



Water Loss

Water Research Foundation
How to use the Free Water Loss Audit
Software v 5.0

What we will be covering

- Getting a handle on water loss
 - How much
 - How risky
 - How to calculate

- Determining the cost of water loss
 - How much is too much

- Determining how to reduce water loss
 - How to do something about too much loss

What is water loss?

- Major shift from unaccounted-for-water to non-revenue water (NRW)
 - And the need to know types of NRW
- NRW is water you are not billing for
 - Not just water you can't account for
 - We'll provide more detail later in this presentation...



Determining the cost of water loss

Not enough to know you the quantity of NRW, you need to know what type of loss you have and what is costing your utility.

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Cost of water loss

Losing money

- 💧 *Wasting chemicals*
- 💧 *Wasting electricity*
- 💧 *Paying more for purchased water*
- 💧 *Lost revenue from theft, inadequate billing process and meter inaccuracy*



What would be the biggest *drivers* to:

💧 Board or council members

💧 Your customers

💧 Regulators

💧 Your utility

💧 ***Cost***

💧 ***Wasting Resources***

💧 ***Publicity***

💧 ***Limited Asset
Management
Implementation***

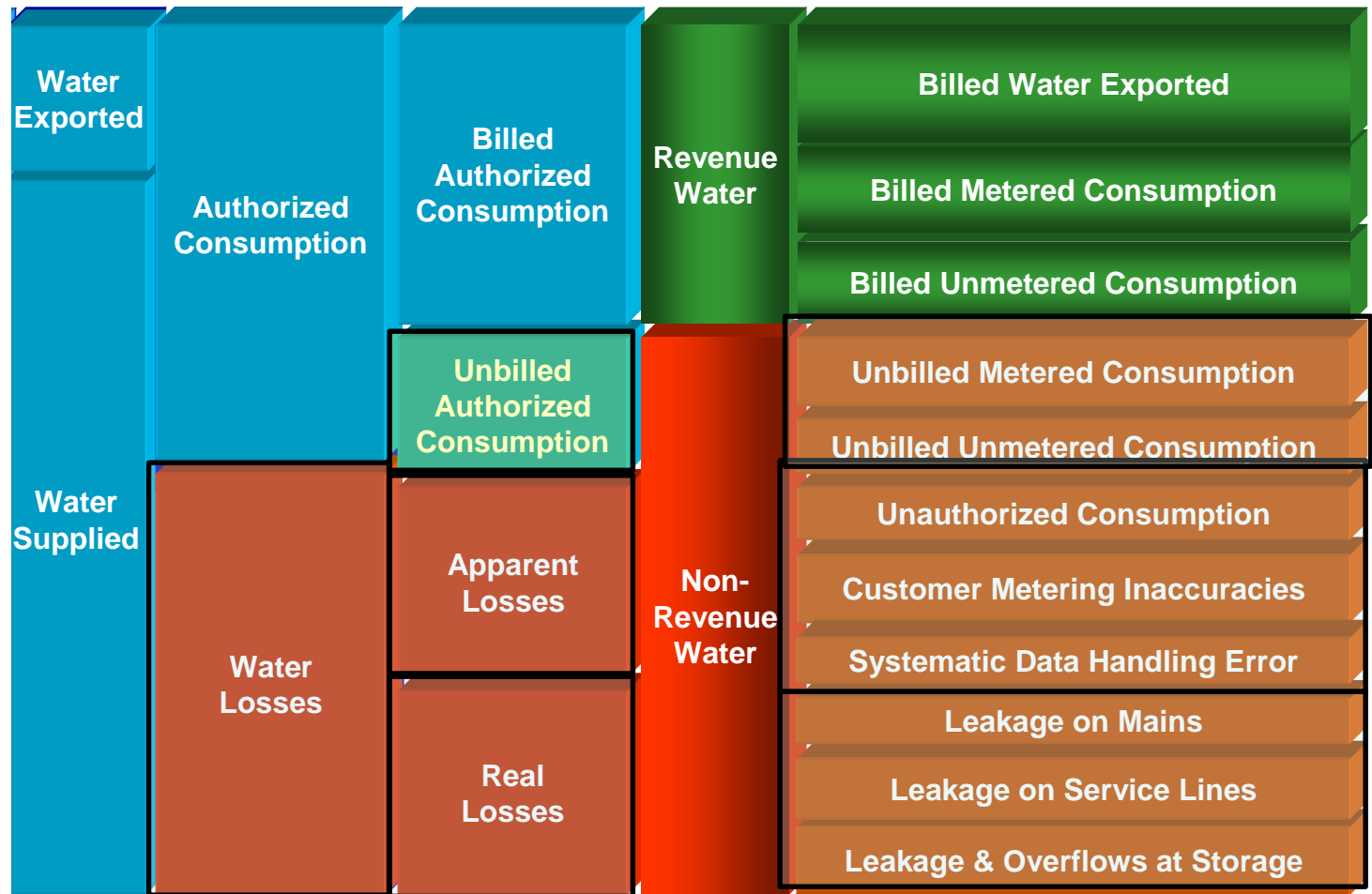


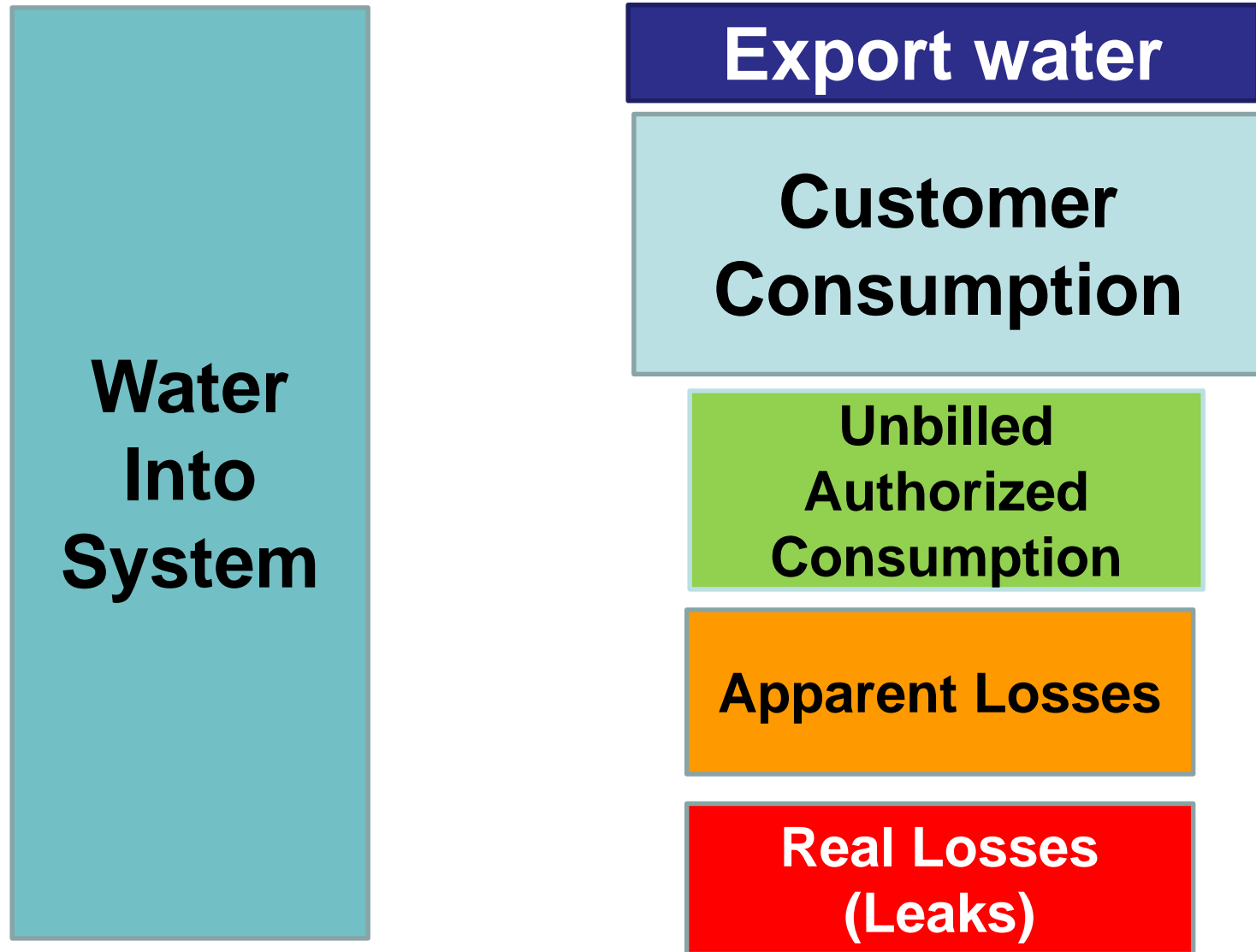
Getting a handle on water loss

How much is lost

Is it leaks, theft, bad meters?

Water audit process: Component analysis





Leaks = water in - export water out - billed volume - estimated unbilled authorized - apparent loss estimate

Billed consumption

💧 Water exported

- Usually to another water system
- Master metered

💧 Billed Customer Consumption

- Metered
- Unmetered but estimated
- Unmetered - flat rate charge

Export water

**Customer
Consumption**



Photo courtesy Missouri American Water

Unbilled authorized consumption

💧 Water you don't bill for

- Fire fighting
- Flushing
- Public parks and golf courses
- Street cleaning
- Municipal facilities (pools, City Hall)

💧 How do you account for the amount of water that is being used?

