

This presentation premiered at WaterSmart Innovations

watersmartinnovations.com





American Water Works
Association

AWWA's New and Improving Tools and Publications for Water Loss Control

Las Vegas, NV
October 8, 2014

George Kunkel P.E.

Philadelphia Water Department

george.kunkel@phila.gov

Water Audits and Loss Control Programs

MANUAL OF WATER SUPPLY PRACTICES

M36

Third Edition

Research Foundation Report

Infrastructure



**WATER
RESEARCH
FOUNDATION**
ADVANCING THE
SCIENCE OF WATER®

WATER LOSS CONTROL

SECOND EDITION

nton | Reinhard Sturm | George Kunkel

AWWA Free Water Audit Software: Reporting Worksheet

City or town name:

State:

Water audit report for:

Northern San Joaquin Combined Water Sewer Storm Utility District (0007990)

Report Year:

2013

2012

Please enter data in the white cells below. Where available, related values will be filled in if entered values are reasonable. Please estimate a value. Indicate your confidence in the accuracy of the input data by grading each component (see page 3-2) using the drop-down list to the left of the input cell. How the misuse over the unit to obtain a description of the grades.

All volumes to be entered as gallons per day (GPD). Enter negative GPD values for return flow.

WATER SUPPLIED

Volume from own sources

1,000,000

MGD/m³

Volume from other sources

0

MGD/m³

Water exported

0

MGD/m³

Water imported

0

MGD/m³

WATER SUPPLIED:

826,000

MGD/m³

AUTHORIZED CONSUMPTION

Billed metered

300,000

MGD/m³

Billed unmetered

50,000

MGD/m³

Unbilled metered

0

MGD/m³

Unbilled unmetered

53,833

MGD/m³

Default option selected for unbilled unmetered - a grading of 3 is applied but not displayed

AUTHORIZED CONSUMPTION:

353,833

MGD/m³

WATER LOSSES (Water Supplied - Authorized Consumption)

472,167

MGD/m³

Apparent Losses

Unaccounted consumption

3,000

MGD/m³

Unauthorized consumption volume entered is greater than the recommended default value

Customer metering inaccuracies

7,000

MGD/m³

Systematic data handling errors

5,000

MGD/m³

Apparent Losses:

15,000

MGD/m³

Real Losses (Current Annual Real Losses or CARL)

Real Losses = Water Losses - Apparent Losses:

458,167

MGD/m³

Real Losses = Water Losses:

472,167

MGD/m³

NON-REVENUE WATER

Non-Revenue Water:

75,000

MGD/m³

Water Losses - Unbilled Metered + Unauthorized Consumption

1,000

MGD/m³

SYSTEM DATA

Length of mains

100

miles

Number of valves AND operating service connections

10

valves/inch main

Service connection density

10

per inch main

Are customer meters typically located at the curbstop or property line?

Yes

(length of service line, below the property boundary, is included in the length of the system. The responsibility of the utility.)

Average length of customer service line has been set to zero and a data grading score of 10 has been applied.

Average operating pressure

60

psi

COST DATA

Total annual cost of operating water system

\$1,000,000

/year

Customer retail unit cost (applied to Apparent Losses)

\$10,000

/gallons (US)

Variable production cost (applied to Real Losses)

\$5,000

/million gallons

(Use Customer Retail Unit Cost or value real losses)

WATER AUDIT DATA VALIDITY SCORE:

*** YOUR SCORE IS: 68 out of 100 ***

A weighted scale for the comparison 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:

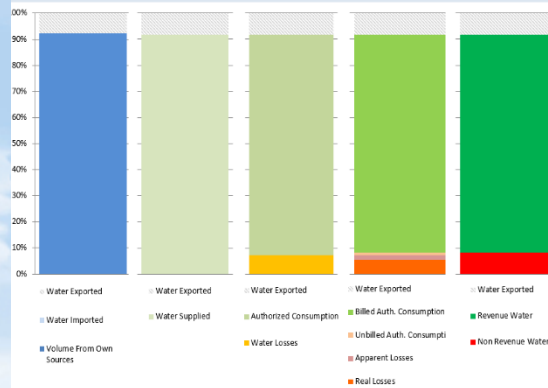
1. Volume totals of operating water system

2. Customer metering inaccuracies

3. Total annual cost of operating water system

The graphic below is a visual representation of the Water Balance with bar heights proportional to the volume of the audit components

Water Audit Report for:	Northern San Leandro Combined Water Sewer Storm Utility District (0007900)	
Reporting Year:	2013	1/2013 - 12/2013
Data Validity Score:	60	



AWWA Free Water Audit Software:		WAS v6.0
<u>M Attributes and Performance Indicators</u>		American Water Works Association Copyright © 2004. All Rights Reserved.
Report for: Philadelphia Water Department		
Year:	<u>2013</u>	<u>1/2013 - 12/2013</u>
WATER AUDIT DATA VALIDITY SCORE IS: 77 out of 100 ***		
Apparent Losses: <u>7,495,000</u> MG/Yr + Real Losses: <u>21,267,500</u> MG/Yr = Water Losses: <u>28,762,500</u> MG/Yr		
Unavoidable Annual Real Losses (AARL)	<u>2,497,300</u> MG/Yr	
Annual cost of Apparent Losses:	<u>\$54,788,450</u>	
Annual cost of Real Losses:	<u>\$7,369,329</u>	Valued at Variable Production Cost Return to Reporting Worksheet when change this assumption
% percent by volume of Water Supplied:	<u>38.1%</u>	
% as percent by cost of operating system:	<u>25.2%</u>	Real Losses valued at Variable Production Costs
Losses per service connection per day:	<u>38.95</u> gallons/connection/day	
Losses per service connection per day:	<u>110.52</u> gallons/connection/day	
Real Losses per length of main per day:	<u>N/A</u>	
Real connection per day per psi pressure:	<u>1.70</u> gallons/connection/day/psi	
CARL = Current Annual Real Losses (CARL):	<u>21,267,500</u> million gallons/year	
Leakage Index (LI) [GAL]/[AARL]	<u>8.52</u>	
Service connection density of less than 32 Service connections/mile of pipeline		

