

# This presentation premiered at WaterSmart Innovations

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# A SNAPSHOT OF WATER LOSS

*Examining the Country's Water Audit Submissions*

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*Water Systems Optimization*



# RESEARCH GOALS



**Water Research Foundation 4372B:**  
*Water Audits in the United States –  
A Review of Water Losses and Data Validity*



1. What are the **reporting frameworks** of states that track water loss?
2. Is data submitted in water audits **reasonable**?
3. Has audit **data quality changed** with repeated auditing?
4. Have reported **water loss volumes** and relevant metrics **changed** with repeated auditing?
5. What **trends in water loss** and cost figures can be observed in the composite data set?
6. How is the quality of audit data affected by **reporting requirements and validation**?

**DATA VALIDITY**

**WATER LOSS METRICS**

# WATER AUDITS

## AWWA Free Water Audit Software

- collects water balance volumes, cost data, and system data
- grades data validity
- determines total volumes of water losses
  - Apparent Losses
  - Real Losses
  - Non-Revenue Water
- calculates performance indicators

The screenshot displays the 'AWWA Free Water Audit Software: Reporting Worksheet' interface. It includes a header with the software name and version (WAS v5.0), a navigation bar with 'Click to access definition' and 'Click to add a comment' buttons, and a main data entry area. The 'Water Audit Report for:' field is set to '<< Please enter system details and contact information on the instructions tab >>'. The 'Reporting Year:' field is empty. A note states: 'Please enter data in the white cells below. Where available, metered values should be used; if metered values are unavailable please estimate a value. Indicate your confidence in the accuracy of the input data by grading each component (n/a or 1-10) using the drop-down list to the left of the input cell. Hover the mouse over the cell to obtain a description of the grades. All volumes to be entered as: MILLION GALLONS (US) PER YEAR'. The interface is divided into several sections: 'WATER SUPPLIED', 'AUTHORIZED CONSUMPTION', 'WATER LOSSES (Water Supplied - Authorized Consumption)', and 'NON-REVENUE WATER'. Each section contains input fields for various components, with a 'Grading' dropdown and a 'Value' field. The 'WATER SUPPLIED' section shows 'Volume from own sources' at 1,000,000 MG/yr, 'Water imported' at n/a, and 'Water exported' at n/a. The 'AUTHORIZED CONSUMPTION' section shows 'Billed metered' at 850,000 MG/yr, 'Billed unmetered' at 0,000 MG/yr, 'Unbilled metered' at 0,000 MG/yr, and 'Unbilled unmetered' at 12,755 MG/yr. The 'WATER LOSSES' section shows 'Unauthorized consumption' at 2,551 MG/yr, 'Customer metering inaccuracies' at 35,417 MG/yr, and 'Systematic data handling errors' at 2,125 MG/yr. The 'NON-REVENUE WATER' section shows a total of 170,408 MG/yr. The interface also includes a 'Master Meter and Supply Error Adjustments' section with 'Pcnt' and 'Value' fields for under-registration and over-registration.

Section	Component	Value (MG/yr)
WATER SUPPLIED	Volume from own sources	1,000,000
	Water imported	n/a
	Water exported	n/a
<b>WATER SUPPLIED:</b>		<b>1,020,408</b>
AUTHORIZED CONSUMPTION	Billed metered	850,000
	Billed unmetered	0,000
	Unbilled metered	0,000
	Unbilled unmetered	12,755
<b>AUTHORIZED CONSUMPTION:</b>		<b>862,755</b>
<b>WATER LOSSES (Water Supplied - Authorized Consumption)</b>		<b>157,653</b>
Apparent Losses	Unauthorized consumption	2,551
	Customer metering inaccuracies	35,417
	Systematic data handling errors	2,125
<b>Apparent Losses:</b>		<b>40,093</b>
<b>Real Losses (Current Annual Real Losses or CARL)</b>		
Real Losses = Water Losses - Apparent Losses:		<b>117,560</b>
<b>WATER LOSSES:</b>		<b>157,653</b>
<b>NON-REVENUE WATER:</b>		<b>170,408</b>

determine the magnitude of water loss  
track/compare performance  
customize water loss control activity

