Implementing SB 555: Validated Water Loss Audits and Reporting

November 3, 2016

California Water Association
2016 Annual Conference

Sue Mosburg
Program Manager
Sweetwater Authority

California Water Loss Control Collaborative Chair
AWWA California-Nevada Water Loss Control Committee Chair
Focus on Water Loss Control

1991 (California Urban Water Conservation Council) **Best Management Practice**
- % unaccounted for water
- Water Balance/Audit – (2009 revision )

2014 (Senate Bill 1420) **Water Management: Urban Water Management Plans**
- Requires water audits, using M36 and AWWA software every 5 years, with Urban Water Management Plans (starting July 2016)

October 9, 2015 (Senate Bill 555) **Urban Retail Water Suppliers: Water Loss Management**
- Annual Water Audit
- Expert validation
- Steps to increase validity
- Performance standards (by 2020)
Senate Bill 555

- On or before **January 2017** DWR shall adopt rules
  - Water loss audits in accordance with AWWA M36 method
  - Process for validating audits
  - Technical qualifications of validator
  - Method for submitting water loss audit reports

- **October 1, 2017** – submit validated water loss audit report
  - Must be attested by: Chief Financial Officer, Chief Engineer, or General Manager
  - DWR shall post all validated reports on the Internet
  - Those deemed incomplete, not valid, unattested or incongruent shall be returned; a complete audit must be resubmitted within 90 days

- Each submitted audit must include steps taken to
  - Increase data validity
  - Reduce apparent loss volume
  - Reduce real loss volume

- DWR shall provide water loss detection technical assistance from available funds

- No earlier than January 1, 2019 (nor later than July 1, 2020) Water Board adoption of performance standard rules
AWWA Free Water Audit Software:

**Reporting Worksheet**

Please enter data in the white cells below. Where available, metered values should be used; if metered values are unavailable, please estimate the input data by grading each component (1 or 1.1) 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

<table>
<thead>
<tr>
<th>WATER SUPPLIED</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume from own sources:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water imported:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water exported:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WATER SUPPLIED:</td>
<td>825.000</td>
<td>MGY</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>AUTHORIZED CONSUMPTION</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Billed metered:</td>
<td>700,000</td>
<td>MGY</td>
</tr>
<tr>
<td>Billed unmetered:</td>
<td>50,000</td>
<td>MGY</td>
</tr>
<tr>
<td>Unbilled metered:</td>
<td>5,000</td>
<td>MGY</td>
</tr>
<tr>
<td>Unbilled unmetered:</td>
<td>10,313</td>
<td>MGY</td>
</tr>
<tr>
<td>AUTHORIZED CONSUMPTION:</td>
<td>760,313</td>
<td>MGY</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WATER LOSSES (Water Supplied - Authorized Consumption)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Unauthorized consumption:</td>
<td>3,000</td>
<td>MGY</td>
</tr>
<tr>
<td>Customer metering inaccuracies:</td>
<td>7.071</td>
<td>MGY</td>
</tr>
<tr>
<td>Systematic data handling errors:</td>
<td>5,000</td>
<td>MGY</td>
</tr>
<tr>
<td>Apparent Losses:</td>
<td>15,071</td>
<td>MGY</td>
</tr>
<tr>
<td>Real Losses (Current Annual Real Losses or CARL):</td>
<td>49,617</td>
<td>MGY</td>
</tr>
<tr>
<td>WATER LOSSES:</td>
<td>64,688</td>
<td>MGY</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NON-REVENUE WATER</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>WATER SUPPLIED - Unbilled Metered - Unbilled Unmetered:</td>
<td>75,000</td>
<td>MGY</td>
</tr>
</tbody>
</table>

**SYSTEM DATA**

| Length of mains: | 100 | D miles |
| Number of active AND inactive service connections: | 4 | 1,000 |
| Service connection density: | 10 | conn./mile main |
| Are customer meters typically located at the curbstop or property line? | | | |
| Average length of customer service line: | 70.0 | ft |
| Average length of customer service line has been set to zero and a data grading score of 10 has been applied |

**COST DATA**

| Total annual cost of operating water system: | 1,000,000 | $/Year |
| Customer retail unit cost (applied to Apparent Losses): | 3.50 | $/1000 gallons (US) |
| Variable production cost (applied to Real Losses): | 3,000 | $/Million gallons |

**PRIORITY AREAS FOR ATTENTION:**

- Volume from own sources
- Customer metering inaccuracies
- Unauthorized consumption
- Unbilled unmetered
- Real Losses (Current Annual Real Losses or CARL)

