WATER LOSS CONTROL PLAN

FOR WELLSTON, OHIO

Contents

Introduction

A public water system (PWS) faces many challenges in maintaining a system with minimal water loss. Rural communities in Ohio are often faced with aging infrastructure and inadequate resources to fix water loss issues. Tracking water loss is essential to reduce the amount of water and resources wasted or lost. This can lessen the financial burden on the community. With proper tracking, a PWS can use their resources effectively to promptly investigate and correct any water loss issues that occur. There are numerous ways a community can effectively track water loss.

Wellston's public water system tracked water loss using different methodologies. Currently, the system's primary way to detect water loss is by analyzing the bills for all the water customers for anomalies. The billing software automatically flags erroneous amounts for the administration to check, and the customer meter reads also undergo a manual review as bills are being processed. Water personnel are sent to check meters for accounts that have unusually high or low water usage for the month. The community has made attempts at minimizing water loss in the past, such as by completing leak detection surveys regularly, and repairing or replacing the leaking main lines. This water audit contains water loss categories and guidance for control measures that aim to improve and add to practices Wellston has in place.

The AWWA M36 is the industry standard guidance for conducting annual water audits. The free water audit software uses data from the community to track and analyze where water is going within a system, and the water system's associated costs and revenue. The data provided to the software is graded through a series of questions, determining the validity and accuracy of each data point. The software gives each PWS a score ranging from 1 to 100. The score range is divided into five tiers. Scoring in a high tier indicates a PWS is following best practices for water auditing. Validity scoring also influences the priorities for future improvement. The M36 gives key takeaways for each system, and a generalized strategy to implement a water loss control program. Public water systems should have a goal of receiving a higher validity score each year they complete the water audit, by accurately collecting their system's water usage, revenue, and expenses. The system can also implement operational improvements, such as meter calibration to lift their validity score and minimize apparent water loss.

definitions for each of the following key data points. The complete water audit software workbook is included in Appendix A of this report.

Water Supplied: 484.320 MG/Yr

Wellston's water system produced 484.320 million gallons of water for the village. The system does not sell wholesale water to any other PWS.

Non-Revenue Water: 205.671 MG/Yr costing ≈ 459,479+ Yr

Total non-revenue water is 205.671 million gallons for the audit year. This was calculated by adding the real losses, apparent losses, and the unbilled authorized consumption. Non-revenue water includes all water that runs through the system but does not generate billable revenue. This includes water that is lost to leaks, and water that makes it to an end user, but does not get billed.

Non-Revenue Water Percentage: 42.27% in 2024

Water Loss Percentage: 41.68% in 2024

These percentages should not be the key takeaway of the audit. Instead, this figure is provided for consistency with reporting standards and to highlight the difference between non-revenue water and water loss. For Wellston in 2024, the vast majority of non-revenue water is actual water loss.

