

# This presentation premiered at WaterSmart Innovations

[watersmartinnovations.com](http://watersmartinnovations.com)





**CAVANAUGH**

*Stewardship Through Innovation*

# Preparing for the Future of Water Loss in Southern Nevada

**Drew Blackwell**

**NRW Program Manager**

**Cavanaugh & Associates, P.A.**

**[Drew.Blackwell@Cavaughnsolutions.com](mailto:Drew.Blackwell@Cavaughnsolutions.com)**





SOUTHERN NEVADA  
WATER AUTHORITY



LAS VEGAS VALLEY  
WATER DISTRICT™



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# What we'll be covering

Why a water  
loss program?

Program Design  
& Key Concepts

Outcomes

Question & Answer

Drew Blackwell

[drew.blackwell@cavanaugholutions.com](mailto:drew.blackwell@cavanaugholutions.com)

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# Why a water loss program?

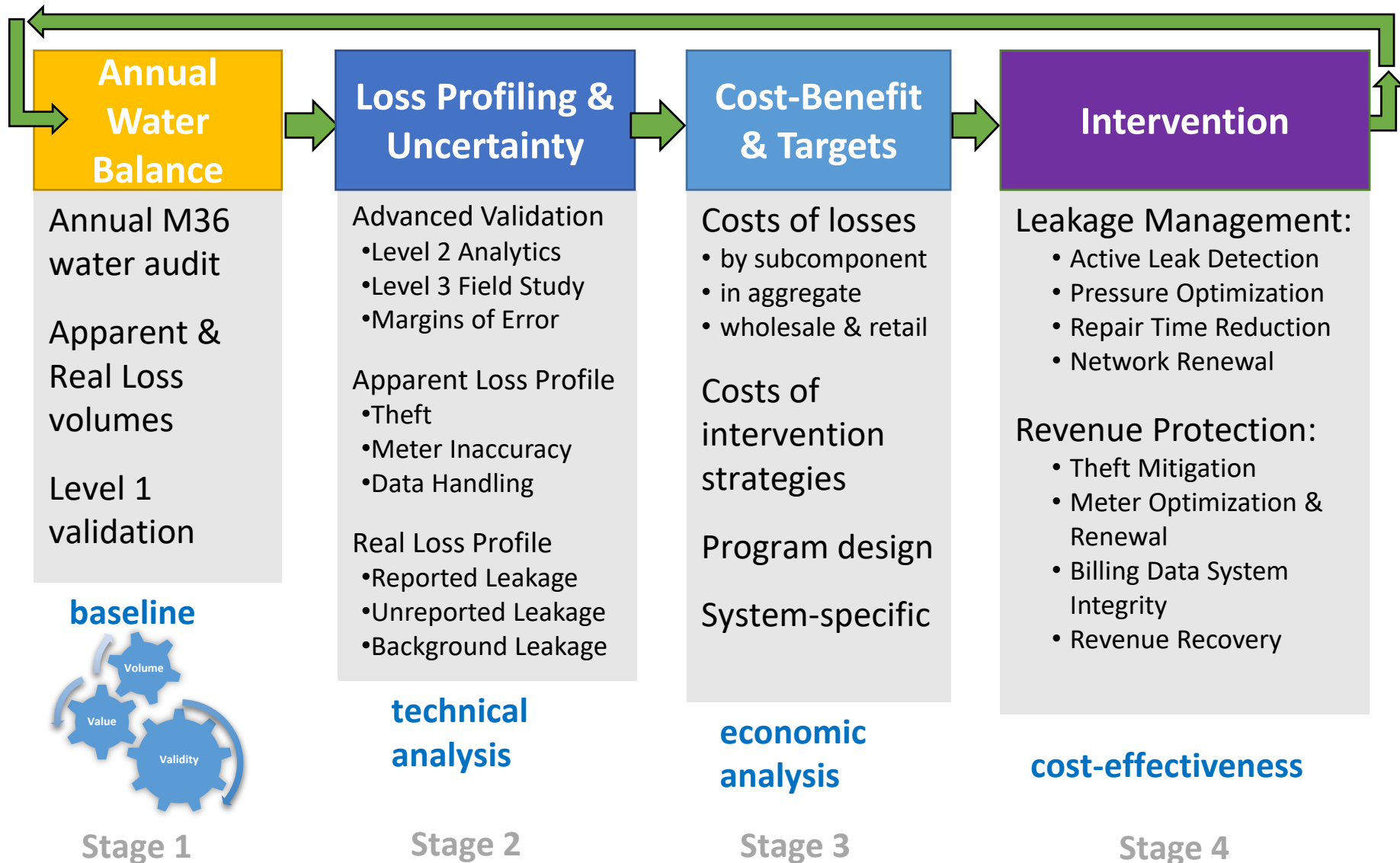
—

**Every** water system experiences water loss.

Establishing a baseline of validated water audit data is the anchor of a **successful** water loss strategy.

The AWWA methodology provides a path to building and progressing your **water loss program**.

# The Big Picture



# Water Loss Programs in North America





# Right Place at the Right Time

AWWA M36  
Manual, 5<sup>th</sup>  
Edition

WRF Guidance  
Manual for  
Water Audit  
Validation

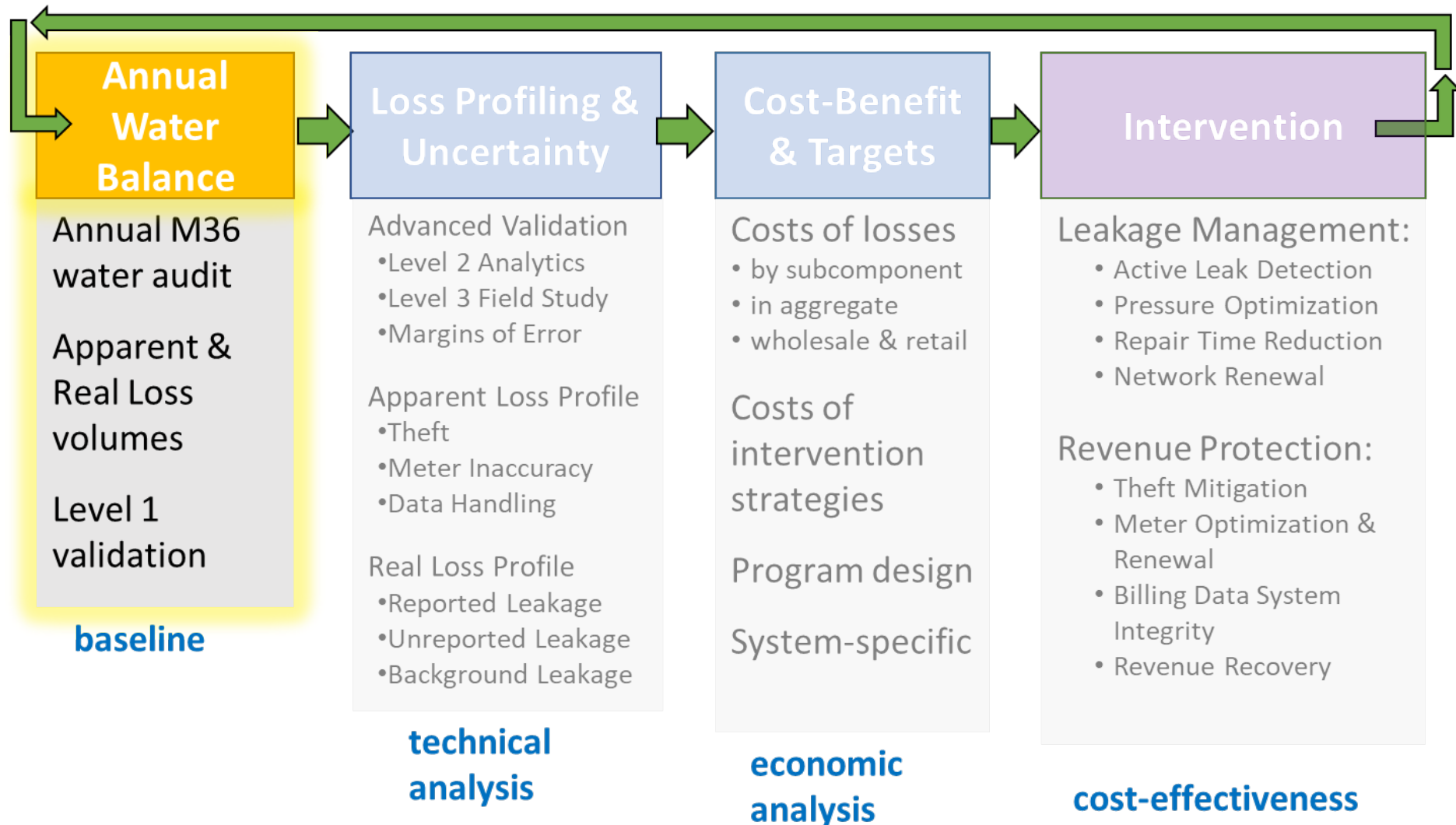
AWWA Water  
Audit Software  
Update  
(version 6)

