

California Department of Water Resources

**Recommendations for Urban Wholesale
Distribution Systems Water-Loss
Audit Reporting**

**Report Pursuant to Section 10608.35 of the
California Water Code**

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California Department of Water Resources

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Contents

<u>1.0 Introduction</u>	Page 1
<u>2.0 Background</u>	Page 2
<u>3.0 Primary Issues Raised by Stakeholders</u>	Page 6
<u>4.0 Recommendations</u>	Page 7
<u>5.0 Stakeholder Input Not Addressed</u>	Page 9
<u>6.0 References</u>	Page 11
<u>Appendix A – Summary of Stakeholder Comments</u>	Page A-1

Acronyms and Abbreviations

AWWA	American Water Works Association
CUWCC	California Urban Water Conservation Council
CWC	California Water Code
DWR	California Department of Water Resources
MWDOC	Municipal Water District of Orange County
SB	Senate Bill
SCADA	Supervisory Control and Data Acquisition
Water Board	State Water Resources Control Board

1.0 Introduction

This report is respectfully submitted to the California State Legislature pursuant to California Water Code (CWC) Section 10608.35. This Section directs the California Department of Water Resources (DWR) to conduct necessary studies and make recommendations to the Legislature by January 1, 2020 on the feasibility of developing and enacting water-loss reporting requirements for urban wholesale water suppliers. In developing this report, DWR coordinated with the State Water Resources Control Board (State Water Board) and solicited public input through three stakeholder meetings/webinars, interviewed seven urban wholesale water suppliers and discussed issues with multiple industry and academic water loss and water meter experts.

2.0 Background

California water suppliers provide water through potable water distribution systems that consist of thousands of miles of pressurized pipelines; millions of connections to homes, businesses, and industries; and interconnections with other water suppliers across the state. Pressurized systems keep contaminants out of the pipes and water supplies. But this pressure can also force water out of the pipes (especially at pipe joints, valves and service connections), resulting in water loss through leaks and pipe failures.

Population growth, climate change, and the recent historic drought have forced Californians to evaluate all aspects of water use and management across the state, including determining the extent of water loss in the state's water suppliers' distribution systems.

The CWC requires urban retail water suppliers to submit annual validated water-loss audit reports to DWR. However, this requirement does not currently apply to wholesale water suppliers. Recognizing the difference in reporting requirements between retailers and wholesalers, SB 606 (Hertzberg, 2018), as part of a larger conservation framework, directed DWR to make a recommendation on the feasibility of extending the urban retail water supplier water-loss requirements to wholesale water suppliers.

The water system infrastructure tends to be very different between retail and wholesale suppliers. Retail water systems typically have many miles of a small-diameter pipe that serve many connections. Wholesale distribution systems typically have fewer miles of significantly larger-diameter pipes with much fewer connections. Wholesale water suppliers tend to have a few large water meters to quantify water sales, while retail suppliers will have a few large meters and then thousands of small meters for retail deliveries.

DWR has identified 49 urban wholesale water suppliers in California. These suppliers vary greatly in terms of size, water supply sources, and delivery mechanisms used in their water systems. Some urban wholesale water suppliers have their own water supplies and reservoirs, while others receive supplies from larger systems such as the State Water Project or the Central Valley Project. Some urban wholesale water suppliers are strictly wholesalers, and others provide both wholesale and retail deliveries. Seven urban wholesale water suppliers contract for and sell water to retailers but have no water infrastructure or delivery mechanism. One example is the Municipal Water District of Orange County (MWDOC), where retail water suppliers receive water directly through infrastructure owned and operated by Metropolitan Water District of Southern California. Most urban wholesale water suppliers have infrastructure with large scale meters to quantify water deliveries. Thirteen urban wholesale water suppliers provide raw water to their retail customers, and 29 urban wholesale water suppliers provide potable water to their retailers.

