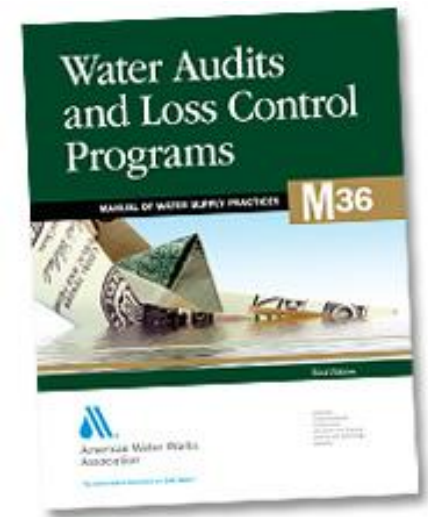


# M36 3<sup>rd</sup> Edition

## Water Audits and Loss Control Programs

- Chapter 1 – Introduction: Auditing Water Supply Operations and Controlling Losses
- Chapter 2 – Conducting the Water Audit
- Chapter 3 – Identifying and Controlling Apparent Losses
- Chapter 4 – Understanding Real Losses: The Occurrence and Impacts of Leakage
- Chapter 5 – Controlling Real Losses: Leakage and Pressure Management
- Chapter 6 – Planning and Sustaining the Water Loss Control Program
- Chapter 7 – Considerations for Small Systems



# Detailed Guidance of the Water Auditing Approach

1. Promotes annual water audits as *standard business practice*
2. Describes 3 levels of auditing detail:
  - “top-down” approach (desktop gathering of information)
  - component analysis of leakage
  - “bottom-up” auditing (field measurements and investigations)
3. Standard terms and definitions for the components of water consumption and loss
4. Robust, reliable performance indicators useful for comprehensive performance tracking & benchmarking
5. Instructive – clear example water audit
6. Applies to systems of all sizes and units of operation

# Defines and Explains Apparent Losses and Revenue Protection Programs

1. Definition and impacts of Apparent Losses
  - Uncaptured Revenue
  - Error in customer consumption tabulations
2. Apparent Losses are multi-faceted
3. The often-overlooked role of the Customer Billing System (CBS) as a consumption database
  - CBS designed for financial purposes, however:
  - CBS also now used for operational data purposes; i.e. the customer consumption database



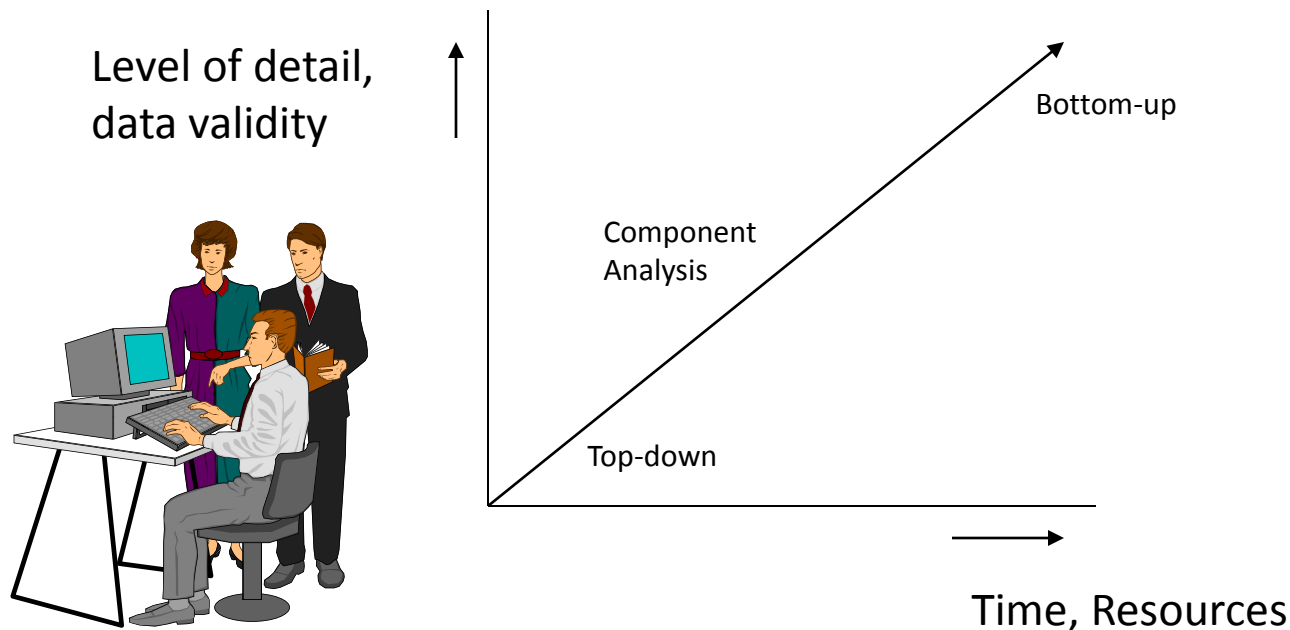
# Defines and Explains Proactive Leakage Management

1. The nature of leakage occurrences in water distribution systems
2. The role of time in leakage management
3. Leakage can be quantified!
4. The role of pressure and leakage
5. Leakage Management: not just “leak detection & repair”
  - Leak Noise Correlating/Loggers/Monitors
  - Continuous Monitors in zones or District Metered Areas (DMA)
  - Inline leak detection of transmission mains
  - Pressure management



# The Levels of Auditing

- Top-down (desktop)
- Component Analysis of Leakage (desktop)
- Bottom-up investigations (field data)