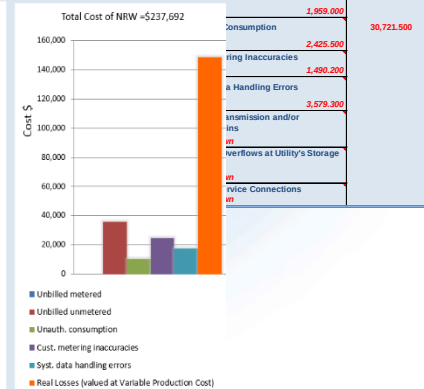
Free Water Audit Software: [Water Balance](#)

American Water Works Association
Copyright © 2014, All Rights Reserved WWA-010

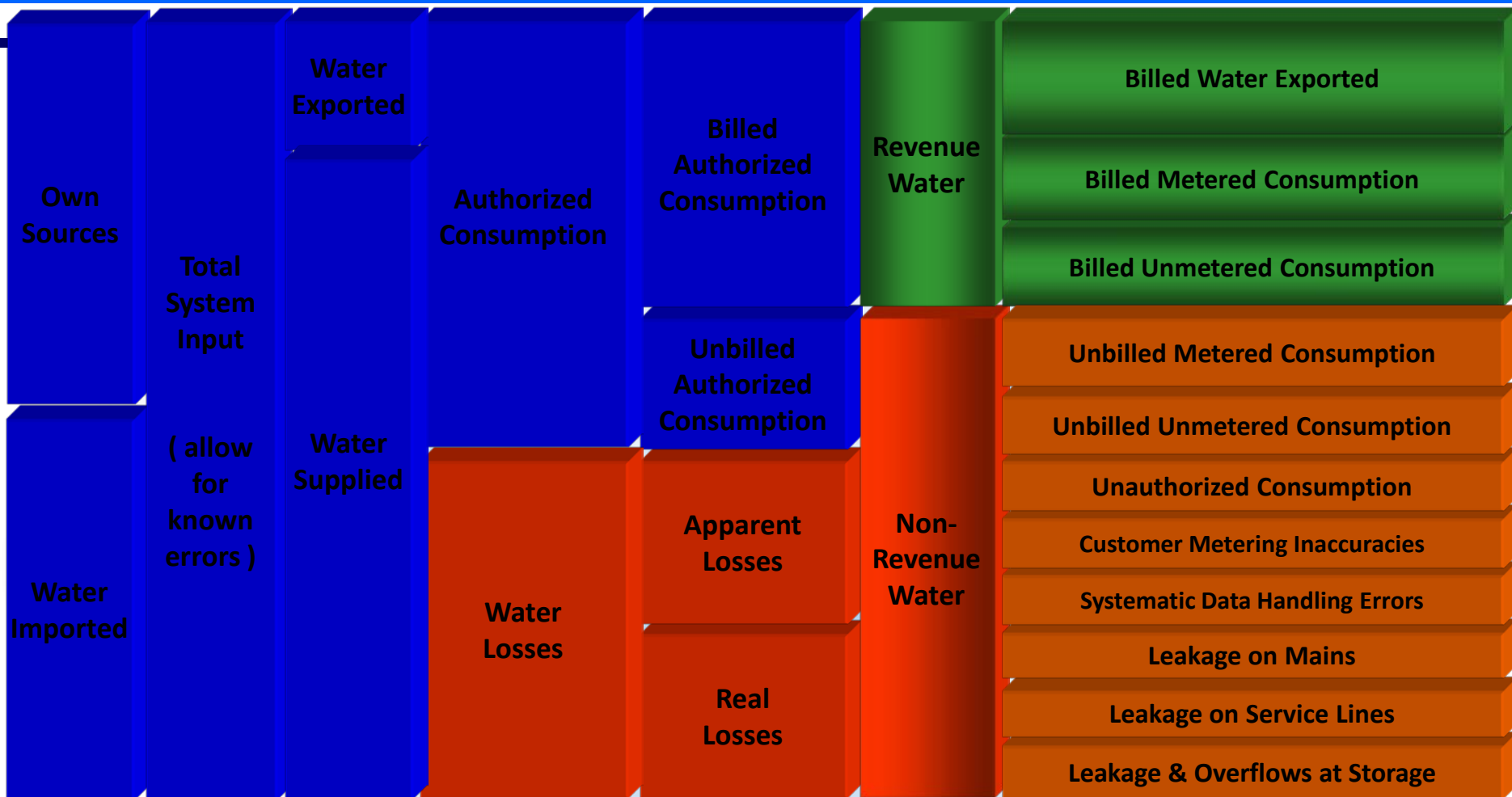
Report for: Philadelphia Water Department	
Year: 2013	Period: 1/2013 - 12/2013
Score: 77	

Billed Water Exported		Revenue Water
Billed Authorized Consumption	Billed Metered Consumption (water exported is removed)	
49,907,000	49,907,000	49,907,000
Billed Unmetered Consumption		
	0.000	
Non-Water Utility District (0007900)		
☐ Show me the <u>VOLUME</u> of Non-Revenue Water ☒ Show me the <u>COST</u> of Non-Revenue Water	Billed Consumption 0.000	Non-Revenue Water (NRW) 0.000
Total Cost of NRW = \$237,692		

Cost Breakdown	Amount	Percentage
Metering Inaccuracies	2,425,500	30.72%
Leakage & Handling Errors	1,490,200	
Transmission and/or Distribution Losses	2,579,300	
Overflows at Utility's Storage		
Other		
Pipe Connections		



IWA / AWWA Standard Water Balance



Management of NRW

- Fire Dept Usage
- Operational Flushing
- Tools for control include



efficient flushing practices and awareness campaigns

- Non-physical / revenue loss - slow meters, billing issues and theft

- Cost impacts at 'retail' rate.