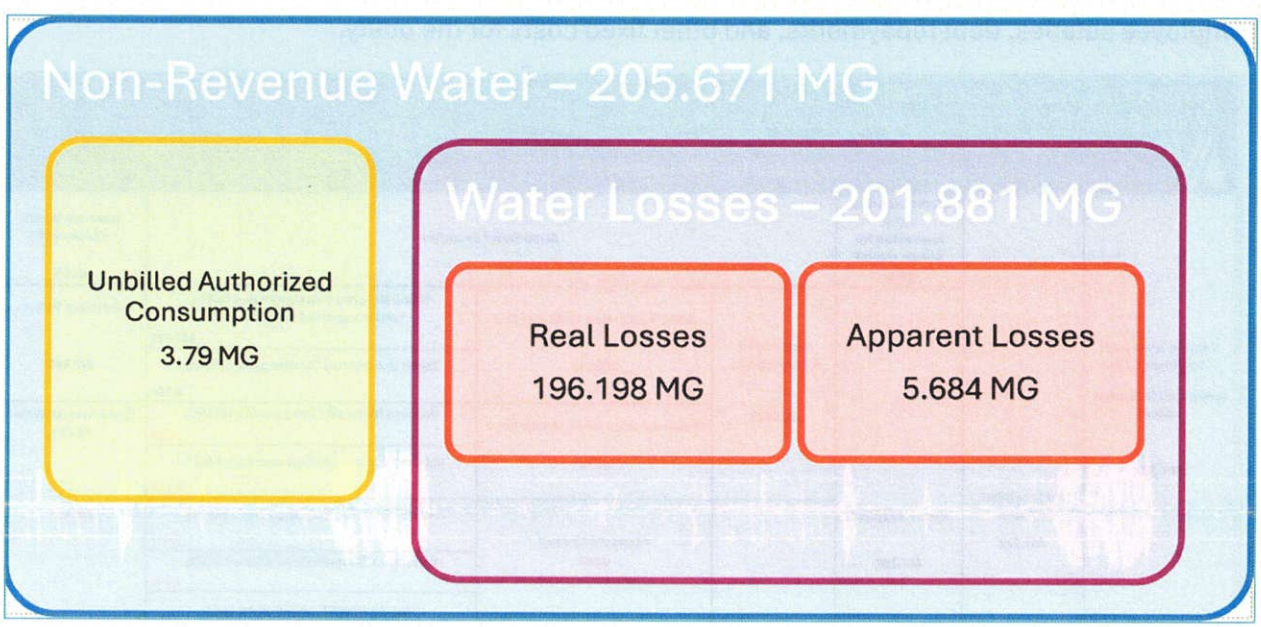


Figure 2: Graphic representation of the relationship between water losses and non-revenue water.

Apparent Losses: 5.684 MG/Yr

Apparent loss includes billing loss, potential theft, and meter inaccuracies in the system. Wellston's apparent loss is estimated to be 5.684 million gallons in 2024. This is considerably less than their calculated real loss. Since apparent losses are losses of revenue the cost is calculated

MG/Y is estimated to be water loss. This is broken down into further, more detailed categories, as shown above.

The analysis highlighted the highest water loss categories:

1. Leakage Level After Reduction: 196.198 MG/Yr contributing to real losses.
2. Customer Metering Inaccuracies: 4.290 MG/Yr contributing to apparent losses.
3. Systematic data handling errors: 0.697 MG/Yr contributing to apparent losses.

It's important to understand how a system's water loss is divided between apparent loss and real loss before taking remedial action. The M36 software has used the data provided by Wellston's staff, created the chart above, and shows how water falls within the balance sheet. Most of the water loss appears to be coming from real loss, such as from leaks within the system. Apparent loss is still seen, with the unauthorized consumption, customer metering inaccuracies, and systematic data handling errors having a combined estimated 5,684,000 gallons a year lost.

