Overview

• Theory
• City of St. John's Program
• New Advancements
• Future Projects
Leak Detection?
Leak Detection?
Leak Detection

What is Leak Detection?

• The process of identifying and reducing "non revenue" water.
  – Primarily Leaks
  – Illegal Use of Water
Leak Detection

What is Non Revenue Water?

- Unbilled Metered Consumption
- Unbilled Unmetered Consumption
- Unauthorized Consumption
- Customer Meter Inaccuracies
- Leakage within Water Distribution System
## IWA Water Balance

<table>
<thead>
<tr>
<th>System Input Volume</th>
<th>Authorised Consumption</th>
<th>Billed Authorised Consumption</th>
<th>Billed Metered Consumption</th>
<th>Billed Unmetered Consumption</th>
<th>Revenue Water</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Unbilled Authorised Consumption</td>
<td>Unbilled Metered Consumption</td>
<td>Unbilled Unmetered Consumption</td>
<td>Non Revenue Water</td>
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<tr>
<td></td>
<td></td>
<td>Apparent Losses</td>
<td>Unauthorised Consumption</td>
<td></td>
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<tr>
<td></td>
<td>Water Losses</td>
<td>Real Losses</td>
<td>Customer Meter Inaccuracies</td>
<td></td>
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<td></td>
<td>Leakage on Transmission &amp; Distribution Mains</td>
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<td></td>
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<td></td>
<td>Leakage and Overflows at Reservoirs</td>
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<td></td>
<td></td>
<td>Leakage on Service Connections up to metering point</td>
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</tbody>
</table>

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IWA Water Balance

In Newfoundland & Labrador the IWA Water Balance is not commonly used due to lack of residential and commercial water meters.

However, we can focus on "Real Losses" within the Water Distribution system.
Leak Management

Leak Management can be divided into four activities:

1. Asset Management
2. Speed and Quality of Repairs
3. Active Leak Detection
4. Pressure Management
Leakage Management

- Pressure Management
- Economic Level of Real Losses
- Active Leakage Control
- Speed and quality of repairs
- Unavoidable Annual Real Losses
- Potentially Recoverable Real Losses
- Current Annual Real Losses
- Pipeline and Assets Management: Selection, Installation, Maintenance, Renewal, Replacement

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Asset Management

The City of St. John's records information on all water main breaks.

This information is entered into the GIS system. This data is reviewed to determine:

- High concentrations of breaks / leaks
- Areas requiring repairs or replacement
- Selection of Materials
Asset Management – All WM Breaks
Asset Management – DI WM Breaks
Asset Management

- Review of Water Main breaks revealed problem with pipe materials, particularly exterior corrosion of ductile iron water main.
- In 2009, CSJ revised water main specification to remove ductile iron as an acceptable material and add PVC as preferred pipe material.
Leak Repairs

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Leak Repairs

The volume of water loss due to leakage is a function of flow rate and time – Leak Run Time.

Leak Run Time is comprised of three components:

- Awareness
- Location
- Repair
Leak Run Time

Leak Run Time Awareness

Leak Volume Loss = (A + L + R) Time x Flow Rate

RUN TIME = Awareness* + Location + Repair
Leakage Rates

How much water is lost from a water main leak or break?

Answer – It Depends

- Type of Break
- Size of Hole / Opening
- **Pressure**
Leakage Rates
Leakage Rates

Typical Water Main Break

- 30 m³/hr
- Awareness = 1-2 hours
- Location = 1-2 hours
- Repair = 8 hours
- Total Time = 12 hours
- Volume = 360m³
Leakage Rates
Leakage Rates

Typical Service Leak

- 3mm Hole in Pipe (1/8"
- Pressure = 70 psi
- Flow = 0.54 m³/hr
- Awareness = 3 months
- Location = 1-2 hours
- Repair = 8 hours
- Total Time = 3 months
- Volume = 1166 m³
Leakage Rates

Summary

- Majority of Water Main breaks are easily and quickly located and repaired.
  - Resulting in short "Leak Run Time"
  - Large Volume of Water lost in Short Period
- Majority of Service Leaks can go undetected for extended periods of time.
  - Resulting in long "Leak Run Time"
  - Large Volume of Water lost in Large Period
- Therefore Leak Detection should be focused on locating leaks that could go undetected.
Active Leak Control

CSJ's Leak Detection Program is comprised of the following tasks:

- Hydrant Sounding
- Hydrant Leaks versus Main Leaks
- Pin – Point Leak Locations
- Repairs
Active Leak Control

Leak Locations are determined using Leak Noise Correlator
Active Leak Control – Correlator Result

Leak position is 139.8 ft from Blue station and 458.1 ft from White station. Time Delay = 0.08982 s
Active Leak Control – Correlator Result
District Metered Areas:

- DMA's are defined as discrete areas in which all incoming (and outgoing) water is metered.
- Typically defined by pressure differences caused by various water distribution infrastructure – PRVs, pump stations, water storage reservoirs, etc.
- Flows are monitored to determine possible leaks.
Active Leak Control - DMAs

DMA Concept

- Minimum night time flow is calculated, leak detection completed to achieve minimum night flows (typically greater than theoretical calculated result).
- Flow data is monitored daily and minimum night flow is compared to actual flow
- Variance in flows = leak(s) or usage
Active Leak Control - DMAs