Nevada  
Assembly Bill  
163

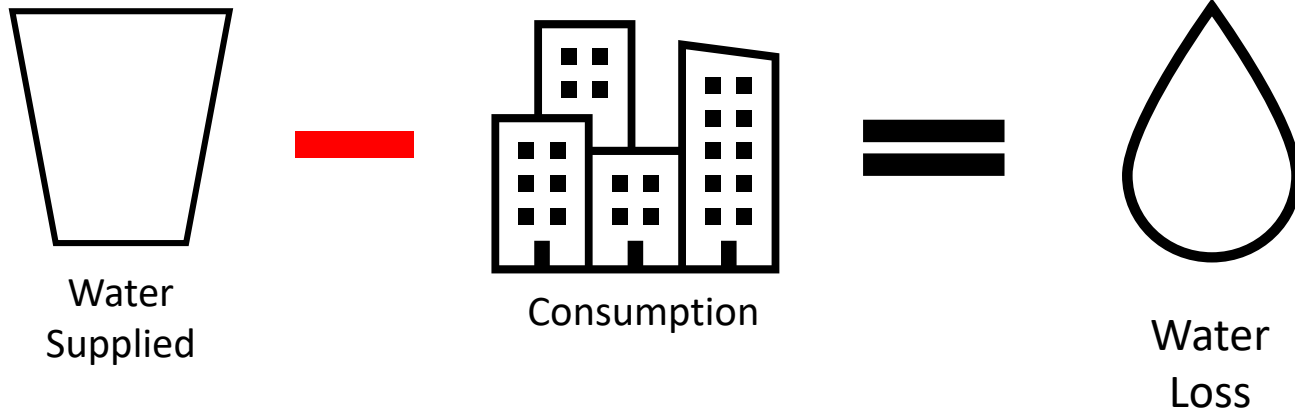


SOUTHERN NEVADA  
WATER AUTHORITY

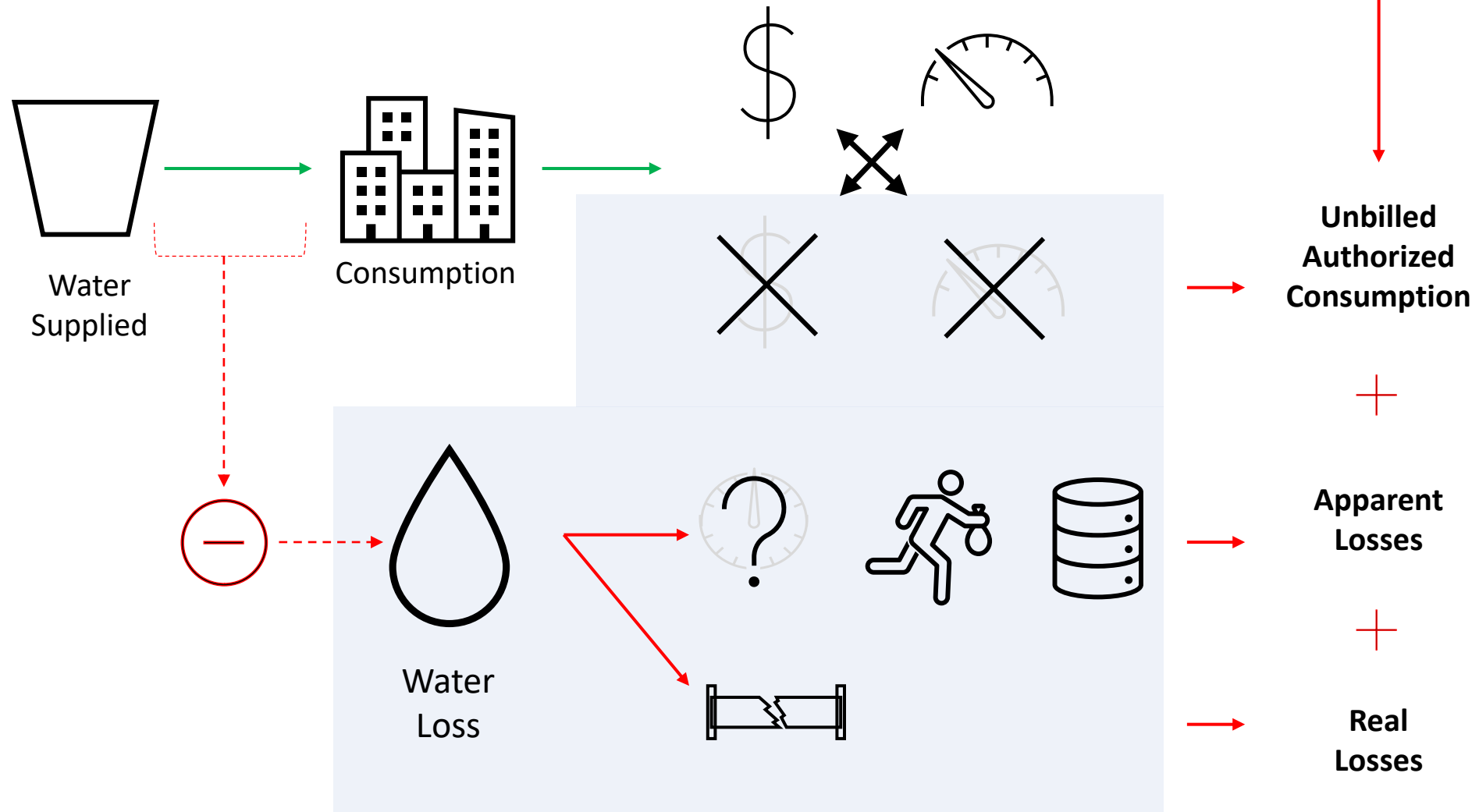
# Focus of SNWA Water Loss Program



# What is Water Loss?



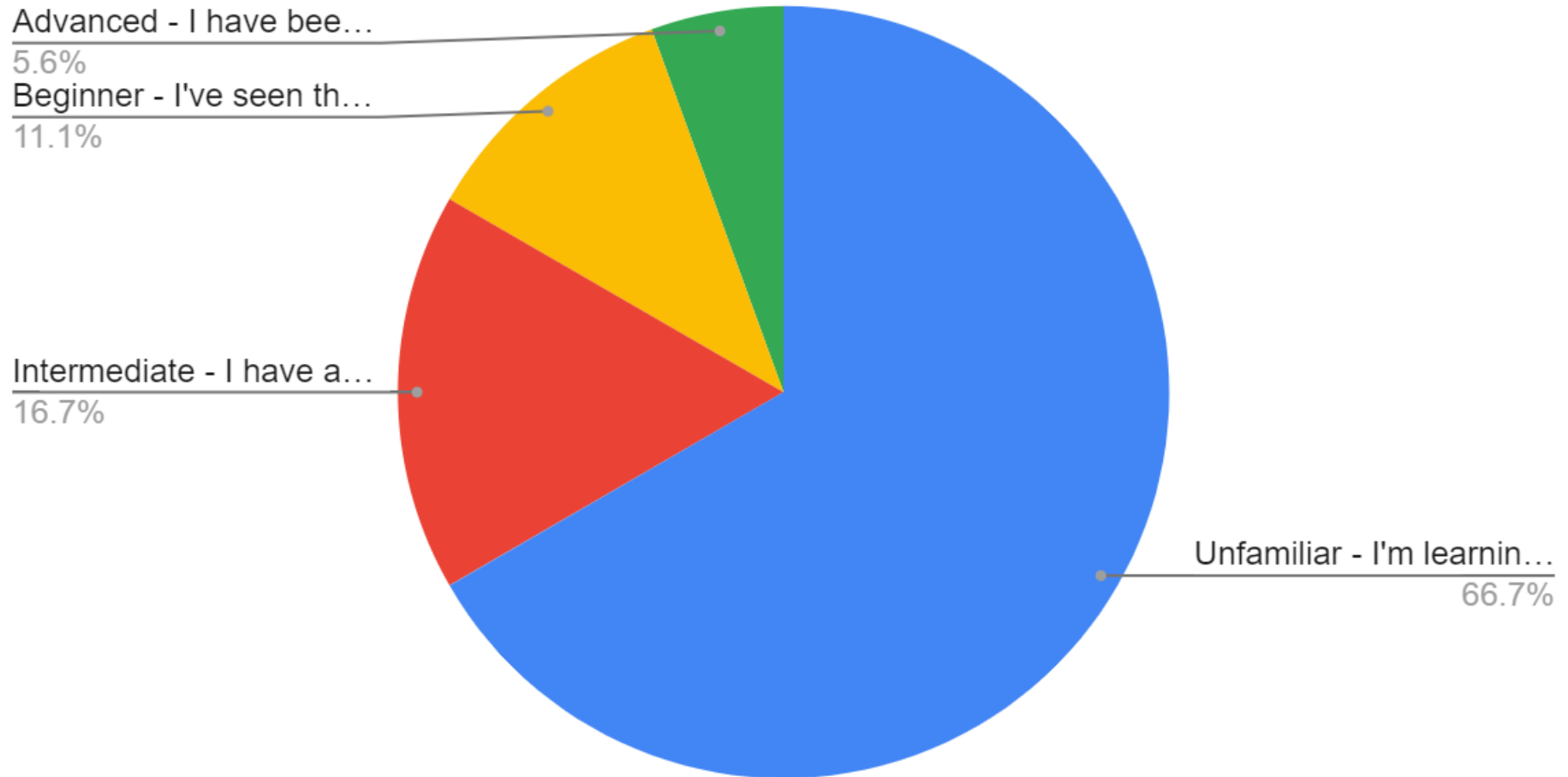
# What is Non-Revenue Water?



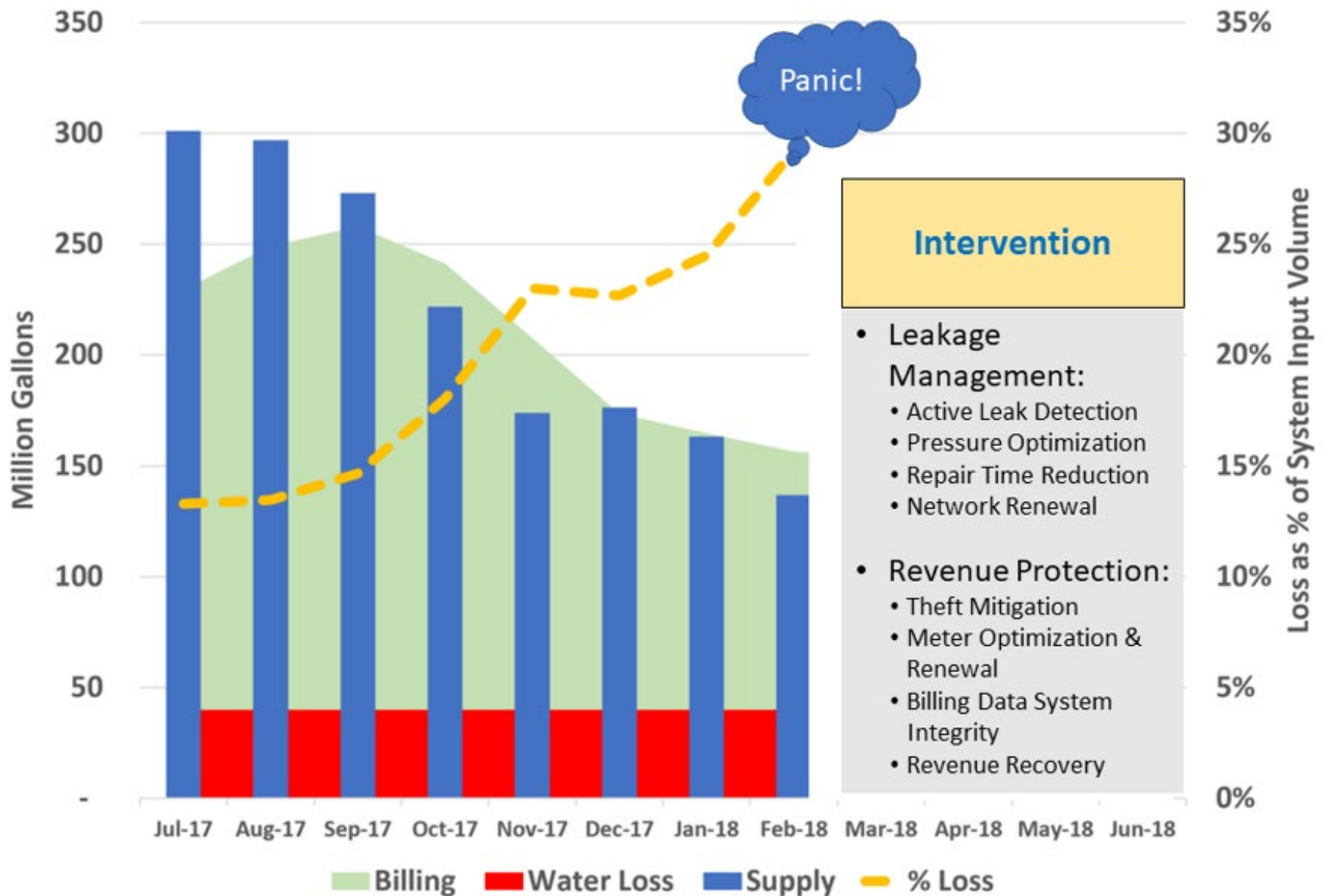
A diagram illustrating the three interlocking gears of the business model canvas. Three blue gears are arranged in a triangle, each with a different number of teeth: the top gear has 8 teeth and is labeled 'Volume', the bottom-left gear has 10 teeth and is labeled 'Value', and the bottom-right gear is the largest with 12 teeth and is labeled 'Validity'. Three curved arrows indicate a clockwise flow from Volume to Value, from Value to Validity, and from Validity back to Volume.

