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Current Transportation Infrastructure Risks in the Lower Mainland – VFPA perspective

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Presentation outline

- **Port of Vancouver overview**
- **Climate risks**
- **Adapting to climate change**

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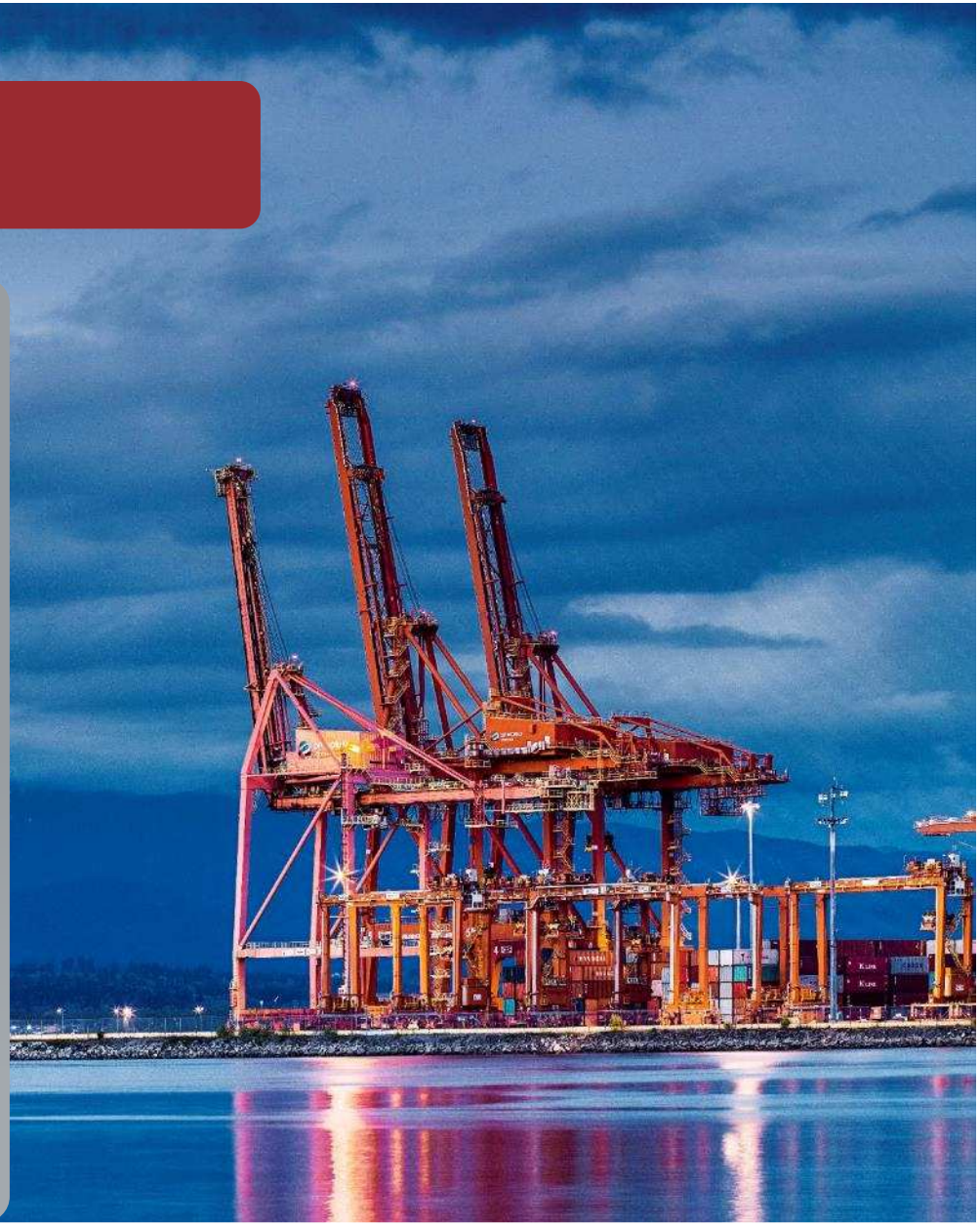
About the Port of Vancouver