Water loss audits are not new to California. DWR, in the early 1990s, developed one of the first leak detection guidance documents that included a water audit protocol and held training workshops throughout the state for many years (California Department of Water Resources, 1992). The American Water Works Association (AWWA) adopted this approach for its first and second editions of the *Manual of Water Supply Practices, M36: Water Audits and Loss Control Programs (M36 Manual)*. Then in the early 2000s, working with water-loss experts from across the country and internationally, AWWA significantly revised the DWR based water-loss audit approach to create its third edition of the M36 Manual. Now in its fourth edition, this publication serves as the current water industry standard and protocol for water-loss audits in the United States. (M36; AWWA, 2018)

The M36 Manual also includes the Water Audit Software Version 5.0

(American Water Works Association, 2014) that allows suppliers to input information electronically regarding distribution system characteristics (e.g., miles of pipelines, number of connections, and operating pressures) and annual operational data (e.g., water production and delivery volumes), estimates of unmetered water use needed for fire flows, and economic values such as customer retail unit cost and variable water production costs. The software provides default values for missing data and requires suppliers to create data validity scores based on how the data inputs to the model were developed and quantified. The testing and accuracy of water production and delivery meters is a significant component of the data validity scores.

Using the supplier data inputs, the AWWA water audit software calculates real and apparent losses for the water system. Real losses are considered the physical water lost to the system. Apparent water loss is water that remains in the pipes, and thus is not actually lost from the system, but is not accounted for because of inaccurate meter reads in under-registering meters, theft, or underestimation of fire or flushing flows. The software also calculates system performance metrics and water-loss-control cost effectiveness appropriate to retailer water systems.

Water suppliers that were members of the California Urban Water Conservation Council (CUWCC) began using the AWWA software program in 2005 as part of the CUWCC's best management practices. Approximately 200 suppliers completed audits until the CUWCC reorganized in 2017 to become the California Water Efficiency Partnership. As part of the reorganization, water suppliers no longer report on best management practice implementation as many of the requirements such as water loss audits are now required by state law.

Urban wholesale water suppliers are currently not required to submit annual water-loss audits. In DWR's interviews with wholesale water suppliers, many described implementing extensive asset management programs and performing best management practices. These practices include daily or weekly visual checks of pipeline systems, meter calibrations and inspections, flow and pressure zone monitoring using real time supervisory control and data acquisition (SCADA), and system modeling. More information from these interviews are included in Appendix A.

As described above, since 2017, California urban retail water suppliers have

been required to submit annual validated water-loss audits to DWR. The water-loss audits must be validated by certified professionals. The validation focuses on how well the audit reflects the agency's operations, including the accuracy of the data inputs and the data validity grading for appropriate entries. It is not expected that retailers initially have high data validity scores, but that they show improvement in their water-loss audit data validity scores over time. The State Water Board is using the submitted water loss data to develop a performance standard that retailer water suppliers will have to comply with by 2027.

As described earlier, wholesale water systems differ significantly from retail systems. The M36 audit program was developed for retail water systems (AWWA, 2016). As a result, some default values for missing data (e.g., unmetered consumption), the data validity scores (e.g., unauthorized consumption), and the performance metrics (e.g., real losses in gallons per connection per day) do not work for urban wholesale water suppliers. Some urban wholesale water suppliers have used the M36 software for water-loss audit reports but leave many of the data entries incomplete and more problematic is the displaying of erroneous outcomes, as they are not applicable to wholesalers (AWWA, 2014).

In the accounting of water losses, calibrating and testing meters for measurement of water volumes is critical to the accuracy of water system audits. The meter readings form the basis for calculating how much water is supplied into the system, how much water is sold to customers, and how much water is used for operations and other authorized consumption. The meters used by wholesale water suppliers are large (typically classified as more than 6 inches), with many wholesaler systems having meters larger than 24 inches and some scaling up to 108 inches. This poses a problem for meter testing because removal is difficult due to size and because they are critically important for system operations. If removed, the meters often need to be transported (sometimes by rail) to a specialized test facility. Testing in place may be feasible but, if the meter siting is not initially designed for in-place testing, the upstream and downstream pipeline flow conditions could adversely affect meter test results. DWR in talking with large water meter experts found that there was not clear consensus on how best to test the accuracy of large meters.

