



March 21, 2023

Rosemary Chiavetta, Secretary  
PA Public Utility Commission  
P.O. Box 3265  
Harrisburg, PA 17105-3265

RE: Water Loss Audit  
Year Ending December 31, 2022  
Docket No. M-2023-3037451

Dear Secretary Chiavetta:

Enclosed is the Columbia Water Company's Water Loss Audits for the year ending December 31, 2022. This audit is being filed as required by PUC Order at M-2008-2062697. Attached is a paper copy of the audit and an electronic Excel copy.

Should you require any additional information, please feel free to contact me.

Sincerely,

A handwritten signature in blue ink, appearing to read "David T. Lewis", is written over a large, faint, circular watermark. The watermark contains the text "CELEBRATING 200 YEARS ANNIVERSARY 2023" and is partially obscured by the signature.

David T. Lewis, P.E.  
President and  
General Manager

Copy via email: Clinton McKinley

**Columbia Water Company**

220 Locust Street ■ P.O. Box 350 ■ Columbia, PA 17512  
Phone: 717-684-2188 ■ Fax: 717-684-4566



# AWWA Free Water Audit Software v6.0

FWAS v6.0

American Water Works Association Copyright © 2020, All Rights Reserved.

This spreadsheet-based water audit tool is designed to help quantify and track water losses associated with water distribution systems and identify areas for improved efficiency and cost recovery. It provides a "top-down" summary water audit format and is not meant to take the place of a full-scale, comprehensive water audit format. Auditors are strongly encouraged to refer to the most current edition of AWWA M36 Manual for Water Audits for detailed guidance on the water auditing process and targeting loss reduction levels. This tool contains several separate worksheets. Sheets can be accessed using the tabs at the bottom of the screen, or by clicking the TOC links below.

## Table of Contents (TOC)

- Start Page** The current sheet. Enter contact information and basic audit details.
- Worksheet** Enter the required data on this worksheet to calculate the water balance and data grading.
- Interactive Data Grading** Answer questions about operational practices for each audit input, and the data validity grades will automatically populate.
- Dashboard** Review NRW components, performance indicators and graphical outputs to evaluate the results of the audit.
- Notes** Enter notes to explain how values were calculated, document data sources, and related information about data management practices.
- Blank Sheet** By popular demand! A blank sheet. The world is your canvas.
- Water Balance** The values entered in the Worksheet automatically populate the Water Balance.
- Loss Control Planning** Use this sheet to interpret the results of the audit validity score and performance indicators.
- Definitions** Use this sheet to understand the terms used in the audit process.
- Service Connection Diagram** Diagrams depicting possible customer service connection line configurations.
- Acknowledgements** Acknowledgements for development of the AWWA Free Water Audit Software v6.0.

### AWWA Web Resources for Water Loss Control

<https://www.awwa.org/Resources-Tools/Resource-Topics/Water-Loss-Control>

Items referenced in the Free Water Audit Software v6.0 on the web:

- Data Grading Matrix v6.0
- Example Water Audit v6.0
- Water Audit Compiler v6.0
- AWWA Reports on Performance Indicators
- M36 Manual

If you have questions or comments regarding this software please contact us at: [wlc@awwa.org](mailto:wlc@awwa.org)

## Enter Basic Information

Name of Utility:	Columbia Water Company
Name of Contact Person:	David Lewis
Email:	dlewis@columbiawater.net
Telephone   Ext.:	(717) 684-2188
City/Town/Municipality:	Columbia
State / Province:	Pennsylvania (PA)
Country:	USA
Audit Preparation Date:	Mar 21 2023
Audit Year:	2022
Audit Year Label:	Calendar (Fiscal, Calendar, etc)
Audit Period Start Date:	Jan 01 2022
Audit Period End Date:	Dec 31 2022
Volume Reporting Units:	Million gallons (US)
Water System Structure:	Retail
Water Type:	Potable Water
System ID Number:	7360123
Validator Name/ID:	n/a
Validator Email:	n/a
Estimated Total Population Served by Water Utility:	33,500