- Canada's largest and most diversified port
- $200 billion in goods annually
- $550 million of cargo/day
- 28% of Canadian trade beyond North America
- 115,300 jobs across Canada



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Operation and assets

- Administration of 16,000 hectares of water and nearly 1,000 hectares of land and assets
- 27 major marine cargo terminals
- 3,105 vessel calls in 2016
- Serviced by three major railways

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Federal port lands and waters

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Our five business sectors

Bulk

Breakbulk

Auto

Container

Cruise

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Port Assets – 750 +/- assets in 14 classes

Dock Structures

Overpasses

Rip Rap

Water Systems

Sanitary Systems

Electrical Systems

Equipment

Buildings

Roads

Terminal Pavement

Storm Systems

Communication Systems

Natural Gas

Other *(site fencing, signs, etc.)*

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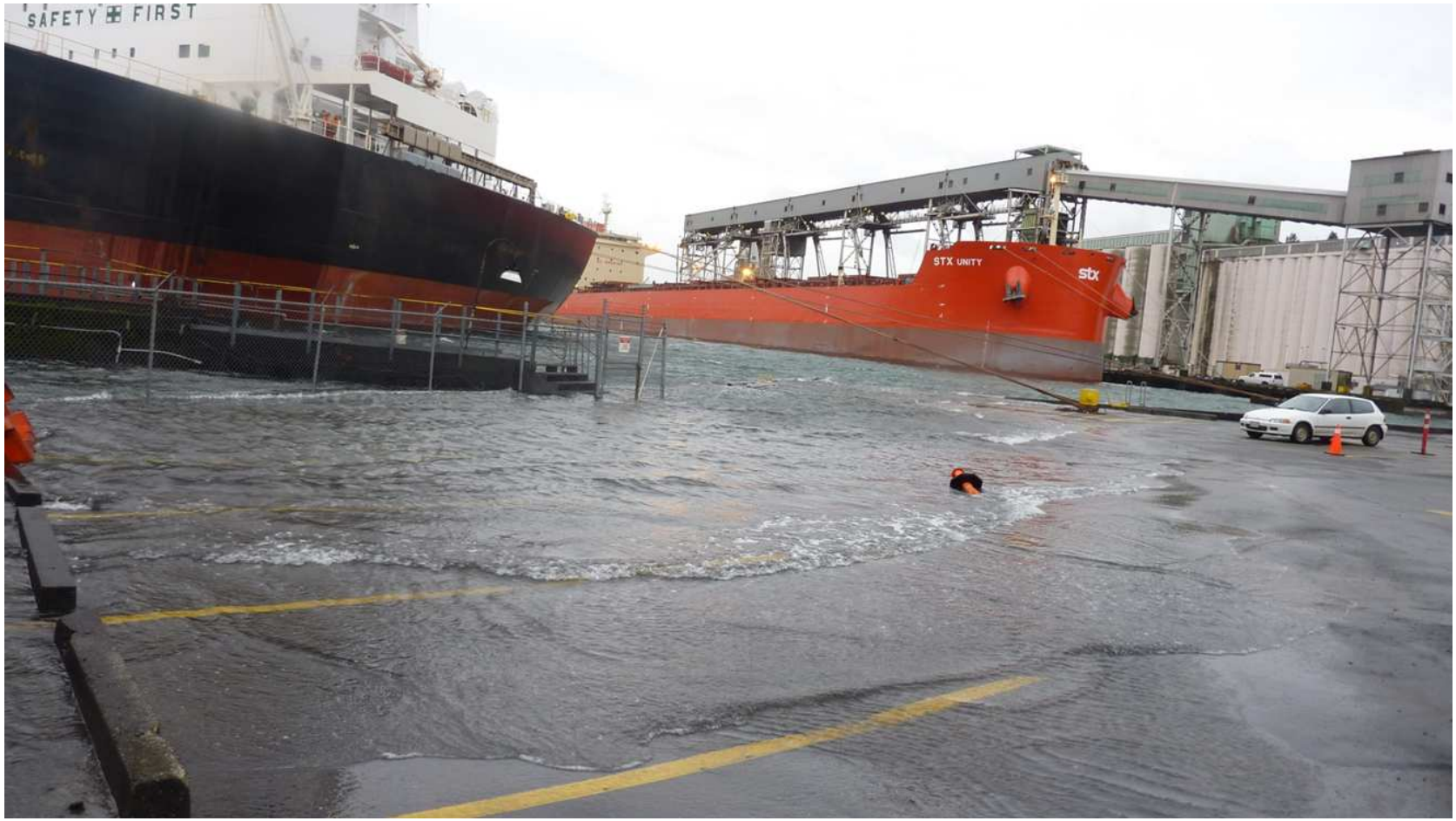
Climate risks

