American Water Works Association

Philadelphia Water Department

DRBC Workshop
Water System Audits and Water Loss Control

Bordentown, NJ

April 13, 2011

Module 2 Session 1

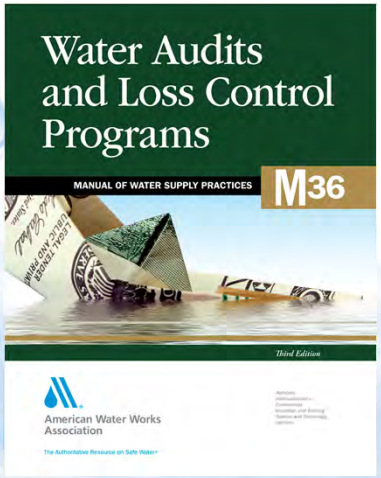
Water Auditing Resources and Tools

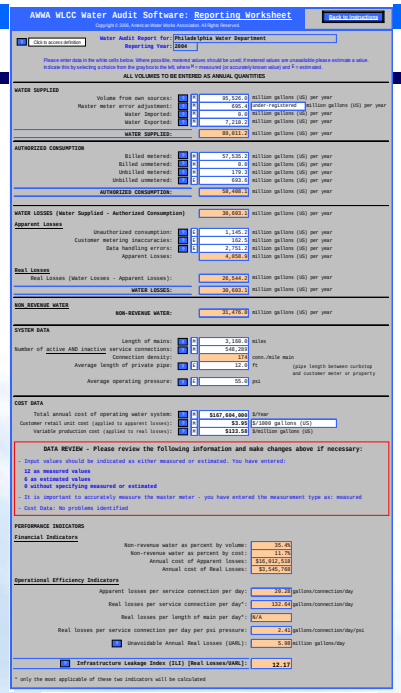
George Kunkel, P.E. Philadelphia Water Department

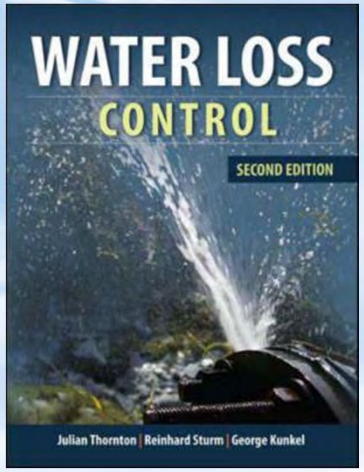
AWWA Water Loss Control Committee

AWWA Tools for Water Loss Control

- The “M” Series: Manuals of Practice
  - Guidance Manuals: widely recognized around the world as source of best practices in water utility operations and management
- AWWA Water Loss Control Committee’s Free Water Audit Software©
  - Originally released 2006; current Version 4.2 software (2010)
- Water Research Foundation Research Reports
- Textbooks
- www.awwa.com - type “water loss control” in search box; select first item in list

