The Development of AWWA's 2020 Position on Non-revenue Water Key Performance Indicators

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Water Management Advisory Committee

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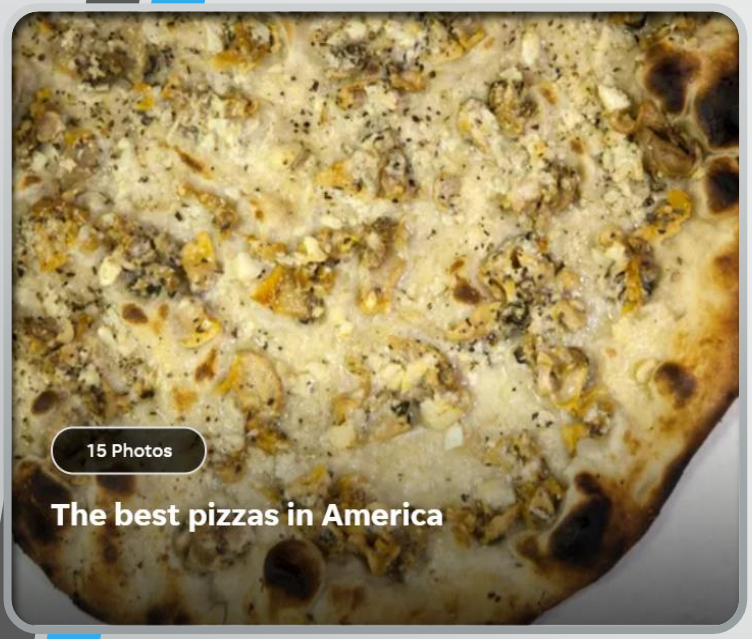
KUNKEL
WATER EFFICIENCY CONSULTING

Agenda

1. Issue of NRW Performance Indicators
2. AWWA NRW Performance Indicators Task Force (PITF)
3. Research findings: ***Assessment of Performance Indicators for Non-revenue Water Target Setting and Progress Tracking***
4. AWWA 2020 Committee Report on NRW Key Performance Indicators (KPI)

Performance Indicators are used throughout Society



1. Frank Pepe's, New Haven, Conn. (White Clam)

- **Business**: Unemployment Rate, Inflation Rate, Dow Jones Industrials Average
- **Health**: Blood pressure, Cholesterol, Body Mass Index
- **Sports**: batting average, home runs, touchdowns or goals scored, points per game
- **Weather**: High and low temperatures, rainfall, snowfall
- **Consumer**: 4-star or 5-star ratings for restaurants (**including Pizza!**), hotels, movies, and other services.
- User reviews on websites, surveys are also mechanisms to rate performance.

History of Water Loss Assessments

- 1957 AWWA Committee Report "Revenue Producing vs. Unaccounted-for Water"
- First known account of water loss tracking
- Subsequent decades saw state and regional water regulatory agencies adopting provisions that define:
  - Losses as varying definitions of "unaccounted-for" water (UFW)
  - Loss levels and targets expressed as an "unaccounted-for" percentage (UFW%), in some form of:

$$\frac{\text{Water Supplied minus Customer Consumption}}{\text{Water Supplied}}$$

Revenue-producing Versus Unaccounted-for Water

Committee Report

A report of Committee 4450 D—Revenue-producing Water, presented on May 13, 1957, at the Annual Conference, Atlantic City, N.J., by E. Shaw Cole (Chairman), Pres., Pitometer Assoc., New York, N.Y. Other members of the committee were: Ellwood H. Aldrich, E. Jerry Allen, David Auld, Egbert D. Case, Oswald A. Gierlich, Dewey W. Johnson, Arthur P. Kuranz, Howard W. Niemeyer, W. K. Van Zandt, and Howard R. Wright.

THE increase in the demand for water due to improved living standards, population growth, and industrial expansion is rapidly approaching the limit of the great natural resources. Most communities are finding it increasingly difficult and expensive to enlarge their sources of supply and plant facilities, so that the incentive to conserve their existing supply is greater than ever.

The cost of an additional supply is frequently more expensive than the original construction because of the need to go a greater distance from the community or to develop a new source which has less yield per invested dollar or simply because of inflation. Ground water is being depleted, and water tables are being lowered. The least expensive supplies were developed initially; but even without considering the steady rise in construction costs, future supplies will be almost certain to cost more than the existing ones.

Conservation is, therefore, a fundamental part of water works operation in an established community, due to the direct money savings in operation and the longer range savings from deferred capital costs for plant expansion.

Direct savings can be made in the cost of production by reducing the amount of chemicals or power consumed, or, if the water supply is purchased, the saving is in dollars paid to the wholesaler. Deferment of the need for plant expansion saves capital expenditures, and is thus another type of saving.

Transmission mains and distribution systems need to be expanded or reinforced when their designed capacity is exceeded, so as to maintain adequate pressures and a satisfactory reserve capacity. Reservoirs, standpipes, and elevated tanks likewise may need to be expanded as consumption increases.

This report is intended to aid the water works industry in its efforts to evaluate and improve conservation practices. It furnishes the operator of the water works plant complete information on the items which must be considered in accounting for the water supplied to the distribution system. If a proper analysis is made, he then will be in a position to determine whether his plant is being operated at maximum efficiency; or if not, what steps he should take to improve conditions.

