

# AWWA Free Water Audit Software Grading Matrix

The tables listed on the following pages reproduce the data grading criteria for each input in the AWWA Water Audit Software Reporting Worksheet.

The data grades will be entered in columns E and J of the worksheet in cells denoted with a red triangle in their upper right hand corners as shown in the image at the right:

To select the correct data grading for each input, determine the highest grade where the utility meets or exceeds all criteria for that grade and all grades below it.

The screenshot displays the AWWA Water Audit Software Reporting Worksheet. It features several data input sections with red triangles in the upper right corners of the input fields, indicating where data grading criteria are applied. The sections include:

- Water Supplied:** Volume from own sources (20,106 MG/yr), Water imported (0.000 MG/yr), Water exported (0.000 MG/yr), and Total WATER SUPPLIED (21,164 MG/yr).
- Authorized Consumption:** Billed metered (1.84 MG/yr), Billed unmetered (0.062 MG/yr), Unbilled metered (0.826 MG/yr), and Unbilled unmetered (0.265 MG/yr). Total AUTHORIZED CONSUMPTION is 3,000 MG/yr.
- Apparent Losses:** Unauthorized consumption (0.053 MG/yr), Customer metering inaccuracies (0.277 MG/yr), and Systematic data handling errors (0.005 MG/yr). Total Apparent Losses is 0.335 MG/yr.
- Real Losses or CARL:** Real Losses = Water Losses - Apparent Losses (17,830 MG/yr). Total WATER LOSSES is 18,164 MG/yr.
- Non-Revenue Water:** Total NON-REVENUE WATER is 19,254 MG/yr.
- Other Inputs:** Length of mains (8.0 miles), Service connection density (44 connections/mile main), Average length of customer service line (0 feet), and Average operating pressure (50.0 psi).
- Costs:** Total annual cost of operating water system (\$60,000/Year), Retail unit cost (\$5.75/\$1000 gallons US), and Wholesale production cost (\$5,497.00/Million gallons).

The final score is displayed as: **\*\*\* YOUR SCORE IS: 27 out of 100 \*\*\***

The interface also includes a navigation bar at the bottom with tabs for: Instructions, Reporting Worksheet, Performance Indicators, Comments, Water Balance, and Dashboard.

## Volume from own sources

GRADE	✓	DESCRIPTION
n/a		Select this grading only if the water utility purchases/imports all of its water resources (i.e. has no sources of its own)
1		Less than 25% of water production sources are metered, remaining sources are estimated. No regular meter accuracy testing or electronic calibration conducted.
2		25% - 50% of treated water production sources are metered; other sources estimated. No regular meter accuracy testing or electronic calibration conducted.
3		Conditions between 2 and 4
4		50% - 75% of treated water production sources are metered, other sources estimated. Occasional meter accuracy testing or electronic calibration conducted
5		Conditions between 4 and 6
6		At least 75% of treated water production sources are metered, or at least 90% of the source flow is derived from metered sources. Meter accuracy testing and/or electronic calibration of related instrumentation is conducted annually. Less than 25% of tested meters are found outside of +/- 6% accuracy.
7		Conditions between 6 and 8
8		100% of treated water production sources are metered, Meter accuracy testing and electronic calibration of related instrumentation is conducted annually, Less than 10% of meters are found outside of +/- 6% accuracy
9		Conditions between 8 and 10
10		100% of treated water production sources are metered, Meter accuracy testing and electronic calibration of related instrumentation is conducted semi-annually, with less than 10% found outside of +/- 3% accuracy. Procedures are reviewed by a third party knowledgeable in the M36 methodology

# Volume from own sources master meter and supply error adjustment

GRADE	✓	DESCRIPTION
n/a		Select n/a only if the water utility fails to have meters on its sources of supply
1		Inventory information on meters and paper records of measured volumes exist but are incomplete and/or in a very crude condition; data error cannot be determined
2		No automatic datalogging of production volumes; daily readings are scribed on paper records without any accountability controls.
2		Flows are not balanced across the water distribution system: tank/storage elevation changes are not employed in calculating the "Volume from own sources" component and
2		Archived flow data is adjusted only when grossly evident data error occurs.
3		Conditions between 2 and 4
4		Production meter data is logged automatically in electronic format and reviewed at least on a monthly basis with necessary corrections implemented.
4		"Volume from own sources" tabulations include estimate of daily changes in tanks/storage facilities.
4		Meter data is adjusted when gross data errors occur, or occasional meter testing deems this necessary.
5		Conditions between 4 and 6
6		Hourly production meter data logged automatically & reviewed on at least a weekly basis.
6		Data is adjusted to correct gross error when meter/instrumentation equipment malfunction is detected; and/or error is confirmed by meter accuracy testing.
6		Tank/storage facility elevation changes are automatically used in calculating a balanced "Volume from own sources" component, and
6		Data gaps in the archived data are corrected on at least a weekly basis.
7		Conditions between 6 and 8
8		Continuous production meter data is logged automatically & reviewed each business day.
8		Data is adjusted to correct gross error from detected meter/instrumentation equipment malfunction and/or results of meter accuracy testing.
8		Tank/storage facility elevation changes are automatically used in "Volume from own sources" tabulations and
8		data gaps in the archived data are corrected on a daily basis.
9		Conditions between 8 and 10
10		Computerized system (SCADA or similar) automatically balances flows from all sources and storages;
10		Results are reviewed each business day.
10		Tight accountability controls ensure that all data gaps that occur in the archived flow data are quickly detected and corrected.
10		Regular calibrations between SCADA and sources meters ensures minimal data transfer error.

