

## MANAGING OLD WATER INFRASTRUCTURE

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ND Rural Water

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## Topics to be Covered Today

- Asset Management
- The Water Balance
- Leak Detection Strategies

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## 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).
- March, 2020 Deadline
- Up to \$9,000
- [www.ndrw.org](http://www.ndrw.org)

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## Planning for Water System Success Training

- Oct. 22 – Dickinson
- Oct. 23 – Stanley
- Oct. 24 – Rugby
- Nov. 5 – Park River
- Nov. 6 – Horace
- Nov. 7 – Lincoln

Watch your mail or visit [www.ndrw.org](http://www.ndrw.org) for more info!

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## 34<sup>th</sup> Annual Water Systems EXPO

February 11-13, 2020  
Delta by Marriott-Fargo

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## Sustainable Systems & Effective Utility Management

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## 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

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## 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







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## The Ten Areas

- Provide a clear set of reference points
  - *Measurable*
  - *“You can’t improve what you don’t measure”*





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## 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

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## Drinking Water Overview

-  Consumption has declined by 5% this decade.
-  1<sup>st</sup> time in 40 years
-  EPA sets legal limits for over 90 contaminants.
-  2018 ASCE Infrastructure Report Card **D**

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## 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

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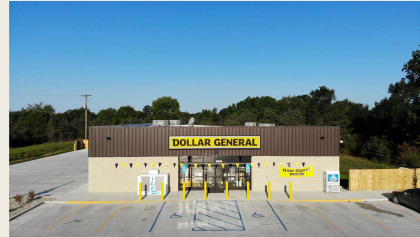
### Let's Take a Poll!

What Size of Community do you Represent?

- Less than 500
- 500-1,000
- 1,000-3,300
- 3,300-10,000
- Greater than 10,000

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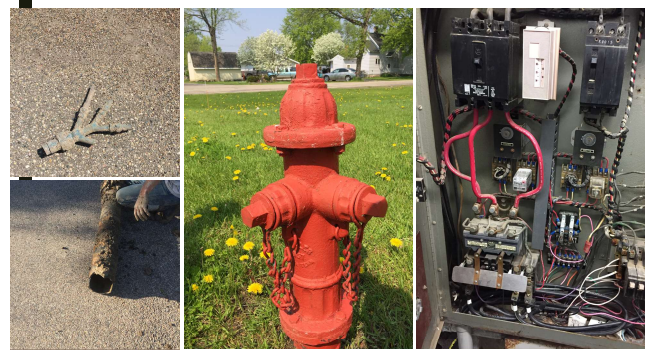
### Do you have a Dollar General?



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Do you have any Old, Aging, Broken, Not Working Efficiently, Well Past its Useful Life, Never Really Worked Right in the First Place, Can't Get Parts For Anymore or Duck Taped Infrastructure?

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## AWWA's *Buried No Longer* draws the following conclusions:

1. Water bills will increase
2. Water systems need investment year after year for decades, and delaying investment makes the problem worse
3. Investment needs will fall mostly heavily on small water systems
4. Slow or negative growth complicates investment for some Midwestern water systems

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## ASSET MANAGEMENT

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## Simple Definition of an "Asset"

- A valuable person or thing
- Property owned by a person or company, regarded as having value

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## Challenges faced by Water Systems

- Determining the best (or optimal) time to rehabilitate/repair/replace aging assets.
- Increasing demand for services or Decreasing demand
- Overcoming resistance to rate increases.
- Diminishing resources.
- Rising service expectations of customers.
- Increasingly stringent regulatory requirements.
- Responding to emergencies as a result of asset failures.
- Protecting assets.

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## Asset Management Definition

- Maintaining a desired level of service for what you want your assets to provide at the lowest life cycle cost.
- Lowest life cycle cost refers to the best appropriate cost for rehabilitating, repairing or replacing an asset.

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## Repair, Rehabilitate or Replace?