- Tools for control include data management, quality control policies/practices, & meter testing & replacement

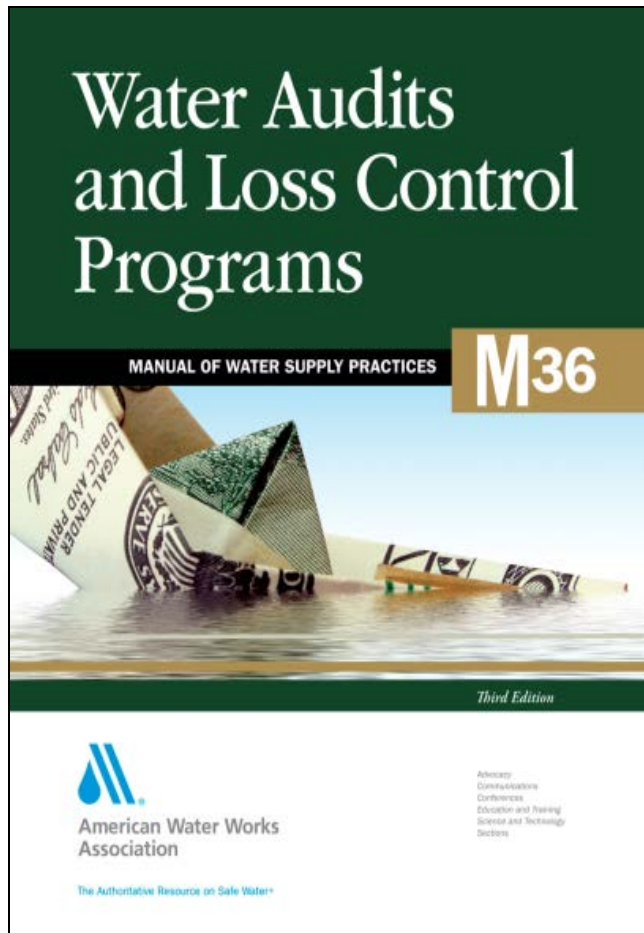
- Physical loss - leakage

- Cost impacts at 'wholesale' rate

- Tools for control include leakage and pressure management



AWWA's Best Practice Guidance Manual



History

- 1st Edition (1991) Based upon method from California Dept. of Water Resources
- 2nd Edition (1999) Minimal revisions
- 3rd Edition (2009) Major rewrite based upon IWA Water Audit Method
- 4th Edition (2015 targeted)
Expansion of content on new tools and better management of water production metering and data management

AWWA Free Water Audit Software

BETA TEST v3 --- AWWA Free Water Audit Software v5.0 --- BETA TEST v3

American Water Works Association Copyright © 2014. All Rights Reserved.

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.

Auditors are strongly encouraged to refer to the most current edition of AWWA M36 Manual for Water Audits for detailed guidance on the water auditing process and targeting loss reduction levels

The spreadsheet contains several separate worksheets. Sheets can be accessed using the tabs towards the bottom of the screen, or by clicking the buttons below.

Please begin by providing the following information

Name of Contact Person:
Email Address:
Telephone (incl Ext.):
Name of City / Utility:
City/Town/Municipality:
State / Province:
Country:
Year:

Audit Preparation Date:
Volume Reporting Units:
PWSID / Other ID:

The following guidance will help you complete the Audit

All audit data are entered on the [Reporting Worksheet](#)

Value can be entered by user
 Value calculated based on input data
 These cells contain recommended default values

Use of Option
(Radio) Buttons: ☒ 0.25% ☐

Select the default percentage by choosing the option button on the left

To enter a value, choose this button and enter a value in the cell to the

The following worksheets are available by clicking the buttons below or selecting the tabs along the bottom of the page

Instructions

The current sheet.
Enter contact information and basic audit details (year, units etc)

Reporting Worksheet

Enter the required data on this worksheet to calculate the water balance and data grading

Comments

Enter comments to explain how values were calculated or to document data sources

Performance Indicators

Review the performance indicators to evaluate the results of the audit

Water Balance

The values entered in the Reporting Worksheet are used to populate the Water Balance

Dashboard

A graphical summary of the water balance and Non-Revenue Water components

Grading Matrix

Presents the possible grading options for each input component of the audit

Service Connection Diagram

Diagrams depicting possible customer service connection line configurations

Definitions

Use this sheet to understand the terms used in the audit process

Loss Control Planning

Use this sheet to interpret the results of the audit validity score and performance indicators

Example Audits

Reporting Worksheet and Performance Indicators examples are shown for two validated audits

Acknowledgements

Acknowledgements for the AWWA Free Water Audit Software v5.0

If you have questions or comments regarding the software please contact us via email at: wc@awwa.org

Instructions Worksheet

Software Features

- Industry Standard
- "FREE"
- +10,000 downloads
- Defaults provided
- 10 volume inputs
- 7 system data inputs
- Data grading

Awwa.org/resources-tools/water-knowledge/water-loss-control.gspix



AWWA Free Water Audit Software: Reporting Worksheet

WAS v5.0

American Water Works Association.
Copyright © 2014, All Rights Reserved.

?	Click to access definition
+	Click to add a comment

Water Audit Report for: **Northern San Leandro Combined Water Sewer Storm Utility District (0007900)**
Reporting Year: **2013** **1/2013 - 12/2013**

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 (n/a or 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

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

WATER SUPPLIED

<----- Enter grading in column 'E' and 'J' ----->

Volume from own sources:	+	?	5	1,000.000	MG/Yr
Water imported:	+	?			MG/Yr
Water exported:	+	?	1	100.000	MG/Yr

Master Meter Error Adjustments

Pcnt:	Value:	
+	?	1
+	?	
+	?	9

Enter negative % or value for under-registration
 Enter positive % or value for over-registration

WATER SUPPLIED: **825.000** MG/Yr

AUTHORIZED CONSUMPTION

Billed metered:	+	?	8	700.000	MG/Yr
Billed unmetered:	+	?	9	50.000	MG/Yr
Unbilled metered:	+	?			MG/Yr
Unbilled unmetered:	+	?		10.313	MG/Yr

Default option selected for Unbilled unmetered - a grading of 5 is applied but not displayed

AUTHORIZED CONSUMPTION: **?** **760.313** MG/Yr

Click here: ?
 for help using option
 buttons below

Pcnt:	Value:	
1.25%		

..... Use buttons to select
 percentage of water
 supplied
OR
 value

Pcnt:	Value:	
		3.000

1.00%		
		5.000

WATER LOSSES (Water Supplied - Authorized Consumption)