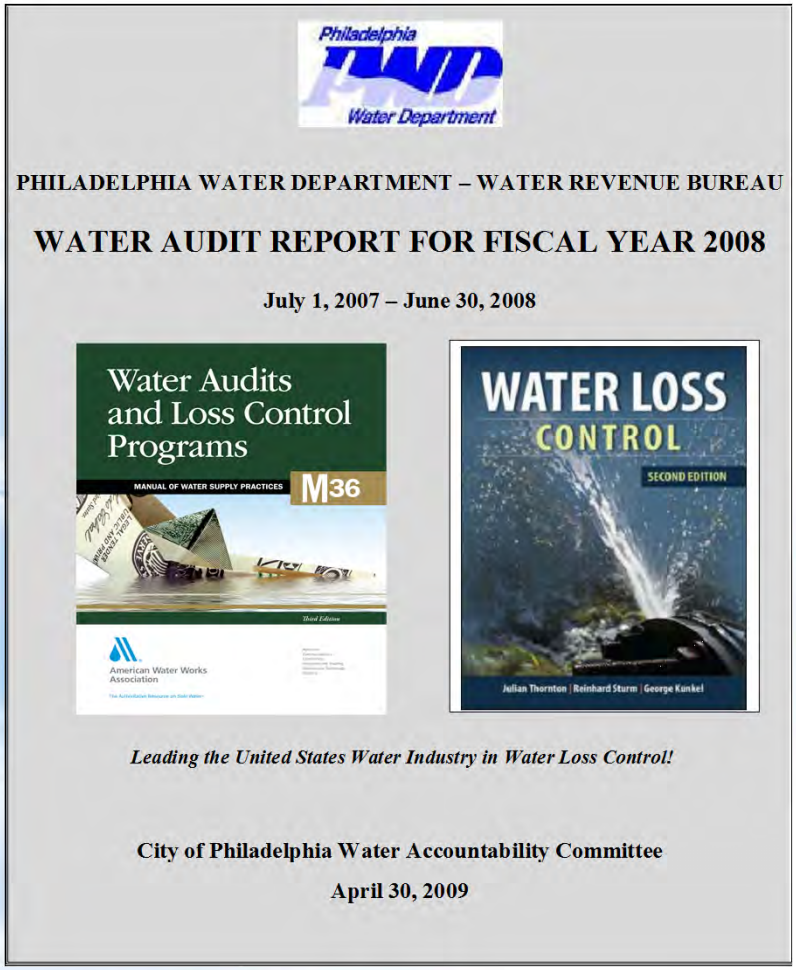






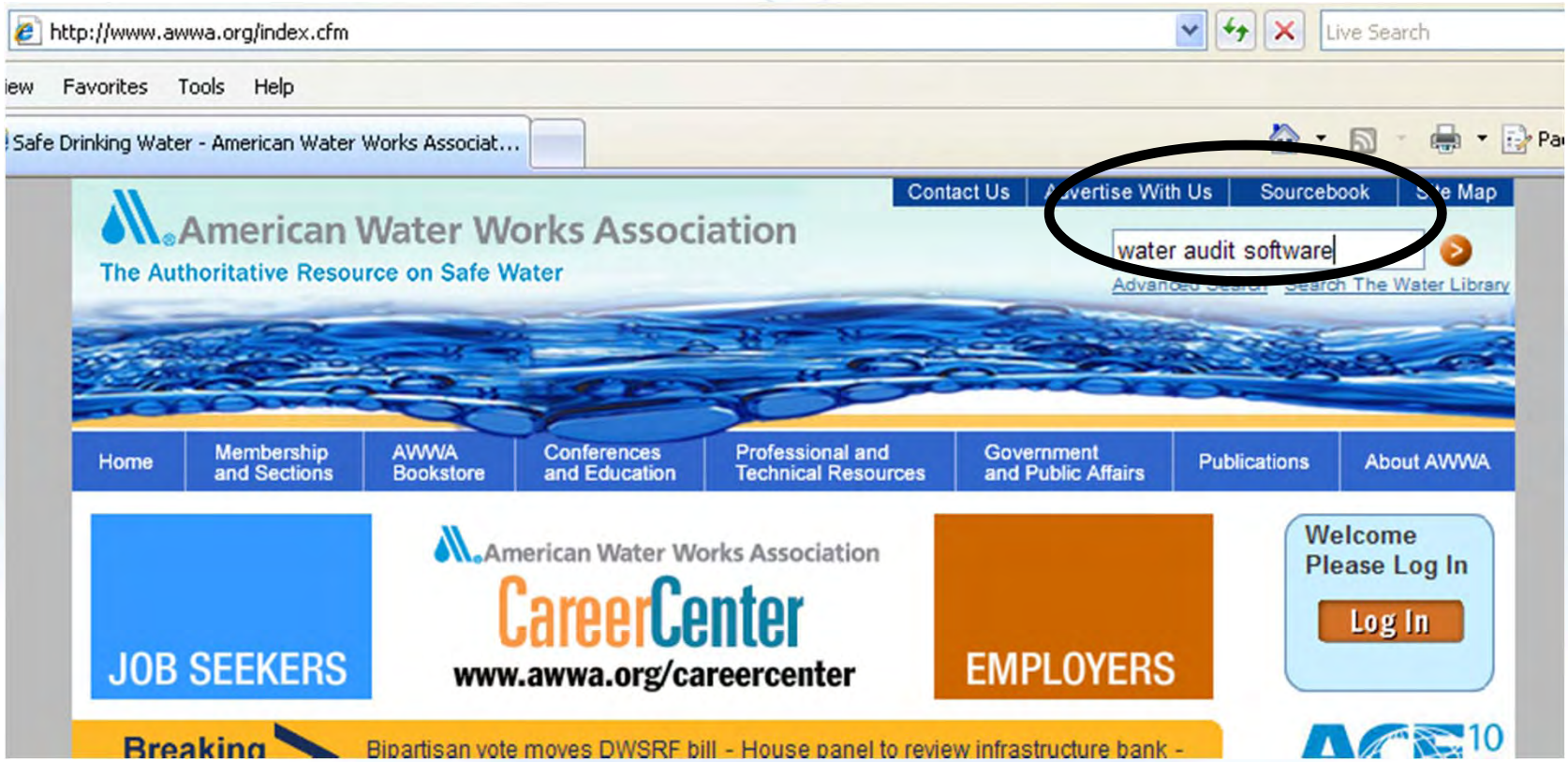
I. Philadelphia's Water Audit Features

- Compiled in MS EXCEL
- 30 Worksheets in a single workbook
- Format serves as a "Bottom-up" role; accepting data on detailed field investigations
- Primary water audit worksheet includes 90 detailed components of consumption & loss:
  - System Input volume: 4 components
  - Unbilled authorized consumption: 32 components
  - Apparent losses: 29 components
  - Real losses: 25 components
- Validity rated in qualitative manner; not quantitatively like AWWA software
- Email your request for a copy to: george.kunkel@phila.gov



