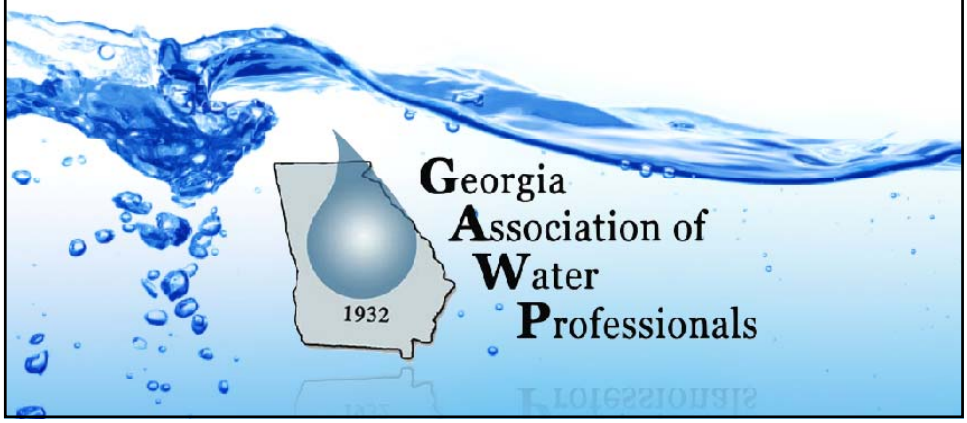
Water Audit Workshop

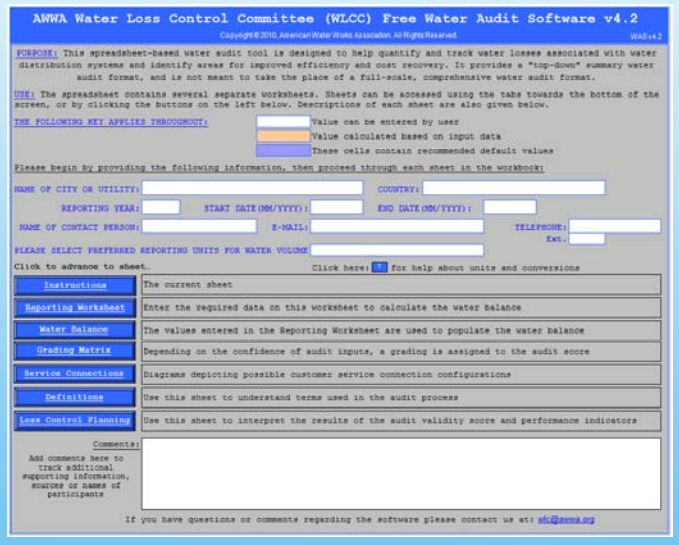
How to Fill Out The Audit Correctly



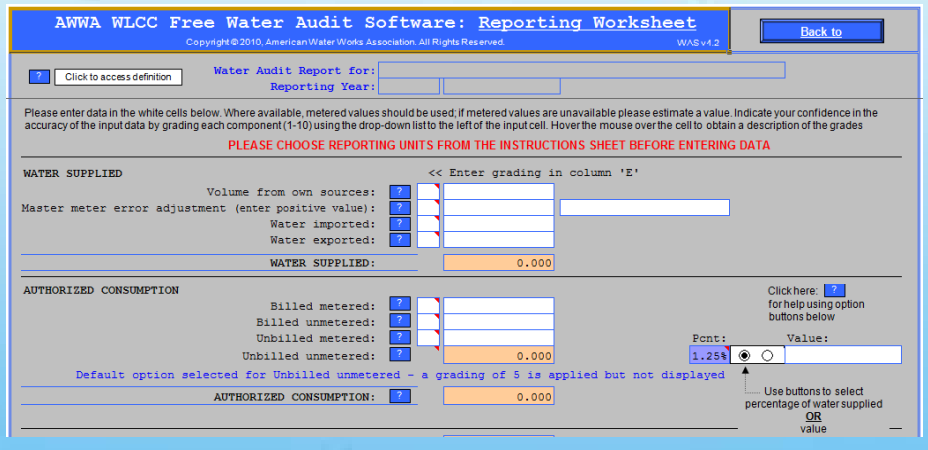
Features of the Free Water Audit Software Package

- Purpose: promote standardized method for audits
- User-friendly tool, easy toggle between worksheets, only use of MS EXCEL is needed
- Designed as a basic “top-down” water audit
- Complete list of terms and definitions
- Performance indicators are calculated, eliminating chance of math errors
- Checks in place to alert questionable data

