Grading >>>	n/a	1	2	3	4	5	6	7	8	9	10
Improvements to attain higher data grading for "Billed Metered Consumption" component:	If n/a is selected because the customer meter population is unmetered, consider establishing a new policy to meter the customer population and employ water rates based upon metered volumes.	to qualify for 2: Conduct investigations or trials of customer meters 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. Launch a program of annual auditing of global billing statistics by utility personnel.		to qualify for 8: Purchase and install meters on unmetered accounts. If customer meter reading success rate is less than 97%, assess cost-effectiveness of Automatic Meter Reading (AMR) or Advanced Metering Infrastructure (AMI) system for portion or entire system; or otherwise achieve ongoing improvements in manual meter reading success rate to 97% or higher. Refine meter accuracy testing program. Set meter replacement goals based upon accuracy test results. Implement annual auditing of detailed billing records by utility personnel and implement third party auditing at least once every five years.		to qualify for 10: Purchase and install meters on unmetered accounts. Launch Automatic Meter Reading (AMR) or Advanced Metering Infrastructure (AMI) system trials if manual meter reading success rate of at least 99% 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 target. Continue annual detailed billing data auditing by utility personnel and conduct third party auditing at least once every three years.		to maintain 10: Continue annual internal billing data auditing, and third party auditing at least every three years. Continue customer meter accuracy testing to ensure that accurate customer meter readings are obtained and entered as the basis for volume based billing. Stay abreast of improvements in Automatic Meter Reading (AMR) and Advanced Metering Infrastructure (AMI) and information management. Plan and budget for justified upgrades in metering, meter reading and billing data management to maintain very high accuracy in customer metering and billing.
Billed unmetered:	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	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.	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.	Conditions between 2 and 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.	Conditions between 4 and 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.	Conditions between 6 and 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.	Conditions between 8 and 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.
Improvements to attain higher data grading for "Billed Unmetered Consumption" component:		to qualify for 2: Conduct research and evaluate cost/benefit of a new water utility policy to require metering of the customer population; thereby greatly reducing or eliminating unmetered accounts. Conduct pilot metering project by installing water meters in small sample of customer accounts and periodically reading the meters or datalogging the water consumption over one, three, or seven day periods.	to qualify for 4: Implement a new water utility policy requiring customer metering. Launch or expand pilot metering study to include several different meter types, which will provide data for economic assessment of full scale metering options. Assess sites with access difficulties to devise means to obtain water consumption volumes. Begin customer meter installation.		to qualify for 6: Refine policy and procedures to improve customer metering participation for all but solidly exempt accounts. Assign staff resources to review billing records to identify errant unmetered properties. Specify metering needs and funding requirements to install sufficient meters to significant reduce the number of unmetered accounts.		to qualify for 8: Push to install customer meters on a full scale basis. Refine metering policy and procedures to ensure that all accounts, including municipal properties, are designated for meters. Plan special efforts to address "hard-to-access" accounts. Implement procedures to obtain a reliable consumption estimate for the remaining few unmetered accounts awaiting meter installation.		to qualify for 10: Continue customer meter installation throughout the service area, with a goal to minimize unmetered accounts. Sustain the effort to investigate accounts with access difficulties, and devise means to install water meters or otherwise measure water consumption.		to maintain 10: Continue to refine estimation methods for unmetered consumption and explore means to establish metering, for as many billed remaining unmetered accounts as is economically feasible.
Unbilled metered:	select n/a if all billing-exempt consumption is unmetered.	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.	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.	Conditions between 2 and 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.	Conditions between 4 and 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.	Conditions between 6 and 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.	Conditions between 8 and 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.

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Grading >>>	n/a	1	2	3	4	5	6	7	8	9	10
Improvements to attain higher data grading for "Unbilled Metered Consumption" component:		to qualify for 2: Reassess the water utility's policy allowing certain accounts to be granted a billing exemption. Draft an outline of a new written policy for billing exemptions, with clear justification as to why any accounts should be exempt from billing, and with the intention to keep the number of such accounts to a minimum.	to qualify for 4: Review historic written directives and policy documents allowing certain accounts to be billing-exempt. Draft an outline of a written policy for billing exemptions, identify criteria that grants an exemption, with a goal of keeping this number of accounts to a minimum. Consider increasing the priority of reading meters on unbilled accounts at least annually.		to qualify for 6: Draft a new written policy regarding billing exemptions based upon consensus criteria allowing this occurrence. Assign resources to audit meter records and billing records to obtain census of unbilled metered accounts. Gradually include a greater number of these metered accounts to the routes for regular meter reading.		to qualify for 8: Communicate billing exemption policy throughout the organization and implement procedures that ensure proper account management. Conduct inspections of accounts confirmed in unbilled metered status and verify that accurate meters exist and are scheduled for routine meter readings. Gradually increase the number of unbilled metered accounts that are included in regular meter reading routes.		to qualify for 10: Ensure that meter management (meter accuracy testing, meter replacement) and meter reading activities for unbilled accounts are accorded the same priority as billed accounts. Establish ongoing annual auditing process to ensure that water consumption is reliably collected and provided to the annual water audit process.		to maintain 10: Reassess the utility's philosophy in allowing any water uses to go "unbilled". It is possible to meter and bill all accounts, even if the fee charged for water consumption is discounted or waived. Metering and billing all accounts ensures that water consumption is tracked and water waste from plumbing leaks is detected and minimized.
Unbilled unmetered:		Extent of unbilled, unmetered consumption is unknown due to unclear policies and poor recordkeeping. Total consumption is quantified based upon a purely subjective estimate.	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.	Conditions between 2 and 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).	Default value of 1.25% of system input volume is employed	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.	Conditions between 6 and 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.	Conditions between 8 and 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.
Improvements to attain higher data grading for "Unbilled Unmetered Consumption" component:		to qualify for 5: Utilize the accepted default value of 1.25% of the volume of water supplied as an expedient means to gain a reasonable quantification of this use. to qualify for 2: Establish a policy regarding what water uses should be allowed to remain as unbilled and unmetered. Consider tracking a small sample of one such use (ex: fire hydrant flushings).	to qualify for 5: Utilize accepted default value of 1.25% of the volume of water supplied as an expedient means to gain a reasonable quantification of this use. to qualify for 4: Evaluate the documentation of events that have been observed. Meet with user groups (ex: for fire hydrants - fire departments, contractors to ascertain their need and/or volume requirements for water from fire hydrants).		to qualify for 5: Utilize accepted default value of 1.25% of the volume of water supplied as an expedient means to gain a reasonable quantification of all such use. This is particularly appropriate for water utilities who are in the early stages of the water auditing process, and should focus on other components since the volume of unbilled, umetered consumption is usually a relatively small quatity component, and other larger-quantity components should take priority.	to qualify for 6 or greater: Finalize policy and begin to conduct field checks to better establish and quantify such usage. Proceed if top-down audit exists and/or a great volume of such use is suspected.	to qualify for 8: Assess water utility policy and procedures for various unmetered usages. For example, ensure that a policy exists and permits are issued for use of fire hydrants by persons outside of the utility. Create written procedures for use and documentation of fire hydrants by water utility personnel. Use same approach for other types of unbilled, unmetered water usage.		to qualify for 10: Refine written procedures to ensure that all uses of unbilled, unmetered water are overseen by a structured permitting process managed by water utility personnel. Reassess policy to determine if some of these uses have value in being converted to billed and/or metered status.		to maintain 10: Continue to refine policy and procedures with intention of reducing the number of allowable uses of water in unbilled and unmetered fashion. Any uses that can feasibly become billed and metered should be converted eventually.
APPARENT LOSSES											
Unauthorized consumption:		Extent of unauthorized consumption is unknown due to unclear policies and poor recordkeeping. Total unauthorized consumption is guesstimated.	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.	conditions between 2 and 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).	Default value of 0.25% of volume of water supplied is employed	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.	Conditions between 6 and 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.	Conditions between 8 and 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.

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Grading Matrix 9

Grading >>>	n/a	1	2	3	4	5	6	7	8	9	10
Improvements to attain higher data grading for "Unauthorized Consumption" component:		<u>to qualify for 5</u>: Use accepted default of 0.25% of volume of water supplied. <u>to qualify for 2</u>: Review utility policy regarding what water uses are considered unauthorized, and consider tracking a small sample of one such occurrence (ex: unauthorized fire hydrant openings)	<u>to qualify for 5</u> Use accepted default of 0.25% of system input volume <u>to qualify for 4</u>: Review utility policy regarding what water uses are considered unauthorized, and consider tracking a small sample of one such occurrence (ex: unauthorized fire hydrant openings)		<u>to qualify for 5</u>: Utilize accepted default value of 0.25% of volume of water supplied as an expedient means to gain a reasonable quantification of all such use. This is particularly appropriate for water utilities who are in the early stages of the water auditing process.	<u>to qualify for 6 or greater</u>: Finalize policy updates to clearly identify the types of water consumption that are authorized from those usages that fall outside of this policy and are, therefore, unauthorized. Begin to conduct regular field checks. Proceed if the top-down audit already exists and/or a great volume of such use is suspected.	<u>to qualify for 8</u>: Assess water utility policies to ensure that all known occurrences of unauthorized consumption are outlawed, and that appropriate penalties are prescribed. Create written procedures for detection and documentation of various occurrences of unauthorized consumption as they are uncovered		<u>to qualify for 10</u>: Refine written procedures and assign staff to seek out likely occurrences of unauthorized consumption. Explore new locking devices, monitors and other technologies designed to detect and thwart unauthorized consumption.		<u>to maintain 10</u>: Continue to refine policy and procedures to eliminate any loopholes that allow or tacitly encourage unauthorized consumption. Continue to be vigilant in detection, documentstion and enforcement efforts.
Customer metering inaccuracies:	select n/a only if the entire customer population is unmetered. In such a case the volume entered must be zero.	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.	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.	Conditions between 2 and 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.	Conditions between 4 and 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.	Conditions between 6 and 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.	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	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.
Improvements to attain higher data grading for "Customer meter inaccuracy volume" component:	If n/a is selected because the customer meter population is unmetered, consider establishing a new policy to meter the customer population and employ water rates based upon metered volumes.	<u>to qualify for 2</u> Gather available meter purchase records. Conduct testing on a small number of meters believed to be the most inaccurate. Review staffing needs of the metering group and budget for necessary resources to better organize meter management	<u>to qualify for 4</u>: Implement a reliable record keeping system for customer meter histories, preferably using electronic methods typically linked to, or part of, the Customer Billing System or Customer Information System. Expand meter accuracy testing to a larger group of meters.		<u>to qualify for 6</u>: Standardize the procedures for meter recordkeeping within an electronic information system. Accelerate meter accuracy testing and meter replacements guided by testing results.		<u>to qualify for 8</u>: Expand annual meter accuracy testing to evaluate a statistically significant number of meter makes/models. Expand meter replacement program to replace statistically significant number of poor performing meters each year.		<u>to qualify for 9</u>: Continue efforts to manage meter population with reliable recordkeeping. Test a statistically significant number of meters each year and analyze test results in an ongoing manner to serve as a basis for a target meter replacement strategy based upon accumulated volume throughput.	<u>to qualify for 10</u>: Continue efforts to manage meter population with reliable recordkeeping, meter testing and replacement. Evaluate new meter types and install one or more types in 5-10 customer accounts each year in order to pilot improving metering technology.	<u>to maintain 10</u>: Increase the number of meters tested and replaced as justified by meter accuracy test data. Continually monitor development of new metering technology and Advanced Metering Infrastructure (AMI) to grasp opportunities for greater accuracy in metering of water flow and management of customer consumption data.
Systematic Data Handling Errors	Note: all water utilities incur some amount of this error. Even in water utilities with unmetered customer populations and fixed rate billing, errors occur in annual billing tabulations. Enter a positive value for the volume and select a grading.	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.	Policy and procedures for activation of new customer accounts and 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.	Conditions between 2 and 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.	Conditions between 4 and 6	Policy and procedures for new account activation and oversight of billing operations is adequate and 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.	Conditions between 6 and 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.	Conditions between 8 and 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.

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Grading >>>	n/a	1	2	3	4	5	6	7	8	9	10
Improvements to attain higher data grading for "Systematic Data Handling Error volume" component:		to qualify for 2: Draft written policy and procedures for activating new water billing accounts and oversight of billing operations. Investigate and budget for computerized customer billing system. Conduct initial audit of billing records by flow-charting the basic business processes of the customer account/billing function.	to qualify for 4 Finalize written policy and procedures for activation of new billing accounts and overall billing operations management. Implement a computerized customer billing system. Conduct initial audit of billing records as part of this process.		to qualify for 6: Refine new account activation and billing operations procedures and ensure consistency with the utility policy regarding billing, and minimize opportunity for missed billings. Upgrade or replace customer billing system for needed functionality - ensure that billing adjustments don't corrupt the value of consumption volumes. Procedurize internal annual audit process.		to qualify for 8: Formalize regular review of new account activation process and general billing practices. Enhance reporting capability of computerized billing system. Formalize regular auditing process to reveal scope of data handling error. Plan for periodic third party audit to occur at least once every five years.		to qualify for 10: Close policy/procedure loopholes that allow some customer accounts to go unbilled, or data handling errors to exist. Ensure that billing system reports are utilized, analyzed and reported every billing cycle. Ensure that internal and third party audits are conducted at least once every three years.		to maintain 10: Stay abreast of customer information management developments and innovations. Monitor developments of Advanced Metering Infrastructure (AMI) and integrate technology to ensure that customer endpoint information is well-monitored and errors/lapses are at an economic minimum.
SYSTEM DATA											
Length of mains:		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.	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.	Conditions between 2 and 4	Sound written policy and procedures exist for documenting new water main installations, but gaps in management result in a uncertain degree of error in tabulation of mains length.	Conditions between 4 and 6	Sound written policy and procedures exist for permitting and commissioning new water mains. Highly accurate paper records with regular field validation; or electronic records and asset management system in good condition. Includes system backup.	Conditions between 6 and 8	Sound written policy and procedures exist for permitting and commissioning new water mains. Electronic recordkeeping such as a Geographical Information System (GIS) and asset management system are used to store and manage data.	Conditions between 8 and 10	Sound written policy exists for managing water mains extensions and replacements. 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.
Improvements to attain higher data grading for "Length of Water Mains" component:		to qualify for 2: Assign personnel to inventory current as-built records and compare with customer billing system records and highway plans in order to verify poorly documented pipelines. Assemble policy documents regarding permitting and documentation of water main installations by the utility and building developers; identify gaps in procedures that result in poor documentation of new water main installations.	to qualify for 4: Complete inventory of paper records of water main installations for several years prior to audit year. Review policy and procedures for commissioning and documenting new water main installation.		to qualify for 6: Finalize updates/improvements to written policy and procedures for permitting/commissioning new main installations. Confirm inventory of records for five years prior to audit year; correct any errors or omissions.		to qualify for 8: Launch random field checks of limited number of locations. Convert to electronic database such as a Geographic Information System (GIS) with backup as justified. Develop written policy and procedures.		to qualify for 10: Link Geographic Information System (GIS) and asset management databases, conduct field verification of data. Record field verification information at least annually.		to maintain 10: Continue with standardization and random field validation to improve the completeness and accuracy of the system.
Number of active AND inactive service connections:		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.	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.	Conditions between 2 and 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.	Conditions between 4 and 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%.	Conditions between 6 and 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.	Conditions between 8 and 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.
Improvements to attain higher data grading for "Number of Active and Inactive Service Connections" component:	**Note: The number of Service Connections does not include fire hydrant leads/lines connecting the hydrant to the water main**	to qualify for 2: Draft new policy and procedures for new account activation and overall billing operations. Research and collect paper records of installations & abandonments for several years prior to audit year.	to qualify for 4: Refine policy and procedures for new account activation and overall billing operations. Research computerized recordkeeping system (Customer Information System or Customer Billing System) to improve documentation format for service connections.		to qualify for 6 Refine procedures to ensure consistency with new account activation and overall billing policy to establish new service connections or decommission existing connections. Improve process to include all totals for at least five years prior to audit year.		to qualify for 8: Formalize regular review of new account activation and overall billing operations policies and procedures. Launch random field checks of limited number of locations. Develop reports and auditing mechanisms for computerized information management system.		to qualify for 10: Close any procedural loopholes that allow installations to go undocumented. Link computerized information management system with Geographic Information System (GIS) and formalize field inspection and information system auditing processes. Documentation of new or decommissioned service connections encounters several levels of checks and balances.		to maintain 10: Continue with standardization and random field validation to improve knowledge of system.
	Note: If customer water	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)									Either of two conditions can be met for a grading of 10:

