City and responders cannot get critical information to the public
- Critical data is lost

Action to Date

- Developed response plans that do not rely on traditional communications systems
- Installed satellite phones and radios at key City facilities
- Established an emergency communications volunteer group (VECTOR)
- Incorporated family reunification planning in Neighbourhood Emergency Preparedness workshops
Impacted System: Communications Systems – Further Work

Risk Reduction Actions
25. Work with the telecommunications companies to ensure antennas and other structures are seismically resilient and include appropriate backup power

Preparedness Actions
26. Update the City emergency communications plan
   • include social media & explore additional methods of communicating with public (e.g. cell text message broadcast, smart phone apps)
27. Develop alternate City website hosted on out-of-area server
28. Develop staff-family reunification system
29. Exercise city-wide and key partner emergency communications as part of annual earthquake drill
Consequences of Damage

- First responders delayed due to road damage
- Bridges and Skytrain lines shut down until inspected
- Downed trolley wires block roads
- Movement to and from downtown peninsula limited due to debris and bridge and road damage
- Public transit service limited for weeks or months
- Aid to the region delayed due to damaged roads, bridges, port and airport facilities
- People can’t move around the region

Action to Date

- Developed Bridge Response Plan
- Seismic upgrades to key bridges ($14 million in seismic upgrades over past 20 years)
- Developed Disaster Response Routes
### Impacted System: Transportation Systems – Further Work

#### Risk Reduction Actions

**30. Complete upgrading of Granville Bridge and approaches in the next capital plan to ensure it can be used by responders within hours following an earthquake**

**31. Work with external partners (e.g. Translink, BC MOTI) to prioritize risk reduction efforts on transit guideways, tunnels, bridges, and bus system**

#### Preparedness Actions

**32. Install seismic sensors on key bridges to decrease inspection time**

**33. Enhance Emergency Social Services plans to support people on the downtown peninsula**

**34. Continue working with the Integrated Partnership for Regional Emergency Management (IPREM) to expand the Disaster Response Route network to marine transportation.**
Entities Impacted: Buildings

- Impacts:
  - Ground Shaking
  - Liquefaction
  - Fire
  - Landslides
  - Tsunamis

Lifelines:
- WATER SYSTEMS
- SEWER SYSTEMS
- ENERGY SYSTEMS
- TRANSPORTATION SYSTEMS
- COMMUNICATIONS SYSTEMS

People, Economy, Buildings:
- CITY FACILITIES
- PRIVATE BUILDINGS
Consequences of Damage

- Reduced emergency response capacity due to damaged fire halls, community centres
- Delays overall response and recovery operations
- Many City services are relocated to undamaged alternate sites, impacting core function of these alternate facilities (e.g. libraries, community centres)
- Loss of data due to data centre damage
- Displaced residents from non-market housing

Action do Date

- Added a seismic assessment to facilities conditions audits
- Planned disposition of East Wing
- Built a post-disaster Emergency Operations Centre
- Re-located key computer systems to data centres in post-disaster building

500+ facilities: e.g. City Hall, Police Stations, Community Centres, Libraries, Fire Halls, Works Yards, Non-market Housing
Municipal Call Centre Relocated to Library, Christchurch

This Library is closed and is currently being used as an emergency response centre

- Please do not try to return any items until libraries reopen
- The due date on all borrowed items is 1st May 2021
- There are no fines at present for overdue library material
- This Christchurch City Library is closed until further notice

For more information visit christchurchcitylibraries.com or call 941 8999

More information:
Impacted System: City Facilities – Further Work

**Risk Reduction Actions**

35. Continue to address high-risk City facilities, prioritizing those on City Hall Campus.

36. Incorporate non-structural seismic safety program into facilities management

**Preparedness Actions**

37. Develop business continuity plans to support identification of alternate business locations

38. Establish a damage control centre for City facilities to coordinate assessment and prioritize facility restoration.
Consequences of Damage

- Building collapse and damage
- Year+ closure of downtown
- Hazardous materials release from industry
- Schools and hospitals damage delays recovery
- Out-migration of residents
- Loss of property tax revenue
- Inspections will take months given current capacity

Action to Date

- Developed HUSAR team to respond to building collapse
- Updated seismic provisions in building bylaw
- Developed rapid damage assessment program

60% of Vancouver’s building stock built before seismic building codes
No damaging earthquake in modern times means all the vulnerable buildings remain
Impacted System: Private Buildings - Overview

Large pre-1973 seismic code buildings

Key City Infrastructure
- Hospitals
- DFPS Pump Stations
- City Hall Campus
- ECOM
- Police
- Community Centres
- Fire Halls
- City Works Yards
- Bridges & Structures

Building data from City of Vancouver building records.
Banding Protects Pump Station, Christchurch
Damage Closes Many Blocks Downtown, Christchurch
Impacted Systems: Private Buildings - Further Work

**Risk Reduction Actions**

39. Establish a technical committee to advise City on high-risk building abatement options

40. Establish consistency in the application of seismic upgrade requirements for existing buildings

41. Facilitate knowledge transfer of seismic building and retrofit techniques between the scientific, regulatory, and development sectors

