

2018 AWWA Water Audit Level 1 Validation

Water System Name: City of Riverside – Public Utilities

Water System ID Number: 3310031

Water Audit Period: Calendar Year 2018

Water Audit & Water Loss Improvement Steps:

Steps taken in preceding year to increase data validity, reduce real loss and apparent loss as informed by the annual validated water audit:

1. Performed annual electronic testing and calibration on key production meters for “Volume from Own Sources” and for “Water Exported” data.
2. Provided a water customer consumption monthly report for “Billed Metered” water.
3. Provided a new detailed method for estimating “Unbilled Unmetered” water, specifically for fire department use.
4. Performed testing for large meters, provided proof of a replacement program for large meters and performed random replacement for small meters under the “Customer Metering Inaccuracies” category.
5. Provided pressure field data to support the hydraulic model for “Average Operating Pressure”.
6. Provided additional depreciation values for pumping wear and tear for booster and well facilities under “Variable Production Cost”.

Certification Statement by Utility Executive:

This water loss audit report meets the requirements of California Code of Regulations Title 23, Division 2, Chapter 7 and the California Water Code Section 10608.34 and has been prepared in accordance with the method adopted by the American Water Works Association, as contained in their manual, *Water Audits and Loss Control Programs, Manual M36, Fourth Edition* and in the Free Water Audit Software version 5.

Todd Jorgenson

AGM-Water



2/4/19

Executive Name (Print)

Executive Position

Signature

Date

Utility Provided

2018 AWWA Water Audit Level 1 Validation – Review Document

Audit Information:

Utility: Riverside PWS ID: 3310031

System Type: Potable Audit Period: Calendar 2018

Utility Representation: Leo Ferrando, William Obeid, Michael Plinski, Jolie Matta, Gaurav Agarwal, Nicholas Marrelli, Greg Tobler, Danielle Williams, Shelly Almgren, Nickey Tuyunbaeva, Brian Seinturier, Gisela Lopez.

Validation Date: 8/6/2019

Call Time: 8:00 am

Sufficient Supporting Documents Provided: Yes

Validation Findings & Confirmation Statement:

Key Audit Metrics:

Data Validity Score: 81 Data Validity Band (Level): Band IV (71-90)

ILI: 2.72

Real Loss: 55.07 (gal/conn/day)

Apparent Loss: 28.88 (gal/conn/day)

Non-revenue water as percent of cost of operating system: 5.3%

Certification Statement by Validator:

This water loss audit report has been Level 1 validated per the requirements of California Code of Regulations Title 23, Division 2, Chapter 7 and the California Water Code Section 10608.34.