# Water Imported

GRADE	✓	DESCRIPTION
n/a		Select n/a if the water utility's supply is exclusively from its own water resources (no bulk purchased/ imported water)
1		Less than 25% of imported water sources are metered, remaining sources are estimated..
		No regular meter accuracy testing
2		25% - 50% of imported water sources are metered; other sources estimated.
		No regular meter accuracy testing
3		Conditions between 2 and 4
4		50% - 75% of imported water sources are metered, other sources estimated.
		Occasional meter accuracy testing conducted
5		Conditions between 4 and 6
6		At least 75% of imported water sources are metered,
		Meter accuracy testing and/or electronic calibration of related instrumentation is conducted annually for all meter installations.
		Less than 25% of tested meters are found outside of +/- 6% accuracy
7		Conditions between 6 and 8
8		100% of imported water sources are metered,
		meter accuracy testing and electronic calibration of related instrumentation is conducted annually,
		less than 10% of meters are found outside of +/- 6% accuracy
9		Conditions between 8 and 10
10		100% of imported water sources are metered,
		Meter accuracy testing and electronic calibration of related instrumentation is conducted semi-annually for all meter installations,
		Less than 10% of accuracy tests found outside of +/- 3% accuracy.

# Water imported master meter and supply error adjustment

GRADE	✓	DESCRIPTION
n/a		Select n/a if the Imported water supply is unmetered, with Imported water quantities estimated on the billing invoices sent by the Exporter to the purchasing Utility
1		Inventory information on imported meters and paper records of measured volumes exist but are incomplete and/or in a very crude condition; data error cannot be determined Written agreement(s) with water Exporter(s) are missing or written in vague language concerning meter management and testing.
2		No automatic datalogging of imported supply volumes; Daily readings are scribed on paper records without any accountability controls to confirm data accuracy and the absence of errors and data gaps in recorded volumes. Written agreement requires meter accuracy testing but is vague on the details of how and who conducts the testing
3		Conditions between 2 and 4
4		Imported supply metered flow data is logged automatically in electronic format and reviewed at least on a monthly basis by the Exporter with necessary corrections implemented. Meter data is adjusted by the Exporter when gross data errors are detected. A coherent data trail exists for this process to protect both the selling and the purchasing Utility. Written agreement exists and clearly states requirements and roles for meter accuracy testing & data management.
5		Conditions between 4 and 6
6		Hourly Imported supply metered data is logged automatically & reviewed on at least a weekly basis by the Exporter. Data is adjusted to correct gross error when meter/instrumentation equipment malfunction is detected; and to correct for error confirmed by meter accuracy testing. Any data gaps in the archived data are detected and corrected during the weekly review. A coherent data trail exists for this process to protect both the selling and the purchasing Utility
7		Conditions between 6 and 8
8		Continuous Imported supply metered flow data is logged automatically & reviewed each business day by the Exporter. Data is adjusted to correct gross error from detected meter/instrumentation equipment malfunction and/or results of meter accuracy testing. Any data errors/gaps are detected and corrected on a daily basis. A data trail exists for the process to protect both the selling and the purchasing Utility
9		Conditions between 8 and 10
10		Computerized system (SCADA/similar) automatically records data & is reviewed each business day by the Exporter. Tight accountability controls ensure that all error/data gaps that occur in the archived flow data are quickly detected and corrected. A reliable data trail exists and contract provisions for meter testing and data management are reviewed by the selling and purchasing Utility at least once every five years.

## Water Exported

GRADE	✓	DESCRIPTION
n/a		Select n/a if the water utility sells no bulk water to neighboring water utilities (no exported water sales)
1		Less than 25% of exported water sources are metered, remaining sources are estimated.
		No regular meter accuracy testing.
2		25% - 50% of exported water sources are metered; other sources estimated.
		No regular meter accuracy testing.
3		Conditions between 2 and 4
4		50% - 75% of exported water sources are metered, other sources estimated.
		Occasional meter accuracy testing conducted.
5		Conditions between 4 and 6
6		At least 75% of exported water sources are metered,
		Meter accuracy testing and/or electronic calibration conducted annually.
		Less than 25% of tested meters are found outside of +/- 6% accuracy.
7		Conditions between 6 and 8
8		100% of exported water sources are metered,
		meter accuracy testing and electronic calibration of related instrumentation is conducted annually,
		less than 10% of meters are found outside of +/- 6% accuracy
9		Conditions between 8 and 10
10		100% of exported water sources are metered,.
		meter accuracy testing and electronic calibration of related instrumentation is conducted semi-annually for all meter installations,
		with less than 10% of accuracy tests found outside of +/- 3% accuracy