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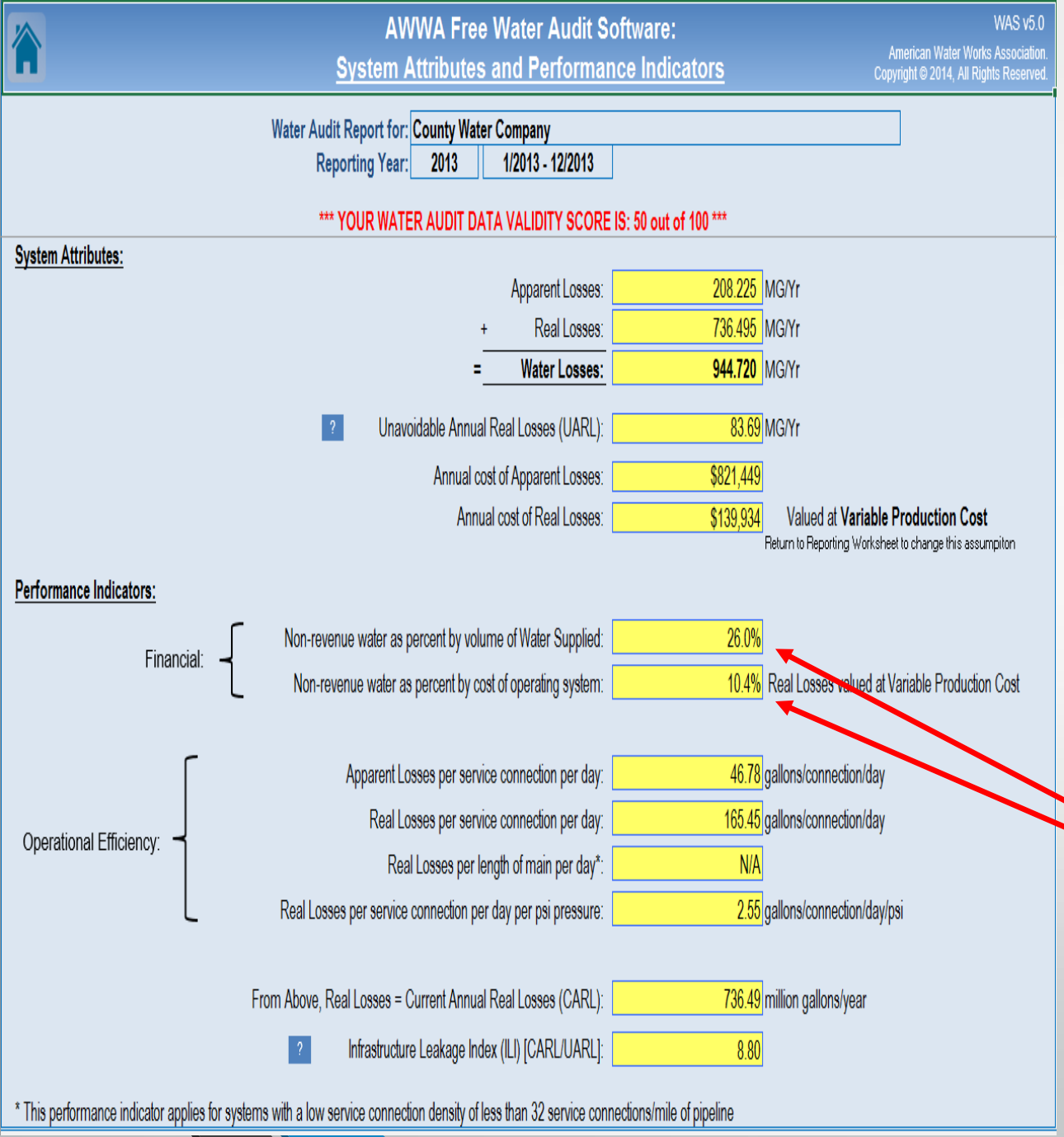
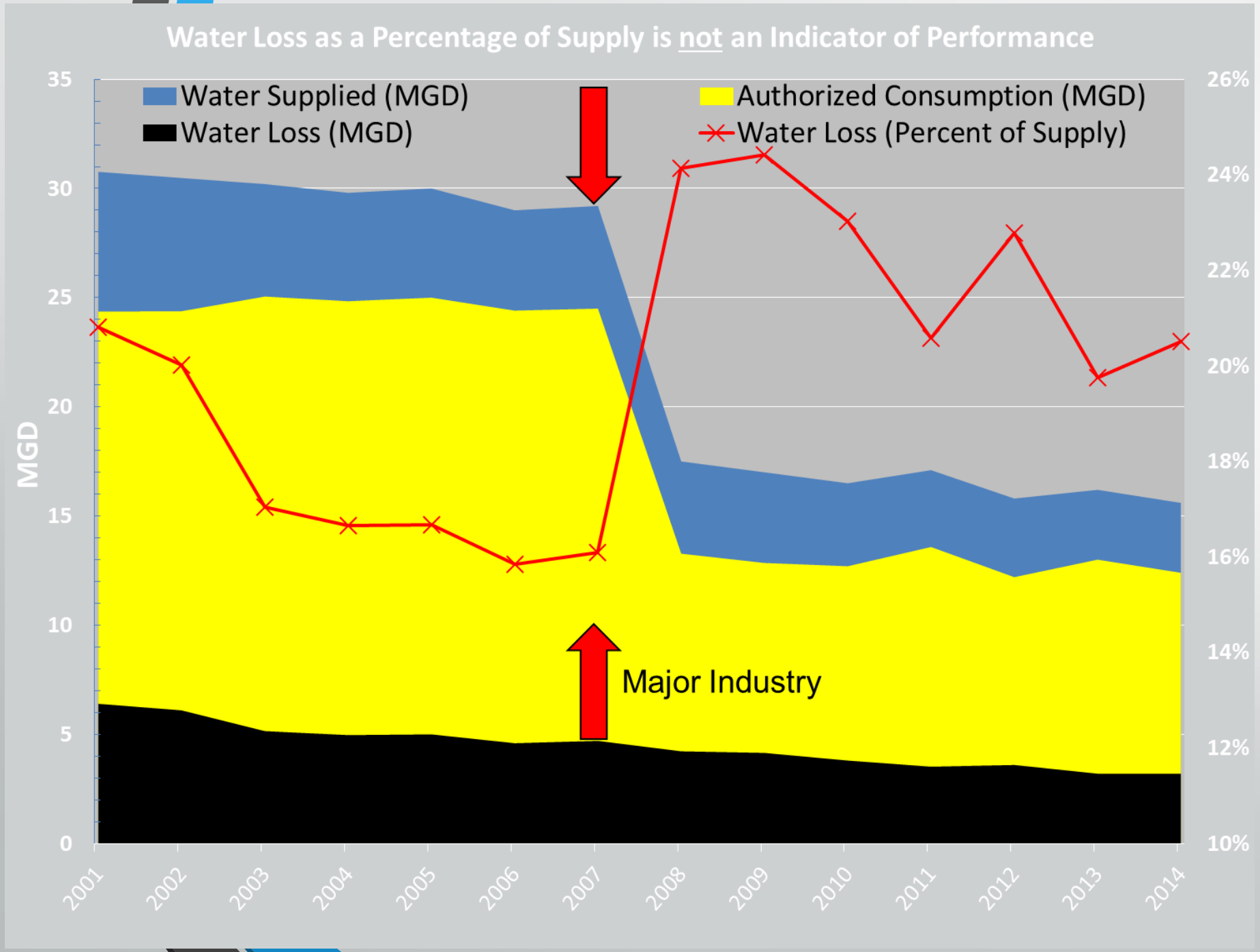
Source: AWWA