## Key of Input Acronyms

*In order of appearance in the Worksheet*

- VOS** Volume from Own Sources
- VOSEA** VOS Error Adjustment
- WI** Water Imported
- WIEA** WI Error Adjustment
- WE** Water Exported
- WEEA** WE Error Adjustment
- BMAC** Billed Metered Authorized Consumption
- BUAC** Billed Unmetered Authorized Consumption
- UMAC** Unbilled Metered Authorized Consumption
- UUAC** Unbilled Unmetered Authorized Consumption
- SDHE** Systematic Data Handling Errors
- CMI** Customer Metering Inaccuracies
- UC** Unauthorized Consumption
- Lm** Length of mains
- Nc** Number of service connections
- Lp** Average length of (private) customer service line
- AOP** Average Operating Pressure
- CRUC** Customer Retail Unit Charge
- VPC** Variable Production Cost

## Color Key

User input

Calculated

Optional default

## Guidance for the Worksheet

Choosing to enter unit of **percent** or **volume** (applies to VOSEA, WIEA, WEEA, CMI)

choose entry option:

1.00%	percent	or
	volume	25.000

Choosing to enter **default** or **custom input** (applies to UUAC, SDHE, UC)

choose entry option:

0.25%	default	or
	custom	75.000

## Guidance for the Interactive Data Grading

Use acronym buttons in IDG header to navigate among inputs. Acronym Key above. White = needs answers, orange = complete, clear = not required. Example below.

VOS	VOSEA	WI	WIEA	WE	WEEA	BMAC	BUAC	UMAC	UUAC
SDHE	CMI	UC	Lm	Nc	Lp	AOP	CRUC	VPC	

After clicking an acronym button, answer all visible questions in the order they're presented, choosing best-fit answer

Grade will populate when all visible questions are complete for an input

7

The limiting criteria will be labeled along the right. If only 1 limiting criterion is shown, improving on that criterion will achieve a higher data grade. If multiple limiting criteria are shown, improving on *each* limiting criterion is necessary to achieve a higher data grade. A complete inventory of data grading criteria is available in the Data Grading Matrix v6.0 (see web resources)

Limiting



2022

White = incomplete  
Orange = complete

Use acronyms for navigation

FWAS v6.0 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> = a test process that confirms the flow measuring accuracy of the primary device (the flowmeter), in its installed location, using an independent reference volume.</p> <p><b>Electronic calibration</b> = 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 conversion to mA, meter transmitter 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?	Less than annual but within last 5 years	Limiting
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), but not to 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	
<b>FINAL DATA GRADE FOR THIS AUDIT INPUT:</b>		<b>5</b>	

go to input

**Volume from Own Sources Error Adjustment (VOSEA) - Data Grading Criteria**

go to notes

vosea	Criteria Question	Select Best-Fit Answers to All Visible Questions
vosea.1	Are tank levels monitored automatically & recorded daily?	Yes
vosea.2	Are daily changes of stored water volumes in distribution system tanks included in the tabulation of the daily "Volume from Own Sources" quantity?	Yes
vosea.3	Is the annual net distribution storage change included in either the VOS input or the VOSEA input?	Yes
vosea.4	Are the flow accuracy test and/or electronic calibration results included in the VOSEA input in the water audit?	Yes, results are analyzed and incorporated
<b>FINAL DATA GRADE FOR THIS AUDIT INPUT:</b>		<b>10</b>

go to input

**Water Imported (WI) - Data Grading Criteria**

go to notes

wi	Criteria Question	Select Best-Fit Answers to All Visible Questions
wi.0	Did the water utility import any water during the audit year?	No
wi.1		
<p><b>For questions 2-10 below: Choose the answer that applies for those meters that measure &gt;90% of the water imported volume.</b></p> <p><b>In-situ flow accuracy testing</b> = a test process that confirms the flow measuring accuracy of the primary device (the flowmeter), in its installed location, using an independent reference volume.</p> <p><b>Electronic calibration</b> = 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 conversion to mA, meter transmitter or similar instrumentation.</p> <p><b>Tertiary device</b> can include SCADA, historian or other computerized archival system.</p>		
wi.2		
wi.3		
wi.4		
wi.5		
wi.6		
wi.7		
wi.8		
wi.9		
wi.10		
<b>FINAL DATA GRADE FOR THIS AUDIT INPUT:</b>		<b>n/a</b>

go to input

**Water Imported Error Adjustment (WIEA) - Data Grading Criteria**

go to notes

wiea	Criteria Question	Select Best-Fit Answers to All Visible Questions
wiea.1		
wiea.2		
wiea.3		
wiea.4		
<b>FINAL DATA GRADE FOR THIS AUDIT INPUT:</b>		<b>n/a</b>