64.688 MG/Yr

Apparent Losses

Unauthorized consumption:	+	?	10	3.000	MG/Yr
---------------------------	---	---	----	-------	-------

Unauthorized consumption volume entered is greater than the recommended default value

Customer metering inaccuracies:	+	?	5	7.071	MG/Yr
Systematic data handling errors:	+	?	4	5.000	MG/Yr

Apparent Losses: **?** **15.071** MG/Yr

Real Losses (Current Annual Real Losses or CARL)

Real Losses = Water Losses - Apparent Losses: **?** **49.617** MG/Yr

WATER LOSSES: **64.688** MG/Yr

NON-REVENUE WATER

NON-REVENUE WATER: **?** **75.000** MG/Yr

Unauthorized consumption: MG/Yr

MG/Yr

Unauthorized consumption volume entered is greater than the recommended default value

Customer metering inaccuracies: MG/Yr

Systematic data handling errors: MG/Yr

MG/Yr

MG/Yr

Apparent Losses: MG/Yr

Real Losses (Current Annual Real Losses or CARL)

Real Losses = Water Losses - Apparent Losses: MG/Yr

WATER LOSSES: MG/Yr

NON-REVENUE WATER

NON-REVENUE WATER: MG/Yr

= Water Losses + Unbilled Metered + Unbilled Unmetered

SYSTEM DATA

Length of mains: miles

Number of active AND inactive service connections:

Service connection density: conn./mile main

Are customer meters typically located at the curbside or property line?

(length of service line, beyond the property boundary, that is the responsibility of the utility)

Average length of customer service line:

Average length of customer service line has been set to zero and a data grading score of 10 has been applied

Average operating pressure: psi

COST DATA

Total annual cost of operating water system: \$/Year

Customer retail unit cost (applied to Apparent Losses): \$/1000 gallons (US)

Variable production cost (applied to Real Losses): \$/Million gallons ☐ Use Customer Retail Unit Cost to value real losses

WATER AUDIT DATA VALIDITY SCORE:

*** YOUR SCORE IS: 60 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: Customer metering inaccuracies

3: Total annual cost of operating water system



AWWA Free Water Audit Software: System Attributes and Performance Indicators

WAS v5.0

American Water Works Association.
Copyright © 2014, All Rights Reserved.

Water Audit Report for: **Northern San Leandro Combined Water Sewer Storm Utility District (0007900)**
Reporting Year: **2013** **1/2013 - 12/2013**

*** YOUR WATER AUDIT DATA VALIDITY SCORE IS: 60 out of 100 ***

System Attributes:

Apparent Losses:	15.071	MG/Yr
+ Real Losses:	49.617	MG/Yr
= Water Losses:	64.688	MG/Yr

? Unavoidable Annual Real Losses (UARL): 15.13 MG/Yr

Annual cost of Apparent Losses: \$52,747

Annual cost of Real Losses: \$148,850 Valued at **Variable Production Cost**

Return to Reporting Worksheet to change this assumption

Performance Indicators:

Financial: { Non-revenue water as percent by volume of Water Supplied: 9.1%
Non-revenue water as percent by cost of operating system: 23.3% Real Losses valued at Variable Production Cost

Operational Efficiency: { Apparent Losses per service connection per day: 41.29 gallons/connection/day
Real Losses per service connection per day: N/A gallons/connection/day
Real Losses per length of main per day*: 1,359.36 gallons/mile/day
Real Losses per service connection per day per psi pressure: N/A gallons/connection/day/psi

From Above, Real Losses = Current Annual Real Losses (CARL): 49.62 million gallons/year

? Infrastructure Leakage Index (ILI) [CARL/UARL]: 3.28

* This performance indicator applies for systems with a low service connection density of less than 32 service connections/mile of pipeline

AWWA Free Water Audit Software[©] (V5.0)

Data Grading for each input



AWWA Free Water Audit Software: Reporting Worksheet

WAS v5

American Water Works Ass
Copyright © 2014, All Rights Re

?	Click to access definition
+	Click to add a comment

Water Audit Report for: << Please enter system details and contact information on the Instructions tab >>
Reporting Year:

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 (n/a or 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

PLEASE CHOOSE REPORTING UNITS FROM THE INSTRUCTIONS SHEET BEFORE ENTERING DATA

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

Master Meter Error Adjustments

WATER SUPPLIED

Volume from own sources:
Water imported:
Water exported:

WATER SUPPLIED:

AUTHORIZED CONSUMPTION

Billed metered:
Billed unmetered:
Unbilled metered:
Unbilled unmetered:

Enter a positive value, otherwise a default percentage of 1.25% (of billed metered)

AUTHORIZED CONSUMPTION:

Enter grading in column 'E' and 'J' -----> Pcnt: Value:
n/a (not applicable). Select this grading only if the water utility purchases/imports all of its water resources (i.e. has no sources of its own)
1. Less than 25% of water production sources are metered, remaining sources are estimated. No regular meter accuracy testing or electronic calibration conducted.
2. 25% - 50% of treated water production sources are metered; other sources estimated. No regular meter accuracy testing or electronic calibration conducted.
3. Conditions between 2 and 4
4. 50% - 75% of treated water production sources are metered, other sources estimated. Occasional meter accuracy testing or electronic calibration conducted.
5. Conditions between 4 and 6
6. At least 75% of treated water production sources are metered, or at least 90% of the source flow is derived from metered sources. Meter accuracy testing and/or electronic calibration of related instrumentation is conducted annually. Less than 25% of tested meters are found outside of +/- 6% accuracy.
7. Conditions between 6 and 8
8. 100% of treated water production sources are metered, meter accuracy testing and electronic calibration of related instrumentation is conducted annually, less than 10% of meters are found outside of +/- 6% accuracy
9. Conditions between 8 and 10
10. 100% of treated water production sources are metered, meter accuracy testing and electronic calibration of related instrumentation is conducted semi-annually, with less than 10% found outside of +/- 3% accuracy. Procedures are reviewed by a third party knowledgeable in the M36 methodology.

