Accounting For Loss Water & Revenues

Ohio Section AWWA
Southeast/Southwest Districts
Joint Spring Meeting

Tom Schwing
Deer Creek State Park
April 21, 2016
AWWA Tools for Water Loss Control

Water Audits and Loss Control Programs

MANUAL OF WATER SUPPLY PRACTICES M36

Third Edition

Research Foundation Report

Infrastructure

Water Loss Control

Second Edition

Reinhard Sturm George Kunzel

Water Research Foundation

Advancing the Science of Water

AWWA Free Water Audit Software:

AWWA Free Water Audit Software:

WATER AUDIT DATA VALIDITY SCORE: 77 out of 100

WATER SUPPLIED:

Water Imported

Water Exported

Non-revenue water as percent by volume of Water Supplied:

Real Losses:

Apparent Losses:

WATER LOSSES (Water Supplied - Authorized Consumption):

AUTHORIZED CONSUMPTION:

WATER SUPPLIED:

Non-revenue water as percent by cost of operating system:

Real Losses per length of main per day:

Real Losses per service connection per day per psi pressure:

Non-revenue water as percent of Water Supplied:

Billed Authorized Consumption

Non-revenue water as percent by volume of Water Supplied:

Billed metered consumption:

Billed unmetered consumption:

Volume from own sources:

Volume of water imported:

Volume of water exported:

Annual cost of Real Losses:

Annual cost of Apparent Losses:

Used Customer Retail Unit Cost to value real losses

Efficiency

Leakage on Transmission and/or Authorized Consumption

Unbilled Metered Consumption

Unbilled unmetered consumption:

Water Works Association.

American Water Works Association.

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AWWA Free Water Audit Software

### Water Audit Report for:

Northern San Leandro Combined Water Sewer Storm Utility District (0007900)

**Reporting Year:** 2013

1/2013 - 12/2013

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**Master Meter Error Adjustments**

- Enter negative % or value for under-registration
- Enter positive % or value for over-registration

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**WATER SUPPLIED**

<table>
<thead>
<tr>
<th>Source</th>
<th>Value (MG/Yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume from own sources</td>
<td>1,000.000</td>
</tr>
<tr>
<td>Water imported</td>
<td>100.000</td>
</tr>
</tbody>
</table>

**WATER SUPPLIED:** 825,000 MG/Yr

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**AUTHORIZED CONSUMPTION**

- Billed metered: 700.000 MG/Yr
- Billed unmetered: 50.000 MG/Yr
- Unbilled metered: 10,313 MG/Yr
- Unbilled unmetered: 25,000 MG/Yr

**AUTHORIZED CONSUMPTION:** 760,313 MG/Yr

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**WATER LOSSES (Water Supplied - Authorized Consumption)**

<table>
<thead>
<tr>
<th>Component</th>
<th>Value (MG/Yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unauthorized consumption</td>
<td>3,000</td>
</tr>
<tr>
<td>Customer metering inaccuracies</td>
<td>7,071</td>
</tr>
<tr>
<td>Systematic data handling errors</td>
<td>5,000</td>
</tr>
</tbody>
</table>

**Apparent Losses:** 15,071 MG/Yr

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**REAL LOSSES = WATER LOSSES - APPARENT LOSSES**

**NON-REVENUE WATER**

**NON-REVENUE WATER:** 75,000 MG/Yr

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**SYSTEM DATA**

- Length of mains: 100.0 miles
- Number of active AND inactive service connections: 1,000
- Service connection density: 10 conn./mile main

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**COST DATA**

- Total annual cost of operating water system: $1,000,000
- Customer retail unit cost (applied to Apparent Losses): $3.50
- Variable production cost (applied to Real Losses): $3,000.00

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**WATER AUDIT DATA VALIDITY SCORE**

- PRIORITY AREAS FOR ATTENTION:
  1. Volume from own sources
  2. Customer metering inaccuracies
  3. Total annual cost of operating water system

Based on the information provided, audit accuracy can be improved by addressing the following components:

- Volume from own sources
- Customer metering inaccuracies
- Total annual cost of operating water system

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**AWWA.org/waterlosscontrol**

Water Loss Management

• Historic Water Loss Management practice focused on:
  – “Unaccounted-for-Water” (UAW) - Often arbitrary set at a percentage
    – i.e. 15%
  – Did not consider the true source of water loss – Apparent or Real
  – Did not consider the cost/benefit of water leak control

• Water Industry’s Best Management Practices focuses on:
  – Accounting for all water – there is no “Unaccounted-for-Water”
  – Determining if water losses are Apparent Losses or Real Losses
  – Addressing Real Losses based on realistic, cost effective activities
    rather than activity for the sake of activity!
Water Loss Management

• Water Resource Issue
  – Is water supply (source) limited?