II. AWWA Website: Water Wiser's Water Loss Control web pages

- Type water audit software or water loss control in the search box

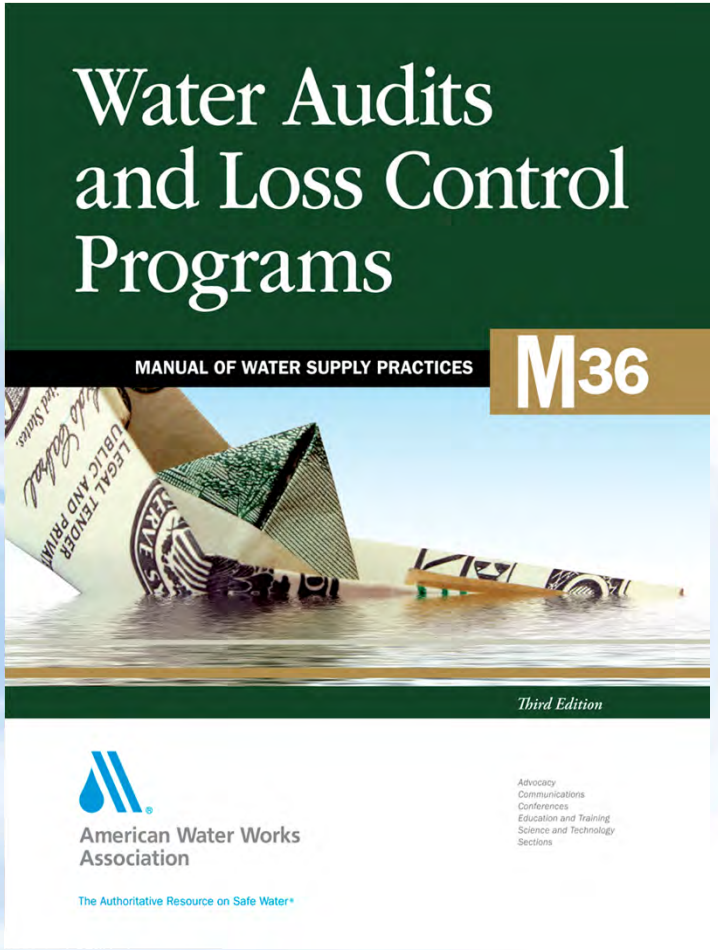


III. AWWA Water Loss Control Committee Projects

- 2001 States Survey Project
  - http://www.awwa.org/files/science/WaterLoss/AWWA-WaterLossPolicy.doc
- 2003: AWWA Water Loss Control Committee Report
  - Published in *Journal AWWA* in August
  - *Applying Worldwide Best Management Practices in Water Loss Control*
  - See workshop handouts, or:
  - http://apps.awwa.org/WaterLibrary/showabstract.aspx?an=JAW_0058472

IV. AWWA M36 Publication

- 3rd Edition, 2009
- The detailed “how-to” guide for water auditing for water utilities
- Available for purchase from AWWA



M36 3rd Edition Table of Contents

M36 Publication: Third Edition, 2009

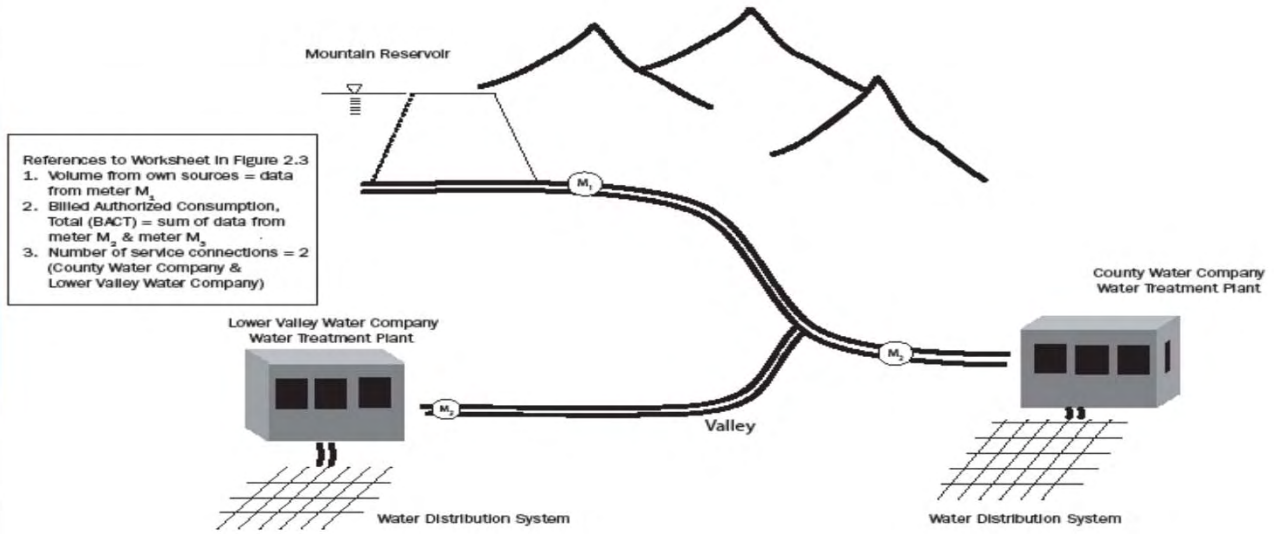
- Features
  1. Conduct annual water audit as *standard business practice*
  2. Describes 3 levels of auditing detail:
     - "top-down" approach (desktop gathering of information)
     - component analysis of leakage
     - "bottom-up" auditing (field measurements and investigations)
  3. Standard terms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

