<table>
<thead>
<tr>
<th>Outline</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Integrated Water Management</strong></td>
</tr>
<tr>
<td><strong>Water Quality Standards</strong></td>
</tr>
<tr>
<td><strong>Case Studies</strong></td>
</tr>
</tbody>
</table>
Integrated Urban Water Management
Water Conservation & Reuse

Municipal Potable Water Supply

Commercial or Residential Building

- Wastewater

LANDSCAPE

Municipal Sanitary Sewer
Domestic Water Use in Canada

Water Conservation (~40%) – 150 L/day per capita

- **Shower/Bath**: 53 L per day
- **Flushing**: 45 L per day
- **Laundry**: 30 L per day
- **Kitchen**: 15 L per day
- **Cleaning**: 7 L per day
Potable Water Demands

Municipal Potable Water Supply

- Kitchen
- Shower

Commercial or Residential Building

- Wastewater

LANDSCAPE

Municipal Sanitary Sewer
Rainwater Harvesting

Municipal Potable Water Supply

- Kitchen
- Shower

Commercial or Residential Building

- Fire
- Toilet
- Cooling
- Laundry

Rainwater

LANDSCAPE

Municipal Sanitary Sewer

- Wastewater
Reclaimed Water

- Municipal Potable Water Supply
  - Kitchen
  - Shower
- Commercial or Residential Building
  - Fire
  - Toilet
  - Cooling
  - Laundry
- Rainwater
- Makeup Water
- Excess
- Stormwater Collection & Treatment

LANDSCAPE IRRIGATION
- Class “A” Recycled Water
  - Toilet & Urinal Flushing
  - Landscape Irrigation
  - Fire Suppression
  - Cooling

STP

Municipal Sanitary Sewer
Excess Non-Potable Water

Municipal Potable Water Supply

- Kitchen
- Shower

Commercial or Residential Building

- Fire
- Toilet
- Cooling
- Laundry

Rainwater

LANDSCAPE IRRIGATION

- Toilet & Urinal Flushing
- Landscape Irrigation
- Fire Suppression
- Cooling

STP

Class “A” Recycled Water

Excess

Municipal Sanitary Sewer

Excess

Makeup Water

Stormwater Collection & Treatment
Sewer Mining

Landscaping

IRRIGATION

STP - Kitchen
- Shower

Municipal Potable Water Supply

Commercial or Residential Building

- Kitchen
- Shower

- Fire
- Toilet
- Cooling
- Laundry

Rainwater

Stormwater Collection & Treatment

Excess

Class “A” Recycled Water
- Toilet & Urinal Flushing
- Landscape Irrigation
- Fire Suppression
- Cooling

Offsite Non-Potable Use

Sewer Mining

Excess

Municipal Sanitary Sewer

Makeup Water

Excess

Sewer Mining

STP

Excess

Municipal Sanitary Sewer

Makeup Water

Excess
Groundwater

- Municipal Potable Water Supply
  - Kitchen
  - Shower

Groundwater

- Commercial or Residential Building
  - Fire
  - Toilet
  - Cooling
  - Laundry

- Rainwater
  - Landscape Irrigation
  - Fire Suppression
  - Cooling

- Makeup Water
  - Excess

- Stormwater Collection & Treatment
  - Excess

- Wastewater
  - Class "A" Recycled Water
    - Toilet & Urinal Flushing
    - Landscape Irrigation
    - Fire Suppression
    - Cooling

- Offsite Non-Potable Use
  - Excess

- Municipal Sanitary Sewer
  - Sewer Mining

- Excess

- Municipal Potable Water Supply
  - Groundwater
Integrated Water Management

- Municipal Potable Water Supply
- Commercial or Residential Building
  - Kitchen
  - Shower
  - Fire
  - Toilet
  - Cooling
  - Laundry
- Makeup Water
- Rainwater
- Stormwater Collection & Treatment
- LANDSCAPE IRRIGATION
  - Toilet & Urinal Flushing
  - Landscape Irrigation
  - Fire Suppression
  - Cooling
- Excess
- Class "A" Recycled Water
  - Toilet & Urinal Flushing
  - Landscape Irrigation
  - Fire Suppression
  - Cooling
- STP
- Municipal Sanitary Sewer
IUWM Benefits

- Lower Water Resource Demands
- Lower Water Treatment Costs
- Reduced Water Flows = Increased Capacity
- Higher Population Density Support
- Reduced Stormwater Impacts
- Reduced Wastewater = Increased Capacity
- Lower Wastewater Treatment Costs
- Fewer Contaminants Entering Environment
Water Use in Canada

- Recirculated
- Consumed
- Discharged

Intake from water supply

- Thermal power
- Manufacturing
- Municipal
- Agriculture
- Mining
Canadian Water Reuse Standards
### Canadian National Guidelines