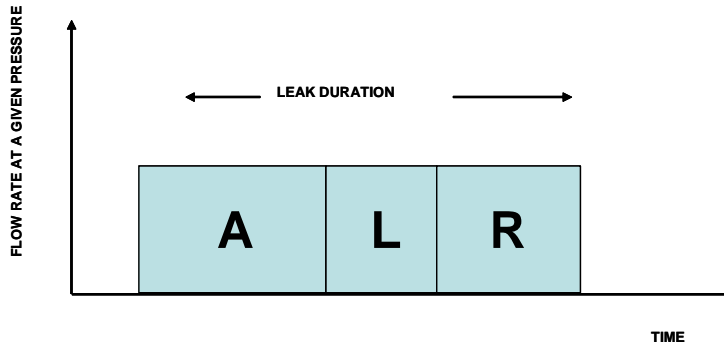


# Top-down Water Audit Process

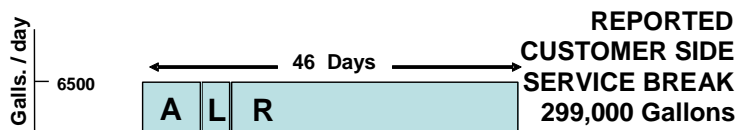
- Pulls together data and information that is readily available
- Advantages: quick to assemble to obtain a preliminary assessment of water efficiency standing (AWWA Free Water Audit Software is a top-down water audit)
- Disadvantages: for most water utilities, incomplete, cursory or suspect data occurs to some extent and limits the *validity* of the top-down water audit



# Component Analysis



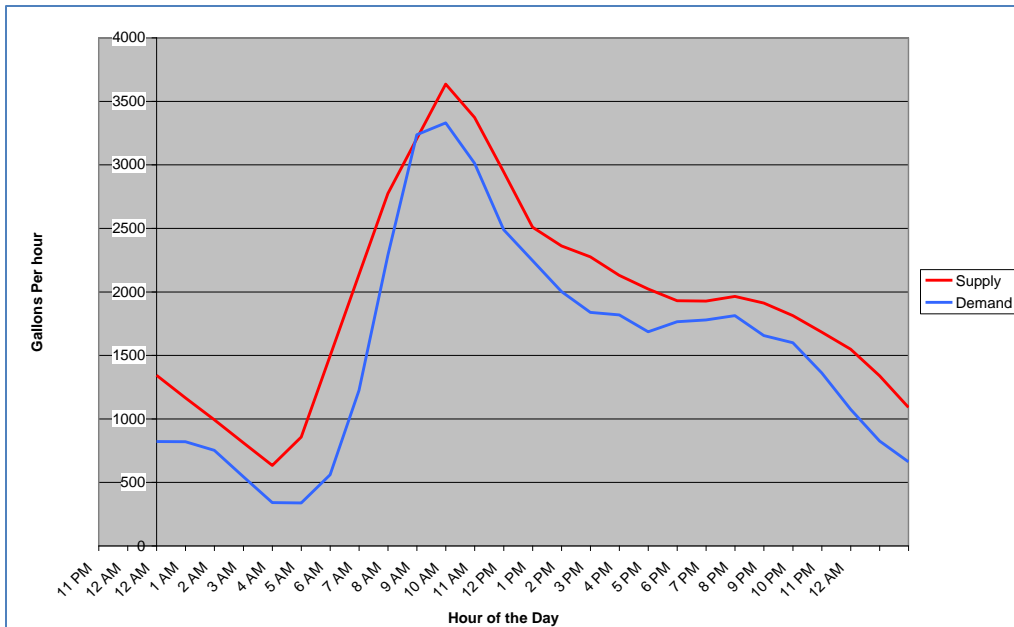
- Generally conducted for leakage; can also be carried-out for apparent loss
- Leakage component analysis based around the time phases in the life of a leak
  - Awareness: leak run time until discovery
  - Location: time to pinpoint a known leak
  - Repair: time to respond and halt the leak flow





# The Bottom-up Water Audit Process

- Bottom-up investigations require detailed fieldwork
  - Apparent Loss Examples
  - Real Loss Examples





# Chapter Review

# Chapter 2

## Conducting the Water Audit

### The M36 has always provided outstanding guidance in the details of auditing

- Water Supplied: source meter data, imports/exports
- Master Meter Error Adjustment
- Authorized Consumption
  - Billed Metered
  - Billed Unmetered
  - Unbilled Metered
  - Unbilled Unmetered



# Chapter 2

## Top-down Apparent Loss Water Audit Data

### Apparent Losses: systematic data handling error

- Category of apparent loss was identified by AWWA WLC Committee
  - Includes all forms of data transfer, handling and archiving error in billing
  - Manual meter reading
  - Automatic meter reading
  - Billing system errors
- The “dark horse” of loss auditing
- The suggested starting point is assessing apparent losses – ***find out what goes on in the billing system!***