M36 Publication: Third Edition, 2009

- Defines and explains the Occurrence of Leakage in Distribution Systems and 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

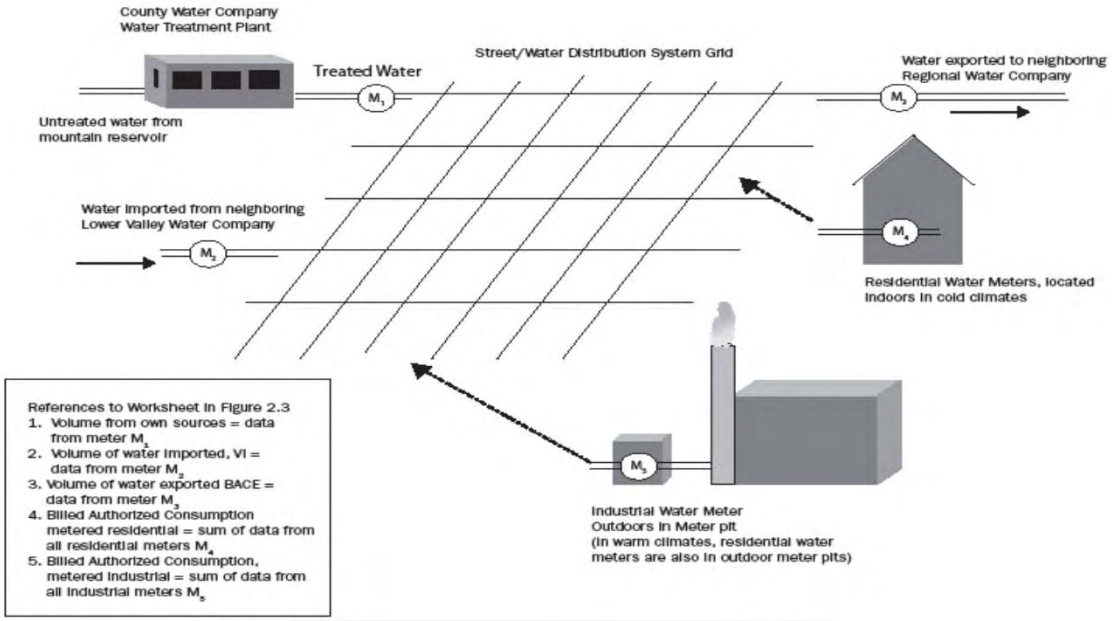
System Boundaries

- Raw or untreated water supply
  - Regional water agencies often sell water on a wholesale basis to local water utilities