**WATER AUDIT DATA VALIDITY SCORE:**

- Water Losses
- Unbilled Metered
- Unbilled Unmetered

**AWWA Free Water Audit Software:**

- Industry Standard (M36)
- Free
- Defaults provided
- ~20 potential inputs
- ~10 inputs for typical utility use

awwa.org/waterlosscontrol
Audit Data Sources

**Supply data**
- Produced
- Purchased
- Metering & testing

**Consumption data**
- Billed water
- Unbilled water
- Meter reading & billing cycle data

**Meter data**
- Meter inventory
- Testing policy
- Test data

**System & Cost data**
- Length of mains
- Connections
- Pressure
- Operating costs
## The Water Balance

<table>
<thead>
<tr>
<th>SYSTEM INPUT VOLUME</th>
<th>AUTHORIZED CONSUMPTION</th>
<th>BILLED AUTHORIZED CONSUMPTION</th>
<th>BILLED METERED CONSUMPTION</th>
<th>BILLED UNMETERED CONSUMPTION</th>
<th>REVENUE WATER</th>
<th>NONREVENUE WATER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AUTHORIZED CONSUMPTION</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>UNBILLED AUTHORIZED CONSUMPTION</td>
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<td></td>
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</tr>
<tr>
<td>WATER LOSSES</td>
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<td></td>
<td>$$$$</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>$$$$</td>
</tr>
</tbody>
</table>

### Own Sources
- Money generated from water sales
- $\sum$ Own Sources: This is the volume of water input to a system from the water supplier's own sources.

### The Water Balance

1. **Own Sources**
   - Money generated from water sales
   - $\sum$ Own Sources: This is the volume of water input to a system from the water supplier's own sources.

2. **Nonrevenue Water**
   - Money drained from water supply
   - $\sum$ Nonrevenue Water

3. **Real Losses**
   - Money drained from water supply
   - $\sum$ Real Losses

### Water Losses

- **Apparent Losses**
  - Money drained from water supply
  - $\sum$ Apparent Losses

- **Unauthorized Consumption**
  - Money drained from water supply
  - $\sum$ Unauthorized Consumption

- **Data Handling Errors**
  - Money drained from water supply
  - $\sum$ Data Handling Errors

- **Real Losses**
  - Money drained from water supply
  - $\sum$ Real Losses
Which Value Goes Where?
<table>
<thead>
<tr>
<th>Functional Focus Area</th>
<th>Water Audit Data Validity Level / Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Audit Data Collection</strong></td>
<td><strong>Level I (0-25)</strong></td>
</tr>
<tr>
<td></td>
<td>Launch auditing and loss control team; address production metering deficiencies</td>
</tr>
<tr>
<td><strong>Short-term loss control</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Long-term loss control</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Target-setting</strong></td>
<td></td>
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<tr>
<td><strong>Benchmarking</strong></td>
<td></td>
</tr>
</tbody>
</table>
WRF 4372 - 2010 Water Data Analysis and Validation:

- Simple steps of data validation were applied

<table>
<thead>
<tr>
<th>California – CUWCC BMP1.2</th>
<th>Count</th>
<th>Percent of Full Data Set</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Utilities Reporting Water Audit Result</td>
<td>125</td>
<td>100%</td>
</tr>
<tr>
<td>Number of Utilities Reporting Negative Water Losses</td>
<td>5</td>
<td>4%</td>
</tr>
<tr>
<td>Number of Utilities Reporting ILI&lt;1</td>
<td>36</td>
<td>29%</td>
</tr>
<tr>
<td>Number of Utilities Reporting ILI&gt;20</td>
<td>3</td>
<td>2%</td>
</tr>
<tr>
<td>Number of Utilities Reporting Erroneous Infrastructure Data</td>
<td>1</td>
<td>1%</td>
</tr>
</tbody>
</table>

| Final Data Set After Removal of Erroneous Water Audit Reports | 80 | 64% |

- Results highlight the problems utilities are facing when completing an audit for the first time!