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Grading Matrix 11

Grading >>>	n/a	1	2	3	4	5	6	7	8	9	10
Average length of customer service line:	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.	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.	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.	Conditions between 2 and 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.	Conditions between 4 and 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.	Conditions between 6 and 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.	Conditions between 8 and 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.
Improvements to attain higher data grading for "Average Length of Customer Service Line" component:		<u>to qualify for 2</u>: Research and collect paper records of service line installations. Inspect several sites in the field using pipe locators to locate curb stops. Obtain the length of this small sample of connections in this manner.	<u>to qualify for 4</u>: Formalize and communicate policy delineating utility/customer responsibilities for service connection piping. Assess accuracy of paper records by field inspection of a small sample of service connections using pipe locators as needed. Research the potential migration to a computerized information management system to store service connection data.		<u>to qualify for 6</u>: Establish coherent procedures to ensure that policy for curb stop, meter installation and documentation is followed. Gain consensus within the water utility for the establishment of a computerized information management system.		<u>to qualify for 8</u>: Implement an electronic means of recordkeeping, typically via a customer information system, customer billing system, or Geographic Information System (GIS). Standardize the process to conduct field checks of a limited number of locations.		<u>to qualify for 10</u>: Link customer information management system and Geographic Information System (GIS), standardize process for field verification of data.		<u>to maintain 10</u>: Continue with standardization and random field validation to improve knowledge of service connection configurations and customer meter locations.
Average operating pressure:		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.	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.	Conditions between 2 and 4	Effective pressure controls separate different pressure zones; moderate pressure variation across the system, occasional open boundary valves are discovered that breech 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. Average pressure is calculated using this mix of data.	Conditions between 4 and 6	Reliable pressure controls separate distinct pressure zones; only very occasional open boundary valves are encountered that breech 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.	Conditions between 6 and 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.	Conditions between 8 and 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.
Improvements to attain higher data grading for "Average Operating Pressure" component:		<u>to qualify for 2</u>: Employ pressure gauging and/or datalogging equipment to obtain pressure measurements from fire hydrants. Locate accurate topographical maps of service area in order to confirm ground elevations. Research pump data sheets to find pump pressure/flow characteristics	<u>to qualify for 4</u>: Formalize a procedure to use pressure gauging/datalogging equipment to gather pressure data during various system events such as low pressure complaints, or operational testing. Gather pump pressure and flow data at different flow regimes. Identify faulty pressure controls (pressure reducing valves, altitude valves, partially open boundary valves) and plan to properly configure pressure zones. Make all pressure data from these efforts available to generate system-wide average pressure.		<u>to qualify for 6</u>: Expand the use of pressure gauging/datalogging equipment to gather scattered pressure data at a representative set of sites, based upon pressure zones or areas. Utilize pump pressure and flow data to determine supply head entering each pressure zone or district. Correct any faulty pressure controls (pressure reducing valves, altitude valves, partially open boundary valves) to ensure properly configured pressure zones. Use expanded pressure dataset from these activities to generate system-wide average pressure.		<u>to qualify for 8</u>: Install a Supervisory Control and Data Acquisition (SCADA) System, or similar realtime monitoring system, to monitor system parameters and control operations. Set regular calibration schedule for instrumentation to insure data accuracy. Obtain accurate topographical data and utilize pressure data gathered from field surveys to provide extensive, reliable data for pressure averaging.		<u>to qualify for 10</u>: Annually, obtain a system-wide average pressure value from the hydraulic model of the distribution system that has been calibrated via field measurements in the water distribution system and confirmed in comparisons with SCADA System data.		<u>to maintain 10</u>: Continue to refine the hydraulic model of the distribution system and consider linking it with SCADA System for real-time pressure data calibration, and averaging.

AWWA Free W… udit Software v5.0 … Matrix 12

Grading >>>	n/a	1	2	3	4	5	6	7	8	9	10
COST DATA											
Total annual cost of operating water system:		Incomplete paper records and lack of financial accounting documentation on many operating functions makes calculation of water system operating costs a pure guesstimate	Reasonably maintained, but incomplete, paper or electronic accounting provides data to estimate the major portion of water system operating costs.	Conditions between 2 and 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.	Conditions between 4 and 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).	Conditions between 6 and 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.	Conditions between 8 and 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.
Improvements to attain higher data grading for "Total Annual Cost of Operating the Water System" component:		to qualify for 2: Gather available records, institute new financial accounting procedures to regularly collect and audit basic cost data of most important operations functions.	to qualify for 4: Implement an electronic cost accounting system, structured according to accounting standards for water utilities		to qualify for 6: Establish process for periodic internal audit of water system operating costs; identify cost data gaps and institute procedures for tracking these outstanding costs.		to qualify for 8: Standardize the process to conduct routine financial audit on an annual basis. Arrange for CPA audit of financial records at least once every three years.		to qualify for 10: Standardize the process to conduct a third-party financial audit by a CPA on an annual basis.		to maintain 10: Maintain program, stay abreast of expenses subject to erratic cost changes and long-term cost trend, and budget/track costs proactively
Customer retail unit cost (applied to Apparent Losses):	Customer population unmetered, and/or only a fixed fee is charged for consumption.	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.	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.	Conditions between 2 and 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.	Conditions between 4 and 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.	Conditions between 6 and 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.	Conditions between 8 and 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 five years.
Improvements to attain higher data grading for "Customer Retail Unit Cost" component:		to qualify for 2: Formalize the process to implement water rates, including a secure documentation procedure. Create a current, formal water rate document and gain approval from all stakeholders.	to qualify for 4: Review the water rate structure and update/formalize as needed. Assess billing operations to ensure that actual billing operations incorporate the established water rate structure.		to qualify for 6: Evaluate volume of water used in each usage block by residential users. Multiply volumes by full rate structure.	Launch effort to fully meter the customer population and charge rates based upon water volumes	to qualify for 8: Evaluate volume of water used in each usage block by all classifications of users. Multiply volumes by full rate structure.		to qualify for 10: Conduct a periodic third-party audit of water used in each usage block by all classifications of users. Multiply volumes by full rate structure.		to maintain 10: Keep water rate structure current in addressing the water utility's revenue needs. Update the calculation of the customer unit rate as new rate components, customer classes, or other components are modified.
Variable production cost (applied to Real Losses):	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	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	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.	Conditions between 2 and 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.	Conditions between 4 and 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.	Conditions between 6 and 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.	Conditions between 8 and 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 imported water, and unit purchase cost serves as the variable production cost.
Improvements to attain higher data grading for "Variable Production Cost" component:		to qualify for 2: Gather available records, institute new procedures to regularly collect and audit basic cost data and most important operations functions.	to qualify for 4: Implement an electronic cost accounting system, structured according to accounting standards for water utilities		to qualify for 6: Formalize process for regular internal audits of production costs. Assess whether additional costs (liability, residuals management, equipment wear, impending infrastructure expansion) should be included to calculate a more representative variable production cost.		to qualify for 8: Formalize the accounting process to include direct cost components (power, treatment) as well as indirect cost components (liability, residuals management, etc.) Arrange to conduct audits by a knowledgable third-party at least once every three years.		to qualify for 10: Standardize the process to conduct a third-party financial audit by a CPA on an annual basis.		to maintain 10: Maintain program, stay abreast of expenses subject to erratic cost changes and budget/track costs proactively

AWWA Free Water Audit Software v5.0 Grading Matrix 13

AWWA Free Water Audit Software: Customer Service Line Diagrams

WAS v5.0

Average Length of Customer Service Line

The three figures shown on this worksheet display the assignment of the Average Length of Customer Service Line, Lp, for the three most common piping configurations.

Figure 1 shows the configuration of the water meter outside of the customer building next to the curb stop valve. In this configuration Lp = 0 since the distance between the curb stop and the customer metering point is essentially zero.

Figure 2 shows the configuration of the customer water meter located inside the customer building, where Lp is the distance from the curb stop to the water meter.

Figure 3 shows the configuration of an unmetered customer building , where Lp is the distance from the curb stop to the first point of customer water consumption, or, more simply, the building line.

In any water system the Lp will vary notably in a community of different structures, therefore the average Lp value is used and this should be approximated or calculated if a sample of service line measurements has been gathered.

Click for more information

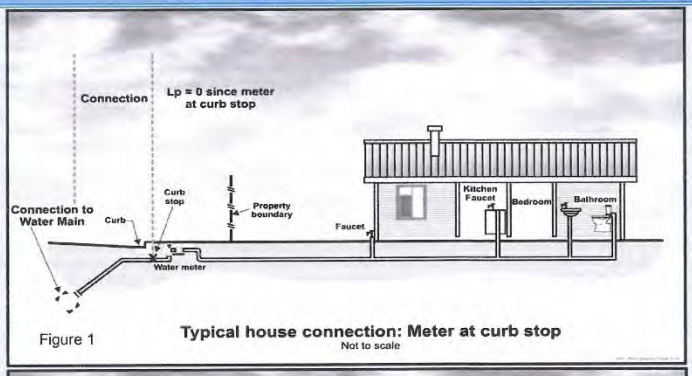

Figure 1 **Typical house connection: Meter at curb stop**
Not to scale

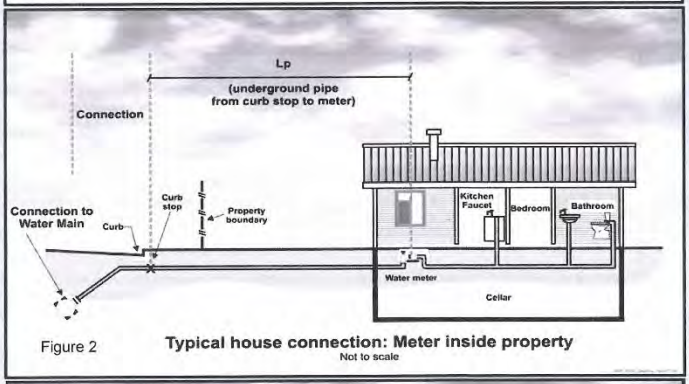

Figure 2 **Typical house connection: Meter inside property**
Not to scale

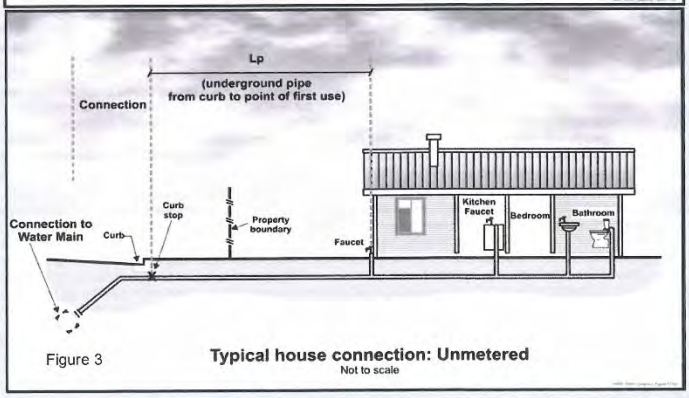

Figure 3 **Typical house connection: Unmetered**
Not to scale

AWWA Free Water Audit Software: Definitions

WAS v5.0

Item Name	Description
Apparent Losses Find	= unauthorized consumption + customer metering inaccuracies + systematic data handling errors Apparent Losses include all types of inaccuracies associated with customer metering (worn meters as well as improperly sized meters or wrong type of meter for the water usage profile) as well as systematic data handling errors (meter reading, billing, archiving and reporting), plus unauthorized consumption (theft or illegal use). NOTE: Over-estimation of Apparent Losses results in under-estimation of Real Losses. Under-estimation of Apparent Losses results in over-estimation of Real Losses.
AUTHORIZED CONSUMPTION Find	= billed water exported + billed metered + billed unmetered + unbilled metered + unbilled unmetered consumption The volume of metered and/or unmetered water taken by registered customers, the water utility's own uses, and uses of others who are implicitly or explicitly authorized to do so by the water utility; for residential, commercial, industrial and public-minded purposes. Typical retail customers' consumption is tabulated usually from established customer accounts as billed metered consumption, or - for unmetered customers - billed unmetered consumption. These types of consumption, along with billed water exported, provide revenue potential for the water utility. **Be certain to tabulate the water exported volume as a separate component and do not "double-count" it by including in the billed metered consumption component as well as the water exported component.** Unbilled authorized consumption occurs typically in non-account uses, including water for fire fighting and training, flushing of water mains and sewers, street cleaning, watering of municipal gardens, public fountains, or similar public-minded uses. Occasionally these uses may be metered and billed (or charged a flat fee), but usually they are unmetered and unbilled. In the latter case, the water auditor may use a default value to estimate this quantity, or implement procedures for the reliable quantification of these uses. This starts with documenting usage events as they occur and estimating the amount of water used in each event. (See Unbilled unmetered consumption)
View Service Connection Diagram Average length of customer service line Find	This is the average length of customer service line, Lp, that is owned and maintained by the customer; from the point of ownership transfer to the customer water meter, or building line (if unmetered). The quantity is one of the data inputs for the calculation of Unavoidable Annual Real Losses (UARL), which serves as the denominator of the performance indicator: Infrastructure Leakage Index (ILI). The value of Lp is multiplied by the number of customer service connections to obtain a total length of customer owned piping in the system. The purpose of this parameter is to account for the unmetered service line infrastructure that is the responsibility of the customer for arranging repairs of leaks that occur on their lines. In many cases leak repairs arranged by customers take longer to be executed than leak repairs arranged by the water utility on utility-maintained piping. Leaks run longer - and lose more water - on customer-owned service piping, than utility owned piping. If the customer water meter exists near the ownership transfer point (usually the curb stop located between the water main and the customer premises) this distance is zero because the meter and transfer point are the same. This is the often encountered configuration of customer water meters located in an underground meter box or "pit" outside of the customer's building. The Free Water Audit Software asks a "Yes/No" question about the meter at this location. If the auditor selects "Yes" then this distance is set to zero and the data grading score for this component is set to 10. If water meters are typically located inside the customer premise/building, or properties are unmetered, it is up to the water auditor to estimate a system-wide average Lp length based upon the various customer land parcel sizes and building locations in the service area. Lp will be a shorter length in areas of high density housing, and a longer length in areas of low density housing and varied commercial and industrial buildings. General parcel demographics should be employed to obtain a composite average Lp length for the entire system. Refer to the "Service Connection Diagram" worksheet for a depiction of the service line/metering configurations that typically exist in water utilities. This worksheet gives guidance on the determination of the Average Length, Lp, for each configuration.
Average operating pressure Find	This is the average pressure in the distribution system that is the subject of the water audit. Many water utilities have a calibrated hydraulic model of their water distribution system. For these utilities, the hydraulic model can be utilized to obtain a very accurate quantity of average pressure. In the absence of a hydraulic model, the average pressure may be approximated by obtaining readings of static water pressure from a representative sample of fire hydrants or other system access points evenly located across the system. A weighted average of the pressure can be assembled; but be sure to take into account the elevation of the fire hydrants, which typically exist several feet higher than the level of buried water pipelines. If the water utility is compiling the water audit for the first time, the average pressure can be approximated, but with a low data grading. In subsequent years of auditing, effort should be made to improve the accuracy of the average pressure quantity. This will then qualify the value for a higher data grading.
Billed Authorized Consumption	All consumption that is billed and authorized by the utility. This may include both metered and unmetered consumption. See "Authorized Consumption" for more information.
Billed metered consumption Find	All metered consumption which is billed to retail customers, including all groups of customers such as domestic, commercial, industrial or institutional. **It does NOT include water supplied to neighboring utilities (water exported) which is metered and billed. Be sure to subtract any consumption for exported water sales that may be included in these billing roles. Water supplied as exports to neighboring water utilities should be included only in the Water Exported component.** 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 lag time since not all customer meters are read on the same day of the meter reading period. However additional analysis is necessary to determine the lag time adjustment value, which may or may not be significant.
Billed unmetered consumption Find	All billed consumption which is calculated based on estimates or norms from water usage sites that have been determined by utility policy to be left unmetered. This is typically a very small component in systems that maintain a policy to meter their customer population. However, this quantity can be the key consumption component in utilities that have not adopted a universal metering policy. **This component should NOT include any water that is supplied to neighboring utilities (water exported) which is unmetered but billed. Water supplied as exports to neighboring water utilities should be included only in the Water Exported component.**