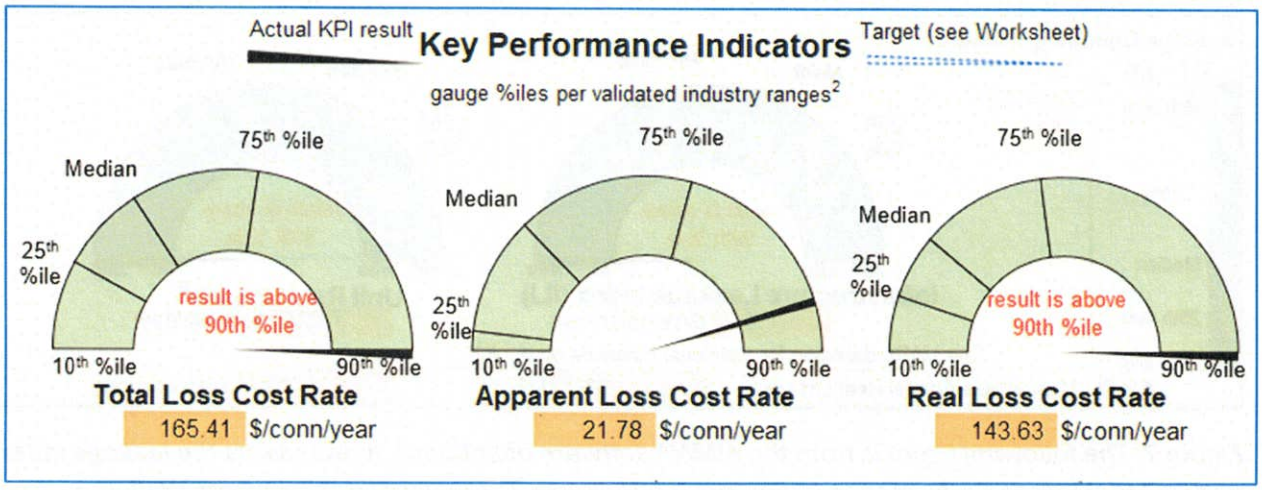


Figure 5: The following figure is from the AWWA dashboard. It represents the water loss cost Performance Indicators for Wellston. These gauges show where Wellston stands in percentiles compared to other validated industry ranges.

As shown above, the total loss cost rate is $165.41 per connection, per year. Real loss is costing more than apparent loss in the system, at $143.63 Rate per connection per year of the total loss cost. The cost of real loss is significantly higher than most other validated water audits, as shown with the gauges. This is most likely due to the aging main water lines and breaks within the system, the water loss from the storage tank, and authorized unbilled consumption. Since many of the performance indicators are high, the data inputs need to be scrutinized in future audits.

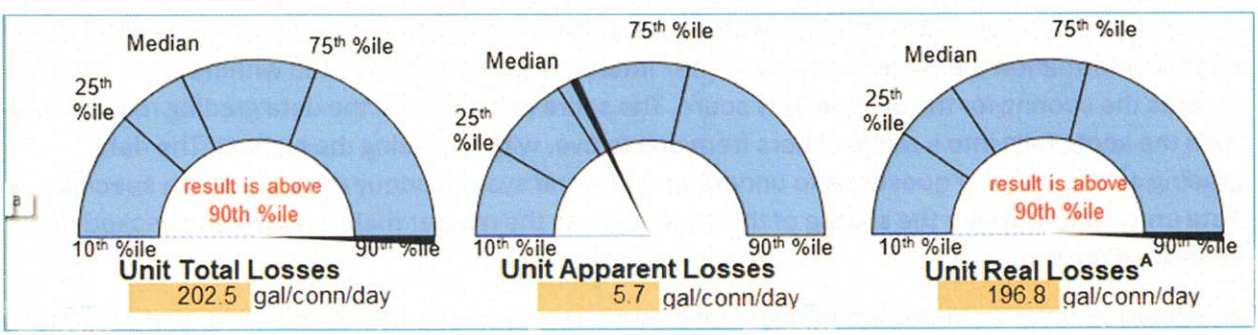


Figure 6: The following figure is from the AWWA dashboard. It represents water loss volumetric per connection Performance Indicators for Wellston. These gauges show where Wellston stands in percentiles compared to other validated industry ranges. These gauges specifically represent the total losses broken down into apparent and real losses.

The figure above notes how the total loss for 2024 is around 202.5 gallons per connection per day. The system has 2,732 service connections, and at 202.5 gallons per connection, equals an estimated 553,230 gallons per day of total loss.