- Sea level rise, freshet flooding
- Higher than average rain/snowfall, temperatures
- More intense and frequent wind and rain storms
- Recent observations:
  - King tides of Dec 17, 2012 & Dec 10, 2014 - flooding at Neptune Terminals & port staff parking lot
  - Storm surge - several recent warnings for Delta, Richmond, English Bay
  - Fraser River flooding – 1894 & 1948 floods; annual monitoring of freshet floods (noticeable high levels in recent years)

King tide of Dec 17, 2014 – Neptune Terminals



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King tide of Dec 17, 2014 – Port staff parking lot

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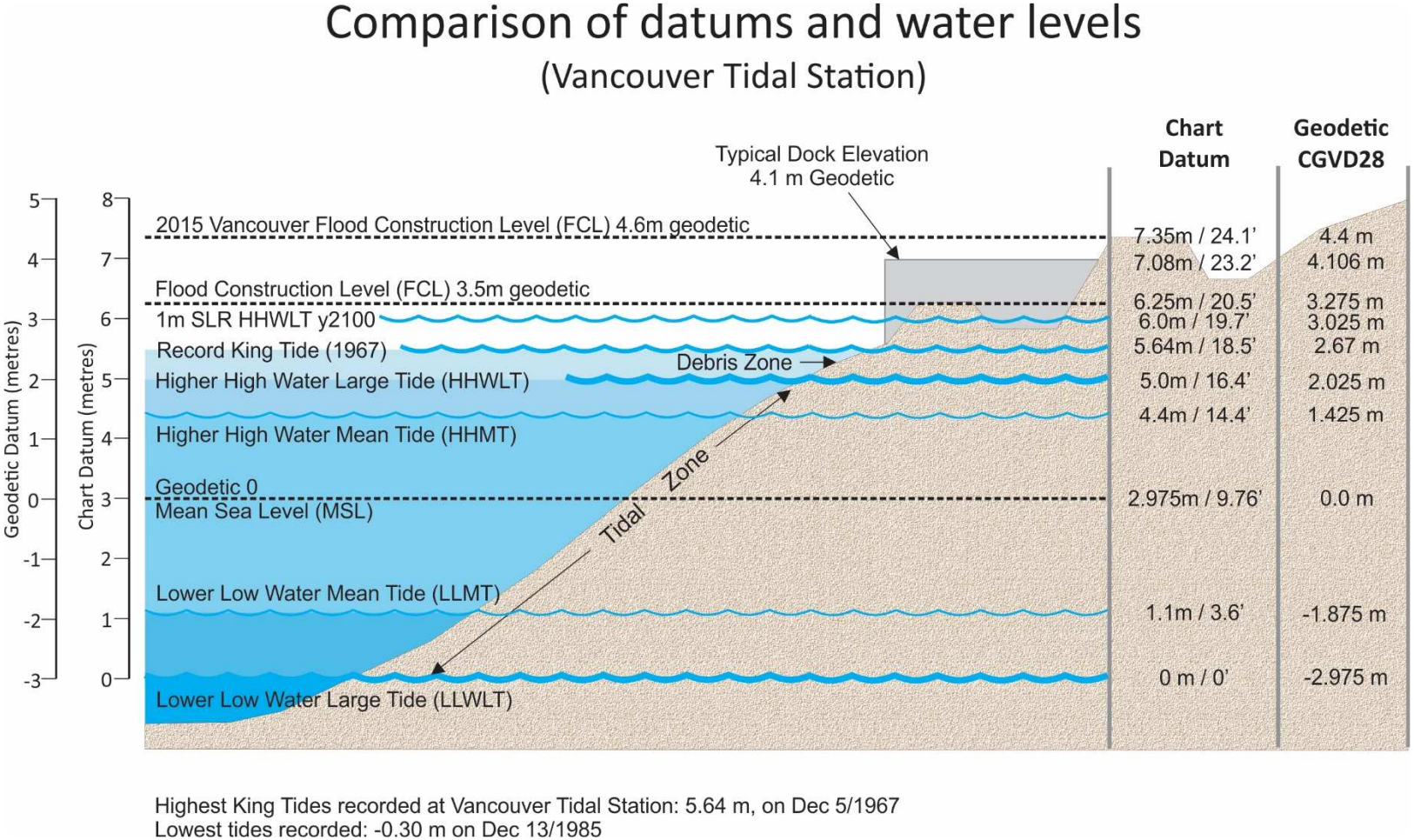
Water levels: High water vs dock elevation