[illegible]

## Count of How familiar are you with the current version of AWWA Free Water Audit Software?



## Loss as % of SIV



# Economic Optimum Level of Intervention

Aggressive Intervention is **Over-Spending**

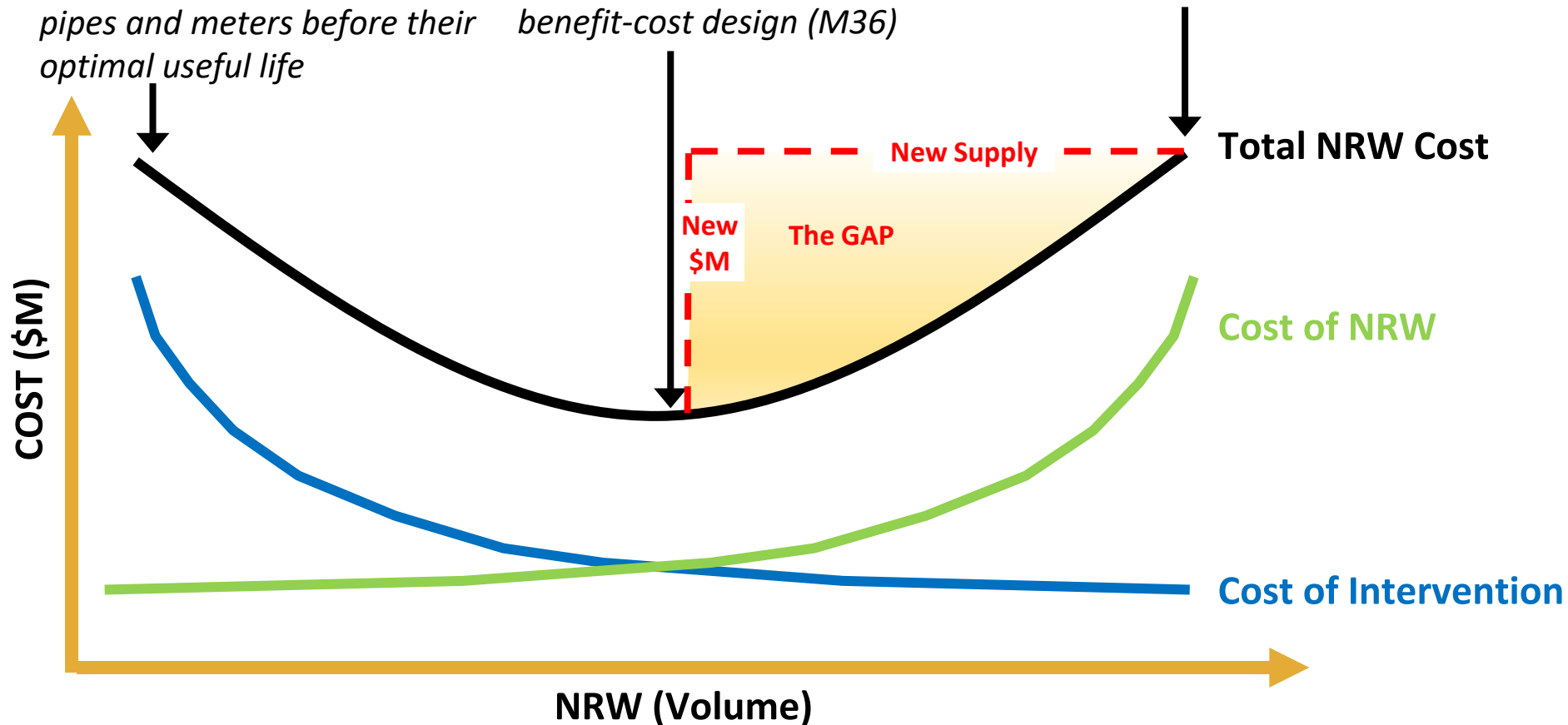
*Example: replacement of pipes and meters before their optimal useful life*

**Economic Optimum NRW & Intervention**

*Economic target from benefit-cost design (M36)*

Reactive Intervention is **Over-Spending**

*Example: fixing only leaks that surface, replacing meters only when they stop*





# Program Design & Key Concepts

—

# A quick note on some firsts in this program....

- Launched immediately after the release of AWWA Free Water Audit Software Version 6
- Shifted from in-person to totally remote

A man with a grey beard and mustache, wearing a blue and white plaid shirt, looking slightly to the right. Behind him is a bookshelf filled with books and papers, with a "DAD" sign on top.

Will Riggs (Guest)

A man with glasses and a beard, wearing a red jacket, against a virtual background of a beach with palm trees and a lifeguard stand.

Larry Lewison

A man with short dark hair, wearing a dark blue sweater over a collared shirt, looking down. A lamp is visible in the background.

Drew Blackwell

A man with short grey hair, wearing a red and white checkered shirt, looking forward.

Steve Cavanaugh

A woman with long blonde hair, wearing a light-colored top, looking forward. A framed abstract painting is on the wall behind her.

Sharla Gibson

A man with glasses, wearing a light blue shirt, looking to the left. He is in an office with a bookshelf and a window with blinds.

Mike Dishari

SS

R

CH

SG

CA

CM

NS

JL

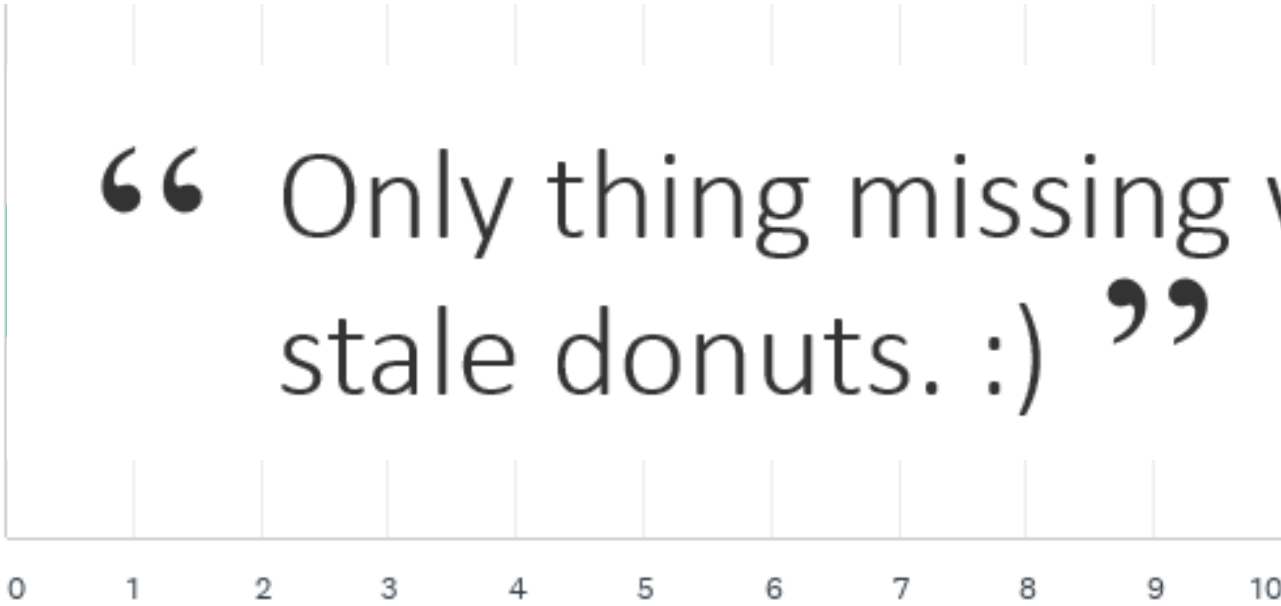
BM



vibe



On a scale of 1 to 10, how effective do you think the virtual workshop format was for the goals of teaching key concepts and utility-specific application? (1 being not effective at all, and 10 being highly effective)



“ Only thing missing was  
stale donuts. :) ”



## Establish Your Team

- Supply Metering
- Customer Metering
- Billing/Finance
- Management





*Assistant General Manager/COO*

*Customer Metering*

*Communications Director/PIO*

*Public Works  
Director*

*Finance*

*Operations Supervisor*

*Billing*

Who should be a part of my Water Loss Control Team?




## Gather Data & Compile Water Audit

- **2019 Data**
- Data Request Sheet/Supporting Documentation
- Water Audit: Inputs & Data Validity Grades




# Assemble the Supporting Documentation

Example of Supporting Documentation for all Water Supplied Volumes



**Southern Nevada Water Authority**  
Water Loss Program



**CAVANAUGH**  
Stewardship Through Innovation

Volume from Own Sources, Water Imported, Water Exported  
UNITS = MG

| Well 3 | Export E-1 | Monthly Distribution Totals |
|--------|------------|-----------------------------|
| 45.61  | -          | 197.60                      |
| 30.59  | -          | 256.68                      |
| 36.22  | -          | 304.67                      |
| 32.58  | -          | 257.74                      |
| 32.04  | -          | 246.59                      |
| -      | 5.18       | 191.36                      |
| 32.85  | 45.79      | 151.72                      |
| 35.91  | 22.46      | 126.58                      |
| 64.49  | -          | 154.46                      |
| 61.89  | -          | 123.32                      |
| 61.18  | -          | 120.17                      |
| 65.44  | -          | 183.87                      |

**WELCOME TO THE SOUTHERN NEVADA WATER AUTHORITY WATER LOSS SITE**

This site has been developed for participants of the Southern Nevada Water Authority Water Loss Program.

**Enter**

Month

|                           | May 2017 | June 2017 |
|---------------------------|----------|-----------|
| Single Family Residential | 31.15    | 32.8      |
| Multi Family Residential  | 16.07    | 15.5      |
| Commercial/Institutional  | 12.67    | 14.2      |
| Industrial                | 1.20     | 1.4       |
| Landscape Irrigation      | 10.02    | 7.5       |
| Municipal                 | 3.45     | 2.8       |
| Water Department          | 1.42     | 1.1       |
| Recycled                  | 8.53     | 9.11      |

**WATER AUDIT TOTALS**  
*excludes recycled water account*

|  |             |                                  |
|--|-------------|----------------------------------|
| Billed Metered Authorized Consumption:     | 1,051.33 MG | includes SF Residential, MF Re:  |
| Billed Unmetered Authorized Consumption:   | N/A         | all billed customers have a me   |
| Unbilled Metered Authorized Consumption:   | 17.27 MG    | this includes our own facility u |
| Unbilled Unmetered Authorized Consumption: |             | this includes minimal flushing,  |

