Water Supply Program

Water Audit Guidance

Introduction

What is a water audit ?

A water audit determines the amount of water lost from a distribution system due to leakage and the cost of this loss to the utility. Water audits balance the amount produced with the amount billed and account for the remaining water (loss). Comprehensive audits can give the utility a detailed profile of the distribution system and water users, allowing easier management of resources and improved reliability. It is an important step towards water conservation and, linked with a leak detection plan, can save the utility a significant amount of money and time.

Elements of the audit include

- Record of the amount of water produced
- Record of the amount delivered to metered users
- Record of the amount delivered to unmetered users
- Record of amount of water loss (balance of water, including leaks)
- Measures to address water loss (leaks and other unaccounted water)

What are the benefits of a water audit ?

Benefits of an audit include improved knowledge and documentation of the distribution system including problem and risk areas. The audit also becomes a valuable tool to manage resources, by getting a better understanding of what is happening to the water after it leaves the treatment plant. Leak detection programs are effective ways to minimize leakage and to fix small problems before they become major ones.

According to the American Water Works Association, these programs lead to reduced water losses, financial improvement, increased knowledge of the distribution system, more efficient use of existing supplies, safeguarding public health and property, improved public relations, reduced legal liability, and reduced disruption to customers.

How do I perform a water audit ?

A water audit can be completed in one day if meter reading records are easily available and significant adjustments to the records are not necessary.

Audits are completed by calculating the difference between the amount of water produced and the amount sold (metered sales) then addressing the difference. Metered sales are compiled and remaining difference between produced water is lost.

Before undertaking the audit, the utility should take time to plan and design the study. The audit should use existing records as much as possible to produce the most accurate results.

An audit records the amount of water produced, amount delivered to metered users, amount delivered to unmetered users, and water loss, along with likely causes for the unaccounted water. Then the results are analyzed and estimates are made for recoverable leakage. Corrective measures

should be evaluated and any needed distribution system improvements should be described. Cost benefit analyses should be performed and an effective course of action implemented.

Once the efficiency of the water system is evaluated, the system should take necessary steps to reduce the amount of recoverable water loss. Effective water audits usually result in leak detection programs, which identify and correct problems in the distribution system. A comprehensive follow up audit might be necessary to determine the accuracy of meters, track unmetered use, and locate and repair leaks.

This document includes a model water audit worksheet and instructions based on one developed by the Texas Water Development Board. This worksheet is simple, but it is sufficient to account for water usage and quantify lost water.

Recommended Strategy

A preliminary audit should be undertaken to determine the amount of water loss, then followed up with congruous measures as determined by the findings of the audit. If water loss is significant, a more detailed study should be undertaken. If a detailed study shows water loss is significant, measures should be taken to reduce the loss.

Planning the Water Audit

Considerations

Water audits can be designed by reviewing the system records and staff expertise and using these resources to develop and complete effective worksheets. Distribution system characteristics vary, so each utility will have different challenges in performing the water audit. Each system will need to decide how it can perform the audit accurately with the least cost. A worksheet should be developed, and a study period set.

Set Study Period

A study period should be set to allow an evaluation of the complete water system. One year is recommended because it includes all seasons and gives enough time to eliminate the effect of meter reading lag. Shorter periods might not give a complete picture of the water system, and longer periods can be difficult to manage.

Develop a worksheet

A worksheet, similar to an accounting spreadsheet, should be developed that will make the computations clear and simple and allow the utility to balance water produced with water used. As well as balancing water in and out of the distribution system, the worksheet should list and account for various water usages.

Water is the commodity and assets (gallons water produced) will be balanced with liabilities (gallons sold) to determine the loss of commodity. If the worksheet is properly designed, a preliminary audit should be able to be completed in a day if using existing meter reading data.

Worksheets can vary in detail and will determine how well the distribution system is described. A more detailed worksheet will provide better understanding of the water usage and could be a useful tool for the water utility.

What is Water Loss ?