Highest King Tides recorded at Vancouver Tidal Station: 5.64 m, on Dec 5/1967
Lowest tides recorded: -0.30 m on Dec 13/1985

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Adapting to climate change – Considerations

- **Scenarios:**
  - What can happen? Evaluate scenarios and factors, and likelihood of occurrence.
- **Consequences:**
  - Based on the likely scenarios, what areas are at risk?
  - Mapping extents of various scenarios
  - Identify infrastructure at risk, potential losses, business interruption.
- **Strategy:**
  - What flood protection infrastructure or plans are in place?
  - What new measures need to be taken?
  - Cost benefit analysis of "tolerable" flooding?

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Adapting to climate change - Challenges

- Uncertainty in forecasting sea level rise, climate change impacts
- Variability in policy across municipalities and agencies of the Greater Vancouver area
- Funding capacity
- Balancing operational impacts and long-term vision
- Understanding of what's at risk, and what mitigation strategies can be effective

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Adapting to climate change – Regional works

- Working with City of Vancouver:
  - Co-funded 2012 "Evaluation of Flood Construction Levels" study
  - Co-funded 2014 "Coastal Flood Risk Assessment" study
  - Participating in Waterfront Road Flood Risk workshops (includes PavCo and TransLink)
- Working with Fraser Basin Council:
  - Participant on Joint Program Committee for Integrated Flood Hazard Management (34 parties - Federal, Provincial, Municipal, YVR, BC Hydro, CN, CP & others)
    - 2 phase Flood Management Strategy