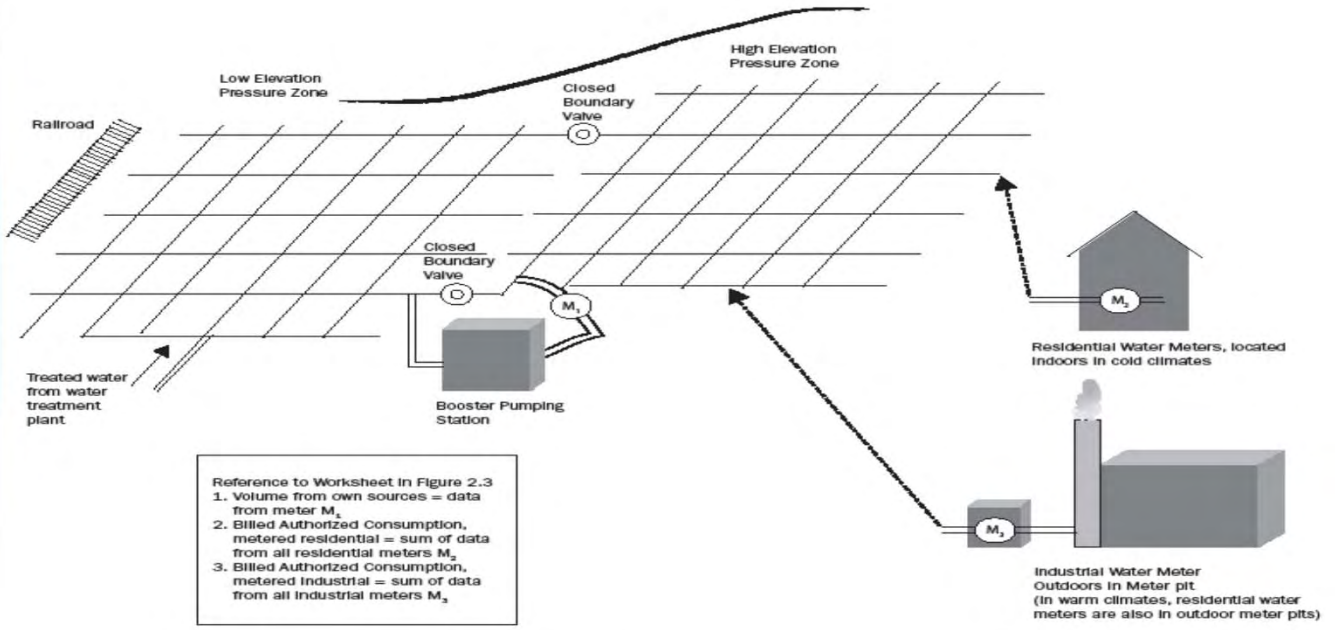
System Boundaries

- Retail Water Supply System
  - Typical of most water utilities
  - Used in the examples throughout the M36



System Boundaries

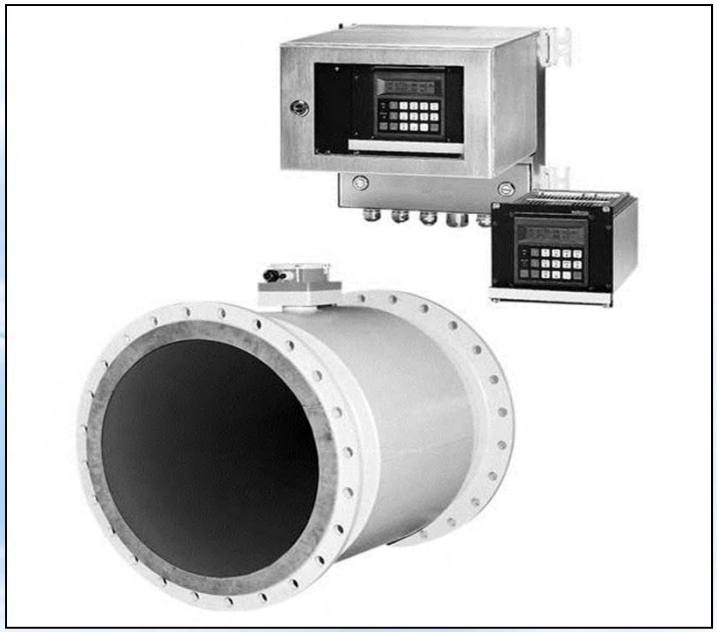
- Individual Zones or DMAs of a retail Water Supply System
  - » Can audit individual zones as desired
  - » Becomes complex in systems with many zones



Assembling Water Audit Data: Chapter 2

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

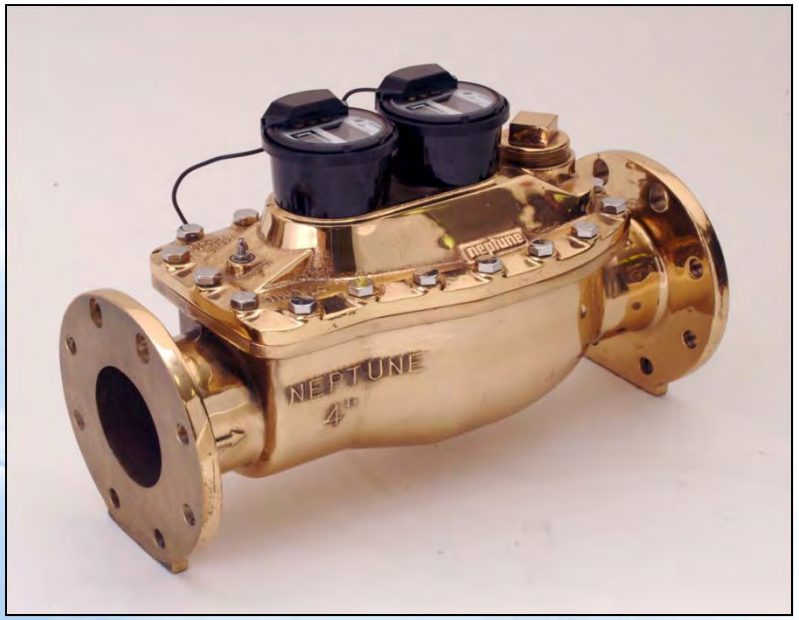
- Water Supplied: source meter data, imports/exports
  - Source meter data: system input
  - Water imported: added
  - Water exported: subtracted
- Master Meter Error Adjustment
  - Added if source meter under-registration exists
  - Subtracted is source meter over-registration exists