# Chapter 2

## Calculating the Performance Indicators

After data is input into the water audit, calculate the performance indicators

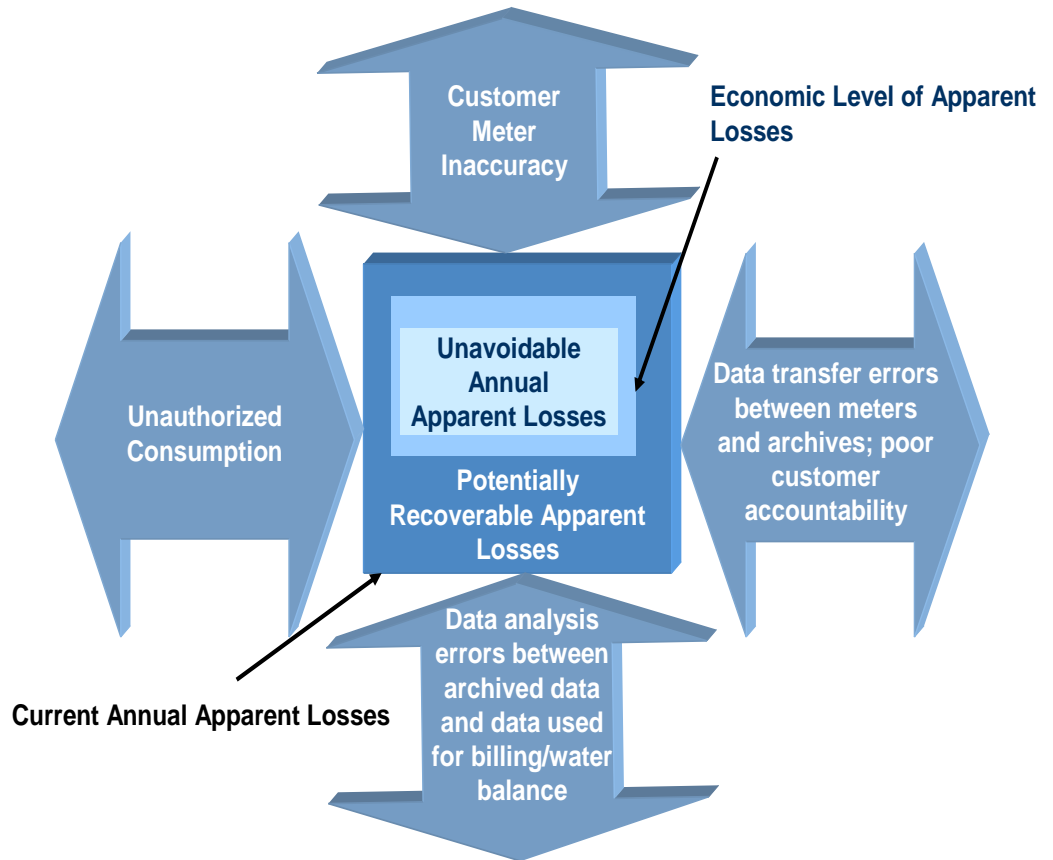
Description	*TWA code	Expressed as:	Calculation	Indicator
Financial: Non-revenue water by volume	Fi36	Volume of Non-revenue water as % of System Input Volume	$= (1,143.96 / 4,402.16)\%$ $= 25.9\%$	25.9%
Financial: Non-revenue water by cost	Fi37	Value of Non-revenue water as % of annual cost to operate the water supply system	$= (\$1,764,317 / \$9,600,000)\%$ $= 18.3\%$	18.3%
Water Losses			$= WL$	944.72
Apparent Losses			$= AL$	208.22
Current Annual Real Losses			$= CARL$	736.50
Apparent Losses Normalized	Op23	[gallons/service connection/day]	$= (AL/Nc/D)$ $= (208,220,000/12,196/365)$	46.8
Real Losses Normalized (1)	Op24	[gallons/service connection/day] or [gallons/mile of mains/day] (only if service connection density is less than 32/mile)	Service connection density = $(12,196/250) = 48.8/\text{mile}$ Op24 = $(736,500,000/12,196/365) =$	165.4
Real Losses Normalized (2)		[gallons/service connection/day/psi of pressure] or [gallons/mile of mains/day/psi of pressure] (only if service connection density is less than 32/mile)	Service connection density = 48.8 connections/mile Real Losses Normalized (2) = $(736,500,000/12,196/365/65) =$	2.54
Unavoidable Annual Real Losses	UARL	UARL (gallons/day) = $(5.41Lm + 0.15Nc + 7.5Lc) \times P$ , where Lm = length of water mains, miles (including hydrant lead length) Nc = number of service connections Lc = $(Nc \times Lp)/5,280$ , miles Lp = Average service connection piping length, ft (See Figures 2.11 – 2.13 for guidance) P = average pressure in the system, psi	Lm = miles of main + total hydrant lead length (miles) = $250 + [(2,750 \times 12)/5,280] = 256.25$ Lc = $(12,196 \times 18)/5,280 = 41.6$ UARL = $[(5.41 \times 256.25) + (0.15 \times 12,196) + (7.5 \times 41.6)] \times 65 = 229,300$ gal/day = 83.69 million gallons/yr	83.69
Infrastructure Leakage Index (ILI)	Op25	Current Annual Real Losses (CARL)/Unavoidable Annual Real Losses (UARL) (dimensionless)	$= 736.50 / 83.69 = 8.80$	8.80

Figure 2.3  
Chapter 2

# Chapter 3

## Identifying and Controlling Apparent Losses

- Revenue Protection Program
  - Flow-charting the billing system
  - Investigate suspect accounts
- Customer Meter Accuracy testing
- Unauthorized Cons.
  - Detect, thwart
  - Review regulations
- Examples provided



# Apparent Losses

## **Apparent Losses: cause uncaptured revenue and distorts the integrity of customer consumption data**

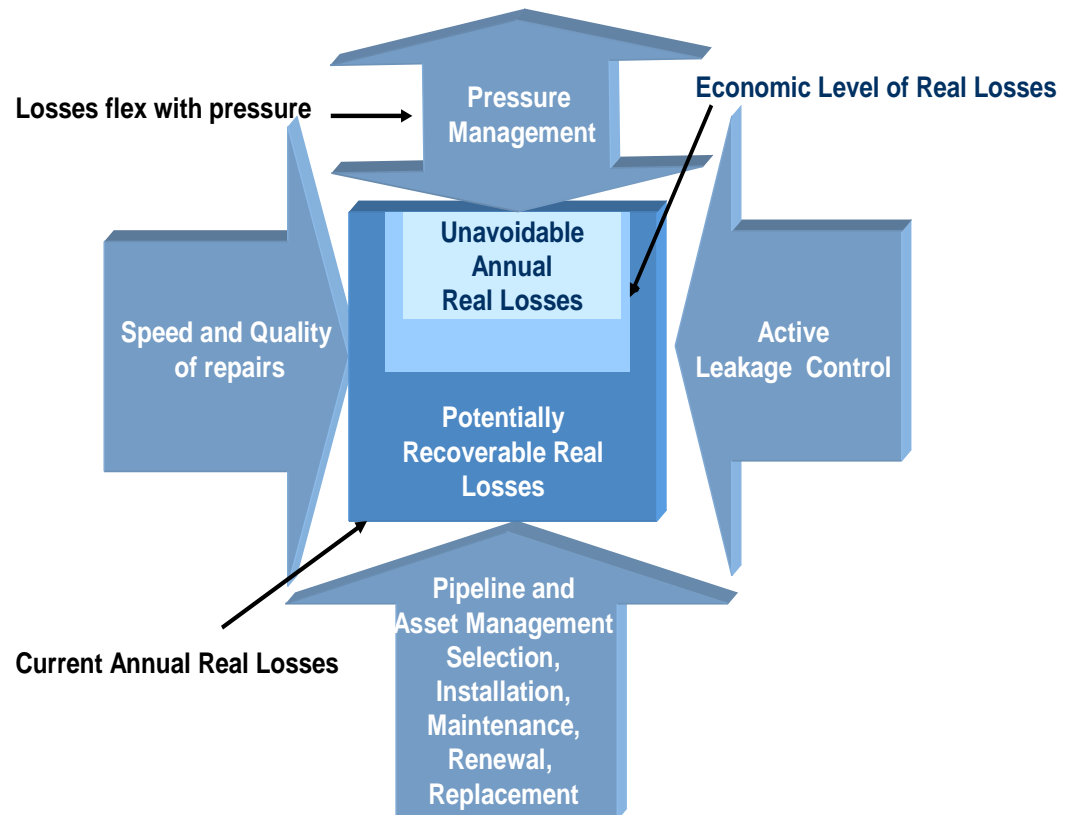
- Customer Metering Inaccuracies
  - Assemble meter demographics from records
  - Conduct regular meter accuracy testing, small samples of meters will suffice
- Unauthorized Consumption
  - Can use default value of 0.25% of water supplied volume
- Systematic Data Handling Errors



