Washington State Water Audit Pilot Results & the Future of Water Loss Tracking

Kate Gasner, WSO

Agenda

- Who's in the room?
- Setting the scene
- AWWA water audit methodology
- Water audit validation
- Washington pilot program
- Future water loss control in Washington

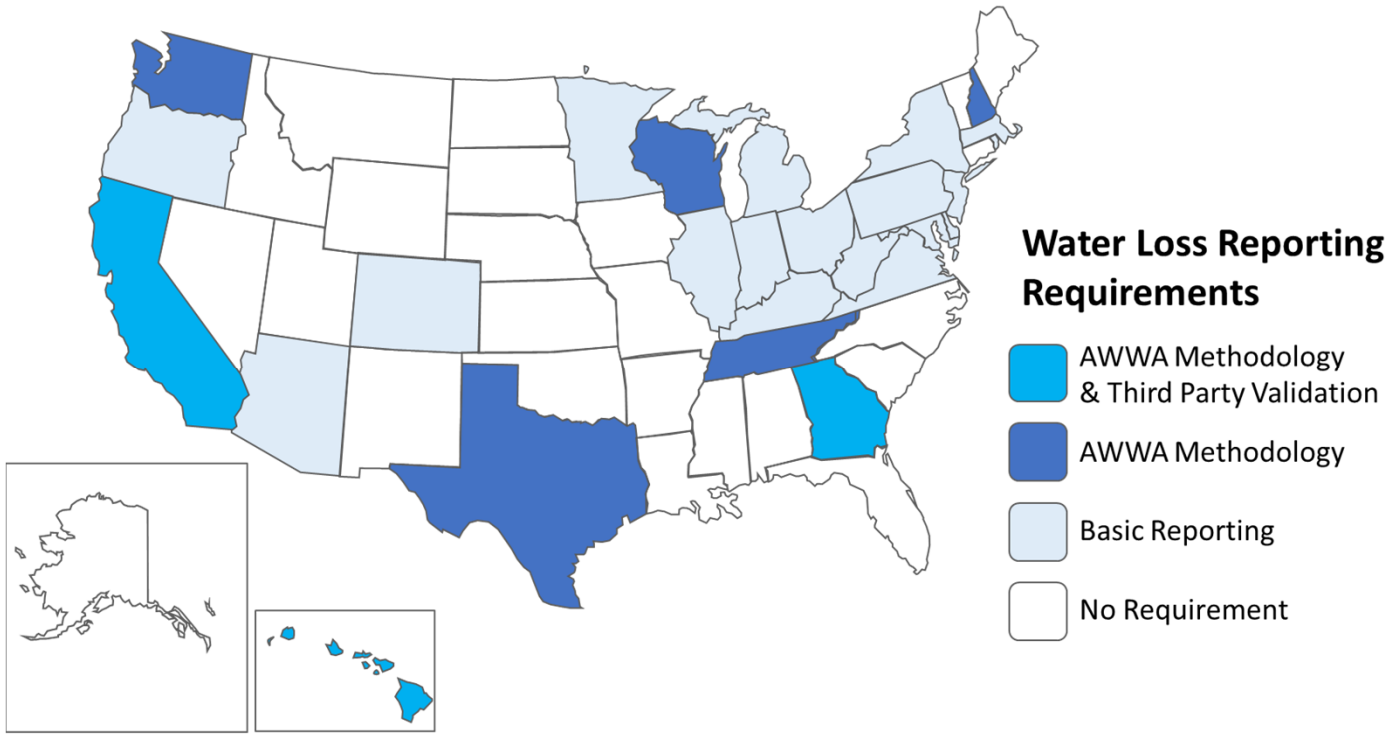
Today's Goals

1. **Learn AWWA water audit methodology**,
   especially as it applies to your system and Washington regulation

2. **Compare results**
   achieved through AWWA and other water loss estimation methodologies

3. **Discuss what next**
   how does WA incentivize improved data and water loss management

Water Loss Reporting in the US

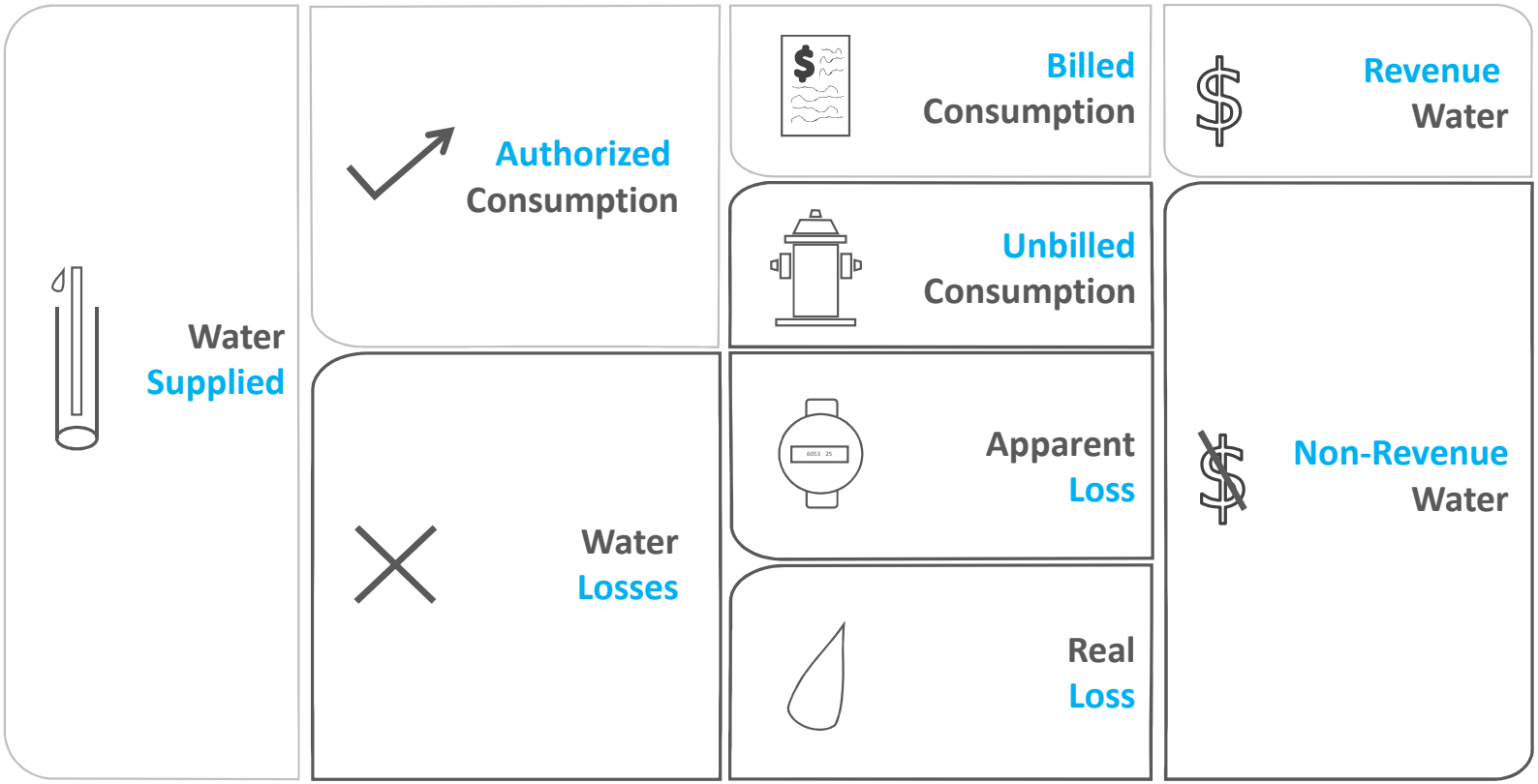


Water Audit

Goals:

- Estimate volumes and values of real loss and apparent loss
- Use a standardized methodology
- Consider the accuracy and quality of data sources
- Interpret performance with performance indicators

The Water Balance

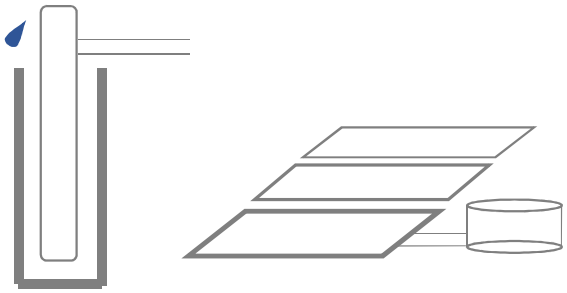


Water Supplied

<table>
<tr><td rowspan="6">Water Supplied
100</td><td rowspan="3">Authorized Consumption
90</td><td rowspan="2">Billed Authorized Consumption
80</td><td>Billed Metered Consumption
75</td><td rowspan="2">Revenue Water
80</td></tr>
<tr><td>Billed Unmetered Consumption
5</td></tr>
<tr><td rowspan="2">Unbilled Authorized Consumption
10</td><td>Unbilled Metered Consumption
8</td><td rowspan="5">Non-Revenue Water
20</td></tr>
<tr><td>Unbilled Unmetered Consumption
2</td></tr>
<tr><td rowspan="3">Water Losses
10</td><td rowspan="3">Apparent Losses
3</td><td>Unauthorized Consumption
1</td></tr>
<tr><td>Customer Metering Inaccuracies
1</td></tr>
<tr><td>Systematic Data Handling Errors
1</td></tr>
<tr><td colspan="2">Real Losses
7</td></tr>
</table>

Water Supplied – Volumes

Volume from Own Sources



Did we treat the water to potable standards?

Water Imported

Did we buy potable water someone else treated?

Did we import raw water from someone else?

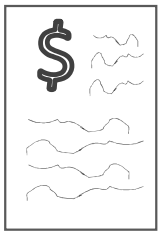
Water Exported

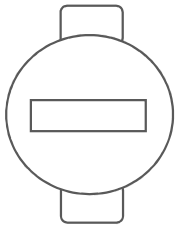
Is the export delivered from the distribution system or point of treatment?