3.0 Primary Issues Raised by Stakeholders

DWR held three meetings with stakeholders in July, August, and November of 2019 to discuss urban wholesaler water-loss control issues and gather input. To further understand the issues, several wholesale water suppliers were interviewed by DWR to help determine the current status of best practices for wholesaler water real losses by urban wholesaler suppliers. The following is a summary from the stakeholder meetings and interviews of the needs and key issues surrounding urban wholesaler water-loss control programs:

- Many urban wholesale water suppliers described challenges with using the required M36 methodology and water system audit software (AWWA, 2016, 2014). Default values, audit software inputs, and some results were not applicable to wholesale systems.
- Some stakeholders, particularly several retail water suppliers, stated that urban wholesale water suppliers should be required to conduct accuracy flow testing on large wholesale delivery meters. Wholesale meter testing would increase the confidence in the water input values for retail water-system audits. Urban retail water suppliers are particularly concerned about the accuracy of water input values and their own retail audits, as the Water Board is in the process of developing a water loss performance standard for retail suppliers.
- Urban wholesale water suppliers expressed concern over the feasibility and cost effectiveness of large-meter accuracy testing, given the size of some of the meters and the limited option and the cost for testing them.
- In addition to auditing potable water systems, other stakeholders suggested that urban wholesale water suppliers be required to conduct water-loss audits for their raw water transmission systems and their recycled water system, where applicable.

4.0 Recommendations

Based on background information gathered, interviews with suppliers, and stakeholder input, DWR makes the following recommendations on the feasibility of developing and enacting water-loss control program related requirements for urban wholesale water suppliers:

1. Require Urban Wholesale Water Suppliers to Complete Annual Reporting. Require the wholesale water suppliers to submit water loss audits to the California Department of Water Resources on an annual schedule, matching the same annual schedule as the urban retail water suppliers. Since meter accuracy is a critical part of the data validity scores and meter testing, validation of the audits should not be required until DWR has completed the large meter accuracy testing study and developed large meter testing protocols.

2. Require Urban Wholesale Water Suppliers to Submit a Comprehensive Inventory of Meters. As part of the annual water loss report (Recommendation 1) require urban wholesale water suppliers to submit an inventory list of the water meters they use to quantify sales to other agencies. The inventory list should include, the brand, model number, and size of meters installed, a description as to whether the meter was installed in accordance with the manufacturer's specifications and the type of accuracy testing/calibration completed on the meter within the past year.

3. Direct Department of Water Resources to Develop a Wholesale Water Loss Audit Form. DWR shall prepare a water loss audit form for urban wholesale water suppliers to use in submitting their annual water loss report (Recommendation 1).

4. Direct DWR to Conduct a Study on Large Meter Accuracy Testing and Develop Protocols for Large Meter Testing. DWR shall complete a study on large-meter accuracy testing that would lead to establishing industry best practices and protocols for large-meter testing. This study is necessary for developing technical and industry consensus regarding the testing of large meters in California and to develop the specifications for accuracy and criteria data validity scores. Currently, there is not consensus within the water industry on best management practices and protocols for large meter testing. The industry acknowledges that problems exist because of testing cost and

practicalities (due to system reliance and/or system configuration). In conducting the study and developing the protocols, DWR would collaborate with urban wholesale water suppliers and the AWWA on the Manual M36 methodology updates (AWWA, 2016), other AWWA manuals (e.g., Manual M6, Manual M33, etc.), other meter accuracy pilot studies, and academic institutions.

5. Direct DWR to Conduct Training. DWR shall provide training workshops for urban wholesale water suppliers on the reporting process and industry best management practices for water-loss control programs. This training would include instruction on using the new DWR-developed wholesale water supplier water-loss audit form. These workshops should also provide a forum to discuss practices, programs, and cost-effective measures to enhance wholesale water-loss control programs.

5.0 Stakeholder Input Not Addressed

The following stakeholder suggestions were not addressed in the recommendations.

Stakeholder comment: Make large meter testing mandatory.

- **Rationale for not including in DWR's recommendations:** Based on discussions with industry experts and urban wholesale water suppliers, urban retailers can request an investigation into meter accuracy or pursue a change in their contract with a particular urban wholesale water supplier that allows for such testing. The intent of this requested testing is to have more accurate meter testing performed where known or suspected issues exist with wholesaler meters (e.g., retailer consumption meters are accounting for more water than the wholesaler system input volume). Methods to test meters in place exist and are documented in AWWA technical peer-reviewed publications (e.g., AWWA Manuals of Water Supply Practice: *Manual M6 – Water Meters – Selection, Installation, Testing and Maintenance*, *Manual M36 – Water Audits and Loss Control Programs*; *Manual M33 – Flowmeters in Water Supply*; and [American Water Works Association 2012, 2016, 2018]). The concern is that given the placement and size of some meters, it is neither physically possible nor economically cost-effective to perform meter testing given the infrastructure constraints. DWR is proposing to study this issue more thoroughly to develop further recommendations as necessary to address meter testing accuracy needs.