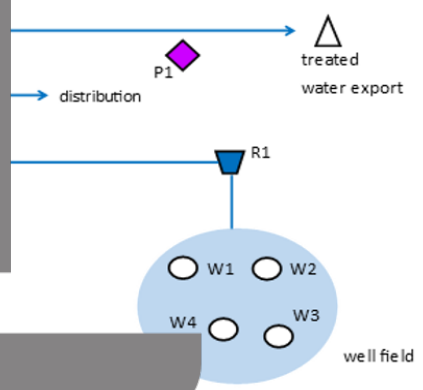
Potable line

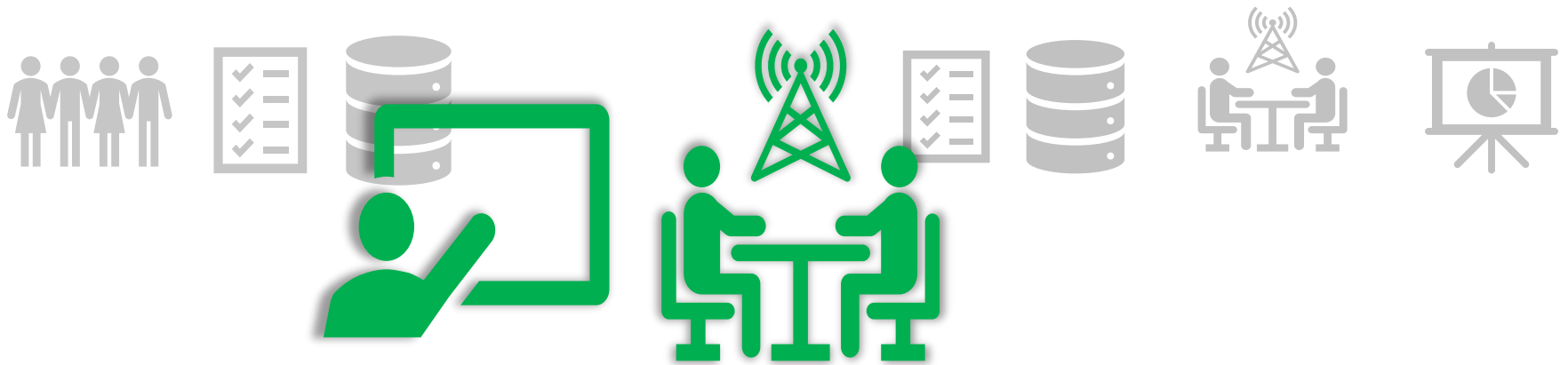
Raw line

Pumping stations

Storage Tank

Well Meter

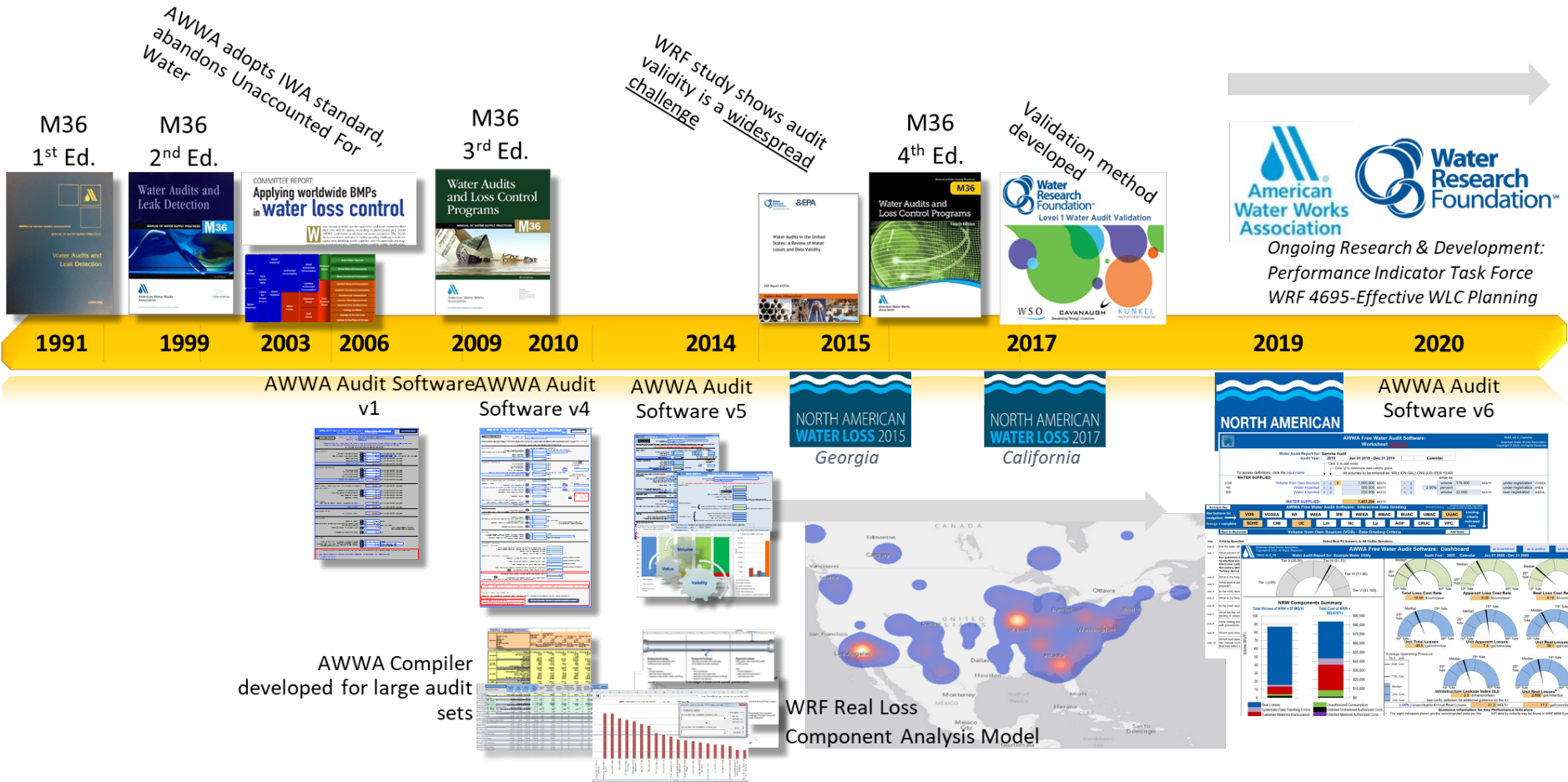




## Workshop and Level 1 Validation Session

- **Learning:** Key Concepts of Water Auditing and Loss Control Programs (AWWA M36 Methodology)
- **Application:** Breakout Level 1 Validation Sessions (2019 Data)

# AWWA M36 Methodology – Water Auditing & Loss Control



# AWWA Free Water Audit Software



**Water Audit Report for:** Pre-Release Example Audit - Review Only  
**Audit Year:** 2019 Jan 01 2019 - Dec 31 2019 Calendar

Click 'n' to add notes  
 Click 'g' to determine data validity grade

To access definitions, click the input name

All volumes to be entered as: MILLION GALLONS (US) PER YEAR

**WATER SUPPLIED**

Volume from Own Sources: n g 7 1,000.000 MG/Yr  
 Water Imported: n g 0 0 MG/Yr  
 Water Exported: n g 0 0 MG/Yr

**WATER SUPPLIED:** 990.099 MG/Yr

**AUTHORIZED CONSUMPTION**

Billed Metered: n g 9 850.000 MG/Yr  
 Billed Unmetered: n g 0 0 MG/Yr  
 Unbilled Metered: n g 0 0 MG/Yr  
 Unbilled Unmetered: n g 4 15.000 MG/Yr

**AUTHORIZED CONSUMPTION:** 865.000 MG/Yr

**WATER LOSSES**

**Apparent Losses**

Default option selected for Systematic Data Handling Errors, with automatic data grading of 3

Systematic Data Handling Errors: n g 3 2.125 MG/Yr  
 Customer Metering Inaccuracies: n g 1 8.586 MG/Yr  
 Unauthorized Consumption: n g 3 2.125 MG/Yr

Default option selected for Unauthorized Consumption, with automatic data grading of 3

**Apparent Losses:** 12.836 MG/Yr

**Real Losses**

**Real Losses:** 112.263 MG/Yr

**WATER LOSSES:** 125.099 MG/Yr

**NON-REVENUE WATER**

**NON-REVENUE WATER:** 140.099 MG/Yr

**SYSTEM DATA**

Length of mains: n g 1 200.0 miles (including fire hydrant lead lengths)  
 Number of service connections: n g 5 5,000 (active and inactive)  
 Service connection density: 25 conn./mile main

Are customer meters typically located at the curbstop/property? Yes  
 n g 10 0

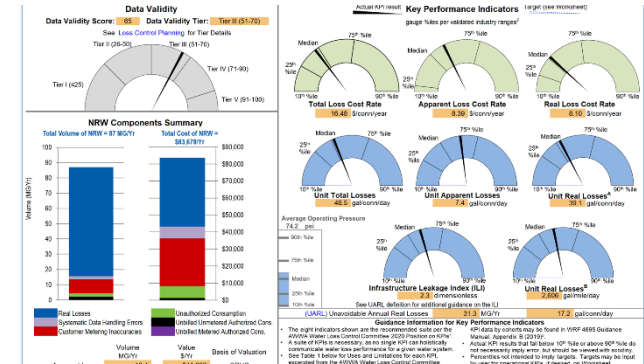
Average length of customer service line has been set to zero and a data grading of 10 has been applied

**Average Operating Pressure:** n g 3 50.0 psi

**COST DATA**

Customer Retail Unit Charge: n g 7 \$2.00 \$/1000 gallons (US)  
 Variable Production Cost: n g 3 \$500.00 \$/Million gallons

**Total Annual Operating Cost:** \$2,500,000 \$/yr (optional input)



Industry Standard  
(M36)

Free

Defaults provided

~13 Volume Inputs

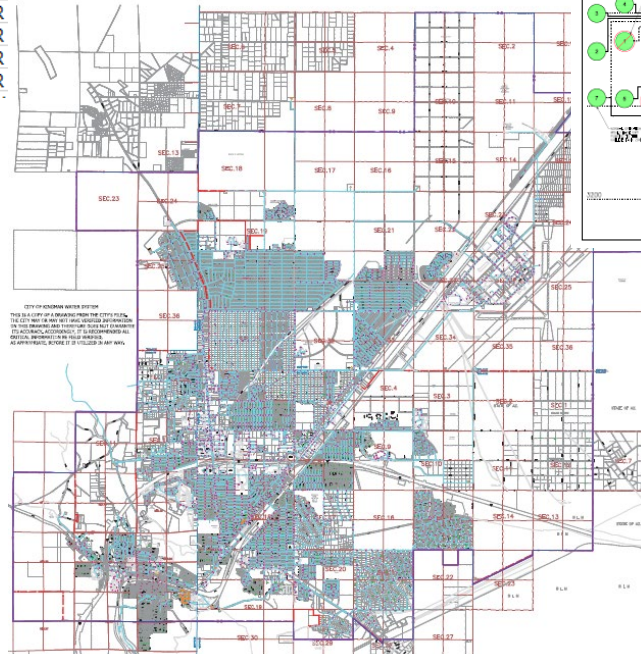
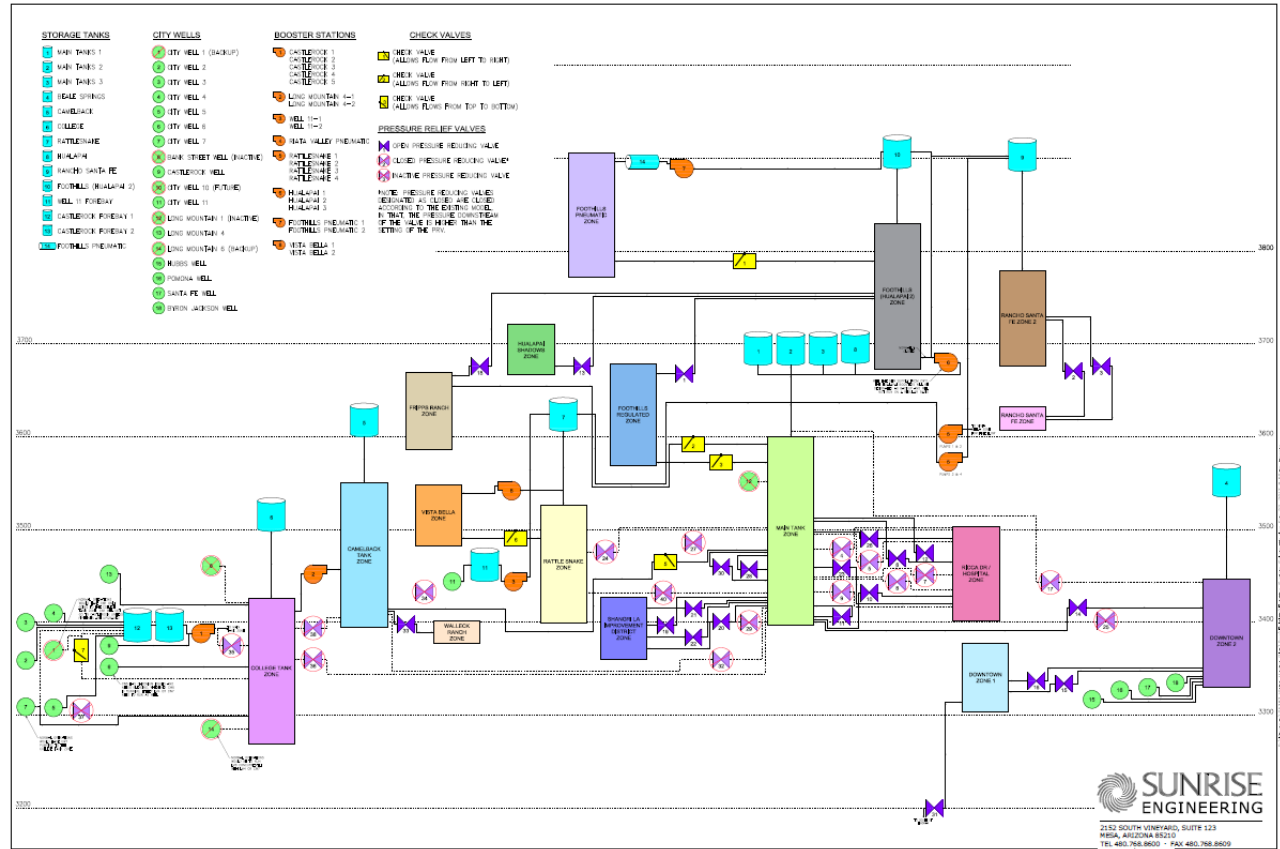
~7 System Data Inputs