Flaws of "unaccounted-for" percentage

- The UFW% is flawed because it:
  - Is mathematically skewed by varying levels of customer consumption
  - Does not reveal volumes of real (physical) losses and apparent (customer) losses
  - Does not include the costs of loss control activities
  - Rarely succeeds in motivating verifiable water loss reductions

Volumetric and Financial percentage indicators still exist in the AWWA Free Water Audit Software, current version 5.0 – will <u>not</u> be in version 6.0 (2020)



Skewed UFW%

An Example:

Consider a large change in customer consumption due to a major water user (industry) halting operations

The UFW% increases dramatically, but….

Water losses by volume continue to drop!

Thus, the UFW% misrepresents the water loss reduction that occurred

Volumetric Percentage Indicators

"For every complex problem, there is an answer that is clear, simple, and wrong."

H.L. Mencken

20th Century American Journalist

Source: Wikiquote

Unfortunately, many water regulatory agencies still employ the UFW% and regard it as:

- Simple to employ and track
- Straightforward to use to set targets (despite a history of inability to motivate measurable loss reductions in water utilities)

*AWWA's 2020 Position advocates that regulatory agencies move away from percentages and focus on **Volume**, **Value**, and **Validity** of water audit data*

AWWA NRW Performance Indicators Task Force (PITF)

- Functioned 2015 - 2019
- Goals
  - Define a defensible position for discontinuing support for percentage indicators
  - Affirm an updated AWWA WLCC position regarding NRW KPIs: existing and new
  - Give general guidance on the use of recommended KPIs for water utilities, regulators, and other industry stakeholders

AWWA NRW PITF Members

- George Kunkel, Kunkel Water Efficiency Consulting, chair
- Andrew Chastain-Howley, Black & Veatch
- Steve Cavanaugh, Cavanaugh
- Steve Davis, Metering Technology Consultants
- Kevin Hickerson, Consolidated Utility District, Murfreesboro, TN
- Maureen Hodgins, Water Research Foundation
- Will Jernigan, Cavanaugh
- Mathieu Laneuville, Province of Quebec, CA
- Chris Leauber, W/WW Authority of Wilson County, TN
- Bruce Macler, US EPA / California State Water Resources Control Board
- Sofia Marcus, Los Angeles Dept of Water & Power
- David Sayers, Black & Veatch
- Brian Skeens, Jacobs
- Dan Strub, City of Austin, TX (Water Loss Control Committee Chair)
- Reinhard Sturm, Water Systems Optimization
- Gary Trachtman, Arcadis
- Alan Wyatt, Independent Consultant

AWWA PITF Deliverables

- **Research: AWWA TEC-funded Project/Report**
  - ***Assessment of Performance Indicators for Nonrevenue Water Target Setting and Progress Tracking***
  - Evaluated technical rigor of performance indicators – gave technical basis for PITF decisions
  - Report available for free download at:

  https://www.awwa.org/Resources-Tools/Resource-Topics/Water-Loss-Control

- **Water Loss Control Committee Report (*Journal AWWA*)**
  - State the new position on NRW KPIs and rationale
  - Publish in *Journal AWWA*

- **Outreach Package**
  - Public relations instruments to convey the messages around KPIs to industry stakeholders

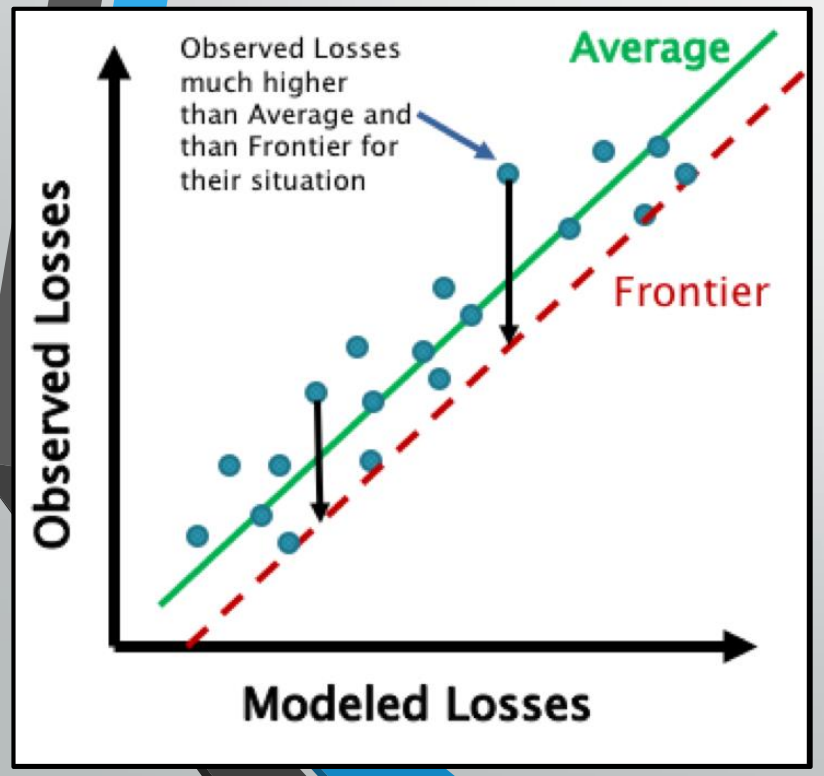
AWWA PITF Recommended KPIs should be:

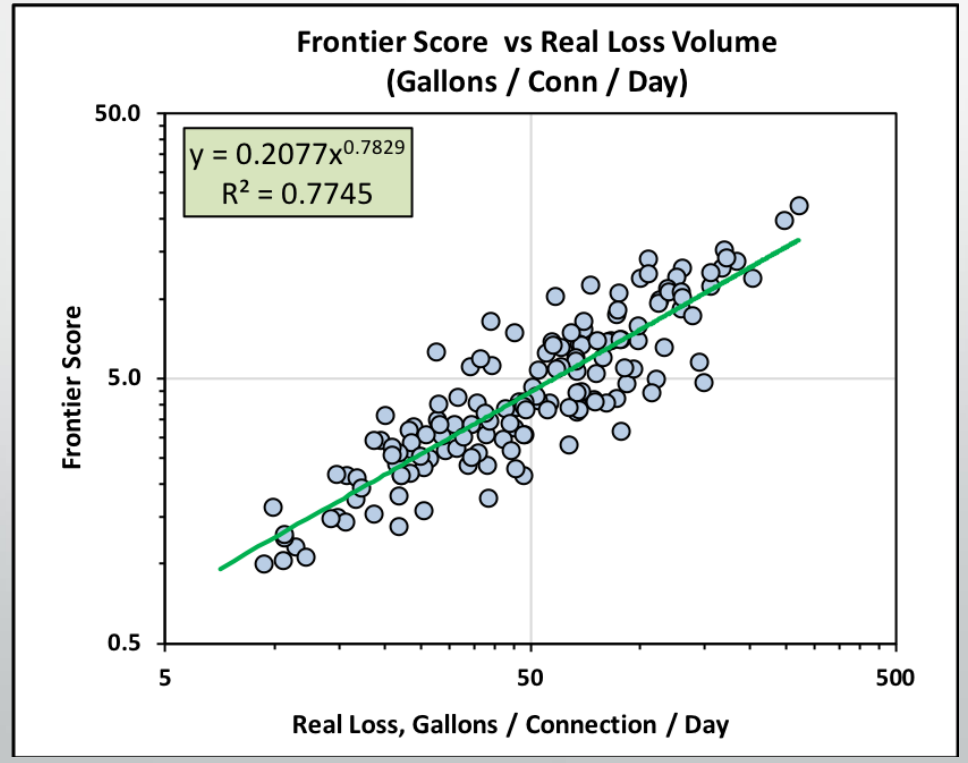
- **Technically rigorous** – reflecting field observations and theoretical principles, without significant bias or influence from situational parameters
- **Easily understood** - by a wide range of stakeholders; including water utilities, regulatory agencies, customers, elected officials, and the media
- **Suitable to use for target-setting & progress monitoring** of loss reduction activities: i.e., they must be ***actionable***
- **Suitable for the state of readiness of North American water utilities & regulatory agencies**
- **Note:**
  - not every KPI is expected to meet each of the above
  - stakeholders should relinquish the dated notion that water loss can be assessed by only "one" KPI
  - many water utilities are new to water loss control; KPIs should allow them to evolve
  - regulatory agencies need a straight-forward and efficient means for water audit data collection and loss control monitoring that can be readily implemented

AWWA TEC-funded research project on NRW KPIs

Assessment of Performance Indicators for Non-revenue Water Target Setting and Progress Tracking

- Primary method to assess technical rigor of KPIs: **Frontier Analysis**
- Compares modeled water losses (using regression analysis) to observed water losses to generate an accurate indicator of utility performance (Frontier Score)
- Candidate indicators are compared to the Frontier Score to assess technical rigor