Authorized Consumption

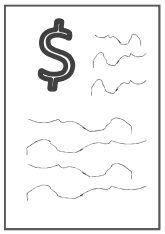
<table>
<tr><td rowspan="6">Water Supplied
100</td><td rowspan="3">Authorized Consumption
90</td><td rowspan="2">Billed Authorized Consumption
80</td><td>Billed Metered Consumption
75</td><td rowspan="2">Revenue Water
80</td></tr>
<tr><td>Billed Unmetered Consumption
5</td></tr>
<tr><td rowspan="2">Unbilled Authorized Consumption
10</td><td>Unbilled Metered Consumption
8</td><td rowspan="5">Non-Revenue Water
20</td></tr>
<tr><td>Unbilled Unmetered Consumption
2</td></tr>
<tr><td rowspan="3">Water Losses
10</td><td rowspan="2">Apparent Losses
3</td><td>Unauthorized Consumption
1</td></tr>
<tr><td>Customer Metering Inaccuracies
1</td></tr>
<tr><td colspan="2">Systematic Data Handling Errors
1</td></tr>
<tr><td colspan="3">Real Losses
7</td></tr>
</table>

Authorized Consumption

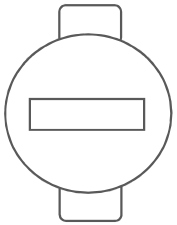




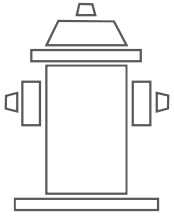
Billed Metered
Consumption



Billed Unmetered
Consumption



Unbilled Metered
Consumption



Unbilled Unmetered
Consumption

Authorized Consumption

District facility use

Tank overflow

Well water lubrication

Firefighting

Main breaks

Flat-rate condominiums

Parks department irrigation

Single-family indoor use

Billed?

Unbilled?

Metered?

Unmetered?

Billed Metered Authorized Consumption

A lot of data

Duplicates

Missing Data

Adjustments

Negative Reads

Zero Reads

Outliers

One summary number

Water Loss

<table>
<tr><td rowspan="6">Water Supplied
100</td><td rowspan="3">Authorized Consumption
90</td><td rowspan="2">Billed Authorized Consumption
80</td><td>Billed Metered Consumption
75</td><td rowspan="2">Revenue Water
80</td></tr>
<tr><td>Billed Unmetered Consumption
5</td></tr>
<tr><td rowspan="2">Unbilled Authorized Consumption
10</td><td>Unbilled Metered Consumption
8</td><td rowspan="5">Non-Revenue Water
20</td></tr>
<tr><td>Unbilled Unmetered Consumption
2</td></tr>
<tr><td rowspan="3">Water Losses
10</td><td rowspan="2">Apparent Losses
3</td><td>Unauthorized Consumption
1</td></tr>
<tr><td>Customer Metering Inaccuracies
1</td></tr>
<tr><td colspan="2">Systematic Data Handling Errors
1</td></tr>
<tr><td colspan="3">Real Losses
7</td></tr>
</table>

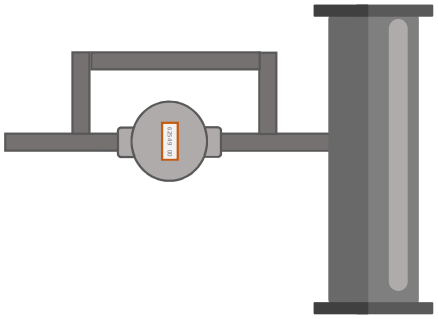
Water Loss

Apparent Losses

vs.

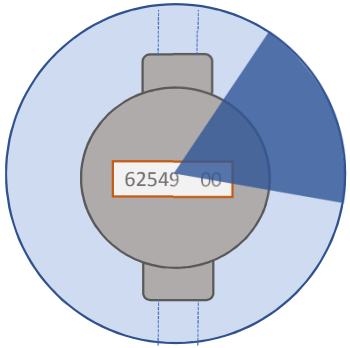
Real Losses

Apparent Loss – Categories



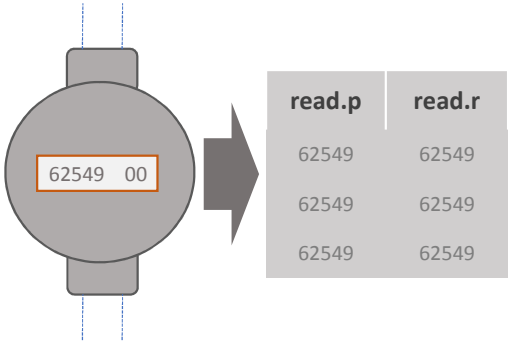
Unauthorized Consumption

Theft!



Metering Inaccuracy

Customer meter under registration

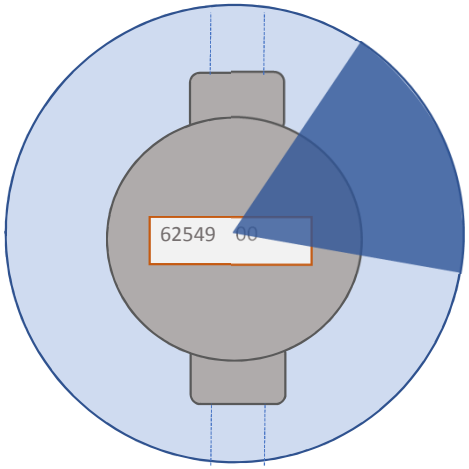


Data Handling Errors

Reporting or other clerical errors during the handling of meter reading data

Apparent Loss – Value

90% Customer Meter Accuracy

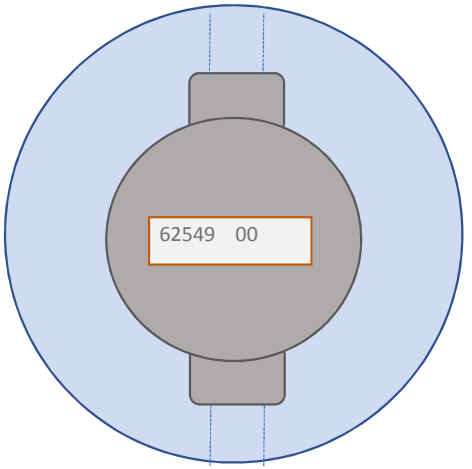


Service Charge: $20

Volume of Use: 9 CCF

Variable Charge: $3.00 x 9 =
$27.00

100% Customer Meter Accuracy



Service Charge: $20

Volume of Use: 10 CCF

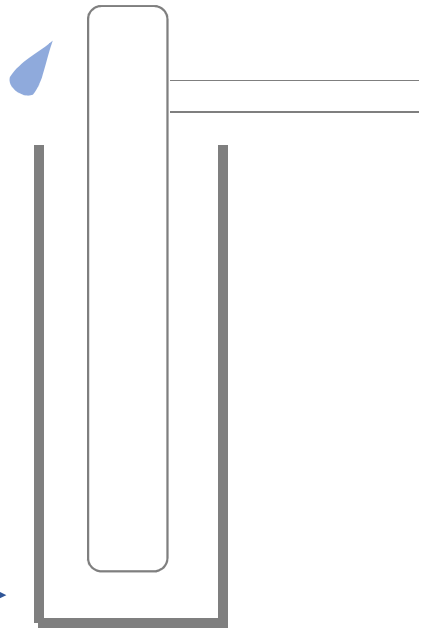
Variable Charge: $3.00 x 10 =
$30.00

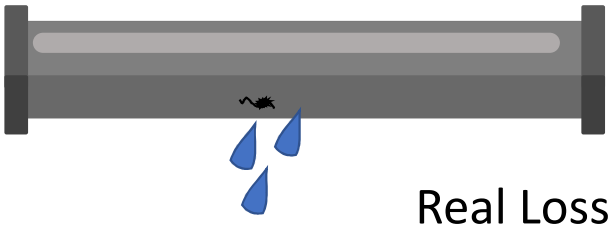
Real Loss – Value

Purchase Costs

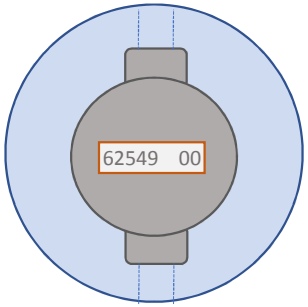
Electricity for Pumping

Chemicals





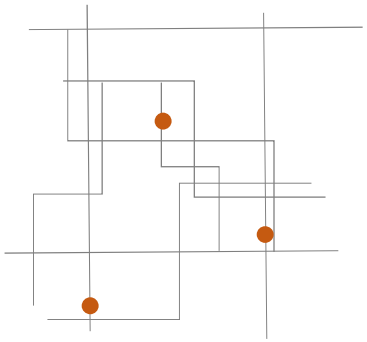
Real Loss



Authorized Consumption

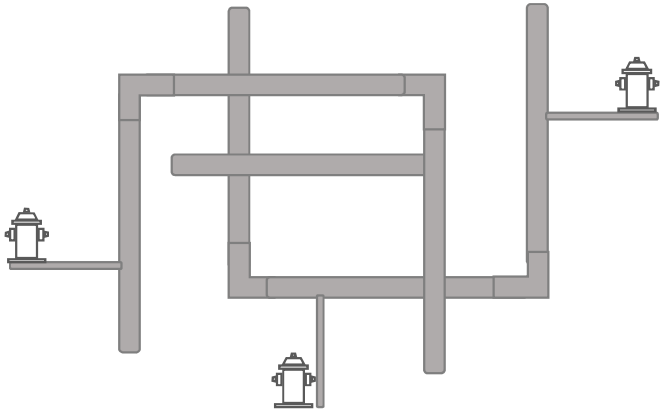
System Infrastructure Data

System Average Pressure



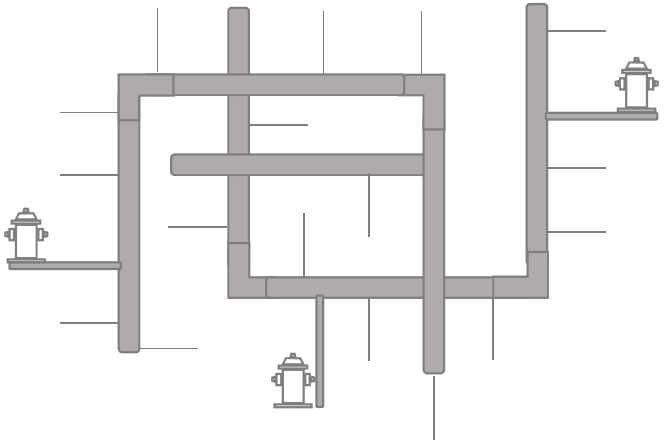
The average pressure across the full potable distribution system.

Miles of Mains



The miles of mains including fire hydrant laterals.

Count of Service Connections



The number of active and inactive service connections.

Cost Data

Total Annual Operating Cost – everything you spend in a year

O&M budget

capital improvements

Customer Retail Unit Cost – weighted average sales commodity rate

no fixed charges

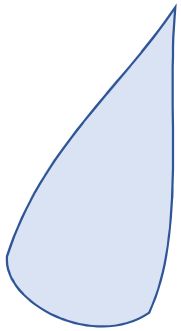
consider all classes and tiers

Variable Production Cost – value of leakage

cost to acquire, treat, and distribute water

any other costs of leakage?