Item Name	Description
Customer metering inaccuracies Find	Apparent water losses caused by the collective under-registration of customer water meters. Many customer water meters gradually wear as large cumulative volumes of water are passed through them over time. This causes the meters to under-register the flow of water. This occurrence is common with smaller residential meters of sizes 5/8-inch and 3/4 inch after they have registered very large cumulative volumes of water, which generally occurs only after periods of years. For meters sized 1-inch and larger - typical of multi-unit residential, commercial and industrial accounts - meter under-registration can occur from wear or from the improper application of the meter; i.e. installing the wrong type of meter or the wrong size of meter, for the flow pattern (profile) of the consumer. For instance, many larger meters have reduced accuracy at low flows. If an oversized meter is installed, most of the time the routine flow will occur in the low flow range of the meter, and a significant portion of it may not be registered. It is important to properly select and install all meters, but particularly large customer meters, size 1-inch and larger. 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. Note that this percentage is a composite average inaccuracy for all customer meters in the entire meter population. The percentage will be multiplied by the sum of the volumes in the Billed Metered and Unbilled Metered components. Alternatively, if the auditor has substantial data from meter testing activities, he or she can calculate their own loss volumes, and 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, 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 routinely to the components of Apparent Loss, since these losses represent water reaching customers but not (fully) paid for. 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 accounts in each class can be calculated to determine a single composite cost that should be entered into this cell. Finally, the weighted average cost should also include additional charges for sewer, storm water or biosolids processing, but only if these charges are based upon the volume of potable water consumed. For water utilities in regions with limited water resources and a questionable ability to meet the drinking water demands in the future, the Customer Retail Unit Cost might also be applied to value the Real Losses; instead of applying the Variable Production Cost to Real Losses. In this way, it is assumed that every unit volume of leakage reduced by leakage management activities will be sold to a customer. Note: the Free Water Audit 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. The monetary units are United States dollars, $.
Infrastructure Leakage Index (ILI) Find	The ratio of the Current Annual Real Losses (Real Losses) to the Unavoidable Annual Real Losses (UARL). The ILI is a highly effective performance indicator for comparing (benchmarking) the performance of utilities in operational management of real losses.
Length of mains Find	Length of all pipelines (except service connections) in the system starting from the point of system input metering (for example at the outlet of the treatment plant). It is also recommended to include in this measure the total length of fire hydrant lead pipe. Hydrant lead pipe is the pipe branching from the water main to the fire hydrant. Fire hydrant leads are typically of a sufficiently large size that is more representative of a pipeline than a service connection. The average length of hydrant leads across the entire system can be assumed if not known, and multiplied by the number of fire hydrants in the system, which can also be assumed if not known. This value can then be added to the total pipeline length. Total length of mains can therefore be calculated as: Length of Mains, miles = (total pipeline length, miles) + [{(average fire hydrant lead length, ft) x (number of fire hydrants)} / 5,280 ft/mile] or Length of Mains, kilometres = (total pipeline length, kilometres) + [{(average fire hydrant lead length, metres) x (number of fire hydrants)} / 1,000 metres/kilometre]
NON-REVENUE WATER Find	= Apparent Losses + Real Losses + Unbilled Metered Consumption + Unbilled Unmetered Consumption. This is water which does not provide revenue potential to the utility.
Number of active AND inactive service connections Find	Number of customer service connections, extending from the water main to supply water to a customer. Please note that this includes the actual number of distinct piping connections, including fire connections, whether active or inactive. This may differ substantially from the number of customers (or number of accounts). **Note: this number does not include the pipeline leads to fire hydrants - the total length of piping supplying fire hyrants should be included in the "Length of mains" parameter.**
Real Losses Find	Physical water losses from the pressurized system (water mains and customer service connections) and the utility's storage tanks, up to the point of customer consumption. In metered systems this is the customer meter, in unmetered situations this is the first point of consumption (stop tap/tap) within the property. The annual volume lost through all types of leaks, breaks and overflows depends on frequencies, flow rates, and average duration of individual leaks, breaks and overflows.
Revenue Water	Those components of System Input Volume that are billed and have the potential to produce revenue.
Service Connection Density Find	=number of customer service connections / length of mains

Item Name	Description
Systematic data handling errors Find	Apparent losses caused by accounting omissions, errant computer programming, gaps in policy, procedure, and permitting/activation of new accounts; and any type of data lapse that results in under-stated customer water consumption in summary billing reports. **Systematic Data Handling Errors result in a direct loss of revenue potential. Water utilities can find "lost" revenue by keying on this component.** Utilities typically measure water consumption registered by water meters at customer premises. The meter should be read routinely (ex: monthly) and the data transferred to the Customer Billing System, which generates and sends a bill to the customer. Data Transfer Errors result in the consumption value being less than the actual consumption, creating an apparent loss. Such error might occur from illegible and mis-recorded hand-written readings compiled by meter readers, inputting an incorrect meter register unit conversion factor in the automatic meter reading equipment, or a variety of similar errors. Apparent losses also occur from Data Analysis Errors in the archival and data reporting processes of the Customer Billing System. Inaccurate estimates used for accounts that fail to produce a meter reading are a common source of error. Billing adjustments may award customers a rightful monetary credit, but do so by creating a negative value of consumption, thus under-stating the actual consumption. Account activation lapses may allow new buildings to use water for months without meter readings and billing. Poor permitting and construction inspection practices can result in a new building lacking a billing account, a water meter and meter reading; i.e., the customer is unknown to the utility's billing system. Close auditing of the permitting, metering, meter reading, billing and reporting processes of the water consumption data trail can uncover data management gaps that create volumes of systematic data handling error. Utilities should routinely analyze customer billing records to detect data anomalies and quantify these losses. For example, a billing account that registers zero consumption for two or more billing cycles should be checked to explain why usage has seemingly halted. Given the revenue loss impacts of these losses, water utilities are well-justified in providing continuous oversight and timely correction of data transfer errors & data handling errors. If the water auditor has not yet gathered detailed data or assessment of systematic data handling error, it is recommended that the auditor apply the default value of 0.25% of the the Billed Authorized Consumption volume. However, if the auditor has investigated the billing system and its controls, and has well validated data that indicates the volume from systematic data handling error is substantially higher or lower than that generated by the default value, then the auditor should enter a quantity that was derived from the utility investigations and select an appropriate grading. Note: negative values are not allowed for this audit component. If the auditor enters zero for this component then a grading of 1 will be automatically assigned.
Total annual cost of operating the water system Find	These costs include those for operations, maintenance and any annually incurred costs for long-term upkeep of the drinking water supply and distribution system. It should include the costs of day-to-day upkeep and long-term financing such as repayment of capital bonds for infrastructure expansion or improvement. Typical costs include employee salaries and benefits, materials, equipment, insurance, fees, administrative costs and all other costs that exist to sustain the drinking water supply. Depending upon water utility accounting procedures or regulatory agency requirements, it may be appropriate to include depreciation in the total of this cost. This cost should not include any costs to operate wastewater, biosolids or other systems outside of drinking water.
Unauthorized consumption Find	Includes water illegally withdrawn from fire hydrants, illegal connections, bypasses to customer consumption meters, or tampering with metering or meter reading equipment; as well as any other ways to receive water while thwarting the water utility's ability to collect revenue for the water. Unauthorized consumption results in uncaptured revenue and creates an error that understates customer consumption. In most water utilities this volume is low and, if the water auditor has not yet gathered detailed data for these loss occurrences, it is recommended that the auditor apply a default value of 0.25% of the volume of water supplied. However, if the auditor has investigated unauthorized occurrences, and has well validated data that indicates the volume from unauthorized consumption is substantially higher or lower than that generated by the default value, then the auditor should enter a quantity that was derived from the utility investigations. Note that a value of zero will not be accepted since all water utilities have some volume of unauthorized consumption occurring in their system. Note: if the auditor selects the default value for unauthorized consumption, a data grading of 5 is automatically assigned, but not displayed on the Reporting Worksheet.
Unavoidable Annual Real Losses (UARL) Find	UARL (gallons/day)=(5.41Lm + 0.15Nc + 7.5Lc) xP, or UARL (litres/day)=(18.0Lm + 0.8Nc + 25.0Lc) xP where: Lm = length of mains (miles or kilometres) Nc = number of customer service connections Lp = the average distance of customer service connection piping (feet or metres) (see the Worksheet "Service Connection Diagram" for guidance on deterring the value of Lp) Lc = total length of customer service connection piping (miles or km) Lc = Nc X Lp (miles or kilometres) P = Pressure (psi or metres) The UARL is a theoretical reference value representing the technical low limit of leakage that could be achieved if all of today's best technology could be successfully applied. It is a key variable in the calculation of the Infrastructure Leakage Index (ILI). Striving to reduce system leakage to a level close to the UARL is usually not needed unless the water supply is unusually expensive, scarce or both. NOTE: The UARL calculation has not yet been proven as fully valid for very small, or low pressure water distribution systems. If, in gallons per day: (Lm x 32) + Nc < 3000 or P <35psi in litres per day: (Lm x 20) + Nc < 3000 or P < 25m then the calculated UARL value may not be valid. The software does not display a value of UARL or ILI if either of these conditions is true.

Item Name	Description
Unbilled Authorized Consumption	All consumption that is unbilled, but still authorized by the utility. This includes Unbilled Metered Consumption + Unbilled Unmetered Consumption. See "Authorized Consumption" for more information. For Unbilled Unmetered Consumption, the Free Water Audit Software provides the auditor the option to select a default value if they have not audited unmetered activities in detail. The default calculates a volume that is 1.25% of the Water Supplied volume. If the auditor has carefully audited the various unbilled, unmetered, authorized uses of water, and has established reliable estimates of this collective volume, then he or she may enter the volume directly for this component, and not use the default value.
Unbilled metered consumption Find	Metered consumption which is authorized by the water utility, but, for any reason, is deemed by utility policy to be unbilled. This might for example include metered water consumed by the utility itself in treatment or distribution operations, or metered water provided to civic institutions free of charge. **It does not include water supplied to neighboring utilities (water exported) which may be metered but not billed.**
Unbilled unmetered consumption Find	Any kind of Authorized Consumption which is neither billed or metered. This component typically includes water used in activities such as fire fighting, flushing of water mains and sewers, street cleaning, fire flow tests conducted by the water utility, etc. In most water utilities it is a small component which is very often substantially overestimated. **It does NOT include water supplied to neighboring utilities (water exported) which is unmetered and unbilled – an unlikely case.** This component has many sub-components of water use which are often tedious to identify and quantify. Because of this, and the fact that it is usually a small portion of the water supplied, it is recommended that the auditor apply the default value, which is 1.25% of the Water Supplied volume. Select the default percentage to enter this value. If the water utility has carefully audited the unbilled, unmetered activities occurring in the system, and has well validated data that gives a value substantially higher or lower than the default volume, then the auditor should enter their own volume. However the default approach is recommended for most water utilities. Note that a value of zero is not permitted, since all water utilities have some volume of water in this component occurring in their system.
Units and Conversions	The user may develop an audit based on one of three unit selections: 1) Million Gallons (US) 2) Megalitres (Thousand Cubic Metres) 3) Acre-feet Once this selection has been made in the instructions sheet, all calculations are made on the basis of the chosen units. Should the user wish to make additional conversions, a unit converter is provided below (use drop down menus to select units from the yellow unit boxes): Enter Units: 1 — Convert From... Million Gallons (US) = Converts to..... 3.06888329 Acre-feet (conversion factor = 3.06888328973723)
Use of Option Buttons	To use the default percent value choose this button To enter a value choose this button and enter the value in the cell to the right Pcnt: 1.25% ◉ ○ Value: **NOTE:** For Unbilled Unmetered Consumption, Unauthorized Consumption and Systematic Data Handling Errors, a recommended default value can be applied by selecting the Percent option. The default values are based on fixed percentages of Water Supplied or Billed Authorized Consumption and are recommended for use in this audit unless the auditor has well validated data for their system. Default values are shown by purple cells, as shown in the example above. If a default value is selected, the user does not need to grade the item; a grading value of 5 is automatically applied (however, this grade will not be displayed).
Variable production cost (applied to Real Losses) Find	The cost to produce and supply the next unit of water (e.g., $/million gallons). This cost is determined by calculating the summed unit costs for ground and surface water treatment and all power used for pumping from the source to the customer. It may also include other miscellaneous unit costs that apply to the production of drinking water. It should also include the unit cost of bulk water purchased as an import if applicable. It is common to apply this unit cost to the volume of Real Losses. However, if water resources are strained and the ability to meet future drinking water demands is in question, then the water auditor can be justified in applying the Customer Retail Rate to the Real Loss volume, rather than applying the Variable Production Cost. The Free Water Audit Software applies the Variable Production costs to Real Losses by default. However, the auditor has the option on the Reporting Worksheet to select the Customer Retail Cost as the basis for the Real Loss cost evaluation if the auditor determines that this is warranted.
Volume from own sources Find	The volume of water withdrawn (abstracted) from water resources (rivers, lakes, streams, wells, etc) controlled by the water utility, and then treated for potable water distribution. Most water audits are compiled for utility retail water distribution systems, so this volume should reflect the amount of treated drinking water that entered the distribution system. Often the volume of water measured at the effluent of the treatment works is slightly less than the volume measured at the raw water source, since some of the water is used in the treatment process. Thus, it is useful if flows are metered at the effluent of the treatment works. If metering exists only at the raw water source, an adjustment for water used in the treatment process should be included to account for water consumed in treatment operations such as filter backwashing, basin flushing and cleaning, etc. If the audit is conducted for a wholesale water agency that sells untreated water, then this quantity reflects the measure of the raw water, typically metered at the source.

