PNWS AWWA Conference

Water Audit Workshop

2018

WSO | CAVANAUGH
Stewardship Through Innovation

Introductions

Mike Dexel
DOH

Reinhard Sturm
WSO

Lucy Andrews
WSO

Introductions

Name

City/Agency

Position

Familiarity with water auditing and water loss control?

Week’s highlight!

Agenda

- Setting the scene
- American Water Works Association water audit methodology
- Water audit validation
- Washington pilot program
- Future water loss control in Washington

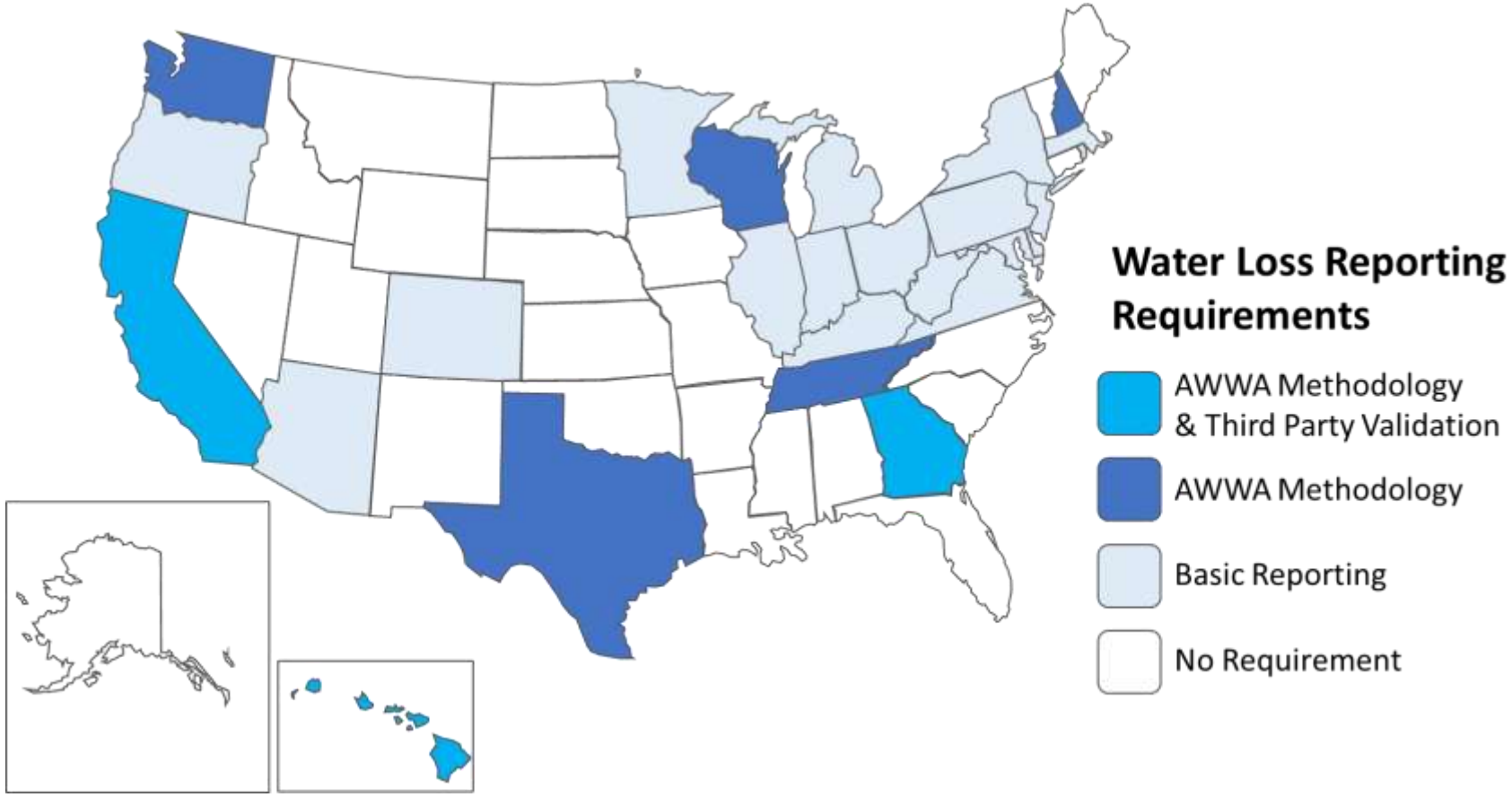
Today's Goals

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. **Plan next steps** toward improved data and water loss management, particularly with a focus on cost justification

Water Loss Reporting in the US

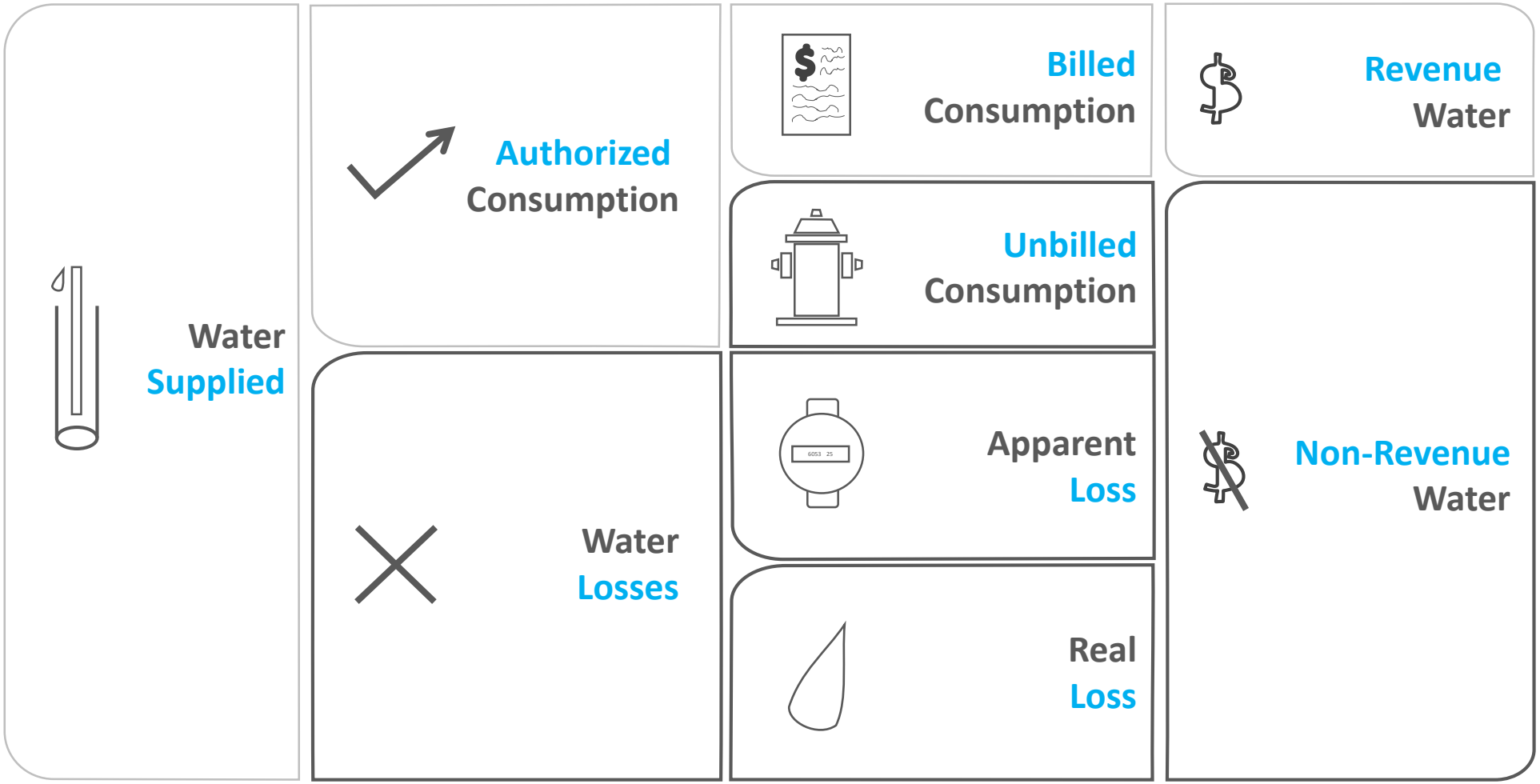


Water Audit

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
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<tr><td>Systematic Data Handling Errors
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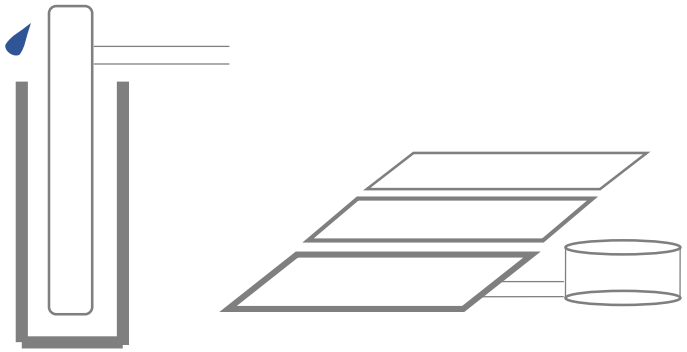
<tr><td colspan="2">Real Losses
7</td></tr>
</table>

Water Supplied – Volumes

Volume from Own Sources



Did we treat the water to potable standards?