Performance Indicators

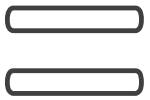


Volumes

Real & Apparent Losses
Real & Apparent Losses per Connection per Day
Infrastructure Leakage Index

Values

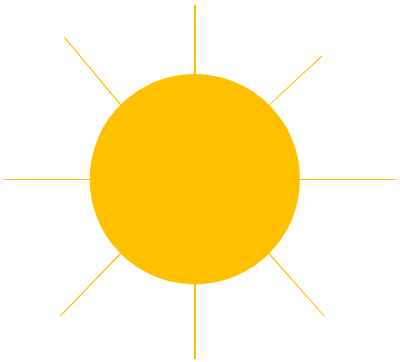
Cost of Real Losses
Cost of Apparent Losses



Validity

Data Validity Grades & Score

No Percentages!



Year 1

Water Supplied: 1000

Authorized Consumption: 900

Water Loss: **100**

Water Loss: **10%**

Year 2

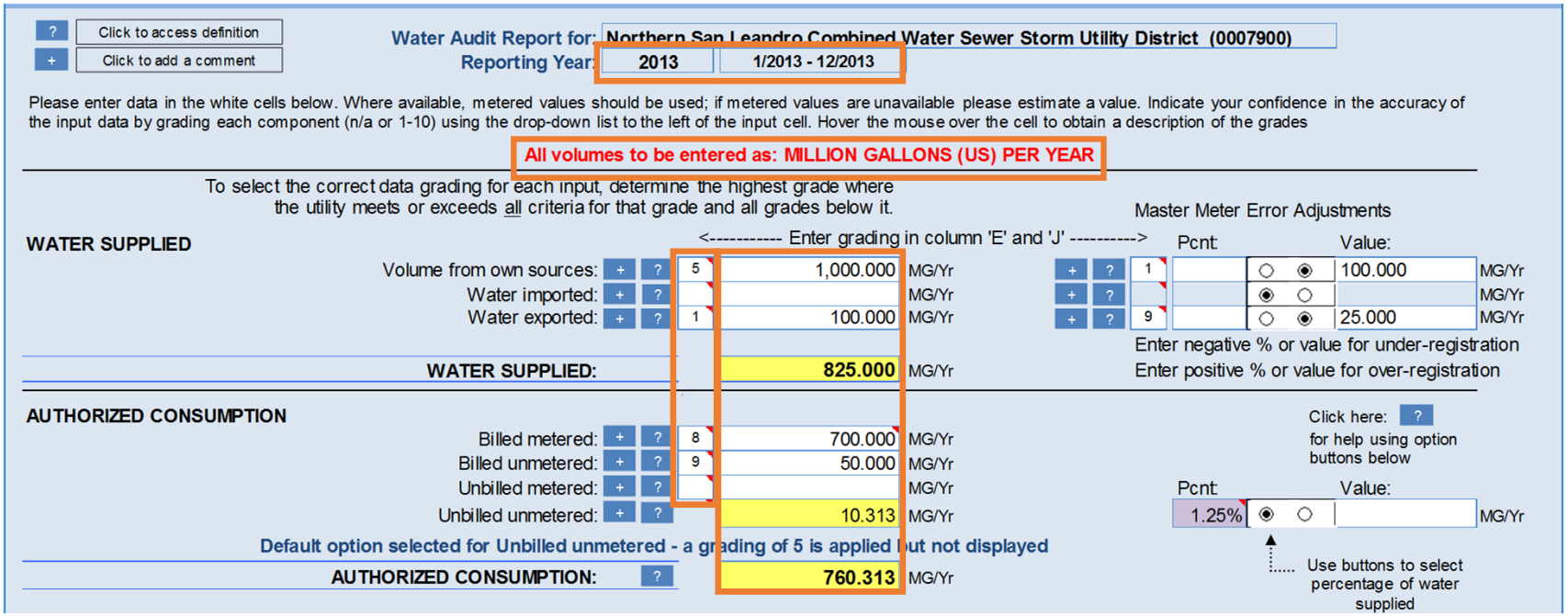
Water Supplied: 800

Authorized Consumption: 700

Water Loss: **100**

Water Loss: **14%**

AWWA Free Water Audit Software



? Click to access definition
+ Click to add a comment

Water Audit Report for: Northern San Leandro Combined Water Sewer Storm Utility District (0007900)
Reporting Year: 2013 1/2013 - 12/2013

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

To select the correct data grading for each input, determine the highest grade where the utility meets or exceeds all criteria for that grade and all grades below it.

<---------- Enter grading in column 'E' and 'J' ---------->

Master Meter Error Adjustments

					Pcnt:	Value:	
WATER SUPPLIED							
Volume from own sources:	5	1,000.000	MG/Yr	1		100.000	MG/Yr
Water imported:			MG/Yr				MG/Yr
Water exported:	1	100.000	MG/Yr	9		25.000	MG/Yr
WATER SUPPLIED:		825.000	MG/Yr				

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

				Pcnt:	Value:	
AUTHORIZED CONSUMPTION						
Billed metered:	8	700.000	MG/Yr			
Billed unmetered:	9	50.000	MG/Yr			
Unbilled metered:			MG/Yr			
Unbilled unmetered:		10.313	MG/Yr	1.25%		MG/Yr
AUTHORIZED CONSUMPTION:		760.313	MG/Yr			

Default option selected for Unbilled unmetered - a grading of 5 is applied but not displayed

Click here: ? for help using option buttons below

Use buttons to select percentage of water supplied

AWWA Free Water Audit Software

*** YOUR WATER AUDIT DATA VALIDITY SCORE IS: 47 out of 100 ***

Performance Indicators:

Financial:	Non-revenue water as percent by volume of Water Supplied:	11.8%	
	Non-revenue water as percent by cost of operating system:	1.9%	Real Losses valued at Variable Productio
Operational Efficiency:	Apparent Losses per service connection per day:	5.14	gallons/connection/day
	Real Losses per service connection per day:	53.38	gallons/connection/day
	Real Losses per length of main per day*:	N/A	
	Real Losses per service connection per day per psi pressure:	0.75	gallons/connection/day/psi
	From Above, Real Losses = Current Annual Real Losses (CARL):	66.17	million gallons/year
	? Infrastructure Leakage Index (ILI) [CARL/UARL]:	3.52	

Data Validity Grades

Data validity grades (DVGs) document utility practices of:

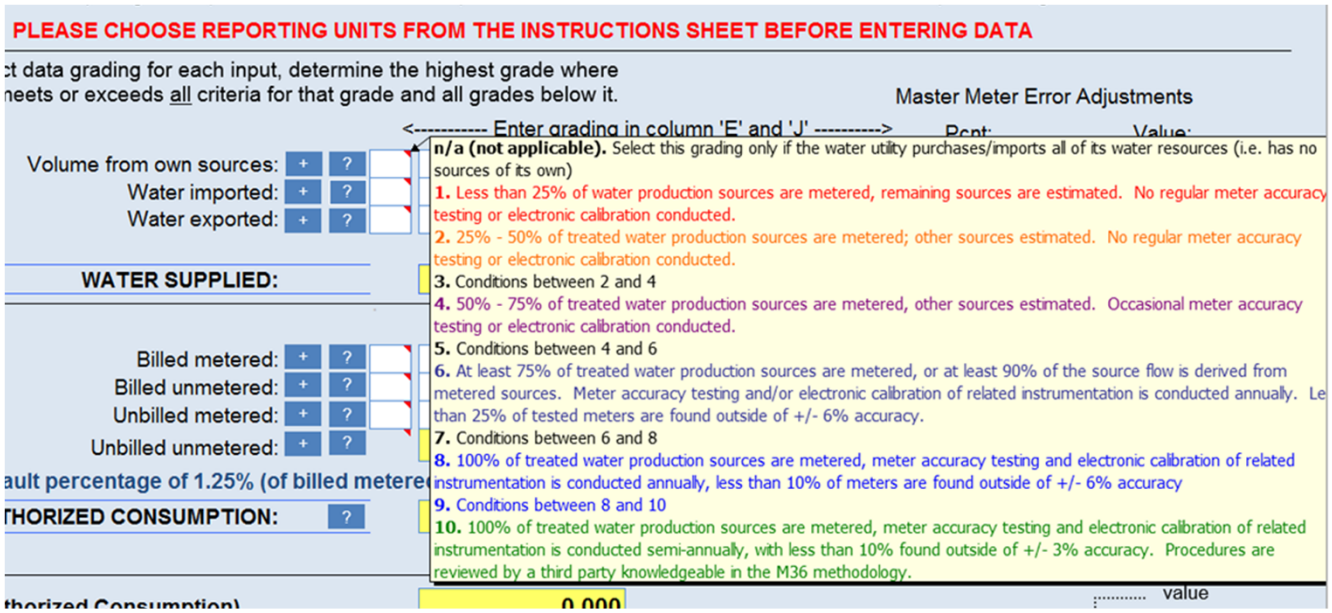
- Data collection
- Data review
- Instrument maintenance

Each audit input is assigned a DVG between 1 and 10 based on criteria

DVG criteria are predominantly qualitative

DVGs are NOT a measure of accuracy!

Data Validity Grades



Meet all criteria at a grade for that grade to apply or drop to a lower grade

Validation

Water audit validation aims to:

- Identify and correct errors
- Evaluate and communicate uncertainty

Level 1 – interview

Level 2 – deep data review

Level 3 – new data from the field

Level 1 Validation

Goals:

- Confirm accurate interpretation and application of methodology
- Identify and correct evident errors
- Select appropriate data validity grades

Process:

1. Compile and transfer supporting documentation.
2. Review supporting documentation.
3. Level 1 validate the water audit through an interview.
4. Review results and attend to any follow-up.
5. Document outcomes.

Washington Pilot Program

Program Goals:

- Improved technical, financial, and managerial capacity
- Water distribution infrastructure maintenance
- Water conservation
- Compliance with 10% water loss requirement

Tools:

- *AWWA Free Water Audit Software*
- *Water audit validation (level 1 and some level 2)*
- *Water loss control methodology and program design*

Washington Regulation – DSL

<table>
<tr><td rowspan="6">Water Supplied</td><td rowspan="3">Authorized Consumption</td><td rowspan="2">Billed Authorized Consumption</td><td>Billed Metered Consumption</td><td rowspan="2">Revenue Water</td></tr>
<tr><td>Billed Unmetered Consumption</td></tr>
<tr><td rowspan="2">Unbilled Authorized Consumption</td><td>Unbilled Metered Consumption</td><td rowspan="5">Non-Revenue Water</td></tr>
<tr><td>Unbilled Unmetered Consumption</td></tr>
<tr><td rowspan="3">Water Losses</td><td rowspan="2">Apparent Losses</td><td>Unauthorized Consumption</td></tr>
<tr><td>Customer Metering Inaccuracies</td></tr>
<tr><td colspan="2">Systematic Data Handling Errors</td></tr>
<tr><td colspan="3">Real Losses</td></tr>
</table>

DSL = “Distribution System Leakage” = Water Supplied minus Authorized Consumption

Washington Regulation – DSL

Distribution system leakage (DSL) must stay below 10%, calculated as a three-year rolling average.