Item Name	Description
Volume from own sources: Master meter and supply error adjustment Find	An estimate or measure of the degree of inaccuracy that exists in the master (production) meters measuring the annual Volume from own Sources, and any error in the data trail that exists to collect, store and report the summary production data. This adjustment is a weighted average number that represents the collective error for all master meters for all days of the audit year and any errors identified in the data trail. Meter error can occur in different ways. A meter or meters may be inaccurate by under-registering flow (did not capture all the flow), or by over-registering flow (overstated the actual flow). Data error can occur due to data gaps caused by temporary outages of the meter or related instrumentation. All water utilities encounter some degree of inaccuracy in master meters and data errors in archival systems are common; thus a value of zero should not be entered. Enter a negative percentage or value for metered data under-registration; or, enter a positive percentage or value for metered data over-registration.
Water exported Find	The Water Exported volume is the bulk water conveyed and sold by the water utility to neighboring water systems that exists outside of their service area. Typically this water is metered at the custody transfer point of interconnection between the two water utilities. Usually the meter(s) are owned by the water utility that is selling the water: i.e. the exporter. If the water utility who is compiling the annual water audit sells bulk water in this manner, they are an exporter of water. Note: The Water Exported volume is sold to wholesale customers who are typically charged a wholesale rate that is different than retail rates charged to the retail customers existing within the service area. Many state regulatory agencies require that the Water Exported volume be reported to them as a quantity separate and distinct from the retail customer billed consumption. For these reasons - and others - the Water Exported volume is always quantified separately from Billed Authorized Consumption in the standard water audit. **Be certain not to "double-count" this quantity by including it in both the Water Exported box and the Billed Metered Consumption box of the water audit Reporting Worksheet. This volume should be included only in the Water Exported box.**
Water exported: Master meter and supply error adjustment Find	An estimate or measure of the volume in which the Water Exported volume is incorrect. This adjustment is a weighted average that represents the collective error for all of the metered and archived exported flow for all days of the audit year. Meter error can occur in different ways. A meter may be inaccurate by under-registering flow (did not capture all the flow), or by over-registering flow (overstated the actual flow). Error in the metered, archived data can also occur due to data gaps caused by temporary outages of the meter or related instrumentation. All water utilities encounter some degree of error in their metered data, particularly if meters are aged and infrequently tested. Occasional errors also occur in the archived data. Thus, a value of zero should not be entered. Enter a negative percentage or value for metered data under-registration; or enter a positive percentage or value for metered data over-registration. If regular meter accuracy testing is conducted on the meter(s) - which is usually conducted by the water utility selling the water - then the results of this testing can be used to help quantify the meter error adjustment. Corrections to data gaps or other errors found in the archived data should also be included as a portion of this meter error adjustment.
Water imported Find	The Water Imported volume is the bulk water purchased to become part of the Water Supplied volume. Typically this is water purchased from a neighboring water utility or regional water authority, and is metered at the custody transfer point of interconnection between the two water utilities. Usually the meter(s) are owned by the water supplier selling the water to the utility conducting the water audit. The water supplier selling the bulk water usually charges the receiving utility based upon a wholesale water rate.
Water imported: Master meter and supply error adjustment Find	An estimate or measure of the volume in which the Water Imported volume is incorrect. This adjustment is a weighted average that represents the collective error for all of the metered and archived imported flow for all days of the audit year. Meter error can occur in different ways. A meter may be inaccurate by under-registering flow (did not capture all the flow), or by over-registering flow (overstated the actual flow). Error in the metered, archived data can also occur due to data gaps caused by temporary outages of the meter or related instrumentation. All water utilities encounter some level of meter inaccuracy, particularly if meters are aged and infrequently tested. Occasional errors also occur in the archived metered data. Thus, a value of zero should not be entered. Enter a negative percentage or value for metered data under-registration; or, enter a positive percentage or value for metered data over-registration. If regular meter accuracy testing is conducted on the meter(s) - which is usually conducted by the water utility selling the water - then the results of this testing can be used to help quantify the meter error adjustment.
WATER LOSSES Find	= apparent losses + real losses Water Losses are the difference between Water Supplied and Authorized Consumption. Water losses can be considered as a total volume for the whole system, or for partial systems such as transmission systems, pressure zones or district metered areas (DMA); if one of these configurations are the basis of the water audit.

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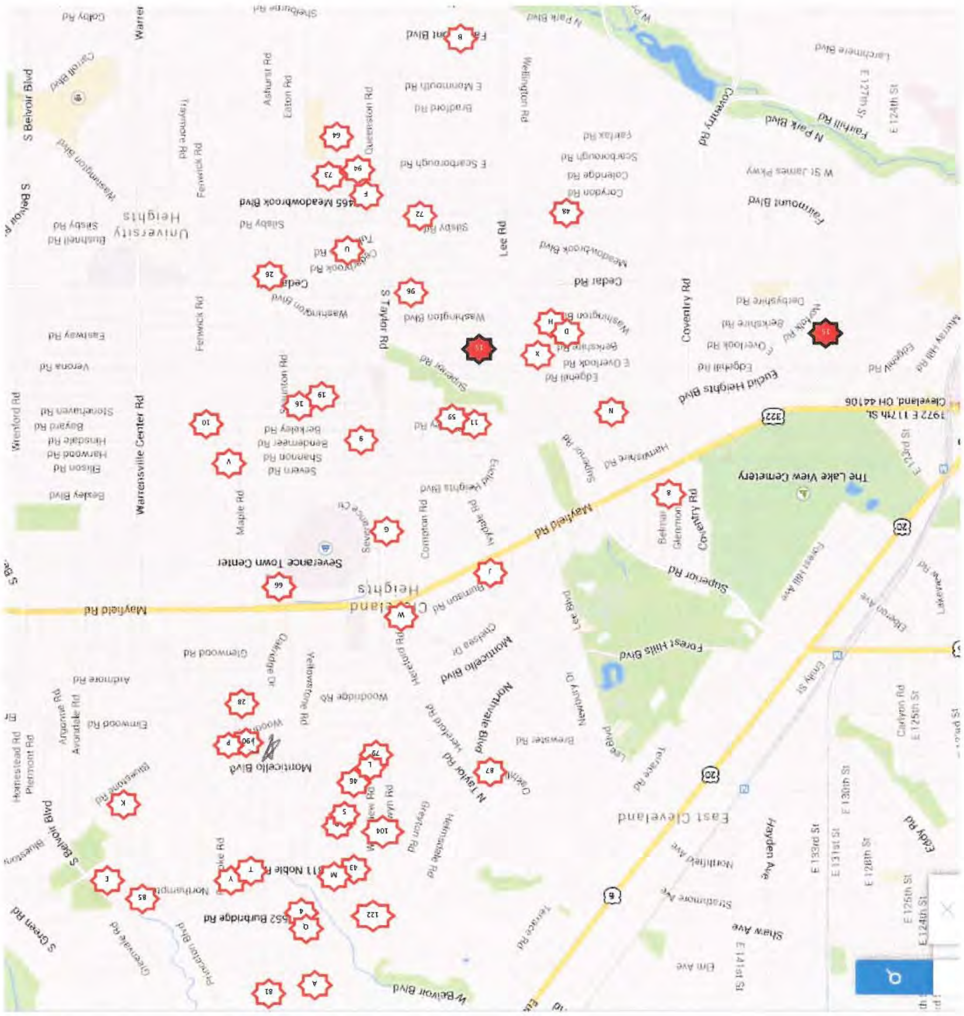

ID	House No.	Street
79	3479	MONTICELLO
43	888	ELBON
4	3637	ATHERSTONE
8	1670	BELMAR
9	3504	BENDEMEER
15	3251	BERKSHIRE
81	3718	MT LAUREL
96	2123	ROSSMOOR
64	2453	KINGSTON
72	3365	MEADOWBROOK
66	3711	LONGWOOD COURT
26	13698	CEDAR
28	1258	CLEVELAND HTS
73	3555	MEADOWBROOK
122	780	WOODVIEW
104	967	SELWYN
19	3586	BLANCHE
46	1080	ELBON
48	3051	ESSEX
59	3315	HYDE PARK
85	3967	NORTHAMPTON
87	16268	OAKHILL
90	1163	OXFORD
A	3605	FENLEY
11	3266	BERKELEY
10	3834	BERKELEY
16	3631	BLANCHE
94	2382	RINARD
B	2654	EXETER
C	1156	OXFORD
D	3061	YORKSHIRE
E	865	QUARRY
F	3465	MEADOWBROOK
G	1594	S. TAYLOR
H	3090	YORKSHIRE
J	3202	RUMSON
K	1034	RENFIELD
L	1112	WOODVIEW
M	2311	NOBLE
N	2952	SOMERTON
P	1158	CLEVELAND HTS BLVD
Q	3652	BURBRIDGE
R	1000	PEMBROOK
S	999	ELBON
T	3744	LOWELL
U	2207	JACKSON
V	3794	SEVERN
W	3410	RUMSON
X	3118	EAST OVERLOOK
Y	3779	LOWELL

ID	Address	Street
1	10	SEVERANCE CIRCLE
2	2300	OVERLOOK
3	30	SEVERANCE CIRCLE
4	3739	MAYFIELD
5	13263	CEDAR
6	2375	EUCLID HTS
7	3301	NORTH PARK
8	3460	MAYFIELD
9	3628	MAYFIELD
10	3882	MAYFIELD
11	2455	LEE
12	1940	LEE
13	500	SEVERANCE PLACE LANE
14	40	SEVERANCE CIRCLE
15	3321	EUCLID HTS
16	1400	CLEVELAND HTS (Lee Rd???)
17	3131	MAYFIELD
18	2355	MURRAY HILL
19	1500	WARRENSVILLE CTR
20	3027	MAYFIELD
21	5	SEVERANCE CIRCLE
22	1893	COVENTRY
23	12506	CEDAR
24	1895	COVENTRY
25	12504	CEDAR
26	2731	LANCASHIRE
27	2729	LANCASHIRE
28	1655	S TAYLOR
29	1855	CHESTNUT HILLS
30	2531	N TAYLOR
31	2212	NOBLE
32	2955	MAYFIELD
33	2047	S TAYLOR
34	1659	S TAYLOR
35	2733	LANCASHIRE
36	12381	CEDAR
37	1854	COVENTRY
38	1657	S TAYLOR