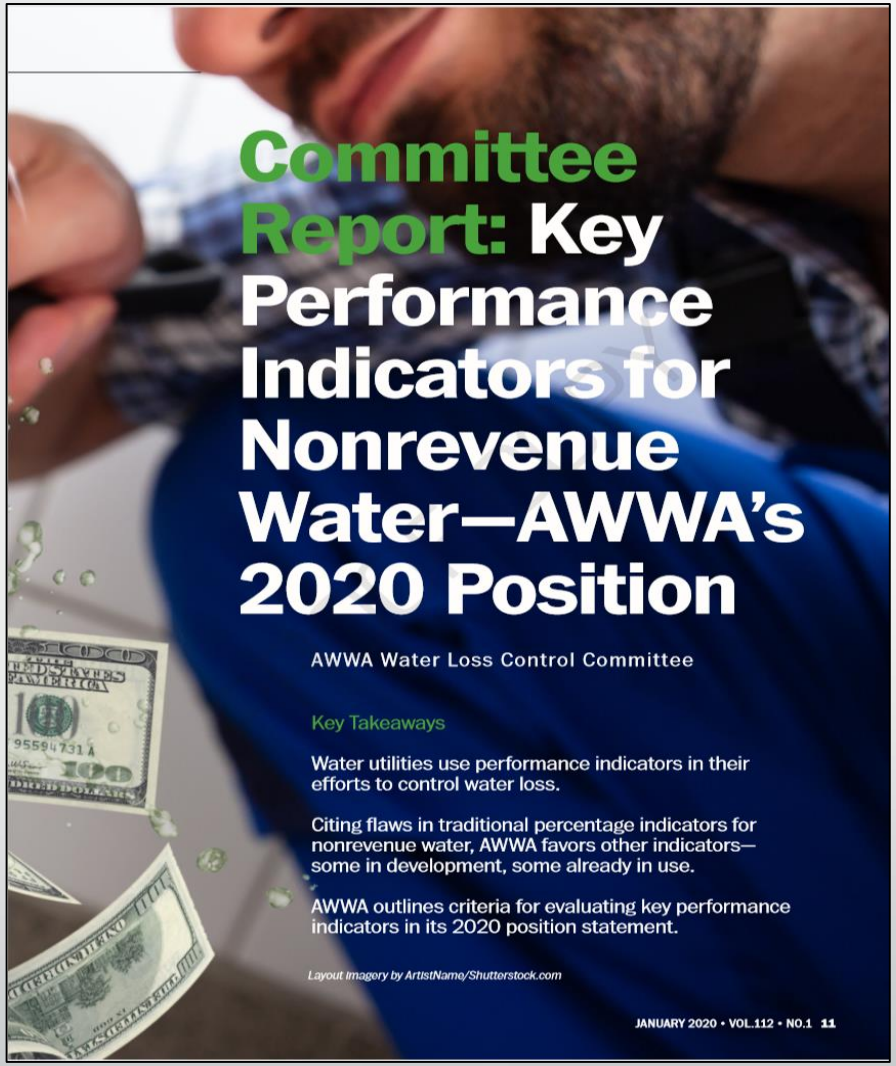




Example: Georgia 2016

Real Loss Volume, in Gallons per Connection per Day correlates closely with the Frontier Score, so that indicator is considered technically rigorous

AWWA's 2020 Position on NRW KPIs



AWWA Water Loss Control Committee Report – January 2020

PITF Recommended Position on NRW KPIs

- **AWWA no longer supports NRW percentage KPI's**, including volumetric indicators such as "unaccounted-for" percentages or financial percentages.
- **AWWA supports the use of the *Loss Cost Rate* indicator**, a new KPI expressed in **$/service connection/year**, with one expression for apparent losses and one for real (leakage) losses.
- **AWWA supports the use of the *Normalized Water Losses* indicator**, a new KPI expressed in **volume/service connection/day**.

The *Loss Cost Rate* - a new financial indicator

- Marries the rate of loss (real and apparent) in gallons/service connection/day

  with

- The unit cost of the loss: retail for apparent loss, variable production for real loss
- Expressed in **value / service connection/year**
- Measures the negative impact of losses to a utility's financial bottom line.
- Applications:
  - Strong NRW assessment value at the utility level, reveals impact of changing loss and cost values yearly
  - Good public relations value, by expressing the impact of costs on a "per customer" level
  - Useful for regulatory agencies when employed as an "out-of-bounds" KPI to flag utilities with very high values.
  - However, it is <u>not</u> appropriate to employ the LCR to set optimally low loss targets in water utilities.

The *Normalized Water Losses* Perf Indicator

- Expressed in **gallons/service connection/day**
- Water Losses = apparent loss + real loss
- Applications:
  - High-level KPI: enables reliable trending of a utility's year-to-year losses
  - Assists the data validation process; can help explain abrupt changes in real or apparent losses and is a buffer against inordinate uncertainty in either of these volumes
  - Don't use NWL as a "stand-alone" KPI, but in combination with the apparent and real loss normalized indicators. Alone, NWL is not actionable because its components include water that is *physically lost* (real losses) and water that is *not physically lost* but under-recorded (apparent losses)
  - **NWL should <u>not</u> be used for target-setting**. Instead, targets can be set using the Normalized Apparent and Real Loss indicators individually