Water Imported

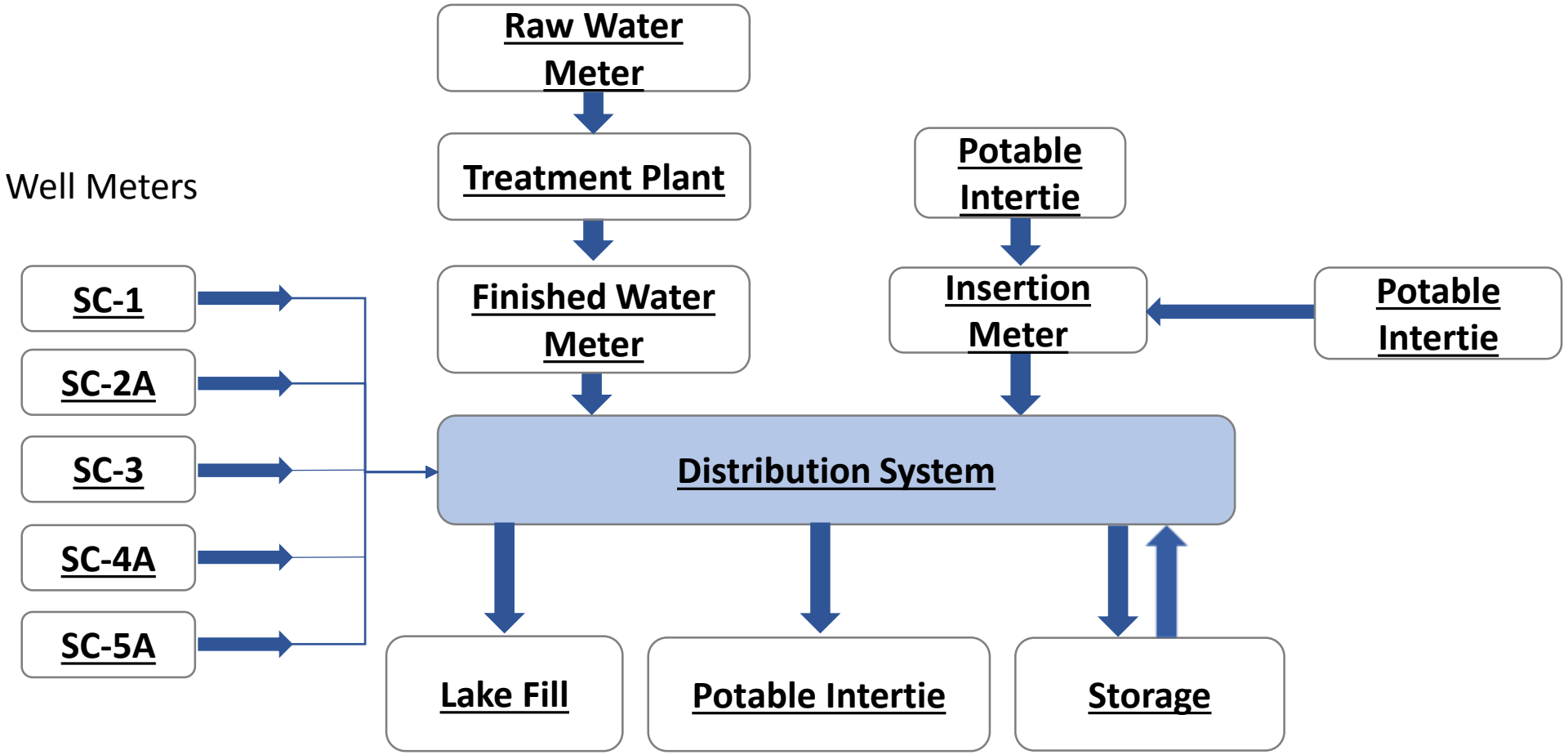
Did we buy potable water someone else treated?

Did we import raw water from someone else?