House No.	Street	Meter Size	Account#	Meter Seriel#	Found Meter #	Brand	Model	Type	Test Date	Low Flow	Low Acc.	Int Flow	Int Acc	Max flow	Max Acc	Weigted Average	Reading	Units	Commentts
3479	MONTICELLO	5/8	3070635	19921112	92883716	Badger	RCDL 25	Disp.	11/19/14	0.25	100.1	2	100.3	15	99.9	100.21%			No Register, Meter tested within AWWA accuracy limits.
888	ELBON	5/8	3080230	19921114	92882105	Badger	RCDL 25	Disp.	11/19/14	0.25	99.5	2	100.1	15	100.1	100.01%			No Register, Meter tested within AWWA accuracy limits.
3637	ATHERSTONE	5/8	3140535	19930105	92944281	Badger	RCDL 25	Disp.	11/19/14	0.25	99.5	2	100.1	15	100.2	100.03%			No Register, Meter tested within AWWA accuracy limits.
1670	BELMAR	5/8	2071190	19930202	42008118	Badger	RCDL 25	Disp.	11/19/14	0.25	99.6	2	100.1	15	100	100.01%			No Register, Meter tested within AWWA accuracy limits.
3504	BENDEMEER	5/8	1038840	19930427	93140954	Badger	RCDL 25	Disp.	11/19/14	0.25	99.8	2	100	15	100.2	100.00%			No Register, Meter tested within AWWA accuracy limits.
3251	BERKSHIRE	5/8	2190175	19930313	92882757	Badger	RCDL 25	Disp.	11/19/14	0.25	99.4	2	100.8	15	100.4	100.53%			No Register, Meter tested within AWWA accuracy limits.
3718	MT LAUREL	5/8	3151490	19921229	92881755	Badger	RCDL 25	Disp.	11/19/14	0.25	99.9	2	100.4	15	100.2	100.30%			No Register, Meter tested within AWWA accuracy limits.
2123	ROSSMOOR	5/8	2092735	19930728	93527361	Badger	RCDL 25	Disp.	11/19/14	0.25	99.6	2	100.3	15	100.2	100.18%			No Register, Meter tested within AWWA accuracy limits.
2453	KINGSTON	5/8	1090315	19930428	93253488	Badger	RCDL 25	Disp.	11/21/14	0.25	99.6	2	100.6	15	100.1	100.38%			No Register, Meter tested within AWWA accuracy limits.
3365	MEADOWBROOK	5/8	1143215	19930624	92941711	Badger	RCDL 25	Disp.	11/21/14	0.25	98.9	2	100.2	15	99.5	99.90%			No Register, Meter tested within AWWA accuracy limits.
3711	LONGWOOD COURT	5/8	2054759	20060607	17543366	Badger	RCDL 25	Disp.	11/21/14	0.25	99.9	2	100.1	15	100.1	100.07%			No Register, Meter tested within AWWA accuracy limits.
13698	CEDAR	5/8	1136330	19930605	92286747	Badger	RCDL 25	Disp.	11/21/14	0.25	100.2	2	100.1	15	99.8	100.07%			No Register, Meter tested within AWWA accuracy limits.
1258	CLEVELAND HTS	5/8	3021630	19921114	92883583	Badger	RCDL 25	Disp.	11/21/14	0.25	99.6	2	100.2	15	100.7	100.19%			No Register, Meter tested within AWWA accuracy limits.
3555	MEADOWBROOK	5/8	1144775	19930611	93457960	Badger	RCDL 25	Disp.	11/21/14	0.25	99.4	2	100	15	99.8	99.88%			No Register, Meter tested within AWWA accuracy limits.
780	WOODVIEW	5/8	3183070	19930914	93583867	Badger	RCDL 25	Disp.	11/21/14	0.25	100.1	2	100.1	15	100	100.09%			No Register, Meter tested within AWWA accuracy limits.
967	SELWYN	5/8	3210615	19930120	92942490	Badger	RCDL 25	Disp.	11/21/14	0.25	98.9	2	100.2	15	99.8	99.95%			No Register, Meter tested within AWWA accuracy limits.
3586	BLANCHE	5/8	2180895	19930311	93457701	Badger	RCDL 25	Disp.	11/19/14	0.25	99.4	2	100.2	15	100.1	100.07%			No Register, Meter tested within AWWA accuracy limits.
1080	ELBON	5/8	3181050	19921209	92881989	Badger	RCDL 25	Disp.	11/21/14	0.25	99.7	2	100.3	15	99.8	100.14%			No Register, Meter tested within AWWA accuracy limits.
3051	ESSEX	5/8	1161775	19930529	93265394	Badger	RCDL 25	Disp.	11/19/14	0.25	99.8	2	100.2	15	100	100.11%			No Register, Meter tested within AWWA accuracy limits.
3315	HYDE PARK	5/8	2163875	19930320	93139600	Badger	RCDL 25	Disp.	11/21/14	0.25	99.4	2	100.1	15	98.4	99.74%			No Register, Meter tested within AWWA accuracy limits.
3967	NORTHAMPTON	5/8	3102575	19921112	92883684	Badger	RCDL 25	Disp.	11/21/14	0.25	99.6	2	100.8	15	100.3	100.55%			No Register, Meter tested within AWWA accuracy limits.
16268	OAKHILL	5/8	3300170	19940623	93508395	Badger	RCDL 25	Disp.	11/21/14	0.25	98.4	2	100.2	15	99.6	99.84%			No Register, Meter tested within AWWA accuracy limits.
1163	OXFORD	5/8	3091395	19921119	92883415	Badger	RCDL 25	Disp.	11/19/14	0.25	100.1	2	100	15	9.8	86.49%			No Register, Meter tested within AWWA accuracy limits.
3605	FENLEY	5/8			92882011	Badger	RCDL 25	Disp.	11/19/14	0.25	99.4	2	100.2	15	100.3	100.10%			No Register, Meter tested within AWWA accuracy limits.
3266	BERKELEY	5/8	2190250	19930319	93139576	Badger	RCDL 25	Disp.	11/19/14	0.25	99.3	2	100.2	15	100	100.04%	100677	CF	Meter tested within AWWA accuracy limits.
3834	BERKELEY	5/8	2192830	19930513	93257740	Badger	RCDL 25	Disp.	11/19/14	0.25	99.4	2	100.1	15	100	99.98%			No Register, Meter tested within AWWA accuracy limits.
3631	BLANCHE	5/8	2181175	19930325	93140242	Badger	RCDL 25	Disp.	11/19/14	0.25	98.6	2	100.2	15	100.1	99.95%	90290	CF	Meter tested within AWWA accuracy limits.
2382	RINARD	5/8	1108030	19930903	93539089	Badger	RCDL 25	Disp.	11/21/14	0.25	96.4	2	100.3	15	100.1	99.69%	139207	CF	Meter tested within AWWA accuracy limits.
2654	EXETER	5/8	108255002	93253729	93253728	Badger	RCDL 25	Disp.	11/19/14	0.25	99.2	2	100.2	15	100.1	100.04%			No Register, Meter tested within AWWA accuracy limits.
1156	OXFORD	5/8			92883545	Badger	RCDL 25	Disp.	11/19/14	0.25	99.6	2	100.2	15	99.9	100.07%	139412	CF	Meter tested within AWWA accuracy limits.
3061	YORKSHIRE	5/8	211549500	92941421	92941421	Badger	RCDL 25	Disp.	11/19/14	0.25	97.4	2	99.8	15	100.4	99.53%			No Register, Meter tested within AWWA accuracy limits.
865	QUARRY	5/8	305521500	92883683	92883683	Badger	RCDL 25	Disp.	11/21/14	0.25	98.4	2	100.3	15	99.6	99.91%	200376	CF	Meter tested within AWWA accuracy limits.
3465	MEADOWBROOK	5/8			93265871	Badger	RCDL 25	Disp.	11/21/14	0.25	98.9	2	100.9	15	99.6	100.41%	118999	CF	Meter tested within AWWA accuracy limits.
1594	S. TAYLOR	5/8			34581800	Badger	RCDL 25	Disp.	11/19/14	0.25	99.8	2	100.1	15	99.6	99.98%	15357	CF	Meter tested within AWWA accuracy limits.
3090	YORKSHIRE	5/8			92942849	Badger	RCDL 25	Disp.	11/19/14	0.25	99.8	2	99.7	15	100.4	99.82%			No Register, Meter tested within AWWA accuracy limits.
3202	RUMSON	5/8	329213001		92942674	Badger	RCDL 25	Disp.	11/21/14	0.25	99.9	2	100.1	15	100.1	100.07%			No Register, Meter tested within AWWA accuracy limits.
1034	RENFIELD	5/8	306419001		93527289	Badger	RCDL 25	Disp.	11/21/14	0.25	99.6	2	100.4	15	99.8	100.19%			No Register, Meter tested within AWWA accuracy limits.
1112	WOODVIEW	5/8	318445001		92943783	Badger	RCDL 25	Disp.	11/21/14	0.25	99.8	2	100	15	100	99.97%	136521	CF	Meter tested within AWWA accuracy limits.
2311	NOBLE	5/8	327067501		92942100	Badger	RCDL 25	Disp.	11/21/14	0.25	97.4	2	100.1	15	99.9	99.67%	109747	CF	Meter tested within AWWA accuracy limits.
2952	SOMERTON	5/8	208321000		92943486	Badger	RCDL 25	Disp.	11/21/14	0.25	100.2	2	100.1	15	100	100.10%	141470	CF	Meter tested within AWWA accuracy limits.
1158	CLEVELAND HTS BLVD	5/8	302121000		92883104	Badger	RCDL 25	Disp.	11/21/14	0.25	100.3	2	100.2	15	99.8	100.16%	107361	CF	Meter tested within AWWA accuracy limits.
3652	BURBRIDGE	5/8	314109000		92882730	Badger	RCDL 25	Disp.	11/21/14	0.25	99.5	2	100.1	15	100.4	100.06%			No Register, Meter tested within AWWA accuracy limits.
1000	PEMBROOK	5/8	317035000		92881527	Badger	RCDL 25	Disp.	11/21/14	0.25	100.1	2	100.4	15	99.8	100.27%	60092	CF	Meter tested within AWWA accuracy limits.
999	ELBON	5/8	318065504		92942616	Badger	RCDL 25	Disp.	11/21/14	0.25	99.4	2	100.2	15	100.2	100.08%			No Register, Meter tested within AWWA accuracy limits.
3744	LOWELL	5/8	310015001		93265475	Badger	RCDL 25	Disp.	11/19/14	0.25	100.1	2	100.1	15	100.1	100.10%			No Register, Meter tested within AWWA accuracy limits.
2207	JACKSON	5/8	128429500		93517868	Badger	RCDL 25	Disp.	11/19/14	0.25	99.7	2	100.2	15	100.1	100.11%			No Register, Meter tested within AWWA accuracy limits.
3794	SEVERN	5/8	220209000		93140163	Badger	RCDL 25	Disp.	11/19/14	0.25	99.6	2	100.2	15	99.4	99.99%	104614	CF	Meter tested within AWWA accuracy limits.
3410	RUMSON	5/8	329261003		93053983	Badger	RCDL 25	Disp.	11/21/14	0.25	98.6	2	100.1	15	100.1	99.88%	65503	CF	Meter tested within AWWA accuracy limits.
3118	EAST OVERLOOK	5/8	126387002		93505290	Badger	RCDL 25	Disp.	11/21/14							0.00%	30497	CF	Broken freeze plate, unable to test
3779	LOWELL	5/8	310049501		92830959	Badger	RCDL 25	Disp.	11/19/14	0.25	100.1	2	100.2	15	99.8	100.13%			No Register, Meter tested within AWWA accuracy limits.
	SHOP	5/8		92881677	92881677	Badger	RCDL 25	Disp.	11/21/14	0.25	99.4	2	100.3	15	100	100.12%			No Register, Meter tested within AWWA accuracy limits.
	SHOP	5/8		92941188	92941188	Badger	RCDL 25	Disp.	11/21/14	0.25	99.6	2	100.1	15	99.5	99.94%			No Register, Meter tested within AWWA accuracy limits.
	SHOP	5/8		93883500	93883500	Badger	RCDL 25	Disp.	11/21/14	0.25	99.8	2	100.3	15	100	100.18%			No Register, Meter tested within AWWA accuracy limits.
	SHOP	5/8		96881679	96881679	Badger	RCDL 25	Disp.	11/21/14	0.25	98.6	2	100.1	15	99.1	99.73%			No Register, Meter tested within AWWA accuracy limits.
	SHOP	5/8		92944157	92944157	Badger	RCDL 25	Disp.	11/21/14	0.25	98.5	2	100.3	15	99.8	99.96%			No Register, Meter tested within AWWA accuracy limits.
	SHOP	5/8		93527272	93527272	Badger	RCDL 25	Disp.	11/21/14	0.25	100	2	100.3	15	100.2	100.24%			No Register, Meter tested within AWWA accuracy limits.
	SHOP	5/8		93053196	93053196	Badger	RCDL 25	Disp.	11/21/14	0.25	98.8	2	100.2	15	100.1	99.98%			No Register, Meter tested within AWWA accuracy limits.

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CLEVELAND HEIGHTS ANOMALY AND METER TEST RECOMMENDATIONS

8-inch Meters

*Check all 8-inch (non-fire) meters [low usage, are they sized correctly]?

Table 1: 8-inch (Non-fire) Meter

Acct#	Size	Jul-	Aug-	Sep-	Oct-	Nov-	Dec-	Jan-	Feb-	Mar-	Apr-	May-	Jun-	Jul-	Sparks
2020055	8		132	122	122	75	95	43	41	55	58	199	180	196	
2021015	8		0	0	0	0	0	0	0	0	0	0		0	
2054560	8		330	372	355	434	417	362	357	366	391	380	397	347	
2054637	8		10	19	8	9	8	10	9	7	8	10	9	10	
2058000	8		0	0	0	0	0	0	0	0	0	0	0	0	

ACCOUNT #	NO.	LOCATION	COMMENTS
2020055	2375	MURRAY HILL	[Master Credit meter?]
2021015	11981	CARLTON Road	[Master Credit meter?]
2054560	3500	MAYFIELD Road	Appears to be for the cemetery although does not reference a connection to this street address. Appears to be reasonable flow characteristics
2054637	3	SEVERANCE CIRCLE	Very low flow for an 8-inch meter. Expect this is not really an 8-inch meter if correctly assigned. Supplies one small office. Check location and size before testing
2058000	1673	S TAYLOR Road	[Master meter?]

6-inch Meters

Table 2: 6-inch Meters

Acct#	Size	Jul-	Aug-	Sep-	Oct-	Nov-	Dec-	Jan-	Feb-	Mar-	Apr-	May-	Jun-	Jul-	Sparks
2020015	6		120	200	300	400	400	400	400	1269	1456	378	154	129	
2053160	6		290	224	194	246	352	241	292	260	319	313	258	215	
2053755	6		846	721	995	621	922	980	967	751	678	455	381	372	
2054638	6		115	152	168	83	51	50	52	56	51	61	74	161	
2294060	6		405	423	320	309	281	311	300	275	286	229	279	258	
2294170	6		0	0	0	0	0	0	0	0	0	0	0	0	

ACCOUNT #	NO.	LOCATION	COMMENTS
2020015			The consumption from Sept 13 to Feb 14 is too rounded. Why is this? Also the highest usage is in the winter months. Check meter.
2054638	5	SEVERANCE CIRCLE	This appears to have a declining usage although this is mainly in the winter suggesting it is used for irrigation. The 20year flow to current flow is 10* This is a multi-

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			story office building. 51% Occupancy Aug 2014. 100K SF. No landscaping so appears odd to have summer increase. Check size etc.
2294170	1826	WARRENSVILLE CTR Road	This is in South Euclid and looks like it might supply the golf course. Just make sure it is not to be billed by CH.

4-inch Meters

Table 3: 4-inch Meters

Acct#	Size	.7	Jul-	Aug-	Sep-	Oct-	Nov-	Dec-	Jan-	Feb-	Mar-	Apr-	May-	Jun-	Jul-	Sparks
1052715	4			92	305	278	225	92	85	72	83	98	78	142	151	
1133275	4			121	113	1	0	0	0	0	0	0	0	0	65	
1133395	4			254	205	406	517	510	380	775	590	520	331	435	287	
2010215	4			687	673	882	468	271	205	195	197	211	239	306	502	
2025030	4			798	963	860	846	819	680	891	988	897	825	772	644	
2055115	4			709	553	266	0	0	0	0	0	0	0	0	0	
2121590	4			46	7	35	45	66	31	104	46	38	35	36	6	
2130290	4			27	25	19	20	17	16	20	20	24	26	19	26	
2250550	4			129	141	5	0	0	0	0	0	0	0	144	187	
2284355	4			8	6	6	9	19	16	15	16	19	17	13	6	
3012375	4			83	78	72	97	74	89	78	80	82	103	66	94	
3012385	4			742	777	718	795	760	766	790	747	793	749	745	674	

ACCOUNT #	NO.	LOCATION	COMMENTS
1133275	13221	CEDAR Road	Sudden drop off in usage for this meter. Very close to the school playing fields. Lots of work being done in this area, but should the meter be off?
2055115	3739	MAYFIELD Road	This is an apartment complex. It appears as though the large usage stopped in Nov 2013.
2130290	2490	LEE Blvd (? Could be Lee Road)	Low usage (10% of average). Is this inaccurate, incorrectly multiplied or undersized? This is Rockefeller Pointe an Office building. Approx. 60000SF of 100K was not rented in Jan 2013, may have no tenants
2250550	1740	CUMBERLAND Road	This is the pool. The usage stops each winter. Just check that it is working correctly next spring.
2284355	1541	WILMAR	This meter has very low usage (but still usage) for a 4-inch meter. Check accuracy and fixed zeros. This may be for the golf course (Oakwood Country Club) as it is near the front entrance. This facility was just up for sale... and recently purchased. There is new development about to take place so it is possible that this meter is no longer needed at the current size.

3-inch Meters

Table 4: 3-inch Meters

Acct#	Size	Jul-	Aug-	Sep-	Oct-	Nov-	Dec-	Jan-	Feb-	Mar-	Apr-	May-	Jun-	Jul-
1037042	3		3	5	8	10	10	7	7	6	8	14	9	10
1154410	3		6	21	30	30	30	18	17	77	24	18	26	10
2014435	3		45	61	101	109	150	59	151	94	91	107	68	112
2054640	3			79	69	76	56	58	66	60	66	68	70	110
2054680	3		109	109	107	117	112	108	114	102	108	93	77	78
2054715	3		25	43	39	33	28	23	24	27	33	29	30	22
2056560	3		0	0	0		75	97	90	80	86	79	82	75
2057998	3		125	124	121	129	118	121	123	117	131	119	124	115
2058034	3		305	386	438	153	51	51	44	36	39	59	130	145
2058046	3		101	92	64	68	84	60	51	43	52	71	77	78
2094495	3		115	56	0	0	0	0	0	0	0	0	12	68
2094655	3		18	11	0	0	0	0	0	0	0	0	0	0
2130210	3		32	33	23	13	6	1	3	2	1	2	0	0
2130255	3		114	127	104	129	111	124	131	103	119	120	126	129
2132540	3		202	124	141	117	91	93	100	82	86	81	90	120
2270900	3		0	0	0	0	0	0	0	0	0	0	0	0
2291160	3		40	39	35	34	37	34	40	30	36	35	38	37
3012377	3		41	34	35	30	32	34	30	26	32	34	28	33
3022380	3		105	122	127	95	108	80	89	78	88	80	91	124
3055995	3		0	0	0	0	0	0	0	0	0	0	0	0

ACCOUNT #	NO.	LOCATION	COMMENTS
1037042	3244	FAIRMOUNT Boulevard	Low flow for 3-inch meter. Check where this is supplying.
1154410	2178	STILLMAN	Communion of Saints School is at 2160 Stillman. This appears to be relatively low flow, possible, but low.
2094495	14539	SUPERIOR	Appears to be some kind of covered warehouse. Check that it should only show usage in the summer
2094655	14575	SUPERIOR	Possibly Cain Park. Is it just an irrigation meter
3055995	1015	QUARRY	Denison park including Soccer fields. Unlikely to be zero use... May not be billable, but check meter is working.
2270900	1700	CREST Road	Millikin Early Childhood Center. Reasonably sized facility with 120 students, appears to be operational. Should be some flow

19 meters are recommended for initial site visit and possible testing.

M.E. SIMPSON COMPANY, INC. - Technical Services

COMPOUND / TURBINE / DISP. METER TEST REPORT

Client : ESG - Cleveland Heights, OH
Premises:
Account name : Kaiser Hospital
Account no. : 3012375
Building Name: Kaiser Hospital
Meter no.:
Address: 10 SEVERANCE CIRCLE
Reg ID :
Meter location : dual meter pit, south side of bldg. in grass
AMR ID: 83511304
Meter size : 4 Brand: Badger - RCRDLL II Type: Turbine S/N: 43021066
Test port: Yes Bypass: Yes Inlet valve : Yes Outlet valve: Yes Data ID: 1

READINGS

Confined Space: Yes O2 Level: 20.9 Gas Present: None Ok to Enter: Yes Supervisor: Matt S. Brown

Meter Reading Upon Arrival	T/H: 003566[00]	L:	FM:	Units: Cubic Feet	
Meter Reading After Post Test	T/H:	L:	FM:	Units:	
Remote Reading Upon Arrival	T/H:	L:	FM:	Units:	

TEST AND REPAIR DATA

Tested: 11/10/14 10:00 AM By: Matt B. & Eric M. Repaired: By:
Upon Arrival - Meter Sealed ☐ Bypass Sealed ☐ Upon Departure - Meter Sealed ☑ Bypass Sealed ☑

TESTS	Test Results			Post Test Results		
Compound	Flow Rate GPM	Allowable Test Accuracy	Actual Test Accuracy	Flow Rate GPM	Allowable Post Test Accuracy	Actual Post Test Accuracy
Minimum		97 - 103			95 - 103	
Below C.O.						
Change Over		90 - 103			90 - 103	
Above C.O.						
Intermediate		97 - 103			97 - 103	
Maximum		97 - 103			97 - 103	

Turb./Disp.	Flow Rate GPM	Allowable Test Accuracy	Actual Test Accuracy	Flow Rate GPM	Allowable Post Test Accuracy	Actual Post Test Accuracy
Start	6		75			
Minimum	15	98.5 - 101.5	99		98.5 - 101.5	
Intermediate	100	98.5 - 101.5	99.5		98.5 - 101.5	
Maximum	310	98.5 - 101.5	101.5		98.5 - 101.5	

TEST AND REPAIR COMMENTS

The meter tested within accuracy limits derived from AWWA M6. We recommed a 4" compound meter be installed in th meter setting.