- Metered
- Unmetered but estimated
- Unmetered

💧 *Can your utility control this use more effectively?*

Unbilled Authorized Consumption



Photo courtesy Iowa American Water

Apparent losses

Apparent Losses

💧 Unauthorized use

- Illegal taps
- Theft at hydrants
- Open unmetered bypasses
- Illegal use of fire services
- Meter tampering

💧 Customer meter inaccuracies

💧 Billing handling errors



Photo courtesy NJ American Water



Photo courtesy California American Water

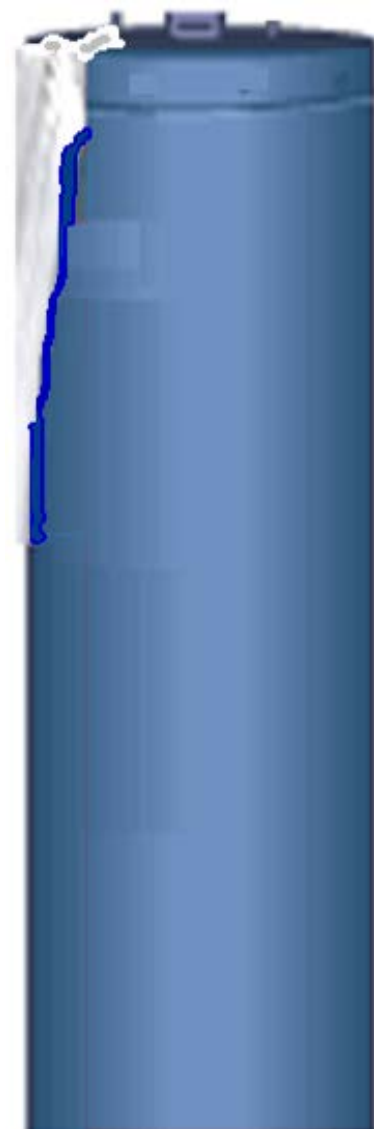
Real losses

- 💧 Leakage on mains
- 💧 Leakage on service lines
- 💧 Storage leaks and overflows

Real losses



Photo courtesy PA American Water



What is acceptable leakage (NRW)?

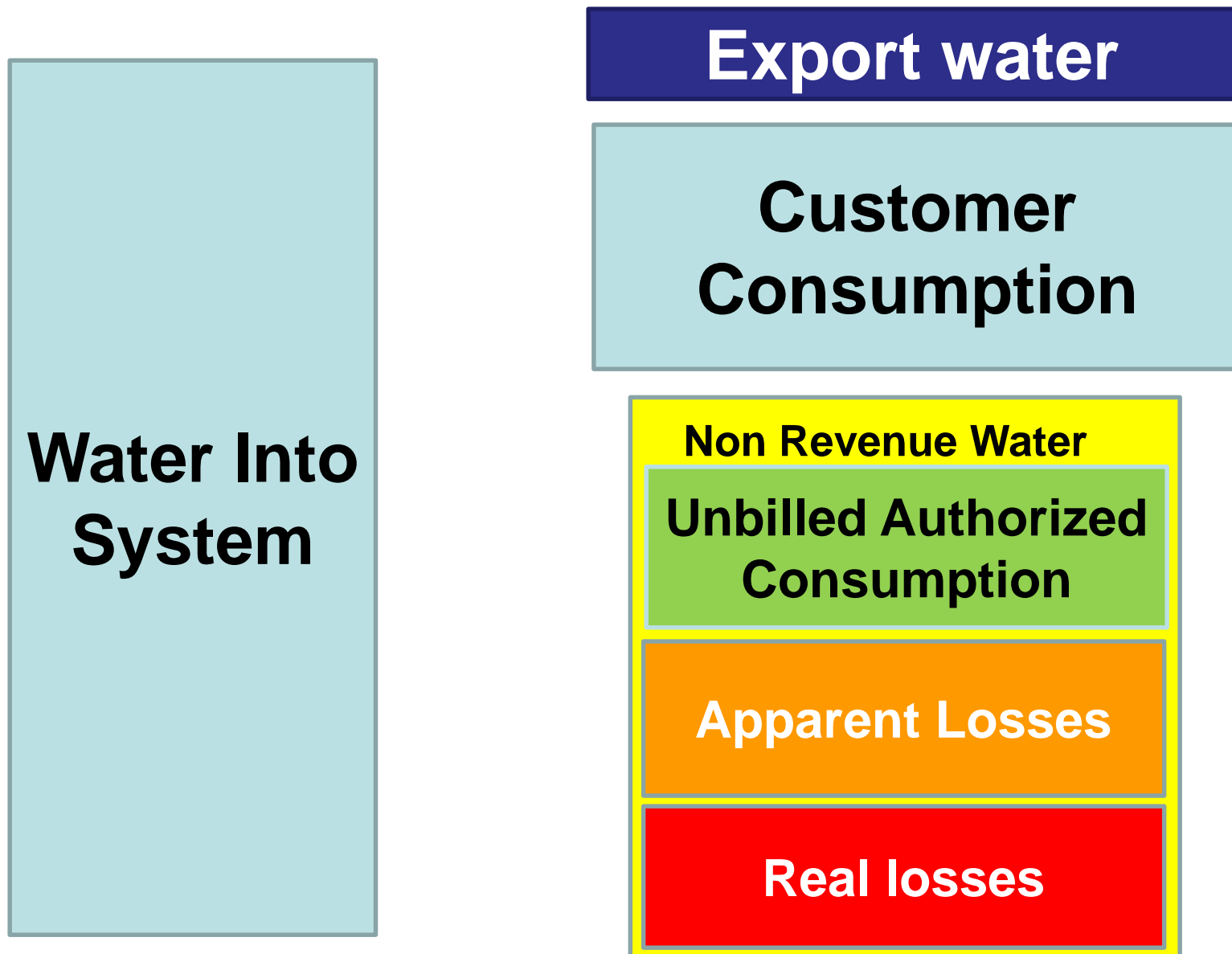
- What is the appropriate level of non-revenue water?
 - Facility and supply limits and economics will help you decide the level of action and you should take and equipment to buy.
- Regulations may apply
 - California: < 10% unaccounted-for water
 - Delaware River Basin Commission mandates systematic approach to monitor (water audit) and control leakage
 - Texas has required utilities to perform water audit every 5 years.
 - New Jersey has not yet set policy with respect to NRW
 - Pending Legislation may change this