Stakeholder comment: Require water-loss audits of non-potable water systems and recycled-water systems in addition to audits of potable water systems.

- **Rational for not including in DWR's recommendations:** DWR did not include this suggestion as a recommendation as it is outside the scope of the legislation which directs DWR to consider the requirements for urban wholesale water suppliers specific to potable pressurized systems. In addition, CWC Section 10608.12 (w) for urban wholesale water suppliers refers to providing water for potable municipal purposes, which excludes recycled water. Wastewater

agencies would also need to be included because they produce and distribute the majority of the recycled water in California.

6.0 References

California Department of Water Resources. Revised 1992. *The Resources Agency and California – Nevada Section of the American Water Works Association, Water Audit and Leak Detection Guidebook*. Sacramento (CA). California Department of Water Resources. 164 pp. [Guidebook.]

American Water Works Association. 2012. *Manual of Water Supply Practice – M6, Water Meters – Selection, Installation, Testing, and Maintenance*. Denver (CO). American Water Works Association. 130 pp. [Manual.]

American Water Works Association. 2014. *Free Water Audit Software*. Version 5.0 Denver (CO). American Water Works Association. [Software Application.]

American Water Works Association. 2016. *Manual of Water Supply Practice – M36, Water Audits and Loss Control Programs*. Denver (CO). American Water Works Association. 422 pp. [Manual.]

American Water Works Association. 2018. *Manual of Water Supply Practice – M33, Flowmeters in Water Supply*. Denver (CO). American Water Works Association. 19 pp. [Manual.]

Appendix A

Summary of Stakeholder Comments

The following is a summary of comments provided and issues raised by the urban wholesale water suppliers during stakeholder interviews and meetings conducted by DWR staff. These issues and comments are diverse and reflect the unique positions of suppliers with wholesaler system infrastructure and interested stakeholders.

- The severity of risk and tremendous liability of large infrastructure failure drives a very rigorous level of system monitoring, inspection, maintenance, and repair of any real water losses.
- Reporting and costly meter testing is not necessary given the additional financial drivers to avoid water losses caused by lost revenue from retailers.
- Losses are often documented to be less than 1 percent of contracted water deliveries. It is best practice that the agreements with urban retailers, in the terms and conditions, cite the ability for the retailer to request meter inspections and testing by wholesale suppliers.
- Challenges exist with the water system audit reporting given the lack of applicability of the M36 manual reporting on wholesaler systems.
- Significant concerns exist regarding the necessity, feasibility, and cost of flow-meter testing beyond electronic calibration.
- Real time supervisory control and data acquisition (SCADA) system monitoring and regular visual inspections on order of daily, weekly, and certainly monthly on both raw- and treated-water delivery infrastructure is constantly occurring along with annual condition assessments of portions of canals and pipelines (i.e., often targeted at older higher-risk or higher-pressure sections).
- Aerial and satellite data also has been leveraged in visual assessments for leakage because it shows up as unintended green habitats developed from higher seepage areas, indicating a potential leak.
- Urban wholesale water suppliers perform regular analysis by operators, including pipeline hydrostatic tests. Multiple wholesalers commented that their systems are tight without real losses. Reported

anomalies reconciled by operators (most often attributable to an interest in financial recovery) that appear to be real losses are only apparent losses. This is because of the large scale of the meter size, constraints on testing meter accuracy, and the effects of piping configurations, rather than from real water losses.

- There is a need for improved water-loss knowledge sharing through education. It is recognized that DWR may be able to provide a positive role by seeking funding support to provide more peer-to-peer support. This support could include education and field training to enhance and accelerate the advancement of best management practices for addressing urban wholesaler real water-loss reductions. Part of this educational effort should include steps to improve the understanding of the current reporting process using the AWWA water-loss audit software (i.e., consistency across suppliers in reported data validation grades) (American Water Works Association 2014).
- There is also a potential for the development of a better tool to audit wholesale water systems, thus providing an enhanced reporting tool to benefit wholesaler and retailer water systems audits. The tool development would be designed directly by DWR or in conjunction with AWWA.