42. Fast-track adoption of seismic provisions in the 2015 National Building Code update

**Preparedness Actions**

43. Mandate storage of structural drawings with fire plans to speed-up assessment of complex/high occupancy buildings

44. Provide tools for residents in single-family homes to self-assess damaged structures

45. Incorporate minimum of two structural engineers on HUSAR team

46. Engage private sector Structural Engineers in damage assessment program
Impacted Systems: People and Economy

- Ground Shaking
- Liquefaction
- Fire
- Landslides
- Tsunamis

Lifelines
- WATER SYSTEMS
- SEWER SYSTEMS
- ENERGY SYSTEMS
- TRANSPORTATION SYSTEMS
- COMMUNICATIONS SYSTEMS

Buildings
- CITY FACILITIES
- PRIVATE BUILDINGS

People

Economy
Impact of Earthquake

- Deaths and injuries
- Displacement of residents
- First responders and social services overwhelmed
- People lose incomes and livelihoods
- Increased physical abuse and social problems
- Desire to help/volunteer

Action to Date

- Developed a Neighbourhood Emergency Preparedness Program to train public in basic emergency preparedness
- Developed plans for Reception Centres and Emergency Shelters
- Stockpiled emergency supplies to assist rapid establishment of these services

Two residents embrace near collapsed building, Christchurch, NZ (2011)

Volunteers at work, Christchurch, NZ (2011)
Impacted System: People - Population Density

Population Density By Neighbourhood
Residents Per Square Kilometer
- 6,300 to 22,200
- 5,600 to 6,300
- 4,400 to 5,600
- 3,500 to 4,400
- 2,000 to 3,500

Key City Infrastructure
- Hospitals
- DFPS Pump Stations
- City Hall Campus
- EOC
- Police
- Community Centres
- Fire Halls
- City Works Yards
- Bridges & Structures

Population data from Statistics Canada

Older multi-family dwellings and older single family homes
single-family homes (many with multiple suites) and low-rise apartments
Impacted System: People – Further Work

**Risk Reduction Actions**

47. Expand public education program with new material and methods of outreach targeting vulnerable populations

48. Develop an earthquake preparedness video to engage and motivate the public to take action

**Preparedness Actions**

49. Develop Community Disaster Support Hubs to facilitate community-based response

50. Revise public education program to include safety assessments and basic rescue

51. Integrate Emergency Social Services into Damage Assessment Teams

52. Work with partners to update emergency shelter plans and develop temporary housing plan
Impacted System: Economy

**Consequences of Damage**
- $75 billion in expected losses from a Cascadia Subduction Zone earthquake (total) = 5.2% of the National GDP
- Anything above 1-2% of GDP will cause national recession
- Lost jobs
- Outmigration of residents
- Long-term decline in Port’s prominence
- Loss of tourism

**Action to Date**
- Engaged with the business community to raise awareness and identify options to support small to medium business in preparing for emergencies.
- Provide personal and family preparedness training to local business staff

- Western Canada’s economic centre
- Major regional Central Business District
- Canada’s largest port
- 34% of regional jobs in Vancouver

Non-structural damage in Christchurch, NZ (2011)
Downtown Christchurch Closed For Several Years

Map current as of 6 May 2011
Temporary traffic management subject to change. Drive with caution and obey traffic signage.
Displaced Coffee Shop Moves Outside, Christchurch
Risk Reduction Actions

53. Continue to develop business preparedness program to raise awareness and support preparedness in small and medium-sized businesses

54. Incorporate emergency preparedness and business continuity resources on the City’s website to facilitate access

Preparedness Actions

55. Establish business community liaison position in City’s Emergency Operations Centre

56. Work with BIAs to develop Business Access Program to facilitate temporary access to buildings in cordoned areas
Summary – 56 Actions

12 Primary Actions + 44 Supporting Actions

- 3 Actions: ASSESS RISK
- 21 Actions: REDUCE RISK
- 32 Actions: PREPARE TO RESPOND
- 44 Actions: RESPOND & RECOVER
12 Priority Actions

1. Analyze weak links in our supply chain for critical supplies and services required in earthquake response
2. Enhance inputs to earthquake impact estimation model (e.g. earthquake hazard maps)
3. Incorporate non-structural seismic safety program into facilities management
4. Harden key components of water system in high risk areas
5. Complete upgrading of Granville Bridge and approaches in the next capital plan to ensure it can be used by responders within hours following an earthquake
6. Establish a technical committee to advise City on high-risk building abatement options
7. Continue to address high-risk City facilities, prioritizing those on City Hall Campus
8. Enhance post-earthquake access to firefighting water supply
9. Update emergency communications plan (include social media & explore additional methods of communicating with public)
10. Develop Community Disaster Support Hubs to facilitate community-based response
11. Expand public education program with new material and methods of outreach targeting vulnerable populations
12. Continue to develop business preparedness program to raise awareness and support preparedness in small and medium-sized businesses
Conclusion

• The City is ready to respond at any time
• Significant work done or underway in assessing and addressing risk
• Staff gaining experience for preparedness, response and recovery whenever possible
• Capital and operating budgets reflect ongoing enhancements across organization
Thank you

Questions?