M.E. SIMPSON COMPANY, INC. - Technical Services

COMPOUND / TURBINE / DISP. METER TEST REPORT

Client : ESG - Cleveland Heights, OH Premises:

Account name : Waldorf Towers Apartments Account no. : 2025030

Building Name: Waldorf Towers Apartments Meter no.:

Address: 2300 OVERLOOK Reg ID :

Meter location : BV/255' N 2ND HYD S EDGEHILL - Vault front of building by sign AMR ID: 84012744

Meter size : 4 Brand: Badger - RCRDLL II Type: Turbine S/N: 43466885

Test port: Yes Bypass: Yes Inlet valve : Yes Outlet valve: Yes Data ID: 2

READINGS

Confined Space: Yes O2 Level: 20.9 Gas Present: None Ok to Enter: Yes Supervisor: Matt S. Brown

Meter Reading Upon Arrival T/H: 026281[00] L: FM: Units: Cubic Feet

Meter Reading After Post Test T/H: L: FM: Units:

Remote Reading Upon Arrival T/H: L: FM: Units:

TEST AND REPAIR DATA

Tested: 11/11/14 11:45 AM By: Matt B. & Eric M. Repaired: By:

Upon Arrival - Meter Sealed ☐ Bypass Sealed ☐ Upon Departure - Meter Sealed ☑ Bypass Sealed ☑

TESTS	Test Results			Post Test Results		
Compound	Flow Rate GPM	Allowable Test Accuracy	Actual Test Accuracy	Flow Rate GPM	Allowable Post Test Accuracy	Actual Post Test Accuracy
Minimum		97 - 103			95 - 103	
Below C.O.						
Change Over		90 - 103			90 - 103	
Above C.O.						
Intermediate		97 - 103			97 - 103	
Maximum		97 - 103			97 - 103	

Turb./Disp.	Flow Rate GPM	Allowable Test Accuracy	Actual Test Accuracy	Flow Rate GPM	Allowable Post Test Accuracy	Actual Post Test Accuracy
Start	8		80			
Minimum	15	98.5 - 101.5	99.8		98.5 - 101.5	
Intermediate	100	98.5 - 101.5	101.2		98.5 - 101.5	
Maximum	300	98.5 - 101.5	101.4		98.5 - 101.5	

TEST AND REPAIR COMMENTS

The meter tested within accuracy limits derived from AWWA M6. There needs to be a 4" compound meter installed in th setting.

M.E. SIMPSON COMPANY, INC. - Technical Services

COMPOUND / TURBINE / DISP. METER TEST REPORT

Client : ESG - Cleveland Heights, OH — Premises:

Account name : Kensington Apartments — Account no. : 3012385

Building Name: Kensington Apartments — Meter no.:

Address: 30 SEVERANCE CIRCLE — Reg ID :

Meter location : 79' S 5TH HYD S MAYFIELD - Off Taylor Street — AMR ID: 83511346

Meter size : 4 — Brand: Badger - RCRDLL II — Type: Turbine — S/N: 43021067

Test port: Yes — Bypass: Yes — Inlet valve : Yes — Outlet valve: Yes — Data ID: 3

READINGS

Confined Space: Yes — O2 Level: 20.1 — Gas Present: None — Ok to Enter: Yes — Supervisor: Matt S. Brown

Meter Reading Upon Arrival — T/H: 025501(00) — L: — FM: — Units: Cubic Feet

Meter Reading After Post Test — T/H: 025603[00] — L: — FM: — Units: Cubic Feet

Remote Reading Upon Arrival — T/H: — L: — FM: — Units:

TEST AND REPAIR DATA

Tested: 11/10/14 12:00 PM — By: Matt B. & Eric M. — Repaired: 11/10/14 1:30 PM — By: Matt B. & Eric M.

Upon Arrival - Meter Sealed ☐ — Bypass Sealed ☑ — Upon Departure - Meter Sealed ☑ — Bypass Sealed ☑

TESTS	Test Results			Post Test Results		
Compound	Flow Rate GPM	Allowable Test Accuracy	Actual Test Accuracy	Flow Rate GPM	Allowable Post Test Accuracy	Actual Post Test Accuracy
Minimum		97 - 103			95 - 103	
Below C.O.						
Change Over		90 - 103			90 - 103	
Above C.O.						
Intermediate		97 - 103			97 - 103	
Maximum		97 - 103			97 - 103	

Turb./Disp.	Flow Rate GPM	Allowable Test Accuracy	Actual Test Accuracy	Flow Rate GPM	Allowable Post Test Accuracy	Actual Post Test Accuracy
Start	x		x	8		75
Minimum	15	98.5 - 101.5	98	15	98.5 - 101.5	99
Intermediate	100	98.5 - 101.5	99	100	98.5 - 101.5	101
Maximum	325	98.5 - 101.5	0	350	98.5 - 101.5	101.5

TEST AND REPAIR COMMENTS

The meter failed to test within accuracy limits derived from AWWA M6. We recommend a 4" compound meter be install in this meter setting. While testing the high flow test debris got stuck in the rotor of the turbine. We opened the meter u and cleaned out the debris and restested. The meter retested within accuracy limits derived from AWWA M6.

M.E. SIMPSON COMPANY, INC. - Technical Services

COMPOUND / TURBINE / DISP. METER TEST REPORT

Client : ESG - Cleveland Heights, OH Premises:

Account name : Heights Garden Apartments Account no. : 2055115

Building Name: Heights Garden Apartments Meter no.:

Address: 3739 MAYFIELD Reg ID :

Meter location : BV--43' W 1ST HYD E CLEVE HTS - Vault on Mayfield by bus stop AMR ID: 84013136

Meter size : 4 Brand: Badger - RCRDLL II Type: Turbine S/N: 43466837

Test port: Yes Bypass: Yes Inlet valve : Yes Outlet valve: Yes Data ID: 4

READINGS

Confined Space: Yes O2 Level: 20.9 Gas Present: None Ok to Enter: Yes Supervisor: Matt S. Brown

Meter Reading Upon Arrival T/H: 013387[00] L: FM: Units: Cubic Feet

Meter Reading After Post Test T/H: 013388[00] L: FM: Units: Cubic Feet

Remote Reading Upon Arrival T/H: L: FM: Units:

TEST AND REPAIR DATA

Tested: 11/12/14 9:45 AM By: Matt B. & Eric M. Repaired: 11/12/14 11:00 AM By: Matt B. & Eric M.

Upon Arrival - Meter Sealed ☐ Bypass Sealed ☐ Upon Departure - Meter Sealed ☐ Bypass Sealed ☐

TESTS	Test Results			Post Test Results		
Compound	Flow Rate GPM	Allowable Test Accuracy	Actual Test Accuracy	Flow Rate GPM	Allowable Post Test Accuracy	Actual Post Test Accuracy
Minimum		97 - 103			95 - 103	
Below C.O.						
Change Over		90 - 103			90 - 103	
Above C.O.						
Intermediate		97 - 103			97 - 103	
Maximum		97 - 103			97 - 103	

Turb./Disp.	Flow Rate GPM	Allowable Test Accuracy	Actual Test Accuracy	Flow Rate GPM	Allowable Post Test Accuracy	Actual Post Test Accuracy
Start	6		0	6		25
Minimum	15	98.5 - 101.5	0	15	98.5 - 101.5	100.5
Intermediate	100	98.5 - 101.5	0	100	98.5 - 101.5	103
Maximum	200	98.5 - 101.5	0	200	98.5 - 101.5	108

TEST AND REPAIR COMMENTS

The meter failed to test within accuracy limits derived from AWWA M6. We opened the meter up and cleaned debris fro measuring element (turbine). The meter then was over registering on the high flow tests. The outlet valve needs replace because it leaks through at .8 gpm. We recommned a 4" compound meter be installed in this meter setting. There is nc ay to seal the bypass valve because the handle is broken.

M.E. SIMPSON COMPANY, INC. - Technical Services

COMPOUND / TURBINE / DISP. METER TEST REPORT

Client : ESG - Cleveland Heights, OH — Premises:

Account name : Cleveland Heights High School — Account no. : 1133395

Building Name: Cleveland Heights High School — Meter no.:

Address: 13263 CEDAR — Reg ID :

Meter location : Basement boiler room — AMR ID:

Meter size : 4 — Brand: Badger - RCRDLL II — Type: Turbine — S/N: 36309263

Test port: No — Bypass: Yes — Inlet valve : Yes — Outlet valve: Yes — Data ID: 5

READINGS

Confined Space: No — O2 Level: — Gas Present: — Ok to Enter: Yes — Supervisor: Matt S. Brown

Meter Reading Upon Arrival — T/H: 002382[00] — L: — FM: — Units: Cubic Feet

Meter Reading After Post Test — T/H: — L: — FM: — Units:

Remote Reading Upon Arrival — T/H: — L: — FM: — Units:

TEST AND REPAIR DATA

Tested: 11/11/14 2:45 PM — By: Matt B. & Eric M. — Repaired: — By:

Upon Arrival - Meter Sealed ☐ — Bypass Sealed ☐ — Upon Departure - Meter Sealed ☑ — Bypass Sealed ☐

TESTS	Test Results			Post Test Results		
Compound	Flow Rate GPM	Allowable Test Accuracy	Actual Test Accuracy	Flow Rate GPM	Allowable Post Test Accuracy	Actual Post Test Accuracy
Minimum		97 - 103			95 - 103	
Below C.O.						
Change Over		90 - 103			90 - 103	
Above C.O.						
Intermediate		97 - 103			97 - 103	
Maximum		97 - 103			97 - 103	

Turb./Disp.	Flow Rate GPM	Allowable Test Accuracy	Actual Test Accuracy	Flow Rate GPM	Allowable Post Test Accuracy	Actual Post Test Accuracy
Start						
Minimum		98.5 - 101.5			98.5 - 101.5	
Intermediate		98.5 - 101.5			98.5 - 101.5	
Maximum		98.5 - 101.5			98.5 - 101.5	

TEST AND REPAIR COMMENTS

There is no way to seal the bypass valve. There is no test port in this meter setting. There is no place to insall a test poi after the meter and before the outlet valve. The meter is piped valve to valve. We recommend a 4" compound meter be installed in this meter setting. During the 20 minutes we were there the meter only registered 2 cubic feet.

M.E. SIMPSON COMPANY, INC. - Technical Services

COMPOUND / TURBINE / DISP. METER TEST REPORT

Client : ESG - Cleveland Heights, OH — Premises:

Account name : Margaret Wagner Apartments — Account no. : 2010215

Building Name: Margaret Wagner Apartments — Meter no.:

Address: 2375 EUCLID HTS — Reg ID :

Meter location : 9'E 2ND HYD W LENNOX — AMR ID: 84720872

Meter size : 4 — Brand: Badger - RCRDLL II — Type: Turbine — S/N: 43883229

Test port: Yes — Bypass: Yes — Inlet valve : Yes — Outlet valve: Yes — Data ID: 6

READINGS

Confined Space: Yes — O2 Level: 20.9 — Gas Present: None — Ok to Enter: Yes — Supervisor: Matt S. Brown

Meter Reading Upon Arrival — T/H: 009332[00] — L: — FM: — Units: Cubic Feet

Meter Reading After Post Test — T/H: — L: — FM: — Units:

Remote Reading Upon Arrival — T/H: — L: — FM: — Units:

TEST AND REPAIR DATA

Tested: 11/11/14 2:00 PM — By: Matt B. & Eric M. — Repaired: — By:

Upon Arrival - Meter Sealed ☐ — Bypass Sealed ☐ — Upon Departure - Meter Sealed ☑ — Bypass Sealed ☑

TESTS	Test Results			Post Test Results		
Compound	Flow Rate GPM	Allowable Test Accuracy	Actual Test Accuracy	Flow Rate GPM	Allowable Post Test Accuracy	Actual Post Test Accuracy
Minimum		97 - 103			95 - 103	
Below C.O.						
Change Over		90 - 103			90 - 103	
Above C.O.						
Intermediate		97 - 103			97 - 103	
Maximum		97 - 103			97 - 103	

Turb./Disp.	Flow Rate GPM	Allowable Test Accuracy	Actual Test Accuracy	Flow Rate GPM	Allowable Post Test Accuracy	Actual Post Test Accuracy
Start	8		80			
Minimum	15	98.5 - 101.5	101		98.5 - 101.5	
Intermediate	100	98.5 - 101.5	102.5		98.5 - 101.5	
Maximum	350	98.5 - 101.5	103		98.5 - 101.5	

TEST AND REPAIR COMMENTS

The meter failed to test within accuracy limits derived from AWWA M6. The plastic piping that was connected to the test port broke when we were removing the test port. The plastic pipe was connected to the test port fitting. The inlet and ou valves turn extremely hard. The meter is over registering on the high flow test. We recommend that the inlet valve, outl valve, and meter be replaced. We recommend a 4" compound meter be installed in this setting.

M.E. SIMPSON COMPANY, INC. - Technical Services

COMPOUND / TURBINE / DISP. METER TEST REPORT

Client : ESG - Cleveland Heights, OH — Premises:

Account name : Beaumont High School — Account no. : 1052715

Building Name: Beaumont High School — Meter no.:

Address: 3301 NORTH PARK — Reg ID :

Meter location : BV/150' E 4TH HYD E LEE — AMR ID: 3227

Meter size : 4 — Brand: Badger - RCRDLL II — Type: Turbine — S/N: 36270684

Test port: Yes — Bypass: Yes — Inlet valve : Yes — Outlet valve: Yes — Data ID: 7

READINGS

Confined Space: Yes — O2 Level: 20.9 — Gas Present: None — Ok to Enter: Yes — Supervisor: Matt S. Brown

Meter Reading Upon Arrival — T/H: 009254[00] — L: — FM: — Units: Cubic Feet

Meter Reading After Post Test — T/H: — L: — FM: — Units:

Remote Reading Upon Arrival — T/H: — L: — FM: — Units:

TEST AND REPAIR DATA

Tested: 11/11/14 7:00 AM — By: Matt B. & Eric M. — Repaired: — By:

Upon Arrival - Meter Sealed ☐ — Bypass Sealed ☐ — Upon Departure - Meter Sealed ☑ — Bypass Sealed ☑

TESTS	Test Results			Post Test Results		
Compound	Flow Rate GPM	Allowable Test Accuracy	Actual Test Accuracy	Flow Rate GPM	Allowable Post Test Accuracy	Actual Post Test Accuracy
Minimum		97 - 103			95 - 103	
Below C.O.						
Change Over		90 - 103			90 - 103	
Above C.O.						
Intermediate		97 - 103			97 - 103	
Maximum		97 - 103			97 - 103	

Turb./Disp.	Flow Rate GPM	Allowable Test Accuracy	Actual Test Accuracy	Flow Rate GPM	Allowable Post Test Accuracy	Actual Post Test Accuracy
Start	7		50			
Minimum	15	98.5 - 101.5	99.8		98.5 - 101.5	
Intermediate	100	98.5 - 101.5	101.3		98.5 - 101.5	
Maximum	160	98.5 - 101.5	100.4		98.5 - 101.5	

TEST AND REPAIR COMMENTS

The meter tested within accuracy limits derived from AWWA M6. We obtained a maximum flow of 160 gpm from the tes port. There needs to be a 4" compound meter installed in this meter setting.