# Chapter 4

## Understanding Real Losses. The Occurrence and Impact of Leakage

- Chapter 4 – Leakage Characteristics
  - Types of leakage
  - Effect of time on leakage losses





# Chapter 4

## Real Loss Water Audit Data

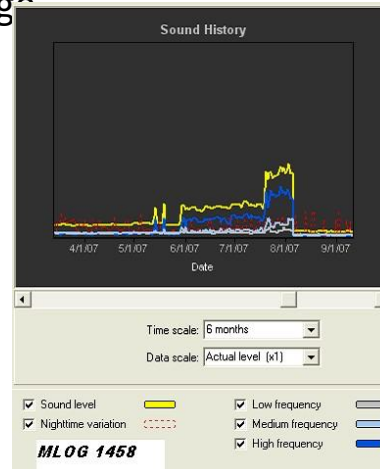
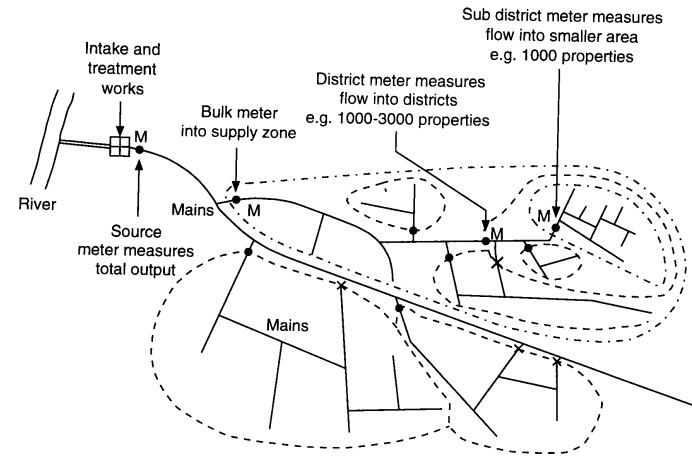
- (Top-down approach: real losses are the “catch-all” after authorized consumption and apparent losses are subtracted from water supplied)
- Component Analysis: a rigorous accounting based upon findings and repairs of reported and unreported leaks and breaks
- Bottom-up approach: actual field measurements of flow and pressure. Most accurate data through investment of field equipment, measurements and analysis. Personnel gain intimate system knowledge



# Chapter 5

## Controlling Real Losses: Leakage and Pressure Management

- Active Leakage Control
  - Traditional leak detection
  - Leak noise monitoring
  - Continuous flow/pressure monitoring in discrete zones or DMAs
- Pressure Management
  - Pressure stabilization
  - Pressure reduction
  - Very cost-effective and successful in addressing high background leakage



# Chapter 6

## Planning & Sustaining the Water Loss Control Program

### Forming the multidisciplinary team

- Water Distribution System Operations
- Water Distribution System Maintenance
- Customer Metering
- Customer Meter Reading
- Infrastructure Management
- Water Quality
- Sewer Collection Systems
- Water Conservation
- Customer Billing Systems
- Water Rate Setting and Finance
- Customer Affairs
- Public Relations
- External stakeholders: regulatory, other
- Executive leadership of the water utility



# Chapter 7

## Consideration for Small Systems

- 54,000 water utilities serve fewer than 10,000 people
- AWWA Free Water Audit Software: designed (and priced) with small systems in mind
- Assistance available through water industry associations such National Rural Water Association and AWWA
- Authorization of funding sources to handle water loss control efforts
- Use of performance-based consulting services contracts

**AWWA WLCC Water Audit Software: Reporting Worksheet** [Back to Instructions](#)

Copyright © 2005 American Water Works Association. All Rights Reserved.

Water Audit Report for **Philadelphia Water Department**  
 Reporting Year: **2004**

Please enter data in the white cells below. Where possible, metered values should be used; if metered values are unavailable please estimate a value. Indicate this by selecting a choice from the gray boxes to the left, where M = measured (or accurately known value) and E = estimated.