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## Systems need Asset Management to:

- Address aging infrastructure assets before they **fail**.
- Keep assets productive, and not allow them to become **disruptive liabilities**.
- Treat all decisions as investment decisions to **maximize limited financial** resources.
- Make **costs transparent** to support financial decisions.

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## 5-step Asset Management Process

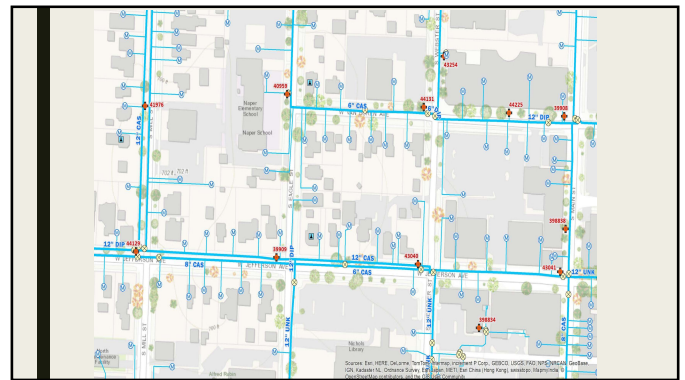
1. **Conducting** a thorough asset inventory.
2. **Prioritizing** the rehabilitation and replacement of your assets.
3. **Developing** an annual estimate of needed reserves and an annual budget.
4. **Implementing** the asset management plan.
5. **Reviewing** and **Revising** the asset management plan.

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## What is the current state of my system's assets?

- What do I own?
- Where is it?
- What is its condition?
- What is its useful life?
- What is its value?

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**Example System Inventory Worksheet**

Asset	Expected Useful Life	Condition	Service History	Adjusted Useful Life	Age	Remaining Useful Life
Well 1 (1993)	30	Good		30	9	21
Well 1 pump	10	Good	Rehab (1996)	10	9	1
Well 2 (1993)	30	Good		30	9	21
Well 2 pump	10	Good	Rehab (1998)	10	9	1
Pumphouse (1993)	30	Good		30	9	21
Electrical transformer	20	Some corrosion	Rehab (1994)	10	9	1
Chlorinator (1993)	10	Good	Rehab (1998)	5	3	2
Storage tank 1 (1993)	40	Good	Rehab (2000) - \$17,000	40	9	31
Storage tank 2 (1993)	40	Good	Rehab (2000) - \$17,000	40	9	31
Storage tank 3 (2000)	40	Almost new		40	2	38
<b>Distribution Systems</b>						
Hydrants (15)	40	Unknown		40	9	31
Valves (95)	40	Unknown	6 valves don't work	40	9	31
6-inch (PHC)	60	Unknown		60	9	51
4-inch (PHC)	60	Unknown		60	9	51
2-inch (PHC)	60	Unknown	Repair breaks (2/year)	60	9	51

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### Estimated Useful Lives

Asset	Expected Useful Life (in years)
Intake Structures	35-45
Wells and Springs	25-35
Galleries and Tunnels	30-40
Chlorination Equipment	10-15
Other Treatment Equipment	10-15
Storage Tanks	30-60
Pumps	10-15
Buildings	30-60
Electrical Systems	7-10
Transmission Mains	35-40
Distribution Pipes	35-40
Valves	35-40
Blow-off Valves	35-40
Backflow Prevention	35-40
Meters	10-15
Service Lines	30-50
Hydrants	40-60
Leak/Monitoring Equipment	5-7
Tools and Shop Equipment	10-15
Landscaping/Grading	40-60
Office Furniture/Supplies	10
Computers	5
Transportation Equipment	10

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## How Do I Prioritize My Assets?

- How soon will you have to replace an asset (its remaining useful life).
- Existing threat to public health, safety, or environment;
- Potential public health, safety, or environmental concern;
- Internal safety concern or public nuisance;
- Improved system operations & maintenance (O&M) efficiency; and
- It would be nice to have...