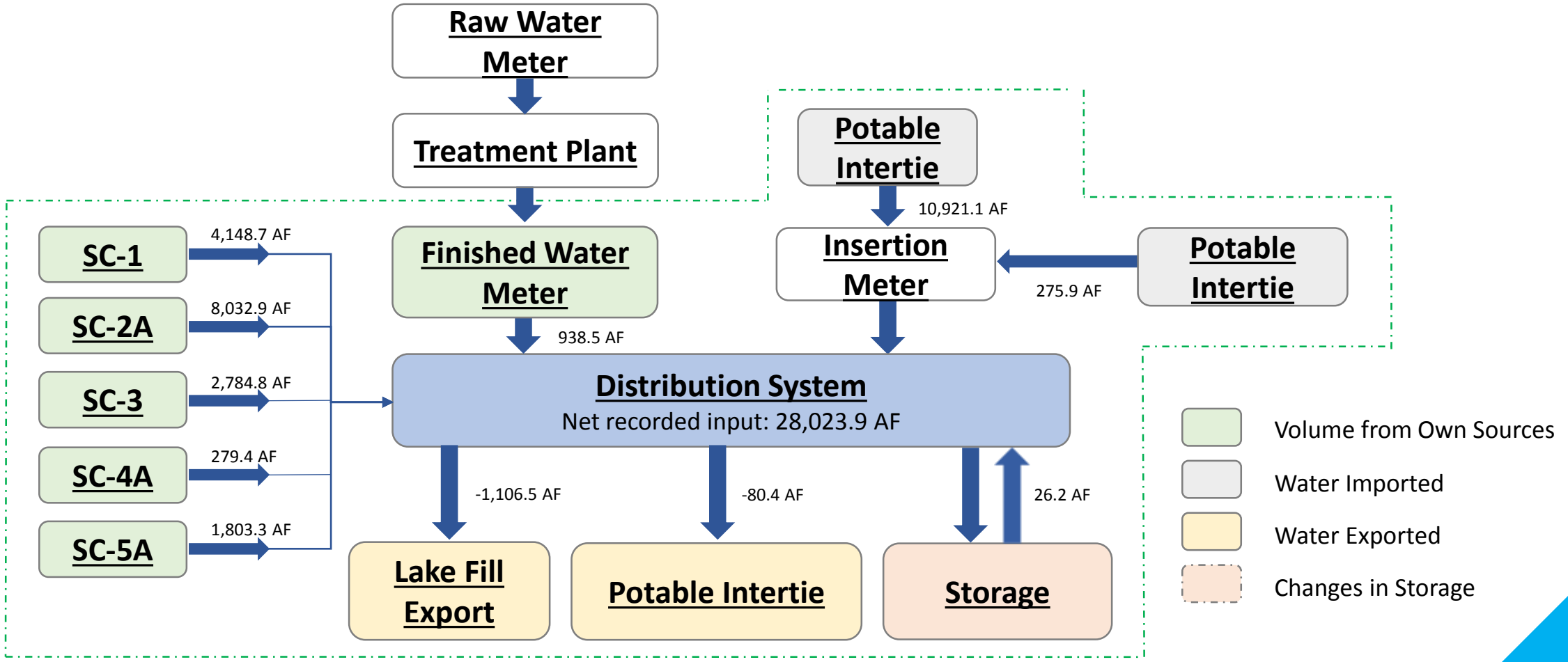
Water Exported

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

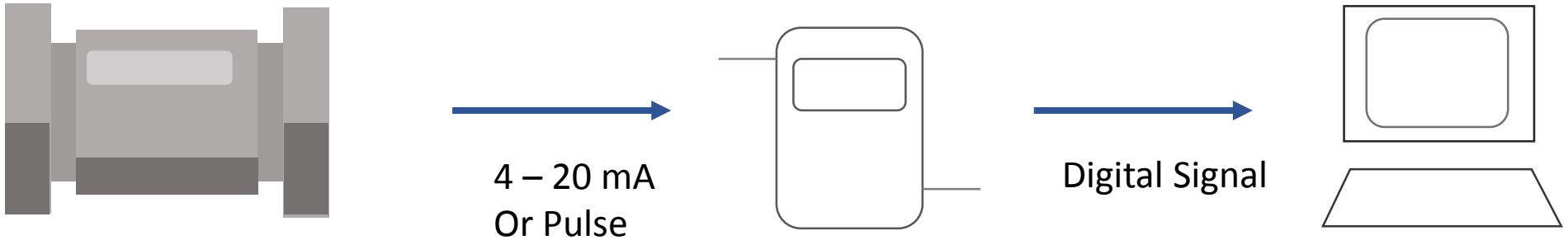
Water Supplied – Audit Boundaries



Water Supplied – Audit Boundaries



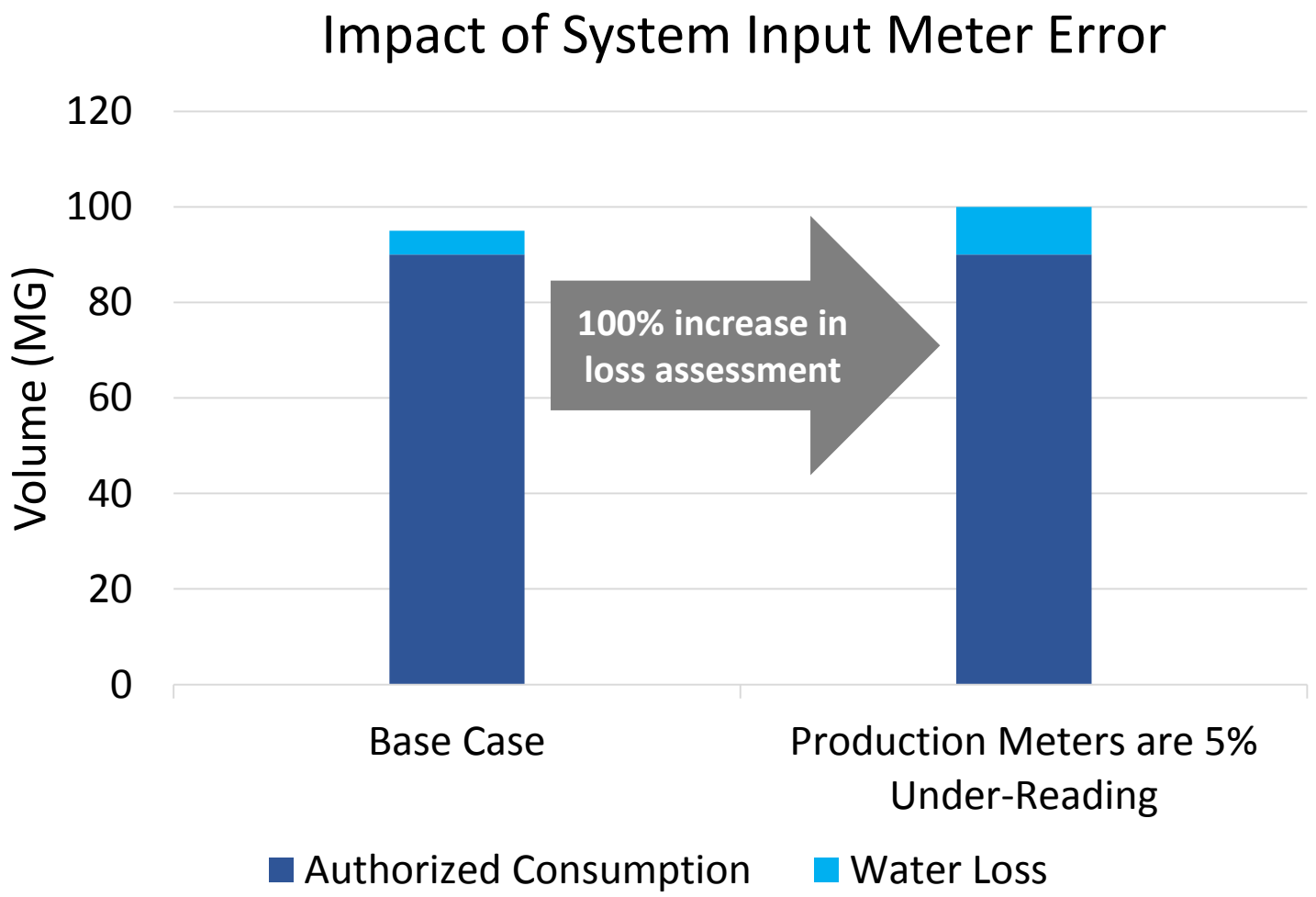
Water Supplied – Data Chain



Measurement Element Secondary Electronics* SCADA System

*Calibration

Water Supplied – Meter Testing



Comparative instrument test

- Ultrasonic
- Insertion
- Pitot tube

Reference volume test

- Tank fill up
- Tank drawdown

Authorized Consumption

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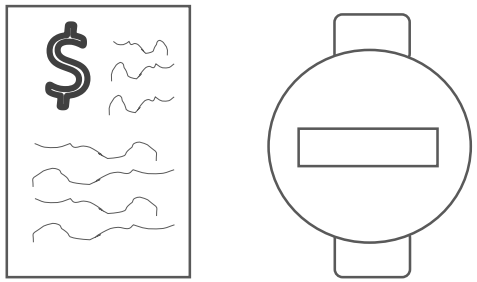
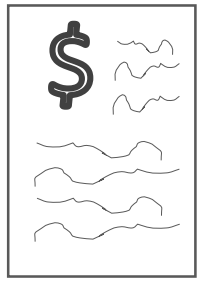
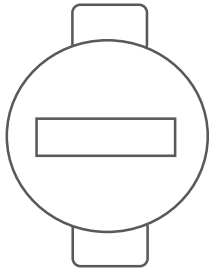
Authorized Consumption



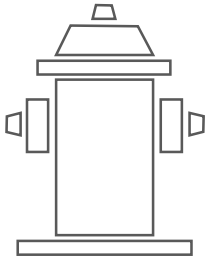
Billed Metered
Consumption



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

Negative Reads

Zero Reads

Adjustments

Outliers

One summary number

Water Loss

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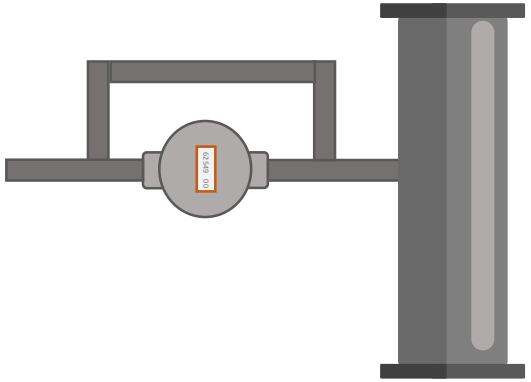
Water Loss

Apparent Losses

vs.

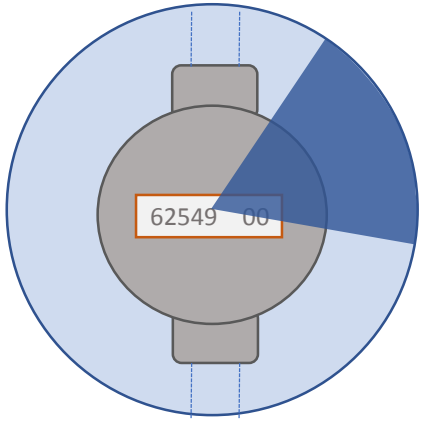
Real Losses

Apparent Loss – Categories



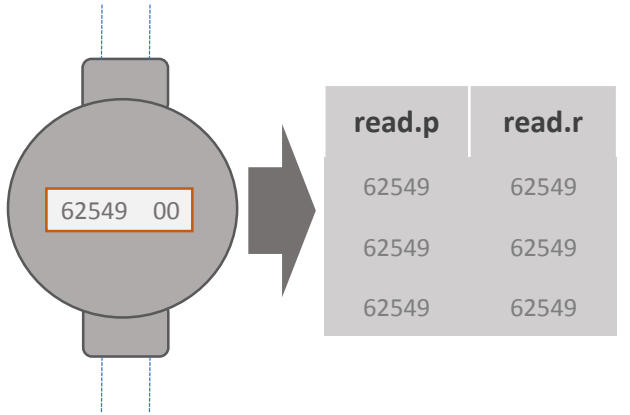
Unauthorized Consumption

Theft!