# Water exported master meter and supply error adjustment

GRADE	✓	DESCRIPTION
n/a		Select n/a only if the water utility fails to have meters on its exported supply interconnections.
1		Inventory information on exported meters and paper records of measured volumes exist but are incomplete and/or in a very crude condition;
		data error cannot be determined
2		Written agreement(s) with the utility purchasing the water are missing or written in vague language concerning meter management and testing
		No automatic datalogging of exported supply volumes;
		Daily readings are scribed on paper records without any accountability controls to confirm data accuracy and the absence of errors and data gaps in recorded volumes.
3		Written agreement requires meter accuracy testing but is vague on the details of how and who conducts the testing.
3		Conditions between 2 and 4
4		Exported metered flow data is logged automatically in electronic format and reviewed at least on a monthly basis, with necessary corrections implemented.
		Meter data is adjusted by the utility selling (exporting) the water when gross data errors are detected.
		A coherent data trail exists for this process to protect both the utility exporting the water and the purchasing Utility.
5		Written agreement exists and clearly states requirements and roles for meter accuracy testing & data management.
5		Conditions between 4 and 6
6		Hourly exported supply metered data is logged automatically & reviewed on at least a weekly basis by the utility selling the water.
		Data is adjusted to correct gross error when meter/instrumentation equipment malfunction is detected; and to correct for error found by meter accuracy testing.
		Any data gaps in the archived data are detected and corrected during the weekly review.
7		A coherent data trail exists for this process to protect both the selling (exporting) utility and the purchasing Utility.
7		Conditions between 6 and 8
8		Continuous exported supply metered flow data is logged automatically & reviewed each business day by the utility selling (exporting) the water.
		Data is adjusted to correct gross error from detected meter/instrumentation equipment malfunction and any error confirmed by meter accuracy testing.
		Any data errors/gaps are detected and corrected on a daily basis.
9		A data trail exists for the process to protect both the selling (exporting) Utility and the purchasing Utility.
9		Conditions between 8 and 10
10		Computerized system (SCADA or similar) automatically records data which is reviewed each business day by the utility selling (exporting) the water.
		Tight accountability controls ensure that all error/data gaps that occur in the archived flow data are quickly detected and corrected.
10		A reliable data trail exists and contract provisions for meter testing and data management are reviewed by the selling Utility and purchasing Utility at least once every five years.

## Billed Metered

GRADE	✓	DESCRIPTION
n/a		n/a (not applicable). Select n/a only if the entire customer population is not metered and is billed for water service on a flat or fixed rate basis. In such a case the volume entered must be zero.
1		Less than 50% of customers with volume-based billings from meter readings; flat or fixed rate billing exists for the majority of the customer population
2		At least 50% of customers with volume-based billing from meter reads; flat rate billing for others.
		Manual meter reading is conducted, with less than 50% meter read success rate, remaining accounts' consumption is estimated.
		Limited meter records, no regular meter testing or replacement.
		Billing data maintained on paper records, with no auditing.
3		Conditions between 2 and 4
4		At least 75% of customers with volume-based, billing from meter reads; flat or fixed rate billing for remaining accounts.
		Manual meter reading is conducted with at least 50% meter read success rate; consumption for accounts with failed reads is estimated.
		Purchase records verify age of customer meters; only very limited meter accuracy testing is conducted.
		Customer meters are replaced only upon complete failure.
		Computerized billing records exist, but only sporadic internal auditing conducted.
5		Conditions between 4 and 6
6		At least 90% of customers with volume-based billing from meter reads; consumption for remaining accounts is estimated.
		Manual customer meter reading gives at least 80% customer meter reading success rate; consumption for accounts with failed reads is estimated.
		Good customer meter records exist, but only limited meter accuracy testing is conducted.
		Regular replacement is conducted for the oldest meters.
		Computerized billing records exist with annual auditing of summary statistics conducting by utility personnel.
7		Conditions between 6 and 8
8		At least 97% of customers exist with volume-based billing from meter reads.
		At least 90% customer meter reading success rate; or at least 80% read success rate with planning and budgeting for trials of Automatic Meter Reading (AMR) or Advanced Metering Infrastructure (AMI) 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 occurs annually by utility personnel, and is verified by third party at least once every five years.
9		Conditions between 8 and 10
10		At least 99% of customers exist with volume-based billing from meter reads.
		At least 95% customer meter reading success rate; or minimum 80% meter reading success rate, with Automatic Meter Reading (AMR) or Advanced Metering Infrastructure (AMI) trials underway.
		Statistically significant customer meter testing and replacement program in place on a continuous basis.
		Computerized billing with routine, detailed auditing, including field investigation of representative sample of accounts undertaken annually by utility personnel. Audit is conducted by third party auditors at least once every three years.



