

Water Audits & Non-Revenue Water

NDLOC March Madness
March 8, 2018
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ND Rural Water

NDRWSA Scholarship Reminder

- Child or grandchild of a current city/rural water system employee or elected city/rural water system official (water system must be a current member of ND Rural Water Systems Association).
- April 28, 2018 Deadline
- Up to \$8,000
- www.ndrw.org

2019 State Water Plan

- This plan will ultimately help identify North Dakota's potential water development projects, the timing of their implementation, and estimated costs.
- Water projects that may require SWC cost-share during the 2019-2021 or future biennia should submit information before March 23, 2018
- www.swc.nd.gov

Sustainable Systems

Effective Utility Management One on One Training

- 360° look at your utility and sets priorities
- Moves you from **reacting** to the "hot priorities" of the day to **proactively** planning for the future
- Engages your staff in the process of assessing and charting your own course for the future
- It is simple, actionable, affordable, and scalable to meet the needs of all utilities

The Ten Areas

- Product Quality
- Customer Satisfaction
- Infrastructure Stability
- Community Sustainability & Economic Development
- Stakeholder Understanding and Support
- Employee Leadership and Development
- Operational Optimization – Energy and Water Efficiency
- Operational Resiliency
- Water Resource Adequacy
- Financial Viability

Drinking Water Overview

- 42 Billion gallons of water a day in the US
- 80% from Surface Water
- 20% from Ground Water
- 155,000 active PWS
- 51,356 CWS
- Most are considered small

Drinking Water Overview

- Consumption has declined by 5% this decade.
- 1st time in 40 years
- EPA sets legal limits for over 90 contaminants.
- 2017 ASCE Infrastructure Report Card - D

Drinking Water Overview

- 1M miles of pipe across the USA
- 240,000 water main breaks per year
- 2 Trillion gallons of DW wasted
- \$1 Trillion needed to maintain and expand service to meet demand in the next 25 years.
- 0.5% replacement rate = 200 years

Topics to be Covered Today

- What is Water Loss?
- What is a Water Audit?
- What is "Non-revenue" Water?
- What are the Impacts to Utility Finance and Water Supply?

Water Loss

- Difference between System Input Volume and Authorized Consumption

What causes lost water?

- Three causes
 1. Apparent Losses
 - Meter Inaccuracy
 - Under Estimations
 - Broken Meters
 - Accounting Errors
 - Unauthorized consumption
 - Sometimes called "Paper Losses"

What causes lost water?

2. Real Water Loss

- Leaks
- Breaks
- Storage Overflows
- "True Losses"

What causes lost water?

3. Authorized, unmetered uses:

- City Facilities
- Pools and Parks
- Firefighting/Fire Hall
- Street Cleaning
- Water and Sewer Flushing
- Water Plant Needs
- Churches

Question: We plan to flush our distribution system this spring. We have often wondered if there is an easy way to determine approximate flow rates from fire hydrants?

Answer: Place a pressure gauge on a 2 1/2" nozzle. Use the chart below to determine gallons per minute (GPM) discharge through the other 2 1/2" nozzle.

FIRE HYDRANT FLOW - 2 1/2" NOZZLE

Residual (PSI)	Flow (GPM)	Residual (PSI)	Flow (GPM)
2	0	30	920
4	240	32	950
6	340	34	980
8	410	36	1010
10	480	38	1050
12	530	40	1060
14	580	42	1090
16	630	44	1110
18	670	46	1135
20	710	48	1155
22	750	50	1180
24	790	52	1205
26	820	54	1230
28	860	56	1250
	890	58	1275
		60	1300

Billing Your Own Usage

- Don't meter or bill yourself?
- Meter the usage but calculate bills using a no charge rate?
- Bill yourself at your normal rate for commercial customers?

Water Loss Facts

1. All water utility distribution systems incur leakage (real losses).
2. All water utilities fail to recover revenue from all of the water that is (or should be) billed to customers (apparent losses).
3. All water utilities are unique.
4. All should employ leakage control & revenue recovery programs.

How much water loss is acceptable?

- Industry standard was always 10-15%
- 30% was not uncommon
- 2017 Report
 - 6 billion gallons per day of drinking water just disappears

Quantifying Water Loss

- Old Way: Unaccounted for Water and Water Loss as a % of system input volume
- New Way: Non-revenue water (NRW)

Unaccounted for Water (UFW)

- Term no longer used
- All volumes of water supplied within a distribution system go towards:
 - Authorized Consumption
 - Water Loss
 - All water should be accounted for

Water Loss % Negatives

- Is greatly affected by changing levels of customer consumption.
- Cannot distinguish among the specific components of Non-revenue water.
- Reveals nothing about water volumes and associated cost.