[go to input](#) **Water Exported (WE) - Data Grading Criteria** [go to notes](#)

we	Criteria Question	Select Best-Fit Answers to All Visible Questions
we.0	Did the water utility export any water during the audit year?	No
we.1	<p><b>For questions 2-10 below: Choose the answer that applies for those meters that measure &gt;90% of the water exported volume.</b>  <b>In-situ flow accuracy testing</b> = a test process that confirms the flow measuring accuracy of the primary device (the flowmeter), in its installed location, using an independent reference volume.  <b>Electronic calibration</b> = a process that checks for error in the metering secondary device(s) and/or the tertiary device(s).  <b>Secondary device</b> can include conversion to mA, meter transmitter or similar instrumentation.  <b>Tertiary device</b> can include SCADA, historian or other computerized archival system.</p>	
we.2		
we.3		
we.4		
we.5		
we.6		
we.7		
we.8		
we.9		
we.10		
FINAL DATA GRADE FOR THIS AUDIT INPUT:		n/a

[go to input](#) **Water Exported Error Adjustment (WEEA) - Data Grading Criteria** [go to notes](#)

weea	Criteria Question	Select Best-Fit Answers to All Visible Questions
weea.1		
weea.2		
weea.3		
weea.4		
FINAL DATA GRADE FOR THIS AUDIT INPUT:		n/a

[go to input](#) **Billed Metered Authorized Consumption (BMAC) - Data Grading Criteria** [go to notes](#)

bmac	Criteria Question	Select Best-Fit Answers to All Visible Questions
bmac.0	Were any customers metered in the audit year?	Yes
bmac.1	For billed metered accounts, what % of bills are estimated in a typical billing cycle?	5% or less
bmac.2	How often does the utility read its customer meters? For systems with multiple read frequencies, select the reading frequency that describes the majority of your customers.	Monthly
bmac.3	Is the BMAC volume pro-rated to represent consumption occurring exactly during the audit period?	No
bmac.4	How frequently does internal review by utility staff of the BMAC volumes occur?	Every billing cycle
bmac.5	What level of detail is examined in the internal review of BMAC volumes?	Totals grouped by use type or customer class and specific accounts flagged for anomalous consumption
bmac.6	When was the most recent billing data review by someone who is independent of the utility billing process?	Within last 3 years
bmac.7	What level of detail was examined in the review by someone who is independent of the utility billing process?	Full billing database query and analysis of raw data to verify the summary consumption volumes
FINAL DATA GRADE FOR THIS AUDIT INPUT:		8

Limiting

[go to input](#) **Billed Unmetered Authorized Consumption (BUAC) - Data Grading Criteria** [go to notes](#)

buac	Criteria Question	Select Best-Fit Answers to All Visible Questions
buac.0	Was there any billed consumption on unmetered accounts in the audit year?	No
buac.1		
buac.2		
buac.3		
FINAL DATA GRADE FOR THIS AUDIT INPUT:		n/a

[go to input](#) **Unbilled Metered Authorized Consumption (UMAC) - Data Grading Criteria** [go to notes](#)

umac	Criteria Question	Select Best-Fit Answers to All Visible Questions
umac.0	Did the water utility have any unbilled-metered consumption in the audit year?	Yes
umac.1	Does the water utility policy articulate which accounts are exempt from billing?	Policy includes specific exemptions
umac.2	How many unbilled metered accounts exist?	Monitored, count available
umac.3	How often is each unbilled customer meter read? For systems with multiple read frequencies, select the reading frequency that describes the majority of your customers.	Monthly or more frequently
umac.4	How often are unbilled metered volumes reviewed for error?	Each billing cycle
<b>FINAL DATA GRADE FOR THIS AUDIT INPUT:</b>		<b>10</b>

[go to input](#) **Unbilled Unmetered Authorized Consumption (UUAC) - Data Grading Criteria** [go to notes](#)

uuac	Criteria Question	Select Best-Fit Answers to All Visible Questions	
uuac.0	On the Worksheet, the status of the default option is:	A system specific volume has been entered	Limiting
uuac.1	How well-understood is the extent of unbilled unmetered use?	Majority identified and tracked	
uuac.2	Which best describes the records that are kept for events of unbilled unmetered use?	Each event is documented	
uuac.3	How is the majority of unbilled unmetered use estimated?	Entirely from event-specific estimates	
<b>FINAL DATA GRADE FOR THIS AUDIT INPUT:</b>		<b>8</b>	