How does this compare to AWWA methodology?

1) Percentage Performance Metrics are misleading

2) Leakage or Water Loss?

Washington Pilot Participants

Arlington Water Department

Camas Municipal Water System

Clark Public Utilities

Fruitland Mutual Water Company

Liberty Lake Sewer and Water District

Nob Hill Water Association

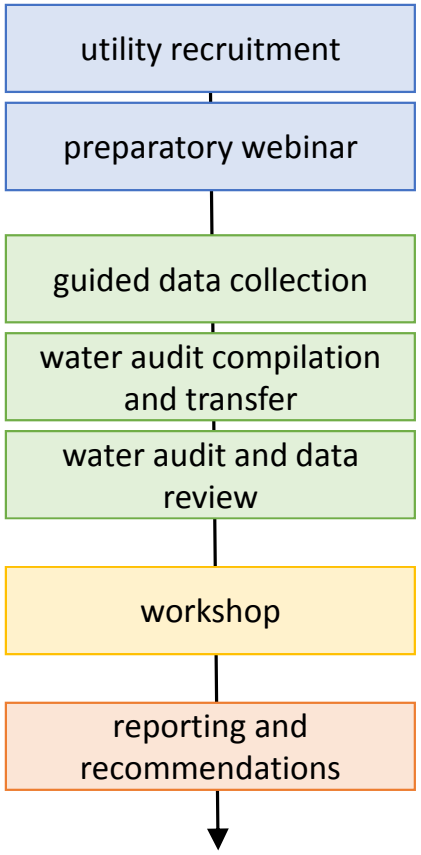
Stevens County Public Utilities Department – Suncrest

Tacoma Water Division

Walla Walla Water Division

Yakima Water Division

Program Overview



10 utilities – range of system types, water loss profiles, and experience with water audit methodology

Program overview and initial instruction in water auditing methodology

Water audit data request and guidance

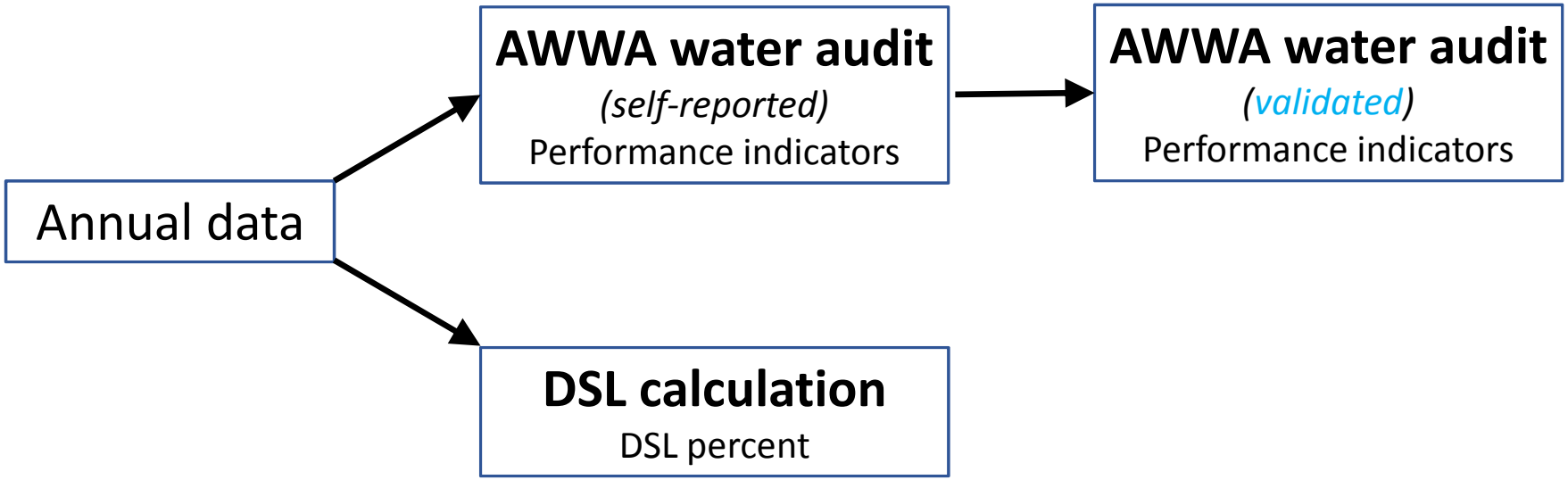
Hands-on water audit compilation and documentation

Data review and validation tailored to each participating utility

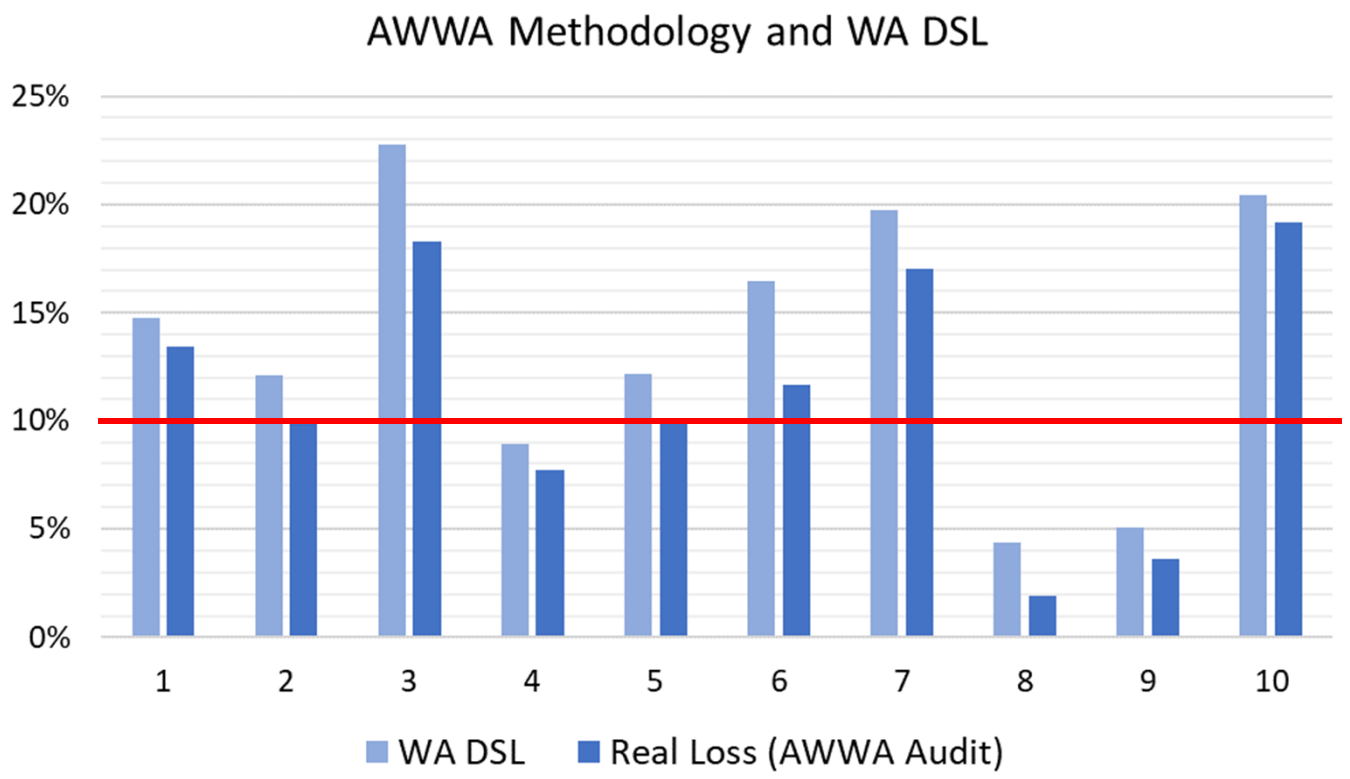
Water audit compilation and validation methodology
Utility-specific methodological and analytical support
Water loss control practices and strategy design

Utility-specific water audit findings and next steps for data management and water loss control
Pilot to Program report and statewide recommendations

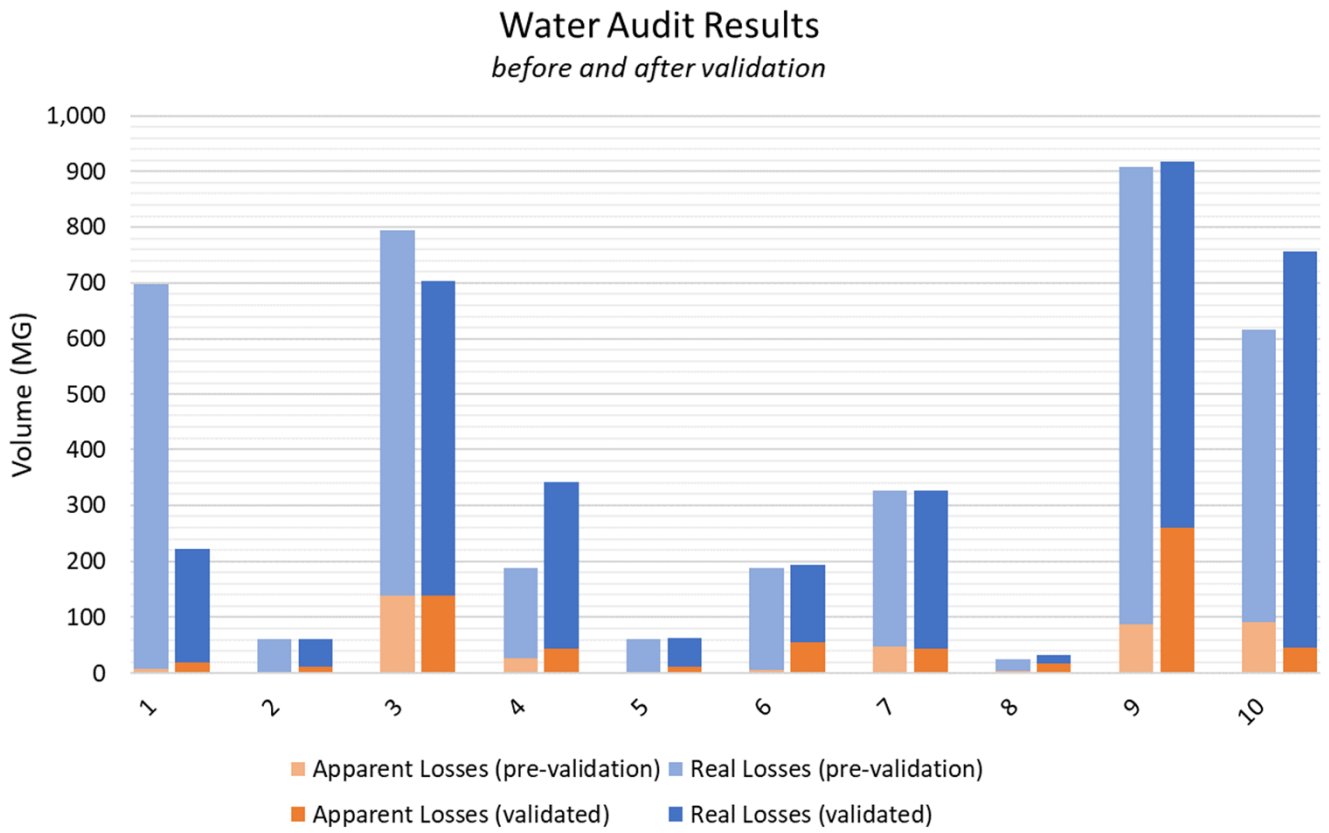
Results


Annual data
AWWA water audit
(self-reported)
Performance indicators
AWWA water audit
(validated)
Performance indicators
DSL calculation
DSL percent