Decision Makers should ask...

- "How much water did we produce or buy and how much did we sell"?
- The Answer affects operation, income and the rates you set.

An Introduction to Water Audits

Do these statements sound familiar?

- The records show that way more water enters the system than leaves it.
- The meters register more water "in" than water "out"!
- It seems that some water just disappears!

It might be time for a Water Audit

What is a Water Audit?

- An audit is defined as an examination of records or financial accounts to check their accuracy.
- **Water Audit:** *Traces the flow of water from the site of water withdrawal or treatment, through the distribution system, and into customer properties.*

What is involved in a water audit?

- Collecting records for a water audit review period (12 months)
- Calculating how much water entered and left the system during the review period
- Testing meters for accuracy
- Estimating the amount and cost of NRW & lost water

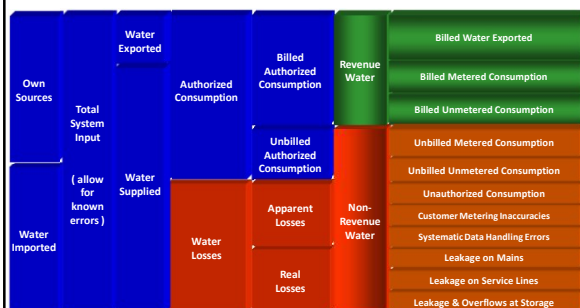
Financial & System Data

- Length of Mains
- # of active and inactive Connections
- Average length of Customer Service
- Average Operating Pressure
- Total annual cost of operating water system
- Customer retail unit cost (applied to Apparent Losses)
- Wholesale production cost (applied to Real Losses)

Water Audit

- Details Consumption & Losses
- The "Water Balance"

Standard Water Balance



Water Balance Components

- **System Input Volume:** The annual input to the water supply system.
- **Authorized Consumption:** The annual volume of metered and/or unmetered water taken by registered customers, the water supplier and other who are authorized to do so.
- **Water Loss:** The difference between system input volume and authorized consumption, consisting of Apparent plus Real Losses

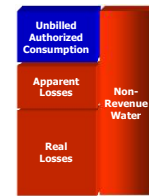
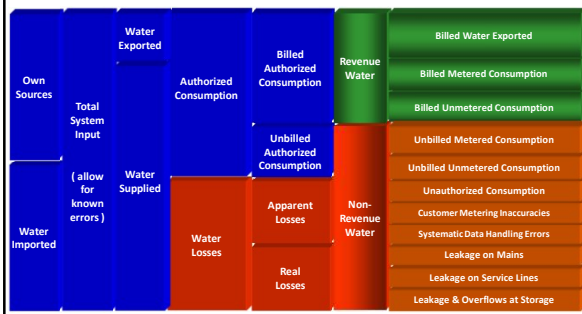
Water Balance Components

- **Apparent Losses:** Unauthorized consumption, all types of metering inaccuracies and systematic data handling errors.
- **Real Losses:** The annual volumes lost through all types of leaks, breaks and overflows on mains, service connections up to the point of customer metering.
- **Revenue Water:** Those components of system input volume which are billed and have the capacity to produce revenue.

Water Balance Components

- **Non-Revenue Water:** Sum of Unbilled Authorized Consumption, Apparent Losses, and Real Losses or the difference between system input volume and billed authorized consumption.

Standard Water Balance



Non-revenue water (NRW)

- Water supplied to the network that does not return revenue to the utility.
- May be expressed as volume or value

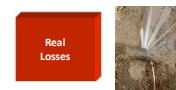
- Fire Dept. Usage
- Operational Flushing
- City Facilities, Parks, Pools...
- Tools for control include efficient flushing practices and awareness campaigns



- Non-physical / revenue loss - slow meters, billing issues and theft
- Cost impacts at 'retail' rate.
- Tools for control include data management, quality control policies/practices, & meter testing & repair



- Physical loss – leakage
- Cost impacts at 'wholesale' rate
- Tools for control include leakage and pressure management



Billed, but Not Collected Metered Use

- Residential, Commercial, Industrial Use, but payment is not collected for leak adjustments, bad debt, or forgiveness.

Questions?

- Has the water leaked into the ground?
- Are the meters wrong?
- Is the water being stolen?
- Has there been an arithmetic mistake?
- Does the system have mistakes in records?