[go to input](#) **Systematic Data Handling Error (SDHE) - Data Grading Criteria** [go to notes](#)

This Data Grading Criteria is hidden when the 'default' input is used on the Worksheet

**FINAL DATA GRADE FOR THIS AUDIT INPUT:** **3**

[go to input](#) **Customer Metering Inaccuracies (CMI) - Data Grading Criteria** [go to notes](#)

cmi	Criteria Question	Select Best-Fit Answers to All Visible Questions
cmi.0	Was there any metered customer usage during the audit period?	Yes
cmi.1	Do you test meters reactively (when triggered by customer complaint or billing/consumption flag)?	Reactive testing conducted

cmi.2	For small size customer meters, which best describes the frequency of proactive testing (effort beyond when triggered by customer complaint or billing/consumption flags)?	No testing conducted, but at least 10% of meter stock has been replaced within two years of the audit period	Limiting
cmi.3			
cmi.4	For mid and large size customer meters, which best describes the frequency of the proactive testing program?	Not recurring, last testing effort occurred more than 5 years prior to audit period	
cmi.5			
cmi.6	Which best describes how the input was derived?	Meter accuracy test results or manufacturer specs are referenced but not analyzed and used directly in calculation	
cmi.7	Has the input derivation been reviewed by someone with expert knowledge in the M36 methodology?	No	
cmi.8	To what extent does meter replacement occur and for which meters?	Annual proactive replacement of subset of meters (i.e. by age or throughput)	
cmi.9	Which best describes the reliability of meter installation records?	Records are kept for meter installations, and they include data on installation date, type, size, and manufacturer	
<b>FINAL DATA GRADE FOR THIS AUDIT INPUT:</b>		<b>4</b>	

[go to input](#) **Unauthorized Consumption (UC) - Data Grading Criteria** [go to notes](#)  
This Data Grading Criteria is hidden when the 'default' input is used on the Worksheet

<b>FINAL DATA GRADE FOR THIS AUDIT INPUT:</b>	<b>3</b>
---	----------

[go to input](#) **Length of Mains (Lm) - Data Grading Criteria** [go to notes](#)

Lm	Criteria Question	Select Best-Fit Answers to All Visible Questions
Lm.1	How was the input derived?	Derived directly from Mains inventory (GIS, ledger, etc)
Lm.2	Are hydrant laterals included in the input derivation?	Yes
Lm.3	Which best describes how the Mains inventory (GIS, ledger, etc) is kept up to date?	Additions or subtractions are updated in the mains inventory (GIS, ledger, etc), at least annually
Lm.4	Which best describes how the Mains inventory (GIS, ledger, etc) is field validated to confirm field conditions match the inventory?	Field validation is accomplished (i.e. in daily operations or specific validation projects)
<b>FINAL DATA GRADE FOR THIS AUDIT INPUT:</b>		<b>10</b>

[go to input](#) **Number of Service Connections (Nc) - Data Grading Criteria** [go to notes](#)

Nc	Criteria Question	Select Best-Fit Answers to All Visible Questions
Nc.1	How was the input derived?	Extracted from Services inventory (GIS, billing system, etc)
Nc.2	What is the count of services based on?	Premise based, i.e. service connection count, location ID count
Nc.3	Are inactive (but still pressurized) service lines included in the input? These may be metered or unmetered.	Yes
Nc.4	Which best describes how the inventory of service connections (GIS, billing system, etc) is kept up to date?	Additions or subtractions are updated in the service line inventory (GIS, billing system, etc), at least annually
Nc.5	Which best describes how the inventory of service connections (GIS, billing system, etc) is field validated to confirm field conditions match the inventory?	Field validation is accomplished for the entire system (i.e. in daily operations or specific validation projects)
<b>FINAL DATA GRADE FOR THIS AUDIT INPUT:</b>		<b>10</b>

[go to input](#) **Average Length of (Private) Customer Service Line (Lp) - Data Grading Criteria** [go to notes](#)