Results – DSL


AWWA Methodology and WA DSL
25%
20%
15%
10%
5%
0%
1
2
3
4
5
6
7
8
9
10
WA DSL
Real Loss (AWWA Audit)

Results – Validation



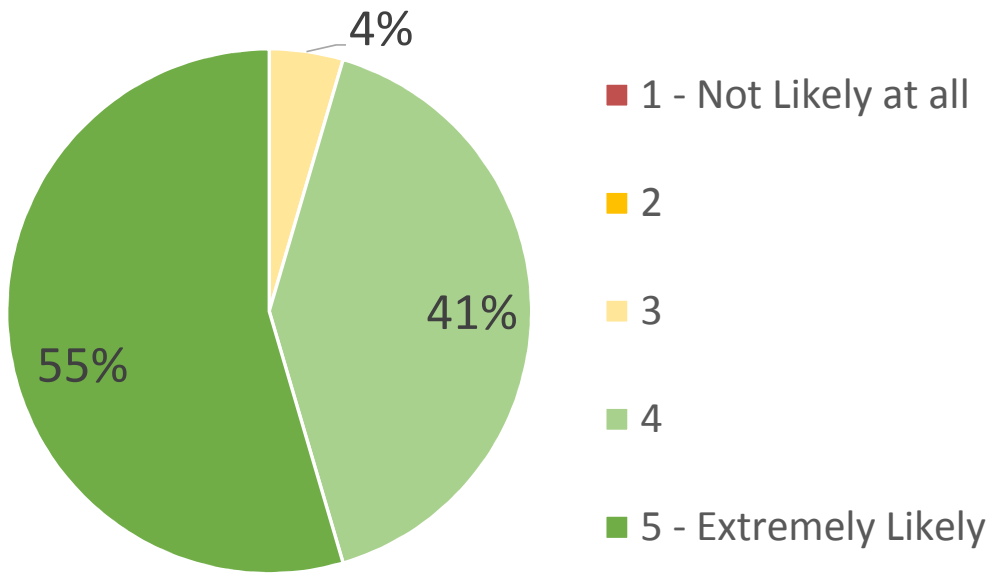
Program Feedback

"The water auditing process is **much more informative** than the traditional WUE reporting."

"The detail that we went into with this framework really illuminated different aspects of the lost water in our system. Those figures help us to really focus in on the areas where the **cost-benefit ratio makes the most sense** to improve the **integrity of our water system**."

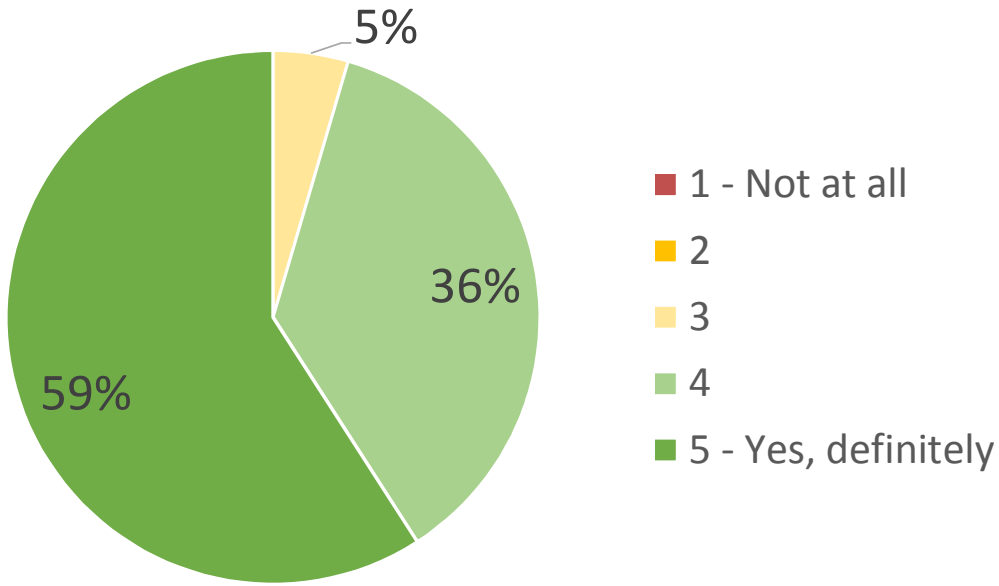
Program Feedback

How likely would you be to **recommend a similar program** to another utility looking for training on water auditing and the M36 methodology?



Program Feedback

Was your training experience **worth the time and expense** with respect to learning the key elements of non-revenue water and interdepartmental team building?



The Future of WA Water Loss Control

From a participant –

> **If the goal of the 10% requirement is to actually help utilities monitor and understand their losses for the sake of lessening them, this program is far more useful than the "production less billed use" method.**
>
> There is real data supporting the loss numbers, so there is less risk that the financial investment would be wasted. If a utility were to use the simple "production less billed use" number to track loss, efforts to reduce loss could be a real shot in the dark.

What now?

The Future of WA Water Loss Control in WA

Possibilities:

- **Voluntary use of AWWA methodology**
  (currently an alternate method permitted in WA code)
- **Educational opportunities** and voluntary use
  - Conferences
  - Training programs
  - Webinars
- **Mandatory requirement**
  - Unsupported
  - Supported

Thank You!

Kate Gasner

Water Systems Optimization

e: *kate.gasner@wsoglobal.com*

p: 415-533-0419

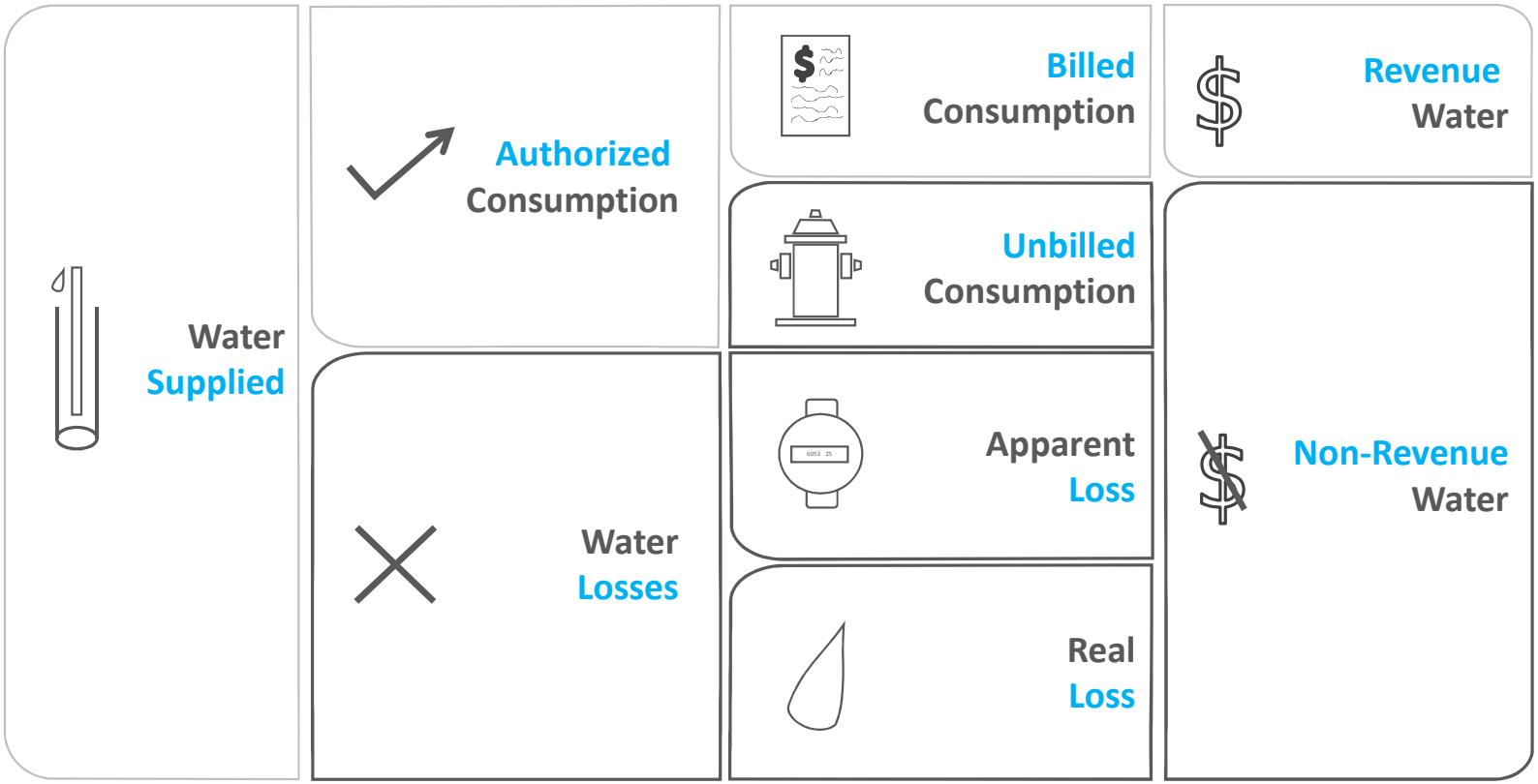
Pioneering Water Loss Control – Groundbreaking Statewide Technical Assistance Programs

Agenda

Kate Gasner, WSO

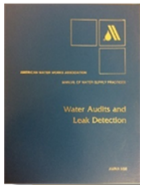
- Who's in the room?
- Water loss standardization timeline
- Statewide program development
- California showcase: setup & outcomes

The Water Balance



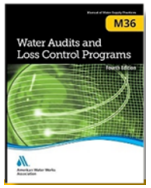
Water Loss Assessments – Standard Methods

1st ed.



1991

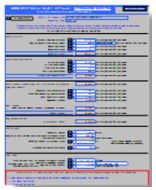
4th ed.