[www.awwa.org/waterlosscontrol](http://www.awwa.org/waterlosscontrol)

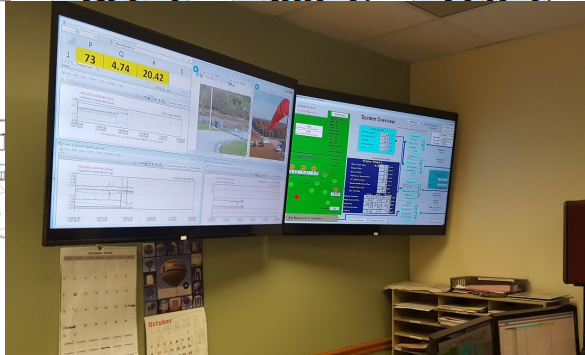


# Level 1 Validation Efforts

| Service | Customer | Location | Location Address           | Depart   |
|---------|----------|----------|----------------------------|----------|
| WA      | 6        | 41017    | KART Building              | Building |
| IR      | 6        | 505      | 301 N. Fifth St.           | Building |
| WA      | 6        | 505      | 301 N. Fifth St.           | Building |
| IR      | 6        | 37507    | Fire Hydrant               | Contract |
| IR      | 6        | 23723    | S Side I-40/Fairgrounds SS | Contract |
| WA      | 6        | 2913     | 1650 Harrison St.          | Fire De  |
| WA      | 6        | 7737     | 3345 Harrison St.          | Fire De  |
| WA      | 6        | 12857    | 302 Eastern St.            | Fire De  |
| WA      | 6        | 26931    | 4000 Sierra Rd.            | Fire De  |
| WA      | 6        | 33765    | Tank Haul                  | Fire De  |
| WA      | 6        | 33769    | Tank Haul                  | Fire De  |
| WA      | 6        | 33771    | Tank Haul                  | Fire De  |
| IR      | 6        | 40831    | Fire Hydrant               | Fire De  |
| WA      | 6        | 5503     | 3000 Fairfax St.           | Golf Co  |
| IR      | 6        | 23757    | Golf Course                | Golf Co  |
| WA      | 6        | 23875    | 1001 Gates Ave.            | Golf Co  |
| IR      | 6        | 25049    | 1003 Gates Ave.            | Golf Co  |
| WA      | 6        | 25049    | 1003 Gates Ave.            | Golf Co  |
| IR      | 6        | 25051    | 1005 Gates Ave.            | Golf Co  |
| IR      | 6        | 25053    | 1007 Gates Ave.            | Golf Co  |
| IR      | 6        | 25055    | 1009 Gates Ave.            | Golf Co  |
| WA      | 6        | 27099    | 1011 E. Gates Ave.         | Golf Co  |
| IR      | 6        | 28703    | 1013 Gates Ave.            | Golf Co  |
| WA      | 6        | 40965    | 402 E. Andy Devine         | Grants   |
| WA      | 6        | 40965    | 402 E. Andy Devine         | Grants   |
| IR      | 6        | 41017    | Eastern Parkway            | Grants   |



|  | J     | K     | L     | M       | N           | P |
|--|-------|-------|-------|---------|-------------|---|
|  | Dec-1 | Jan-1 | Feb-1 | Mar-1   | Grand Total |   |
|  |       |       |       | 201988  | 2652965     |   |
|  |       |       |       | 0       | 625149.2    |   |
|  |       |       |       | 0       | 607399.1    |   |
|  |       |       |       | 17657   | 1158169     |   |
|  |       |       |       | 42726.6 | 1023072.2   |   |
|  |       |       |       | 0.2     | 513648.5    |   |
|  |       |       |       | 0       | 332791      |   |
|  |       |       |       | 0713.4  | 407113.2    |   |



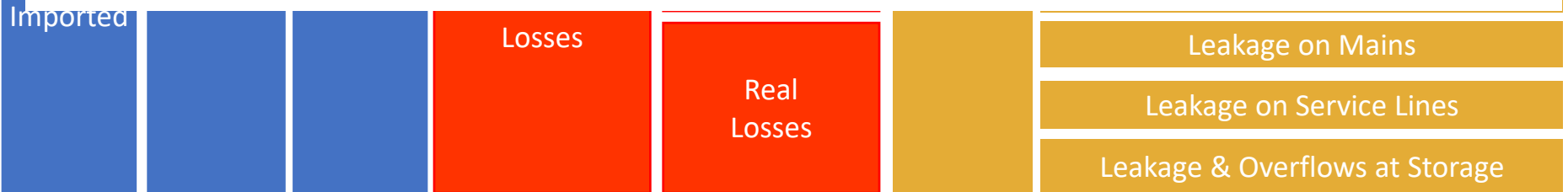
# The Water Balance & Water Auditing



# Water balance

The summary of key water audit data that shows water management from source to customer, with the sum of quantities in all columns equal and thus balancing.

*M36 Water Auditing and Loss Control Programming, 4<sup>th</sup> Ed.*



# Level 1 Validation



## **WRF PROJECT 4639:**

*ESTABLISHING WATER UTILITY GUIDANCE AND  
METHODOLOGY FOR WATER AUDIT VALIDATION*

**Data validation** – a quality control process conducted to the water audits submitted by water utilities. verify, and improve as needed, the data inputs and gradings of

**Water Loss Audit validation** – does not make data inputs or gradings “right” or “wrong”, but merely aligns them with the actual conditions that occurred in the operation of the utility for the audit year

Level 1 -- Top down Data Review

Level 2 -- Top down Data Mining Review

Level 3 -- Bottom up Field Investigation

## Purpose of Level 1 Validation

1. Review of audit methodology and volume determination
2. Review of Data Validity Grade selection

# Data Validity Grading

v6

Test Utility  
2019

AWWA Free Water Audit Software: Interactive Data Grading

acronym key

VOS
VOSEA
WI
WIEA
WE
WEEA
BMAC
BUAC
UMAC
UUAC

SDHE
CMI
UC
Lm
Nc
Lp
AOP
CRUC
VPC

White = incomplete  
Orange = complete  
Use acronyms for navigation

FWAS v6.0\_Gamma. American Water Works Association. Copyright © 2020, All Rights Reserved.

Limiting criteria  
(see Start Page for details)

go to input

Volume from Own Sources (VOS) - Data Grading Criteria

go to notes

| vos                                    | Criteria Question   | Select Best-Fit Answers to All Visible Questions                               |          |
|--|---|--|----------|
| vos.0                                  | Did the water utility supply any water from its own sources during the audit year?  | Yes  |          |
| vos.1                                  | What percent of own supply volume is metered?   | >99%   |          |
|  | <p><b>For questions 2-10 below: Choose the answer that applies for those meters that measure &gt;90% of the finished water volume.</b></p> <p><b>In-situ flow accuracy testing</b> refers to a test process that confirms the flow measuring accuracy of the primary device (the flowmeter), in its installed location.</p> <p><b>Electronic calibration</b> refers to a process that checks for error in the metering secondary device(s) and/or the tertiary device(s).</p> <p><b>Secondary device</b> can include meter transmitter, DP cell, chart recorder or similar instrumentation.</p> <p><b>Tertiary device</b> can include SCADA, historian or other computerized archival system.</p> |  |          |
| vos.2                                  | What is the frequency of electronic calibration?  | Annually   |          |
| vos.3                                  | What level of data transfer errors are checked as part of the electronic calibration process?   | Data transfer errors are checked at secondary device(s) AND tertiary device(s) |          |
| vos.4                                  | Is the most recent electronic calibration documentation available for review?   | Yes  |          |
| vos.5                                  | What is the frequency of in-situ flow accuracy testing?   | Less than annual but within last 5 years                                       | Limiting |
| vos.6                                  | Is the most recent in-situ flow accuracy testing documentation available for review?  | Yes  |          |
| vos.7                                  | What are the total volume-weighted average results of in-situ flow accuracy testing (during or closest to audit year)?  | At or within ±3%   |          |
| vos.8                                  | Have testing and calibration procedures been closely scrutinized for compliance with procedures described in the AWWA M36 and/or M33 Manual(s)?   | Yes  |          |
| vos.9                                  | Which best describes the frequency of finished water meter readings?  | Continuous   |          |
| vos.10                                 | Which best describes the frequency of data review for anomalies/errors? These can include numbers that are outside of typical patterns, and zero or 'null' values that may reflect a gap in data recording.   | Daily  |          |
| FINAL DATA GRADE FOR THIS AUDIT INPUT: |   | 7  |          |