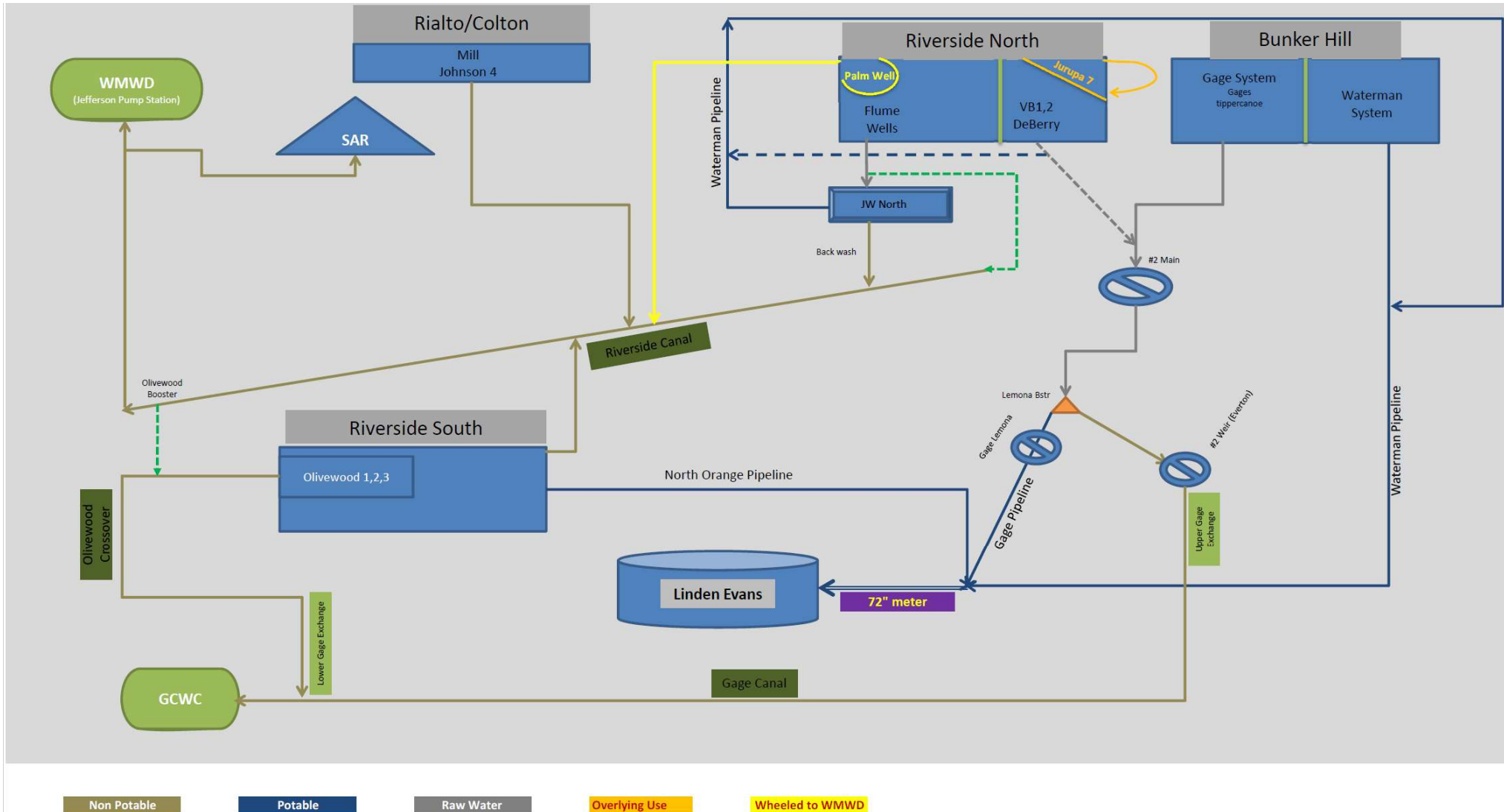
All recommendations on volume derivation and Data Validity Grades were incorporated into the water audit. ☑

Validator Information:

Water Audit Validator: Larry Lewison, Will Jernigan P.E.