**ALL VOLUMES TO BE ENTERED AS ANNUAL QUANTITIES**

WATER SUPPLIED	
Volume from own sources:	M 95,524.0 million gallons (MG) per year
Master meter error adjustment:	M 695.4 million gallons (MG) per year
Water Imported:	M 0.0 million gallons (MG) per year
Water Exported:	M 7,210.2 million gallons (MG) per year
<b>WATER SUPPLIED:</b>	<b>89,011.2</b> million gallons (MG) per year

AUTHORIZED CONSUMPTION	
Billed metered:	M 57,935.2 million gallons (MG) per year
Billed unmetered:	E 0.0 million gallons (MG) per year
Unbilled metered:	M 179.3 million gallons (MG) per year
Unbilled unmetered:	E 693.6 million gallons (MG) per year
<b>AUTHORIZED CONSUMPTION:</b>	<b>58,498.1</b> million gallons (MG) per year

WATER LOSSES (Water Supplied - Authorized Consumption)	
<b>Apparent Losses</b>	
Unauthorized consumption:	E 1,145.2 million gallons (MG) per year
Customer metering inaccuracies:	M 125.3 million gallons (MG) per year
Data handling errors:	E 2,751.2 million gallons (MG) per year
<b>Apparent Losses:</b>	<b>4,959.9</b> million gallons (MG) per year
<b>Real Losses</b>	
Real Losses (Water Losses - Apparent Losses):	26,544.2 million gallons (MG) per year
<b>WATER LOSSES:</b>	<b>30,603.1</b> million gallons (MG) per year

NON-REVENUE WATER	
<b>NON-REVENUE WATER:</b>	<b>31,476.0</b> million gallons (MG) per year

SYSTEM DATA	
Length of mains:	M 3,160.0 miles
Number of active AND inactive service connections:	M 548,289
Connection density:	E 174 conn./mile main
Average length of private pipe:	E 12.0 ft (pipe length between curbspot and customer meter or property)
Average operating pressure:	E 55.0 psi

COST DATA	
Total annual cost of operating water system:	M \$167,604,000 \$/Year
Customer retail unit cost (applied to apparent losses):	M \$3.95 /71000 gallons (MG)
Variable production cost (applied to real losses):	M \$133.56 \$/million gallons (MG)

**DATA REVIEW - Please review the following information and make changes above if necessary:**

- Input values should be indicated as either measured or estimated. You have entered:
  - 12 as measured values
  - 6 as estimated values
  - 0 without specifying measured or estimated
- It is important to accurately measure the master meter - you have entered the measurement type as: measured
- Cost Data: No problems identified

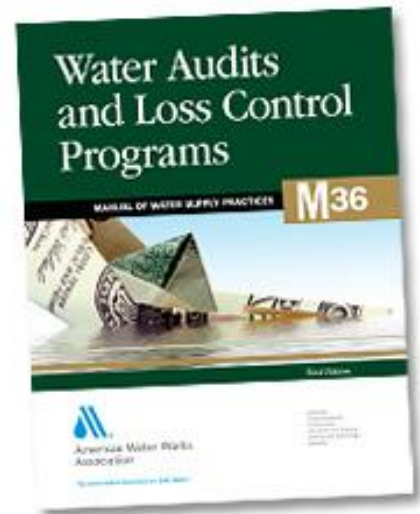
PERFORMANCE INDICATORS	
<b>Financial Indicators</b>	
Non-revenue water as percent by volume:	35.4%
Non-revenue water as percent by cost:	13.7%
Annual cost of Apparent Losses:	\$16,012,518
Annual cost of Real Losses:	\$3,545,768
<b>Operational Efficiency Indicators</b>	
Apparent losses per service connection per day:	20.28 gallons/connection/day
Real losses per service connection per day:	132.64 gallons/connection/day
Real losses per length of main per day:	N/A
Real losses per service connection per day per psi pressure:	2.43 gallons/connection/day/psi
Unavoidable Annual Real Losses (UARL):	5.99 million gallons/day
<b>Infrastructure Leakage Index (ILI) (Real Losses/UARL):</b>	<b>12.17</b>

\* only the most applicable of these two indicators will be calculated

# Appendices

- A – Blank Forms
- B - Assessing Water Resources Management
- C – AWWA Free Water Audit Software
- D – Case Studies
  - WCSA, Abingdon, VA
  - EID, Placerville, CA
  - Halifax Water, Halifax, Nova Scotia, Canada
  - Philadelphia Water Department

# SUMMARY – M36 3<sup>rd</sup> Edition



- *Details and Promotes the IWA/AWWA Water Audit Method*
- *Describes cost-effective ways to control apparent and real losses*
- *Gives Planning Guidance and Support Information – link to Free Water Audit Software*
- *The methods and tools exist to control water and revenue losses.*

Send your comments & questions to:

[wlc@awwa.org](mailto:wlc@awwa.org)

Or

[chastain-howleya@bv.com](mailto:chastain-howleya@bv.com)

# **History: AWWA Water Audit Methodology**

- **Method published in 2000 by IWA Water Loss Task Force with AWWA participation**
- **All water goes to either consumption or loss - with definitions for all uses and water losses**
- **Designed to function for all units of measure**
- **Includes performance indicators for realistic assessments, benchmarking, and target-setting**
- **AWWA WLCC recommended IWA Water Balance and Performance Indicators in 2003**





American Water Works  
Association

August 2003 Volume 95 Number 8

# Journal

**Top 10 trends**  
and market developments,  
page 34



## Financial Concerns

**financial concerns**

BY AWWA WATER LOSS  
CONTROL COMMITTEE

COMMITTEE REPORT:

**Applying worldwide BMPs  
in water loss control**

# Opflow Online

Volume 32, No. 5 May 2006

## **Unaccounted for No More Water Audit Software Assesses Water Loss**

By George Kunkel

Water utilities now have a standardized tool to determine water supply efficiency: a spreadsheet software package for compiling a basic audit of water supply operations, developed by AWWA's Water Loss Control Committee. The software is available to anyone for free download.

The software was developed to

- promote the best-practice water audit method developed by the International Water Association and AWWA,
- assess water supply efficiency in a standard, reliable manner, and
- give utilities a simple, user-friendly way to compile and compare their water audit data with other utilities.