Metrics - what should you use?

- **Percentage of NRW is helpful but not best**
 - Comparison between systems can be impacted by differences in consumption major customers and yearly fluctuations.
 - Heavy summer consumption can distort NRW percentage when comparing year to year.
- **Using water loss per connection as outlined in the Audit Software may be best**

Determining how to reduce water loss





Components of the water balance

Billed Consumption

Biggest User of Water

💧 Exports

- If you are the seller, make sure the meter is accurate.

💧 Residential customer use

- Usually the prime component of small system use

💧 Commercial customer use

- Many not significant water users

💧 Industrial customer use

- Can be the most significant user in a small system – may be as factor in night use

Export water

Customer Consumption



Photo courtesy California American Water

Authorized unbilled use

Meter, estimate, report

Unbilled Authorized Consumption

- Municipal services
 - Metering for fountains, municipal buildings, parks
- Flushing
 - Filling mains – compute volume
 - Fire flow tests – measure time and flow
 - Flushing – measure time and flow
- Fire fighting
 - Estimating flows and duration
 - Metering usually not an option
- Other uses??

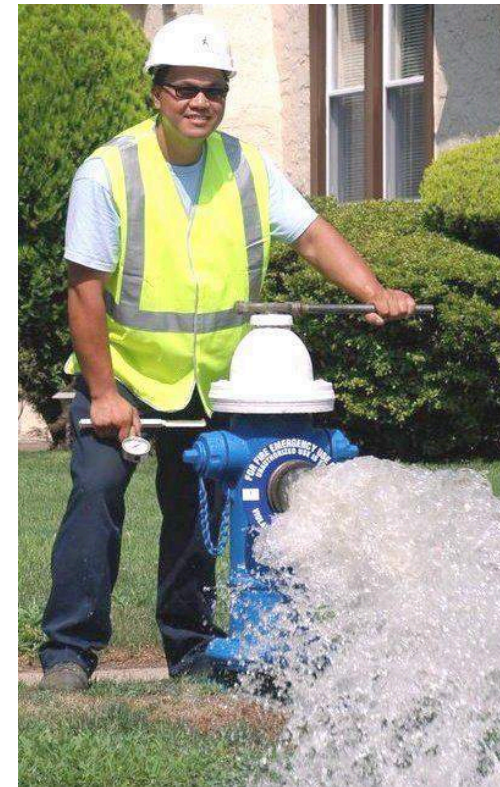


Photo courtesy NY American Water

Apparent losses Difficult to Estimate

Apparent Losses

- 💧 **Illegal use of hydrants**
- 💧 **Meter Tampering**
- 💧 **Customers opening bypasses**
- 💧 **Illegal connections**
- 💧 **Billing Errors**