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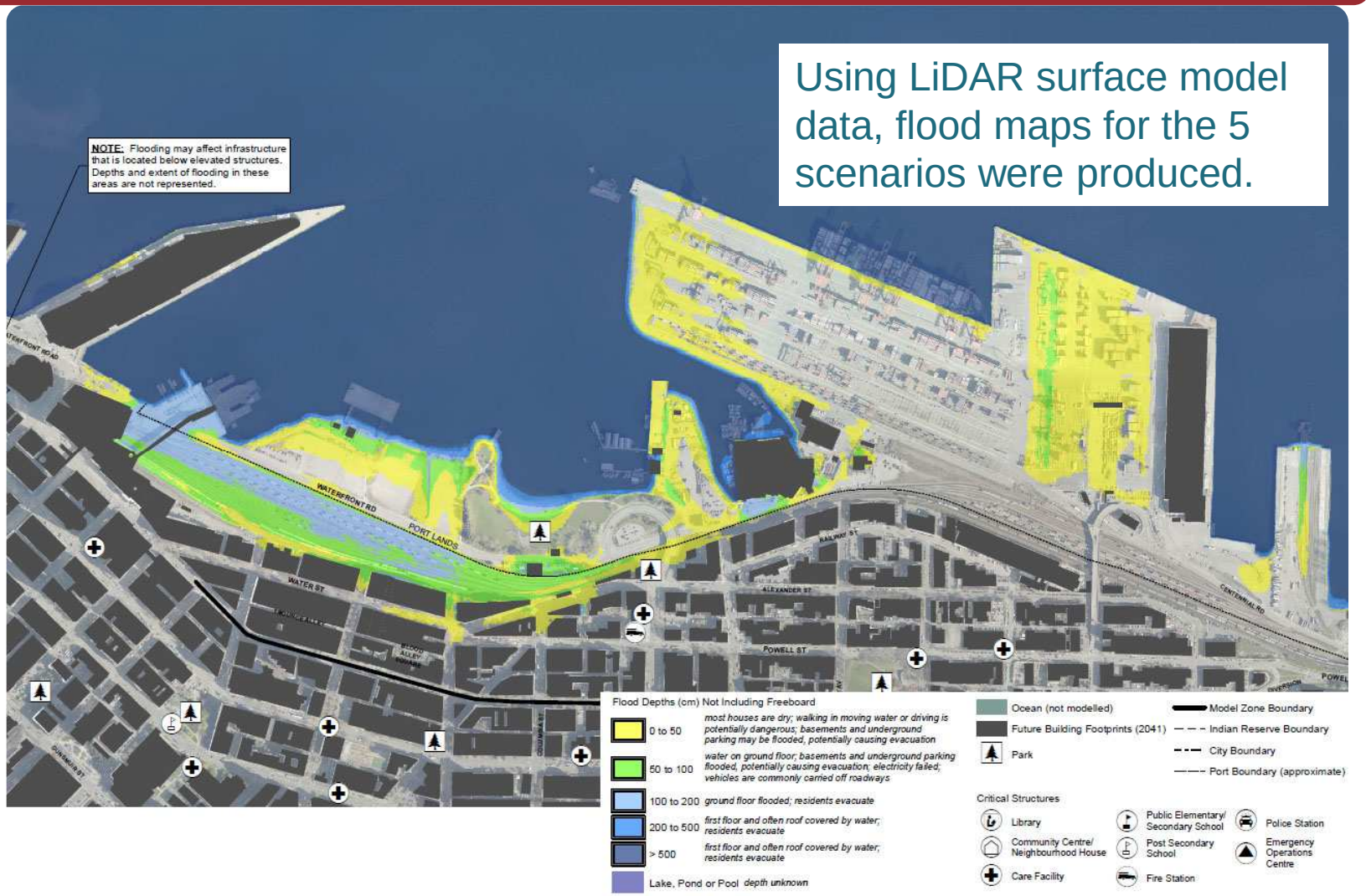
Adapting to climate change – 2014 study

Using LiDAR surface model data, flood maps for the 5 scenarios were produced.



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Adapting to climate change – In-house works

- For 2018, VFPA has started a multi-year initiative to advance our work on climate change adaptation
  - Continuing to update port authority flood maps for each trade area
  - Continuing to conduct climate change risk assessments using the updated flood maps
  - Developing a framework for climate adaptation guidelines that can be used by us and our tenants, including potential future changes to lease, permitting and/or procurement practices
- Through this initiative, VFPA hopes to develop policies, planning guidelines and engineering design guidelines to ensure resiliency of the port's infrastructure assets