Metering Inaccuracy

Customer meter under registration

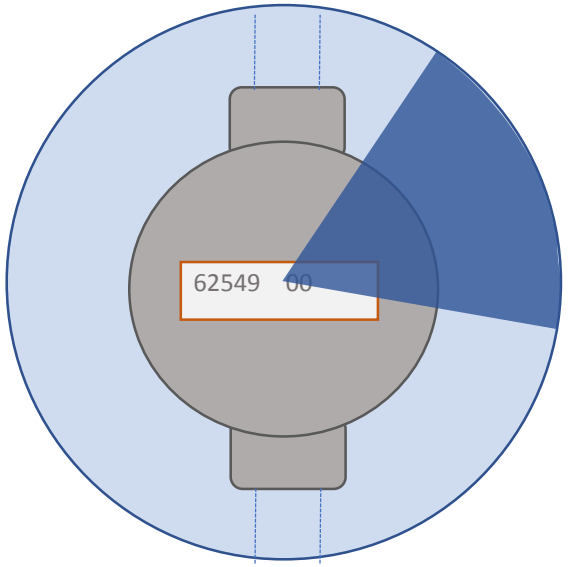


Data Handling Errors

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

Apparent Loss – Value

90% Customer Meter Accuracy

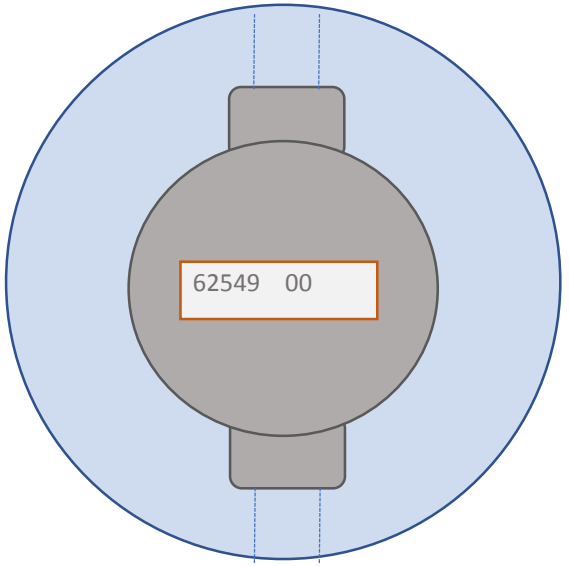


Service Charge: $20

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

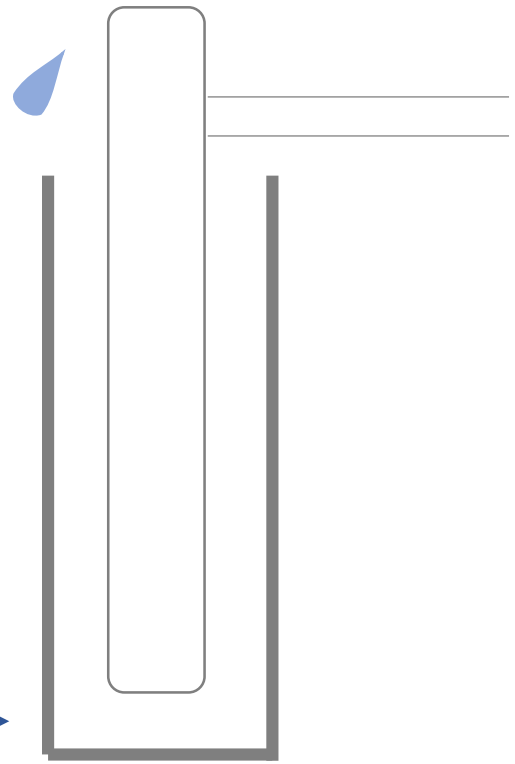
Variable Charge: $3.00 x 10 = **$30.00**

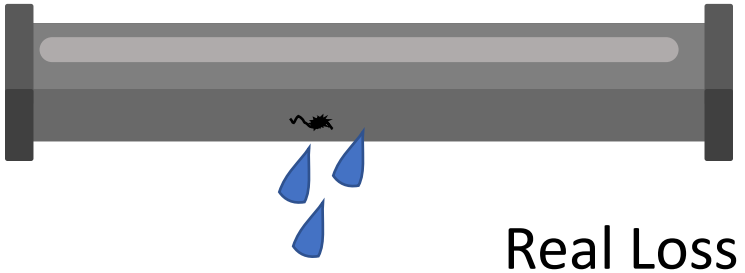
Real Loss – Value

Purchase Costs

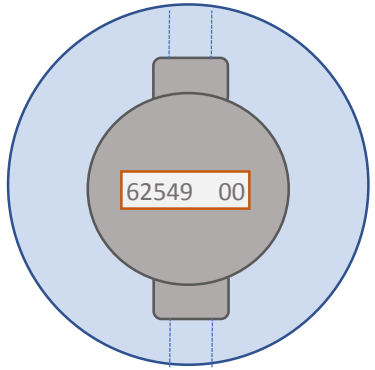
Electricity for Pumping

Chemicals



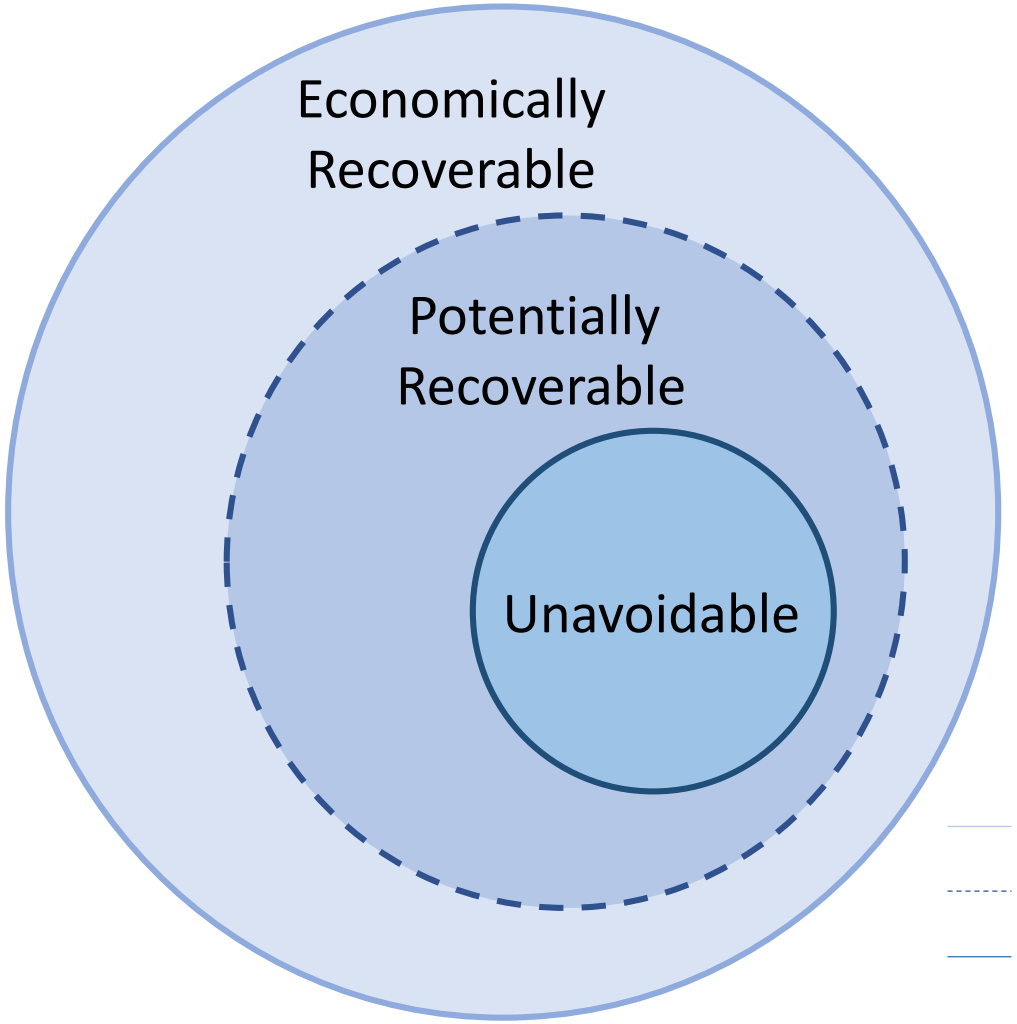


Real Loss



Authorized Consumption

Unavoidable Annual Real Loss

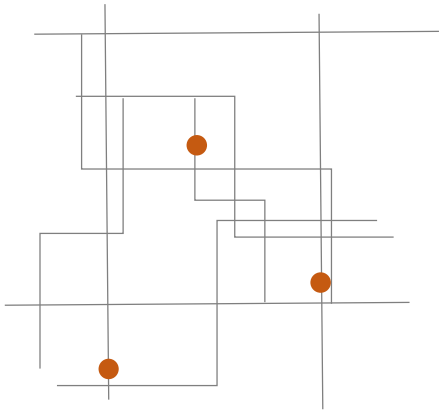


The AWWA audit software models the **technical minimum** volume of real loss based on **system infrastructure data**.