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**EXAMPLE Prioritization Worksheet**

Date Worksheet Completed/Updated: 8/14/02

Asset	Remaining Useful Life	Importance	Redundancy	Priority (1 is high)
Well 1 (1993)	21	Needed for service	Other well, but need backup	6
Well 1 pump	1	Needed for service	Other well, but need backup	3
Well 2 (1993)	21	Needed for service	Other well, but need backup	6
Well 2 pump	1	Needed for service	Other well, but need backup	3
Pumphouse (1993)	21	Needed for service	Other well, but need backup	6
Electrical components	1	Needed for control	No redundancy - corrosion	2
Chlorinator (1993)	2	Mandatory	No redundancy - need backup	1
Storage tank-1 (1993)	31	Need for fire flow and demand	Other Tanks	6
Storage tank-2 (1993)	31	Need for fire flow and demand	Other Tanks	6
Storage tank-3 (2000)	38	Need for fire flow and demand	Other Tanks	6
Distribution System:				
Hydrants (15)	11	Needed for public safety	Other hydrants	5
Valves (45)	11	Needed for isolation	Other valves, but some are out of service	4
6-inch (PVC)	51	Needed for delivery	No redundancy	6
4-inch (PVC)	51	Needed for delivery	No redundancy	6
2-inch (PVC)	51	Needed for delivery	No redundancy	6

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## How Do I Plan for the Future?

- Determine how much it will cost to rehabilitate and replace your assets as they deteriorate.

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**EXAMPLE Required Reserve Worksheet**

Date Worksheet Completed/Updated: 8/15/02

Asset (list from highest to lowest priority)	Activity	Years until action needed	Cost (\$)	Reserve required
1. Chlorinator	Replace Fluorobas replacement unit	2	\$5,000	
2. Pumphouse - Electrical	Replace switch control roller			\$5,000
3. Well Pumps	Replace Well 1 Pump	2	\$3,000	\$3,000
	Replace Well 2 Pump	1	\$5,000	\$5,000
4. Well	Need replacement of 6 inch well	50	\$40,000	\$3,000
5. Valve	Replacement of 4.5 valve	42	\$52,500	\$7,200
6. Hydrants	Replacement of 27,000 hydrants	21	\$80,000	\$1,833
7. Tanks	Rehabilitate 3 tanks (1,993 tanks, 1994 tank, 2000 tanks)	5	\$50,000	\$10,000
	Replace 2 tanks (1,993 tanks)	24	\$40,000	\$1,290
	Replace 1 tank (2000 tank)	38	\$20,000	\$520
Total reserve in the current year				\$36,399

**Don't Forget Inflation!**

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## How Do I Carry Out This Plan?

- Preparing a financial forecast (next 5 years) will help you determine if you will need to supplement your revenues to carry out your asset management plan.

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## Budgeting Worksheet

- Your system's annual **revenues** from fees, loans and grants, interest from any accounts, and other sources of income.
- Your annual **expenditures** on maintenance, utilities, salaries and benefits, office supplies, professional services, taxes, and loan payments.
- Your **net** income.
- How much **additional** funding you will need to continue to operate and maintain your system and replace and repair your assets.

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**EXAMPLE Budgeting Worksheet**