*Source: Reinhard Sturm 2013*
Statewide Water Loss Management Program

**Phase 1**
Establish Annual M36 Water Auditing
- Implement established requirement for annual M36 Water Audits
- Educate Regulatory Community on M36 Method and appropriate use of performance indicators
- Establish Statewide Water Loss Control Committee
- Develop State Manual and Training Framework
- Provide extended, progressive training to utilities

**Phase 2**
Achieve Minimum Standard of Audit Reliability
- Augment DWR Data Management & Review Process
- Establish posting system and communication protocols
- Establish minimum standards of validation for quality assurance
- Determine by Agency or 3rd Party
- Establish validation program until certification program is in place
- Design and implement a Certified Water Audit program for sustained quality control
- CA-NV Section Administers Qualified Water Loss Auditors Certification Program

**Phase 3**
Manage Water Loss Performance for Long-Term Reduction
- Suite of Performance and Process Measures
- System specific improvement over time in a cost-effective manner
- No universal targets
- Excessive thresholds established
- Annual audit submission threshold exceedances
- System specific progress review during Urban Water Management Plan submissions
Water Loss Collaborative Timeline

- **June 10, 2015** - AWWA ACE15
- **July 1** – Rough plan put to paper
- **July 18** – First Steering Committee meets in Sacramento
- **July 28**
  - Initial cost estimate
  - Draft timeline
  - Preliminary scope

- **August**
  - Building out the program
  - Development Contract with Department of Water Resources
  - Senate Bill 555 moving forward with opposition
Water Loss Collaborative Timeline

- **September 18** – Funding meetings
- **September 28**
  - CA-NV AWWA Water Loss Collaborative launch email
  - Water Loss Collaborative logo unveiled
- **October**
  - SB 555 signed into law
  - Leak Detection Training
- **November/December**
  - Solid budget estimate
  - Getting the word out
  - Funding meetings
  - Scope refinement
  - Basic Website
Water Loss Collaborative Timeline

- **January 5, 2016** – California Water Board votes to fund Water Loss Technical Assistance Program through CA-NV AWWA
- **February 26** – CA-NV AWWA Receives notice to proceed
- **March** – Request for Proposal issued by CA-NV AWWA
- **April** – Consultant Program Management Team Selection
- **May 4** – CA-NV AWWA Governing Board Approves Contracts
  - Notice to proceed issued to Program Management Team
  - Registration Website launched
- **May 26** – Outreach and Recruitment Stakeholders meet
- **May 31** – Water Loss TAP formal Launch press release
- **June 15** – Fully Executed Grant Contract
- **June 22** – Fully Executed Contract PM Team
- **June 28, 2016** – Program launch webinar
- **August 9** – First workshop
WATER LOSS CONTROL COLLABORATIVE
Turning audits to action

EARLY ADOPTERS PROGRAM
for utilities that have submitted an AWWA water audit to the CUWCC

CLASSES / WORKSHOPS
- Statewide program introduction
- Review of water audit concepts, M36, and software
- Intro to validation techniques
- Intro to component analysis

UTILITY AUDIT SUBMISSION
- 2015 audit data
- Audit software preparation by utilities
- July 2016 UWMP submission

LEVEL 1 VALIDATION
- 2015 audit as submitted
- One on one sessions with experts to validate data sources
- Documentation of findings & rec’s

VALIDATION WORKSHOPS
- Program Review
- Review of Validation techniques
- Component Analysis Review

UTILITY AUDIT PREPARATION
- 2016 audit data
- Audit software preparation by utilities

FOLLOW UP AUDIT REVIEW
- Higher level check in with experts on 2016 audits pre-submission
- Review prior years audit rec’d’s and actions taken

STATEWIDE SUBMISSION POST-VALIDATION
- 2016 validated audit submissions
- Statewide program analysis & refinement

NEW LEARNERS PROGRAM
for utilities whose UWMP water audit report will be their first AWWA software submission

CLASSES / WORKSHOPS
- Statewide program introduction
- Introduction to audit methodology, M36, and software
- Team building
- Data collection
- Common mistakes

UTILITY AUDIT SUBMISSION
- 2015 audit data
- Audit software preparation by utilities
- July 2016 UWMP submission

AUDIT BASICS TECHNICAL REVIEW
- 2015 audit as submitted
- One on one Q&A with experts to confirm understanding, review questions, and address concerns after first compilation

VALIDATION WORKSHOPS
- Program Review
- Water Audit Concept Review
- Intro to Validation techniques

UTILITY AUDIT PREPARATION
- 2016 audit data
- Audit software preparation by utilities

LEVEL 1 VALIDATION
- Review of 2016 audit pre-submission
- One on one sessions with experts to validate data sources for 2016 audits
- Documentation of findings & rec’s
Water Loss TAP Goals:
to provide:

• Training on AWWA Water Audit Methodology
• Level 1 Validation of Water Audits
• 452 Urban Water Agencies

WAVE 1
in-person work session

WAVE 2
teleconference work session

WAVE 3
in-person work session

WAVE 4
final validation teleconference work session
Water Loss Technical Assistance Program Timeline

- Submission of level 1 validated audits
CALIFORNIA WATER LOSS CONTROL COLLABORATIVE

Water Loss Technical Assistance Program
AKA: the Water Loss TAP

waterlosscontrolcollaborative@gmail.com
The Water Loss Technical Assistance Program (Water Loss TAP) aids urban water suppliers in complying with California Senate Bill 555, requiring utilities to submit a completed and Level 1 validated water loss audit annually to the California Department of Water Resources (DWR).