Current Annual Real Losses
Economic Level of Real Losses
Unavoidable Annual Real Losses

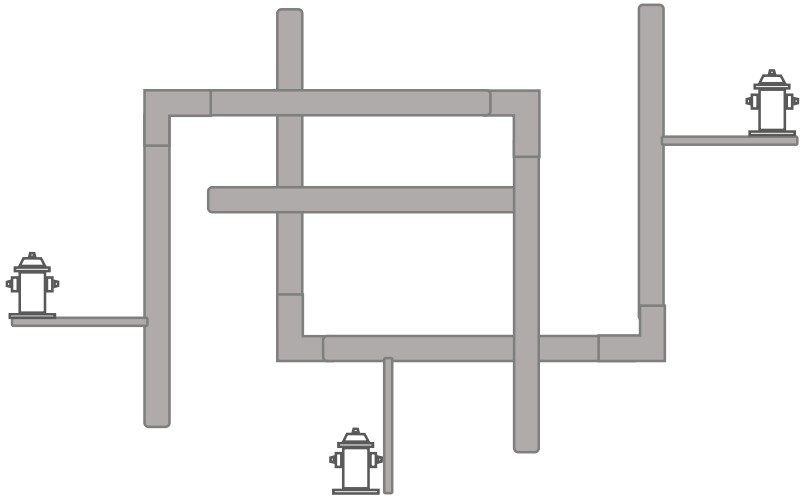
System Infrastructure Data

System Average Pressure



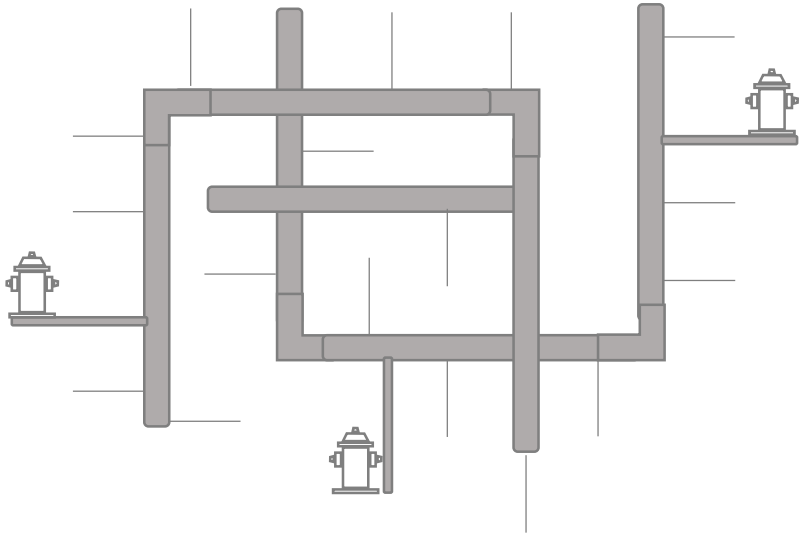
The average pressure across the full potable distribution system.

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

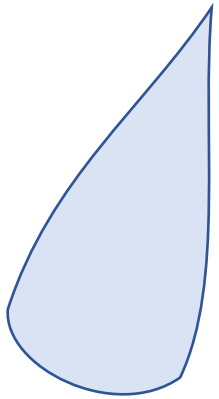
consider all classes and tiers

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

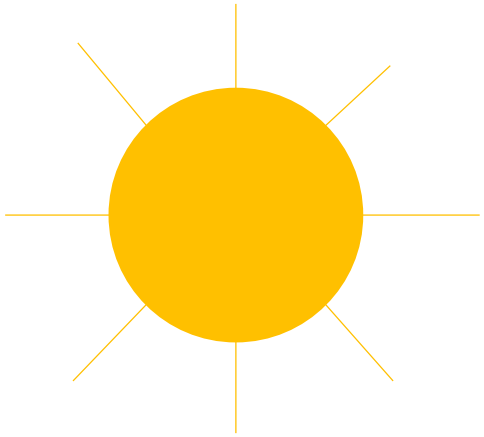
Values

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

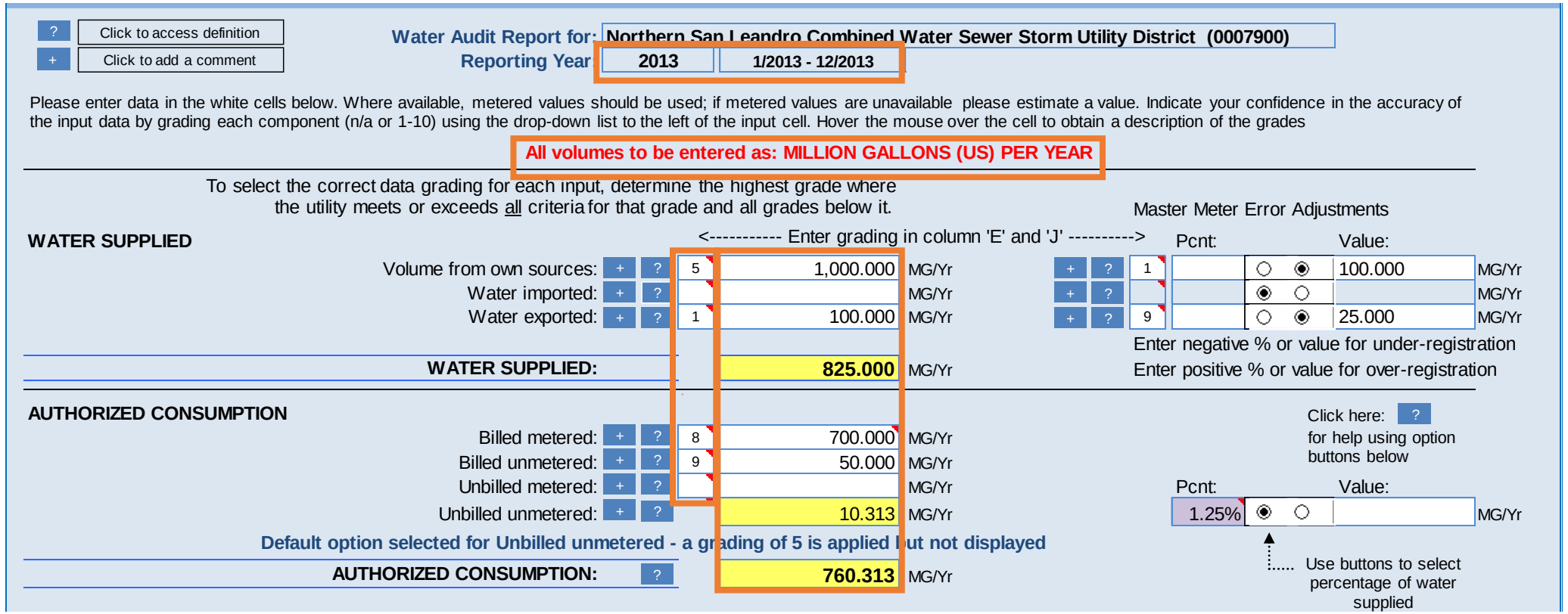
Water Supplied: 800

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

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

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

AUTHORIZED CONSUMPTION				Pcnt:	Value:	
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			

Click here: ? for help using option buttons below

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

..... 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:

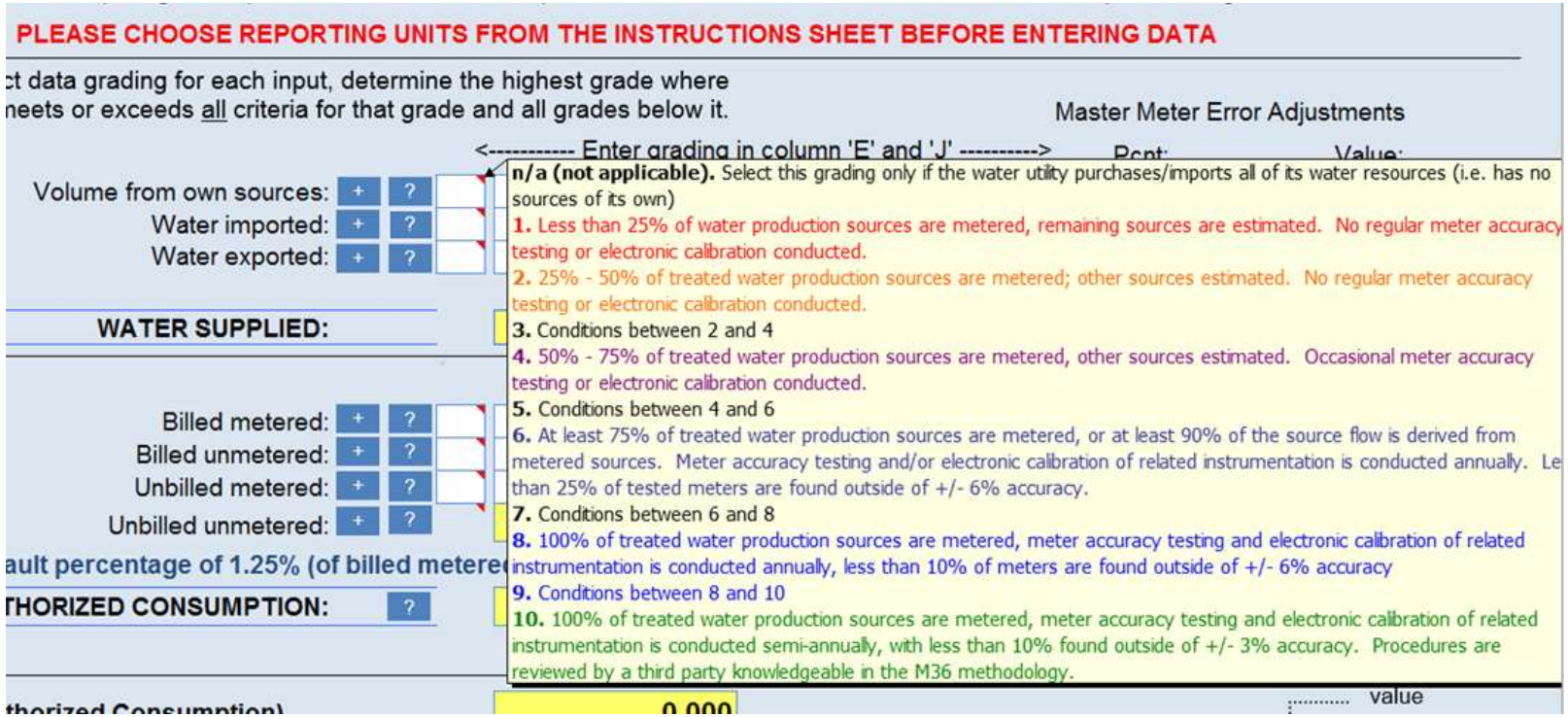
- Data collection
- Data review
- Instrument maintenance