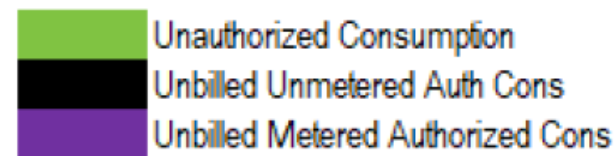
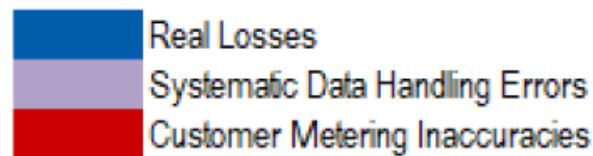
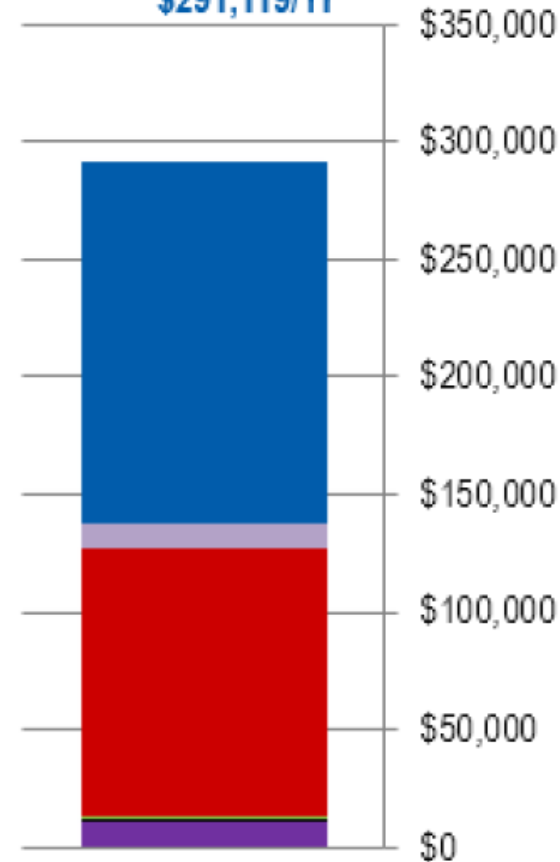
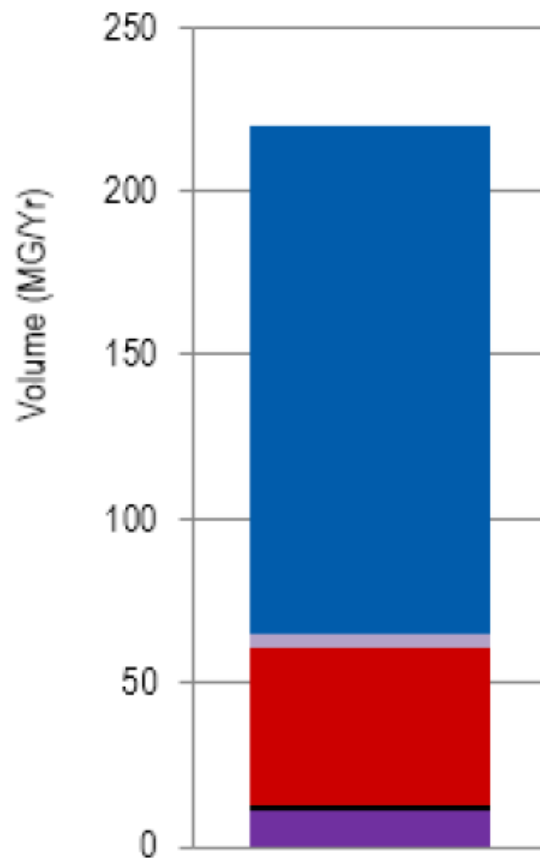


# NRW Profile

## NRW Components Summary

Total Volume of NRW = 220 MG/Yr

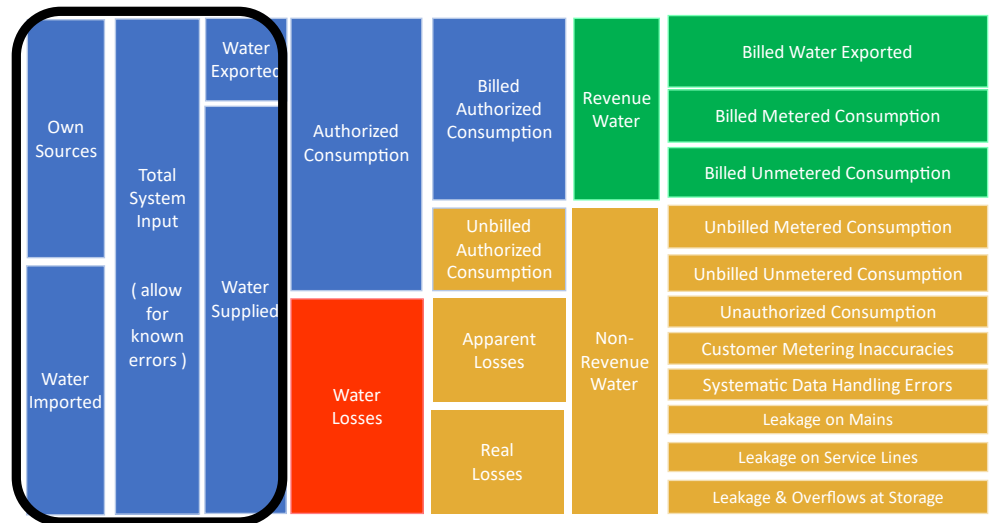
Total Cost of NRW =  
\$291,119/Yr



# Supply Meter Testing

## Potential Errors in Water Supplied

- Meter wear
- Meter location
- Meter selection
- Meter data transfer
- Flow data archiving



# Customer Meter Testing

## Goals:

- Study accuracy of the meter stock
- Calculate an Apparent Loss volume\* due to metering inaccuracy
- Inform proactive management of meter stock's accuracy



***in the Water Balance, our understanding of Apparent Losses  
directly impacts our understanding of Real Losses***



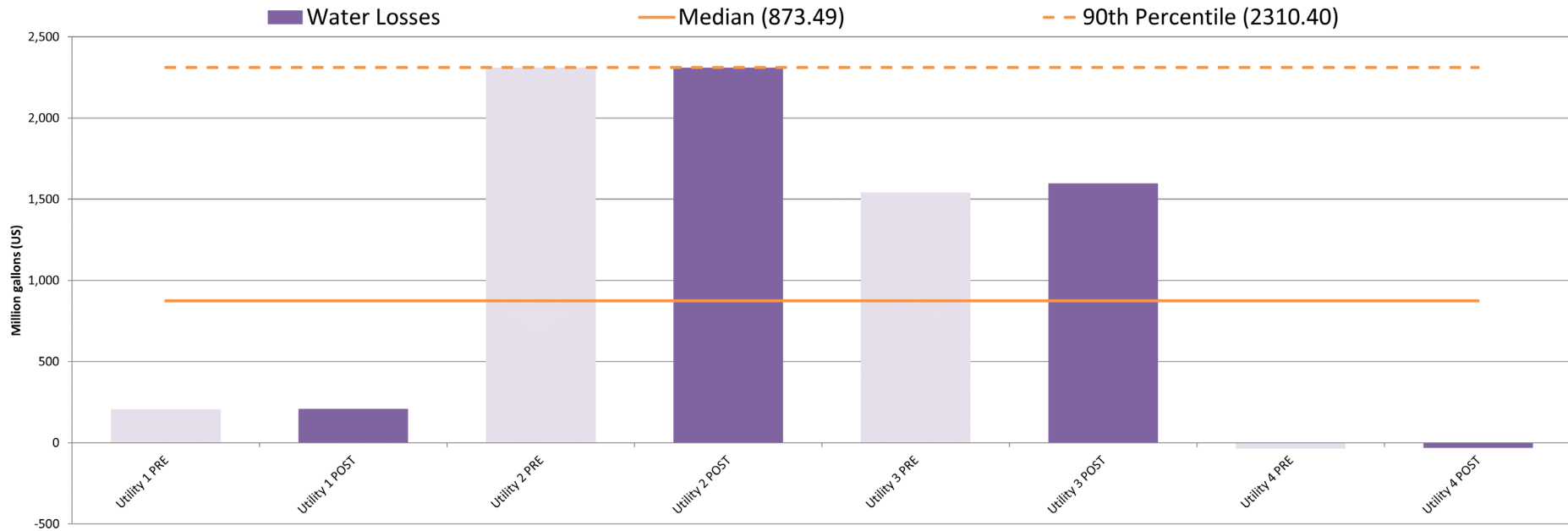
## Rinse & Repeat with 2020 data

- Data Gathering and Water Audit Compilation
- Level 1 Validation Sessions (2020 Data)

