Budd Inlet
West Bay Marina
## Potential Sea Rise

<table>
<thead>
<tr>
<th>UW Scenarios (2007)</th>
<th>2050</th>
<th>2100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Low</td>
<td>3”</td>
<td>6”</td>
</tr>
<tr>
<td>Medium</td>
<td>6”</td>
<td>13”</td>
</tr>
<tr>
<td>Very High</td>
<td>22”</td>
<td>50”</td>
</tr>
</tbody>
</table>
City Policies...2010

- Protect downtown
  - Understand implications of 50 inches of sea rise
- Incorporate flexibility into public and private infrastructure
  - Building elevations, setbacks, stormwater design
- Maintain control of valuable shorelines
2011 Work Plan

- Complete an engineering analysis of potential sea walls
  - Progression of responses to 50 inches of sea rise
- Incorporate sea rise issues in Comprehensive Plan and Shoreline Master Program revisions
- Work with LOTT and Port of Olympia
- Track emerging science
British Columbia Policy and Design Standard

Figure 1: Recommended Global Sea Level Rise Curve for Planning and Design in BC

source: Figure 3-5, this document
2011 Outcomes...
Expected and Unexpected

- Refined understanding of flood dynamics and risks
- Logical long-term approach
- Good foundation for future management
- Greater sense of urgency than expected
New Perspectives on the Problem

- Downtown is currently vulnerable
  - Developing future thresholds for sea rise response may understate today’s risk
- Sea rise is increasingly predictable and appreciable
Budd Inlet Flood Dynamics

- *Tides*: Extreme events, storm surge, atmospheric pressure, historical events
- *Wind and waves*: Water levels, shoreline interactions and overtopping
- *Rainfall and runoff*
- *Indian/Moxlie Creek*
- *Capitol Lake*
- *Sea level rise*
100-Year Event Wind and Waves
10-Year Wind and Waves
Combining Flooding Risks

- Many possible combinations
  - Modest tide with precipitation and sea rise
  - Extreme tide with wind and waves
  - Influence of sea level rise...0.25, 0.5, 1, 2, and 4 feet
- Probability and historical events
- Highlights sensitivities and hot spots
Linking Water Elevations to Downtown Landscape

- Land elevation
- Land use
- Essential services...emergency transportation corridors, LOTT, City Hall, pump stations
- Stormwater and wastewater pipe systems
- Shoreline traits
Emergency Transportation Corridors
Essential Public Services
Indian/Moxlie Creek and its Stormwater System
Flood Water Depths at Street Drains
Indian/Moxlie Hot Spots
Stormwater and Wastewater
Current Approach to Protection
Existing 10-Year Tide Event
Existing 100-Year Tide Event
100-Year Tide Event with 0.25 Feet Sea Rise
100-Year Tide Event with 0.5 Feet Sea Rise
Response Strategy – Now and Up to 0.25 feet of Sea Rise

- Temporary emergency responses, while planning for the future:
  - Seal storm drains at specific locations
    - Reduce stormwater backflows and flows to the wastewater system
    - Pump as needed
  - Sandbag low-lying shorelines
- Continue with small projects…consolidate stormwater outfalls, heighten shorelines
Response Strategy – More than 0.25 feet of Sea Rise

- Emergency response becomes impractical:
  - Construct priority sea walls to a height of 1 foot
    - Much of shoreline is public
  - Install tide gates and small pumps
  - Upgrade shoreline for utilities, structural stability
  - Manage Indian/Moxlie Creek flooding
Initial Sea Wall Construction
Tidal Gate
Potential Shorelines
Response Strategy - More than 0.5 feet of Sea Rise

- Increase sea wall construction
  - Expand and heighten sea walls
  - Continue installing tide gates and pump stations
  - Plan for the large Indian/Moxlie Creek pump station or rerouting street drains
  - Continue consolidating stormwater systems
Consolidating Stormwater Outfalls
Response Strategy – Over 1 Foot of Sea Rise

- Implement downtown-wide protection
  - Protect the rest of peninsula
  - Construct Indian/Moxlie pump
  - Increase height of existing sea walls
Long-term Sea Wall Approach
Potential Indian/Moxlie Pumps
Potential High Costs

- **Sea Walls**
  - Initially…+/- $8 million

- **Pump Station**
  - Indian/Moxlie…+/- $25 million
  - Other miscellaneous pump stations…$12 million

- **Consolidating Stormwater Pipes**
  - Major system…$1,500/foot
  - Minor system…$500/foot
Summary

- Higher existing risks than anticipated
- Improve emergency responses now
- Plan for capital projects in 10 to 15 years
- Not surprisingly, long-term costs are high
Next Steps

- Continue to improve field data
- Develop better emergency responses tactics
- Incorporate sea rise into Comprehensive Plan and shoreline planning
- Consider supplementing federal flood maps with local knowledge
- Begin considering construction needs
Questions?

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