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:

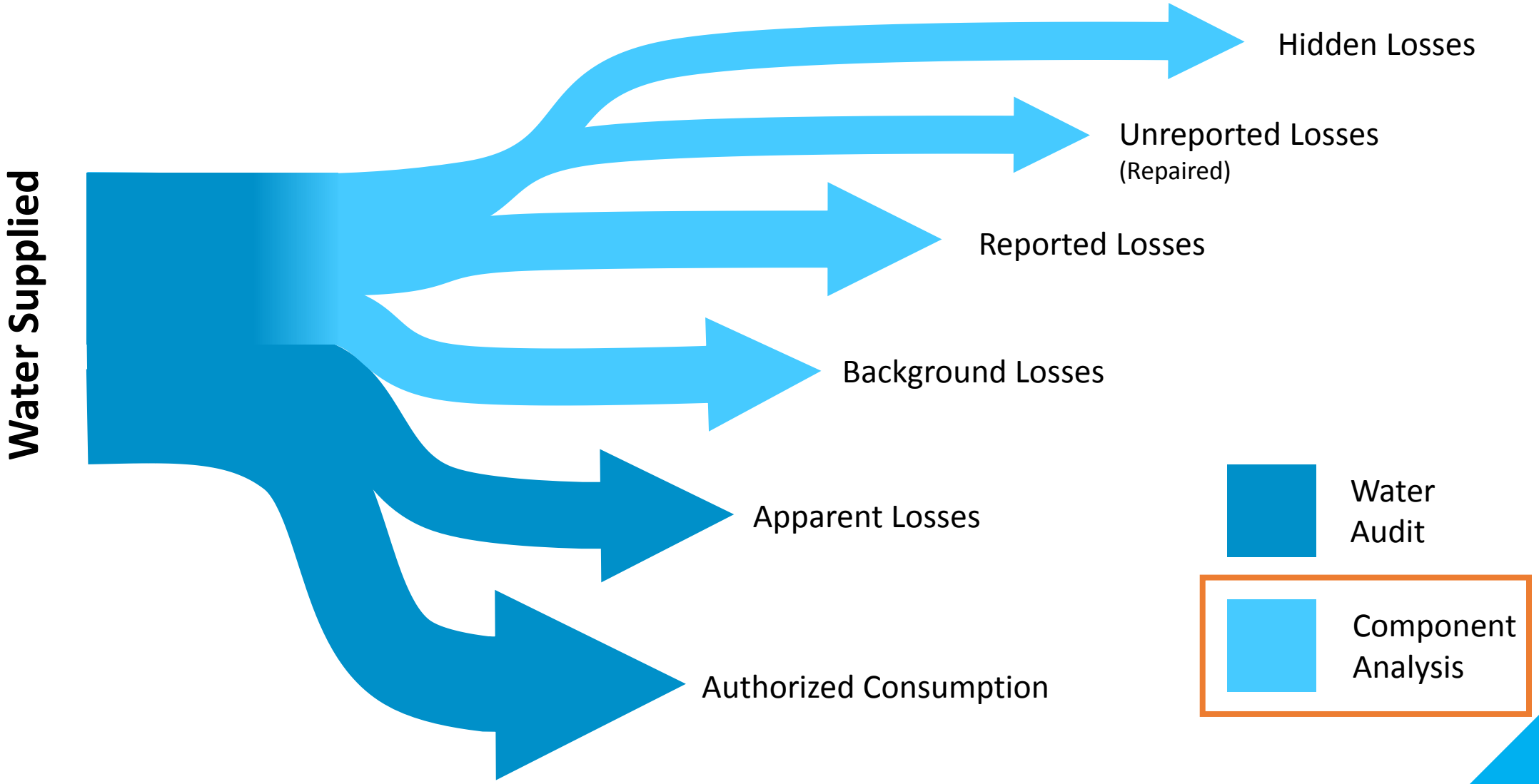
- Confirm accurate interpretation and application of methodology
- Identify and correct evident errors
- Select appropriate data validity grades

Level 1 Validation

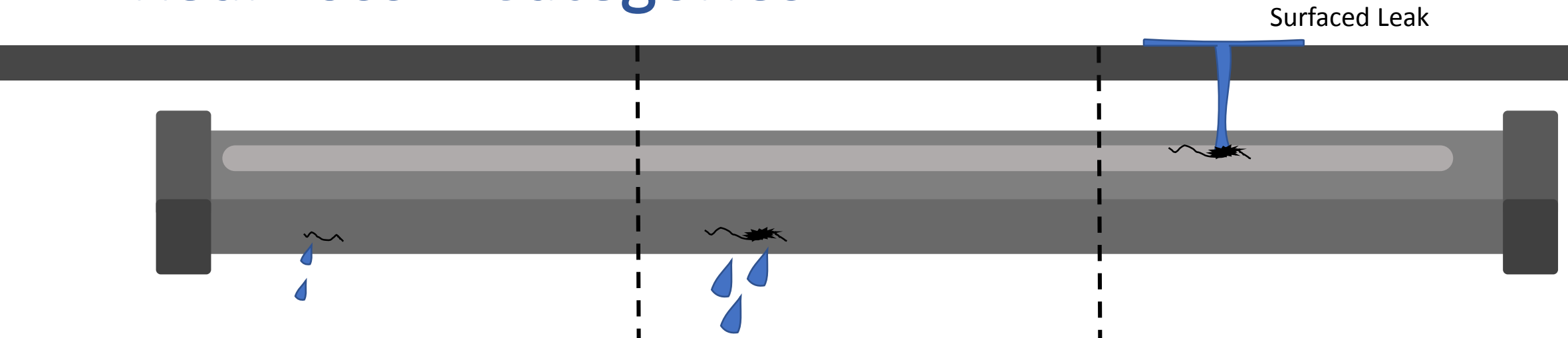
Process

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.

Analysis after the Water Audit



Real Loss – Categories



Background Leakage

Unreported and un-detectable using traditional acoustic equipment

Unreported Leakage

Detectable using traditional acoustic equipment.

Reported Leakage

Surfaced and is reported by public or utility staff.

Leakage Intervention

Pressure Management

Active Leakage Control

Improved Response Time

Current Annual Real Losses

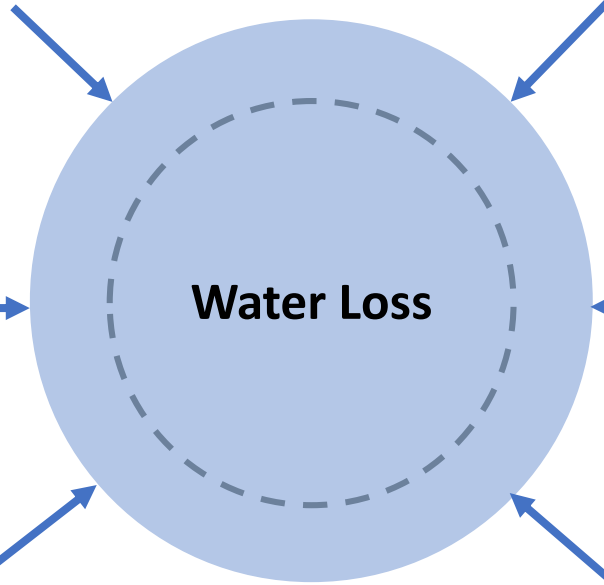
Economic Level of Real Losses

Unavoidable Annual Real Losses

Benefits of Water Loss Control

Data Management
Make sure you are billing for all the water you deliver.

Asset Management
Target assets for repair or replacement



Leak Detection
Find leaks so you can repair them.

Hydraulic Understanding
Refined understanding of system hydraulics.

Meter Management
Repair or replace large and small customer meters with an optimal schedule.

Pressure Management
Increase or reduce pressure where needed. Decrease the frequency and intensity of transients.

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

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

Water Supplied	Authorized Consumption	Billed Authorized Consumption	Billed Metered Consumption	Revenue Water
			Billed Unmetered Consumption	
		Unbilled Authorized Consumption	Unbilled Metered Consumption	Non-Revenue Water
			Unbilled Unmetered Consumption	
	Water Losses	Apparent Losses	Unauthorized Consumption	
			Customer Metering Inaccuracies	
			Systematic Data Handling Errors	
		Real Losses		

DSL = 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?