2015

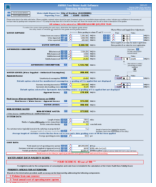
AWWA Water Audit Methodology

v1



2005

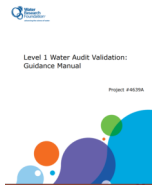
v5



2014

V6 in 2020!

Water Audit Software



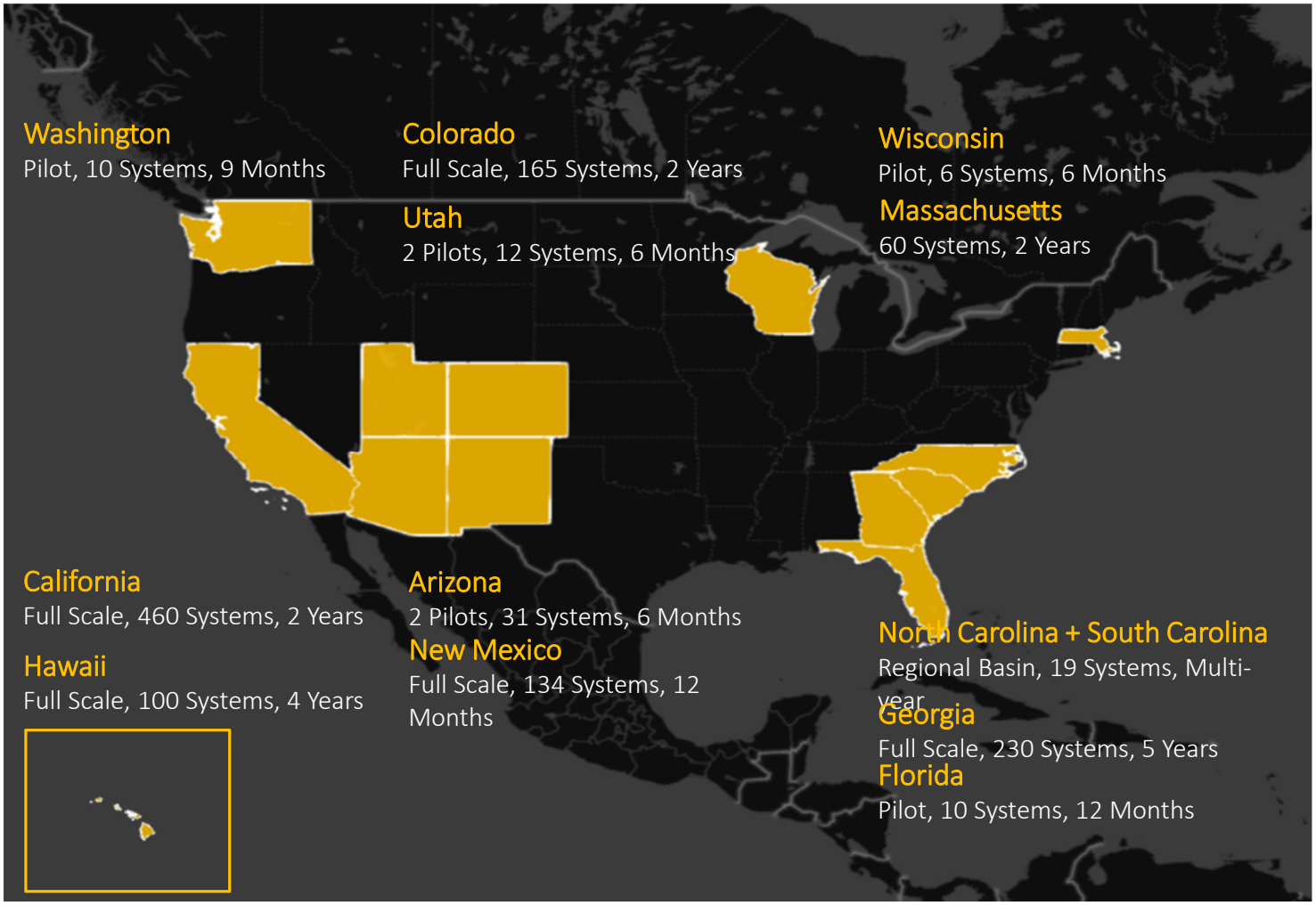
2016

Water Audit Validation

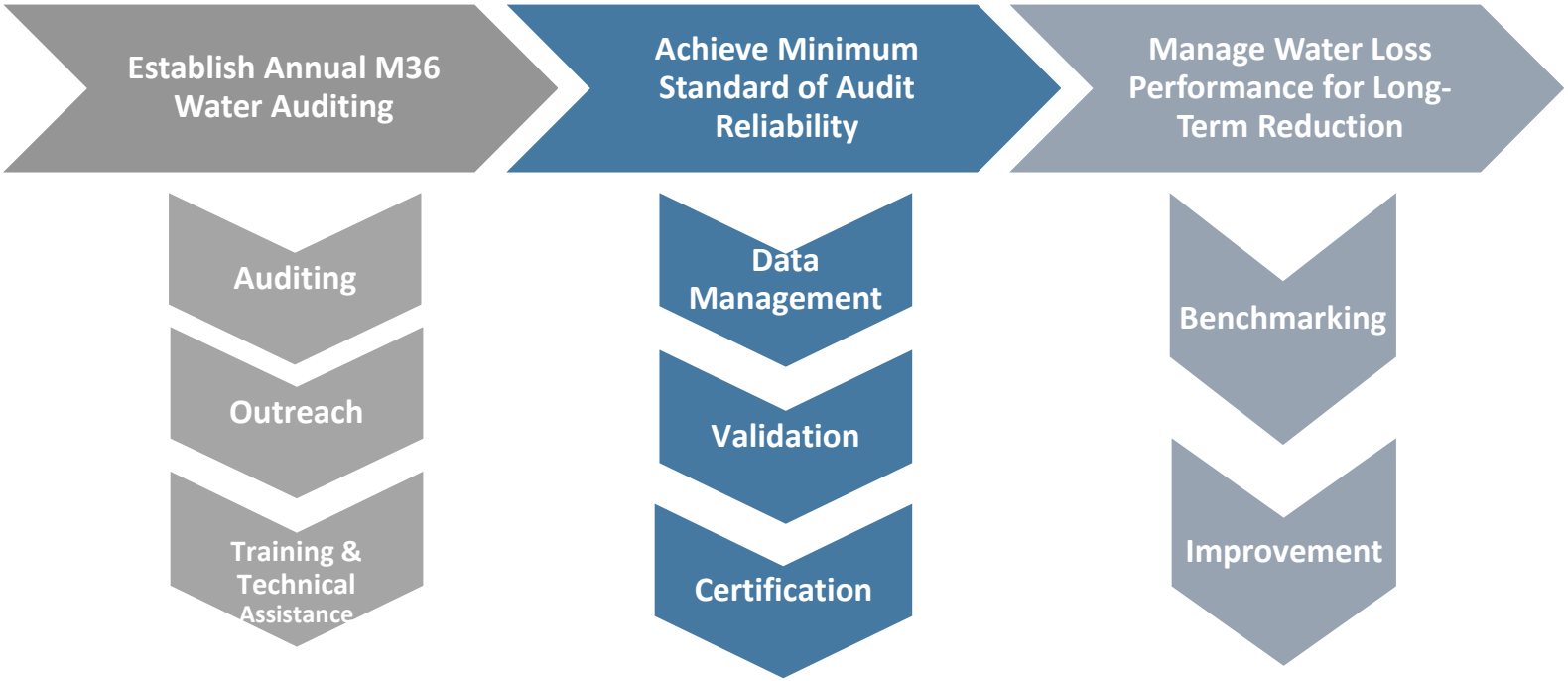
Water Loss Control Program Design

Calculate Water Losses	Breakdown Leakage Volumes	Economic Analysis	Implement Interventions
• AWWA Water Audit Model • Real Losses v. Apparent Losses	• Background • Reported • Hidden	• Value Lost Water • Evaluate Cost of Intervention	• Leak Detection • Pressure Management • Repair Time Reduction

State Programming To Date



Statewide Programming Framework



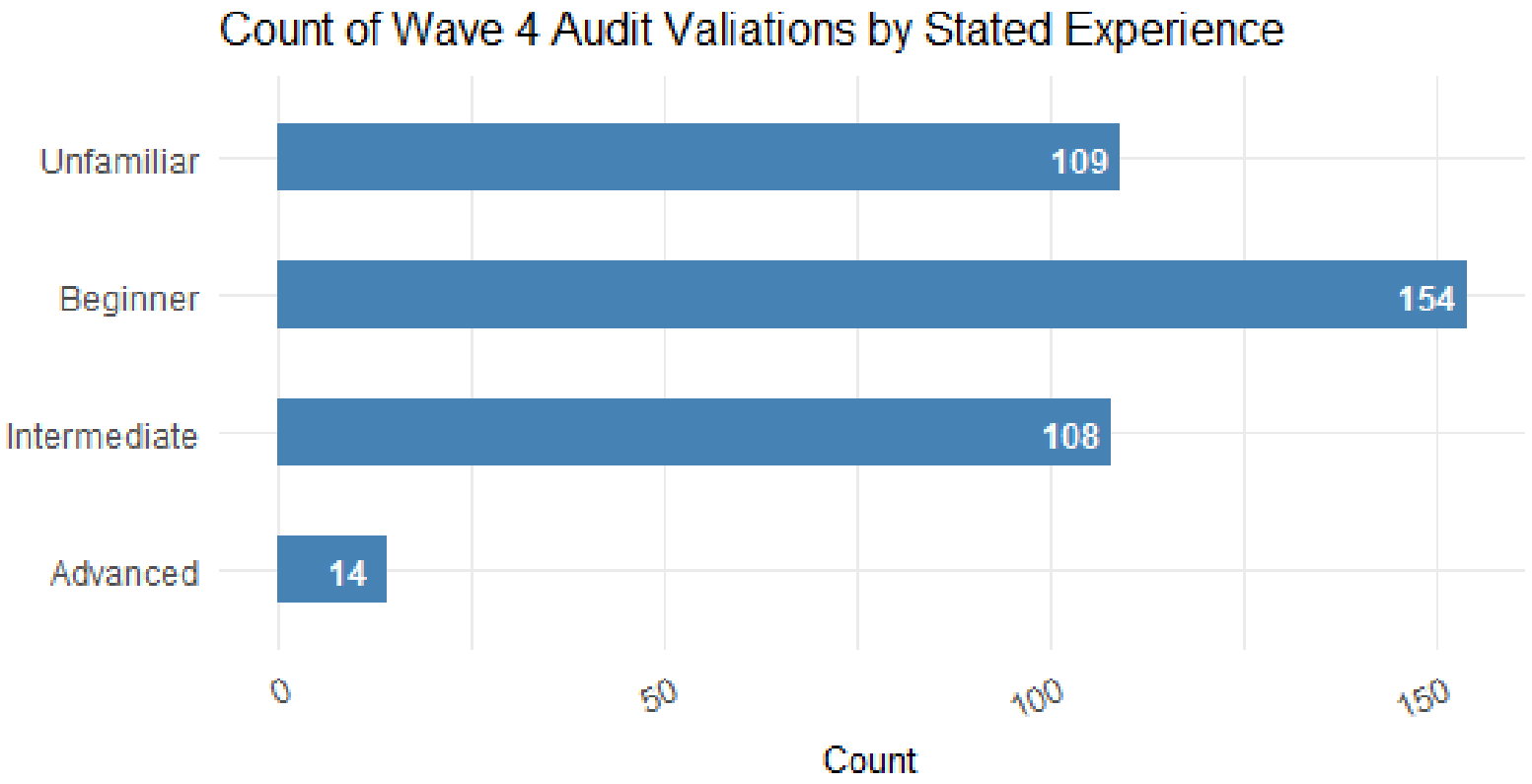
California Water Loss Technical Assistance