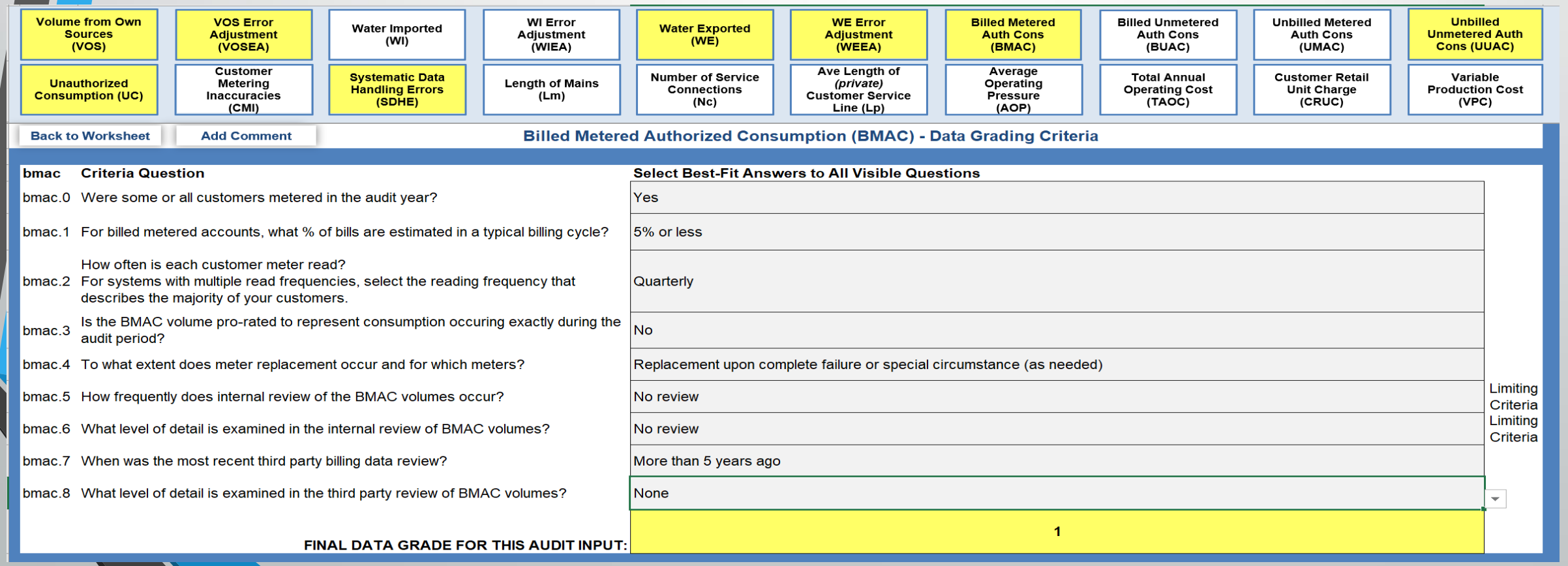
PITF – 2020 Position on NRW KPIs

AWWA Recommended Water Loss Performance Indicators – Fit for Multiple Purposes and Users									
Type	**Indicator**	**Description**	**Suitable Purposes**					**Limitations Needing Further Data Collection and Assessment**	**Principal Users**
			Assess-ment	Bench-marking	Target-Setting	Plan-ning	Track-ing		
Volume	Apparent losses (vol / conn / day)[1]	Strong and understandable indicator for multiple users	✓	✓	✓	✓	✓		Utilities Regulators
	Real losses (vol / conn / day)	Strong and understandable indicator for multiple users	✓	✓	✓	✓	✓		Utilities, Regulators, Policy Makers
	Real losses (vol / pipeline length / day)	Strong and understandable indicator for use by utilities with low connection density	✓	✓	✓	✓	✓	Data collection and assessment of the level of "low" connection density	Utilities, Regulators, Policy Makers
	Total Water losses (vol / conn / day)	Strong and understandable indicator; suitable for high-level performance measurement	✓	✓			✓		Utilities, Regulators, Policy Makers, Customers
	Real losses by pressure (vol / conn / day / pressure unit)	Robust but specialized indicator; technical rigor may be influenced by network materials.	✓	✓		✓	✓	Data collection and assessment of the use and applicable context(s) in NA	Utilities
	Infrastructure Leakage Index (ILI)	Robust but specialized ratio indicator, which can be influenced by pressure and connection density.	✓	✓			✓	Data collection and assessment for guidance on wide use in NA	Utilities
Value	Apparent Loss Cost Rate (value / conn / year)	Indicators with sufficient technical rigor. Provide the unit financial value of each type of loss, which is very useful for planning and assessment of cost efficiency of water loss reduction and control interventions and programs.	✓			✓	✓	Data collection and assessment on AWWA indicators or contextual parameters to use in conjunction with Loss Cost Rates	Utilities, Regulators, Customers
	Real Loss Cost Rate (value / conn / year)		✓			✓	✓		Utilities, Regulators, Customers
Validity	Data Validity Tier (DVT)[2]	Strong indicator of water loss audit data quality, if data has been validated. Tier provides guidance on priority areas of activity.	✓	✓		✓	✓		Regulators, Utilities

Notes: 1. Blue shading highlights real losses, green shading highlights apparent losses.
2. Data Validity Tier is a band-type grouping of Data Validity Scores: Tier I: DVS=0-25; Tier II: DVS=26-50; Tier III: DVS=51-70; Tier IV: DVS=71-90; Tier V: DVS=91-100

AWWA Free Water Audit Software – Version 6.0 Release targeted for mid-2020

- Will **not** include percentage indicators
- Will include an improved Data Grading capability



Volume from Own Sources (VOS)	VOS Error Adjustment (VOSEA)	Water Imported (WI)	WI Error Adjustment (WIEA)	Water Exported (WE)	WE Error Adjustment (WEEA)	Billed Metered Auth Cons (BMAC)	Billed Unmetered Auth Cons (BUAC)	Unbilled Metered Auth Cons (UMAC)	Unbilled Unmetered Auth Cons (UUAC)
Unauthorized Consumption (UC)	Customer Metering Inaccuracies (CMI)	Systematic Data Handling Errors (SDHE)	Length of Mains (Lm)	Number of Service Connections (Nc)	Ave Length of *(private)* Customer Service Line (Lp)	Average Operating Pressure (AOP)	Total Annual Operating Cost (TAOC)	Customer Retail Unit Charge (CRUC)	Variable Production Cost (VPC)

Back to Worksheet | Add Comment

Billed Metered Authorized Consumption (BMAC) - Data Grading Criteria

bmac	Criteria Question	Select Best-Fit Answers to All Visible Questions	
bmac.0	Were some or all customers metered in the audit year?	Yes	
bmac.1	For billed metered accounts, what % of bills are estimated in a typical billing cycle?	5% or less	
bmac.2	How often is each customer meter read? For systems with multiple read frequencies, select the reading frequency that describes the majority of your customers.	Quarterly	
bmac.3	Is the BMAC volume pro-rated to represent consumption occuring exactly during the audit period?	No	
bmac.4	To what extent does meter replacement occur and for which meters?	Replacement upon complete failure or special circumstance (as needed)	
bmac.5	How frequently does internal review of the BMAC volumes occur?	No review	Limiting Criteria
bmac.6	What level of detail is examined in the internal review of BMAC volumes?	No review	Limiting Criteria
bmac.7	When was the most recent third party billing data review?	More than 5 years ago	
bmac.8	What level of detail is examined in the third party review of BMAC volumes?	None	
	FINAL DATA GRADE FOR THIS AUDIT INPUT:	1	

Guidance on the use of NRW Perf Indicators

- Water Utilities
  - Benefits: managing resources well, equitable water rates, revenue recovery, operational efficiency
- Regulatory Agencies
  - Water audit data collection: an efficient data collection process is essential
    - ***Training and Level 1 Validation are strongly recommended for a robust program***
  - Regulatory mission: water resources, financial, energy, etc. The mission sets the focus.
  - Loss Reduction target-setting: fine after utilities have mature, trustworthy data. Consider keying on utilities with "out-of-bounds" performance, rather than seeking "optimization" of utilities now
- Policy Makers: sustaining water resources, affordability, energy efficiency
- Customers: quoting losses on a "per customer" basis, equitable water rates