Ideal DMA Size

- 150-200 Fire Hydrants,
- 2500 Service Connections
- 30 km of Water Mains
- Leak Survey to be Completed in 1-2 days
- Total Leak Run Time of 3-4 days
Active Leak Control - DMAs

CSJ DMAs

- 23 Current Zones
- 28+ Proposed Zones
- 12 Zone Water Meters Installed
- 5 Zone Water Meters Installations Planned
- Remote Communications to be Installed in 2010
Active Leak Control - DMAs

CSJ DMA - Example

- Master Meter + 2 Sub Meters
Active Leak Control – DMA Results

Site: KENMOUNT

Flow (m³/h)

03 Nov 10 17 24 01 Dec 08 15 22 29 05 Jan 12 19 26

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Active Leak Control – DMA Case #1

Site: KENMOUNT

Flow (m3/h)

24” Valve Repair

Hydrant Flow

07 Nov 08 09 10 11 12 13 14 15 16
Active Leak Control – DMA Case #2

Site: KENMOUNT

Flow (m³/h)

07 Dec 08 09 10 11 12 13 14 15

Supply Hospital

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Active Leak Control – DMA Case #3

Site: KENMOUNT

Flow (m³/h)

07 Dec 09 11 13 15 17 19 21 23 25 27 29

WM Break
Active Leak Control – DMA Case #4

Site: KENMOUNT

Switch Hospital Supply Back??

Flow (m³/h)

04 Jan 05 06 07 08 09 10

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Active Leak Control – DMA Case #5

Site: KENMOUNT

Flow (m3/h): 0 to 800

- Water Main Break
- PRV Problem
- Found Open Division Gate

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Active Leak Control – DMA Case #6

Site: KENMOUNT

Flow (m³/h)

01 Dec 05 09 13 17 21 25 29 02 Jan 06 10 14 18 22

30 CM
Active Leak Control – DMA Overview

Site: KENMOUNT

Flow (m3/hr)

0 200 400 600 800

03 Nov 10 17 24 01 Dec 08 15 22 29 05 Jan 12 19 26

Case #1
Case #2
Case #3
Case #4
Case #5
Case #6

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Pressure Management - Future

Theory of Pressure Management

- During periods of low demand water pressure is reduced below normal setting.
- Lower water pressure will result in reduced leakage and reduced water main breaks.
- Typically pressure management is completed during off-peak hours – nighttime.
Pressure Management - Concept

Two Basic Types of Pressure Management

- **Time of Day**
  - Pressure Setting Changed for different times of the Day

- **Flow Modulation**
  - Pressure Varies with Flow
  - Higher Flow = Higher Pressure
  - Lower Flow = Lower Pressure
Pressure Management – Time of Day

45m From 07:00 - 01:00

30m From 01:00 - 07:00
Pressure Management – Flow Mod.
Pressure Management - Equipment
Pressure Management – CSJ Example
Pressure Management – CSJ Example
### Pressure Management - Savings

Example of Flow Rates

<table>
<thead>
<tr>
<th>Pressure</th>
<th>3mm (1/8&quot;) Hole</th>
<th>4.8mm (3/16&quot;) Hole</th>
<th>6.5mm (1/4&quot;) Hole</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Flow</td>
<td>Volume</td>
<td>Flow</td>
</tr>
<tr>
<td>120 psi</td>
<td>0.71m³/hr</td>
<td>6195 m³</td>
<td>1.59m³/hr</td>
</tr>
<tr>
<td>110 psi</td>
<td>0.68m³/hr</td>
<td>5932 m³</td>
<td>1.52m³/hr</td>
</tr>
<tr>
<td>100 psi</td>
<td>0.65m³/hr</td>
<td>5656 m³</td>
<td>1.45m³/hr</td>
</tr>
<tr>
<td>90 psi</td>
<td>0.61m³/hr</td>
<td>5362 m³</td>
<td>1.37m³/hr</td>
</tr>
<tr>
<td>80 psi</td>
<td>0.58m³/hr</td>
<td>5059 m³</td>
<td>1.30m³/hr</td>
</tr>
<tr>
<td>70 psi</td>
<td>0.54m³/hr</td>
<td>4732 m³</td>
<td>1.22m³/hr</td>
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<tr>
<td>60 psi</td>
<td>0.50m³/hr</td>
<td>4381 m³</td>
<td>1.13m³/hr</td>
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<tr>
<td>50 psi</td>
<td>0.46m³/hr</td>
<td>3999 m³</td>
<td>1.03m³/hr</td>
</tr>
<tr>
<td>40 psi</td>
<td>0.41m³/hr</td>
<td>3577 m³</td>
<td>0.92m³/hr</td>
</tr>
</tbody>
</table>
Pressure Management - Savings

Example of Potential Savings

- Assume 6 – 3mm leaks
- 8 hour reduction period

Case 1 - Pressure Reduction - 100 psi to 80psi
- Annual Volume of Water Saved = 1200 m$^3$

Case 2 - Pressure Reduction - 80 psi to 60psi
- Annual Volume of Water Saved = 1350 m$^3$
Leak Detection

Future Plans for CSJ

- Continue to Install Zone Water Meters
- Implement Remote Data Collection
- Calculate Minimum Night Flow for each zone
- Conduct Pilot project for Pressure management
- Investigate feasibility of extending leak detection to 12 month operation.
Thank You