## Billed Unmetered

GRADE	✓	DESCRIPTION
n/a		Select n/a if it is the policy of the water utility to meter all customer connections and it has been confirmed by detailed auditing that all customers do indeed have a water meter; i.e. no intentionally unmetered accounts exist
1		Water utility policy does not require customer metering; flat or fixed fee billing is employed.
		No data is collected on customer consumption.
		The only estimates of customer population consumption available are derived from data estimation methods using average fixture count multiplied by number of connections, or similar approach.
2		Water utility policy does not require customer metering; flat or fixed fee billing is employed.
		Some metered accounts exist in parts of the system (pilot areas or District Metered Areas) with consumption read periodically or recorded on portable dataloggers over one, three, or seven day periods.
		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.
3		Conditions between 2 and 4
4		Water utility policy does require metering and volume based billing in general. However, a liberal amount of exemptions and a lack of clearly written and communicated procedures result in up to 20% of billed accounts believed to be unmetered by exemption; or the water utility is in transition to becoming fully metered, and a large number of customers remain 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.
5		Conditions between 4 and 6
6		Water utility policy does require metering and volume based billing but established exemptions 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.
7		Conditions between 6 and 8
8		Water utility policy does require metering and volume based billing for all customer accounts. However, less than 5% of billed accounts remain unmetered because meter installation is hindered by unusual circumstances.
		The goal is to minimize the number of unmetered accounts.
		Reliable estimates of consumption are obtained for these unmetered accounts via site specific estimation methods.
9		Conditions between 8 and 10
10		Water utility policy does require 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.

Unbilled metered:

GRADE	✓	DESCRIPTION
n/a		Select n/a if all billing-exempt consumption is unmetered.
1		Billing practices exempt certain accounts, such as municipal buildings, but written policies do not exist; and a reliable count of unbilled metered accounts is unavailable.
		Meter upkeep and meter reading on these accounts is rare and not considered a priority.
		Due to poor recordkeeping and lack of auditing, water consumption for all such accounts is purely guesstimated.
2		Billing practices exempt certain accounts, such as municipal buildings, but only scattered, dated written directives exist to justify this practice.
		A reliable count of unbilled metered accounts is unavailable.
		Sporadic meter replacement and meter reading occurs on an as-needed basis.
		The total annual water consumption for all unbilled, metered accounts is estimated based upon approximating the number of accounts and assigning consumption from actively billed accounts of same meter size.
3		Conditions between 2 and 4
4		Dated written procedures permit billing exemption for specific accounts, such as municipal properties, but are unclear regarding certain other types of accounts.
		Meter reading is given low priority and is sporadic.
		Consumption is quantified from meter readings where available.
		The total number of unbilled, unmetered accounts must be estimated along with consumption volumes.
5		Conditions between 4 and 6
6		Written policies regarding billing exemptions exist but adherence in practice is questionable.
		Metering and meter reading for municipal buildings is reliable but sporadic for other unbilled metered accounts.
		Periodic auditing of such accounts is conducted.
		Water consumption is quantified directly from meter readings where available, but the majority of the consumption is estimated.
7		Conditions between 6 and 8
8		Written policy identifies the types of accounts granted a billing exemption.
		Customer meter management and meter reading are considered secondary priorities, but meter reading is conducted at least annually to obtain consumption volumes for the annual water audit.
		High level auditing of billing records ensures that a reliable census of such accounts exists.
9		Conditions between 8 and 10
10		Clearly written policy identifies the types of accounts given a billing exemption, with emphasis on keeping such accounts to a minimum.
		Customer meter management and meter reading for these accounts is given proper priority and is reliably conducted.
		Regular auditing confirms this.
		Total water consumption for these accounts is taken from reliable readings from accurate meters.

# Unbilled Unmetered

GRADE	✓	DESCRIPTION
1		Extent of unbilled, unmetered consumption is unknown due to unclear policies and poor recordkeeping.
		Total consumption is quantified based upon a purely subjective estimate.
2		Clear extent of unbilled, unmetered consumption is unknown, but a number of events are randomly documented each year, confirming existence of such consumption, but without sufficient documentation to quantify an accurate estimate of the annual volume consumed.
3		Conditions between 2 and 4
4		Extent of unbilled, unmetered consumption is partially known, and procedures exist to document certain events such as miscellaneous fire hydrant uses.
		Formulae is used to quantify the consumption from such events (time running multiplied by typical flowrate, multiplied by number of events).
5		Default value of 1.25% of system input volume is employed
6		Coherent policies exist for some forms of unbilled, unmetered consumption but others await closer evaluation.
		Reasonable recordkeeping for the managed uses exists and allows for annual volumes to be quantified by inference, but unsupervised uses are guesstimated.
7		Conditions between 6 and 8
8		Clear policies and good recordkeeping exist for some uses (ex: water used in periodic testing of unmetered fire connections), but other uses (ex: miscellaneous uses of fire hydrants) have limited oversight. Total consumption is a mix of well quantified use such as from formulae (time running multiplied by typical flow, multiplied by number of events) or temporary meters, and relatively subjective estimates of less regulated use.
9		Conditions between 8 and 10
10		Clear policies exist to identify permitted use of water in unbilled, unmetered fashion, with the intention of minimizing this type of consumption.
		Good records document each occurrence and consumption is quantified via formulae (time running multiplied by typical flow, multiplied by number of events) or use of temporary meters.