Date Worksheet Completed/Updated: 8/14/202

Revenues		Expenses		Net Income	
Service Fees	\$249,971	Maintenance	\$55,320	Total Revenues	\$255,430
Fees and Service Charges (bills, connection fee, fire fee, etc.)	\$5,284	Utilities (power, telephone)	\$2,992	Total Expenses	\$249,072
Impact Fees (demand fee, system development fee, etc.)	\$173	Salaries and Benefits	\$76,089	<b>Net Income</b>	
Secured Funding		Equipment Cost	\$1,377	(Revenue - Expenses)	\$10,358
Interest		Chemicals	\$40,512		
Other		Monitoring and Testing	\$8,096		
		Rent or Mortgage			
		Insurance	\$1,233		
		Professional Services (legal, accounting, engineering, etc.)	\$400		
		Training Costs	\$1,000		
		Billing Costs	\$2,400		
		Fees (state PWS fee, franchise fee, conservation fee, etc.)	\$500	<b>Additional Reserves Needed</b>	
		Security	\$609	Total Required Reserves	\$15,628
		Other (debt payments, taxes, miscellaneous, etc.)	\$53,430	<b>Net Income</b>	\$10,358
<b>Total Revenues</b>	<b>\$255,430</b>			<b>Additional Reserves Needed (Income - Required Reserves)</b>	<b>-\$4,270</b>
		<b>Total Expenses</b>	<b>\$249,072</b>		

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### What is my best long-term funding strategy?

- Do we have enough funding to maintain our assets for our required level of service?
- Revising the rate structure.
- Funding a dedicated reserve from current revenues (i.e., creating an asset annuity).
- Financing asset rehabilitation, repair, and replacement through borrowing or other financial assistance.

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### Making the Commitment

- Asset management requires an investment in time and resources.
- Asset management is not a 1-year project, or even a 5-year project.
- It is a continual, fundamental change in the way infrastructure assets are managed.

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### Do not let the TTWWADI Syndrome Hold you back?

That's  
The  
Way  
We've  
Always  
Done  
It



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### Barriers to implementing an Asset Management Program may include:

- Expecting to see immediate results.
- Changing from a focus on operations to a focus on assets.
- Reconciling a short-term focus (e.g., rate increases) with long-term view of system sustainability.

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### In Summary...

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## Asset management will enable your system to:

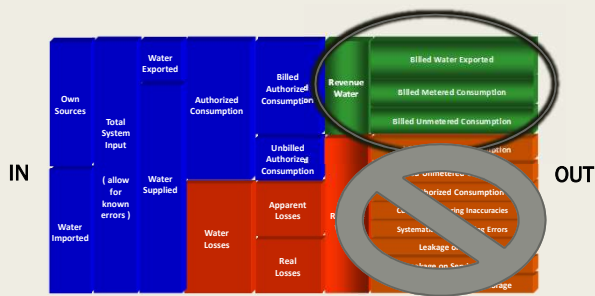
- Have more efficient and focused operations.
- Choose capital projects that meet the system's true needs.
- Base rates on sound operational decisions.
- Improve its financial health.
- Reduce environmental violations due to failed or poorly performing assets.
- Improve the security and safety of infrastructure assets.

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## AN INTRODUCTION TO THE WATER BALANCE

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## Standard Water Balance



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## What causes lost/unaccounted for water?

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

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## What causes lost/unaccounted for water?

2. *Real Water Loss*
  - Leaks
  - Breaks
  - Storage Overflows
  - "True Losses"

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## What causes lost/unaccounted for water?

3. *Authorized, unmetered uses:*
  - City Facilities
  - Pools and Parks
  - Football Fields/Schools
  - Firefighting/Fire Hall
  - Street Cleaning
  - Water and Sewer Flushing
  - Water Plant Needs
  - Churches

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## 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 should employ leakage control & revenue recovery programs.
4. All water utilities are unique.

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## How much water loss is acceptable?

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

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## Quantifying Water Loss

- Old Way: Unaccounted for Water and Water Loss as a % of system input volume
- Still fine to use to set you in the right direction!
- New Way: Tracking Non-Revenue Water (NRW)



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## Water Loss % Negatives

- Is greatly affected by changing levels of customer consumption.
  - > 1,000,000 Gallons Sent to Distribution
  - > 700,000 Gallons Accounted For
  - > 300,000 Gallons Lost
  - > 30% Water Loss
  - > 1,500,000 Gallons Sent to Distribution
  - > 1,200,000 Gallons Accounted For
  - > 300,000 Gallons Lost
  - > 20% Water Loss

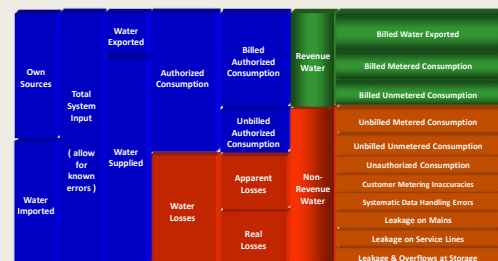
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## Water Loss % Negatives

- Cannot distinguish among the specific **components** of Non-Revenue Water.
- Reveals nothing about water **volumes** and associated **cost**.