Lp	Criteria Question	Select Best-Fit Answers to All Visible Questions
Lp.0	Are customer meters typically located at the curbside or property line?	No
Lp.1	How was the input derived?	Derived from full mapping and customer inventory
Lp.2	Which best describes how the Customer Service Line and Meter Locations mapping is kept up to date?	Additions or subtractions are updated in the service line and meter locations inventory, at least annually
Lp.3	Which best describes how the Customer Service Line mapping is validated to what is in the field?	Field validation is accomplished (i.e. through normal work order processes or specific validation projects)
Lp.4	Which best describes the policy to define where the utility's ownership of the service line ends, and the customer's ownership of the service line begins?	Policy is clear, and adherence in practice is consistent
<b>FINAL DATA GRADE FOR THIS AUDIT INPUT:</b>		<b>10</b>

[go to input](#) **Average Operating Pressure (AOP) - Data Grading Criteria** [go to notes](#)

aop	Criteria Question	Select Best-Fit Answers to All Visible Questions
aop.1	Which best describes checks on the boundary integrity for the system's pressure zone(s)?	Normally-closed boundary valves between zones have been confirmed within the past 3 years to be fully closed
aop.2	Which best describes how one-time pressure readings (i.e. from hydrants) are collected?	Collected annually during routine system flushing and/or hydrant testing