Validator Qualifications: Contractor for California Water Loss TAP

Validator Provided



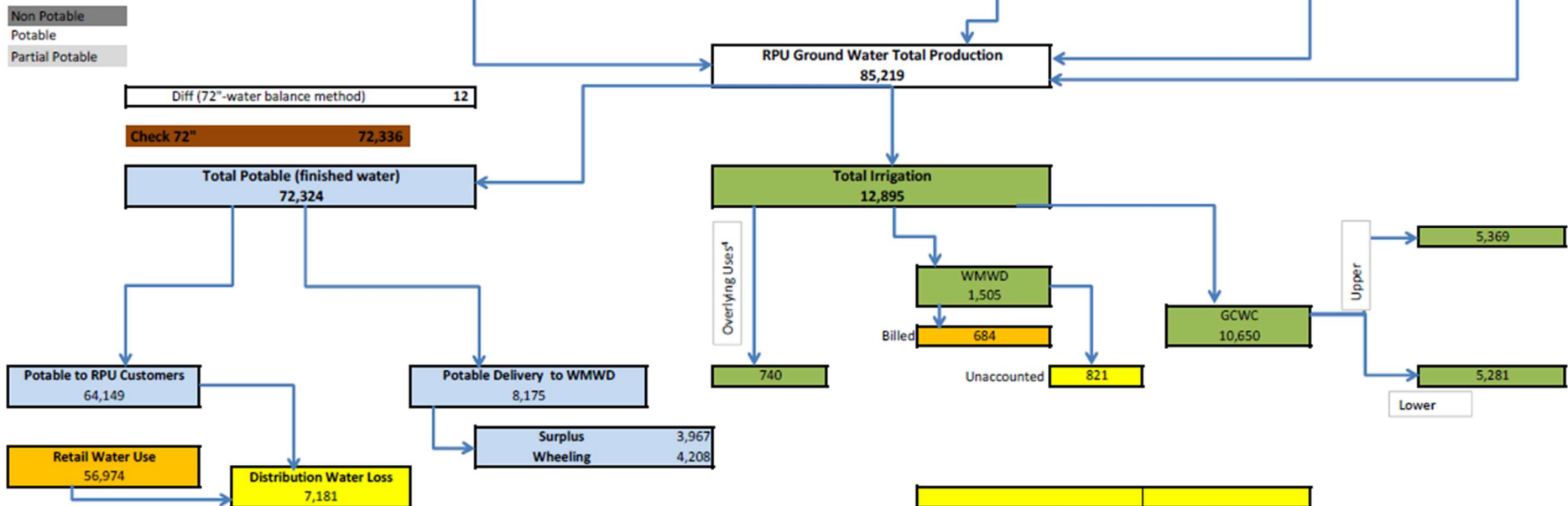
Schematic of RPU Ground Water Production in 2017

Bunker Hill					
Gage Production		waterman Production			
AF/Y		WMWD (Waterman)	AF/Y	UCR Total	AF/Y
GAGE WELL 92-1	2,827.6	WMWD RAUB WELL 5	0.0	UCR WARREN WELL 1	0.0
GAGE WELL 92-2	2,359.7	WMWD RAUB WELL 6	1,132.2	UCR WARREN WELL 4	0.0
GAGE WELL 92-3	2,013.2	WMWD RAUB WELL 7	1,107.6	UCR COOLEY WELL H	554.0
GAGE WELL 56-1	1,604.6	WMWD RAUB WELL 8	1,217.5		
GAGE WELL 46-1R	1,837.1	WMWD WARREN WELL 1	522.4		
GAGE WELL 31-1	2,304.4	WMWD WARREN WELL 4	228.3	Meeks & Daley	
GAGE WELL 30-1	0.0	WMWD COOLEY WELL H	0.0	M.D. LEASE M&D 59	0.0
GAGE WELL 98-1	3,383.5	WMWD COOLEY WELL I	0.0	M.D. LEASE RAUB WELL 5	0.0
GAGE WELL 29-3	1,699.0	WMWD COOLEY WELL J	0.0	M.D. LEASE RAUB WELL 6	126.9
GAGE WELL 29-2	721.0			M.D. LEASE RAUB WELL 7	265.3
GAGE WELL 51-1	1,687.9			M.D. LEASE RAUB WELL 8	39.6
GAGE WELL 26-1	1,172.8			M.D. LEASE WARREN WELL 1	892.4
GAGE WELL 27-1	1,218.7			M.D. LEASE WARREN WELL 4	1,683.8
GAGE WELL 66-1	2,594.7			M.D. TIPPECANOE WELL	0.0
GAGE WELL 27-2	1,158.7			RHWC	
GAGE WELL 29-1	521.9			RHWC COOLEY WELL H	168.0
TIPPECANOE WELL	1,520.5			RHWC COOLEY WELL I	261.8
				RHWC COOLEY WELL J	10.2
				RHWC RAUB 8	0.0
Potable	52,290				
Non Potable					
				Total Bunker Hill	58,297

Rialto-Colton Production	
	AF/Y
MILL WELL	0.3
JOHNSON WELL 4 IRR	921.0
Potable	0
Non Potable	921
Total Rialto-Colton	921