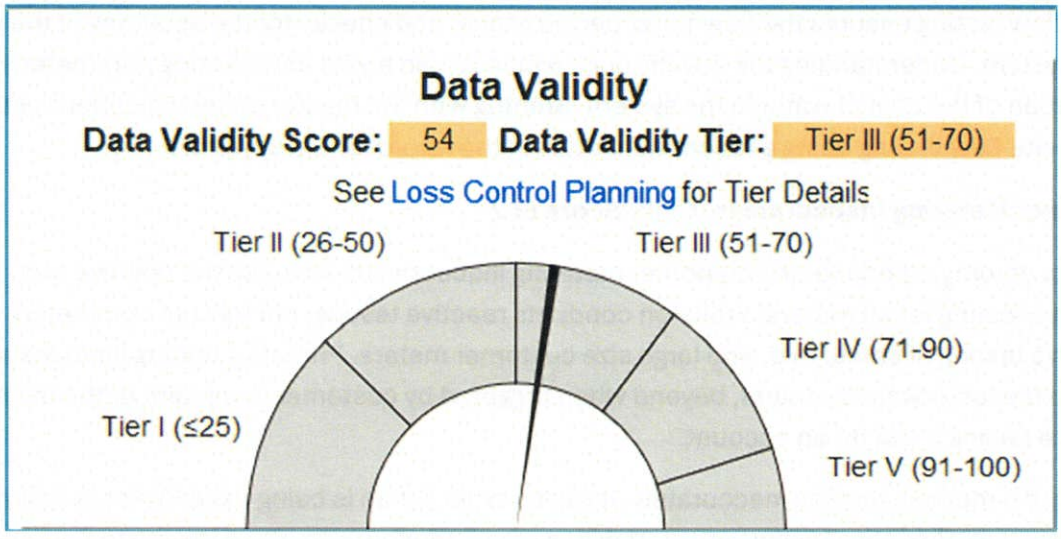


Figure 8: This figure is from AWWA's water audit dashboard for Wellston. Wellston scored 54 of Validity Score, landing in data validity Tier III.

The following are recommended categories for the Village of Wellston to prioritize for improvement. Recommended strategies should be implemented to improve the data validity score in future audit years. Within each category, recommendations have been included along with the current score of that category, ranging from one to ten. The possible improvements will be expanded upon further. Categories with a score of three or less should be prioritized for future improvement.

Priority in Validity Categories and Methods for Improvement

This section provides insights into how future water audits can build upon the work done for the 2024 audit year by improving data validity. The areas below are highlighted because they are shown as the most influential on the overall validity score. The data in these categories is not necessarily indicative of a problem, but the data can be made more reliable by improving how it is measured, tracked, or handled.

Volume from Own Sources (VOS): Score of 3

The score for the volume from own sources section could be improved. To improve the accuracy and data of the VOS section, we recommend that the master meter is checked and calibrated first. The master meter is the first point of tracking the amount of water being produced and used within the system. Validating that the master meter is the correct type, installed properly, and is reading flow accurately will verify the data collected for the VOS input, and could instantly decrease the amount of apparent water loss occurring in the system. The system should electronically calibrate the master meter. After this, the system could improve upon the accuracy of their data collection and the meter by completing in-situ flow testing.

Strategies for Water Loss Control

Wellston is experiencing loss in the form of apparent and real water losses. The M36 software shows the system to have much more real loss than apparent loss, as the data grading also shows the system having an overall good handling of their records and meter reads, with brand new meters.

Apparent Loss Strategies

The M36 creates a calculated estimate for apparent loss, based off the system's water production and reported, tracked consumption. The unauthorized consumption, or water theft, and the systematic data handling errors are contributing to the moderate water loss percentage in the system, at 41.68% total water loss.

Systematic data handling errors could be improved upon by having an internal and external review of the billing software. This includes a review of the customer accounts, and comparing the list to addresses known in the system, the lead service line inventory, and county records. This rules out if the software is missing any water usage that should be receiving bills. All systems should try to minimize manual entries and prioritize using automated meter reads and processes when possible. The system could implement a new SOP, regarding systematic data handling, allowing for more consistent work and data records between staff. Wellston should keep up with their monthly manual checks of their billing software. Lastly, the system should investigate the customer metering inaccuracies and determine any points where unauthorized consumption could occur.

Meter errors could be occurring in the system. Typically, meter errors lead to low reads, taking directly from the revenue for the system. Testing about 2% to 5% of the customer meters annually can improve the data validity for meter readings. The system has a low number of large-sized meters. Although the system has new meters, they could inspect business meters to make sure it is the correct meter type for the flow rate, and take a small, random sample of meters to proactively test each year for accuracy.

Unauthorized consumption, or water theft, can be found through normal daily operations. The billing and consumption data can be used to find extraneously low water usage in an account, which may indicate unauthorized use. Water system personnel should continue checking such accounts for misconduct or issues with the meter read. The village could also implement a proactive program of field inspections to identify and address illegal connections, bypassed meters, and unmetered connections. Lastly, the system could educate the community about the importance of legal water connections, the expenses of the water system, and the consequences of water theft.