Water Audit Data Quality & Validation Levels

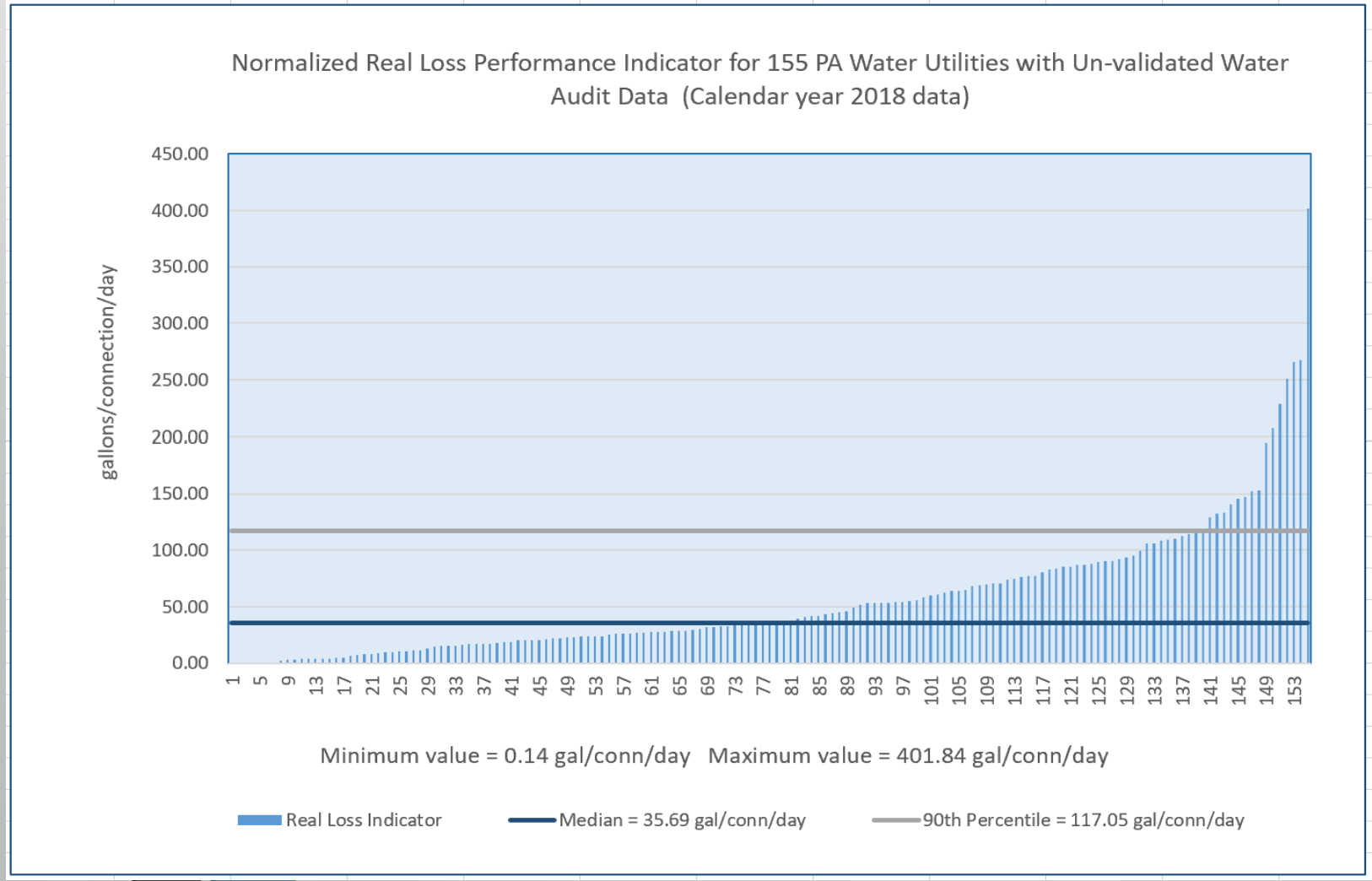
- The Data Validation Process includes five levels of data quality which are defined below:
  - **Self-reported** – data has been collected, but not been subject to any in-depth review
  - **Filtered** - have been checked for technical plausibility by employing a screening criteria, such as ILI < 1.0 or > 20.0
- Data validation conducts in-depth review of the data sources and practices of the water utility
  - **Level 1 validated** - focuses primarily on the suitability of the data gradings assigned to the various inputs, with scrutiny on the data inputs to flag gross or egregious errors
  - **level 2 validated** - in-depth investigation of various input data and information of one or more components of the water audit. This is still largely a desk-top activity.
  - **level 3 validated** - Bottom-up review and investigation into a single component or sub-component that collects new or additional data at a field/source level, and provides detailed analysis

DRBC's Water Audit Process

- Annual requirement for PWSs to report on calendar year
- Reminder email to docket holders, engineers, and operators in Jan/Feb – water audits due March 31
- Electronic delivery to water.audit@drbc.gov
- Receive, track, and process water audit submissions annually
- QAQC/Validation – somewhere between Filtered – Level 1 Validated
  - Check that data validity score is generated (usually due to missing grades)
  - Check for gross unit errors on reported volumes