There are two types of loss, real and apparent losses. Real loss includes water lost through leakage of distribution systems, service connections, and storage tanks (including overflow). Apparent loss includes meter and record inaccuracies and unauthorized water uses such as theft and unauthorized connections. Authorized unmetered uses can be considered a special type of lost water, and they can also represent lost revenue so should be estimated carefully.

Conducting the Audit

Compile water production and sales data

Once the study period has been set and a worksheet has been developed, the audit can be conducted. A set of model forms and instructions are included that can be used if the utility does not choose to develop one. Records should be compiled and meters should be checked so accurate totals are recorded.

Once totals are computed, the worksheet should then be filled in, and water delivered should be balanced with water used. Unmetered uses should be documented along with the methods to quantify them. An attempt to account for water loss should be made. Based on the findings of the audit, options should be developed to reduce water loss.

Make adjustments as necessary

When making adjustments to metered amounts, document the adjustments and how they were calculated. All records should reflect any adjustments and should be verifiable. If adjustments are made for significant amounts of water then the system should make changes to eliminate need of adjustments in the future. Adjustments could be known production meter inaccuracy, or the difference between finished reservoir storage at the beginning and end of the study period. One difficulty might be in adjusting existing records to fit the study period. When meter reading periods overlap, some adjustments will be necessary to represent the study period. Some flow records might have to be pro-rated so that all flow measurements reflect the same period. This should be done carefully to insure the accuracy of the audit.

Comprehensive Audits (optional)

In addition to the above, a more thorough or comprehensive audit would include the following:

- Develop an inventory of meters
- Analyze water loss and methods to reduce the loss
- Check accuracy of meters

Compile a list of different types, sizes, and age of meters in the distribution system. This will help estimate the accuracy of the meters on a system wide scale. This can compliment the water usage information and show usage patterns in the distribution system. It also will help any meter replacement program and cross-connection control program.

Possible corrective measures include leak detection programs, meter replacement or installation programs, and conservation programs. Factors to be considered include: where the losses occur, how much loss is in each problem area, what possible solutions exist, cost of the solutions, and time to make the solutions.

It will be important to verify records and check meter accuracy, as these will affect the accuracy of the audit. Meters should be inventoried so they can be tested for accuracy and checked for proper size and type. If meters measure in units other than gallons, the units must be converted to allow compilation. Records should be checked carefully to make sure that units are correct, all measurements are included, measurements represents the same time period, and that calculations are correct.

Follow up

Plan for reducing water losses

If the unaccounted or unmeasured water loss is greater than 10%, we are requesting that you prepare a plan within three months outlining steps that you intend to take for further identifying and reducing water losses. Steps that you may choose include initiating or expanding a leak detection and repair program or eliminating unmetered accounts. Cost benefit analyses should be conducted to choose the right option. If future annual audits continue to show unmeasured water greater than 10%, the plan for reducing water losses should be updated and re-submitted.

Benefits of recovering leakage

Benefits the utility should consider are the lost commodity, risk of allowing leaks, and the liability of not addressing leaks. Lost commodity is easy to quantify, as it should be the bottom line of the audit worksheet. Risks include letting small problems continue that might cause major outages and emergency repairs. Liabilities of leakage, or inaction, include capacity waste, water theft (or dead meters), road or foundation collapse, and flooded basements. Leaks also pose a serious cross connection threat, as they are a direct conduit into the distribution system whenever pressure fluctuates.

Cost of recovering leakage

Costs include the personnel and the equipment required to make improvements. Repair costs should not be included because these need to be done eventually.

Long term goals

Long term follow up should include updating the audit, reducing loss and checking meters. After the first audit, areas where data is lacking should be identified and addressed. Subsequent audits should provide greater accuracy and reduction of water losses.

More Information

Sources of information on Water Audits include:

AWWA manual M36 *Water Audits and Leak Detection*

International Water Association *Losses from Water Supply Systems: Standard Terminology and Recommended Performance Measures*.

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Water Supply Program

AUDIT SHEET EXPLANATIONS

Note: Units should be reported in millions of gallons.

Line 1 – Total Water Supply to Distribution System

This is the total volume of all water supplied to the system as measured by the master meter(s) and interconnects with other sources of supply. If water is purchased from an interconnected system, please include detailed quantities on an appendix.