Real Loss Strategies

The water audit findings indicate that while apparent losses are present, a substantial portion of the non-revenue water in the Village of Wellston is due to real losses. Real losses are an important aspect of NRW because they include leakage from distribution mains, leakage and overflows from storage tanks, and leakage from service connections up to and including the meter. Real water losses are significant because they contribute costs to the water system due to the additional energy and chemical usage required to treat the lost water.

year for accuracy. This will improve the customer metering data source, improving the data validity score.

5. **Tracking Water Use:** Wellston should eventually put a plan into place to more accurately track flushing and fire water usages. This will not decrease the cost of non-revenue water, as it is unbilled usage, but rather decrease the amount of water loss and the water loss percentage within the system.

Overall, the village of Wellston is in a good baseline position for data validity, with an implemented billing structure with software that flags anomalous amounts, leak detection occurring in recent years, and an up to date GIS map and inventory. The system should improve their data validity score and water loss volumes in future water audits by implementing the various recommended strategies listed throughout the water loss control plan. Other strategies may be found by the system and implemented as well. Water audits should be completed annually by the system, with a new copy of the M36 downloaded from the AWWA's website each time. An external review of the water system should be completed every 3 years. Wellston should focus on implementing the first three strategies within 2026, to gain better data accuracy from the source and lower real loss occurring within the system, then complete another water audit in 2027.

Appendix A – AWWA Water Audit Data Sheets

Attached is a printed copy of the source data from the AWWA free water audit software. A digital copy of this workbook is also provided with the water loss control plan printout. Additional sheets beyond what is printed exist in the full workbook. The following sheets are printed:

1. Start page
2. Primary worksheet
3. Dashboard
4. Water balance
5. Loss control planning

AWWA Free Water Audit Software v6.1

FWAS v6.1

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)

AWWA Web Resources for Water Loss Control

https://www.awwa.org/resource/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
- Leakage Emissions Initiative - Water Loss Control Committee Report[10]

Enter Basic Information

Name of Utility:	Wellston PWS
Name of Contact Person:	Mindy Eisnaugle
Email:	meisnaugle@cityofwellston.org
Telephone | Ext.:	740-384-2720
City/Town/Municipality:	Wellston
State / Province:	Ohio (OH)
Country:	United States
Audit Preparation Date:	Nov 22 2025
Audit Year:	2025
Audit Year Label:	Calendar (Fiscal, Calendar, etc)
Audit Period Start Date:	Jan 01 2024
Audit Period End Date:	Dec 31 2024
Volume Reporting Units:	Million gallons (US)
Water System Structure:	Retail
Water Type:	Potable Water
System ID Number:	OH4001912
Validator Name/ID:	Bud Mason
Validator Email:	cmason@glcap.org
Estimated Total Population Served by Water Utility:	5,412

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

If you have questions or comments regarding this software please contact us at: wlc@awwa.org

AWWA Free Water Audit Software: Worksheet

FWAS v6.1

Water Audit Report for: **Wellston PWS**
Audit Year: **2025** | **Jan 01 2024 - Dec 31 2024** | **Calendar**

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

To edit water system info: go to start page

To access definitions, click the input name

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

Water Supplied Error Adjustments

WATER SUPPLIED

choose entry option:

		n	g				n	g				
VOS	Volume from Own Sources:	n	g	3	484.320	MG/Yr	n	g	8		percent	VOSEA
WI	Water Imported:	n	g	n/a	0.000	MG/Yr						WIEA
WE	Water Exported:	n	g	n/a	0.000	MG/Yr						WEEA
	WATER SUPPLIED:				484.320	MG/Yr						

AUTHORIZED CONSUMPTION

choose entry option:

BMAC	Billed Metered:	n	g	8	278.649	MG/Yr		
BUAC	Billed Unmetered:	n	g	n/a	0.000	MG/Yr		
UMAC	Unbilled Metered:	n	g	4	3.093	MG/Yr		
UUAC	Unbilled Unmetered:	n	g	3	0.697	MG/Yr	0.25%	default

Default option selected for Unbilled Unmetered, with automatic data grading of 3

AUTHORIZED CONSUMPTION: 282.439 MG/Yr

WATER LOSSES

201.881 MG/Yr

Apparent Losses

choose entry option:

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

SDHE	Systematic Data Handling Errors:	n	g	3	0.697	MG/Yr	0.25%	default	
CMI	Customer Metering Inaccuracies:	n	g	2	4.290	MG/Yr	1.50%	percent	under-registration
UC	Unauthorized Consumption:	n	g	3	0.697	MG/Yr	0.25%	default	

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

Apparent Losses: 5.684 MG/Yr

Real Losses

Real Losses: 196.198 MG/Yr

WATER LOSSES: 201.881 MG/Yr

NON-REVENUE WATER

NON-REVENUE WATER: 205.671 MG/Yr

SYSTEM DATA

Lm	Length of mains:	n	g	8	68.7	miles	(including fire hydrant lead lengths)
Nc	Number of service connections:	n	g	10	2,732		(active *and* inactive)
	Service connection density:				40	conn./mile main	
	Are customer meters typically located at the curbstop/property line?				Yes		
Lp		n	g	10			

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

AOP	Average Operating Pressure:	n	g	6	111.0	psi

COST DATA

CRUC	Customer Retail Unit Charge:	n	g	7	$10.54	$/1000 gallons (US)	Total Annual Operating Cost
VPC	Variable Production Cost:	n	g	9	$2,000.00	$/Million gallons	$1,471,655 $/yr (optional input)

Click here to calculate carbon emissions ---> carbon

WATER AUDIT DATA VALIDITY TIER:

***** The Water Audit Data Validity Score is in Tier III (51-70). See Dashboard tab for additional outputs. *****

go to dashboard

A weighted scale for the components of supply, consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION TO IMPROVE DATA VALIDITY:

Based on the information provided, audit reliability can be most improved by addressing the following components:

1: Volume from Own Sources (VOS)
2: Customer Metering Inaccuracies (CMI)
3: Billed Metered (BMAC)

KEY PERFORMANCE INDICATOR TARGETS:

OPTIONAL: If targets exist for the operational performance indicators, they can be input below:

Unit Total Losses:		gal/conn/day
Unit Apparent Losses:		gal/conn/day
Unit Real Losses^:		gal/conn/day
Unit Real Losses^D:		gal/mile/day

If entered above by user, targets will display on KPI gauges (see Dashboard)

FWAS v6.1

AWWA Free Water Audit Software: Dashboard

go to worksheet | go to grading | go to references

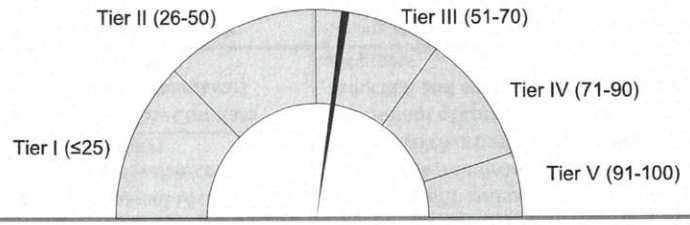
Water Audit Report for: Wellston PWS

Audit Year: 2025 Calendar Jan 01 2024 - Dec 31 2024

Data Validity

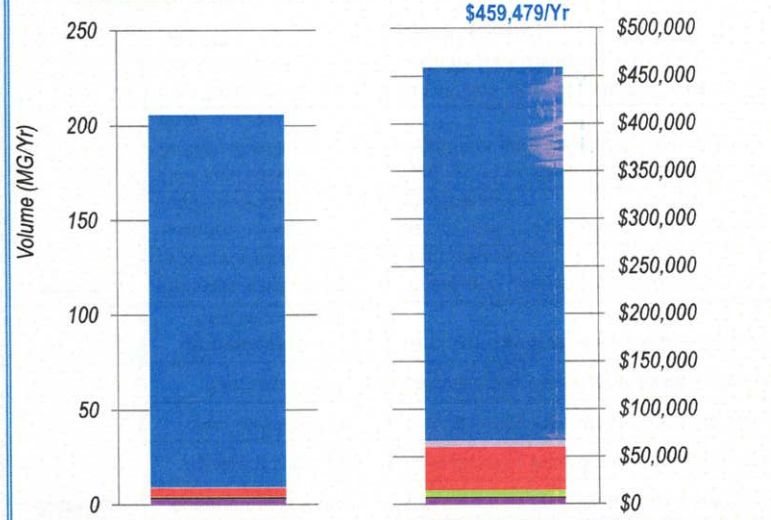
Data Validity Score: 54 **Data Validity Tier:** Tier III (51-70)