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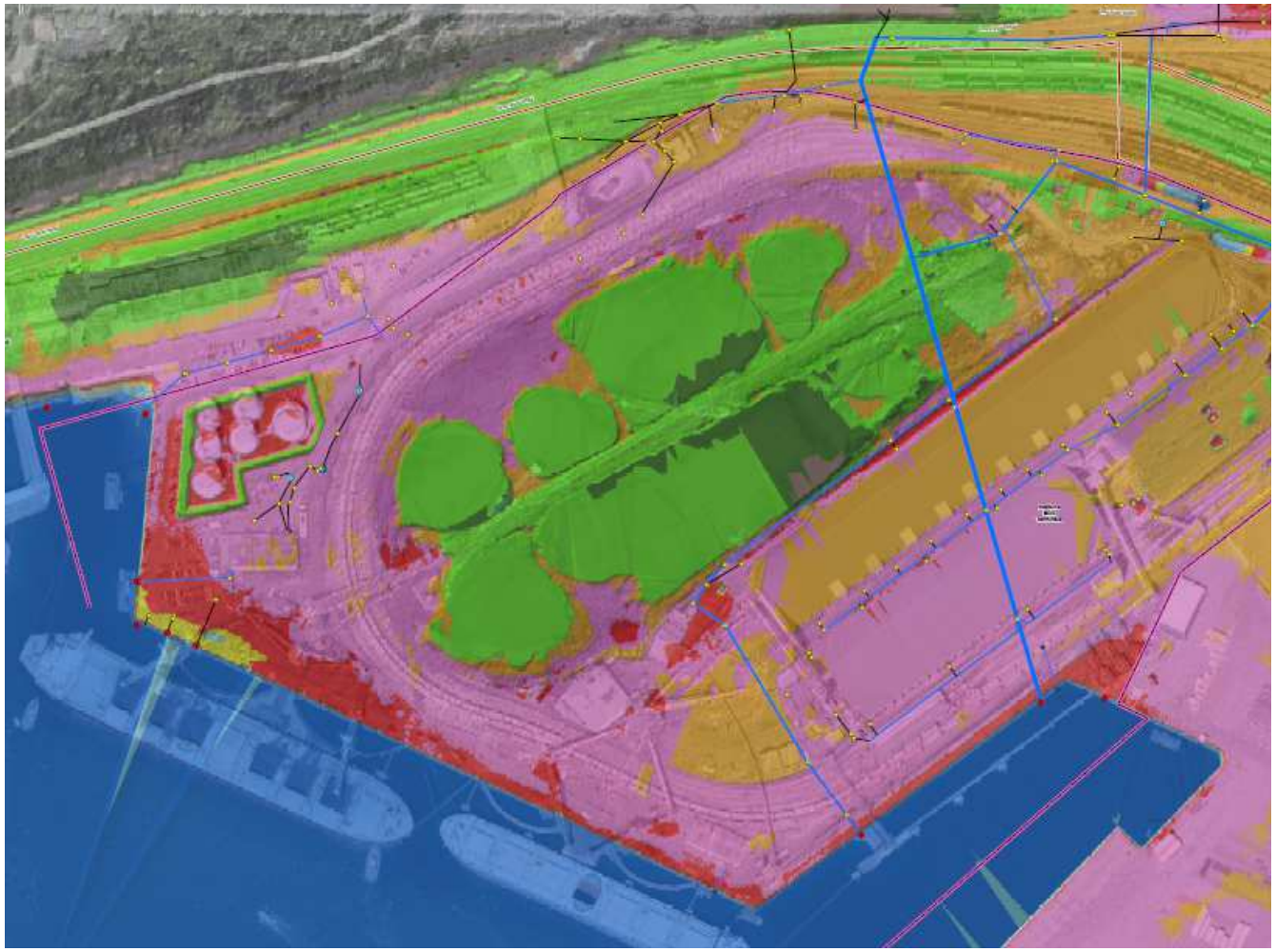
Adapting to climate change – Sample flood map