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

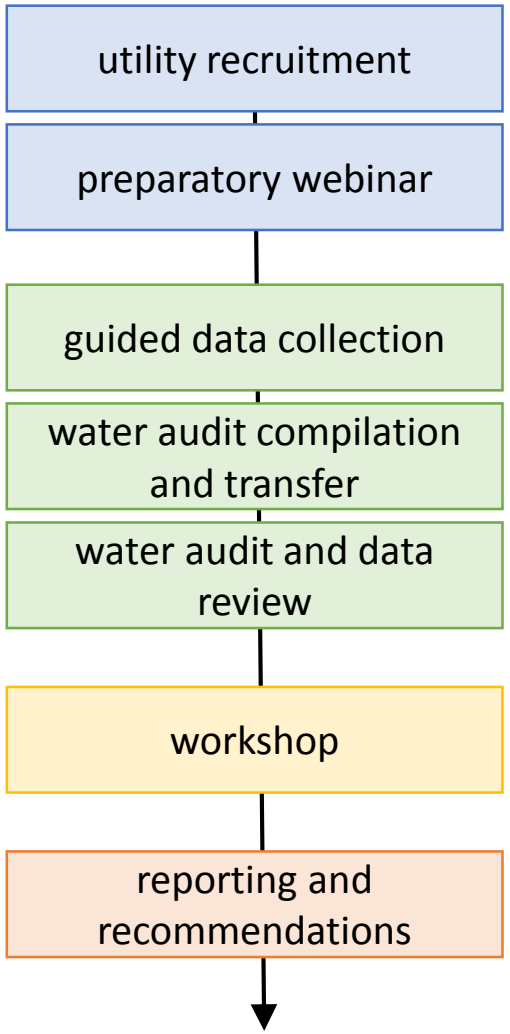
Stevens County Public Utilities Department – Suncrest

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

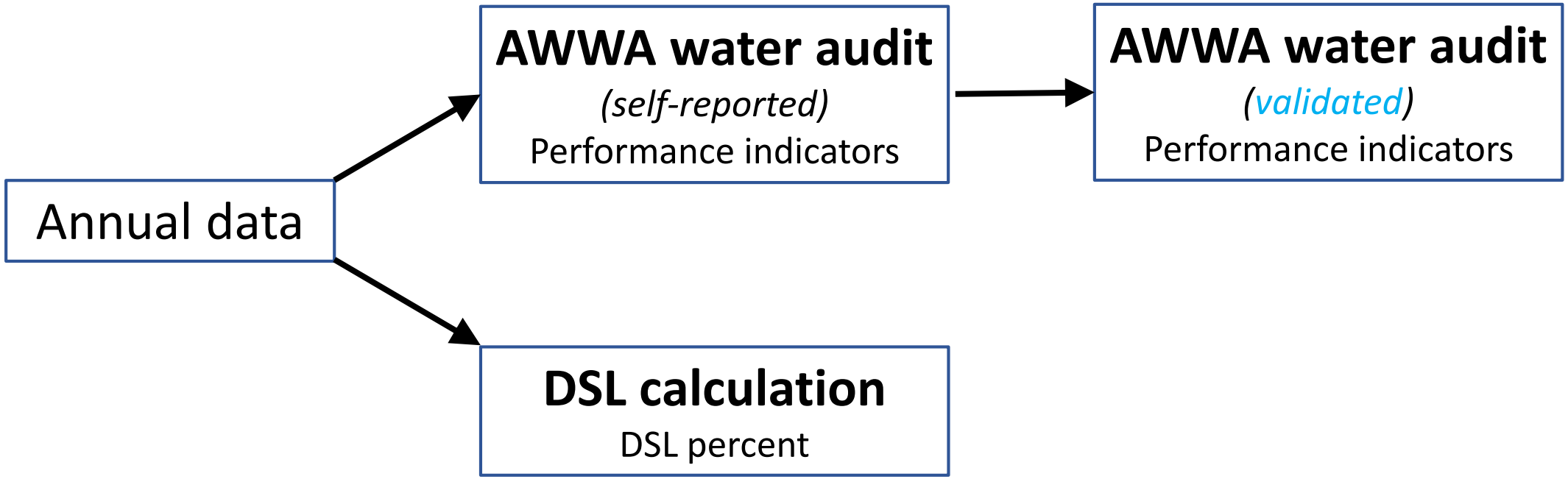
Hands-on water audit compilation and documentation

Data review and validation tailored to each participating utility

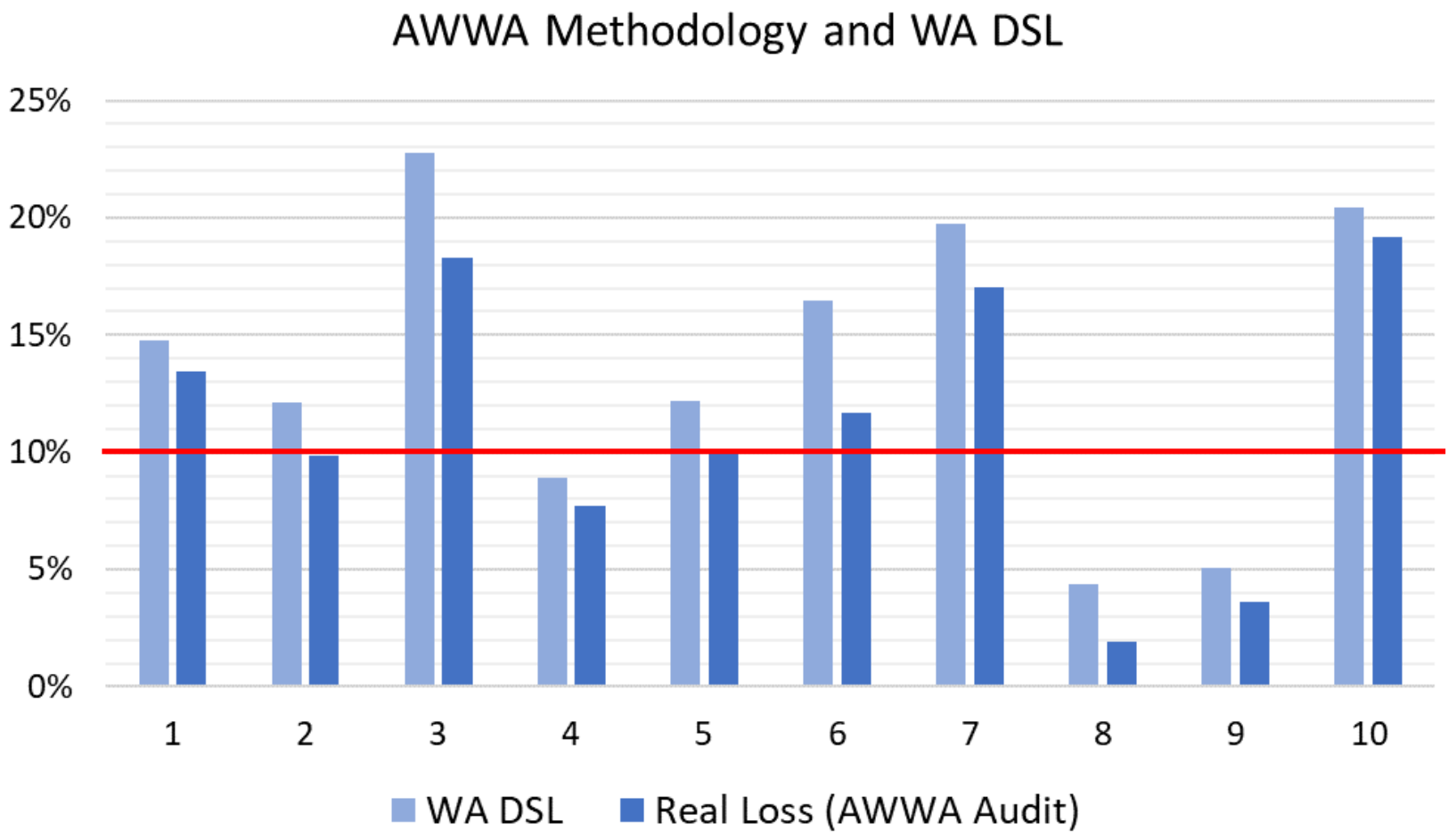
Water audit compilation and validation methodology
Utility-specific methodological and analytical support
Water loss control practices and strategy design