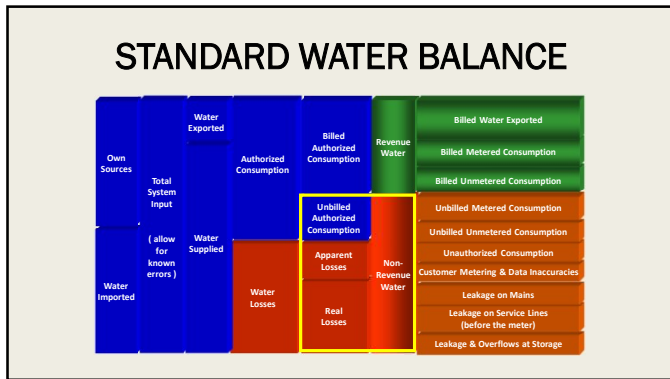
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## STANDARD WATER BALANCE

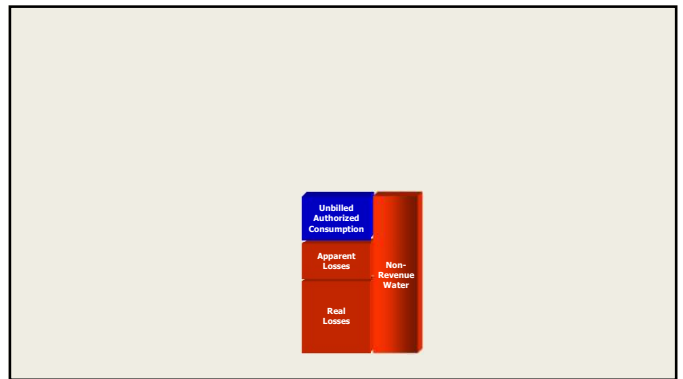


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## Non-Revenue Water (NRW)

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

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

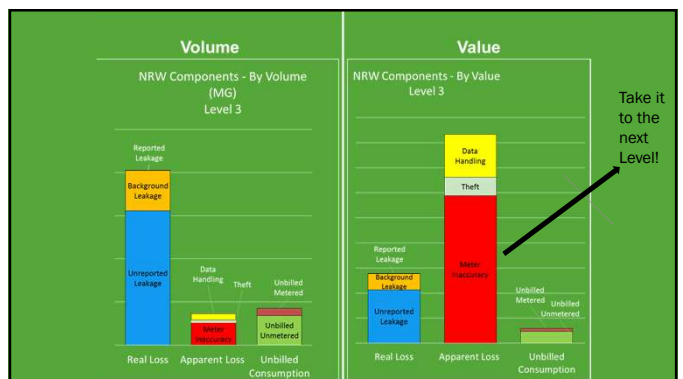
- Non-physical / revenue loss - slow meters, billing issues and theft
- Cost impacts at 'retail' rate.
- Tools for control include data management, quality control policies/practices, & meter testing & repair

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

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## So You Think You Have A Leak ?



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## WATER LOSS AND LEAK DETECTION

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### North Dakota Rural Water Systems Association

*New Horizons in Rural Living*

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## STEPS TO DETERMINE WATER LOSS

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## ALWAYS BREAKDOWN THE NUMBERS!

- ▶ 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...