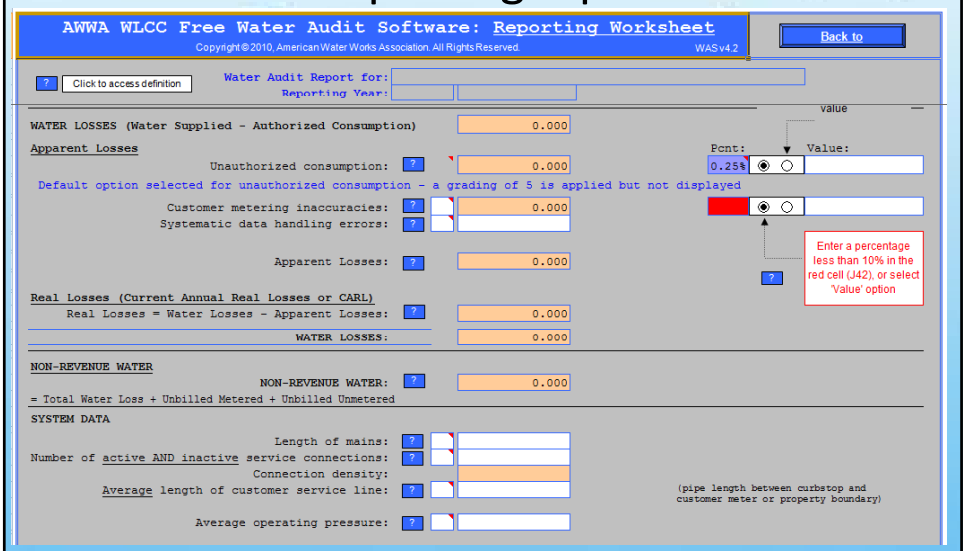
AWWA Water Audit Software – Instructions



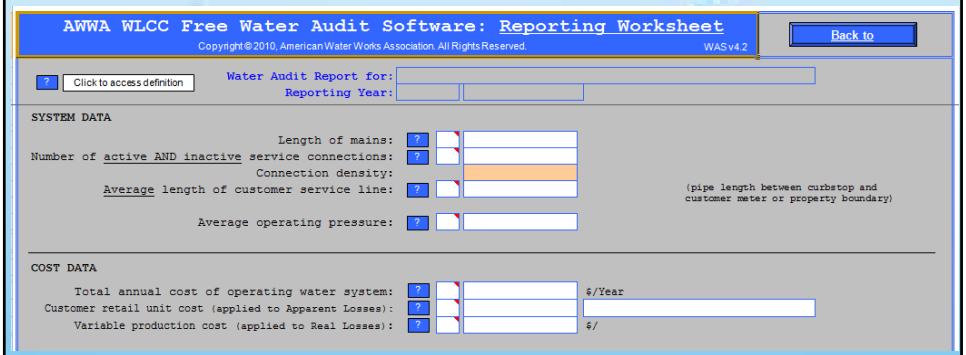
AWWA Water Audit Software – Reporting Input



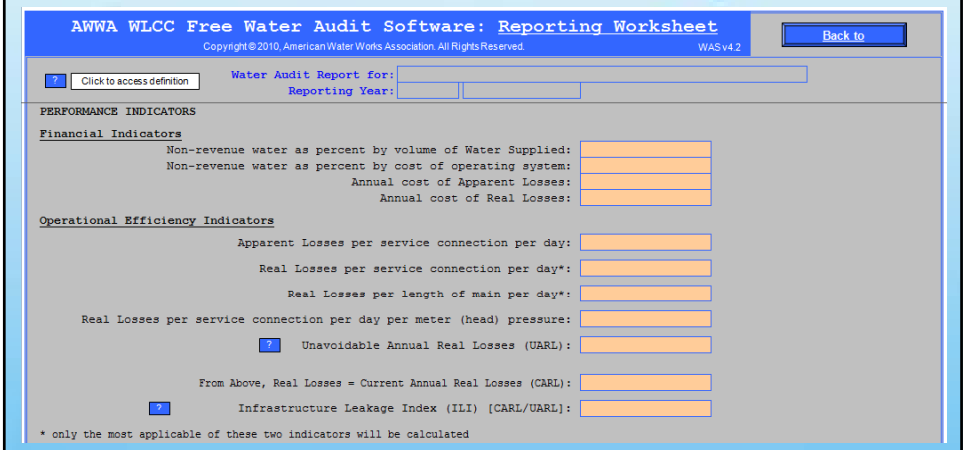
AWWA Water Audit Software – Reporting Input