# Unauthorized Consumption

GRADE	✓	DESCRIPTION
1		Extent of unauthorized consumption is unknown due to unclear policies and poor recordkeeping. Total unauthorized consumption is guesstimated.
2		Unauthorized consumption is a known occurrence, but its extent is a mystery. There are no requirements to document observed events, but periodic field reports capture some of these occurrences. Total unauthorized consumption is approximated from this limited data.
3		Conditions between 2 and 4
4		Procedures exist to document some unauthorized consumption such as observed unauthorized fire hydrant openings. Use formulae to quantify this consumption (time running multiplied typical flowrate, multiplied by number of events).
5		Default value of 0.25% of volume of water supplied is employed
6		Coherent policies exist for some forms of unauthorized consumption (more than simply fire hydrant misuse) but others await closer evaluation. Reasonable surveillance and recordkeeping exist for occurrences that fall under the policy. Volumes quantified by inference from these records.
7		Conditions between 6 and 8
8		Clear policies and good auditable recordkeeping exist for certain events (ex: tampering with water meters, illegal bypasses of customer meters); but other occurrences have limited oversight. Total consumption is a combination of volumes from formulae (time x typical flow) and subjective estimates of unconfirmed consumption.
9		Conditions between 8 and 10
10		Clear policies exist to identify all known unauthorized uses of water. Staff and procedures exist to provide enforcement of policies and detect violations. Each occurrence is recorded and quantified via formulae (estimated time running multiplied by typical flow) or similar methods. All records and calculations should exist in a form that can be audited by a third party.

## Customer metering inaccuracies:

GRADE	✓	DESCRIPTION
n/a		Select n/a only if the entire customer population is unmetered. In such a case the volume entered must be zero.
1		Customer meters exist, but with unorganized paper records on meters; no meter accuracy testing or meter replacement program for any size of retail meter.
		Metering workflow is driven chaotically with no proactive management. Loss volume due to aggregate meter inaccuracy is guesstimated.
2		Poor recordkeeping and meter oversight is recognized by water utility management who has allotted staff and funding resources to organize improved recordkeeping and start meter accuracy testing.
		Existing paper records gathered and organized to provide cursory disposition of meter population.
		Customer meters are tested for accuracy only upon customer request.
3		Conditions between 2 and 4
4		Reliable recordkeeping exists; meter information is improving as meters are replaced.
		Meter accuracy testing is conducted annually for a small number of meters (more than just customer requests, but less than 1% of inventory).
		A limited number of the oldest meters are replaced each year.
		Inaccuracy volume is largely an estimate, but refined based upon limited testing data.
5		Conditions between 4 and 6
6		A reliable electronic recordkeeping system for meters exists.
		The meter population includes a mix of new high performing meters and dated meters with suspect accuracy.
		Routine, but limited, meter accuracy testing and meter replacement occur.
		Inaccuracy volume is quantified using a mix of reliable and less certain data.
7		Conditions between 6 and 8
8		Ongoing meter replacement and accuracy testing result in highly accurate customer meter population.
		Testing is conducted on samples of meters of varying age and accumulated volume of throughput to determine optimum replacement time for various types of meters.
9		Ongoing meter replacement and accuracy testing result in highly accurate customer meter population.
		Statistically significant number of meters are tested in audit year.
		This testing is conducted on samples of meters of varying age and accumulated volume of throughput to determine optimum replacement time for these meters.
10		Good records of all active customer meters exist and include as a minimum: meter number, account number/location, type, size and manufacturer.
		Ongoing meter replacement occurs according to a targeted and justified basis.
		Regular meter accuracy testing gives a reliable measure of composite inaccuracy volume for the customer meter population.
		New metering technology is embraced to keep overall accuracy improving.
		Procedures are reviewed by a third party knowledgeable in the M36 methodology.