Photo courtesy PA American Water



Photo courtesy NJ American Water

Apparent losses

Evaluate meter accuracy

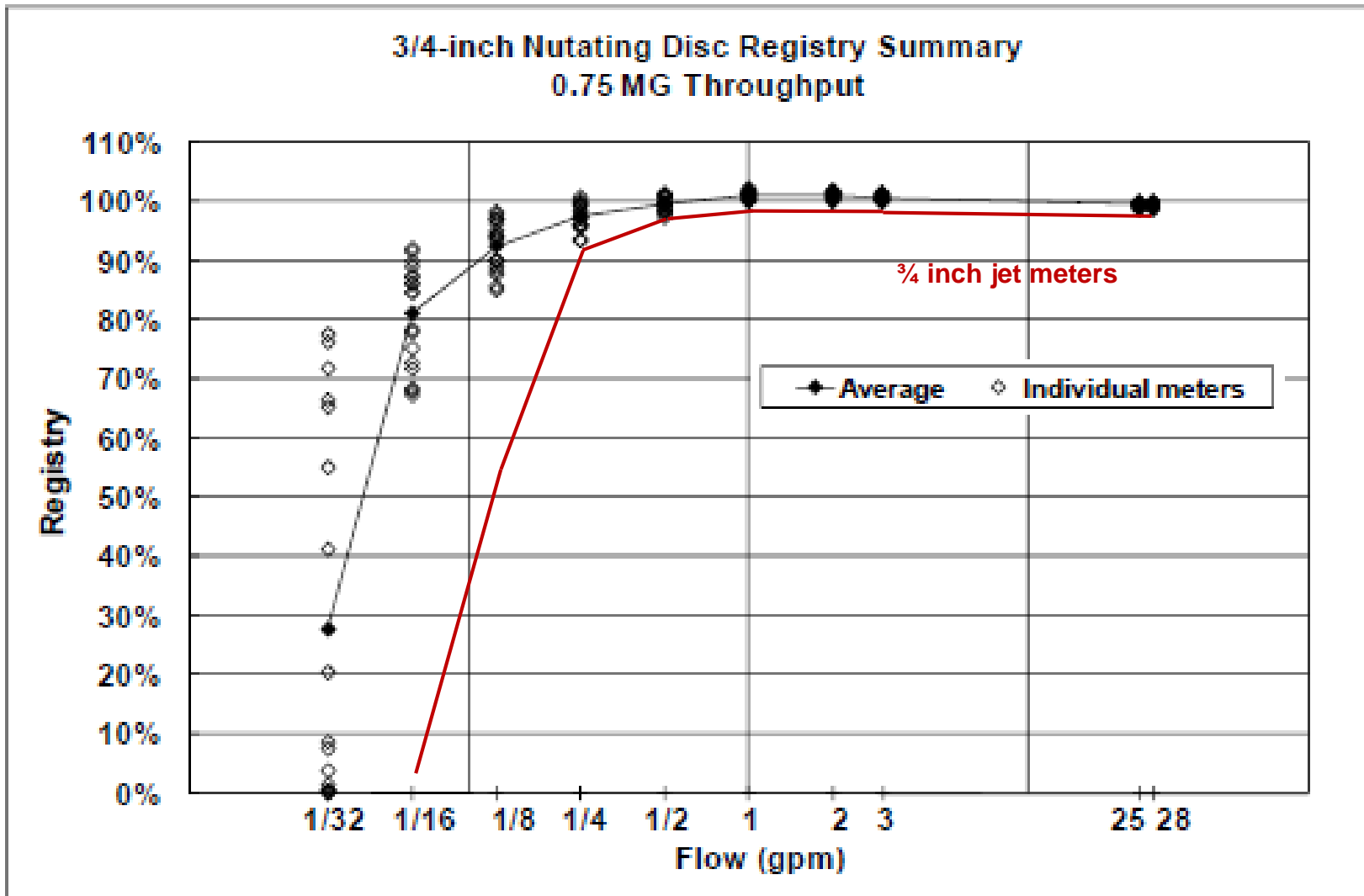
- 💧 Test customer meters/master meters on a routine basis – 10 years - 20 years
- 💧 Are you metering everyone
- 💧 Are you billing everyone?