2016 through 2017

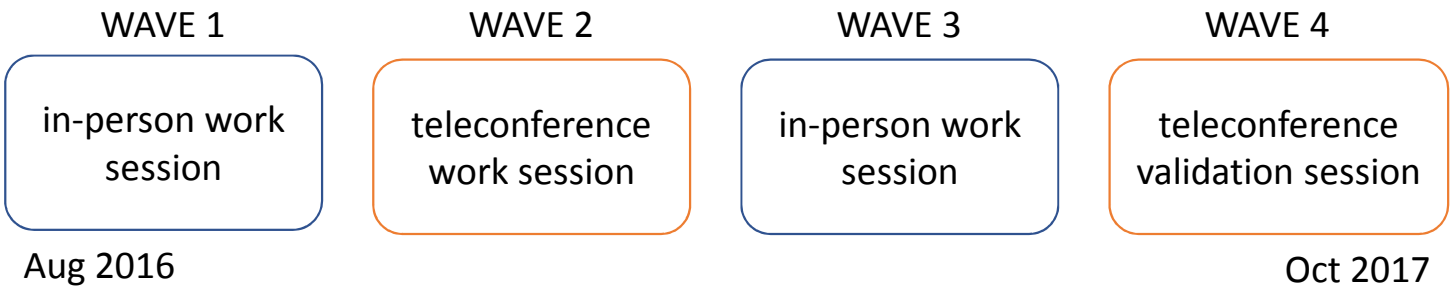
1. Teach water auditing and water loss control best-practice methods

2. Level 1 validate retail urban water supplier water audits submitted from across the state to DWR in 2017 submittal cycle

Varying Experience to Start



California TAP – Program Setup



- progressive learning model
- value of practice rounds in Wave 2
- two tracks to accommodate different experiences

California Program Outcomes

1,500+ people participated

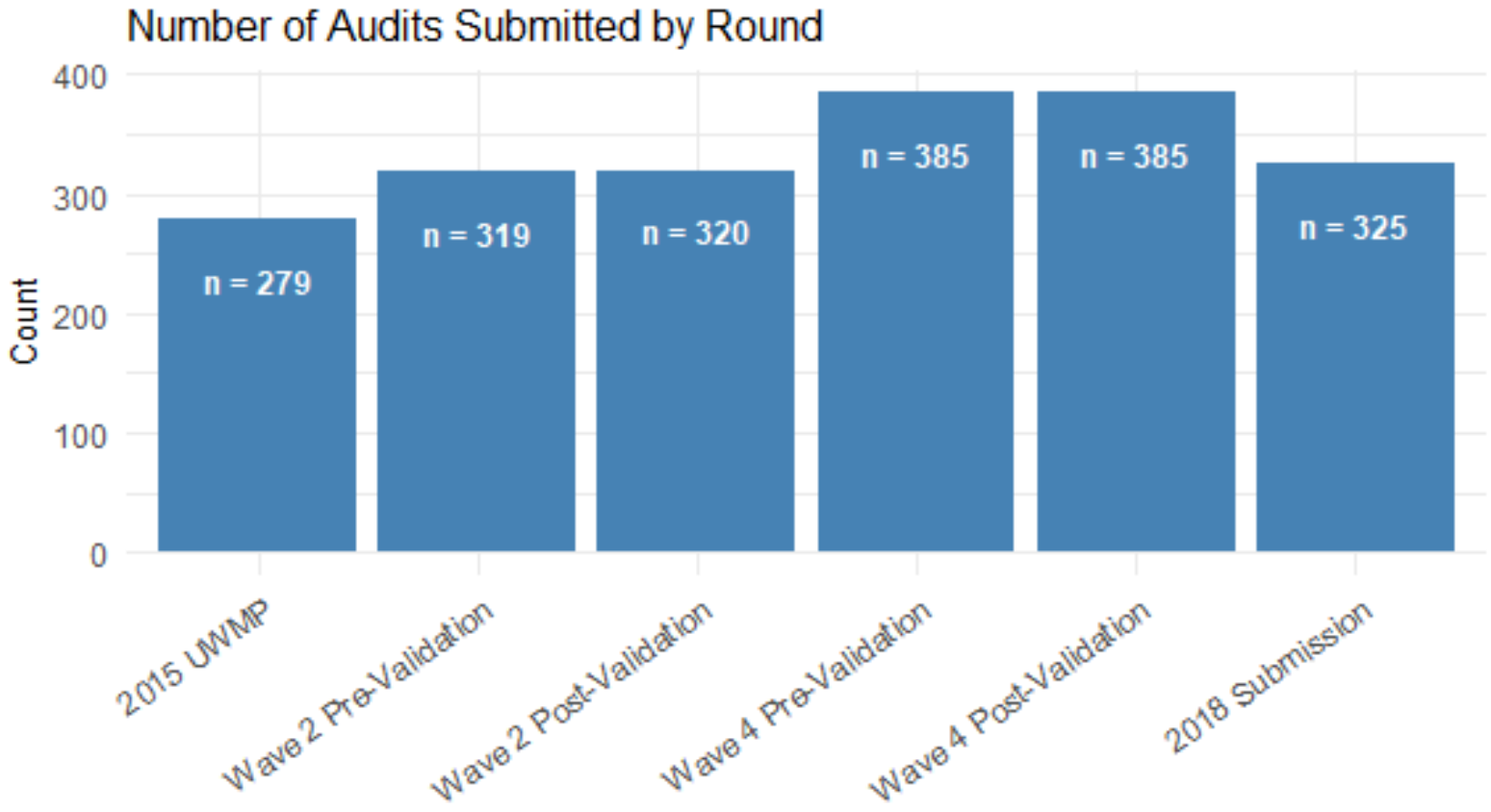
73 workshops taught

"We not only achieved our goal of completing a water audit, we learned a lot along the way and the experience was enjoyable."

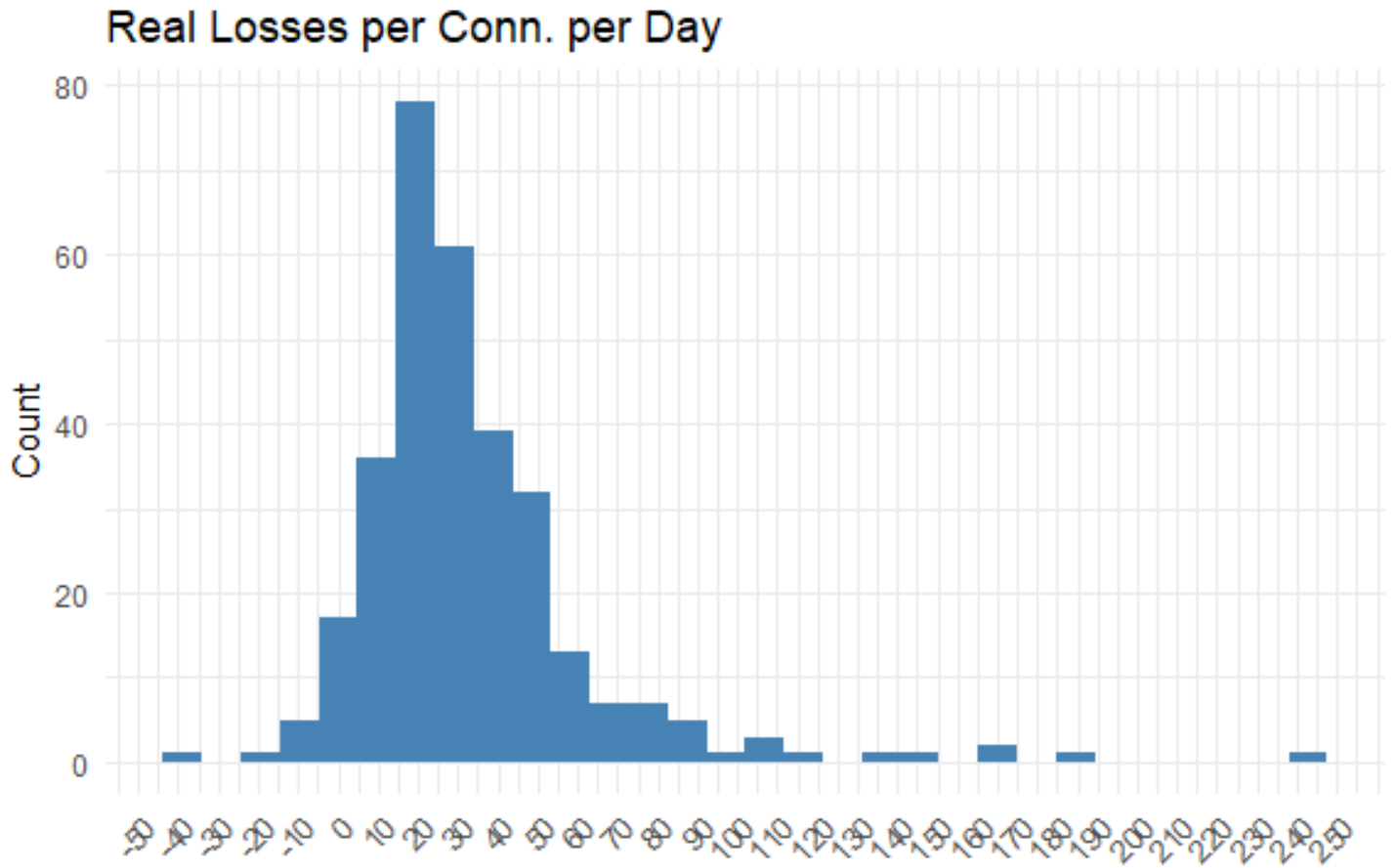
"The whole process brought to light the areas in which our District could improve and how the interaction between departments affects the water loss analysis."

"Very comprehensive and surprisingly high level of person-to-person communication."