# DATA VALIDATION

*accurate data inputs* → *accurate results*

## LEVELS OF DATA VALIDATION

### SELF-REPORTED

no in-depth review  
auditor assigns data validity grades

### LEVEL 1

third-party surface-level “desktop” review  
no new data – only existing sources  
**data validity grades** are main focus

### LEVEL 2

third-party deeper “desktop” review  
investigation of *all* available data sources  
**validation of SIV and consumption** is main focus

### LEVEL 3

third-party “desktop” review *and* field investigation  
production and customer meter accuracy testing  
pressure data collection  
**field confirmation of water balance** is main focus

# REGIONAL AUDIT PROGRAMS

ENTITY	ABBREVIATION	PROGRAM START	LEVEL OF VALIDATION
California Urban Water Conservation Council	CA	2010	self-reported
Delaware River Basin Commission	DRBC	2012	self-reported
Georgia Department of Natural Resources	GA	2012	level 1
Tennessee Comptroller of the Treasury	TN	2013	self-reported
Texas Water Development Board	TX	2005	self-reported

## PROGRAMMATIC CONSIDERATIONS

amount of training, ongoing education, and technical support

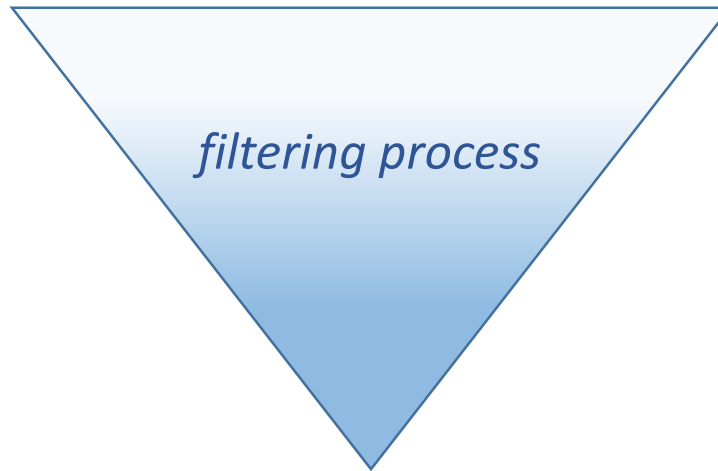
extent of validation

driving forces and purpose of auditing  
*(allocation of funds, quantification of losses, scarcity, etc.)*

# FILTERING PROCESS

*are self-reported audits realistic?*

all audit submissions



audits included for further  
analysis, statistics, totals

# FILTERING PROCESS

*are self-reported audits realistic?*

	METRIC	CRITERIA FOR EXCLUSION
<i>volumetric</i>	Infrastructure Leakage Index	< 1.0
		> 20.0
	Real Losses	< 0 ( <i>negative real losses</i> )
	cost of Non-Revenue Water	> 100% of system operating costs
	incomplete audit	key fields not filled out
<i>financial</i>	Customer Retail Cost	more than 2 orders of magnitude off of the data set's median
	Variable Production Cost	more than 2 orders of magnitude off of the data set's median

median values preferred over average values

cost figure calculations can vary amongst utilities  
*but costs still represent financial boundaries/economic potential*



# PERFORMANCE INDICATORS

*for the composite data set – most recent realistic audits from each region*

	PERFORMANCE INDICATOR	MEDIAN	AVERAGE	UNIT
<i>financial</i>	customer retail unit cost	\$4.67	\$8.33	\$ / 1,000 gal
	variable production cost	\$950.00	\$2,085.28	\$ / million gal
	NRW as % of operating cost	7.8%	10.2%	% of operating cost
<i>volumetric</i>	Apparent Losses	573	14.9	gal / serv conn / day
	Real Losses (serv conns)	39.9	51.8	gal / serv conn / day
	Real Losses (mains)	785.5	1,132.4	gal / mile of main / day
	Real Losses (pressure)	0.6	0.8	gal / serv conn / day / PSI
	ILI	2.48	3.12	(dimensionless)
	data validity score	73.1	71.7	points out of 100