Riverside North Production	
	AF/Y
FLUME WELL 1	0.5
FLUME WELL 2	152.2
FLUME WELL 3	826.3
FLUME WELL 4	1,525.1
FLUME WELL 6	0.7
FLUME WELL 7	2,075.7
GAGE DE-BERRY WELL	0.0
VAN BUREN WELL 1	1,769.7
VAN BUREN WELL 2	1,828.2
JURUPA WELL 7	739.9
Potable	8,071
Non Potable	847
Total Riverside North	8,918

Riverside South Production	
	AF/Y
11TH ST. WELL IRR	0.0
CUNNINGHAM WELL	0.0
ELECTRIC ST. WELL	1,527.7
ELECTRIC ST. WELL IRR	0.9
FIRST ST. WELL IRR	262.3
FILL WELL IRR	627.8
GARNER WELL B	2,013.2
GARNER WELL D	1,722.9
GARNER WELL C	2,239.6
MOORE-GRIFFITH WELL	1,572.7
MULBERRY WELL	0.0
OLIVEWOOD WELL 1	1,388.1
OLIVEWOOD WELL 2	1,869.8
OLIVEWOOD WELL 3	909.4
PALMYRITA WELL	761.2
PALMYRITA WELL IRR	0.9
TWIN SPRINGS WELL	1,310.4
Fairmount Park #1	0.0
Fairmount Park 2	0.0
Mori	0.0
Brunton Well 1R	875.0
Potable	12,023
Non Potable	5,059
Total Riverside South	17,082



Assumptions:
1- Wells Productions are considered the reference
2- #2 Well (Everton), Gage Lemona, and JW North measurements are considered accurate
3- Non Potable from Bunker Hill and Riverside North are estimated by proportionality at #2 Well

Water Loss below Linden	7,181
Irrigation Water Loss	821
Total Water Loss (AF/Y)	8,002

#	AWWA Water Audit Input	Code	Final DVG	Basis on Input Derivation	Basis on Data Validity Grade
1	Volume from Own Sources	VOS	9	Supply meter profile: Series of wells from 4 different groundwater basins (Bunker Hill, Riverside North, Riverside south, Rialto/Colton). VOS input derived from: Manual reads from production meters as archived (SCADA used only for monitoring). Comments: Input derivation from supporting documents confirmed. Exclusion of non-potable volumes confirmed. Meter accuracy and electronic calibration test results provided for Linden 72" mag meter.	Percent of own supply metered: 100% Signal calibration frequency: Annual. Volumetric testing frequency: Annual. Volumetric testing method: Manometer Percent of own supply tested and/or calibrated: 90%+ Comments: Limiting criteria for DVG is semi-annual testing and signal calibration.
2	VOS Master Meter & Supply Error Adjustment	VOS MMSEA	6	Input derivation: Simple average from accuracy test results. Net storage change included in MMSEA input: Yes as a practice however, volume confirmed to be negligible amount. Comments: Linden meter is the final measurement point prior to delivery of potable water to customer base.	Supply meter read frequency: Daily. Supply meter read method: Manual and automatic logging. Frequency of data review for trends & anomalies: Each business day. Storage levels monitored in real-time: Yes. Comments: No additional comments.
3	Water Imported	WI	n/a	Import meter profile: Have multiple interconnections with neighboring utilities including ability to get MWD water if needed.	
4	WI Master Meter & Supply Error Adjustment	WI MMSEA	n/a		
5	Water Exported	WE	9	Export meter profile: Water is delivered to WMWD through two connections (Green Orchard and Mockingbird). Comments: Input derivation from supporting documents confirmed. Exclusion of non-potable volumes confirmed. Exclusion from BMAC input confirmed. Volumetric accuracy tests and electronic calibration results were provided for Mockingbird and Green Orchard.	Percent of export supply metered: 100% Signal calibration frequency: Within last 5 years but less than annually. Will be semi-annual in 2018 Volumetric testing frequency: Annual. Volumetric testing method: Insertion type. Percent of export supply tested and/or calibrated: n/a. Comments: Working on reinstalling meter vault to include test ports and move to annual testing & calibration.
6	WE Master Meter & Supply Error Adjustment	WE MMSEA	6	Input derivation: Left at 0% based on test data. Comments: No additional comments.	Export meter read frequency: Daily. Export meter read method: Manual and automatic logging. Frequency of data review for trends & anomalies: Each business day. Comments: No additional comments.
7	Billed metered	BMAC	7	Customer meter profile:	Percent of customers metered: 100%