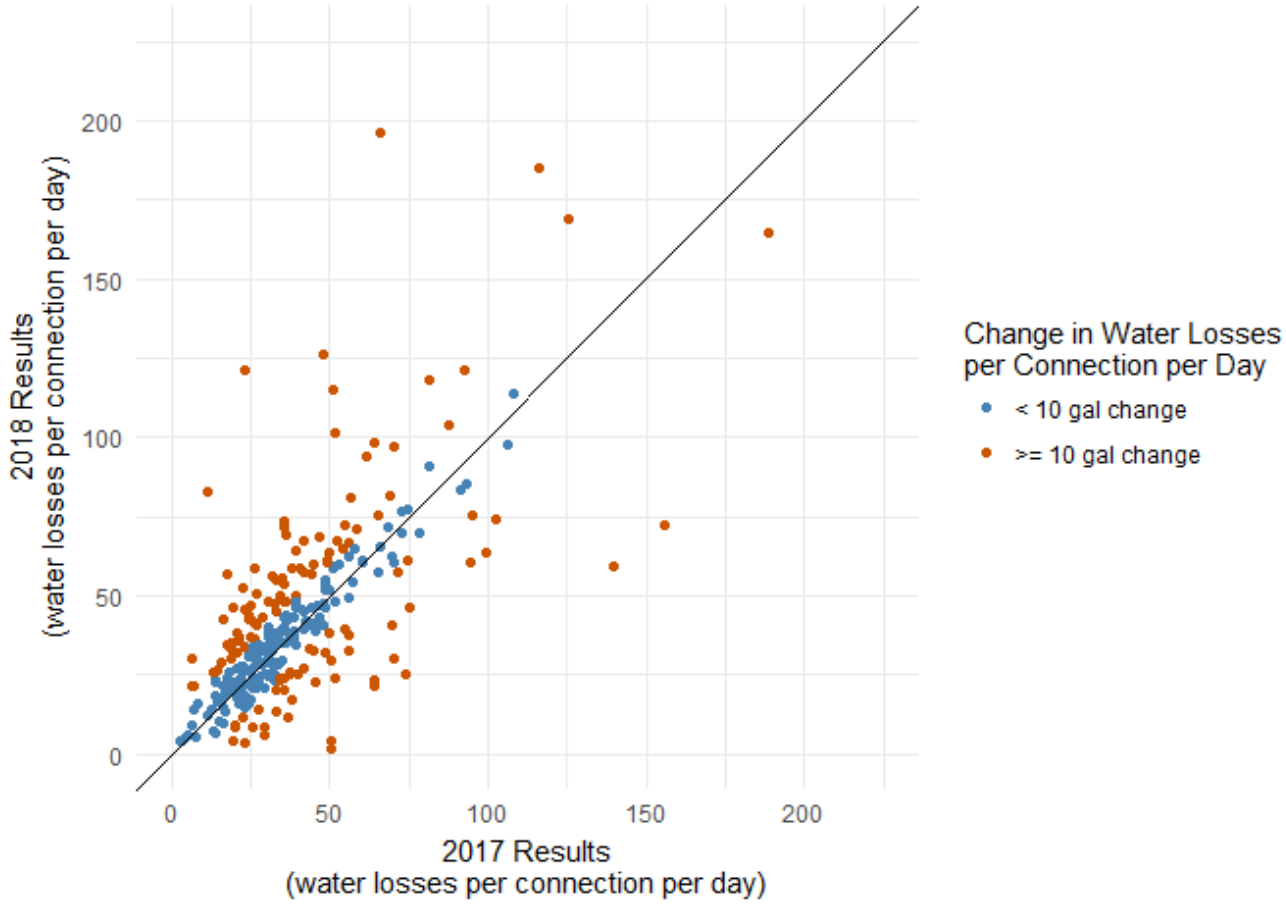
California Program Outcomes



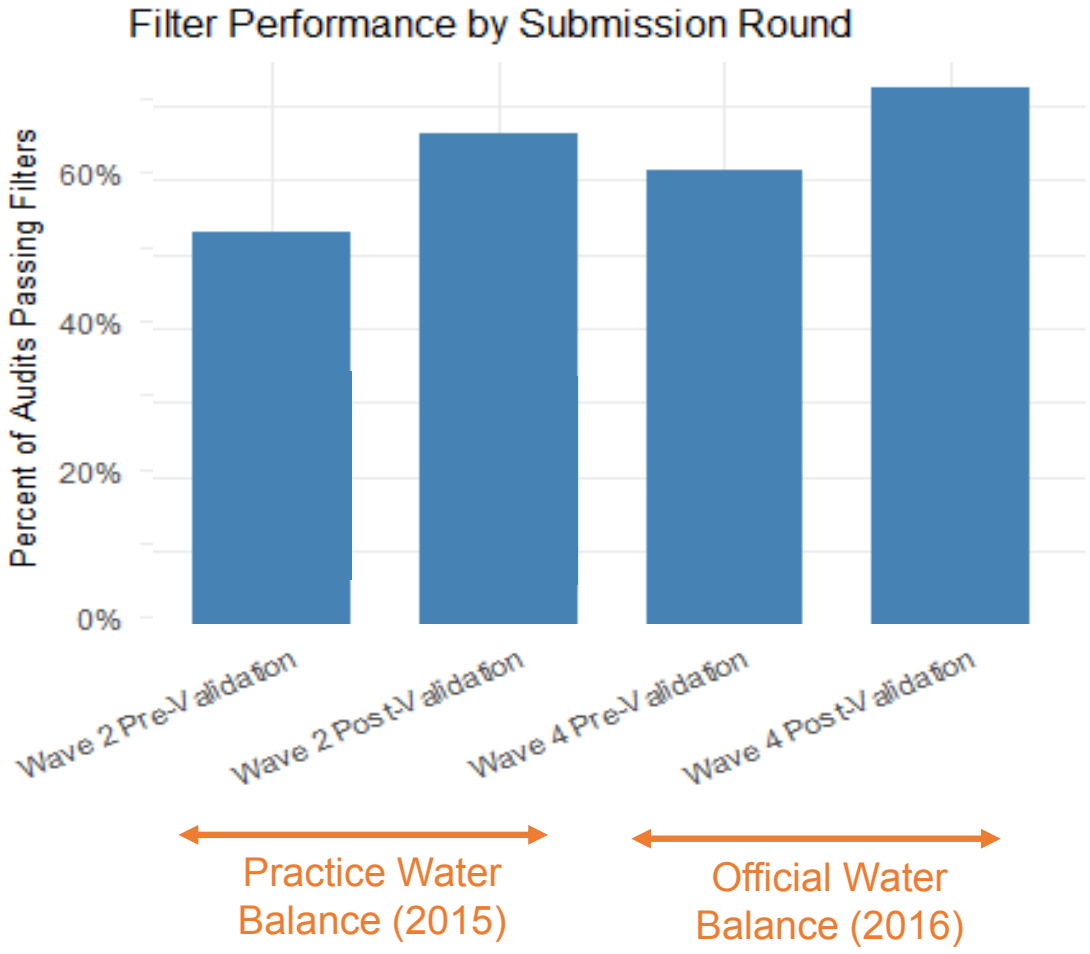
California Program Outcomes



California Program Outcomes



California Program Outcomes



California Program Outcomes

CA water suppliers are still refining water audit data

Source meter accuracy

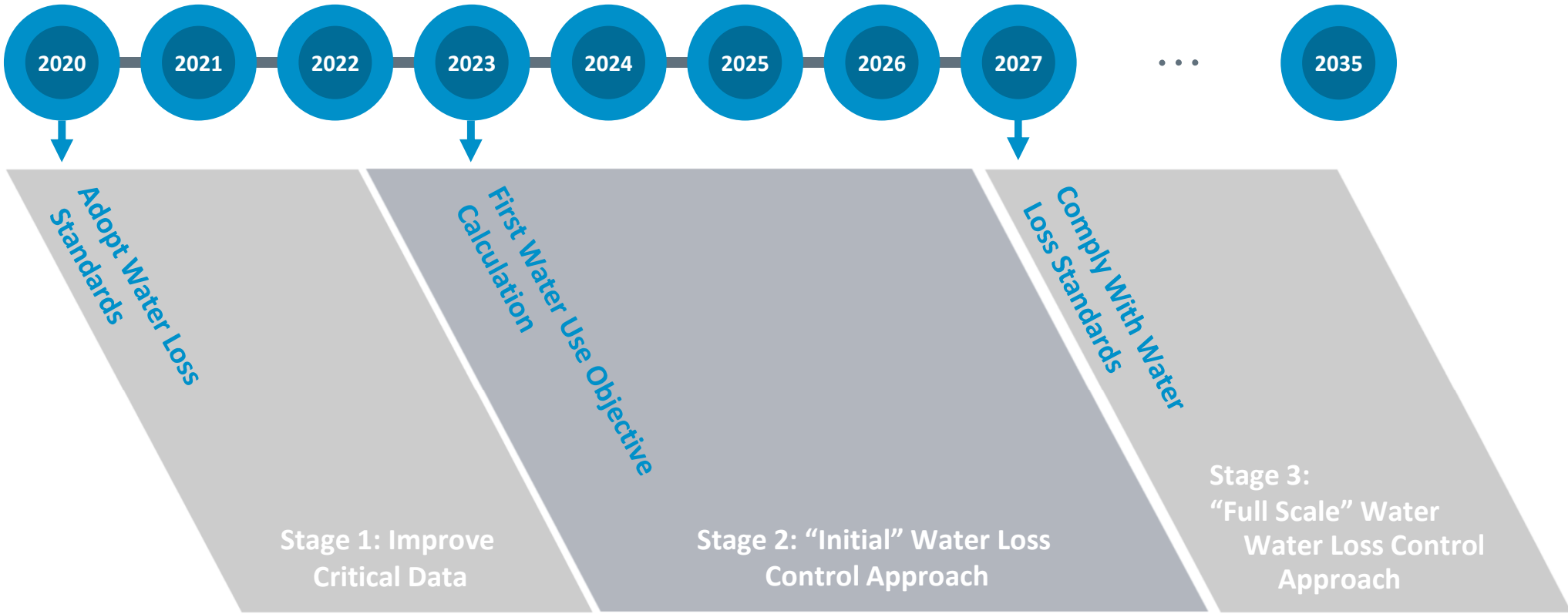
- Meters aren't regularly tested or well documented
- Meters are owned by another agency
- Volumetric testing feasibility isn't known

Billing data pro-rating & integrity (supply and sales volumes not aligned)

Customer meter inaccuracy (test data not available)

Pressure (field data not available and/or representative; many inputs are guesses)

California – Looking Ahead



Thank You!

Kate Gasner

Water Systems Optimization

e: *kate.gasner@wsoglobal.com*

p: 415-533-0419