#### Health Canada Reuse Guideline

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>UNITS</th>
<th>TOILET FLUSHING</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>MEDIAN</td>
</tr>
<tr>
<td>BOD</td>
<td>mg/L</td>
<td>≤ 10</td>
</tr>
<tr>
<td>TSS</td>
<td>mg/L</td>
<td>≤ 10</td>
</tr>
<tr>
<td>TURBIDITY</td>
<td>NTU</td>
<td>≤ 2 (TSS Altern.)</td>
</tr>
<tr>
<td>FECAL COLIFORMS</td>
<td>CFU/100 ml</td>
<td>≤ 0</td>
</tr>
<tr>
<td>E. coli</td>
<td>CFU/100 ml</td>
<td>≤ 0</td>
</tr>
<tr>
<td>CI Residual</td>
<td>mg/L</td>
<td>0.1 to 1.0*</td>
</tr>
</tbody>
</table>

Note: * Recommended that chlorination be used at least as a secondary means of disinfection to maintain a chlorine residual within the distribution system.
Applicable to:

• Single-family homes
• Multi-unit residential or commercial buildings
• Cluster systems
• Cluster systems serving multiple properties under different ownership

Installed according to CSA Standards B128.01-06/B128.2-06/B128.3-12
**BC Reuse Water Quality Standard**

- No longer have Permitting process
- Registration – Verifying treatment & reuse complies with Regulation

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Indirect potable reuse</th>
<th>Greater exposure potential</th>
<th>Moderate exposure potential</th>
<th>Lower exposure potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>site specific</td>
<td>6.5 to 9</td>
<td>6.5 to 9</td>
<td>6.5 to 9</td>
</tr>
<tr>
<td>BOD$_5$, TSS</td>
<td>BOD$_5$ 5 mg/L TSS &lt; 5 mg/L</td>
<td>10 mg/L</td>
<td>25 mg/L</td>
<td>45 mg/L</td>
</tr>
<tr>
<td>turbidity</td>
<td>maximum 1 NTU</td>
<td>average 2 NTU, maximum 5 NTU</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>fecal coliform (/100 mL)</td>
<td>median &lt; 1 CFU or &lt; 2.2 MPN</td>
<td>median &lt; 1 CFU, maximum 400 CFU</td>
<td>median 100 CFU; maximum 1 000 CFU</td>
<td>n/a</td>
</tr>
</tbody>
</table>
# Alberta Water Reuse Standard

<table>
<thead>
<tr>
<th>Permitted Uses</th>
<th>Treatment Requirements</th>
<th>Effluent Quality Requirements</th>
<th>Monitoring Requirements</th>
</tr>
</thead>
</table>
| Conventional wastewater irrigation, both unrestricted and restricted | A best practicable treatment approach, providing the required effluent quality (essentially secondary treatment with disinfection) | - CBOD $< 100$ mg/L  
- COD $< 150$ mg/L  
- TSS $< 100$ mg/L  
- EC $< 1.0$ dS/m for unrestricted use  
  1.0-2.5 dS/m for restricted use  
  $> 2.5$ unacceptable  
- SAR $< 4$ for unrestricted use  
  4-9 for restricted use when EC $> 1.0$ dS/m  
  $> 9$ unacceptable  
- pH = 6.5-8.5  
- Total coliform $< 1000$ /100 mL  
- Fecal coliform $< 200$ /100 mL | Twice annually  
Twice annually  
Twice annually  
Twice annually  
Twice annually  
Twice annually  
Twice annually  
Geometric mean of weekly or daily samples in a calendar month, depending on whether or not storage is provided |
Codes & Performance Standards

• B128.1-06  Design & Installation of Non-Potable Water Systems
• B128.2-06  Maintenance and Testing of Non-Potable Water Systems
• B128.3-12  Performance of Non-Potable Water Treatment Systems
  o Mixed Wastewater
  o Bath/Shower
  o Laundry
  o Combined Greywater
<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NSF 350</td>
<td>Onsite Residential &amp; Commercial Water Reuse Treatment Systems Performance Standard (mixed wastewater &amp; greywater sources)</td>
</tr>
<tr>
<td>Z1207</td>
<td>International Association of Plumbing and Mechanical Officials (IAPMO) – Greywater Recycling (no treatment)</td>
</tr>
</tbody>
</table>
Conservation Coop - Ottawa

- 84 Unit Facility
- CMHC Project (“Light” Grey)
- Showers & Bathtubs
- Toilet Flushing
- 8 Unit Experiment
Conservation Coop - Ottawa

Water $\rightarrow$ Septic

Coarse Screening $\rightarrow$ Filtration

BOD 130 mg/L

Ozonation
<table>
<thead>
<tr>
<th>Toronto Healthy House</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Residential Duplex</strong></td>
</tr>
<tr>
<td><strong>Rainwater – Potable Use</strong></td>
</tr>
<tr>
<td><strong>Mixed Wastewater Reuse</strong></td>
</tr>
<tr>
<td>- Toilet Flushing</td>
</tr>
<tr>
<td>- Laundry &amp; Bath/Shower</td>
</tr>
<tr>
<td>- Irrigation</td>
</tr>
</tbody>
</table>
Toronto Healthy House
Toronto Healthy House