#	AWWA Water Audit Input	Code	Final DVG	Basis on Input Derivation	Basis on Data Validity Grade
				Age profile: Average age of 10 years Reading system: Manual. Read frequency: Monthly. Comments: Lag-time correction is not employed in input derivation. Input derivation from supporting documents confirmed. Exclusion of non-potable volumes confirmed. Looking towards changeout to AMI in the future – Alpha testing phase, Beta phase in 2019 then decision on implementation. Adjusted input volume to remove recycle water (111 AF).	Small meter testing policy: Reactive testing plus limited sampling occurs on 10% of replaced meters. Number of small meters tested/year: 524 Large meter testing policy: Targeted testing is conducted annually based on practice to test all meters within specified period. Number of large meters tested/year: 350 Meter replacement policy: Based on an age threshold per previous testing results. Small meters are 20 years. Large meters are 20 years. Number of replacements/year: 1,064 (1,006 small meters, 58 large meters) Billing data auditing: Standard billing QC, plus review of volumes by use type each billing cycle. Comments: Limiting criteria of DVG is regular meter accuracy testing where results directly inform maintenance and replacement activities.
8	Billed unmetered	BUAC	n/a		
9	Unbilled metered	UMAC	9	Profile: Tracked through rate code W299 representing own facilities. Input derivation: Direct from meter readings. Comments: Input derivation from supporting documents confirmed. Field crew uses this rate code to identify these uses and appropriately code this consumption.	Policy for billing exemptions: Limited to own facilities. Comments: Written policy needs to clearly identify specific accounts or rate codes which receive a billing exemption.
10	Unbilled unmetered	UUAC	9	Profile: Operational flushing/maintenance and fire department usage. Comments: Flushing and fire suppression volumes provided and applied. Summary of unbilled unmetered usage from monthly. Fire department provided an incident report to obtain estimates.	Comments: DVG based on all uses tracked by event using site-specific estimation methods.
11	Unauthorized consumption	UC	5	Comments: Default input applied.	Comments: Default grade applied.
12	Customer metering inaccuracies	CMI	6	See BMAC comments regarding meter testing & replacement activities. Input derivation: Calculated as weighted average from analysis of limited test data. Comments: Approximately 418 large meters tested, 124 small meters tested (totaled tested roughly 1% of inventory). Test results not provided.	Characterization of meter testing: Routine (proactive), but not fully representative. Characterization of meter replacement: Ongoing (proactive), annual.