WATER LOSSES (Water Supplied - Authorized Consumption)

0.000

Apparent Losses

Unauthorized consumption: 0.000

Default option selected for unauthorized consumption - a grading of 5 is applied but not displayed

Customer metering inaccuracies: 0.000
Systematic data handling errors: 0.000

Pcnt:	Value:
0.25%	☐
1.00%	☐
0.25%	☐

AWWA Free Water Audit Software©

Guidance on Use of Water Audit Data

Water Loss Control Planning Guide					
	Water Audit Data Validity Level / Score				
Functional Focus Area	Level I (0-25)	Level II (26-50)	Level III (51-70)	Level IV (71-90)	Level V (91-100)
Audit Data Collection	Launch auditing and loss control team; address production metering deficiencies	Analyze business process for customer metering and billing functions and water supply operations. Identify data gaps.	Establish/revise policies and procedures for data collection	Refine data collection practices and establish as routine business process	Annual water audit is a reliable gauge of year-to-year water efficiency standing
Short-term loss control	Research information on leak detection programs. Begin flowcharting analysis of customer billing system	Conduct loss assessment investigations on a sample portion of the system: customer meter testing, leak survey, unauthorized consumption, etc.	Establish ongoing mechanisms for customer meter accuracy testing, active leakage control and infrastructure monitoring	Refine, enhance or expand ongoing programs based upon economic justification	Stay abreast of improvements in metering, meter reading, billing, leakage management and infrastructure rehabilitation
Long-term loss control		Begin to assess long-term needs requiring large expenditure: customer meter replacement, water main replacement program, new customer billing system or Automatic Meter Reading (AMR) system.	Begin to assemble economic business case for long-term needs based upon improved data becoming available through the water audit process.	Conduct detailed planning, budgeting and launch of comprehensive improvements for metering, billing or infrastructure management	Continue incremental improvements in short-term and long-term loss control interventions
Target-setting			Establish long-term apparent and real loss reduction goals (+10 year horizon)	Establish mid-range (5 year horizon) apparent and real loss reduction goals	Evaluate and refine loss control goals on a yearly basis
Benchmarking			Preliminary Comparisons - can begin to rely upon the Infrastructure Leakage Index (ILI) for performance comparisons for real losses (see below table)	Performance Benchmarking - ILI is meaningful in comparing real loss standing	Identify Best Practices/ Best in class - the ILI is very reliable as a real loss performance indicator for best in class service
For validity scores of 50 or below, the shaded blocks should not be focus areas until better data validity is achieved.					

AWWA Water Loss Control Committee: Annual Water Audit Data Collection Initiative since 2011

💧 Goal: create a dataset of validated water utility water audit data (IWA/AWWA Method)

💧 Steps:

- Enlist water utilities that are motivated to employ best practices
- Gather the water audit data via AWWA Free Water Audit Software©
- Conduct a 60-90 minute telephone interview w/ WLC Committee members
- Post the utility data on the AWWA website as examples of best practice adopters and their data

💧 Primary Focus: “Validation” of data

AWWA Free Water Audit Software: Reporting Worksheet

Water Audit Report for: Northern San Leandro Combined Water Sewer Storm Utility District (0007900)

Reporting Year: 2013 1/2013 - 12/2013

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 (1/5 or 1/10) using the drop-down 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

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

Enter grading in column 'E' and 'J' -----> Pct: Value:

WATER SUPPLIED

Volume from own sources: 5 1,000,000 MGYr

Water imported: 5 100,000 MGYr

Water exported: 1 100,000 MGYr

WATER SUPPLIED: 825,000 MGYr

Master Meter Error Adjustments

Click here: 1 100,000 MGYr

Click here: 5 25,000 MGYr

Enter negative % or value for under-registration

Enter positive % or value for over-registration

AUTHORIZED CONSUMPTION

Billed metered: 5 700,000 MGYr

Billed unmetered: 5 50,000 MGYr

Unbilled metered: 5 10,313 MGYr

Unbilled unmetered: 5 10,313 MGYr

Default option selected for Unbilled unmetered - a grading of 5 is applied but not displayed

AUTHORIZED CONSUMPTION: 760,313 MGYr

WATER LOSSES (Water Supplied - Authorized Consumption)

64,688 MGYr

Apparent Losses

Unauthorized consumption: 5 3,000 MGYr

Unauthorized consumption volume entered is greater than the recommended default value

Customer metering inaccuracies: 5 7,071 MGYr

Systematic data handling errors: 5 5,000 MGYr

Apparent Losses: 15,071 MGYr

Real Losses (Current Annual Real Losses or CARL)

Real Losses = Water Losses - Apparent Losses: 49,617 MGYr

WATER LOSSES: 64,688 MGYr

NON-REVENUE WATER

NON-REVENUE WATER: 75,000 MGYr

= Water Losses + Unbilled Metered + Unbilled Unmetered

SYSTEM DATA

Length of mains: 100.0 miles

Number of active AND inactive service connections: 1,000

Service connection density: 10 connections/mile

Are customer meters typically located at the curbside or property line? Yes

Average length of customer service line: 60.0 feet

Average length of customer service line has been set to zero and a data grading score of 10 has been applied

Average operating pressure: 60.0 psi

COST DATA

Total annual cost of operating water system: \$1,000,000 \$/year

Customer retail unit cost (applied to Apparent Losses): \$3.50 \$/1000 gallons (US)

Variable production cost (applied to Real Losses): \$3,000.00 \$/million gallons

Use Customer Retail Unit Cost to value real losses

WATER AUDIT DATA VALIDITY SCORE:

*** YOUR SCORE IS: 60 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: Customer metering inaccuracies

3: Total annual cost of operating water system

AWWA Free Water Audit Software©

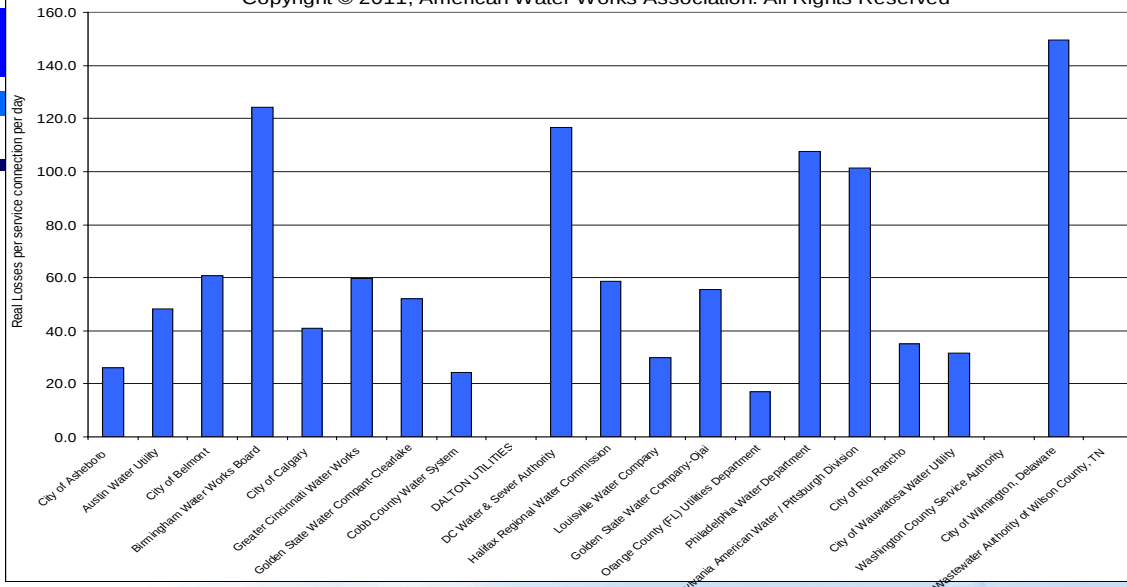
Companion “Compiler” Software

- EXCEL spreadsheet tool that allows data from multiple water audits to be “compiled” into one spreadsheet
- Data can be copied to user’s EXCEL files
- Available for free download from AWWA website

Administrative	Name of City or Utility	City of Asheboro	Austin Water	City of Belmont
	Country	USA	Utility	USA
	Reporting Year	United States		
	Start Date	FY08-09	2010	FY 09-10
	End Date	7/1/2008	10/1/2009	7/1/2009
	Name of Contact Person	6/1/2009	9/1/2010	6/30/2010
	E-Mail	Michael Rhoney	Dan Strub	Chuck Flowers
	Telephone	mrhoney@ci.asheb	dan.strub@ci.austir	cflowers@cityofbel
	Telephone Ext	336-626-1234	512-972-0349	704-825-0512
Audit Data				
Water Supplied	Volume Units	Million gallons (US)	Million gallons (US)	Million gallons (US)
	Volume From Own Sources	1,491.690	43,786.936	593.075
	Master meter error adjustment	138.572	893.611	12.104
	Water imported	-	-	-
	Water exported	-	-	-
WATER SUPPLIED		1,630.262	44,680.547	605.179
Authorized Consumption	Billed metered	1,311.441	39,367.872	438.054
	Billed unmetered	-	311.434	-
	Unbilled metered	35.791	90.417	-
	Unbilled unmetered	113.521	191.471	45.612
	Unbilled unmetered (1 = Default; 2 = Value)	2	2	2
AUTHORIZED CONSUMPTION		1,460.753	39,961.194	483.665
Water Losses	WATER LOSSES (Water Supplied - Authorized Consumption)	169.509	4,719.353	121.513
	Unauthorized consumption	4.076	125.480	1.513
	Unauthorized consumption (1 = Default; 2 = Value)	1	2	1
	Customer metering inaccuracies	41.667	857.613	18.252
	Systematic data handling errors	-	24.885	-
	Apparent Losses	45.743	1,007.978	19.765
	Real Losses = (Water Losses - Apparent Losses)	123.766	3,711.375	101.748
	WATER LOSSES	169.509	4,719.353	121.513
Non-Revenue Water	NON-REVENUE WATER			
	318.821	5,001.241	167.125	
System Data	Length of mains	237	3,639	95
	Number of active AND inactive service connections	13,000	210,893	4,600
	Connection density	54.9	58.0	48.4
	Average length of customer service line	20	0	20
	Average operating pressure	75	77.3	66
Cost Data	Total annual cost of operating water system	\$3,048,480	\$168,249,678	\$1,357,542
	Customer retail unit cost (applied to Apparent Losses)	\$5.90	\$3.91	\$6.98
	Customer retail unit cost (units)	\$/100 cubic feet (cc \$/1000 gallons (US \$/1000 gallons (US		
	Variable production cost (applied to Real Losses)	\$510.00	\$341.00	\$330.00
Performance Indicators				
Financial Indicators	Non-revenue water as percent by volume	19.6%	11.2%	27.6%
	Non-revenue water as percent by cost	16.4%	3.2%	13.7%
	Annual cost of Apparent Losses	\$360,779	\$3,941,194	\$137,961
	Annual cost of Real Losses	\$63,121	\$1,265,579	\$33,577
Operational Efficiency Indicators	Apparent Losses per service connection per day	9.640	13.095	11.772
	Real Losses per service connection per day*	26.084	48.215	60.600
	Real Losses per length of main per day*	N/A	N/A	N/A
	Real Losses per service connection per day per psi pressure	0.348	0.624	0.918
	Unavoidable Annual Real Losses (UARL)	98.591	1,447.995	32.151
	Infrastructure Leakage Index (ILI) [Real Losses/UARL]	1.255	2.563	3.165