• Operational Issue
  – Is it limiting the water facility’s ability to provide an adequate reliable supply of water to the customers?

• Economic Issue
  – Is the value of the loss water greater than the cost of recovering the loss water?
Water Loss Impact on Private Water Companies

- Traditionally Viewed as Economic Issue
  - Disallow cost for chemical and power costs for producing water above the 15% UAW
  - Penalty for an UAW greater than 15%

- The lower the level of Real Losses in a water system, the higher the cost of further reducing water losses to a lower level.
  - Diminishing return on Water Loss Control activities
Water Loss Audit

Bottom Up!
Start with the activity

Timeframe
Minimum one (1) year period

Resources
Time, Personnel, Money

Measurement Tools
Meters measuring input into the water system
Meters measuring consumption

Data Collection
Validity of the data
Known Knowns & Knowns Unknowns

Develop a Water Balance

– Quantified via Measurement or Estimates the Consumption and Losses of the water system

– Based on Knowns

– Therefore – There is no Unaccounted-for-Water!
Water Consumption

Authorized & Billed Consumption (Revenue Water)

- Billed Water Exported
- Billed Metered Consumption
- Billed Unmetered Consumption

Authorized & Unbilled Consumption (Non-Revenue Water)

- Unbilled Metered Consumption
- Unbilled Unmetered Consumption
Water Losses (Non-Revenue)

Apparent Losses
- Unauthorized Consumption
- Customer Metering Inaccuracies
- Systematic Data Handling Errors

Real Losses
- Leakage on Transmission & Distribution Mains
- Leakage & Overflows at Utility Storage Tanks
- Leakage on Service Connections up to point of the Customer Metering
Who Needs a Meter?
Water Over the Top
Some Definitions

- **System Input Volume**
  - The annual volume of water input into the water supply system

- **Authorized Consumption**
  - The annual volume of metered and/or unmetered water taken by registered customers and others authorized to do so.

- **Water Losses**
  - The difference between System Input Volume and Authorized Consumption – consisting of Apparent Losses plus Real Losses

- **Apparent Losses**
  - The unauthorized consumption, all types of customer metering inaccuracies and systematic data handling errors (nonphysical losses)
Some More Definitions

- **Real Losses**
  - The annual volume of water lost through all types of leaks, breaks, overflows on mains, tanks, service connections up to the customer’s metering (physical losses)

- **Revenue Water**
  - The components of System Input Volume that are billed and produce revenue.

- **Nonrevenue Water**
  - The sum of unbilled authorized consumption, Apparent and Real Losses
  - The Value can be determined by the difference between System Input Volumes and Billed Authorized Consumption
IWA/AWWA Standard Water Balance

- Own Sources
  - Total System Input
  - Water Exported
    - Authorized Consumption
      - Billed Authorized Consumption
      - Unbilled Authorized Consumption
    - Non-Revenue Water
      - Billed Water Exported
      - Billed Metered Consumption
      - Billed Unmetered Consumption
      - Unbilled Metered Consumption
      - Unbilled Unmetered Consumption
      - Unauthorized Consumption
      - Customer Metering Inaccuracies
      - Systematic Data Handling Errors
      - Leakage on Mains
      - Leakage on Service Lines
      - Leakage & Overflows at Storage

- Water Imported
  - (allow for known errors)
    - Water Supplied
      - Water Losses
      - Apparent Losses
      - Real Losses

Total System Input (allow for known errors)
Four Pillars of Apparent Loss Control

- Customer Metering Inaccuracies
- Unauthorized Consumption
- Current Annual Apparent Losses
- Data analysis errors between archived data and data used for billing/water balance
- Unavoidable Annual Apparent Losses
  (This is a theoretical reference value)
- Data transfer errors between meters and archives; poor customer accountability

Apparent Losses in this range are not economically recoverable
Economically Recoverable Annual Apparent Losses