data set is skewed – averages are far above medians

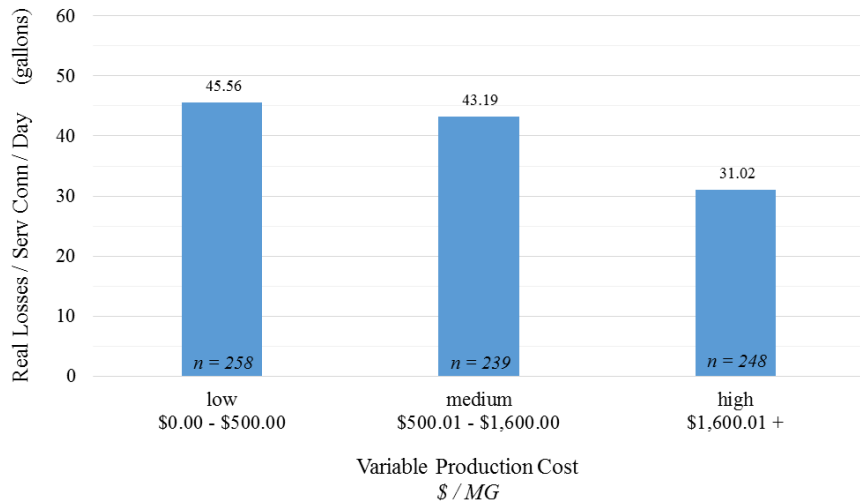
values indicate potential magnitudes – *not* absolute measurements

# KEY FINDINGS

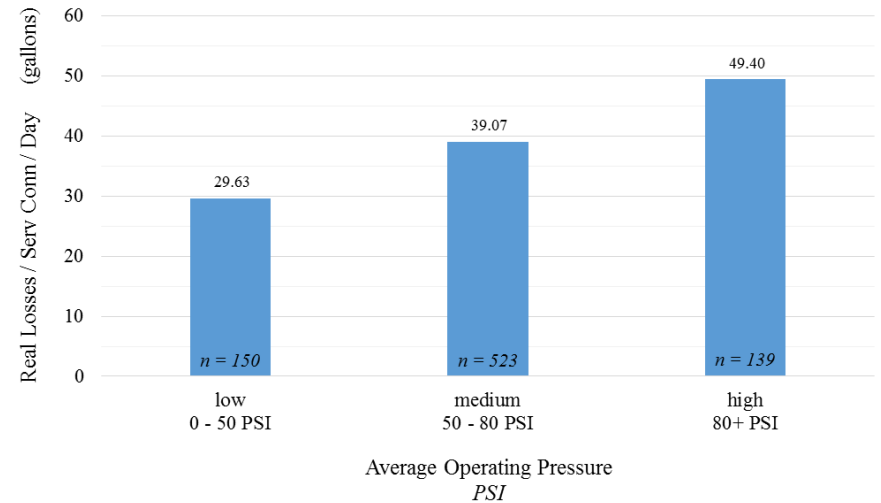
## WATER LOSS PERFORMANCE

- *more water imported ~ lower Real Losses*
- *higher operating pressure ~ higher Real Losses*
- *higher Variable Production Cost ~ lower Real Losses*

Variable Production Cost and Real Losses



Pressure and Real Losses



# KEY FINDINGS

## DATA VALIDITY

- many audits are unrealistic
  - *more training (ie GA, TN) produces fewer unrealistic audits*
  - *even level 1 validation doesn't fully eliminate unrealistic audits*

	CA	DRBC	GA	TN	TX
total audits	300	517	452	629	2,646
# of unrealistic audits	100	130	74	122	1,065
<i>% of unrealistic audits</i>	<i>33%</i>	<i>25%</i>	<i>16%</i>	<i>19%</i>	<i>40%</i>

- utilities with unrealistic audits tended to self-grade their data validity the highest
  - *unrealistic – 77.1 vs. realistic – 73.1*
  - *GA level 1 validation produced the lowest data validity grades*

# RECOMMENDATIONS

1. States establish annual audit reporting to inform water loss control activity and track water losses.
2. Provide training, education, and technical assistance to utility auditors. And keep providing support!
3. Avoid collecting only self-reported data – rigorously validate all audits so that data is *useful*.
4. Encourage openness – auditing is a chance to improve efficiency, not point fingers!

# OPPORTUNITY

Water loss control offers a significant opportunity for the **recovery of financial losses and water losses.**

the composite data set (1,290 audits) represents

**355,906 MG** in water losses

**\$556,752,484** in financial losses

averaged per utility, this is

**275.9 MG** in water losses

**\$431,591** in financial losses

*per year!*

# THANK YOU!



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