**The WLC Committee envisions that many utilities will find the software highly useful through defining their water loss standing and revealing the effects of losses on operations and revenue streams.**



# Water Audits are a Sound Business Practice

The American Water Works Association (AWWA) recommends that every water utility accurately meter all water taken into its system and all water distributed from its system at its customers' point of service, read its meters at sufficiently frequent intervals to support its rate structures and provide accurate bills to its customers. **AWWA also recommends that utilities conduct regular water audits to ensure accountability.**

Customers reselling utility water such as apartment complexes, wholesalers, agencies, associations, or businesses should be guided by principles that encourage accurate metering, consumer protection, and financial equity.

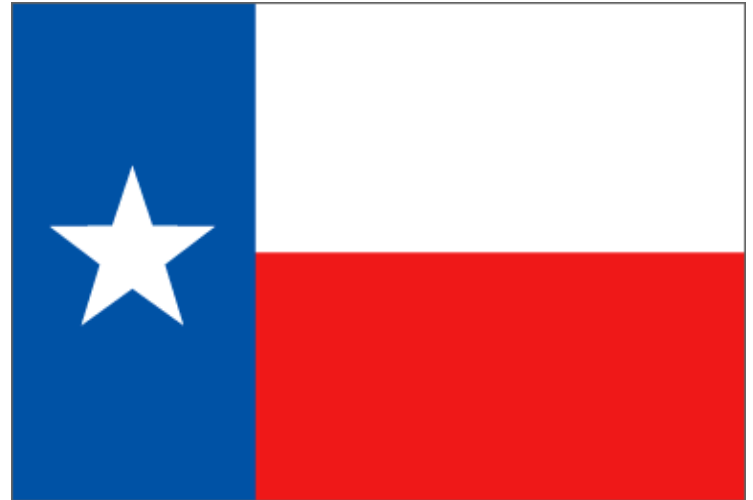
Metering and water auditing provide an effective means of managing water system operations and essential data for system performance studies, facility planning, and the evaluation of conservation measures. Water audits evaluate the effectiveness of metering and meter reading systems, as well as billing, accounting, and loss control programs. Metering consumption of all water services provides a basis for assessing users equitably and encourages the efficient use of water.

An effective metering program relies upon the proper sizing, typing, and installation of meters and periodic performance testing, repair, maintenance, and ultimate replacement of all meters. **Accurate metering, water auditing and effective water loss control promote an equitable recovery of revenue based on level of service and wise use of available water resources.**

*AWWA Water Loss Control*

# State of Texas

- *First state to legislate requirement for utility water audits*
- *House Bill 3338 (2003) required water audits from water utilities for 2005 and 2010 operations*
- *Texas Water Development Board selected IWA/AWWA Water Audit Method*
- *Over 2,000 water audits collected in 2006 and 2011*
- *Findings confirmed that many water utilities hadn't previously tracked water efficiency data*
- *Audit data collection annually for grant or loans*



*Report on evaluation of 2005 data can be found at:  
[http://www.twdb.state.tx.us/RWPG/rpfgm\\_rpts.asp](http://www.twdb.state.tx.us/RWPG/rpfgm_rpts.asp)*

# California

- California Urban Water Conservation Council
  - Consortium of about 300 water utilities that agree to implement best management practices for water conservation
  - Revised BMP 1.2 for Water Loss Control effective 2009
  - Utilizing AWWA Free Water Audit Software©



***This is the most ambitious Water Audit and Loss Control Program authorized to date in the US***

Five Year Validation Phase: advance utilities to Level IV data validity

Years 5-6: conduct component analysis, select performance indicator for leakage control & set target level

Final four years: must meet level for leakage control by year 10 (2019)

# *New Mexico – Office of the State Engineer*

- Adopted IWA/AWWA Water Audit Method and advocates use of AWWA Free Water Audit Software©
- Sponsored pilot water audit and study in several small water utilities



See website references at:

[www.ose.state.nm.us/water-info/conservation/h2o-tech-assist.html](http://www.ose.state.nm.us/water-info/conservation/h2o-tech-assist.html)

# State of Georgia



- Decades long struggle for use of water from Lake Lanier; 2009 court ruling went against the City of Atlanta's continued level of withdrawals for water supply
- Landmark **Water Stewardship Bill** passed March 18, 2010: requires IWA/AWWA water audit by all water utilities by 2013
- Metropolitan North Georgia Water Planning District: part of Atlanta Regional Commission; oversees +60 water utilities in multi-county Atlanta area
  - Requires water utilities to submit water audits via AWWA Free Water Audit Software©
  - Developed training program around the software

[www.legis.ga.gov/legis/2009\\_2010/pdf/sb370.pdf](http://www.legis.ga.gov/legis/2009_2010/pdf/sb370.pdf)

[www.northgeorgiawater.com/files/WSWC\\_SECTION8.PDF](http://www.northgeorgiawater.com/files/WSWC_SECTION8.PDF)



# *Tennessee Comptroller of the Treasury*

## *Water & Wastewater Financing Board*



- At the June 6, 2012, meeting the following was adopted by the Boards:
- Require that the AWWA Excel Spreadsheet (in the specific format created by utilizing the AWWA Free Water Audit Software) be submitted electronically in an Excel format.
  - The Excel spreadsheet is not considered audited information, but only submitted simultaneously.
- In accordance with TCA 68-221-1010(d)(1) and TCA 7-82-401(h)(1), failure to include the required schedule constitutes excessive water loss and...referral to the appropriate board.
- Current Board referrals include;
  - For audits received by the Comptroller of the Treasury from 1/1/2013 to 12/31/2014 -Validity score of 65 or less or non-revenue water as a percent by cost of operating system of 30% or greater;

<http://www.comptroller.tn.gov/wwfb/>

# *Delaware River Basin Commission*

## *Pennsylvania Public Utility Commission*

◆ DRBC revised its Water Code in March 2009 to incorporate the IWA/AWWA Water Audit Method and AWWA Free Water Audit Software©

Collecting water audits – initially on a volunteer basis - mandatory by 2012

◆ PA PUC launched pilot water audit program in 2010 with five companies employing AWWA Free Water Audit Software©:

Pennsylvania-American Water

Aqua Pennsylvania

United Water

York Water Company

Superior Water Company

◆ The two agencies are sharing resources in launching the water audit programs



# Summary—Why Manage Non-Revenue Water

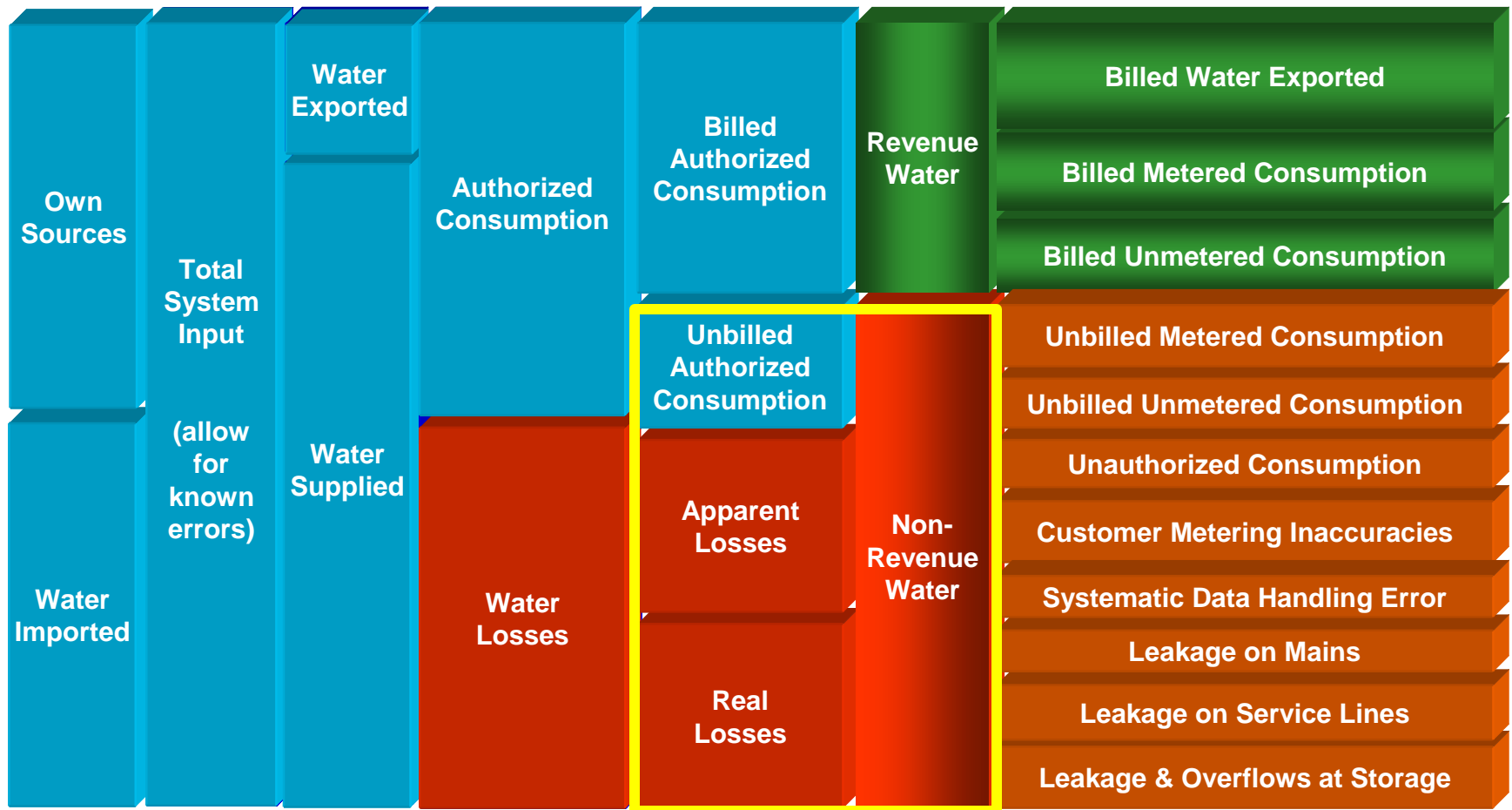
- *The US drinking water industry is facing challenges of resource shortages, aging infrastructure, legal liability, public health and funding needs*
- *To address these, managing non-revenue water should become a standard business practice*
- *AWWA is actively promoting the IWA/AWWA Water Audit Method and providing tools for its use*
- *A number of state/regional agencies are already embracing these methods and applying them*



# The Method



# Water Audit & Revenue Recovery: Background



## Software Examples

- Examples which show two completed water audits are embedded into the body of the spreadsheet:

– The City of Philadelphia (US)  
units of million gallons (US)



City of Philadelphia  
LIFE • LIBERTY • AND YOU™

– The Region of Peel (Canada)  
units of thousand cubic meters.



# Software

## Instructions Worksheet

### AWWA Water Loss Control Committee (WLCC) Free Water Audit Software v4.0

Copyright © 2009, American Water Works Association. All Rights Reserved.

WAS v4.0

**PURPOSE:** This spreadsheet-based water audit tool is designed to help quantify and track water losses associated with water distribution systems and identify areas for improved efficiency and cost recovery. It provides a "top-down" summary water audit format, and is not meant to take the place of a full-scale, comprehensive water audit format.

**USE:** The spreadsheet contains several separate worksheets. Sheets can be accessed using the tabs towards the bottom of the screen, or by clicking the buttons on the left below. Descriptions of each sheet are also given below.

**THE FOLLOWING KEY APPLIES THROUGHOUT:**

Value can be entered by user

Value calculated based on input data

These cells contain recommended default values

Please begin by providing the following information, then proceed through each sheet in the workbook:

NAME OF CITY OR UTILITY:

COUNTRY:

REPORTING YEAR:

START DATE (MM/YYYY):

END DATE (MM/YYYY):

NAME OF CONTACT PERSON:

E-MAIL:

TELEPHONE:

Ext.

PLEASE SELECT PREFERRED REPORTING UNITS FOR WATER VOLUME:

Click to advance to sheet...