Compiler©: great for comparisons

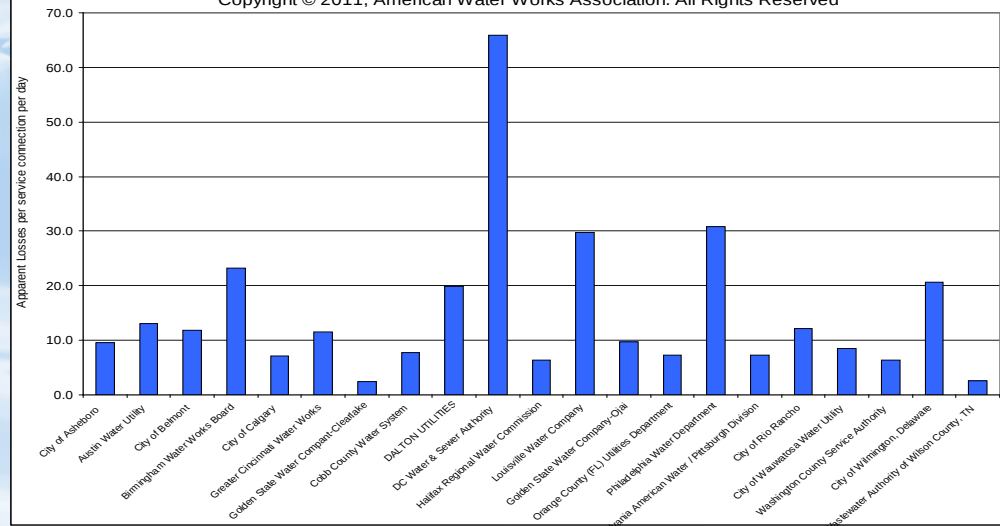
2011 Validated Water Audit Data - AWWA Water Loss Control Committee
Copyright © 2011, American Water Works Association. All Rights Reserved



Real losses: gallons per
service connection per day

Apparent losses: gallons per
service connection per day

2011 Validated Water Audit Data - AWWA Water Loss Control Committee
Copyright © 2011, American Water Works Association. All Rights Reserved



Tool to set a Leakage Management Strategy

- Water Research Foundation Project 4372: *Real Loss Component Analysis – A Tool for Economic Water Loss Control*
- Free Spreadsheet tool hosted on AWWA website
- Input data on leak events and cost; guidance is provided on best leakage control strategies



The image cannot be displayed. Your computer may not have enough memory to open this image, or the image may have been corrupted. Restart your computer, and then open the file again. If the red x still appears, you may have to delete the image and then insert it again.

WaterRF 4372: Real Loss Component Analysis: A Tool for Economic Water Loss Control

MAIN MENU

Macros must be enabled to properly use the WaterRF 4372 Component Analysis Modeling Software

Instructions	Complete set of instructions for the WaterRF Component Analysis Modeling Software
Start Page	Enter the audit period and select reporting units
Summary	Summary of the water audit performance indicators and the results of the Real Losses Component Analysis
AWWA Water Balance	Enter the required data from the AWWA WLCC Free Water Audit Software: Reporting Sheet to populate the Water Audit
Performance Indicators	Select your desired water loss performance indicator to be displayed in comparison to a North American water utility data set
Real Loss Components	Carry out a Real Losses Component Analysis using this sheet
RL Components Chart	A chart summarizing the results in the Real Loss Component Analysis
Failure Frequency	Comparison of your utility's mains and service line failure frequencies against industry averages and targets
A-L-R Times	Use this sheet to evaluate if a reduction in location and repair times for reported and unreported leaks would provide an opportunity to reduce real losses
Economic Intervention	Use this sheet to establish a preliminary schedule for proactive leak detection surveys
Pressure Management	Use this sheet to evaluate if pressure management and a reduction in average system pressure provides an opportunity to reduce real losses cost effectively
Glossary	Glossary of all terms used in the WaterRF 4372 Component Analysis Model
License	License

7/4/2014 ©2014 Water Research Foundation. ALL RIGHTS RESERVED

Real (Leakage) Loss Tool to set a Leakage Control Strategy

Inputs

➤ Number of Leaks

➤ Types of Leaks

➤ Timing of events (leak identified, leak repaired)

WaterRF 4372: Real Loss Component Analysis: A Tool for Economic Water Loss C

Value to be entered by the user
Value is automatically filled in/calculated by Model
Recommended default value

REAL LOSSES COMPONENT ANALYSIS

SUMMARY: REAL LOSS COMPONENT ANALYSIS

System Component	Background Leakage (MG)	Reported Failures (MG)	Unreported Failures (MG)	Total (MG)
Reservoirs	-	-	-	-
Mains and Appurtenances	-	-	-	-
Service Connections	-	-	Select Reservoir Background Leakage Rate	-
Total Annual Real Loss	-	-	OR	-
Real Losses as Calculated by Water Audit				-
Hidden Losses/Unreported Leakage Currently Running Undetected				-

Note: To the left you have the summary table of the real loss component analysis. Please enter the data in step 1 through 4 for the summary table to be populated.

Step 1: BACKGROUND LEAKAGE, REPORTED LEAKAGE AND UNREPORTED LEAKAGE FROM RESERVOIRS

Instructions: First enter the capacity of all distribution system reservoirs and tanks in use during the audit period. In case the system input volume is based on raw water meters located upstream of the Water Treatment Plant (WTP) then also include the capacity of the WTP reservoirs. Next select a reservoir background leakage rate - either the default value provided by the model or a utility specific flow rate. If reservoirs and tanks are well maintained and the utility does not suspect any background leakage from the reservoirs and tanks then enter zero as the utility specific flow rate. In case a reservoir or tank was reported leaking or has overflowed, enter the estimated volume in cell G27. If a proactive investigation/inspection of the system reservoirs and tanks has discovered a leaking reservoir or tank then enter the estimated annual volume lost in cell G28.

	Capacity (MG)	Background Leakage Rate (gpm/MG)	Annual Volume (MG)
Total Reservoir/Tank Capacity		0.25	0.00
Reported Reservoir Leakage and any recorded Reservoir and Tank Overflows			
Unreported Reservoir Leakage			
Total Background Leakage, Reported and Unreported leakage from Reservoirs			-

Default Value 0.25 (gpm/MG)

Utility Specific Background Leakage Rate - (gpm/MG)

Step 2: BACKGROUND LEAKAGE ON MAINS AND SERVICES

Instructions: The background leakage volume from mains and service connections will be automatically calculated after selecting one of the default Infrastructure Condition Factors (ICF) based on infrastructure age or after a utility specific ICF has been selected and entered in cell P43. The level of background leakage tends to increase with infrastructure age and is higher for systems with higher pressure. The volume of background losses is generally a significant component of the total real loss volume, at times up to 50% of the total volume of real losses. Overestimating (ICF used in model is too high) or underestimating (ICF used in model is too low) the background leakage volume might lead to a real loss control strategy that is not truly optimized. Selecting the ICF based on general age of the distribution network should only be seen as a starting point. It is strongly recommended that over time a utility specific ICF is assessed and confirmed through field tests using one of the recommended approaches outlined in the AWWA M36 manual.