M.E. SIMPSON COMPANY, INC. - Technical Services

COMPOUND / TURBINE / DISP. METER TEST REPORT

Client : ESG - Cleveland Heights, OH Premises:

Account name : Home Depot Account no. : 2058034

Building Name: Home Depot Meter no.:

Address: 3460 MAYFIELD Reg ID :

Meter location : In sprinkler room in back of building AMR ID: 3580996

Meter size : 3 Brand: Badger - RCRDLL II Type: Turbine S/N: None

Test port: No Bypass: No Inlet valve : Yes Outlet valve: Yes Data ID: 8

READINGS

Confined Space: No O2 Level: Gas Present: Ok to Enter: Yes Supervisor: Matt S. Brown

Meter Reading Upon Arrival T/H: 020849[00] L: FM: Units: Cubic Feet

Meter Reading After Post Test T/H: L: FM: Units:

Remote Reading Upon Arrival T/H: L: FM: Units:

TEST AND REPAIR DATA

Tested: 11/12/14 12:30 PM By: Matt B. & Eric M. Repaired: By:

Upon Arrival - Meter Sealed ☐ Bypass Sealed ☐ Upon Departure - Meter Sealed ☐ Bypass Sealed ☐

TESTS	Test Results			Post Test Results		
Compound	Flow Rate GPM	Allowable Test Accuracy	Actual Test Accuracy	Flow Rate GPM	Allowable Post Test Accuracy	Actual Post Test Accuracy
Minimum		97 - 103			95 - 103	
Below C.O.						
Change Over		90 - 103			90 - 103	
Above C.O.						
Intermediate		97 - 103			97 - 103	
Maximum		97 103			97 - 103	

Turb./Disp.	Flow Rate GPM	Allowable Test Accuracy	Actual Test Accuracy	Flow Rate GPM	Allowable Post Test Accuracy	Actual Post Test Accuracy
Start						
Minimum		98.5 - 101.5			98.5 - 101.5	
Intermediate		98.5 - 101.5			98.5 - 101.5	
Maximum		98.5 - 101.5			98.5 - 101.5	

TEST AND REPAIR COMMENTS

There is no serial number anywhere on this meter. This meter is untestable in current setting due to no test port. This meter is oversized and needs replaced with a 3" compound meter. We watched the dial on the register for 15 minutes a meter registered 7.5 gallons of water during that time. We even flushed all the toilets and sinks in the men's bathroom.

M.E. SIMPSON COMPANY, INC. - Technical Services

COMPOUND / TURBINE / DISP. METER TEST REPORT

Client : ESG - Cleveland Heights, OH — Premises:

Account name : Dave's Supermarket — Account no. : 2057998

Building Name: Dave's Supermarket — Meter no.:

Address: 3628 MAYFIELD — Reg ID :

Meter location : Upper level by mechanical room — AMR ID: 83503317

Meter size : 3 — Brand: Badger - T-Series — Type: Turbine — S/N: 16899017

Test port: No — Bypass: Yes — Inlet valve : Yes — Outlet valve: Yes — Data ID: 9

READINGS

Confined Space: No — O2 Level: — Gas Present: — Ok to Enter: Yes — Supervisor: Matt S. Brown

Meter Reading Upon Arrival — T/H: 030654[0] — L: — FM: — Units: Cubic Feet

Meter Reading After Post Test — T/H: — L: — FM: — Units:

Remote Reading Upon Arrival — T/H: — L: — FM: — Units:

TEST AND REPAIR DATA

Tested: 11/12/14 2:00 PM — By: Matt B. & Eric M. — Repaired: — By:

Upon Arrival - Meter Sealed ☐ — Bypass Sealed ☐ — Upon Departure - Meter Sealed ☑ — Bypass Sealed ☑

TESTS	Test Results			Post Test Results		
Compound	Flow Rate GPM	Allowable Test Accuracy	Actual Test Accuracy	Flow Rate GPM	Allowable Post Test Accuracy	Actual Post Test Accuracy
Minimum		97 - 103			95 - 103	
Below C.O.						
Change Over		90 - 103			90 - 103	
Above C.O.						
Intermediate		97 - 103			97 - 103	
Maximum		97 - 103			97 - 103	

Turb./Disp.	Flow Rate GPM	Allowable Test Accuracy	Actual Test Accuracy	Flow Rate GPM	Allowable Post Test Accuracy	Actual Post Test Accuracy
Start						
Minimum		98.5 - 101.5			98.5 - 101.5	
Intermediate		98.5 - 101.5			98.5 - 101.5	
Maximum		98.5 - 101.5			98.5 - 101.5	

TEST AND REPAIR COMMENTS

This meter is not testable due to no test port in setting. This meter was purchased without the test port pre-installed. Th is a flat spot on the meter where the test port should be. We recommend a 3" compound mater be installed in this settin The meter registered 35 gallons in 15 minutes while observing register dial.

M.E. SIMPSON COMPANY, INC. - Technical Services

COMPOUND / TURBINE / DISP. METER TEST REPORT

Client : ESG - Cleveland Heights, OH Premises:

Account name : Oakwood Gardens Account no. : 20-5656-0

Building Name: Oakwood Gardens Meter no.:

Address: 3882 MAYFIELD Reg ID :

Meter location : ON WILMAR--64' S OF MAYFIELD IN VAULT AMR ID: 86143009

Meter size : 3 Brand: Badger - T-Series Type: Turbine S/N: 46626988

Test port: Yes Bypass: Yes Inlet valve : Yes Outlet valve: Yes Data ID: 10

READINGS

Confined Space: Yes O2 Level: 20.8 Gas Present: None Ok to Enter: Yes Supervisor: Matt S. Brown

Meter Reading Upon Arrival T/H: 001284[0] L: FM: Units: Cubic Feet

Meter Reading After Post Test T/H: L: FM: Units:

Remote Reading Upon Arrival T/H: L: FM: Units:

TEST AND REPAIR DATA

Tested: 11/01/14 10:00 AM By: Matt B. & Eric M. Repaired: By:

Upon Arrival - Meter Sealed ☐ Bypass Sealed ☐ Upon Departure - Meter Sealed ☐ Bypass Sealed ☐

TESTS	Test Results			Post Test Results		
Compound	Flow Rate GPM	Allowable Test Accuracy	Actual Test Accuracy	Flow Rate GPM	Allowable Post Test Accuracy	Actual Post Test Accuracy
Minimum		97 - 103			95 - 103	
Below C.O.						
Change Over		90 - 103			90 - 103	
Above C.O.						
Intermediate		97 - 103			97 - 103	
Maximum		97 - 103			97 - 103	

Turb./Disp.	Flow Rate GPM	Allowable Test Accuracy	Actual Test Accuracy	Flow Rate GPM	Allowable Post Test Accuracy	Actual Post Test Accuracy
Start	4		90			
Minimum	8	98.5 - 101.5	99		98.5 - 101.5	
Intermediate	100	98.5 - 101.5	105		98.5 - 101.5	
Maximum	300	98.5 - 101.5	103.3		98.5 - 101.5	

TEST AND REPAIR COMMENTS

The meter failed to test within accuracy limits derived from AWWA M6. There is no way to seal the bypass valve, the ha is broken off. There needs to be a 3" compound meter installed in this setting. No way to seal the meter. The inlet and outlet vlaves have packing leaks while turning. This meter is registering high on the higher flow tests.

M.E. SIMPSON COMPANY, INC. - Technical Services

COMPOUND / TURBINE / DISP. METER TEST REPORT

Client : ESG - Cleveland Heights, OH — Premises:

Account name : Apartments 2455 Lee — Account no. : 2130255

Building Name: Apartments 2455 Lee — Meter no.:

Address: 2455 LEE — Reg ID :

Meter location : 109' N 2ND HYD N MAYFIELD - Vault south of entrance — AMR ID: 4061981

Meter size : 3 — Brand: Badger - RCRDLL II — Type: Turbine — S/N: None

Test port: Yes — Bypass: Yes — Inlet valve : Yes — Outlet valve: Yes — Data ID: 11

READINGS

Confined Space: Yes — O2 Level: 20.8 — Gas Present: None — Ok to Enter: Yes — Supervisor: Matt S. Brown

Meter Reading Upon Arrival — T/H: 009791[00] — L: — FM: — Units: Cubic Feet

Meter Reading After Post Test — T/H: — L: — FM: — Units:

Remote Reading Upon Arrival — T/H: — L: — FM: — Units:

TEST AND REPAIR DATA

Tested: 11/12/14 2:30 PM — By: Matt B. & Eric M. — Repaired: — By:

Upon Arrival - Meter Sealed ☐ — Bypass Sealed ☐ — Upon Departure - Meter Sealed ☐ — Bypass Sealed ☐

TESTS	Test Results			Post Test Results		
Compound	Flow Rate GPM	Allowable Test Accuracy	Actual Test Accuracy	Flow Rate GPM	Allowable Post Test Accuracy	Actual Post Test Accuracy
Minimum		97 - 103			95 - 103	
Below C.O.						
Change Over		90 - 103			90 - 103	
Above C.O.						
Intermediate		97 - 103			97 - 103	
Maximum		97 - 103			97 - 103	

Turb./Disp.	Flow Rate GPM	Allowable Test Accuracy	Actual Test Accuracy	Flow Rate GPM	Allowable Post Test Accuracy	Actual Post Test Accuracy
Start						
Minimum		98.5 - 101.5			98.5 - 101.5	
Intermediate		98.5 - 101.5			98.5 - 101.5	
Maximum		98.5 - 101.5			98.5 - 101.5	

TEST AND REPAIR COMMENTS

There is no serial number on this meter anywhere. This meter is untestable due to the valves not being operable. We c not move the bypass valve with a wrench and hammer. The inlet and outlet valves turn slightly but extremely hard with wrench and hammer. We recommend all valves and meter be replaced in this meter setting. We recommend a 3" compound meter.

M.E. SIMPSON COMPANY, INC. - Technical Services

COMPOUND / TURBINE / DISP. METER TEST REPORT

Client : ESG - Cleveland Heights, OH Premises:

Account name : Zagara's Market Account no. : 2132540

Building Name: Zagara's Market Meter no.:

Address: 1940 LEE Reg ID :

Meter location : Back of store by fire protection system AMR ID: 5885821

Meter size : 3 Brand: Badger - T-Series Type: Turbine S/N: 17845862

Test port: No Bypass: Yes Inlet valve : Yes Outlet valve: Yes Data ID: 12

READINGS

Confined Space: No O2 Level: Gas Present: Ok to Enter: Yes Supervisor: Matt S. Brown

Meter Reading Upon Arrival T/H: 020483[00] L: FM: Units: Cubic Feet

Meter Reading After Post Test T/H: L: FM: Units:

Remote Reading Upon Arrival T/H: L: FM: Units:

TEST AND REPAIR DATA

Tested: 11/11/14 3:30 PM By: Matt B. & Eric M. Repaired: By:

Upon Arrival - Meter Sealed ☐ Bypass Sealed ☐ Upon Departure - Meter Sealed ☑ Bypass Sealed ☑

TESTS	Test Results			Post Test Results		
Compound	Flow Rate GPM	Allowable Test Accuracy	Actual Test Accuracy	Flow Rate GPM	Allowable Post Test Accuracy	Actual Post Test Accuracy
Minimum		97 - 103			95 - 103	
Below C.O.						
Change Over		90 - 103			90 - 103	
Above C.O.						
Intermediate		97 - 103			97 - 103	
Maximum		97 - 103			97 - 103	

Turb./Disp.	Flow Rate GPM	Allowable Test Accuracy	Actual Test Accuracy	Flow Rate GPM	Allowable Post Test Accuracy	Actual Post Test Accuracy
Start						
Minimum		98.5 - 101.5			98.5 - 101.5	
Intermediate		98.5 - 101.5			98.5 - 101.5	
Maximum		98.5 - 101.5			98.5 - 101.5	

TEST AND REPAIR COMMENTS

There is no test port on this meter. The flat area where the test port should be is not there. This new style turbine meter was ordered without a test port. We watched the dial on the meter for 5 to 7 minutes, the dial never registered any water We recommend a 3" compound meter be installed in this setting.

M.E. SIMPSON COMPANY, INC. - Technical Services

COMPOUND / TURBINE / DISP. METER TEST REPORT

Client : ESG - Cleveland Heights, OH — Premises:

Account name : Severance Place Apartments — Account no. : 2054680

Building Name: Severance Place Apartments — Meter no.:

Address: 500 SEVERANCE PLACE LANE — Reg ID :

Meter location : Vault on Mayfield by bus stop — AMR ID: 83428679

Meter size : 3 — Brand: Badger - RCRDLL II — Type: Turbine — S/N: 41753019

Test port: Yes — Bypass: No — Inlet valve : Yes — Outlet valve: Yes — Data ID: 13

READINGS

Confined Space: Yes — O2 Level: 20.9 — Gas Present: None — Ok to Enter: Yes — Supervisor: Matt S. Brown

Meter Reading Upon Arrival — T/H: 004034[00] — L: — FM: — Units: Cubic Feet

Meter Reading After Post Test — T/H: — L: — FM: — Units:

Remote Reading Upon Arrival — T/H: — L: — FM: — Units:

TEST AND REPAIR DATA

Tested: 11/12/14 8:30 AM — By: Matt B. & Eric M. — Repaired: — By:

Upon Arrival - Meter Sealed ☐ — Bypass Sealed ☐ — Upon Departure - Meter Sealed ☐ — Bypass Sealed ☐

TESTS	Test Results			Post Test Results		
Compound	Flow Rate GPM	Allowable Test Accuracy	Actual Test Accuracy	Flow Rate GPM	Allowable Post Test Accuracy	Actual Post Test Accuracy
Minimum		97 - 103			95 - 103	
Below C.O.						
Change Over		90 - 103			90 - 103	
Above C.O.						
Intermediate		97 - 103			97 - 103	
Maximum		97 - 103			97 - 103	

Turb./Disp.	Flow Rate GPM	Allowable Test Accuracy	Actual Test Accuracy	Flow Rate GPM	Allowable Post Test Accuracy	Actual Post Test Accuracy
Start	x		x			
Minimum	8	98.5 - 101.5	102		98.5 - 101.5	
Intermediate	100	98.5 - 101.5	105		98.5 - 101.5	
Maximum	300	98.5 - 101.5	110		98.5 - 101.5	

TEST AND REPAIR COMMENTS

The meter failed to test within accuracy limits derived from AWWA M6. The valves in this setting do not shut down. We tested the meter and it was over registering and we believe this is due to the valves not shutting down completely. We recommend the inlet valve and the outlet valves be replaced along with a 3" compound meter installed in this setting.