Customer Meter Inaccuracies

- Collective under-registration or malfunction of customer water meters
 - Meter Wear
 - Improper Sizing or Type
 - Improper Installation
 - Aggressive Water Quality
 - Malfunction

Inaccurate Meters

- Source Meters
 - Iron and Manganese in Raw Water
 - Other Corrosions
- Mechanical Residential Meters
 - Age and Volume
 - Water Quality
- Large Commercial Meters
 - Business, Car Washes, Factories, Schools, Hospitals
 - Compound Meters

Meter Testing Recommendations

- Suggested schedule per AWWA is as follows: 5/8" every 10 years, 3/4" every 8 years, 1" every 7 years, 2" every 5 years, 3" every 4 years, 4" every 2 years, 6" or larger every year.
- Meter Replacement Program

Meter Policy

- Every water system should have a written meter installation, calibration, inspection and replacement policy
- They are the cash registers of your system
- Meter Replacement Reserve
 - \$2/month x 12 months x 15 years
 - \$360

Commercial & Industrial (C&I) Meter Accuracy

- Increased revenue from better accuracy.
- Great Return-on-Investment as 30-65% of volume passes through 5-10% of the meter population.

Benefits of Large Meter Testing

- A 10% drift in accuracy is a substantial loss
- Assuming the value of water is \$4 per 1,000 gallons:
 - Meter registering 100,000 Gallons per day
 - A 10% loss is 10,000 Gallons per Day/\$40 per day
 - 70,000 Gallons per week/\$280 per week
 - 3,650,000 Gallons per year/\$14,600 per year
 - That's one large meter registering at 90% Accuracy Level

Performance Indicators for NRW and Water Losses

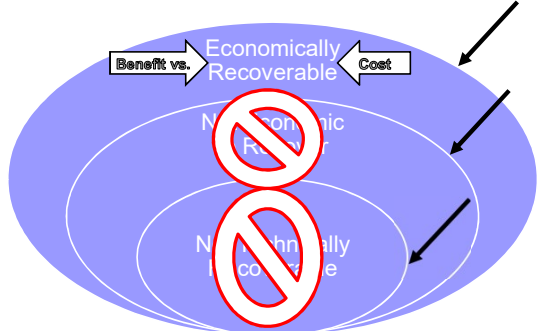
- Volume of Non-Revenue Water as a % of system input volume.
- Volume of Non-Revenue water as a % of the annual cost of running the water system.
- Volume of Apparent Losses per service connection.

Performance Indicators for Non-Revenue Water and Water Losses

- Real Losses vs Gallons/service connections/day when the system is pressurized
- Unavoidable Annual Real Losses (UARL)
- Infrastructure Leakage Index: Ratio of Current Annual Real Losses to UARL

Cost-effective strategy to control losses

Real Loss Control Categories



Real Loss Control Actions

- Pressure Management
- Active Leakage Controls
- Speed & Quality of Repairs
- Asset Management Program

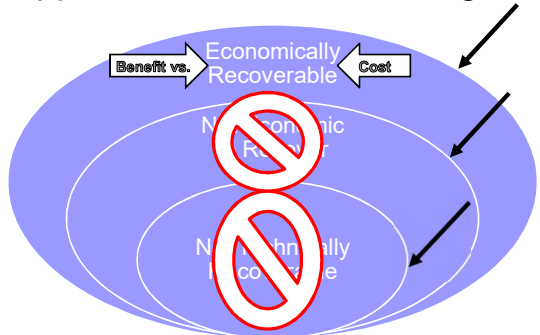
So you found a leak, How much water did you actually lose?

- Leak Loss Charts
- $2.8 \times \text{Area}(\text{sq. in}) \times (\text{Sq. Root of } 148 \times \text{psi}) = \text{gpm}$
- Daily records are important

Always Breakdown Your Losses

- 100,000 gallons/month
- 3,333 gallons/day
- 139 gallons/hour
- 2.32 gallons/minute
- How many blocks of mains, service lines, hydrants, valves, curb stops, old meters...

Apparent Loss Control Categories



Apparent Loss Control Actions

- Customer Metering Inaccuracies
- Unauthorized Consumption
- Data Transfer Errors
- Data Analysis Errors

AWWA Water Audit Software

- [AWWA Water Audit Software](#)

World Bank Estimates

- Global Average of 27% NRW
- \$14.6B (US) of annual losses

Building an Effective Water Loss Control Program

- Annual Water Audit, Quantify NRW Volume, Determine NRW Valuation, Validate & Improve Data
- Identify Expenditures on NRW Management
- Identify Economic Levels of NRW
- Make case to achieve Economic Levels of NRW
- Select Targets and Monitor

Benefits of Reducing NRW

- Increase Revenue
- Lower Costs
- Enhance Customer Service
- Optimize Assets
- Reduce Risks

Thank You!

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