Module 3.1
Controlling Real Losses: Leakage Management

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What are Real Losses?

• Physical losses of treated water from a system
• Components, as defined in the water audit, are:
  ▪ Leakage on transmission and distribution mains
  ▪ Leakage on service connections (to the meter)
  ▪ Leakage and overflow at storage facilities
• 3 components are not distinguished in a top down audit
Measure, then act

- Calculate or measure then monitor your losses
- Recalculate your losses
  - Make sure your apparent loss calculations or assumptions are valid

Figure 1: Understanding the problem of leakage (source: Water and Sanitation Program of the World Bank, in LIEMBERGER 2007)
General leakage management program

- Identify a cross-functional team that will have ownership of the program
- Compile an audit, assign a value to real losses
- Validate source meters
- Identify a preliminary target range, estimate savings
General leakage management program

- Quantify components (reported, unreported leaks & background)
  - Utilize MNF, pilot zones, DMAs
- Assign values to leakage component volumes
- Compile short term plan, find the “low hanging fruit”
- Implement short term plan, attain short term economic level
- Recalculate component analysis considering new data
- Set medium and long term reduction goals, include methods
## Target setting guidelines using ILI

### General Guidelines for Setting a Target ILI
(without doing a full economic analysis of leakage control options)

<table>
<thead>
<tr>
<th>Target ILI Range</th>
<th>Financial Considerations</th>
<th>Operational Considerations</th>
<th>Water Resources Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0 - 3.0</td>
<td>Water resources are costly to develop or purchase; ability to increase revenues via water rates is greatly limited because of regulation or low ratepayer affordability.</td>
<td>Operating with system leakage above this level would require expansion of existing infrastructure and/or additional water resources to meet the demand.</td>
<td>Available resources are greatly limited and are very difficult and/or environmentally unsound to develop.</td>
</tr>
<tr>
<td>&gt;3.0 - 5.0</td>
<td>Water resources can be developed or purchased at reasonable expense; periodic water rate increases can be feasibly imposed and are tolerated by the customer population.</td>
<td>Existing water supply infrastructure capability is sufficient to meet long-term demand as long as reasonable leakage management controls are in place.</td>
<td>Water resources are believed to be sufficient to meet long-term needs, but demand management interventions (leakage management, water conservation) are included in the long-term planning.</td>
</tr>
<tr>
<td>&gt;5.0 - 8.0</td>
<td>Cost to purchase or obtain/treat water is low, as are rates charged to customers.</td>
<td>Superior reliability, capacity and integrity of the water supply infrastructure make it relatively immune to supply shortages.</td>
<td>Water resources are plentiful, reliable, and easily extracted.</td>
</tr>
</tbody>
</table>

AWWA Water Audit Software v 4.2
Economics of Water Loss

- Value Delivery Strategy: Water loss value plus leakage control costs need to be compared to avoided costs (recovery)
Four pillars for managing real losses

- Pressure management
- Active leakage control
- Infrastructure management
- Speed and quality of repairs
Four pillars for managing real losses: visual aide

- Pressure Management
- Active Leakage Control
- Speed & Quality of Repairs
- Pipeline and Assets Management: Main Renewal Replacement

Economic Level of Real Losses

Unavoidable Annual Real Losses

Potentially Recoverable Real Losses

Current Annual Real Losses

Figure 2-1
Pressure Management

- Provide optimum levels of service
- Ensure sufficient and efficient supply
- Reduce unnecessary or excessive pressure
- Eliminate transients
- Eliminate faulty level controls
Pressure Control Options

- Match input head to topography
- Boost critical areas rather than complete zone
- Match pump sizes and regimes to demand
- Use balancing tanks and reservoirs
- Use network analysis where available
- If other options are not available use pressure reducing valves
Pressure Control Pros

- Immediate reduction in leakage
- Reduction in usage (e.g., car washing, sprinklers)
- Reduction in burst frequency in short term
- Stabilizing pressure reduces stress on the network
- Better service to customers
Pressure Control Cons

- Unacceptably low pressure due to undersized pipes or partly shut valves; fire flows may be reduced
- Noise on the system
- Valve operations affecting PRV performance
- Supply difficulties with high rise buildings
- Special consumers (industry, dialysis)
Pressure Management: Types of PRVs

- **Fixed outlet**
  - some benefits but cannot respond to changing conditions

- **Time controlled**
  - can be set to respond to known 24 hour profile

- **Flow modulated**
  - sophisticated response to changing conditions
Pressure Management: Modulation

Reservoir

Download daily pressure log

Central PC

Upload daily pressure log

Download daily profile

Download daily profile

Target node

Outlet pressure

Flow

Time

20

45

20

Time

20

Pressure

Time

www.amwater.com
Leakage Control: the DMA

- District metered areas (DMA) are effective in localizing and reducing real losses

BenchLeak, courtesy: R. McKenzie
Leakage Control: DMA appurtenances
Active Leakage Control

- **Leak Detection**
  - Step Testing
  - Noise Logging
    - Correlating
    - Non-correlating
    - Permanent
    - Lift and Shift
  - Correlation
    - Accelerometers
    - Hydrophones
  - In situ
  - Sounding Survey
  - Gas injection
  - Other

- **Tools**
  - Pressure stabilization
  - Pressure reduction
  - Main and service replacement
  - Reduction in the number of joints and fittings

- **Leakage & break components and reduction tools**

  - **Background leakage**
    - Un-reported and un-detectable using traditional acoustic equipment.
  - **Unreported leaks**
    - Often does not surface but is detectable using traditional acoustic equipment.
  - **Reported breaks**
    - Often surfaces and is reported by the public or utility workers

(from J. FilhoTardelli, SABESP, Sao Paulo, Brazil, Internal reports 2004)
ALC: Step Testing

- A step test is a method of narrowing down the search for suspected leakage by successively shutting parts of a discrete area, and noting the effect on the incoming flow.

- The integrity of the area must be established, all boundary valves shut, and the status of all other valves known.

- Supply should preferably be from a single source and must be metered.
ALC: Step Testing

Flow In
ACL: Step Testing

Advantages

• Easy interpretation of results
• Non-acoustic method
• Finds large leaks quickly

Disadvantages

• Relatively crude method – works best with large leaks
• Potential water quality problems
• Interrupts customers supply
• Usually requires night work
• Labor intensive
ALC: Noise Logging
ALC: Noise Logging

Image showing clear, consistent leak noise

Image showing variable levels of noise = No Leak Status
ALC: Noise Logging, Permanent
ALC: Correlating Loggers

- Correlation Graphic
- Pipe Graphic
- Map Panel (2 loggers)
- Pipe Information Panel
- Correlation Button Panel
- Individual Recordings Correlation Panel
ALC: Other Technologies

Cable driven

Tethered

Free Swimming
ALC: Other Technologies

Fiber Optic Cable

Remote Field Eddy Current

Ground Penetrating Radar

Using Hydrogen Gas

Aerial thermography
Leak Detection Pinpointing

Once an acoustic leak signature has been identified, a ground microphone is used to pinpoint the leak from the surface.
Active Leakage Control: The Future?
Infrastructure Management

- Rehabilitation and replacement
  - Structural Lining
  - Spot Repair
- Replacement
  - Choice of material
  - Pipe bursting
  - Pipe pulling
Speed and Quality of Repairs

- Why find and repair leaks quickly?

REPORTED
MAINS BREAK
22,000 Gallons

REPORTED
UTILITY SIDE
SERVICE BREAK
104,000 Gallons

REPORTED
CUSTOMER SIDE
SERVICE BREAK
299,000 Gallons
Questions ?