aop.3	Which best describes where continuous pressure data (via temporary data loggers or permanent telemetry) is collected?	All zone boundary conditions only (i.e. supply entry points, PRVs, booster stations)
aop.4	Which best describes how continuous pressure data is collected?	Temporary data logger(s) deployed, adequately capturing seasonal variation during the year
aop.5	How was the input derived?	Calculated from field data as a simple average
<b>FINAL DATA GRADE FOR THIS AUDIT INPUT:</b>		<b>7</b>

Limiting

[go to input](#) **Customer Retail Unit Charge (CRUC) - Data Grading Criteria** [go to notes](#)

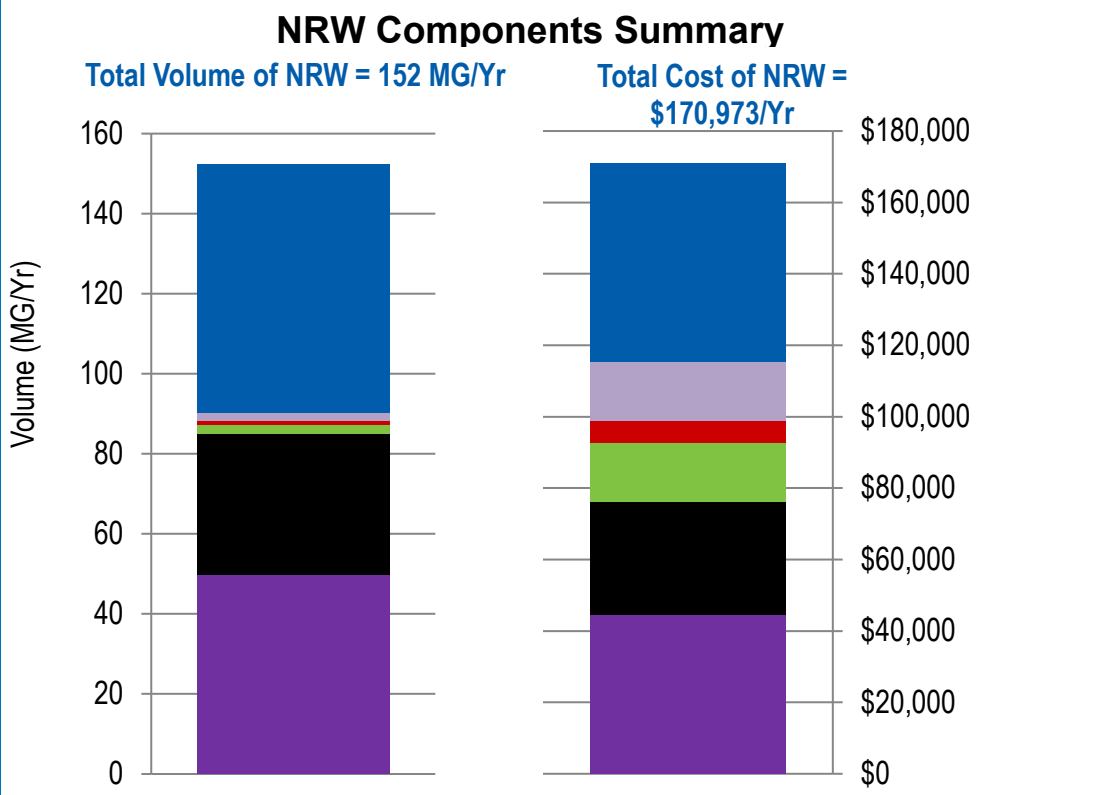
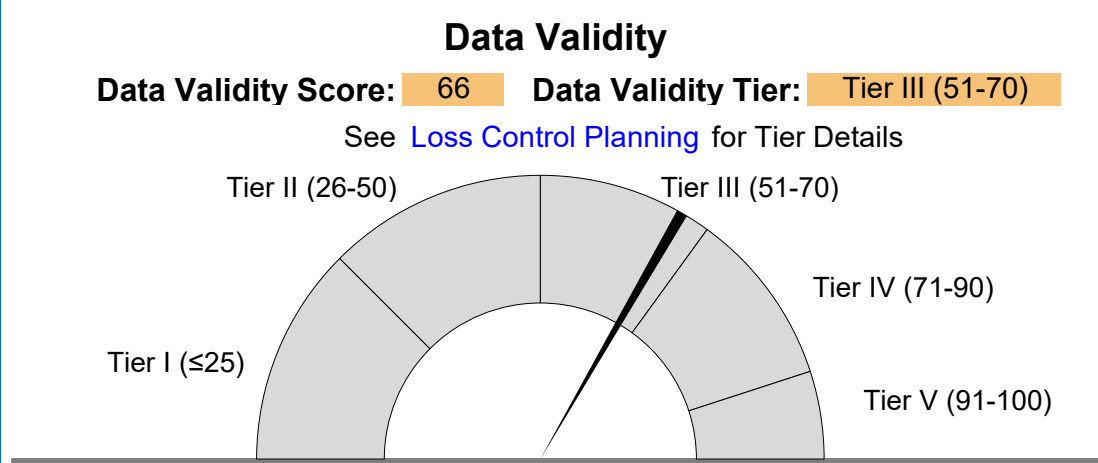
cruc	Criteria Question	Select Best-Fit Answers to All Visible Questions
cruc.0	Was any metered consumption billed on a volumetric basis in the audit period?	Yes
cruc.1	Which best describes the use and reliability of the current rate structure?	Customer bill calculations have been checked to confirm the rate structure is correctly implemented
cruc.2	Choose the option that best describes how the input was derived	A volume-weighted average of all rates was calculated
cruc.3	Is there any additional volumetric revenue the utility receives that depends on water meter readings, such as sewer?	No
cruc.4	Has the input derivation been reviewed by someone with expert knowledge in the M36 methodology?	No
<b>FINAL DATA GRADE FOR THIS AUDIT INPUT:</b>		<b>9</b>