See Loss Control Planning for Tier Details



NRW Components Summary

Total Volume of NRW = 206 MG/Yr **Total Cost of NRW = $459,479/Yr**



Real Losses
Systematic Data Handling Errors
Customer Metering Inaccuracies
Unauthorized Consumption
Unbilled Unmetered Auth Cons
Unbilled Metered Authorized Cons

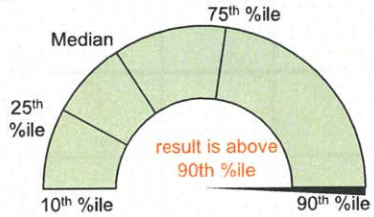
	Volume MG/Yr	Value $/Yr	Carbon Emissions mt/Yr
Apparent Losses	5.7	$59,504	0
Real Losses	196.2	$392,395	0
Unbilled Authorized Cons	3.8	$7,579	0
Non-Revenue Water	205.7	$459,479	0

mt = metric tons

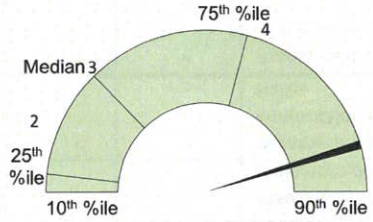
Key Performance Indicators

Actual KPI result — Target (see Worksheet)

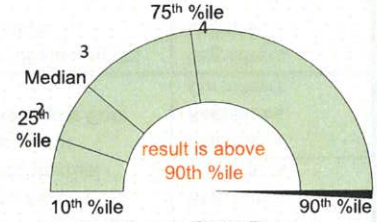
gauge %iles per validated industry ranges[2]



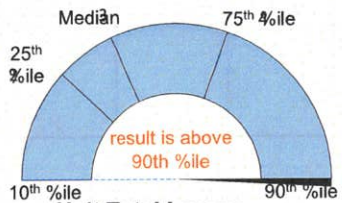
Total Loss Cost Rate
165.41 $/conn/year



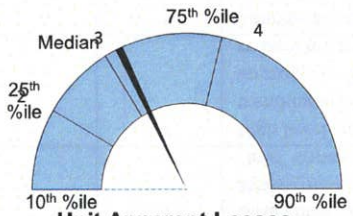
Apparent Loss Cost Rate
21.78 $/conn/year



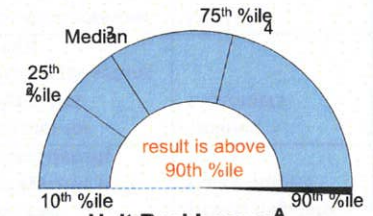
Real Loss Cost Rate
143.63 $/conn/year



Unit Total Losses
202.5 gal/conn/day

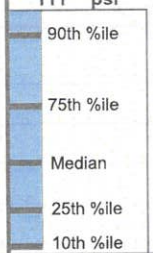


Unit Apparent Losses
5.7 gal/conn/day

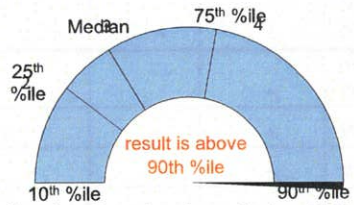


Unit Real Losses[A]
196.8 gal/conn/day

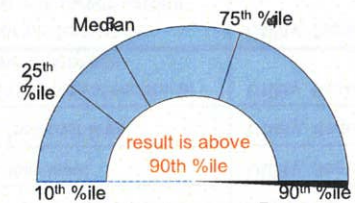
Average Operating Pressure
111 psi



AOP is above 90th %ile



Infrastructure Leakage Index (ILI)
6.2 dimensionless



Unit Real Losses[B]
7,824 gal/mile/day

See UARL definition for additional guidance on the ILI

(UARL) Unavoidable Annual Real Losses	31.7 MG/Yr	31.8 gal/conn/day

Guidance Information for Key Performance

- The eight indicators shown are the recommended suite per the AWWA Water Loss Control Committee 2020 Position on KPIs[1].
- 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)[1], 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)[2].
- 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)[5].
- Actual KPI results that fall below 10th %ile or above 90th %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.