						Pressure Corrected Calculation	
System Component	Units	Quantity	Component UARL Values (g/unit/d/psi)	Infrastructure Condition Factor	Average Pressure (psi)	N1 (Leakage-Pressure Exponent) Value	Annual Volume (MG)
Mains	miles	-	2.87	1.0	0.0	1.5	-
Services - Main to Curb-Stop	number	-	0.112	1.0	0.0	1.5	-
Services - Curb-Stop to Meter	miles	-	4.78	1.0	0.0	1.5	-
Total Background Leakage on Mains and Services							-

Select Infrastructure Condition Factor (ICF) based on age of distribution network

ICF 1 for System Age <50 years 1.0

ICF 1.5 for System Age 50 - 70 years 1.5

ICF 2.5 for System Age >70 years 2.5

Enter ICF values assessed through implementing the approaches outlined in the AWWA M36 manual

Real (Leakage) Loss Tool to set a Leakage Control Strategy

Summary Worksheet

- Displays performance indicator values
- Displays summary of recommended actions for

- Economic frequency for Leak Detection work to cover the entire system
- Pressure Management options

Key: Utilities need to start to routinely compile data on leak events in a standardized format

WaterRF 4372: Real Loss Component Analysis: A Tool for Economic Water Loss Control

WaterRF 4372 COMPONENT ANALYSIS MODEL SUMMARY

As the input data is filled into the model, this sheet will populate with the results and recommendations from the Real Losses Component Analysis, A-L-R Times, Economic Intervention and Pressure Management tabs. The performance indicators from the AWWA Free Water Audit Software have been added to show a brief review of the performance of the system being analyzed

WATER AUDIT PERFORMANCE INDICATORS

Financial	
Non-revenue water as percent by volume of water supplied:	
Non-revenue water as percent by cost of operating system:	
Annual cost of Apparent Losses:	
Annual cost of Real Losses:	
Operational Efficiency	
Apparent Losses per service connection per day:	gal/service conn/day
Real Losses per service connection per day*:	gal/service conn/day
Real Losses per length of main per day:	gal/mi/day
Real Losses per service connection per day per PSI pressure:	gal/service conn/day/psi
Unavoidable Annual Real Losses (UARL):	N/A MG/Yr
Current Annual Real Losses (CARL):	MG/Yr
Infrastructure Leakage Index (ILI) [CARL/UARL]:	

REAL LOSS COMPONENT ANALYSIS RESULTS

System Component	Background Leakage	Reported Failures	Unreported Failures	Total
	(MG)	(MG)	(MG)	(MG)
Reservoirs	-	-	-	-
Mains and Appurtenances	-	-	-	-
Service Connections	-	-	-	-
Total Annual Real Loss	-	-	-	-
Real Losses as Calculated by Water Audit				-
Hidden Losses/Unreported Leakage Currently Running Undetected				-

AWARNSS, LOCATION AND REPAIR TIME REDUCTION RESULTS

	Reported Failures	Unreported Failures	
Total Potential Savings if Location and Repair Duration is Reduced as Simulated on the A-L-R Times Options Sheet	-	-	(MG)
Total Potential Cost Savings if Location and Repair Duration is Reduced as Simulated on the A-L-R Times Options Sheet	\$ -	\$ -	Per Year

ECONOMIC INTERVENTION FREQUENCY FOR PROACTIVE LEAK DETECTION RESULTS

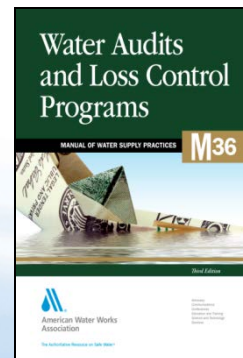
Percentage of the System to be Surveyed per Year		%
Average Annual Budget for Intervention (Proactive Leak Detection)		\$/year
Potentially Recoverable Leakage		MG/year

ALTERNATIVE PRESSURE MANAGEMENT SCENARIO RESULTS

User-Inputted Reduction in Average System Pressure	-	PSI
Assumed % Reduction in Average System Pressure		
Estimated Real Loss Reduction from Pressure Management Program		MG/Yr
Financial Savings from Pressure Management Program		\$/Year
User-Estimated Cost of Pressure Reduction	-	\$
Resulting Pressure Management Program Payback Period		Years

Summary

- 💧
 Robust, accessible tools exist for water utilities for audit supplies and control losses
- 💧
 M36 Guidance Manual: new edition coming in 2015
- 💧
 Free Tools are available to:
 - Compile the water audit
 - Compare with other utilities
 - Plan leakage reductions



Category	Item	Value	Unit
Water Supplied	Volume from Own System	5,881,480	gallons (US)
	Master meter water performance	5,881,472	gallons (US)
	Volume from Other Sources	44,680,547	gallons (US)
	Master meter water performance	44,680,547	gallons (US)
Authorized Consumption	Unlimited consumption	533,821	gallons (US)
	Unlimited consumption	533,821	gallons (US)
	Unlimited consumption	533,821	gallons (US)
	Unlimited consumption	533,821	gallons (US)
Water Losses	Unaccounted consumption	45,743	gallons (US)
	Unaccounted consumption	45,743	gallons (US)
	Unaccounted consumption	45,743	gallons (US)
	Unaccounted consumption	45,743	gallons (US)
Non-Revenue Water	Unaccounted consumption	45,743	gallons (US)
	Unaccounted consumption	45,743	gallons (US)
	Unaccounted consumption	45,743	gallons (US)
	Unaccounted consumption	45,743	gallons (US)