Limiting

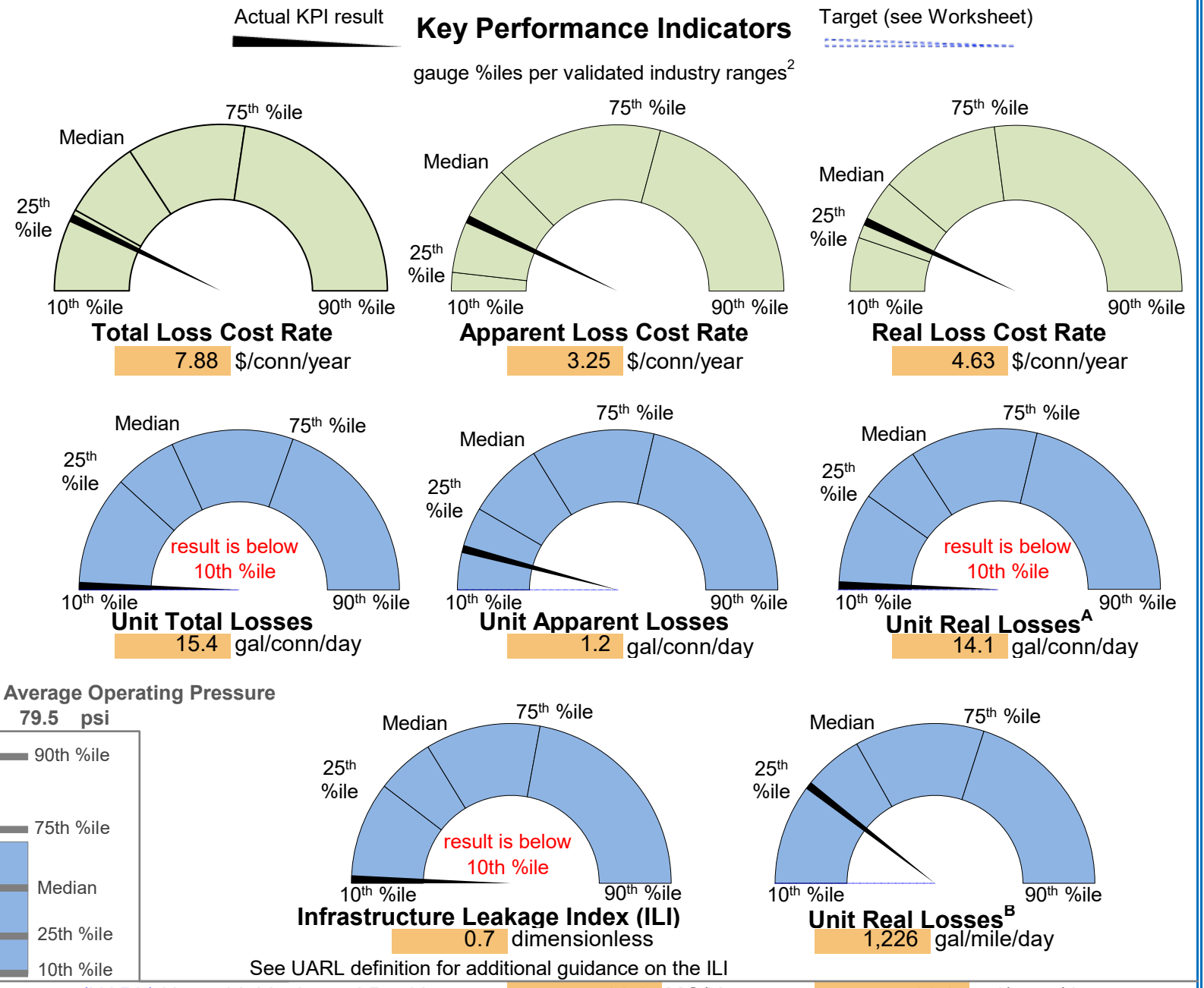
[go to input](#) **Variable Production Cost (VPC) - Data Grading Criteria** [go to notes](#)

vpc	Criteria Question	Select Best-Fit Answers to All Visible Questions
vpc.1	Choose the option that best describes how the input was derived	Only one source of water exists, which was the basis for the input derivation
vpc.2	Choose the option that best describes which short-run marginal costs have been included in the input, using the definitions below for reference. Short-run marginal costs can include the following: - chemicals + power for treatment, typically applicable if the utility is producing/treating water - power for distribution, typically applicable if pumps exist in the distribution network - water acquisition costs, typically applicable if the utility is purchasing water or incurs any extraction costs for withdrawing from a source Some short-run marginal costs may not be applicable. The auditor should analyze the system characteristics to determine which costs are applicable for inclusion in the VPC input derivation. See also the latest AWWA M36 Manual for further guidance.	All applicable short-run marginal costs are included
vpc.3	Choose the option that best describes which long-run marginal costs have been included in the input, using the definitions below for reference. Long-run marginal costs can include the following: - water treatment residuals management, typically applicable if solids are produced from water treatment process - accelerated wear & tear on dynamic equipment, typically applicable if pumps exist for treatment and/or distribution, or any other equipment exists that wears out as a function of use instead of time (i.e. filter media, chemical dosing pumps, uv disinfection bulbs, etc) - payouts for damage claims from main and service line breaks, typically applicable if damage claims are paid by the utility - accelerated expansion of supply capacity, typically applicable if the utility is at or nearing supply capacity, or scarcity costs in water scarce areas - full cost pricing that includes all lifecycle costs and externalities (internalized or not) Some long-run marginal costs may not be applicable. The auditor should analyze the system characteristics to determine which costs are applicable for inclusion in the VPC input derivation. See also the latest AWWA M36 Manual for further guidance.	Long-run marginal costs have been evaluated for applicability, and all applicable costs are included
vpc.4	Has the input derivation been reviewed by someone with expert knowledge in the M36 methodology?	No
<b>FINAL DATA GRADE FOR THIS AUDIT INPUT:</b>		<b>9</b>

Limiting



Component	Volume (MG/Yr)	Value (\$/Yr)	Basis of Valuation
Real Losses	5.3	\$39,046	CRUC
Systematic Data Handling Errors	62.0	\$55,642	VPC
Customer Metering Inaccuracies	85.0	\$76,285	VPC
Unauthorized Consumption	152.3	\$170,973	Blended