Click here:  for help about units and conversions

<a href="#">Instructions</a>	The current sheet
<a href="#">Reporting Worksheet</a>	Enter the required data on this worksheet to calculate the water balance
<a href="#">Water Balance</a>	The values entered in the Reporting Worksheet are used to populate the water balance
<a href="#">Grading Matrix</a>	Depending on the confidence of audit inputs, a grading is assigned to the audit score
<a href="#">Service Connections</a>	Diagrams depicting possible customer service connection configurations
<a href="#">Definitions</a>	Use this sheet to understand terms used in the audit process
<a href="#">Loss Control Planning</a>	Use this sheet to interpret the results of the audit validity score and performance indicators

# AWWA WLCC Free Water Audit Software: Reporting Worksheet

[Back to Instructions](#)

Copyright © 2009, American Water Works Association. All Rights Reserved.

WAS v4.0

[?](#) Click to access definition

Water Audit Report for: **Philadelphia Water Department**  
 Reporting Year: **2008** 7/2007 - 6/2008

Please enter data in the white cells below. Where available, metered values should be used; if metered values are unavailable please estimate a value. Indicate your confidence in the accuracy of the input data by grading each component (1-10) using the drop-down list to the left of the input cell. Hover the mouse over the cell to obtain a description of the grades

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

## WATER SUPPLIED

<< Enter grading in column 'E'

Volume from own sources:	<a href="#">?</a>	7	94,536.900	Million gallons (US)/yr (MG/Yr)
Master meter error adjustment:	<a href="#">?</a>	10	2,779.300	over-registered MG/Yr
Water imported:	<a href="#">?</a>	n/a		MG/Yr
Water exported:	<a href="#">?</a>	10	7,100.400	MG/Yr
<b>WATER SUPPLIED:</b>			<b>84,657.200</b>	MG/Yr

## AUTHORIZED CONSUMPTION

Billed metered:	<a href="#">?</a>	7	57,242.400	MG/Yr
Billed unmetered:	<a href="#">?</a>	n/a		MG/Yr
Unbilled metered:	<a href="#">?</a>	n/a		MG/Yr
Unbilled unmetered:	<a href="#">?</a>	8	764.200	MG/Yr

Click here: [?](#)  
for help using option buttons below

**AUTHORIZED CONSUMPTION:** [?](#) 58,006.600 MG/Yr

Pcnt:  Value:  764.200

Use buttons to select percentage of water supplied

OR value

**WATER LOSSES (Water Supplied - Authorized Consumption)** 26,650.600 MG/Yr

## Apparent Losses

Unauthorized consumption:	<a href="#">?</a>	8	2,086.300	MG/Yr
Customer metering inaccuracies:	<a href="#">?</a>	8	190.300	MG/Yr
Systematic data handling errors:	<a href="#">?</a>	5	4,674.400	MG/Yr
<b>Apparent Losses:</b>	<a href="#">?</a>		<b>6,951.000</b>	MG/Yr

Pcnt:  Value:  2,086.300

190.300

Choose this option to enter a percentage of billed metered consumption. This is NOT a default value

## Real Losses

Real Losses = Water Losses - Apparent Losses: [?](#) 19,699.600 MG/Yr

**WATER LOSSES:** 26,650.600 MG/Yr

## NON-REVENUE WATER

**NON-REVENUE WATER:** [?](#) 27,414.800 MG/Yr

= Total Water Loss + Unbilled Metered + Unbilled Unmetered



**SYSTEM DATA**

Length of mains:	<input type="text" value="9"/>	<input type="text" value="3,137.0"/>	miles
Number of <u>active AND inactive</u> service connections:	<input type="text" value="7"/>	<input type="text" value="547,932"/>	
Connection density:		<input type="text" value="175"/>	conn./mile main
<u>Average</u> length of customer service line:	<input type="text" value="7"/>	<input type="text" value="12.0"/>	ft (pipe length between curbstop and customer meter or property boundary)
Average operating pressure:	<input type="text" value="10"/>	<input type="text" value="55.0"/>	psi

**COST DATA**

Total annual cost of operating water system:	<input type="text" value="10"/>	<input type="text" value="\$219,182,339"/>	\$/Year
Customer retail unit cost (applied to Apparent Losses):	<input type="text" value="9"/>	<input type="text" value="\$4.97"/>	\$/1000 gallons (US)
Variable production cost (applied to Real Losses):	<input type="text" value="9"/>	<input type="text" value="\$215.50"/>	\$/Million gallons

**PERFORMANCE INDICATORS**

Financial Indicators

Non-revenue water as percent by volume of Water Supplied:	<input type="text" value="32.4%"/>
Non-revenue water as percent by cost of operating system:	<input type="text" value="17.8%"/>
Annual cost of Apparent Losses:	<input type="text" value="\$34,546,470"/>
Annual cost of Real Losses:	<input type="text" value="\$4,245,264"/>

Operational Efficiency Indicators

Apparent Losses per service connection per day:	<input type="text" value="34.76"/>	gallons/connection/day
Real Losses per service connection per day*:	<input type="text" value="98.50"/>	gallons/connection/day
Real Losses per length of main per day*:	<input type="text" value="N/A"/>	
Real Losses per service connection per day per psi pressure:	<input type="text" value="1.79"/>	gallons/connection/day/psi
<input type="text" value="?"/> Unavoidable Annual Real Losses (UARL):	<input type="text" value="2,178.15"/>	million gallons/year
<input type="text" value="?"/> Infrastructure Leakage Index (ILI) [Real Losses/UARL]:	<input type="text" value="9.04"/>	

\* only the most applicable of these two indicators will be calculated

**WATER AUDIT DATA VALIDITY SCORE:**

**\*\*\* YOUR SCORE IS: 82 out of 100 \*\*\***

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

**PRIORITY AREAS FOR ATTENTION:**

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

**1: Volume from own sources**

**2: Billed metered**

**3: Systematic data handling errors**

**For more information, click here to see the Grading Matrix worksheet**