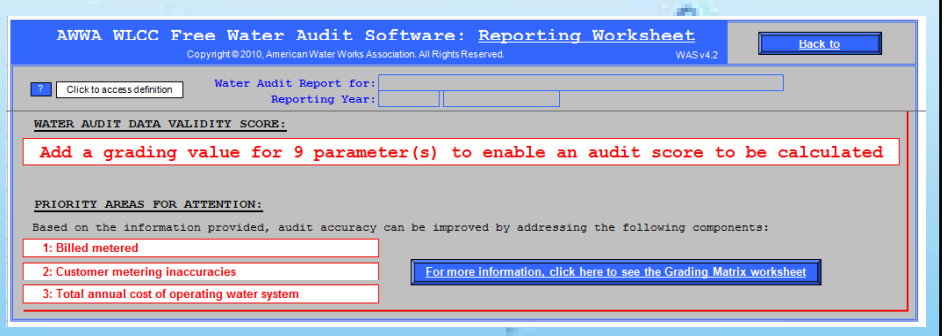
AWWA Water Audit Software – Reporting Input



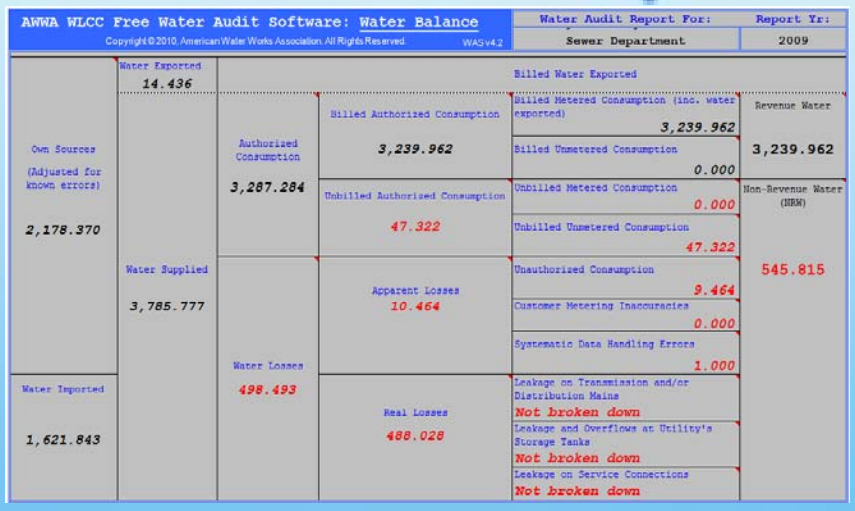
AWWA Water Audit Software – Reporting Output