#### Guidance Information for Key Performance

- The eight indicators shown are the recommended suite per the AWWA Water Loss Control Committee 2020 Position on KPIs<sup>1</sup>.
- A suite of KPIs is necessary, as no single KPI can holistically communicate water loss performance for a given water system.
- See Table 1 below for Uses and Limitations for each KPI, excerpted from the AWWA Water Loss Control Committee Report (2020)<sup>1</sup>, with naming conventions updated.
- Percentiles (%iles) shown on KPI gauges come from Level 1 validated data in the AWWA WLCC Reference Water Audit Dataset (2020)<sup>2</sup>.
- KPI %iles shown above are not segregated by cohorts. Limited

KPI data by cohorts may be found in WRF 4695 Guidance Manual, Appendix B (2019)<sup>5</sup>.

- Actual KPI results that fall below 10<sup>th</sup> %ile or above 90<sup>th</sup> %ile do not necessarily imply error, but should be viewed with scrutiny.
- Percentiles not intended to imply targets. Targets may be input by user for operational KPIs, if desired, on Worksheet.
- See UARL and ILI in Definitions tab for discussion of size and pressure limitations.
- Systems that fall on the extreme ends of size or connection density should use caution when interpreting Unit Losses KPIs.

**Table 1**    Source: AWWA Water Loss Control Committee Report (2020)<sup>1</sup>, with naming conventions updated

**2020 AWWA Water Audit Method – Water Audit Outputs and Key Performance Indicators: Uses and Limitations**

Type	Indicator	Description	Suitable Purposes					Uses and Limitations	Principal Users
			Assessment	Bench-Marking	Target-Setting	Planning	Tracking		
Attribute	Apparent Loss Volume	Calculated by Free Water Audit Software	✓				✓	Assess loss level	Utility, Regulators
	Apparent Loss Cost	Calculated by Free Water Audit Software	✓				✓	Assess cost loss level	Utility, Regulators
	Real Loss Volume	Calculated by Free Water Audit Software	✓				✓	Assess loss level	Utility, Regulators
	Real Loss Cost	Calculated by Free Water Audit Software	✓				✓	Assess loss cost level	Utility, Regulators
	Unavoidable Annual Real Loss (UARL)	Calculated by Free Water Audit Software	✓				✓	Reveal theoretical technical low level of leakage	Utility, Regulators
Volume	Unit Apparent Losses (vol/conn/day)	Strong and understandable indicator for multiple users.	✓	✓	✓	✓	✓	Used for performance tracking and target-setting	Utility, Regulators
	Unit Real Losses <sup>A</sup> (vol/conn/day)	Strong and understandable indicator for multiple users.	✓	✓	✓	✓	✓	Used for performance tracking and target-setting	Utility, Regulators, Policy Makers
	Unit Real Losses <sup>B</sup> (vol/pipeline length/day)	Strong and understandable indicator for use by utilities with low connection density.	✓	✓	✓	✓	✓	Data collection and assessment of systems with "low" connection density	Utility, Regulators, Policy Makers
	Unit Total Losses (vol/conn/day) <b>New KPI</b>	Strong and understandable indicator, suitable for high-level performance measurement.	✓				✓	High level indicator for trending analysis. Not appropriate for target-setting or benchmarking	Utilities, Customers
	Infrastructure Leakage Index (ILI)	Robust, specialized ratio KPI; can be influenced by pressure and connection density.	✓	✓			✓	Benchmarking after pressure management is implemented	Utilities
Value	Apparent Loss Cost Rate (value/conn/year) <b>New KPI</b>	Indicators with sufficient technical rigor. Provide the unit financial value of each type of loss, which is useful for planning and assessment of cost efficiency of water loss reduction and control interventions and programs.	✓			✓	✓	Data collection and assessment on AWWA indicators or contextual parameters to use in conjunction with Loss Cost Rates	Utilities, Regulators, Customers
	Real Loss Cost Rate (value/conn/year) <b>New KPI</b>		✓			✓	✓		Utilities, Regulators, Customers
Validity	Data Validity Tier (DVT)	Strong indicator of water loss audit data quality, if data has been validated. Tier provides guidance on priority areas of activity.	✓	✓		✓	✓	Assess caliber of data inputs of the water audit	Regulators, Utilities