- Economic Level of Apparent Losses
Four Pillars of Real ( Leakage) Loss Control

Unavoidable
Annual
Real Losses

Speed and Quality
of repairs

Active
Leakage Control

Pipeline and
Asset Management
Selection,
Installation,
Maintenance,
Renewal,
Replacement

Losses flex with pressure

Pressure Management

Economic Level of Real Losses

Potentially
Recoverable Real
Losses

Current Annual Real Losses

Losses flex with pressure
Water Loss Control Program Components

• Active Leakage Control
  – Reactive
  – Proactive

• Optimized Leak Repair Activities
  – Timely & Quality Repairs
  – Controlling the ALR times

• Water System Pressure Management
  – Control system pressure to reduce leakage & creation of new leaks

• System Rehabilitation & Renewal
  – Reinvestment in aged infrastructure
Type of Leakage

• Reported Leakage
  – Generally surfacing, is visible and readily reported by public

• Unreported Leakage
  – Generally non-surfacing, not visible but is detectable using traditional leak detection methods

• Background Leakage
  – Small weeping leaks, non-surfacing, no visible water and not detectable using traditional leak detection methods
Background Leakage

Un-reported and undetectable using traditional acoustic equipment.

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

Un-reported leakage

Often does not surface but is detectable using traditional acoustic equipment.

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

Reported leakage

Often surfaces and is reported by the public or utility workers.

Tools
- Pressure stabilization
- Pressure reduction
- Main and service replacement
- Optimization repair time
- Proactive leak detection
Water Main Break
Service Leak
Time Period in the Life of a Leak

A – Awareness, L – Location, R - Repair
Time Period in the Life of a Leak

• Awareness Time – The time to become aware of that a leak exists.

• Location Time – The time to taken to pinpoint the source of the leak once aware of the leak.

• Repair Time – The time it takes to actually repair the leak and stop its water loss.
Comparing Water Leak Loss Impacts

Example of various leakage types & impacts of time on the volume of loss
How are we doing?

- **Unavoidable Annual Real Losses (UARL)**
  - The theoretical value representing the low limit of leakage that could be achieved *if all of today’s* best technology could be successfully applied.

- **Current Annual Real Losses (CARL)**
  - Real losses from the system

- **Infrastructure Leakage Index (ILI)**
  - The ratio of Current Annual Real Losses (CARL) to Unavoidable Annual Real Losses (UARL)
Components of UARL

- Miles of Water Main (including fire hydrant leads)
  - Gallons / mile of main / day / psi

- Service Connections from Water Main to Curb Stop
  - Gallons / Service Connection / day / psi

- Service Connection from Curb Stop to Meter
  - Gallons / Mile of Service Connection / day / psi
How Low Could You Go?
Unavoidable Annual Real Losses (UARL)

\[ \text{UARL (gal)} = (5.4Lm + 0.15Nc + 7.5Lc) \times P \]

- **Main length**
- **Number of conns.**
- **Length of private pipes, Property line to meter**

**Average Pressure**
Calculation of UARL

UARL = (5.4 Lm + 0.15 Nc + 7.5 Lc) X P

Variables:

- Lm – Length of water main
- Nc – Number of Connections
- Lp – Average Length of service Line
- Lc = Nc X Lp
- P - Pressure
Infrastructure Leakage Index ILI

ILI = \frac{\text{CARL (current leakage)}}{\text{UARL (technical low leakage limit)}}
Calculation of ILI

ILI = CARL / UARL

ILI of 1 means the Current Annual Real Losses equal the Unavoidable Annual Real Real Losses.

While in theory an ILI of 1 is possible, it is not realistic.
<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.</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>
<tr>
<td>Greater than 8.0</td>
<td>Although operational and financial considerations may allow a long-term ILI greater than 8.0, such a level of leakage is not an effective utilization of water as a resource. Setting a target level greater than 8.0 - other than as an incremental goal to a smaller long-term target - is discouraged.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 1.0</td>
<td>If the calculated Infrastructure Leakage Index (ILI) value for your system is 1.0 or less, two possibilities exist. a) you are maintaining your leakage at low levels in a class with the top worldwide performers in leakage control. b) A portion of your data may be flawed, causing your losses to be greatly understated. This is likely if you calculate a low ILI value but do not employ extensive leakage control practices in your operations. In such cases it is beneficial to validate the data by performing field measurements to confirm the accuracy of production and customer meters, or to identify any other potential sources of error in the data.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Review of AWWA Software Program

- Marion PWS