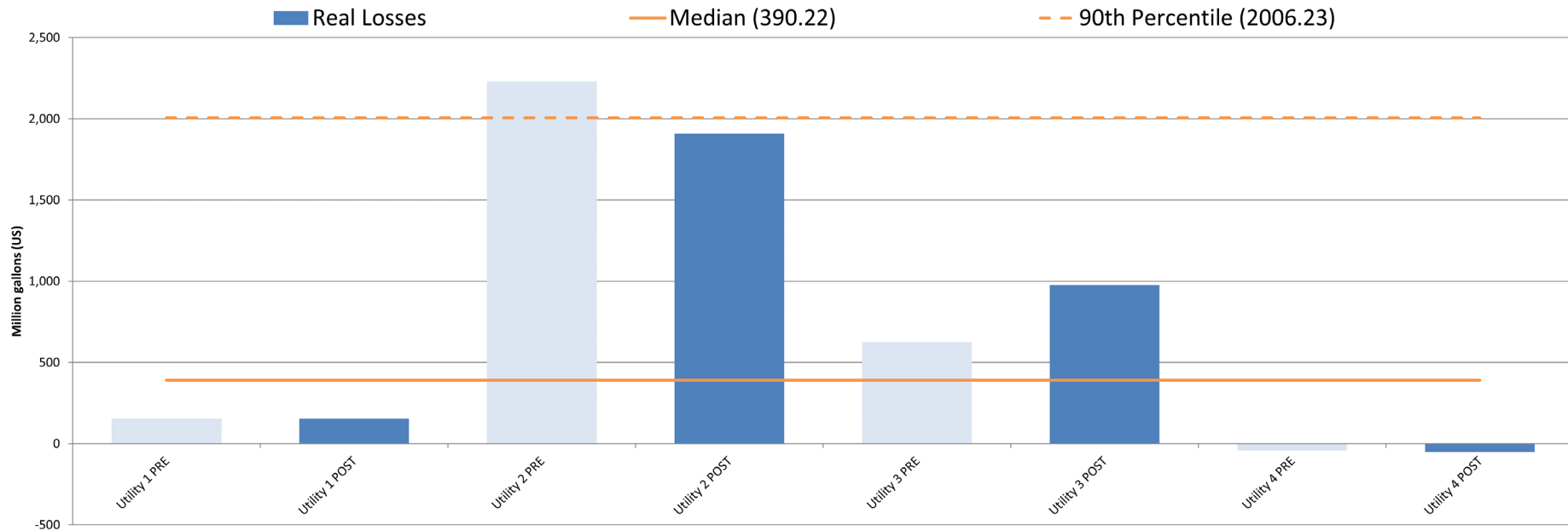
# Outcomes

—

# Water Loss by volume - 2019

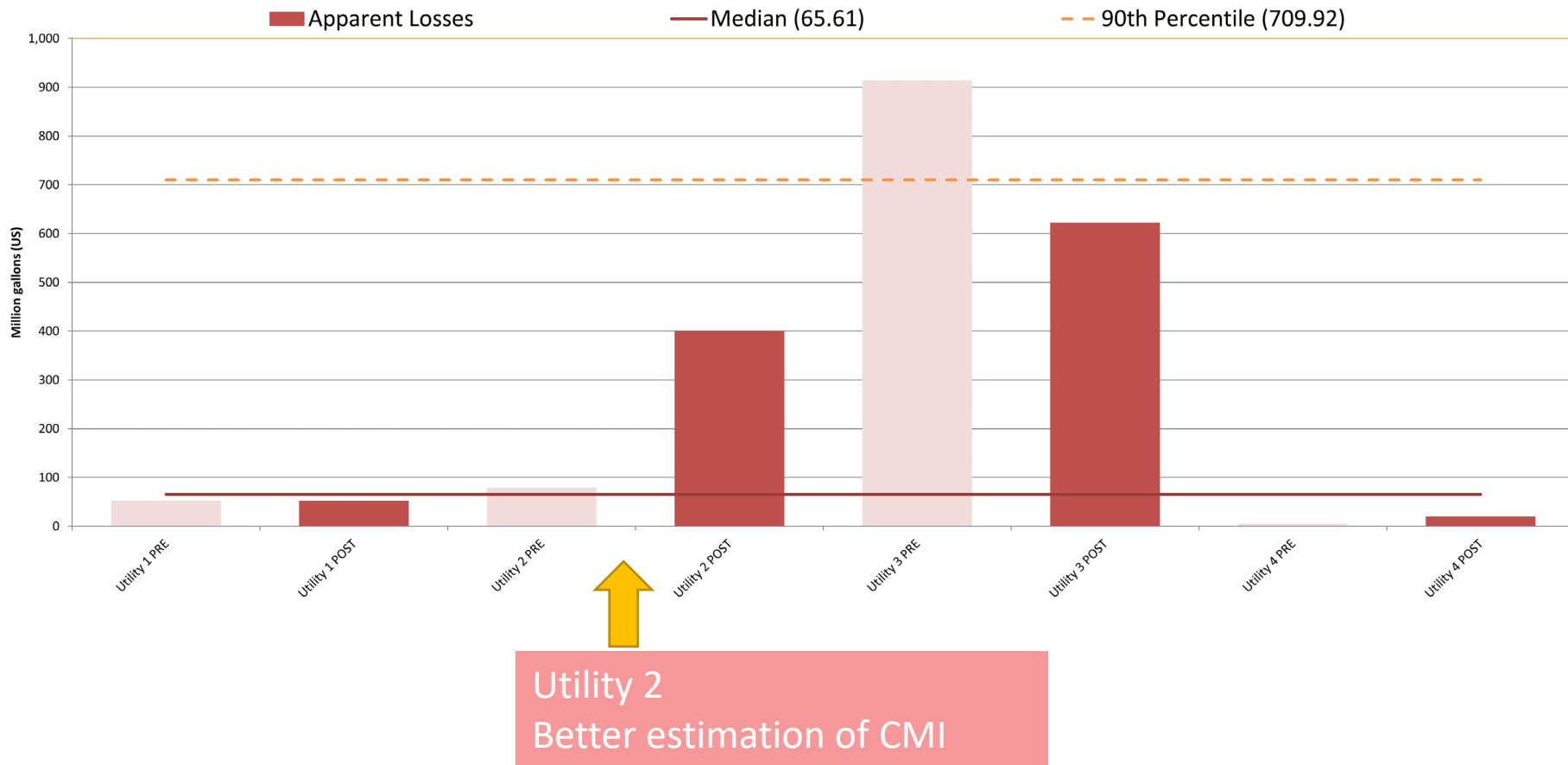


# Real Loss by volume - 2019



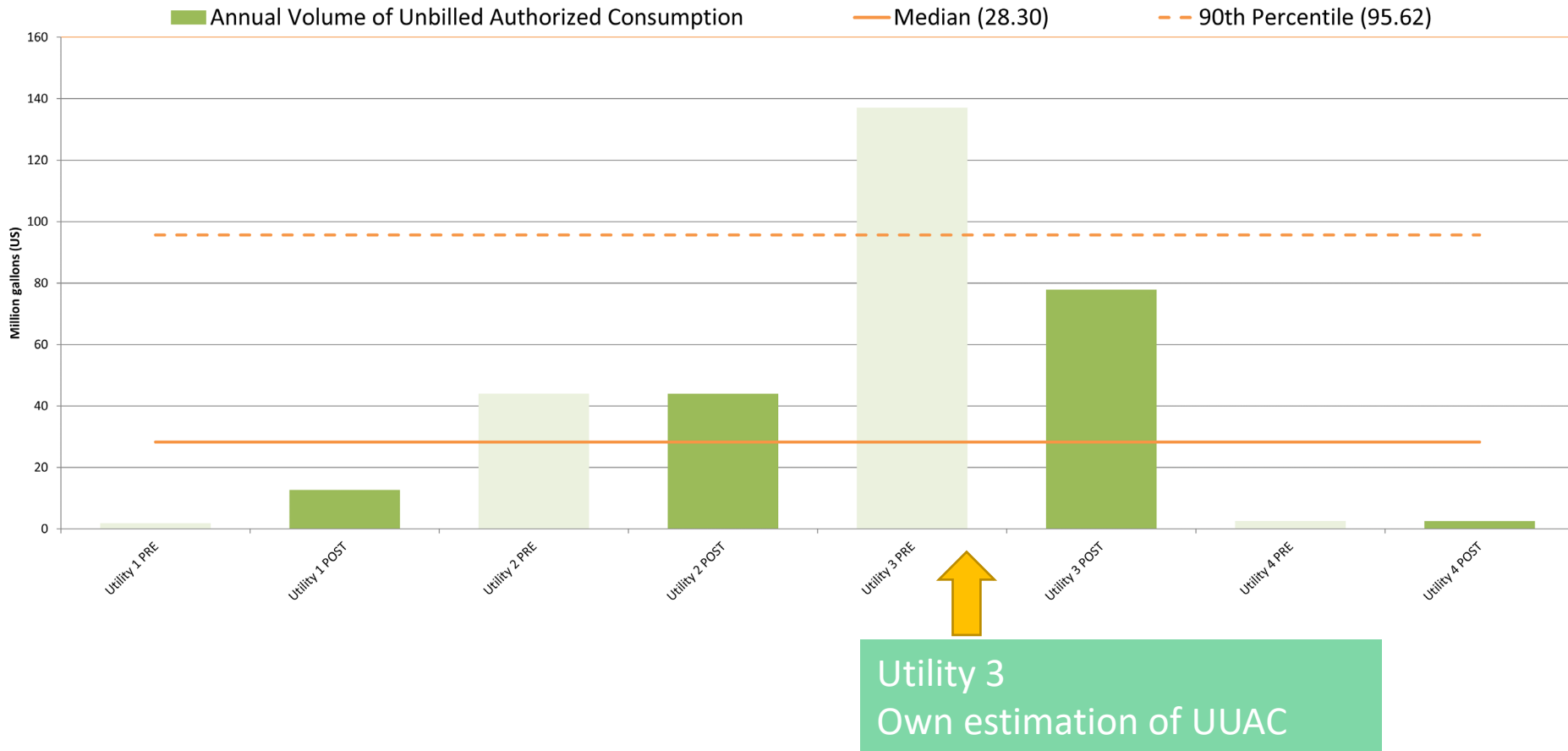
Utility 4  
Questionable accuracy of  
supply meter