AWWA Water Audits in Pennsylvania

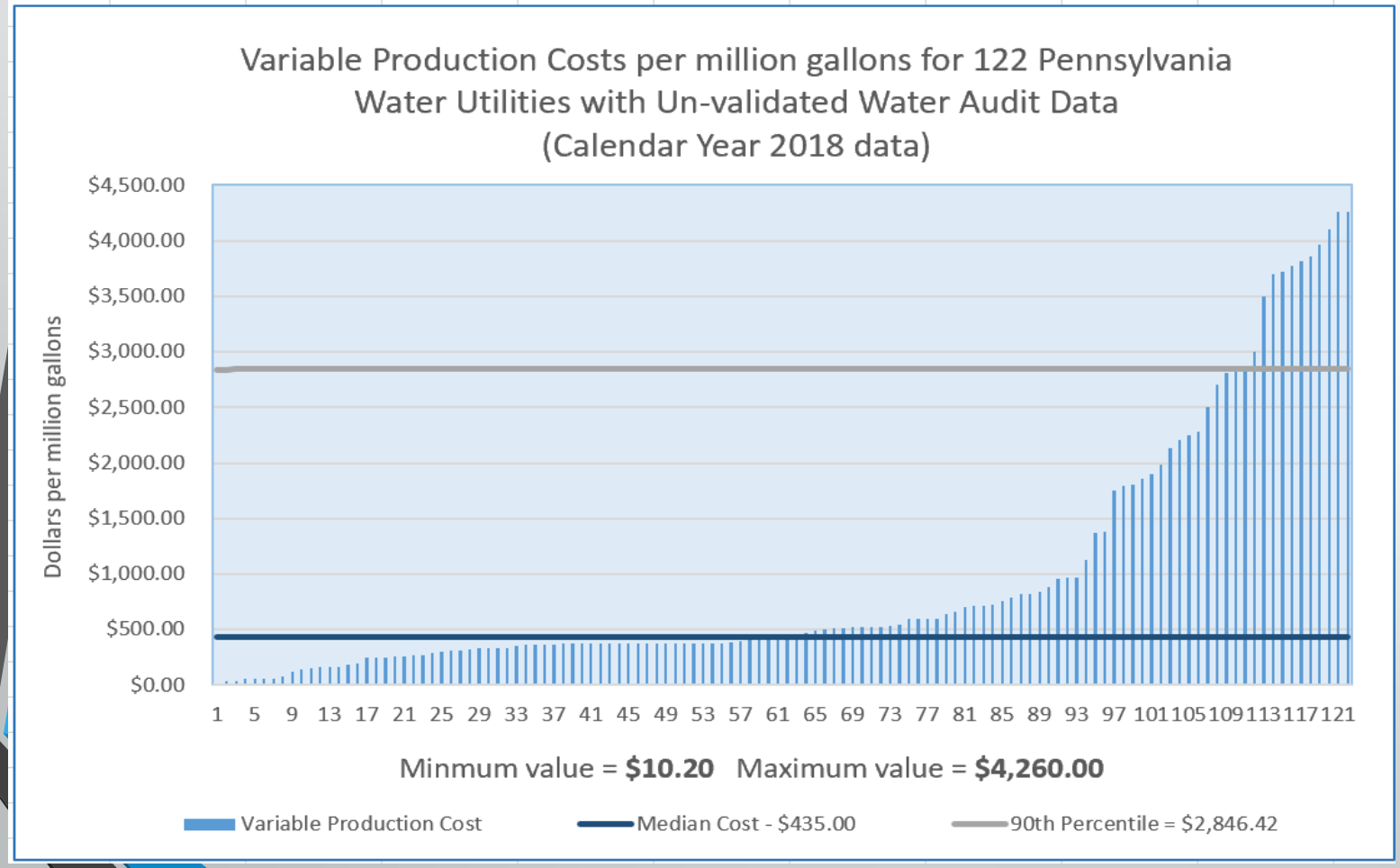
DRBC, PA PUC & volunteer utility data



- Real (leakage) losses – median value 35.69 gallons/service connection/day
- USA dataset (CA, GA) median value 32.47 gallons/service connection/day

AWWA Water Audits in Pennsylvania

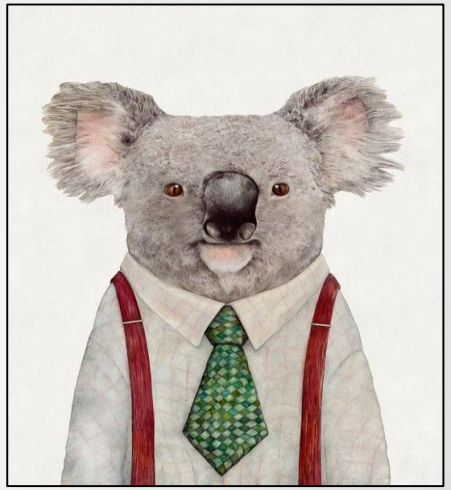
DRBC, PA PUC & volunteer utility data



- Variable Production Costs (applied to leakage – median value $435.00 /million gallons
- USA dataset (CA, GA) median value $683.80 /million gallons
- High values at right side of chart are largely imported water systems

Progressive US State Agencies: State of Georgia

- AWWA Water Audit required by 2009 legislation
- Training & Level 1 data validation, qualified water loss auditors (QWLA)
- Piloting several loss reduction technologies
- Metro Atlanta area has set leakage reduction targets



QWLA

Metro Atlanta, GA region
Metropolitan North Georgia Water Planning District

Water Resource Management Plan - Leakage Reduction Targets (issued June 2017)

- **Water utilities with real losses greater than 60 gallons/connection/day (2013 data) must adopt a 2025 goal to reduce to less than 60 gallons/connection/day and demonstrate progress in the interim years toward meeting this goal.**
- **Water utilities with real losses between 35 and 60 gallons/connection/day (2013 data) must adopt a 2025 goal to reduce to less than 35 gallons/connection/day and demonstrate progress in the interim years toward meeting this goal**

Progressive US State Agencies: State of California

- AWWA Water Audit required by 2015 legislation motivated by drought
- Includes training & Level 1 data validation, Water Audit Validator (WAV) program
- State WR Control Board is currently working to set water loss standards
- Initial loss reduction steps likely by 2022, reductions in phases 2023-2035

California Governor Jerry Brown in 2015

California State Water Resources Control Board

California Water Code Section 10608.34 requires the State Water Board to develop water loss performance standards for urban retail water suppliers between January 2019 and July 2020. The State Water Board is required to evaluate the life-cycle cost of achieving these standards.

Information is available at:

https://www.waterboards.ca.gov/water_issues/programs/conservation_portal/water_loss_control.html

Also find information on the California Water Loss Collaborative

https://ca-nv-awwa.org/canv/CNS/Water_Loss/CNS/Partnership_for_Saving_Water/collaborative.aspx

Conclusion

- **Percentage indicators should be laid to rest – AWWA advocates against their use**
- **The PITF is recommending use of two new KPIs**
  - Loss Cost Rate
  - Normalized Water Losses
- **Upcoming Deliverables**
  - AWWA WLCC Committee Report (January 2020)
  - AWWA Free Water Audit Software v6.0 in 2020
  - M36, 5th Edition in 2022

Source: Daily Mail