The Water Loss TAP is brought to you by the California-Nevada Section AWWA.
New Learner (NL)
Water Auditing 101: designed to build a strong foundation for water auditing and data validation.
- Limited prior involvement with AWWA M36 Water Auditing.
- Results in Level 1 Validated Water Audit for October 2017 submittal to DWR.

Early Adopter (EA)
Water Auditing 201: designed to focus on data validation and advanced water loss analysis.
- Previous engagement with AWWA M36 Water Auditing.
- Results in Level 1 Validated Water Audit for October 2017 submittal to DWR.
Wave 1 is a day-long in-person work session (classroom) that covers the basics of water auditing and introduces water audit data validation.

Objectives
- Introduce Water Loss TAP
- Begin technical assistance
- Create utility water audit teams

Technical Assistance Themes
New Learners: Water Audit Fundamentals
Early Adopters: Introducing Data Validity

Action Steps

- Register your utility and water audit team for the Water Loss TAP (Register here)
- RSVP to attend an in person work session
  Not sure which track you are? Not sure if you've already RSVP'd? Check here
- Attend the work session (8AM - 3:30PM)

Materials to bring:
1. Laptop Computer with the AWWA Free Water Audit Software v5.0 (optional: your most recent Water Audit, as submitted with your Urban Water Management Plan completed using this software - we will not work with your audit’s specific data during the Wave 1 session, but this can serve as a good reminder of your audit volumes and practices to date).
2. Work Session Slides (Downloadable here)
3. Lunch on your own (breakfast and snacks provided)
4. Questions on Water Audit Methodology and Validation

July 2016 - September 2016
Wave 2 is a teleconference work session in which water auditing experts and each utility's water audit team examine the utility's FY14-15 water audit in a two-hour interview.

Action Steps

Compile your FY14-15 or CY15 water audit and supporting documents

Schedule a teleconference session before your work session

Send your water audit and supporting documents to the Program Management Team (PMT) one month before your work session

Implement any amendments or actions from your teleconference work session

Attend your work session

October 2016 - February 2017

1 2 3 4
Water Loss
Technical Assistance Program

Level 1 Validation
Top-down review of supporting documents for water audit

Review of input derivations

Affirmation of operational policies and practices to data grades

Documentation of basis for inputs and data grades

Flagging indicators of hidden inaccuracies requiring further investigation (gremlins)
<table>
<thead>
<tr>
<th>Level</th>
<th>Descriptor</th>
<th>Validation Focus</th>
<th>What’s involved</th>
<th>Outcome</th>
<th>Depends on</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Top down score review validation</td>
<td>Data grades, data validity score, gross errors and anomalies in the metrics</td>
<td>Desktop review of what is immediately available. 1 to 2 hour phone call to interview utility staff, preparatory and documentation time. Interview questions are focused on practices to make sure the data grades have been applied correctly and consistently. Through this discussion, anomalies are discussed and either confirmed, corrected, or noted for needing further investigation.</td>
<td>Validation interview form documenting the call, including any recommendations from the validation expert.</td>
<td>System size &amp; complexity</td>
</tr>
<tr>
<td>2</td>
<td>Top down data mining validation</td>
<td>Supply and consumption volumes from existing data that is mined</td>
<td>Data mining for limited desktop analysis. Analysis of available data, including production database and reports from SCADA system to identify gaps in the data chain. Data mining in the billing system to confirm and cleanse consumption volumes to remove redundancies from the data mining process which can come about from record duplications. Also validates exclusion of non-potable volumes in the totals. Validates that consumption volumes from low mid and high level detail extractions are corroborated. Analysis of available meter testing data for audit calculations. Applies 95% confidence limits to the AWWA water balance.</td>
<td>Technical Memo with findings and recommendations</td>
<td>Complexity of supply setup, metering setup and billing setup. Can limit scope to just look at 1 of the 3 between supply, metering and billing.</td>
</tr>
<tr>
<td>3</td>
<td>Bottom up field investigation validation</td>
<td>Supply and consumption volumes from new data that is gathered or mined</td>
<td>Field investigations and extensive data mining. Supply meter testing and in-field verification of meter-transmitter-SCADA data chain. In field customer meter testing. Night flow testing &amp; analysis for leakage.</td>
<td>Technical Memo with field data, findings and recommendations</td>
<td>Varies widely by system, mainly on how much field work is involved</td>
</tr>
</tbody>
</table>
### 2016 UWMP Submitted Data - Unfiltered