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## RECORDKEEPING

MAINTAIN DAILY RECORDS OF  
WATER PRODUCED OR PURCHASED

OPERATORS WILL DEVELOP TRENDS  
OF THE WATER USE AND IDENTIFY  
WHEN A PROBLEM OCCURS

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**WATER LOSS REPORT**

FOR THE MONTH OF \_\_\_\_\_

WATER BOUGHT/PRODUCED: \_\_\_\_\_

WATER SOLD (METERED) \_\_\_\_\_

TOTAL WATER LOST (GALS) \_\_\_\_\_

TOTAL WATER LOST (%) \_\_\_\_\_

ACCOUNTED FOR WATER LOST \_\_\_\_\_  
(FIRES, FLUSHING, ETC.)

TOTAL UNACCOUNTED FOR WATER (GALS) \_\_\_\_\_

TOTAL UNACCOUNTED FOR WATER (%) \_\_\_\_\_

TO OBTAIN PERCENTAGES, DIVIDE WATER LOST BY WATER BOUGHT/PRODUCED.

## WATER AUDITS

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## WATER METERS

READ METERS CONSISTENTLY  
CLOSE TO THE SAME DATE  
AVOID ESTIMATIONS  
METER REPAIRS PERFORMED TIMELY

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## METER POLICY

- ▶ EVERY WATER SYSTEM SHOULD HAVE A WRITTEN METER INSTALLATION, CALIBRATION AND REPLACEMENT POLICY
- ▶ THEY ARE THE CASH REGISTERS OF YOUR SYSTEM
- ▶ METER REPLACEMENT RESERVE
  - ▶ \$2/MONTH X 12 MONTHS X 15 YEARS
  - ▶ \$360

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## WATER METER AUDITS

- ▶ SERIAL NUMBERS
- ▶ CURRENT READING
- ▶ READING INTEGER
- ▶ REMOTE READING FUNCTION TEST
- ▶ LOW FLOW FUNCTION TEST
- ▶ EVERY 3-5 YEARS OR WITHIN A YEAR OF HIRING A NEW AUDITOR OR WATER SYSTEM OPERATOR

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## CUSTOMER METER INACCURACIES

- ▶ COLLECTIVE UNDER-REGISTRATION OR MALFUNCTION OF CUSTOMER WATER METERS
  - ▶ METER WEAR
  - ▶ IMPROPER SIZING OR TYPE
  - ▶ IMPROPER INSTALLATION
  - ▶ AGGRESSIVE WATER QUALITY
  - ▶ MALFUNCTION

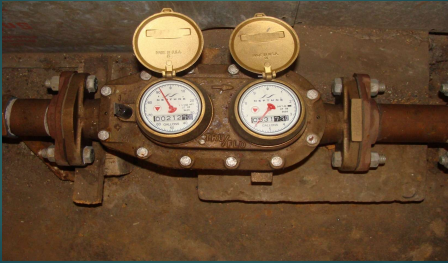
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## WHAT NOT TO DO!



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## COMPOUND METERS



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## WATER AUDITS

- ▶ METER READING DATES AVERAGE OUT
- ▶ PERCENTAGES AREN'T ALWAYS ACCURATE
- ▶ ACCOUNT FOR AUTHORIZED UNMETERED WATER USE

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## MAPS AND MAINTENANCE RECORDS

- ▶ WATER MAINS
- ▶ VALVES
- ▶ HYDRANTS
- ▶ CURB STOPS
- ▶ DO THEY WORK?

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## LEAK LOCATING



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## SOMETIMES THEY SHOW UP



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## WHERE TO START LOOKING?

- ▶ OLDEST PART OF THE SYSTEM
- ▶ NEWEST PART OF THE SYSTEM
- ▶ WHERE WAS LAST WORK COMPLETED
- ▶ PREVIOUS PROBLEM AREAS
- ▶ AREA THAT HAS FROZEN
- ▶ HIGH STRESS AREAS

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## LEAK LOCATING EQUIPMENT

- ▶ PRESSURE TESTING

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## PRESSURE TESTING

- ▶ WHERE ARE THE VALVES?
- ▶ DO THEY WORK?
- ▶ TAKES TIME AND ENERGY!