Photo courtesy California American Water

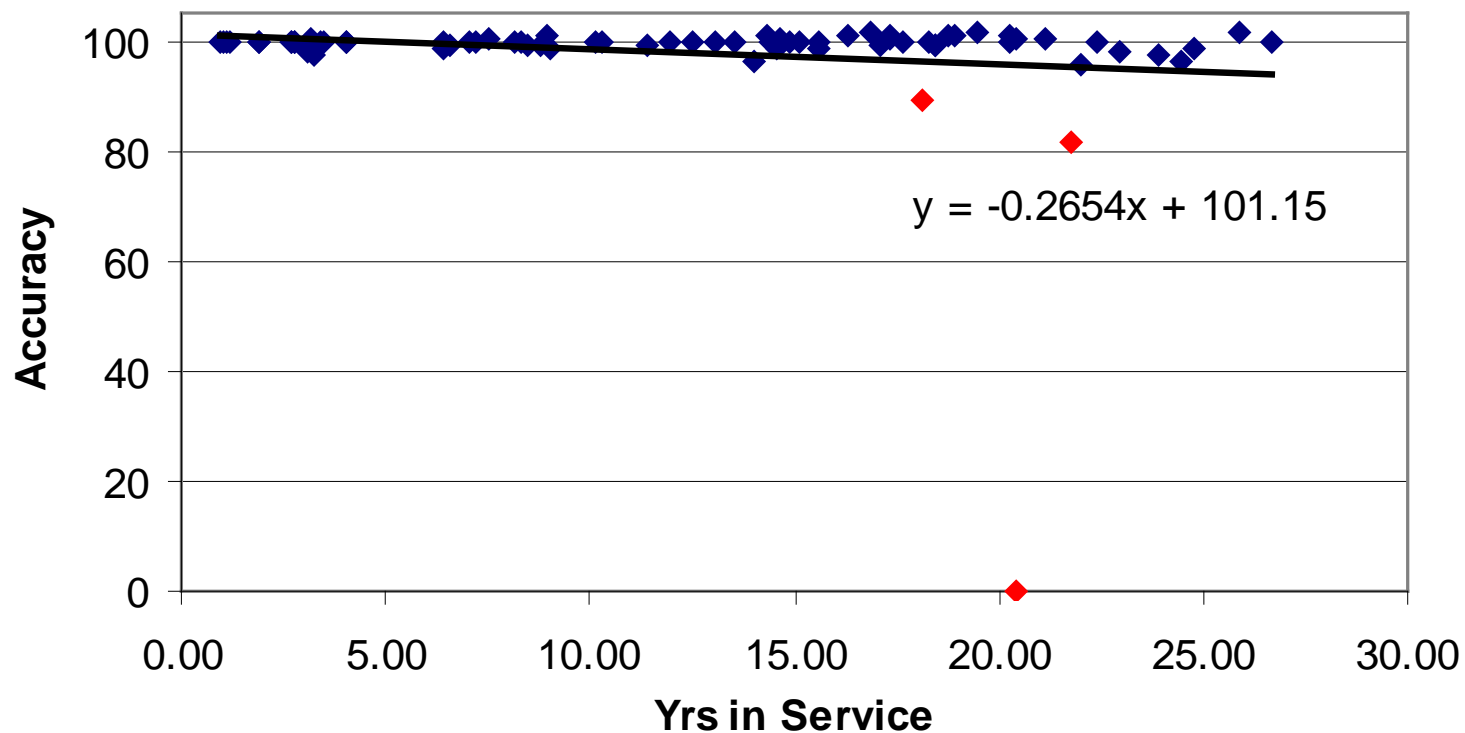
How accurate are your customer meters?

- Accuracy depends on style and manufacturer



How accurate are your customer meters?

- But accuracy ranges widely regardless of age and volume used (and can be impacted by water quality).



(Data courtesy Kansas City Water Services Dept.)

Calculating and Identifying real losses

Real losses

- Real Loss is the difference between all NRW and the other forms of NRW (we just covered)
 - Authorized unbilled consumption
 - Apparent loss



Photo courtesy NJ American Water

The focus is usually on leakage

Leakage and break types *and tools*

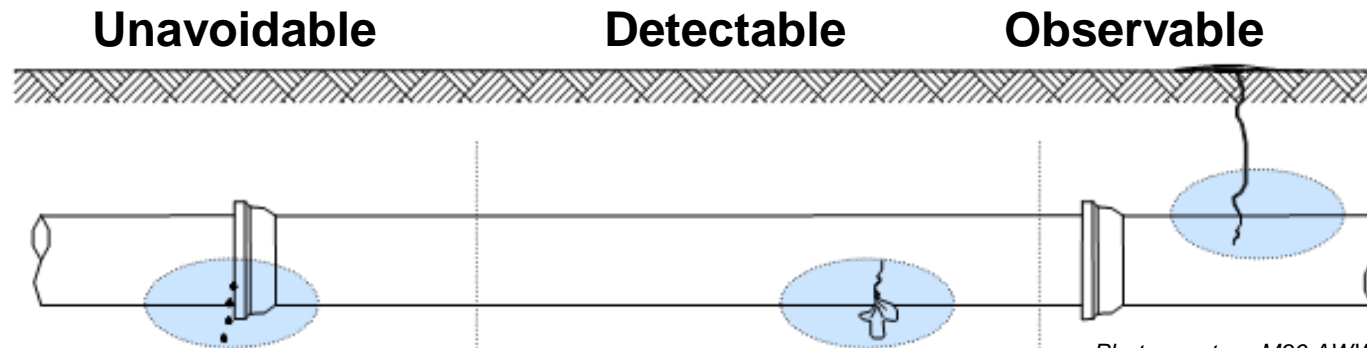


Photo courtesy M36 AWWA manual

Background Leakage

Tools

- Pressure Stabilization
- Pressure Reduction
- Main and service line replacement
- Reduction in the number of joints and fittings