AWWA Water Audit Software – New Grading System



AWWA Water Audit Software – Water Balance



AWWA WLCC Free Water Audit Software: Water Balance

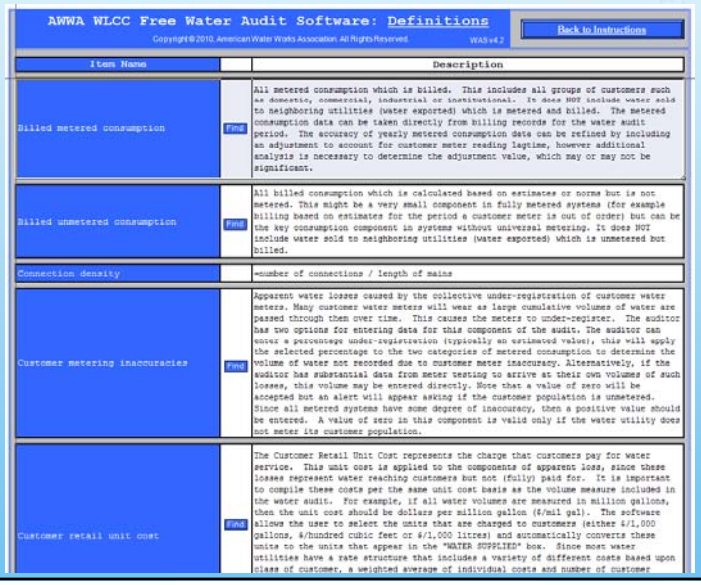
 WAS v4.2

Water Audit Report For: Sewer Department

Report Yr: 2009

Own Sources (Adjusted for known errors) 2,178.370	Water Exported 14.436			Billed Water Exported	
	Water Supplied 3,785.777	Authorized Consumption 3,287.284	Billed Authorized Consumption 3,239.962	Billed Metered Consumption (inc. water exported) 3,239.962	Revenue Water 3,239.962
				Billed Unmetered Consumption 0.000	
			Unbilled Authorized Consumption 47.322	Unbilled Metered Consumption 0.000	Non-Revenue Water (NRW) 545.815
				Unbilled Unmetered Consumption 47.322	
		Water Losses 498.493	Apparent Losses 10.464	Unauthorized Consumption 9.464	
				Customer Metering Inaccuracies 0.000	
				Systematic Data Handling Errors 1.000	
Water Imported 1,621.843			Real Losses 488.028	Leakage on Transmission and/or Distribution Mains Not broken down	
				Leakage and Overflows at Utility's Storage Tanks Not broken down	
				Leakage on Service Connections Not broken down	

AWWA Water Audit Software - Definitions



AWWA WLCC Free Water Audit Software: Definitions

 WAS v4.2

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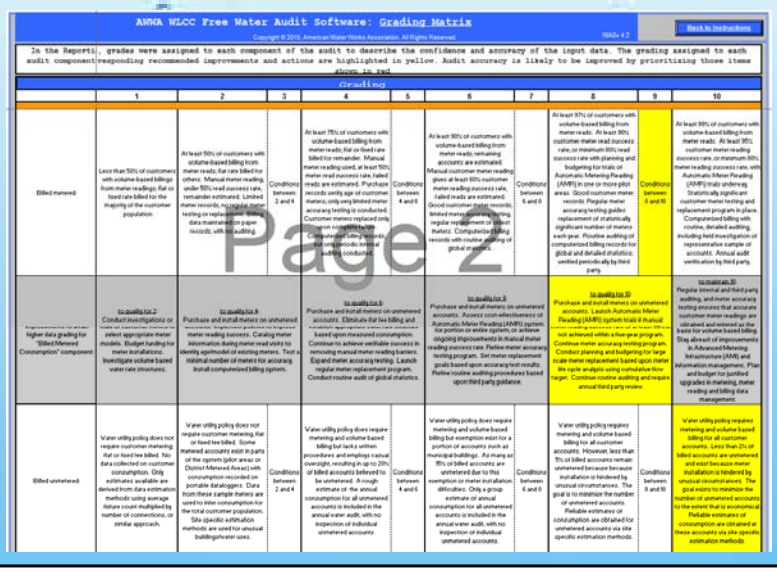
Item Name		Description
Billed metered consumption	Find	All metered consumption which is billed. This includes all groups of customers such as domestic, commercial, industrial or institutional. It does NOT include water sold to neighboring utilities (water exported) which is metered and billed. The metered consumption data can be taken directly from billing records for the water audit period. The accuracy of yearly metered consumption data can be refined by including an adjustment to account for customer meter reading lagtime, however additional analysis is necessary to determine the adjustment value, which may or may not be significant.
Billed unmetered consumption	Find	All billed consumption which is calculated based on estimates or norms but is not metered. This might be a very small component in fully metered systems (for example billing based on estimates for the period a customer meter is out of order) but can be the key consumption component in systems without universal metering. It does NOT include water sold to neighboring utilities (water exported) which is unmetered but billed.
Connection density		=number of connections / length of mains
Customer metering inaccuracies	Find	Apparent water losses caused by the collective under-registration of customer water meters. Many customer water meters will wear as large cumulative volumes of water are passed through them over time. This causes the meters to under-register. The auditor has two options for entering data for this component of the audit. The auditor can enter a percentage under-registration (typically an estimated value), this will apply the selected percentage to the two categories of metered consumption to determine the volume of water not recorded due to customer meter inaccuracy. Alternatively, if the auditor has substantial data from meter testing to arrive at their own volumes of such losses, this volume may be entered directly. Note that a value of zero will be accepted but an alert will appear asking if the customer population is unmetered. Since all metered systems have some degree of inaccuracy, then a positive value should be entered. A value of zero in this component is valid only if the water utility does not meter its customer population.
Customer retail unit cost	Find	The Customer Retail Unit Cost represents the charge that customers pay for water service. This unit cost is applied to the components of apparent loss, since these losses represent water reaching customers but not (fully) paid for. It is important to compile these costs per the same unit cost basis as the volume measure included in the water audit. For example, if all water volumes are measured in million gallons, then the unit cost should be dollars per million gallon ($/mil gal). The software allows the user to select the units that are charged to customers (either $/1,000 gallons, $/hundred cubic feet or $/1,000 litres) and automatically converts these units to the units that appear in the "WATER SUPPLIED" box. Since most water utilities have a rate structure that includes a variety of different costs based upon class of customer, a weighted average of individual costs and number of customer