Primary Treatment → Bio-Filtration

Storage ← Ozonation

Roughing Filter → Dual Media Filter

CHLORINE
Yellowknife Micro-Systems

- 5 Residential Homes
- Expensive Trucked Water Supply
- Reuse for Toilet Flushing
- $8,000/yr Water Savings
Yellowknife – Residential Housing

- Recirculation Zone
- Primary Treatment
- Biofilter
- Ozonation
- 2 Stage Filtration
- Storage
- Ultra Violet Disinfection

Process Flow:
- BACKWASH
- RECIRCULATION
Quayside Village, North Vancouver

Greywater Reuse

Low Technology Treatment

Resident Operated (19 units)

- Toilet Flushing (30% saving)

Rainwater Harvesting
Quayside Village, North Vancouver

Storage → CHLORINE → Primary Treatment → Bio-Filtration → Slow Sand Filtration → SEWER
Alberta Sustainable Home

Greywater Reuse
- Slow sand filtration, soil box, garden wall, UV

Rainwater Harvesting
- Roof, rain barrels, underground cisterns and underground pipes for potable water
- Treatment with slow sand filtration and ultraviolet disinfection
- Kitchen, dishwasher & one bathroom sink
Dockside Green, Victoria BC

Conservation & Reclaimed

65 % Water Reduction

Landscape Irrigation

Toilet & Urinal Flushing

Canadian MBR Technology
### Vancouver Convention Centre

<table>
<thead>
<tr>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reclaimed Mixed Wastewater</td>
</tr>
<tr>
<td>- Green Roof Irrigation</td>
</tr>
<tr>
<td>- Toilet &amp; Urinal Flushing</td>
</tr>
<tr>
<td>- Indirect Fire Suppression</td>
</tr>
</tbody>
</table>

- $12,000/mo savings in water

GE/Zenon MBR Technology
Sustainability Research Focus

Rainwater - Potable Use

Reclaimed Non-Potable Use
- Landscape Irrigation
- Toilet & Urinal Flushing
- Green Roof Irrigation
UBC CIRS Building - Reuse

PROCESS FLOW DIAGRAM
N.T.S.

SANITARY FORCE MAIN
BOD=250 TSS=250

SANITARY TO GVRD
BOD=250 TSS=250

S1
waste sludge to GVRD Sanitary

S2
SANITARY to & from CAMPUS
200mm ø

S3
COLLECTION/SYSTEM

COLLECTION BUFFER TANK (CBT)

SANITARY FROM CIRS
200mm ø

HEADWORKS

50mm Overflow Pipe

100mm Overflow

SOLARIUM

50mm = 50mm

BAR SCREEN Splitter

BLENDING TANK-2
2 tanks @ 6.0m3 tank

AEROBIC TANKS
4 tanks @ 4.8m3 tank

GRAVITY CLARIFIERS
2 tanks @ 1.5m3 tank

SAND FILTERS

CONSTRUCTED WETLANDS

ULTRA-FILTRATION
BC – Indirect Potable Reuse

District of Sechelt

- Veolia Organica Greenhouse Process (SBR)
- Filtration + GAC
- Meets BC Indirect Potable Reuse Standard:
  - < 5 mg/L BOD & < 5 mg/L TSS
  - < 1 NTU Turbidity
  - < 1 CFU/100 mL
Dawson Creek Reclaimed Lagoon Effluent

- Shell Canada Oil and gas activities was consuming 20% of City’s potable water
- Lagoon wastewater treatment + post treatment – reclaimed water facility produces 4 ML/d
- Used for deep well injection, road dust control, and mud preparation
Alberta – Industrial Reuse

Gold Bar Tertiary WWTP (Edmonton)
- Onsite washdowns & polymer mixing
- Suncor Refinery - 15 ML/d for hydrogen and steam production, & cooling
- Snowmaking & Crop Irrigation

Bonnybrook Tertiary WWTP (Calgary)
- Enamx Shepard Energy Centre natural gas-fuelled power facility - 14 ML/d for cooling
Oil Sands

- On average mining requires 3.1 barrels of water per barrel of bitumen produced
- Oil sands fresh water use in 2012 was about 187 million m³ – 40% of the City of Toronto’s annual water consumption.
- Oil sands recycle 80-95% of the water used (AER 2013)
17.1 Fresh water management techniques .. reclamation and reuse of water for non-potable purposes, should include:

- the use of technical water (for example: air conditioning condensate) where possible;
- the use of water recovery systems (for example: filtering and reuse of laundry water – last rinse use for first wash);
- reclamation and reuse as technical water (flushing toilets, laundry, open deck washing) of properly treated and filtered wastewaters;
Reuse in Other Provinces

Saskatchewan – Agricultural Irrigation
- Swift Current (1973) – 338 ha
- Moose Jaw (1983) – 1194 ha
- Lloydminster (1983)
- 28 smaller communities

Manitoba
- Roblin (1996) – 40 acre wetland & 20 acres poplar plantation

Ontario
- Guleph – greywater recycling and rainwater harvesting rebate programs
WARNING: NON-POTABLE WATER
DO NOT DRINK
Thank you!

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