## Systematic Data Handling Errors:

GRADE	✓	DESCRIPTION
n/a		Note: all water utilities incur some amount of this error. Even in water utilities with unmetered customer populations & fixed rate billing, errors occur in annual billing tabulations. Enter a positive value for the volume & select a grading.
1		Policies and procedures for activation of new customer water billing accounts are vague and lack accountability.
		Billing data is maintained on paper records which are not well organized.
		No auditing is conducted to confirm billing data handling efficiency.
		An unknown number of customers escape routine billing due to lack of billing process oversight.
2		Policy & procedures for activation of new customer accounts & oversight of billing records exist but need refinement.
		Billing data is maintained on paper records or insufficiently capable electronic database.
		Only periodic unstructured auditing work is conducted to confirm billing data handling efficiency.
		The volume of unbilled water due to billing lapses is a guess.
3		Conditions between 2 and 4
4		Policy and procedures for new account activation and oversight of billing operations exist but needs refinement.
		Computerized billing system exists, but is dated or lacks needed functionality.
		Periodic, limited internal audits conducted and confirm with approximate accuracy the consumption volumes lost to billing lapses.
5		Conditions between 4 and 6
6		Policy & procedures for new account activation and oversight of billing operations is adequate & reviewed periodically.
		Computerized billing system is in use with basic reporting available.
		Any effect of billing adjustments on measured consumption volumes is well understood.
		Internal checks of billing data error conducted annually.
		Reasonably accurate quantification of consumption volume lost to billing lapses is obtained.
7		Conditions between 6 and 8
8		New account activation and billing operations policy and procedures are reviewed at least biannually.
		Computerized billing system includes an array of reports to confirm billing data and system functionality.
		Checks are conducted routinely to flag and explain zero consumption accounts.
		Annual internal checks conducted with third party audit conducted at least once every five years.
		Accountability checks flag billing lapses.
		Consumption lost to billing lapses is well quantified and reducing year-by-year.
9		Conditions between 8 and 10
10		Sound written policy and procedures exist for new account activation and oversight of customer billing operations.
		Robust computerized billing system gives high functionality and reporting capabilities which are utilized, analyzed and the results reported each billing cycle.
		Assessment of policy and data handling errors are conducted internally and audited by third party at least once every three years, ensuring consumption lost to billing lapses is minimized and detected as it occurs.

## Length of Mains

GRADE	✓	DESCRIPTION
1		Poorly assembled and maintained paper as-built records of existing water main installations makes accurate determination of system pipe length impossible. Length of mains is guesstimated.
2		Paper records in poor or uncertain condition (no annual tracking of installations & abandonments).
		Poor procedures to ensure that new water mains installed by developers are accurately documented.
3		Conditions between 2 and 4
4		Sound written policy and procedures exist for documenting new water main installations, but gaps in management result in an uncertain degree of error in tabulation of mains length.
5		Conditions between 4 and 6
		Sound written policy and procedures exist for permitting and commissioning new water mains.
6		Highly accurate paper records with regular field validation; or electronic records and asset management system in good condition.
		Includes system backup.
7		Conditions between 6 and 8
		Sound written policy and procedures exist for permitting and commissioning new water mains.
8		Electronic recordkeeping such as a Geographical Information System (GIS) and asset management system are used to store and manage data.
9		Conditions between 8 and 10
		Sound written policy exists for managing water mains extensions and replacements.
10		Geographic Information System (GIS) data and asset management database agree and random field validation proves truth of databases.
		Records of annual field validation should be available for review

## Number of active AND inactive service connections

**Note: The number of Service Connections does not include fire hydrant leads/lines connecting the hydrant to the water main**

GRADE	✓	DESCRIPTION
1		Vague permitting (of new service connections) policy and poor paper recordkeeping of customer connections/billings result in suspect determination of the number of service connections, which may be 10-15% in error from actual count
2		General permitting policy exists but paper records, procedural gaps, and weak oversight result in questionable total for number of connections, which may vary 5-10% of actual count.
3		Conditions between 2 and 4
4		Written account activation policy and procedures exist, but with some gaps in performance and oversight.
		Computerized information management system is being brought online to replace dated paper recordkeeping system.
		Reasonably accurate tracking of service connection installations & abandonments; but count can be up to 5% in error from actual total.
5		Conditions between 4 and 6
6		Written new account activation and overall billing policies and procedures are adequate and reviewed periodically.
		Computerized information management system is in use with annual installations & abandonments totaled.
		Very limited field verifications and audits.
		Error in count of number of service connections is believed to be no more than 3%.
7		Conditions between 6 and 8
8		Policies and procedures for new account activation and overall billing operations are written, well-structured and reviewed at least biannually.
		Well-managed computerized information management system exists and routine, periodic field checks and internal system audits are conducted.
		Counts of connections are no more than 2% in error.
9		Conditions between 8 and 10
10		Sound written policy and well managed and audited procedures ensure reliable management of service connection population.
		Computerized information management system, Customer Billing System, and Geographic Information System (GIS) information agree; field validation proves truth of databases.
		Count of connections recorded as being in error is less than 1% of the entire population.