Assembling Water Audit Data

Authorized Consumption: water that meets a beneficial use, and is sanctioned by the water utility

- Billed Metered
- Billed Unmetered
- Unbilled Metered
- Unbilled Unmetered



Assembling Water Audit Data

Apparent Losses: cause uncaptured revenue and distort the integrity of customer consumption data

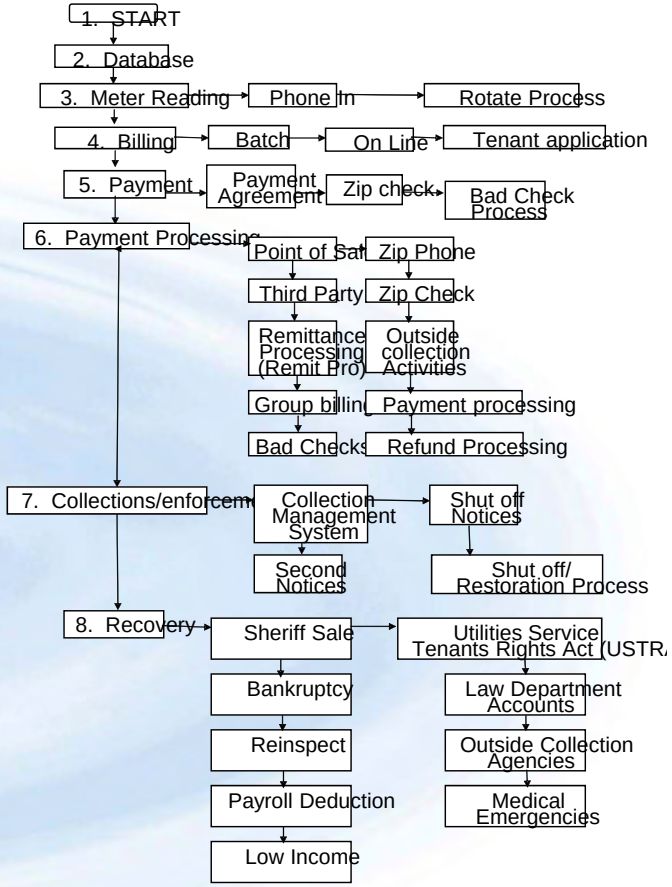
- Customer Metering Inaccuracies
  - Assemble meter demographics from records
  - Conduct regular meter accuracy testing, small samples of meters will suffice
- Unauthorized Consumption
  - Can use default value of 0.25% of water supplied volume
- Systematic Data Handling Errors

Assembling 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
- The “dark horse” of loss auditing
  - Can be subtle and tedious
  - Can often be readily corrected by programming or procedures improvements
- The suggested starting point is assessing apparent losses – ***find out what goes on in the billing system! Start with a flow-charting process***

OVERVIEW OF CUSTOMER BILLING SYSTEM



Assembling Water Audit Data

Systematic Data Handling Error

- Data Transfer Error
  - Customer meter reading
  - Manual meter reading
    - Limited efficiency in many areas
  - Automatic Meter Reading
    - High data transfer efficiency
    - AMI offers a new world of capabilities
- Data Handling Error
  - Customer Billing Systems
    - Created with financial intentions
    - Used for financial & operations purposes
      - Billing adjustments, non-billed accounts, poor account management

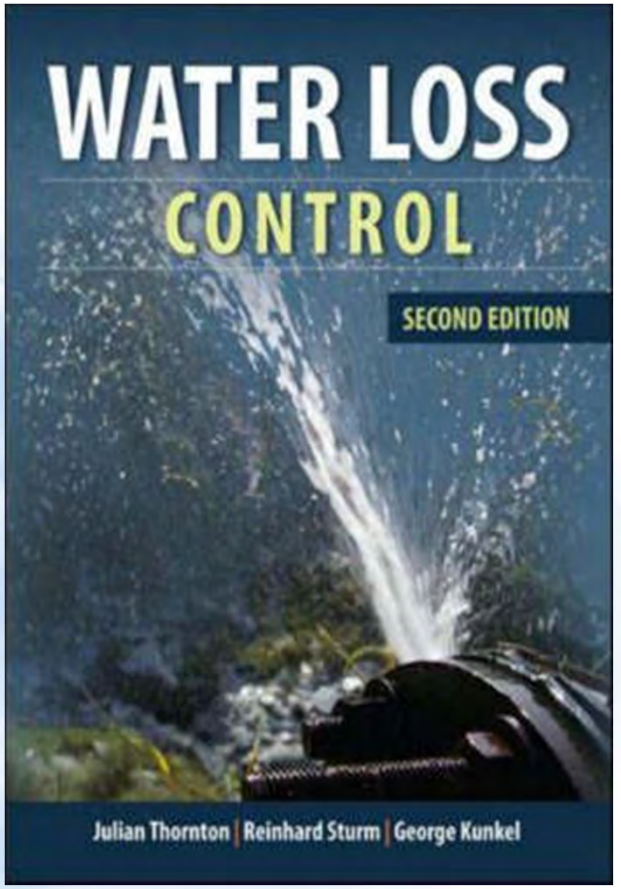
City of Philadelphia – 2nd largest water utility AMR System in the United States