Unreported Leaks

Tools

- Pressure Stabilization
- Pressure Reduction
- Main and service line replacement
- Reduction in the number of joints and fittings
- Proactive leak detection and repair

Reported Breaks

Tools

- Pressure Stabilization
- Pressure Reduction
- Main and service line replacement
- Reduction in the number of joints and fittings
- Improve speed of repair

How much does NRW cost – unit costs

- ◆ Real losses and unbilled authorized use cost the amount of money it takes to produce the water (sale price if bought, treatment and electrical costs if produced).
- ◆ Apparent losses could have been sold at retail price (if used but not stolen or otherwise avoiding payment), so its value is greater at the retail rate, the rate customers pay.



Estimating Leakage - Summary

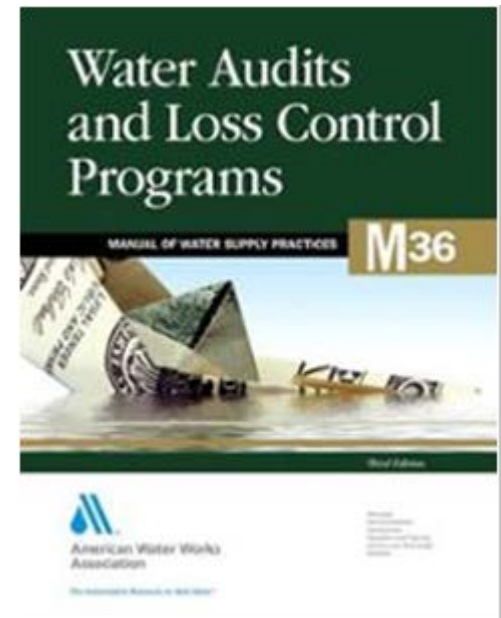
- Start by getting an estimate of your non-revenue water by components
- Then see if you can estimate areas of authorized unbilled and other losses
- Work to minimize different categories of loss (note it may vary within your system)

AWWA tool for water audit



AWWA tool for water audits

- 💧 **AWWA Manual M36, 3rd edition (2009)**
 - Section devoted to small systems
- 💧 **The AWWA Water Loss Control Committee (WLCC) continues to develop and update supporting software and research documents**
- 💧 **Free software available on AWWA website**



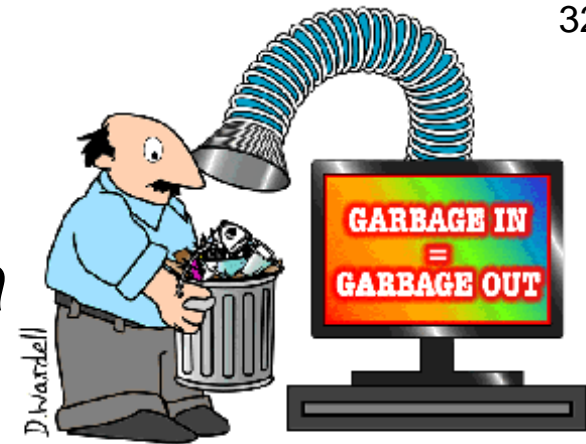
Do you know how much NRW you have?

- Start with what you know and can readily obtain
 - Compare water leaving the treatment facility with what you bill for?
 - Estimate consumption that you authorize but don't bill for and sources of apparent loss.
 - Leakage = Measured Total Water Production
less Total Revenue Sales Volume
less Estimated Apparent Loss Volumes
less Calculated Authorized Unbilled Water Volume

How good is the data you used?

- ◆ Check into data that is missing, poor or questionable quality
 - Work to improve weak or missing data
 - Focus on critical data (like master meters)
 - Worry about the big stuff

The audit is fed by data *and depends on good data*



💧 How much water do you send out?

- Purchased water
- Water produced and sent into system

💧 How much water gets to the customer?

- Metered and billed
- Estimated and billed

💧 How much water is used but not billed?

- Flushing
- Municipal uses (firefighting, street cleaning, etc.)