AWWA Free Water Audit Software
Water Balance

VOLUME in MG/Yr

Water Audit Report for: Wellston PWS
Audit Year: 2025
Data Validity Tier: Tier III (51-70)

Jan 01 2024 - Dec 31 2024

FWAS v6.1

Volume from Own Sources (VOS) (corrected for known errors) 484.320	System Input Volume 484.320	Water Exported (WE) (corrected for known errors) 0.000	Billed Water Exported			Revenue Water (Exported) 0.000
		Water Supplied 484.320	Authorized Consumption 282.439	Billed Authorized Consumption 278.649	Billed Metered Consumption (BMAC) (water exported is removed) 278.649	Revenue Water 278.649
					Billed Unmetered Consumption (BUAC) 0.000	
				Unbilled Authorized Consumption 3.790	Unbilled Metered Consumption (UMAC) 3.093	Non-Revenue Water (NRW) 205.671
					Unbilled Unmetered Consumption (UUAC) 0.697	
			Water Losses 201.881	Apparent Losses 5.684	Systematic Data Handling Errors (SDHE) 0.697	
					Customer Metering Inaccuracies (CMI) 4.290	
					Unauthorized Consumption (UC) 0.697	
Water Imported (WI) (corrected for known errors) 0.000				Real Losses 196.198	Target Leakage Reduction 0.000	
					Leakage Level After Reduction 196.198	

AWWA Free Water Audit Software: Determining Water Loss Standing

FWAS v6.1

Water Audit Report for: **Wellston PWS**

Audit Year: **2025** **Jan 01 2024 - Dec 31 2024**

Data Validity Tier: **Tier III (51-70)**

Water Loss Control Planning Guide

Functional Focus Area	Water Audit Data Validity Tier (Score Range)				
	Tier I (1-25)	**Tier II (26-50)**	**Tier III (51-70)**	**Tier IV (71-90)**	**Tier V (91-100)**
Audit Data Collection	Launch auditing and loss control team; address supply metering deficiencies	Analyze business process for customer metering and billing functions and water supply operations; Identify data gaps; improve supply metering	Establish/revise policies and procedures for data collection	Refine data collection practices and establish as routine business process	Annual water audit is a reliable gauge of year-to-year water efficiency standing
Short-term loss control	Research information on leak detection programs; Begin flowcharting analysis of customer billing system	Conduct loss assessment investigations on a sample portion of the system: customer meter testing, leak survey, unauthorized consumption, etc	Establish ongoing mechanisms for customer meter accuracy testing, active leakage control and infrastructure monitoring	Refine, enhance or expand ongoing programs based upon economic justification	Stay abreast of improvements in metering, meter reading, billing, leakage management and infrastructure rehabilitation
Long-term loss control		Begin to assess long-term needs requiring large expenditure: customer meter replacement, water main replacement program, new customer billing system or AMR/AMI system	Begin to assemble economic business case for long-term needs based upon improved data becoming available through the water audit process	Conduct detailed planning, budgeting and launch of comprehensive improvements for metering, billing or infrastructure management	Continue incremental improvements in short-term and long-term loss control interventions
Target-setting			Establish long-term apparent and real loss reduction goals (+10 year horizon)	Establish mid-range (5 year horizon) apparent and real loss reduction goals	Evaluate and refine loss control goals on a yearly basis
Benchmarking			Preliminary Comparisons - can begin to rely upon with PIs for performance comparisons for real losses	Performance Benchmarking with PIs is meaningful in comparing real loss standing	Identify Best Practices/ Best in class; PIs are very reliable as real loss performance indicators for best in class service

For validity scores of 50 or below, the shaded blocks should not be focus areas until better data validity is achieved.