## Average length of customer service line:

Gradings 1-9 apply if customer properties are unmetered, if customer meters exist and are located inside the customer building premises, or if the water utility owns and is responsible for the entire service connection piping from the water main to the customer building. In any of these cases the average distance between the curb stop or boundary separating utility/customer responsibility for service connection piping, and the typical first point of use (ex: faucet) or the customer meter must be quantified. Gradings of 1-9 are used to grade the validity of the means to quantify this value. (See the "Service Connection Diagram" worksheet)

GRADE		DESCRIPTION
	✓	
<p>Note: if customer water meters are located outside of the customer building next to the curb stop or boundary separating utility/customer responsibility, then the auditor should answer "Yes" to the question on the Reporting Worksheet asking about this. If the answer is Yes, the grading description listed under the Grading of 10(a) will be followed, with a value of zero automatically entered at a Grading of 10. See the Service Connection Diagram worksheet for a visual presentation of this distance.</p>		
1		Vague policy exists to define the delineation of water utility ownership and customer ownership of the service connection piping.
		Curb stops are perceived as the breakpoint but these have not been well-maintained or documented. Most are buried or obscured. Their location varies widely from site-to-site, and estimating this distance is arbitrary due to the unknown location of many curb stops.
2		Policy requires that the curb stop serves as the delineation point between water utility ownership and customer ownership of the service connection piping.
		The piping from the water main to the curb stop is the property of the water utility; and the piping from the curb stop to the customer building is owned by the customer.
		Curb stop locations are not well documented and the average distance is based upon a limited number of locations measured in the field.
3		Conditions between 2 and 4
4		Good policy requires that the curb stop serves as the delineation point between water utility ownership and customer ownership of the service connection piping.
		Curb stops are generally installed as needed and are reasonably documented.
		Their location varies widely from site-to-site, and an estimate of this distance is hindered by the availability of paper records of limited accuracy.
5		Conditions between 4 and 6
6		Clear written policy exists to define utility/customer responsibility for service connection piping.
		Accurate, well-maintained paper or basic electronic recordkeeping system exists.
		Periodic field checks confirm piping lengths for a sample of customer properties.
7		Conditions between 6 and 8
8		Clearly worded policy standardizes the location of curb stops and meters, which are inspected upon installation.
		Accurate and well maintained electronic records exist with periodic field checks to confirm locations of service lines, curb stops and customer meter pits.
		An accurate number of customer properties from the customer billing system allows for reliable averaging of this length.
9		Conditions between 8 and 10
10		Either of two conditions can be met for a grading of 10:
		a) Customer water meters exist outside of customer buildings next to the curb stop or boundary separating utility/customer responsibility for service connection piping. If so, answer "Yes" to the question on the Reporting Working asking about this condition. A value of zero and a Grading of 10 are automatically entered in the Reporting Worksheet
		b). Meters exist inside customer buildings, or properties are unmetered. In either case, answer "No" to the Reporting Worksheet question on meter location, and enter a distance determined by the auditor. For a Grading of 10 this value must be a very reliable number from a Geographic Information System (GIS) and confirmed by a statistically valid number of field checks.

## Average operating pressure

GRADE	✓	DESCRIPTION
1		Available records are poorly assembled and maintained paper records of supply pump characteristics and water distribution system operating conditions.
		Average pressure is guesstimated based upon this information and ground elevations from crude topographical maps.
		Widely varying distribution system pressures due to undulating terrain, high system head loss and weak/erratic pressure controls further compromise the validity of the average pressure calculation.
2		Limited telemetry monitoring of scattered pumping station and water storage tank sites provides some static pressure data, which is recorded in handwritten logbooks.
		Pressure data is gathered at individual sites only when low pressure complaints arise.
		Average pressure is determined by averaging relatively crude data, and is affected by significant variation in ground elevations, system head loss and gaps in pressure controls in the distribution system.
3		Conditions between 2 and 4
4		Effective pressure controls separate different pressure zones; moderate pressure variation across the system, occasional open boundary valves are discovered that breach pressure zones.
		Basic telemetry monitoring of the distribution system logs pressure data electronically.
		Pressure data gathered by gauges or dataloggers at fire hydrants or buildings when low pressure complaints arise, and during fire flow tests and system flushing.
		Reliable topographical data exists.
5		Conditions between 4 and 6
6		Reliable pressure controls separate distinct pressure zones; only very occasional open boundary valves are encountered that breach pressure zones.
		Well-covered telemetry monitoring of the distribution system (not just pumping at source treatment plants or wells) logs extensive pressure data electronically.
		Pressure gathered by gauges/dataloggers at fire hydrants and buildings when low pressure complaints arise, and during fire flow tests and system flushing.
		Average pressure is determined by using this mix of reliable data.
7		Conditions between 6 and 8
8		Well-managed, discrete pressure zones exist with generally predictable pressure fluctuations.
		A current full-scale SCADA System or similar realtime monitoring system exists to monitor the water distribution system and collect data, including real time pressure readings at representative sites across the system.
		The average system pressure is determined from reliable monitoring system data.
9		Conditions between 8 and 10
10		Well-managed pressure districts/zones, SCADA System and hydraulic model exist to give very precise pressure data across the water distribution system.
		Average system pressure is reliably calculated from extensive, reliable, and cross-checked data.
		Calculations are reported on an annual basis as a minimum.