Quantifying Real Losses in the Water Audit

- 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

V. Water Loss Textbooks

- Water Loss Control, 2nd Edition (2008)
- Strong guidance on loss control activities
  - Real losses: leakage management
  - Apparent losses:
    - Customer metering
    - Addressing unauthorized consumption
    - Analyzing the customer billing system data

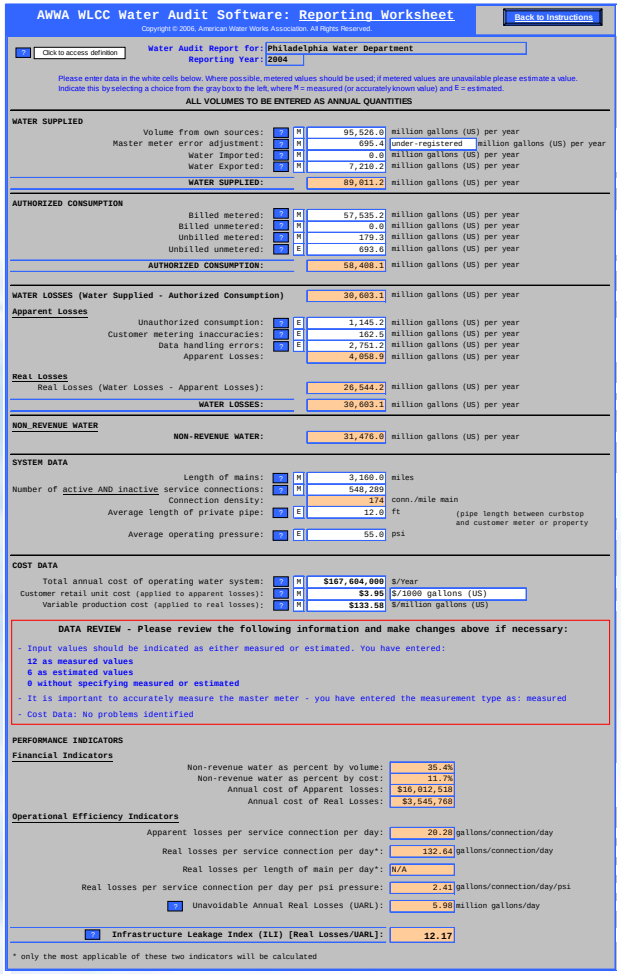


VI. Water Auditing and Loss Control Research Projects

- Water Research Foundation
  - Project 2811: Evaluating Water Losses and Planning Loss Control Strategies (2006)
  - Project 2928: Leakage Management Technologies
  - Project 3183: Continuous Leak Monitoring - from Start to Repair (final report awaited)
  - Project 4372: Effective Organization and Component Analysis of Water Utility Leakage Data (launching in 2011)
- United Kingdom Water Industry Research
  - See the “Managing Leakage” series of reports

VII. AWWA Free Water Audit Software©

- Version 4.2 issued May 2010
- Designated water audit data collection method by:
  - Delaware River Basin Commission
  - PA PUC Pilot Program (2009-2010)
  - California Urban Water Conservation Council
    - 300 large water utilities
  - State of Georgia
- Users can refer questions or comments to **wlc@aww.org**



AWWA WLCC Water Audit Software: Reporting Worksheet

Back to Instructions

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Click to access definition

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 box 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	95,526.0	million gallons (US) per year	
Master meter error adjustment:	M	695.4	under-registered	million gallons (US) per year
Water Imported:	M	0.0	million gallons (US) per year	
Water Exported:	M	7,210.2	million gallons (US) per year	
WATER SUPPLIED:		89,011.2	million gallons (US) per year	

AUTHORIZED CONSUMPTION

Billed metered:	M	57,535.2	million gallons (US) per year
Billed unmetered:	M	0.0	million gallons (US) per year
Unbilled metered:	M	179.3	million gallons (US) per year
Unbilled unmetered:	E	693.6	million gallons (US) per year
AUTHORIZED CONSUMPTION:		58,408.1	million gallons (US) per year