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

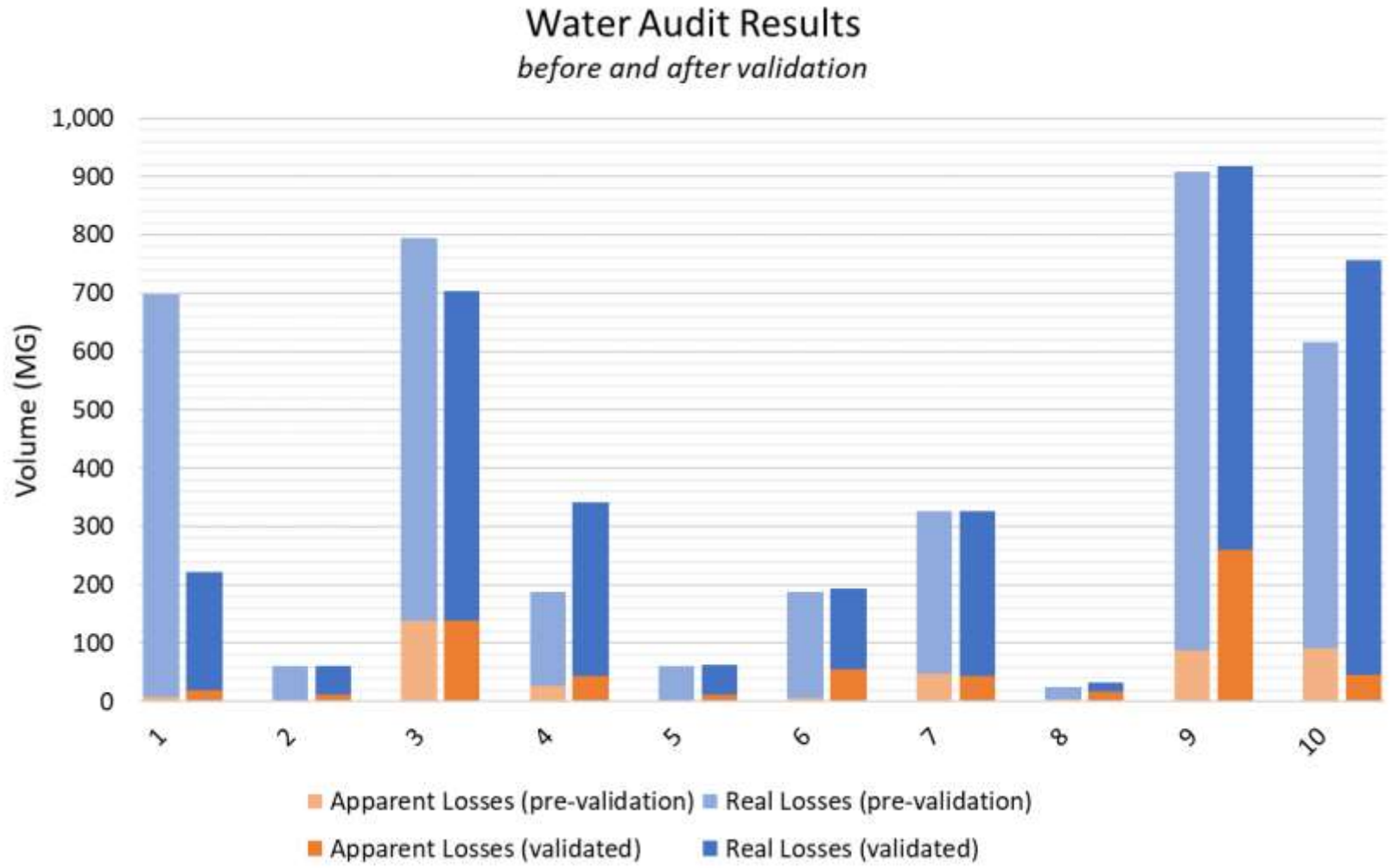
Results


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



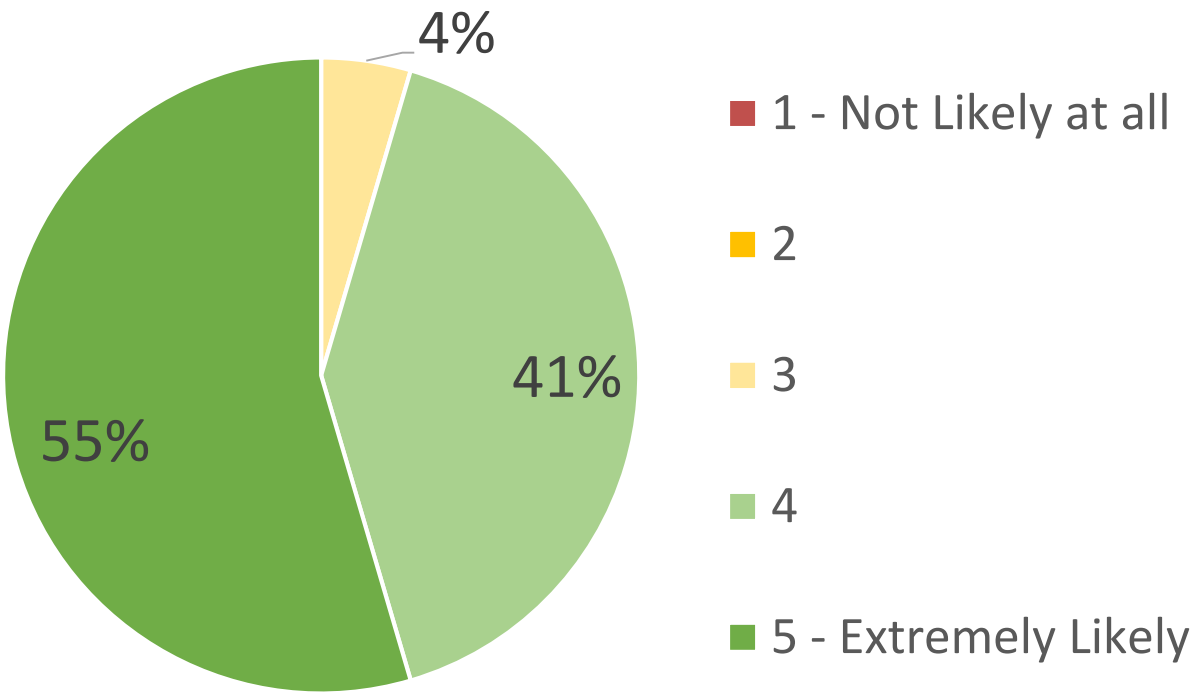
Program Feedback

"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**."

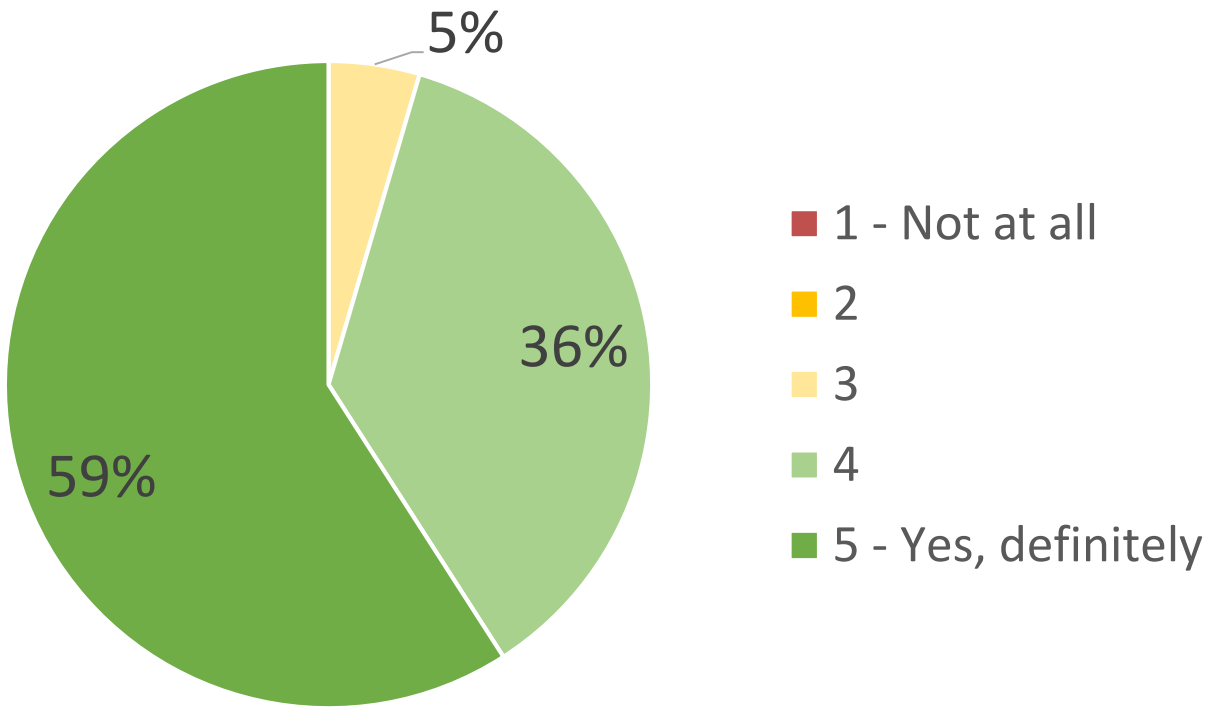
Program Feedback

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

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

Reflection and Wrap Up

- What did you learn today?
- What will you change? What will you continue to do?
- What's your top-priority action step?