AWWA Water Audit Software - Grading Matrix



AWWA WLCC Free Water Audit Software: Grading Matrix

Back to Instructions

In the Reporting Worksheet, grades were assigned to each component of the audit to describe the confidence and accuracy of the input data. The grading assigned to each audit component, corresponding recommended improvements and actions are highlighted in yellow. Audit accuracy is likely to be improved by prioritizing those items shown in red.

Grading										
	1	2	3	4	5	6	7	8	9	10
Billed metered	Less than 50% of customers with volume-based billing from meter readings; flat or fixed rate billed for the majority of the customer population	At least 50% of customers with volume-based billing from meter reads; flat rate billed for others. Manual meter reading, under 50% read success rate, remainder estimated. Limited meter records, no regular meter testing or replacement. Billing data maintained on paper records, with no auditing	Conditions between 2 and 4	At least 75% of customers with volume-based billing from meter reads; flat or fixed rate billed for remainder. Manual meter reading used, at least 50% meter read success rate, failed reads are estimated. Purchase records verify age of customer meters; only very limited meter accuracy testing is conducted. Customer meters replaced only upon complaint. Computerized billing records; only occasional internal audits conducted	Conditions between 4 and 6	At least 90% of customers with volume-based billing from meter reads; remaining accounts are estimated. Manual customer meter reading given at least 95% customer meter reading success rate, failed reads are estimated. Good customer meter records; limited meter accuracy testing, regular replacement of oldest meters. Computerized billing records with routine updating of global statistics.	Conditions between 6 and 8	At least 97% of customers with volume-based billing from meter reads. At least 90% customer meter read success rate, or minimum 95% read success rate with planning and budgeting for trials of Automatic Metering Reading (AMR) in one or more pilot areas. Good customer meter records. Regular meter accuracy testing guides replacement of statistically significant number of meters each year. Routine auditing of computerized billing records for global and detailed statistics; verified periodically by third party.	Conditions between 8 and 10	At least 99% of customers with volume-based billing from meter reads. At least 95% customer meter reading success rate, or minimum 95% meter reading success rate, with Automatic Meter Reading (AMR) trials underway. Statistically significant customer meter testing and replacement program in place. Computerized billing with routine, detailed auditing, including field investigation of representative sample of accounts. Annual audit verification by third party.
[illegible] higher data grading for "Billed Metered Consumption" component	to qualify for 2: Conduct investigations or trials of customer metered to select appropriate meter models. Budget funding for meter installations. Investigate volume based water rate structures.	to qualify for 4: Purchase and install meters on unmetered accounts. Implement policies to improve meter reading success. Catalog meter information during meter read visits to identify age/model of existing meters. Test a minimal number of meters for accuracy. Install computerized billing system.		to qualify for 6: Purchase and install meters on unmetered accounts. Eliminate flat fee billing and establish appropriate water rate structure based upon measured consumption. Continue to achieve verifiable success in removing manual meter reading barriers. Expand meter accuracy testing. Launch regular meter replacement program. Conduct routine audit of global statistics.		to qualify for 8: Purchase and install meters on unmetered accounts. Assess cost-effectiveness of Automatic Meter Reading (AMR) system for portion or entire system, or achieve ongoing improvements in manual meter reading success rate. Refine meter accuracy testing program. Set meter replacement goals based upon accuracy test results. Refine routine auditing procedures based upon third party guidance.		to qualify for 10: Purchase and install meters on unmetered accounts. Launch Automatic Meter Reading (AMR) system trials if manual meter reading success rate of at least 95% is not achieved within a five-year program. Continue meter accuracy testing program. Conduct planning and budgeting for large scale meter replacement based upon meter life cycle analysis using cumulative flow meter. Continue routine auditing and require annual third party review.		to maintain 10: Regular interval and third party auditing, and meter accuracy testing ensures that accurate customer meter readings are obtained and entered as the basis for volume based billing. Stay abreast of improvements in Advanced Metering Infrastructure (AMI) and information management. Plan and budget for justified upgrades in metering, meter reading and billing data management.
Billed unmetered	Water utility policy does not require customer metering, flat or fixed fee billed. No data collected on customer consumption. Only estimates available are derived from data estimation methods using average fixture count multiplied by number of connections, or similar approach.	Water utility policy does not require customer metering, flat or fixed fee billed. Some metered accounts exist in parts of the system (prior areas or District Metered Areas) with consumption recorded on portable dataloggers. Data from these sample meters are used to infer consumption for the total customer population. Site specific estimation methods are used for unusual buildings/water uses.	Conditions between 2 and 4	Water utility policy does require metering and volume based billing but lacks written procedures and employs manual oversight, resulting in up to 20% of billed accounts believed to be unmetered. A rough estimate of the annual consumption for all unmetered accounts is included in the annual water audit, with no inspection of individual unmetered accounts.	Conditions between 4 and 6	Water utility policy does require metering and volume based billing but exemption exist for a portion of accounts such as municipal buildings. As many as 15% of billed accounts are unmetered due to this exemption or meter installation difficulties. Only a group estimate of annual consumption for all unmetered accounts is included in the annual water audit, with no inspection of individual unmetered accounts.	Conditions between 6 and 8	Water utility policy requires metering and volume based billing for all customer accounts. However, less than 5% of billed accounts remain unmetered because because installation is hindered by unusual circumstances. The goal is to minimize the number of unmetered accounts. Reliable estimates of consumption are obtained for unmetered accounts via site specific estimation methods.	Conditions between 8 and 10	Water utility policy requires metering and volume based billing for all customer accounts. Less than 2% of billed accounts are unmetered and exist because meter installation is hindered by unusual circumstances. The goal exists to minimize the number of unmetered accounts to the extent that is economical. Reliable estimates of consumption are obtained at these accounts via site specific estimation methods.