Line 2 – Adjustments to Water Delivery

Adjustments could be an increase or a decrease in storage capacity from the beginning to the end of the study period or adjustment for known broken or inaccurate master meters.

Line 3 – Net Water Produced

This is the net adjusted water produced and/or measured through the master meters, from plants and interconnections, after adjustments.

Line 4 – Gallons of Metered Water Sold

This lists the total amount of water that is sold through meters in the system. This includes residential, commercial, industrial, institutional, and other metered sales such as standpipes for water haulers. It is important to evaluate when the meters are read so that the readings can be adjusted to reflect the time it takes to actually read the meters. To assure that the production/purchase records are comparable to the customers' meter readings, consumption during the meter reading period must be adjusted to match the production/purchase period.

Line 5 – Billed Unmetered Sales

These are sales to customers that are not metered. They include connections that are not metered and any bulk sales (eg. through hydrants). These amounts should be detailed in an appendix

Line 6 – Unbilled Authorized Consumption

Provided on the chart is a general listing of potential uses that are frequently not metered, however, if these facilities are metered they should be included in Line 4. You may use this list or make your own estimates of unmetered users and accounts. Please include detail amounts with documentation in an appendix.

Line 7 – Apparent Water Losses

These consist of unauthorized consumption and meter inaccuracies. Meter inaccuracy includes production meters and customer meters. These amounts should be documented in an appendix.

Line 8 – Real Water Losses

These losses are generally those that cannot be metered. They primarily include leaks and tank overflow. Any water that has not been documented in other categories should be listed as lost and included in one of the three categories.

Line 9 – Net Lost Water

Net lost or unmeasured water is determined by subtracting the sum of Lines 4, 5, and 6 from Line 3 (3 – (4+5+6)). This should be the same value as the sum of Lines 7 and 8 (7+8).

Line 10 – Percentage of Lost Water

The percentage of lost or unmeasured water is calculated by dividing Line 9 by Line 3.

Table 1 *
WATER AUDIT WORKSHEET FOR TREATED WATER
(units should be reported in millions of gallons)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
WATER DELIVERED													
1. Total Water Supply to Distribution System													
2. Adjustments to Water Delivery													
3. Net Water Produced													
WATER USED													
4. Gallons of Metered Water Sold													
Residential													
Commercial													
Industrial													
Institutional													
Other													
Total													
5. Billed Unmetered Sales													
6. Unbilled Authorized Consumption													
Water Main Flushing													
Sewer/Storm Drain Flushing													
Parks/Playgrounds/Swimming Pools													
Golf Courses													
Cemeteries													
Road Medians													
Schools													
Training/Fire Fighting													
Construction													
Storage Tank Drainage													
Sewer Plant Uses													
Total													
7. Apparent Water Losses													
Water Meter Malfunction													
Theft													
Other													
Total													
8. Real Water Losses													
Leaks													
Storage Overflow													
Other													
Total													
9. Net Lost or Unmeasured Water													
10. Percentage of Lost or Unmeasured Water													

* adapted from the Texas Water Development Board
** available as an Excel spreadsheet

ANNUAL WATER AUDIT SUMMARY

SYSTEM INFORMATION

SYSTEM NAME: _____

SYSTEM ID: _____

WATER AUDIT INFORMATION

A. Total Water Produced (Line 3): _____

B. Total Lost or Unmeasured Water (Line 3 minus Line 4) or (Line 5 plus Line 6): _____

C. % of Water Lost or Unmeasured to Total Water Produced (Total Unmeasured Water divided by Total Water Produced): _____
Note: If greater than 10%, a plan should be prepared outlining steps to identify and reduce water system losses.

WATER AUDITOR

Name of person completing this report: _____

Signature: _____ Date: _____

Phone Number: _____ E-mail Address: _____

Please mail this summary page, the worksheet, and any other supporting documents that you may want to submit to:

Maryland Department of the Environment
Water Supply Program
1800 Washington Boulevard
Baltimore, Maryland 21230

For questions, please call (410) 631-3706