Application of Dutch Water Resources Processes within the North American Market

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Where’s the Connection?

- Canadian Based
- Multi-disciplinary
  - Water
  - Transportation
  - Structures
  - Systems (ITS/IWS)
- Global Consulting
- 800+ staff
Where’s the Connection?

- Canadian Based
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- Netherland Based
- Multi-disciplinary
  - Water
  - Environment/Sustainability
  - Buildings/Manufacturing
  - Transportation
- Global Consulting
- 4000+ staff
Where’s the Connection?

- Since 2002, partnerships in the following sectors:
  - Transportation Planning & Intelligent Transportation Systems
  - Bridges – Architecture & Structural Design
  - Water Sectors:
    - Water Treatment
    - Wastewater Treatment
    - Flood Management & Analysis
Dutch Processes Explored

- Adaptive Strategies
  - Living with Water
    - Public Awareness
    - Contingency & Emergency Planning
  - Coastal Defense
    - Upgrading Program
    - New System
  - Space for Water
    - Internal drainage, retention, and urban planning
    - Flood Plain Management
Flood Management – the Dutch Way
Flood Management – the Dutch Way

- The Netherlands is built on the delta area of four European rivers
- 70% of GDP is earned on land that would flood if left undefended
- Extended flood-defence networks
- Part of our culture and history
- Prince William of Orange involved in water-management issues
Flood Management – the Dutch Way
Flood Management – the Dutch Way

- A Holistic Approach to Water Management:
  - Limits to protection: combining soft measures with hard defences
  - Room for Rivers programme
  - Living with Water programme (knowledge and awareness)
  - Adaptive technology
Flood Management Program
Fraser River, Lower Mainland, BC

*Municipalities of Surrey, Delta, Richmond, New Westminster and Coquitlam
Flood Management Program
Fraser River, Lower Mainland, BC

- Fraser River facts:
  - Longest River in BC (2.2 km)
  - Contributing basin 220,000 km²
  - Average flow = 3500 m³/s
  - Highest flow (1894 event) = 17,000 m³/s
  - Pop. at mouth* = over 950,000
  - GDP at mouth* = $90 billion

*Municipalities of Surrey, Delta, Richmond, New Westminster and Coquitlam
Program Components

- City of Surrey
  - Dike and Pump Station Assessments
- City of Richmond
  - Mid-Island Dike Assessment
- Corporation of Delta
  - Flood Infrastructure Assessments
  - Dike Height Analysis
- City of New Westminster
  - Queensborough Area Flood Assessments
Fraser River Infrastructure

Surrey Ferry Dock, 1902

Rail Bridge, 1903

Patullo Bridge, 1953 (opened 1937)
Fraser River Flooding

- By 1890 area had a general store, hotel, saloon and livery stables
- Floods 1894 (largest flood on record) – some deaths in the area
- 1920 south Westminster Dyking District (WDD) was formed
- 2.6 miles of dykes, 7 flood boxes, 4.3 miles of interior ditches
- 1930’s Provincial Dyking Commissioner
- 1936 Fraser River flooded the area
- 1940 Provincial Program – new floodboxes, pump stations, ditches
- 1948 Second largest flood on record
- 1972 Flooding again
- 1975 South Westminster Dyking District transferred to Surrey with agreement for Province to improve existing dyking & flood protection systems
- After works started, Federal government pulls additional funding for Fraser River Flood Control Program in 1979 – *dykes never fully completed*
- 2000 & 2007 Surrey upgrades some of the dyke “holes” with Provincial funding
Fraser River – 1894 Flood of Record

- Development was still sparse and relatively little damage
- Diking Districts formed (ex. South Richmond 1905-1950).
Dykes overtopped, whole area flooded – Rail/roads/docks closed
Fraser River – 1964 Flood
Fraser River – Land Use Changes
Level of Protection & Prioritization

- **Risk Approach Method**
  - By Netherlands Ministry of Transport, Public Works, and Water Management
  - Investment Cost vs. Risk
  - Optimum level of protection
  - Dike heights for higher levels of protection
Risk Approach Method

Risk ($) =

Probability of Failure \text{(return period)}
\times \text{Economic Consequences} \text{(damage ($))}
Level of Protection & Prioritization

Fraser River / Lower Mainland
Freshet: 15% (1:500)
Sea: 37.5% (1:200)
Total: 52.5% (1:143)

The Netherlands
Green: 6% (1:1,250)
Yellow: 3.75% (1:2,000)
Orange: 2% (1:4,000)
Red: 0.75% (1:10,000)
Economic Consequences (Damage)

Tangible Damage
- Direct damage
  - property, infrastructure
- Indirect damage
  - loss of business

Intangible
- Number of casualties

Determine Maximum Damage
Economic Consequences (Damage)

- Geographical Information
- Flood Information
- Damage Function
- Maximum Damage
- Flooding Depth
- Damage Factor
- Damage
Economic Consequences (Damage)

- Geographical Information (topography)
- Flood Information
- Flooding Depth (1.1m)
- Damage Function
- Damage Factor (70% at 1.1m)
- Maximum Damage ($40B)
- Damage

Damage with 1.1m Flood = $40B x 70%
= $28B
How High?

- What does a 1:10,000 design level mean in terms of elevation?
- What about climate change and sea level rise?

<table>
<thead>
<tr>
<th>Design Height</th>
<th>Average Crest Level</th>
<th>Average Crest Level With CC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provincial Standard</td>
<td>3.6 m</td>
<td>+ 0.5 m</td>
</tr>
<tr>
<td>1:1,000</td>
<td>+ 0.2 m</td>
<td>+ 0.7 m</td>
</tr>
<tr>
<td>1:10,000</td>
<td>+ 0.4 m</td>
<td>+ 0.9 m</td>
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Questions...