WATER LOSSES (Water Supplied - Authorized Consumption) 30,603.1 million gallons (US) per year

Apparent Losses

Unauthorized consumption:	E	1,145.2	million gallons (US) per year
Customer metering inaccuracies:	E	162.5	million gallons (US) per year
Data handling errors:	E	2,751.2	million gallons (US) per year
Apparent Losses:		4,058.9	million gallons (US) per year

Real Losses

Real Losses (Water Losses - Apparent Losses):	26,544.2	million gallons (US) per year
WATER LOSSES:	30,603.1	million gallons (US) per year

NON_REVENUE WATER

NON-REVENUE WATER:	31,476.0	million gallons (US) per year

SYSTEM DATA

Length of mains:	M	3,160.0	miles	
Number of active AND inactive service connections:	M	548,289		
Connection density:		174	conn./mile main	
Average length of private pipe:	E	12.0	ft	(pipe length between curbstop 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	$/1000 gallons (US)
Variable production cost (applied to real losses):	M	$133.58	$/million gallons (US)

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

Financial Indicators

Non-revenue water as percent by volume:	35.4%
Non-revenue water as percent by cost:	11.7%
Annual cost of Apparent losses:	$16,012,518
Annual cost of Real Losses:	$3,545,768

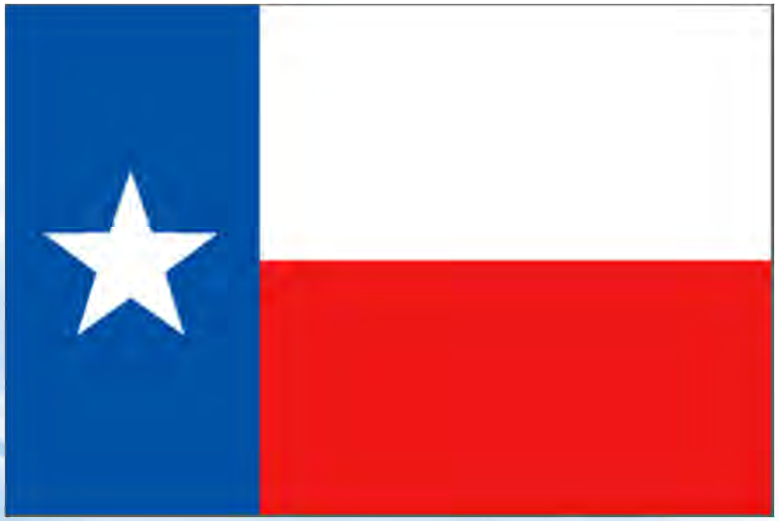
Operational Efficiency Indicators

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:	2.41	gallons/connection/day/psi
Unavoidable Annual Real Losses (UARL):	5.96	million gallons/day
Infrastructure Leakage Index (ILI) [Real Losses/UARL]:	12.17	

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

VIII. Regulatory Agencies:State of Texas

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



Report on evaluation of 2005 data can be found at:
http://www.twdb.state.tx.us/RWPG/rpfgm_rpts.asp

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©
  - Software training workshops held

www.legis.ga.gov/legis/2009_2010/pdf/sb370.pdf

www.northgeorgiawater.com/files/WSWC_SECTION8.PDF

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

Delaware River Basin Commission
DELAWARE · NEW JERSEY
PENNSYLVANIA · NEW YORK
UNITED STATES OF AMERICA

PENNSYLVANIA
PUC
PUBLIC UTILITY COMMISSION

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
  - Will utilize AWWA Free Water Audit Software©
- www.cuwcc.org/mou/bmp1-utility-operations-programs.aspx

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

IX. Conferences

- AWWA Annual Conference & Exposition June 12-15, 2011 Washington DC
  - Water Loss Control Committee meeting on Monday afternoon, June 13th
  - Water Loss Control Technical Session on Tuesday morning, June 14th
- Distribution System Symposium Sept 11-14, 2011, Nashville, TN
  - Water Loss Control – all day technical session on Tuesday, Sept 13th

X. AWWA Water Loss Control Committee

- Promotes water audits and efficiency best practices
- Maintains M36 Publication
- Maintains AWWA Free Water Audit Software©
- Conducts workshops, conference sessions, webcasts and trainings
- Partnered with IWA Water Loss Specialist Group
- 2011: Water Audit Data Collection Initiative
  - Look for list of validated water audit data later in 2011 on AWWA website

Got Tools???

- We've got 'em
  - Guidance Manual
  - Textbooks
  - Research reports
  - Web pages
  - Software
  - Regulatory agencies
  - Conferences
  - Networking
- Plenty of great tools exist for water auditing and loss control!!!