M.E. SIMPSON COMPANY, INC. - Technical Services

COMPOUND / TURBINE / DISP. METER TEST REPORT

Client : ESG - Cleveland Heights, OH — Premises:

Account name : City Hall / Police Department — Account no. : 2054640

Building Name: City Hall / Police Department — Meter no.:

Address: 40 SEVERANCE CIRCLE — Reg ID :

Meter location : Vault in front by hydrant in grass — AMR ID: 83428183

Meter size : 3 — Brand: Badger - RCRDLL II — Type: Turbine — S/N: 41753017

Test port: Yes — Bypass: No — Inlet valve : Yes — Outlet valve: Yes — Data ID: 14

READINGS

Confined Space: Yes — O2 Level: 20.9 — Gas Present: None — Ok to Enter: Yes — Supervisor: Matt S. Brown

Meter Reading Upon Arrival — T/H: 001297[00] — L: — FM: — Units: Cubic Feet

Meter Reading After Post Test — T/H: — L: — FM: — Units:

Remote Reading Upon Arrival — T/H: — L: — FM: — Units:

TEST AND REPAIR DATA

Tested: 11/11/14 9:00 AM — By: Matt B. & Eric M. — Repaired: — By:

Upon Arrival - Meter Sealed ☐ — Bypass Sealed ☐ — Upon Departure - Meter Sealed ☑ — Bypass Sealed ☐

TESTS	Test Results			Post Test Results		
Compound	Flow Rate GPM	Allowable Test Accuracy	Actual Test Accuracy	Flow Rate GPM	Allowable Post Test Accuracy	Actual Post Test Accuracy
Minimum		97 - 103			95 - 103	
Below C.O.						
Change Over		90 - 103			90 - 103	
Above C.O.						
Intermediate		97 - 103			97 - 103	
Maximum		97 - 103			97 - 103	

Turb./Disp.	Flow Rate GPM	Allowable Test Accuracy	Actual Test Accuracy	Flow Rate GPM	Allowable Post Test Accuracy	Actual Post Test Accuracy
Start	4		80			
Minimum	8	98.5 - 101.5	100.1		98.5 - 101.5	
Intermediate	100	98.5 - 101.5	100.4		98.5 - 101.5	
Maximum	270	98.5 - 101.5	100.2		98.5 - 101.5	

TEST AND REPAIR COMMENTS

The meter tested within accuracy limits derived from AWWA M6. There needs to be a 3" compound meter in this setting We obtained a maximum flow of 270 gpm from the test port.

M.E. SIMPSON COMPANY, INC. - Technical Services

COMPOUND / TURBINE / DISP. METER TEST REPORT

Client : ESG - Cleveland Heights, OH — Premises:

Account name : 3321 Euclid Heights — Account no. : 2014435

Building Name: 3321 Euclid Heights — Meter no.:

Address: 3321 EUCLID HTS — Reg ID :

Meter location : BV 143'N OF HYD IN FRONT OF — AMR ID: 81416554

Meter size : 1.5" — Brand: Badger - 120 — Type: Displacement — S/N: 36260409

Test port: Yes — Bypass: Yes — Inlet valve : Yes — Outlet valve: Yes — Data ID: 15

READINGS

Confined Space: Yes — O2 Level: 20.8 — Gas Present: None — Ok to Enter: Yes — Supervisor: Matt S. Brown

Meter Reading Upon Arrival — T/H: 020232[0] — L: — FM: — Units: Cubic Feet

Meter Reading After Post Test — T/H: — L: — FM: — Units:

Remote Reading Upon Arrival — T/H: — L: — FM: — Units:

TEST AND REPAIR DATA

Tested: 11/13/14 10:00 AM — By: Matt B. & Eric M. — Repaired: — By:

Upon Arrival - Meter Sealed ☐ — Bypass Sealed ☐ — Upon Departure - Meter Sealed ☐ — Bypass Sealed ☐

TESTS	Test Results			Post Test Results		
Compound	Flow Rate GPM	Allowable Test Accuracy	Actual Test Accuracy	Flow Rate GPM	Allowable Post Test Accuracy	Actual Post Test Accuracy
Minimum		97 - 103			95 - 103	
Below C.O.						
Change Over		90 - 103			90 - 103	
Above C.O.						
Intermediate		97 - 103			97 - 103	
Maximum		97 - 103			97 - 103	

Turb./Disp.	Flow Rate GPM	Allowable Test Accuracy	Actual Test Accuracy	Flow Rate GPM	Allowable Post Test Accuracy	Actual Post Test Accuracy
Start	x		x			
Minimum	1.5	95 - 101	99.2		95 - 101	
Intermediate	8	98.5 - 101.5	99.4		98.5 - 101.5	
Maximum	50	98.5 - 101.5	100.1		98.5 - 101.5	

TEST AND REPAIR COMMENTS

The meter tested within accuracy limits derived from AWWA M6.

M.E. SIMPSON COMPANY, INC. - Technical Services

COMPOUND / TURBINE / DISP. METER TEST REPORT

Client : ESG - Cleveland Heights, OH — Premises:

Account name : Oaks Condo — Account no. : 3022380

Building Name: Oaks Condo — Meter no.:

Address: 1400 CLEVELAND HTS — Reg ID :

Meter location : Vault in front of 1418 — AMR ID: 3153306

Meter size : 3 — Brand: Badger - RCRDLL II — Type: Turbine — S/N: None

Test port: Yes — Bypass: Yes — Inlet valve : Yes — Outlet valve: Yes — Data ID: 16

READINGS

Confined Space: Yes — O2 Level: 20.5 — Gas Present: None — Ok to Enter: Yes — Supervisor: Matt S. Brown

Meter Reading Upon Arrival — T/H: 017334[00] — L: — FM: — Units: Cubic Feet

Meter Reading After Post Test — T/H: — L: — FM: — Units:

Remote Reading Upon Arrival — T/H: — L: — FM: — Units:

TEST AND REPAIR DATA

Tested: 11/13/14 11:00 AM — By: Matt B. & Eric M. — Repaired: — By:

Upon Arrival - Meter Sealed ☐ — Bypass Sealed ☐ — Upon Departure - Meter Sealed ☑ — Bypass Sealed ☑

TESTS	Test Results			Post Test Results		
Compound	Flow Rate GPM	Allowable Test Accuracy	Actual Test Accuracy	Flow Rate GPM	Allowable Post Test Accuracy	Actual Post Test Accuracy
Minimum		97 - 103			95 - 103	
Below C.O.						
Change Over		90 - 103			90 - 103	
Above C.O.						
Intermediate		97 - 103			97 - 103	
Maximum		97 - 103			97 - 103	

Turb./Disp.	Flow Rate GPM	Allowable Test Accuracy	Actual Test Accuracy	Flow Rate GPM	Allowable Post Test Accuracy	Actual Post Test Accuracy
Start	4		50			
Minimum	8	98.5 - 101.5	99.1		98.5 - 101.5	
Intermediate	100	98.5 - 101.5	99.3		98.5 - 101.5	
Maximum	200	98.5 - 101.5	101.2		98.5 - 101.5	

TEST AND REPAIR COMMENTS

The meter tested within accuracy limits derived from AWWA M6. We only obtained 200 gpm from the test port. We recommend that a 3" compound meter be installed in this setting. There is no serial number anywhere on this meter.

M.E. SIMPSON COMPANY, INC. - Technical Services

COMPOUND / TURBINE / DISP. METER TEST REPORT

Client : ESG - Cleveland Heights, OH — Premises:

Account name : Nursing Center — Account no. : 2053755

Building Name: Nursing Center — Meter no.:

Address: 3131 MAYFIELD — Reg ID :

Meter location : Vault at entrance — AMR ID: 84012745

Meter size : 6 — Brand: Badger - RCRDLL II — Type: Turbine — S/N: 43466884

Test port: Yes — Bypass: Yes — Inlet valve : Yes — Outlet valve: Yes — Data ID: 17

READINGS

Confined Space: Yes — O2 Level: 20.9 — Gas Present: None — Ok to Enter: Yes — Supervisor: Matt S. Brown

Meter Reading Upon Arrival — T/H: 024014[00] — L: — FM: — Units: Cubic Feet

Meter Reading After Post Test — T/H: — L: — FM: — Units:

Remote Reading Upon Arrival — T/H: — L: — FM: — Units:

TEST AND REPAIR DATA

Tested: 11/14/14 11:00 AM — By: Matt B. & Eric M. — Repaired: — By:

Upon Arrival - Meter Sealed ☐ — Bypass Sealed ☑ — Upon Departure - Meter Sealed ☐ — Bypass Sealed ☑

TESTS	Test Results			Post Test Results		
Compound	Flow Rate GPM	Allowable Test Accuracy	Actual Test Accuracy	Flow Rate GPM	Allowable Post Test Accuracy	Actual Post Test Accuracy
Minimum		97 - 103			95 - 103	
Below C.O.						
Change Over		90 - 103			90 - 103	
Above C.O.						
Intermediate		97 - 103			97 - 103	
Maximum		97 - 103			97 - 103	

Turb./Disp.	Flow Rate GPM	Allowable Test Accuracy	Actual Test Accuracy	Flow Rate GPM	Allowable Post Test Accuracy	Actual Post Test Accuracy
Start	18		85			
Minimum	30	98.5 - 101.5	98		98.5 - 101.5	
Intermediate	125	98.5 - 101.5	95		98.5 - 101.5	
Maximum	300	98.5 - 101.5	95		98.5 - 101.5	

TEST AND REPAIR COMMENTS

The meter failed to test within accuracy limits derived from AWWA M6. We recommend a 6" compound meter be install in this setting.

M.E. SIMPSON COMPANY, INC. - Technical Services

COMPOUND / TURBINE / DISP. METER TEST REPORT

Client : ESG - Cleveland Heights, OH — Premises:

Account name : Warrensville Community Apartments — Account no. : 2294060

Building Name: Warrensville Community Apartments — Meter no.:

Address: 1500 WARRENSVILLE CTR — Reg ID :

Meter location : BV/198' S 2ND HYD S MAYFIELD — AMR ID: 84012747

Meter size : 6 — Brand: Badger - RCRDLL II — Type: Turbine — S/N: 43466883

Test port: Yes — Bypass: Yes — Inlet valve : Yes — Outlet valve: Yes — Data ID: 19

READINGS

Confined Space: Yes — O2 Level: 20.8 — Gas Present: None — Ok to Enter: Yes — Supervisor: Matt S. Brown

Meter Reading Upon Arrival — T/H: 007351[00] — L: — FM: — Units: Cubic Feet

Meter Reading After Post Test — T/H: — L: — FM: — Units:

Remote Reading Upon Arrival — T/H: — L: — FM: — Units:

TEST AND REPAIR DATA

Tested: 11/13/14 1:00 PM — By: Matt B. & Eric M. — Repaired: — By:

Upon Arrival - Meter Sealed ☐ — Bypass Sealed ☐ — Upon Departure - Meter Sealed ☑ — Bypass Sealed ☑

TESTS	Test Results			Post Test Results		
Compound	Flow Rate GPM	Allowable Test Accuracy	Actual Test Accuracy	Flow Rate GPM	Allowable Post Test Accuracy	Actual Post Test Accuracy
Minimum		97 - 103			95 - 103	
Below C.O.						
Change Over		90 - 103			90 - 103	
Above C.O.						
Intermediate		97 - 103			97 - 103	
Maximum		97 - 103			97 - 103	

Turb./Disp.	Flow Rate GPM	Allowable Test Accuracy	Actual Test Accuracy	Flow Rate GPM	Allowable Post Test Accuracy	Actual Post Test Accuracy
Start	10		50			
Minimum	30	98.5 - 101.5	101		98.5 - 101.5	
Intermediate	125	98.5 - 101.5	101.2		98.5 - 101.5	
Maximum	300	98.5 - 101.5	101.4		98.5 - 101.5	

TEST AND REPAIR COMMENTS

The meter tested within accuracy limits derived from AWWA M6. We recommend a 6" compound meter be installed in t meter setting.

M.E. SIMPSON COMPANY, INC. - Technical Services

COMPOUND / TURBINE / DISP. METER TEST REPORT

Client : ESG - Cleveland Heights, OH Premises:

Account name : Community Center Account no. : 20-5316-0

Building Name: Community Center Meter no.:

Address: 3027 MAYFIELD Reg ID :

Meter location : Vault in front of building by stand pipe AMR ID: 84013493

Meter size : 6 Brand: Badger - RCRDLL II Type: Turbine S/N: 43466882

Test port: Yes Bypass: Yes Inlet valve : Yes Outlet valve: Yes Data ID: 20

READINGS

Confined Space: Yes O2 Level: 20.9 Gas Present: None Ok to Enter: Yes Supervisor: Matt S. Brown

Meter Reading Upon Arrival T/H: 011252[00] L: FM: Units: Cubic Feet

Meter Reading After Post Test T/H: L: FM: Units:

Remote Reading Upon Arrival T/H: L: FM: Units:

TEST AND REPAIR DATA

Tested: 11/14/14 9:30 AM By: Matt B. & Eric M. Repaired: By:

Upon Arrival - Meter Sealed ☐ Bypass Sealed ☐ Upon Departure - Meter Sealed ☐ Bypass Sealed ☑

TESTS	Test Results			Post Test Results		
Compound	Flow Rate GPM	Allowable Test Accuracy	Actual Test Accuracy	Flow Rate GPM	Allowable Post Test Accuracy	Actual Post Test Accuracy
Minimum		97 - 103			95 - 103	
Below C.O.						
Change Over		90 - 103			90 - 103	
Above C.O.						
Intermediate		97 - 103			97 - 103	
Maximum		97 - 103			97 - 103	

Turb./Disp.	Flow Rate GPM	Allowable Test Accuracy	Actual Test Accuracy	Flow Rate GPM	Allowable Post Test Accuracy	Actual Post Test Accuracy
Start	17		75			
Minimum	30	98.5 - 101.5	98		98.5 - 101.5	
Intermediate	125	98.5 - 101.5	95		98.5 - 101.5	
Maximum	300	98.5 - 101.5	94		98.5 - 101.5	

TEST AND REPAIR COMMENTS

The meter failed to test within accuracy limits derived from AWWA M6. We recommend a 6" compound meter be install in this setting.

M.E. SIMPSON COMPANY, INC. - Technical Services

COMPOUND / TURBINE / DISP. METER TEST REPORT

Client : ESG - Cleveland Heights, OH Premises:

Account name : Severance Medical Arts Building Account no. : 2054638

Building Name: Severance Medical Arts Building Meter no.:

Address: 5 SEVERANCE CIRCLE Reg ID :

Meter location : Basement main building water room AMR ID:

Meter size : 6 Brand: Neptune - Trident Type: Turbine S/N: 18801606

Test port: Yes Bypass: Yes Inlet valve : Yes Outlet valve: Yes Data ID: 21

READINGS

Confined Space: No O2 Level: Gas Present: Ok to Enter: Yes Supervisor: Matt S. Brown

Meter Reading Upon Arrival T/H: 0245365[00] L: FM: Units: Cubic Feet

Meter Reading After Post Test T/H: L: FM: Units:

Remote Reading Upon Arrival T/H: L: FM: Units:

TEST AND REPAIR DATA

Tested: 11/13/14 7:15 AM By: Matt B. & Eric M. Repaired: By:

Upon Arrival - Meter Sealed ☐ Bypass Sealed ☐ Upon Departure - Meter Sealed ☐ Bypass Sealed ☑

TESTS	Test Results			Post Test Results		
Compound	Flow Rate GPM	Allowable Test Accuracy	Actual Test Accuracy	Flow Rate GPM	Allowable Post Test Accuracy	Actual Post Test Accuracy
Minimum		97 - 103			95 - 103	
Below C.O.						
Change Over		90 - 103			90 - 103	
Above C.O.						
Intermediate		97 - 103			97 - 103	
Maximum		97 - 103			97 - 103	

Turb./Disp.	Flow Rate GPM	Allowable Test Accuracy	Actual Test Accuracy	Flow Rate GPM	Allowable Post Test Accuracy	Actual Post Test Accuracy
Start	8		40			
Minimum	30	98.5 - 101.5	103		98.5 - 101.5	
Intermediate	125	98.5 - 101.5	99		98.5 - 101.5	
Maximum	300	98.5 - 101.5	103		98.5 - 101.5	

TEST AND REPAIR COMMENTS

The meter failed to test within accuracy limits derived from AWWA M6. We recommend this meter be replaced with a 6" compound meter. This meter is over registering.