#	AWWA Water Audit Input	Code	Final DVG	Basis on Input Derivation	Basis on Data Validity Grade
				Quantitative inaccuracy volume provided however, formula needs correction.	Comments: DVG limiting criteria is less certain data within the inaccuracy volume. Weighted calculation incorrectly performed.
13	Systematic data handling errors	SDHE	5	Comments: Default input applied.	Comments: Default grade applied.
14	Length of mains	Lm	9	Input derivation: Totaled from GIS based map. Hydrant leads included: Yes. Comments: No additional comments.	Mapping format: Digital. Asset management database: In place but separate from GIS system. Map updates & field validation: Accomplished through normal work order processes. Comments: No additional comments.
15	Number of service connections	Ns	10	Input derivation: Standard report run from GIS, confirmed by billing system. Basis for database query: Location or other premise-based ID. Comments: No additional comments.	CIS updates & field validation: Accomplished through normal meter reading processes. Estimated error of total count within: 1%. Comments: No additional comments.
16	Ave length of cust. service line	Lp	10	Comments: Default input and grade applied, as customer meters are typically located at the property boundary given California climate.	
17	Average operating pressure	AOP	9	Number of zones, general profile: Thirty-eight pressure zones with some gravity and then boost to other zones. Typical pressure range: 40 – 200 psi Input derivation: Calculated as weighted average from analysis of field data. Comments: No additional comments.	Extent of static pressure data collection: Hydrant pressures taken during routine system flushing and/or hydrant testing. Characterization of real-time pressure data collection: Full-scale - telemetry or pressure logging (including seasonal variations) in place beyond the boundary points in all zones representing full pressure profile. Hydraulic model: In place and calibrated within the last 5 years. Comments: No additional comments.
18	Total annual operating cost	TAOC	10	Input derivation: From official financial reports. Comments: Confirmed costs limited to water only, and water debt service included.	Frequency of internal auditing: Annually. Frequency of third-party CPA auditing: Annually. Comments: No additional comments.
19	Customer retail unit cost	CRUC	9	Input derivation: Total consumptive revenue divided by Billed Metered Authorized Consumption. Sewer charges are based on water meter readings. Sewer revenues are not incorporated into calculation. Comments: No additional comments.	Characterization of calculation: Weighted average composite of all rates. Input calculations have been reviewed by an M36 water loss expert. Comments: No additional comments.

#	AWWA Water Audit Input	Code	Final DVG	Basis on Input Derivation	Basis on Data Validity Grade
20	Variable production cost	VPC	7	Supply profile: Own sources only. Primary costs included: Treatment chemicals and supply & distribution power. Secondary costs included: Pumping equipment wear & tear. Comments: Elec \$5,852,435+ Chem \$513,496+ Pump maint \$1,889,530. Input changed from \$326.10/AF to \$124.85/AF based on revised costs.	Characterization of calculation: Primary costs plus some but not all applicable secondary costs. Input calculations have not been reviewed by an M36 water loss expert. Comments: No additional comments.

Key Audit Metrics

(~)	VALIDITY	Data Validity Score: 81	Data Validity Band (Level): Band IV (71-90)	
(#)	VOLUME	ILI: 2.72	Real Loss: 55.07 (gal/conn/day)	Apparent Loss: 28.88 (gal/conn/day)
(\$)	VALUE		Annual Cost of Real Losses: \$539,801	Annual Cost of Apparent Losses: \$1,609,969

Infrastructure & Water Loss Management Practices:

Infrastructure age profile: Varying Infrastructure replacement policy (current, historic): Capital based, currently about 5 to 6 miles per year with plans to increase to 6 to 8 miles based on cost of service study. Selection is based on internal developed index (function of age, break frequency).

Estimated main failures/year: 100 Estimated service failures/year: 1,600

Extent of proactive leakage management: None currently in place.

Other water loss management comments: Beta phase of AMI migration.

Comments on Audit Metrics & Validity Improvements

The Infrastructure Leakage Index (ILI) of 2.72 describes a system that experiences leakage at 2.72 times the modeled technical minimum for its system characteristics. The Data Validity Score falling within Band IV (71-90) suggests that next steps may be focused primarily on evaluating cost-effective interventions for water & revenue loss recovery, while maintaining data collection & validation processes with data improvements as warranted. Opportunities to improve the reliability of audit inputs and outputs include:

- Improved understanding of Supply Meter (Own or 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.
- Temporal alignment of Billed Metered Authorized Consumption with Water Supplied: consider pro-rating the first and last months of the audit period to better align consumption with actual dates of use and using read date as basis for reporting.
- 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. Continue to develop the meter testing program around using test results to formulate maintenance and replacement activities.

Further Recommendations

Since Data Validity Score is >50, consider follow-on implementations as described in the AWWA M36 Manual, once the annual water audit is established:

- 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 interventions.