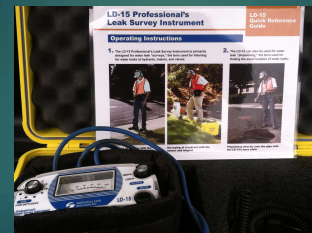
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## LEAK LISTENING

- ▶ PRONE TO INTERFERENCE
- ▶ LIMITED IF WATER LOSS IS LOW
- ▶ TAKES TIME AND PATIENCE

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## LEAK LISTENER



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### LEAK CORRELATION

- ▶ HIGHLY ACCURATE
- ▶ REQUIRES DETAILED RECORDS
- ▶ CAN BE USED IN NOISIER LOCATIONS
- ▶ WORKS BEST IN AREAS WHERE A LEAK IS KNOWN TO EXIST

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### ACOUSTIC METER

A close-up of an acoustic meter device attached to a pipe. The device is a cylindrical metal tube with a sensor at the end, and it is connected to a black electronic device with a screen and buttons.

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## ACOUSTIC METER

- ▶ USED ON LARGE DIAMETER OR LONG LENGTHS OF PIPE TO DETERMINE IF WATER LOSS IS PRESENT
- ▶ REQUIRES DIRECT CONTACT WITH THE WATERMAIN

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## PRESSURE DATA LOGGERS



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## PRESSURE DATA LOGGERS

- ▶ MONITOR SYSTEM PRESSURES 24/7
- ▶ MONITOR DURING VARYING SYSTEM CONDITIONS
- ▶ CAN BE PLACED IN MULTIPLE AREAS OF THE SYSTEM
- ▶ DATA COLLECTED CAN ASSIST IN LOCATING AREAS OF CONCERN

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## FLOW TESTING

- ▶ ESTABLISH BASELINE FLOWS
- ▶ HELPS DETERMINE OBSTRUCTIONS
- ▶ HELPS DETERMINE IF A LEAK MAY BE PRESENT

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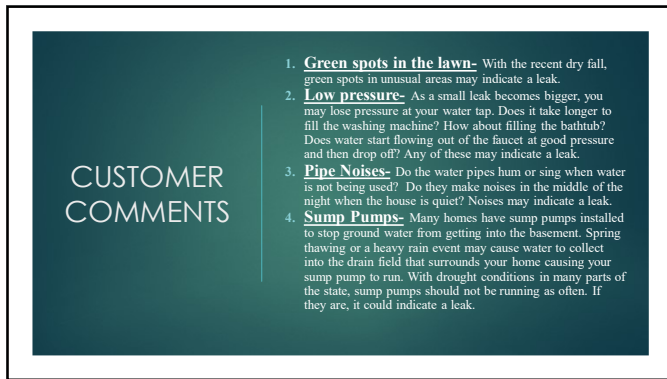
## HYDRANT FLOW TESTING

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## THE CUSTOMER

YOUR EYES AND EARS OF THE WATER SYSTEM

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**CUSTOMER COMMENTS**

1. **Green spots in the lawn-** With the recent dry fall, green spots in unusual areas may indicate a leak.
2. **Low pressure-** As a small leak becomes bigger, you may lose pressure at your water tap. Does it take longer to fill the washing machine? How about filling the bathtub? Does water start flowing out of the faucet at good pressure and then drop off? Any of these may indicate a leak.
3. **Pipe Noises-** Do the water pipes hum or sing when water is not being used? Do they make noises in the middle of the night when the house is quiet? Noises may indicate a leak.
4. **Sump Pumps-** Many homes have sump pumps installed to stop ground water from getting into the basement. Spring thawing or a heavy rain event may cause water to collect into the drain field that surrounds your home causing your sump pump to run. With drought conditions in many parts of the state, sump pumps should not be running as often. If they are, it could indicate a leak.