<table>
<thead>
<tr>
<th>STATISTIC</th>
<th>2016 n = 292</th>
<th>2016 n = 292</th>
<th>2016 n = 292</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>financial</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Customer Retail Unit Cost</td>
<td>$0.00</td>
<td>$3.93</td>
<td>$180,097.61</td>
<td>$ / 1,000 gal</td>
</tr>
<tr>
<td>Variable Production Cost</td>
<td>$0.00</td>
<td>$1,315.45</td>
<td>$25,007,000.00</td>
<td>$ / million gal</td>
</tr>
<tr>
<td>NRW as % of Operating Cost</td>
<td>0.00%</td>
<td>3.54%</td>
<td>242305%</td>
<td>% of operating cost</td>
</tr>
<tr>
<td><strong>volumetric</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apparent Losses</td>
<td>-4.34</td>
<td>6.36</td>
<td>122.3</td>
<td>gal/ serv conn / day</td>
</tr>
<tr>
<td>Real Losses (serv conns)</td>
<td>-35</td>
<td>19.46</td>
<td>334.54</td>
<td>gal/ serv conn / day</td>
</tr>
<tr>
<td>Real Losses (pressure)</td>
<td>-0.66</td>
<td>0.371</td>
<td>5.31</td>
<td>gal/ serv conn / day / psi</td>
</tr>
<tr>
<td>ILI</td>
<td>-3.03</td>
<td>1.18</td>
<td>17.84</td>
<td>CARL / UARL</td>
</tr>
<tr>
<td>Data Validity Score</td>
<td>2.35</td>
<td>75.33</td>
<td>98.27</td>
<td>points out of 100</td>
</tr>
</tbody>
</table>
California Data Reliability Timeline

- 2012-14 BMP1.2 - CUWCC
- 2015 UWMPs
- 2016 TAP L1 Audits
- 2018 QWLAV...
- 2019, 20...

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- DWR Requirement
- Year 2 data – L1
- Baseline – L1
- Self Reported
- Self Reported
### Next Steps – 2019/2020

**Are We Healthy?**

<table>
<thead>
<tr>
<th>Performance Indicators</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Revenue Water</td>
<td>gal/conn/year and $/conn/year</td>
</tr>
<tr>
<td>Apparent Losses</td>
<td>gal/conn/day</td>
</tr>
<tr>
<td>Real Losses</td>
<td>gal/conn/day or gal/length of main</td>
</tr>
<tr>
<td>Real Losses (normalized for pressure)</td>
<td>gal/conn/day or gal/length of main/psi</td>
</tr>
<tr>
<td>Infrastructure Leakage Index (ILI)</td>
<td></td>
</tr>
<tr>
<td>Data Validity Score</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Practices</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Auditing</td>
<td></td>
</tr>
<tr>
<td>Level of Validation (1, 2, 3)</td>
<td></td>
</tr>
<tr>
<td>Customer Meter Testing (CMT)</td>
<td></td>
</tr>
<tr>
<td>Large</td>
<td></td>
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<tr>
<td>Small</td>
<td></td>
</tr>
<tr>
<td>NRW Component Analysis</td>
<td></td>
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<tr>
<td>Active vs Reactive Leak Detection</td>
<td></td>
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<tr>
<td>Utilization of District Metered Areas for Night Flow Analysis</td>
<td></td>
</tr>
<tr>
<td>Pressure Management</td>
<td></td>
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<tr>
<td>Meter Replacement</td>
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<tr>
<td>Revenue Protection Programs</td>
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</tbody>
</table>
Water Loss Control Collaboration

- Water Loss TAP (Stakeholder/steering Committee)
- Coordination between industry associations, regulators, utilities
- Water Audit Rulemaking Group
- Water Loss Control Committee CA-NV AWWA Section
- Qualified Water Loss Auditor Certificate (QWALV) development subcommittee
- Leak detection, pressure management, meter testing training
- Executive Order/ Urban Advisory Group (wholesale and small system)
- CEC devices study
- PUC Rate case
- WRF projects to further refine the process, real loss component analysis, data validity criteria, water loss control program design
Questions?

Sue Mosburg
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619-409-6882