Data Entry Exercise

- Switch to Excel to enter data and discuss

Audit Output – Performance Indicators

- Financial Performance Indicators
  - allow for economic understanding of losses and provides comparison for project payback
- Operational Performance Indicators
  - defines and quantifies industry standards
  - highlights areas of comparison and annual tracking
  - creates indices for comparison across water systems
- Validity Score and Top 3 Priority Areas

Financial Performance Indicators

- % Non-revenue water by volume
- % Non-revenue water by cost

- Annual cost of apparent losses
- Annual cost of real losses

Operational Performance Indicators

- Water Losses (WL) - gal
- Apparent Losses (AL) - gal
- Current Annual Real Losses (CARL) – gal
- Normalized Apparent Losses
  - gal/service connection/day
- Normalized Real Losses
  - gal/service connection/day
  - gal/service connection/day/psi
  - gal/miles of mains/day
  - gal/miles of mains/day/psi

Operational Performance Indicators (continued)

- Unavoidable Annual Real Losses (UARL)
  - gal
  - calculation based on worldwide data for lowest theoretical real losses attainable
  - not valid for systems with less than 3,000 connections or connection density less than 32 connections per mile
  - includes consideration for rise in system leakage, service connection density, system pressure
- Infrastructure Leakage Index (ILI)
  - dimensionless
  - CARL/UARL

Excerpts from AWWA North-American Dataset (2011)

Key Performance Indicator	#	Average	Range		
NRW as a % by Volume	21	22.6%	6.8%	-	45.5%
NRW as a % by Cost	21	10.0%	1.7%	-	23.0%
Apparent Losses (gals/conn/day)	21	14.95	2.36	-	65.89
Op24 – Real Losses (gals/conn/day)	18	63.32	17.07	-	149.71
Op24 – Real Losses (gals/mile of main/day)	3	1,821.15	645.42	-	3,496.21
Infrastructure Leakage Index (ILI)	21	3.57	1.15	-	12.68
Water Audit Data Validity Score	21	74.97	52.28	-	89.72

Excerpts from AWWA North-American Dataset (2011)

Cost Data	#	Average	Range		
Annual operating cost (Million $)	21	51.22	1.36	-	224.43
Annual operating cost ($/1,000 gal of Water Supplied)	21	$ 3.32	$ 1.15	-	$ 8.14
Customer retail unit cost ($/1,000 gal)	21	$ 4.57	$ 1.10	-	$ 8.38
Variable production (or import) cost ($/1,000 gal)	21	$ 0.73	$ 0.18	-	$ 2.16
NRW - Total Annual Cost (Million $)	21	5.81	0.04	-	42.97