## Total annual cost of operating water system

GRADE	✓	DESCRIPTION
1		Incomplete paper records and lack of financial accounting documentation on many operating functions makes calculation of water system operating costs a pure guesstimate
2		Reasonably maintained, but incomplete, paper or electronic accounting provides data to estimate the major portion of water system operating costs.
3		Conditions between 2 and 4
4		Electronic, industry-standard cost accounting system in place.
		However, gaps in data are known to exist, periodic internal reviews are conducted but not a structured financial audit.
5		Conditions between 4 and 6
6		Reliable electronic, industry-standard cost accounting system in place, with all pertinent water system operating costs tracked.
		Data audited periodically by utility personnel, but not a Certified Public Accountant (CPA).
7		Conditions between 6 and 8
8		Reliable electronic, industry-standard cost accounting system in place, with all pertinent water system operating costs tracked.
		Data audited at least annually by utility personnel, and at least once every three years by third-party CPA.
9		Conditions between 8 and 10
10		Reliable electronic, industry-standard cost accounting system in place, with all pertinent water system operating costs tracked.
		Data audited annually by utility personnel and annually also by third-party CPA.

## Customer retail unit cost (applied to Apparent Losses):

GRADE	✓	DESCRIPTION
n/a		Customer population unmetered, and/or only a fixed fee is charged for consumption.
1		Antiquated, cumbersome water rate structure is used, with periodic historic amendments that were poorly documented and implemented; resulting in classes of customers being billed inconsistent charges. The actual composite billing rate likely differs significantly from the published water rate structure, but a lack of auditing leaves the degree of error indeterminate.
2		Dated, cumbersome water rate structure, not always employed consistently in actual billing operations. The actual composite billing rate is known to differ from the published water rate structure, and a reasonably accurate estimate of the degree of error is determined, allowing a composite billing rate to be quantified.
3		Conditions between 2 and 4
4		Straight-forward water rate structure in use, but not updated in several years. Billing operations reliably employ the rate structure. The composite billing rate is derived from a single customer class such as residential customer accounts, neglecting the effect of different rates from varying customer classes.
5		Conditions between 4 and 6
6		Clearly written, up-to-date water rate structure is in force and is applied reliably in billing operations. Composite customer rate is determined using a weighted average residential rate using volumes of water in each rate block.
7		Conditions between 6 and 8
8		Effective water rate structure is in force and is applied reliably in billing operations. Composite customer rate is determined using a weighted average composite consumption rate, which includes residential, commercial, industrial, institutional (CII), and any other distinct customer classes within the water rate structure.
9		Conditions between 8 and 10
10		Current, effective water rate structure is in force and applied reliably in billing operations. The rate structure and calculations of composite rate - which includes residential, commercial, industrial, institutional (CII), and other distinct customer classes - are reviewed by a third party knowledgeable in the M36 methodology at least once every 5 years.

## Variable production cost (applied to Real Losses):

GRADE	✓	DESCRIPTION
Note: if the water utility purchases/imports its entire water supply, then enter the unit purchase cost of the bulk water supply in the Reporting Worksheet with a grading of 10		
1		Incomplete paper records and lack of documentation on primary operating functions (electric power and treatment costs most importantly) makes calculation of variable production costs a pure guesstimate
2		Reasonably maintained, but incomplete, paper or electronic accounting provides data to roughly estimate the basic operations costs (pumping power costs and treatment costs) and calculate a unit variable production cost.
3		Conditions between 2 and 4
4		Electronic, industry-standard cost accounting system in place.
		Electric power and treatment costs are reliably tracked and allow accurate weighted calculation of unit variable production costs based on these two inputs and water imported purchase costs (if applicable). All costs are audited internally on a periodic basis.
5		Conditions between 4 and 6
6		Reliable electronic, industry-standard cost accounting system in place, with all pertinent water system operating costs tracked.
		Pertinent additional costs beyond power, treatment and water imported purchase costs (if applicable) such as liability, residuals management, wear and tear on equipment, impending expansion of supply, are included in the unit variable production cost, as applicable. The data is audited at least annually by utility personnel.
7		Conditions between 6 and 8
8		Reliable electronic, industry-standard cost accounting system in place, with all pertinent primary and secondary variable production and water imported purchase (if applicable) costs tracked.
		The data is audited at least annually by utility personnel, and at least once every three years by a third-party knowledgeable in the M36 methodology.
9		Conditions between 8 and 10
10		Either of two conditions can be met to obtain a grading of 10:
		1) Third party CPA audit of all pertinent primary and secondary variable production and water imported purchase (if applicable) costs on an annual basis.or: 2) Water supply is entirely purchased as bulk water imported, and the unit purchase cost - including all applicable marginal supply costs - serves as the variable production cost. If all applicable marginal supply costs are not included in this figure, a grade of 10 should not be selected.