# Apparent Loss by volume - 2019

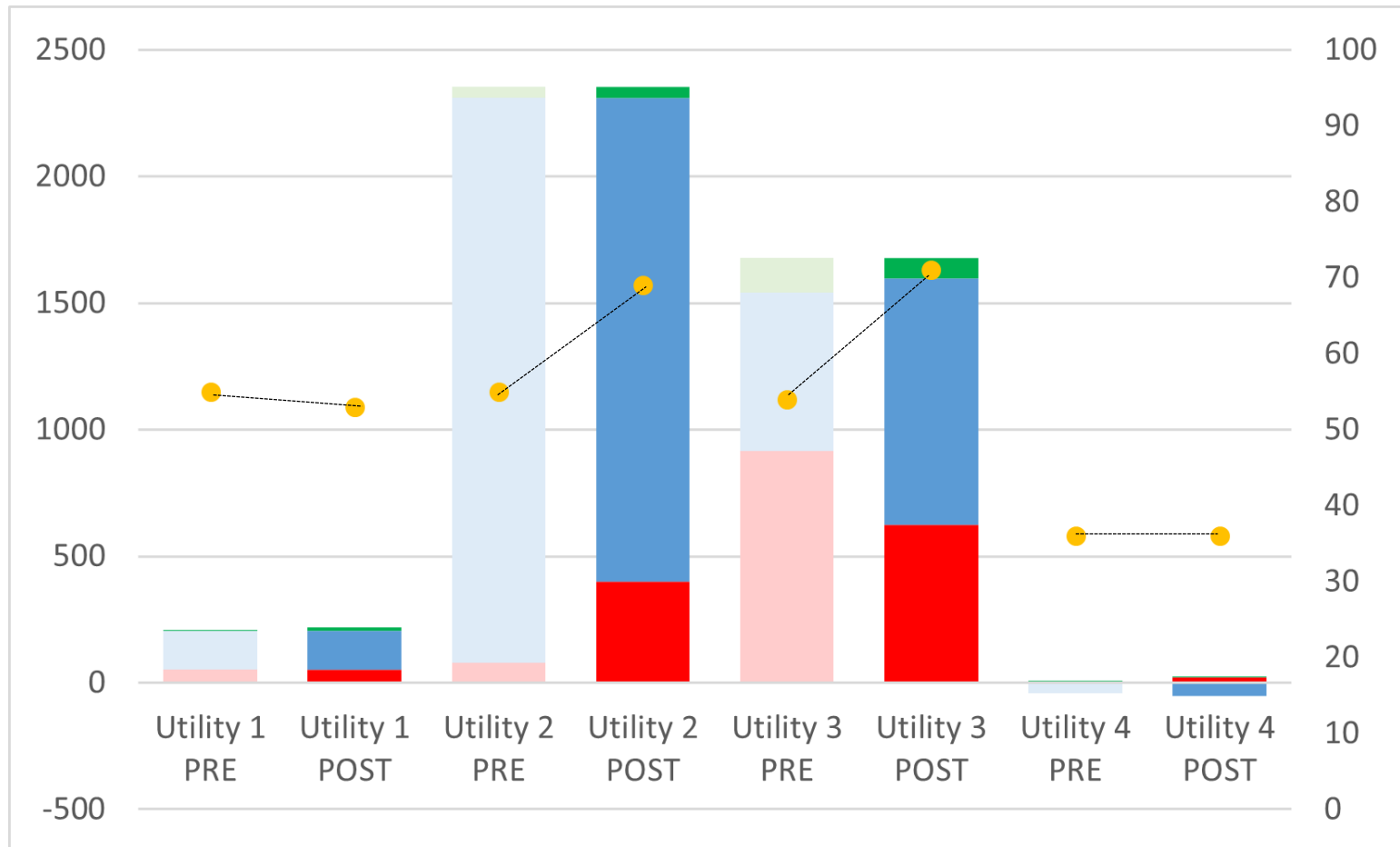




# Unbilled Authorized Consumption Loss by volume - 2019



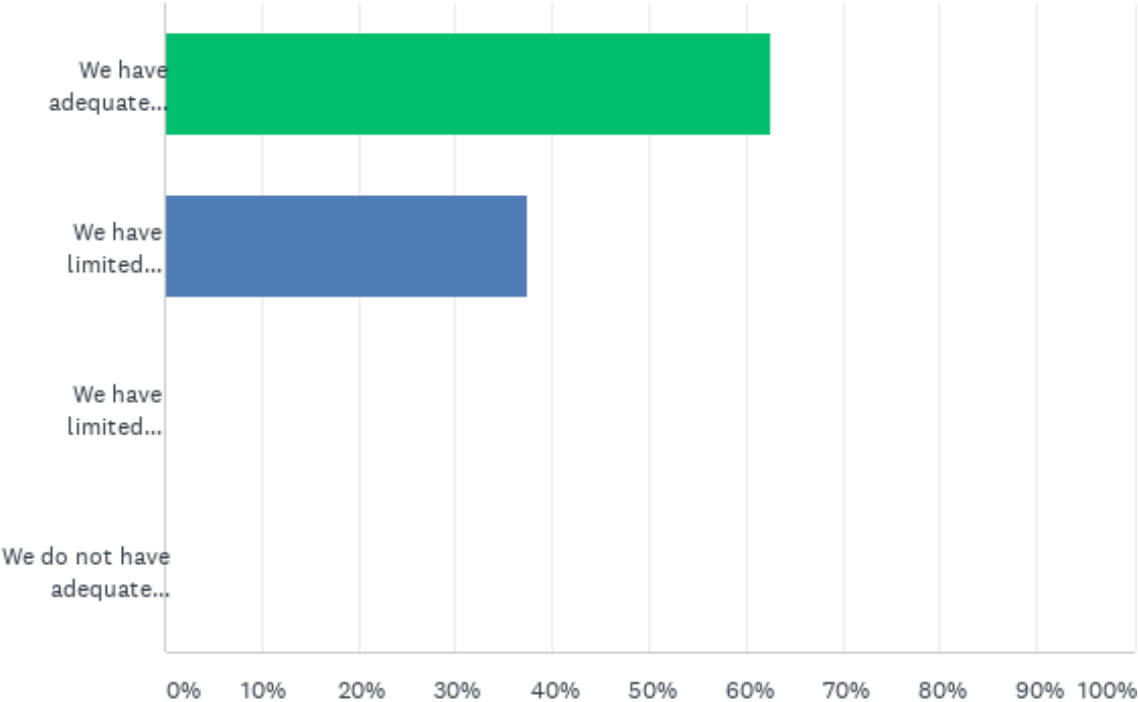
# NRW by volume - 2019



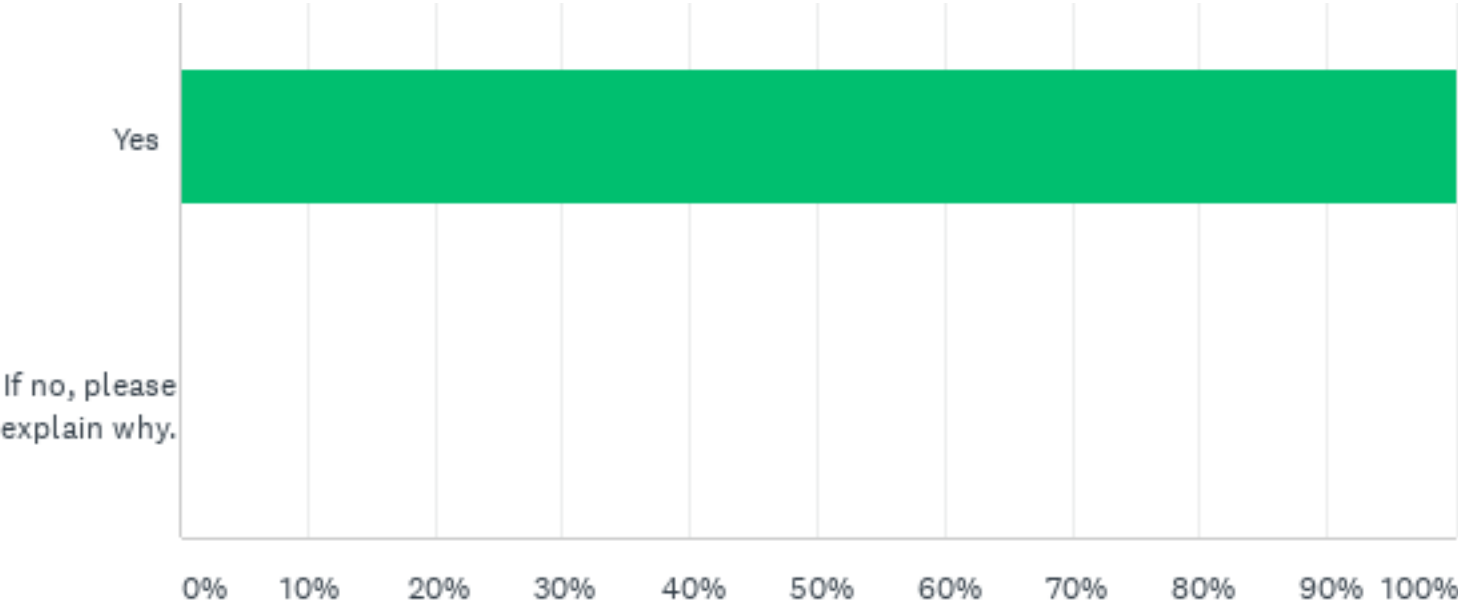
# Common Utility Recommendations

- Improved understanding of Supply Meter (Import) Master Meter Error: consider adopting or increasing the rigor of a source meter volumetric testing and calibration program, informed by the guidance provided in AWWA Manual M36 – Appendix A.
- Level 2 validation on raw data for Billed Metered Authorized Consumption to determine and resolve any instances of potable volume duplication or non-potable volume inclusion.
- Provide detailed customized estimate of Unbilled Unmetered Authorized Consumption: consider producing itemized, agency-specific estimates of unbilled unmetered (operational) uses per month. Ensure leakage estimates are excluded.
- Improved estimation of CMI: consider a customer meter testing program which tests a sample of random meters whose stratification (by size, age, or other characteristics) represents the entire customer meter stock.

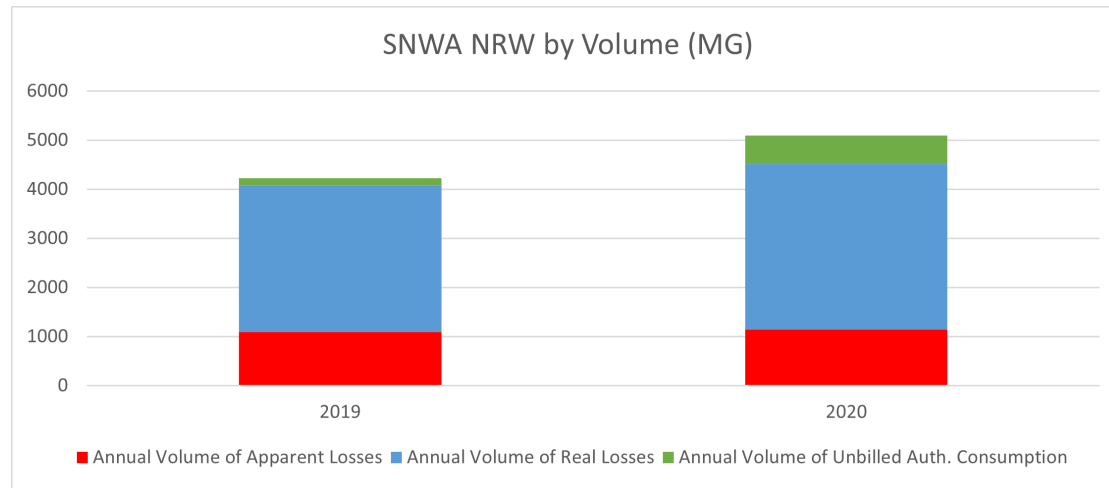
After completing the SNWA Water Loss Program, what is the level of capacity (e.g., staff, time, expertise, other resources) in your utility to complete water audits using the AWWA M-36 methodology?



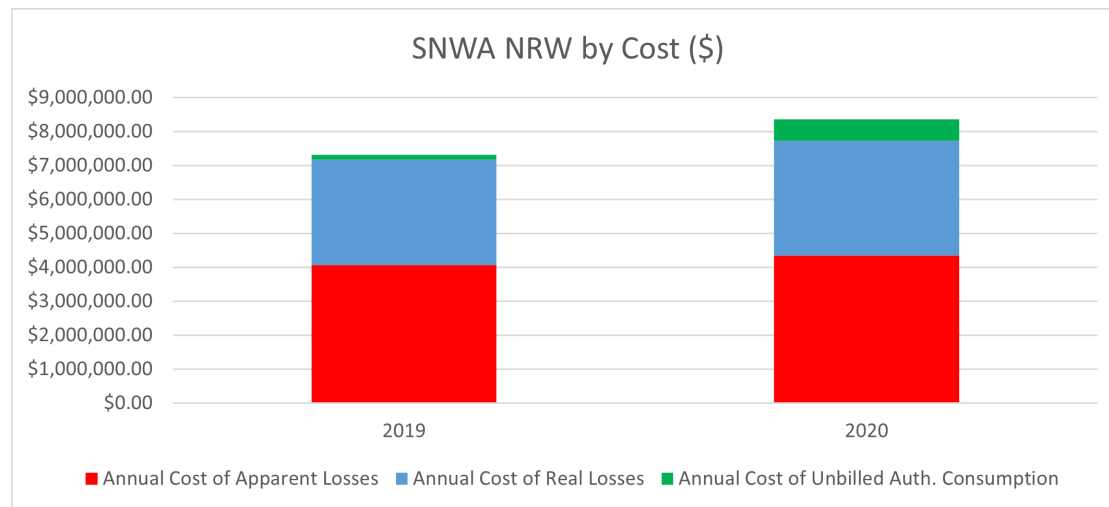
Do you feel the SNWA Water Loss Program has equipped you to comply with Nevada AB163?



# Aggregate NRW – SNWA Water Purveyors



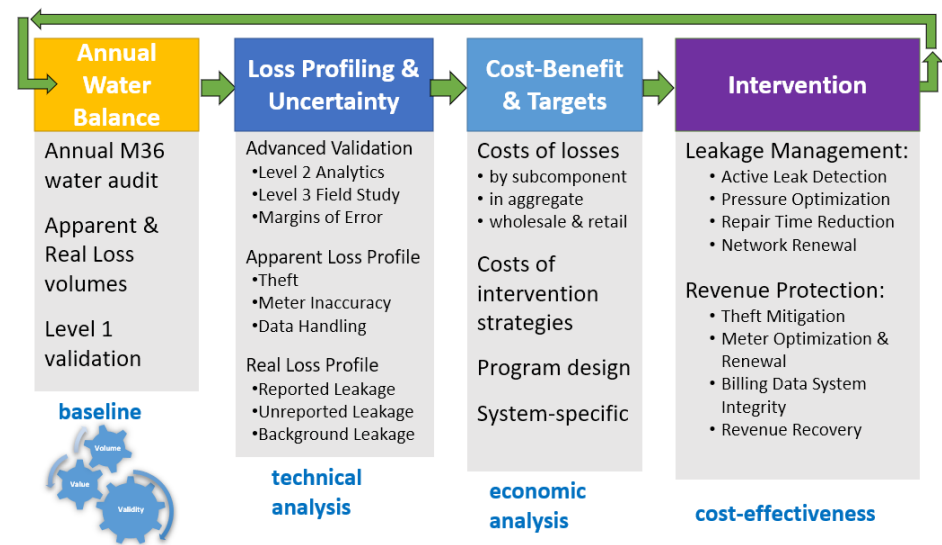
5 Billion  
Gallons



\$8M  
Dollars

# Recommended Next Steps for SNWA

- Continue to encourage annual Level 1 Water Audit Validations
- Conduct a Real Loss Component Analysis to develop your leakage profile.
- Conduct an Apparent Loss Component Analysis to develop your apparent loss profile.
- Cost-benefit analysis & target setting for water loss components.
- Design & implement water loss control program for cost-effective loss reduction and revenue recovery.





# Question & Answer

Drew Blackwell

[drew.blackwell@cavanaugholutions.com](mailto:drew.blackwell@cavanaugholutions.com)



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