Catch Basin
Oil/Water Separator
Lift Station
Outfall
Abandoned
Abandoned Storm Line

Storm Line

Diameter unknown
200 - 250 mm
300 - 460 mm
600 - 762 mm
1375 mm
Tenant Boundary (approx.)
PMV Jurisdiction

LiDAR Surface Model

Elevation (geodetic)

> 20 m
10 - 20 m
7 - 10 m
6 - 7 m
4.6 - 6 m
4 - 4.6 (to new FCL inc. freeboard)
3.5 - 4 (to new CoV FCL)
2.64 - 3.5 (to old FCL 3.5m)
2 - 2.64 (to record king tide level)
0 - 2 (to normal high water mark)
< 0 (below geodetic datum)

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Adapting to climate change – In-house works

- VFPA recently developed Green Infrastructure Guidelines to provide guidelines for embedding sustainability best practices in the development of infrastructure, considering all aspects of the asset's life cycle (i.e. concept, design, construction, operation, decommissioning).
  - Guidelines are currently being piloted on VFPA-led infrastructure projects. The pilot program will inform whether guidelines should ultimately be applied to tenant-led infrastructure projects.

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Green Instructure Guidelines

- Best practices/guidelines scan - local agencies; US ports
  - Local Agencies/Municipalities
    - Metro Vancouver
    - TransLink
    - Vancouver International Airport
    - Ministry of Transportation and Infrastructure
    - Ministry of Advanced Education, Innovation and Technology
    - City of Vancouver
    - City of North Vancouver
    - City of Richmond
  - Port Authorities
    - Port of Long Beach
    - Port of Los Angeles
    - Port of New York and New Jersey

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Green Instructure Guidelines

- Approach selected – Customized list of 198 best practices considerations, based on:
  - Sustainability topics most important to VFPA
  - Type of infrastructure projects delivered at the Port
  - Existing practices: ENVISION framework (a national rating system for sustainable infrastructure) and practices of local agencies and other port authorities (incl. the West Coast Ports Initiative)

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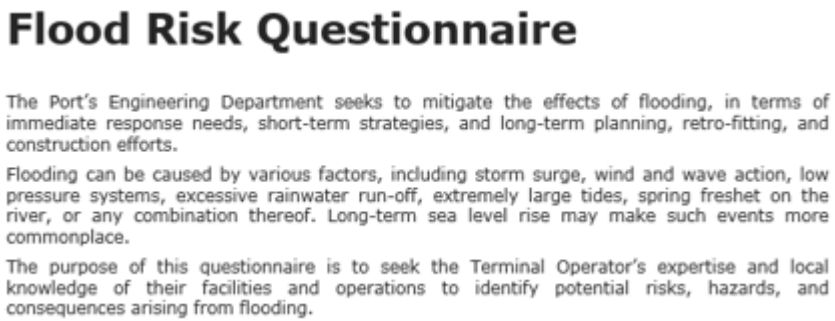
Adapting to climate change – Working with tenants

- Major port development applications are reviewed with an eye towards sea level rise risks and resiliency
  - Neptune steel sheet pile wall rehabilitation – reviewing options to raise south-west corner of terminal
  - Lynnterm Westgate (G3 grain terminal) development – recommending raising of site grades
  - Cargill Terminal substation upgrade – setting of minimum slab elevation
- Understanding impact of climate change to tenant operations



Flood Risk Questionnaire

The Port's Engineering Department seeks to mitigate the effects of flooding, in terms of immediate response needs, short-term strategies, and long-term planning, retro-fitting, and construction efforts.

Flooding can be caused by various factors, including storm surge, wind and wave action, low pressure systems, excessive rainwater run-off, extremely large tides, spring freshet on the river, or any combination thereof. Long-term sea level rise may make such events more commonplace.

The purpose of this questionnaire is to seek the Terminal Operator's expertise and local knowledge of their facilities and operations to identify potential risks, hazards, and consequences arising from flooding.

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Thank you

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