How to Get the Free AWWA Water Audit

- Go to awwa.org
- Select Water Loss Control from the Resource and Tools menu
- Scroll down the Water Loss Control Committee page and select AWWA Water Loss Control Free Water Audit Software

Completing the AWWA water audit

- Read the instructions provided in the first software tab
- Tab summary

Instructions	Basic guidelines
Reporting Worksheet	You enter basic information to calculate water balance
Water Balance	This spreadsheet provides estimates of apparent and real losses
Grading Matrix	This spreadsheet provides an evaluation of the quality of your data
Service Connections	This spreadsheet provides illustrations
Definitions	This spreadsheet provides descriptions of key terms
Loss Control Planning	This spreadsheet provides suggestions about how to proceed

Using the Audit software

- Enter data in white boxes on the reporting worksheet.
 - Note boxes at far right provide options for default estimates or your own data if you can provide it.
 - Orange boxes self calculate in the worksheet**

PLEASE CHOOSE REPORTING UNITS FROM THE INSTRUCTIONS SHEET BEFORE ENTERING DATA

WATER SUPPLIED << Enter grading in column 'E'

Volume from own sources:

Master meter error adjustment (enter positive value):

Water imported:

Water exported:

WATER SUPPLIED:

AUTHORIZED CONSUMPTION

Billed metered:

Billed unmetered:

Unbilled metered:

Unbilled unmetered:

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

AUTHORIZED CONSUMPTION:

WATER LOSSES (Water Supplied - Authorized Consumption)

Apparent Losses

Unauthorized consumption:

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

Customer metering inaccuracies:

Systematic data handling errors:

Apparent Losses:

Real Losses (Current Annual Real Losses or CAHL)

Real Losses = Water Losses - Apparent Losses:

WATER LOSSES:

Click here: for help using option buttons below

Pent: Value:

Use buttons to select percentage of water supplied OR value

Pent: Value:

Enter a percentage less than 10% in the red cell (J42), or select 'Value' option

Data Categories

- 💧 Water supplies data (previous slide)
- 💧 Authorized consumption data (previous slide)
- 💧 Water loss data (previous slide)
- 💧 System data
- 💧 Cost data

SYSTEM DATA	
Length of mains:	<input type="text"/>
Number of <u>active AND inactive</u> service connections:	<input type="text"/>
Connection density:	<input type="text"/>
<u>Average</u> length of customer service line:	<input type="text"/>
Average operating pressure:	<input type="text"/>

(pipe length between curbside and customer meter or property boundary)

COST DATA	
Total annual cost of operating water system:	<input type="text"/> \$/Year
Customer retail unit cost (applied to Apparent Losses):	<input type="text"/>
Variable production cost (applied to Real Losses):	<input type="text"/> \$/

Output provided BACKGROUND

- Amount by category of water loss
- Value of water loss
- Comparison of leakage to calculated minimum (Known as ILI or Infrastructure Leak Index)

PERFORMANCE INDICATORS

Financial Indicators

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 Indicators

Apparent Losses per service connection per day:

Real Losses per service connection per day*:

Real Losses per length of main per day*:

Real Losses per service connection per day per meter (head) pressure:

Unavoidable Annual Real Losses (UARL):

From Above, Real Losses = Current Annual Real Losses (CARL):

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

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

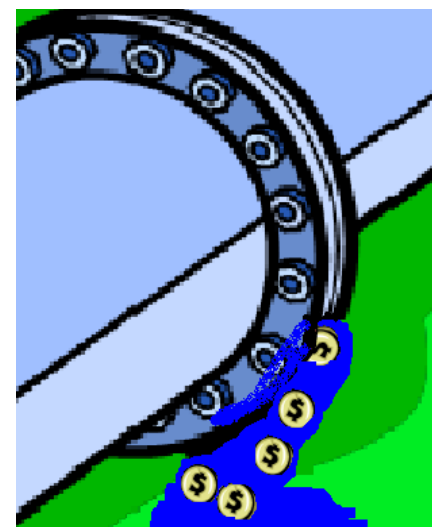
What the heck is ILI

- ILI is the ratio of water that is actually leaking compared to water lost at a theoretical minimum called unavoidable loss (pipe weeps and seeps).
- Unavoidable loss is a calculation involving miles of service lines & mains, connections, pressure.
- **Small systems should not use ILI.**
 - Quantities measured too small to be relevant
 - Keep it simple



Focus on the Economics

- Make your best estimate of leakage
 - Use water audit and night flow to gauge how much volume you lose per year.
- Calculate what that avoidable leakage is costing you
 - Multiply the annual loss by the cost to produce the water (higher if purchased as finished water)
- Examine possible leak detection approaches and costs
 - Leak surveys (in house, consultant, step tests, district metering)



The Economics of Leak Reduction

- Compare cost of a program with potential savings.
 - *Expect that you can only reduce part of leakage with any leak detection program*
- Contingency plan - be prepared to deal with a severe break that may threaten your supply.
 - Know where to get help



Photo courtesy NJ American Water