DRBC Workshop
Water System Audits and Water Loss Control
Bordentown, NJ
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Module 2 Session 2
Overview of AWWA's Free Water Audit Software© & Compiler

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AWWA Water Loss Control Committee

AWWA Free Water Audit Software®

A few people to credit….

- David Sayers, Delaware River Basin Commission – main software developer
- George Kunkel, P.E. Philadelphia Water Department
- Andrew Chastain-Howley, Miya (sub-committee chair)
- David Goff, P. E. Goff Water Audits and Engineering
- Alain Lalonde, Veritec/Miya
- Over 30 beta test utilities and testers.

AWWA Free Water Audit Software©

Chronology

- ⬥ 2005 Beta Version 1.0 in development
- ⬥ April 2006 First published software Version 2.0
- ⬥ August 2007 Second version of software 3.0
  - – April 2009, M36 Third Edition Published
- ⬥ April 2009, Software Version 4.0 published – with important data grading capability
- ⬥ January 2010, Software Version 4.1 posted: minor update to Version 4.0
- ⬥ May 2010, Software Version 4.2 posted: minor update to Version 4.0 and French language version posted

Why was the AWWA Free Water Audit Software© created?

- Interest in water loss assessment is on the rise!
- Manuals are fine for reading, but in the cyber-age we also need computer tools!
- Most utilities need something simple and easy to assist with water audits
- Reduce the learning curve with respect to the new methodology
- Ensure standardization of data collection & analysis
- Version 4.0 – need to label the "quality" of the data
- No significant revision (Version 5.0) before 2012

Water Audit Software Employs a Top-down Approach

- Advantage: **quickly pulls together data and information that is readily available**

- Disadvantage: **for most water utilities, incomplete or inaccurate data limits the *validity* of the top-down water audit**
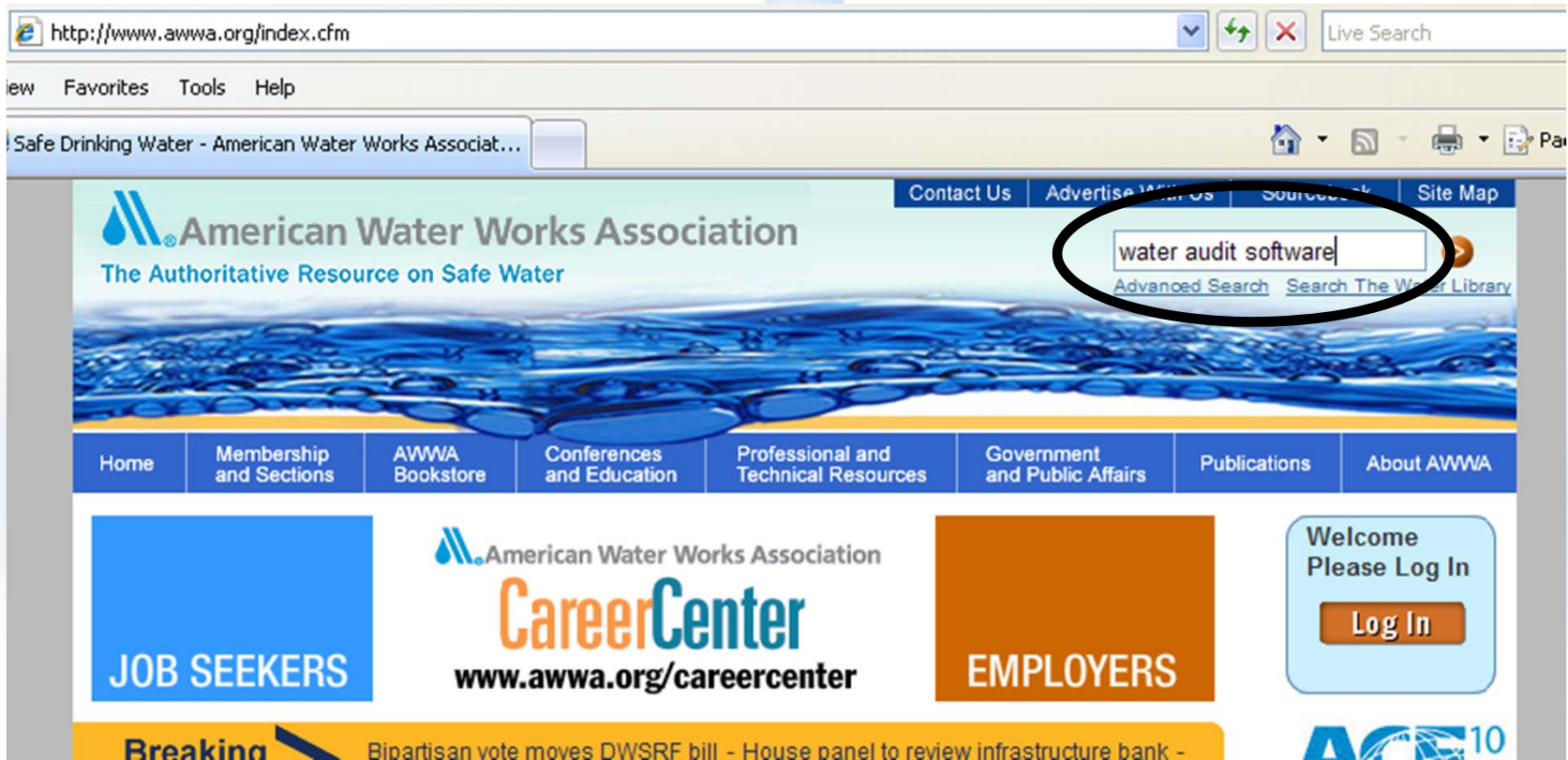
IWA/AWWA Water Audit Method: Water Balance
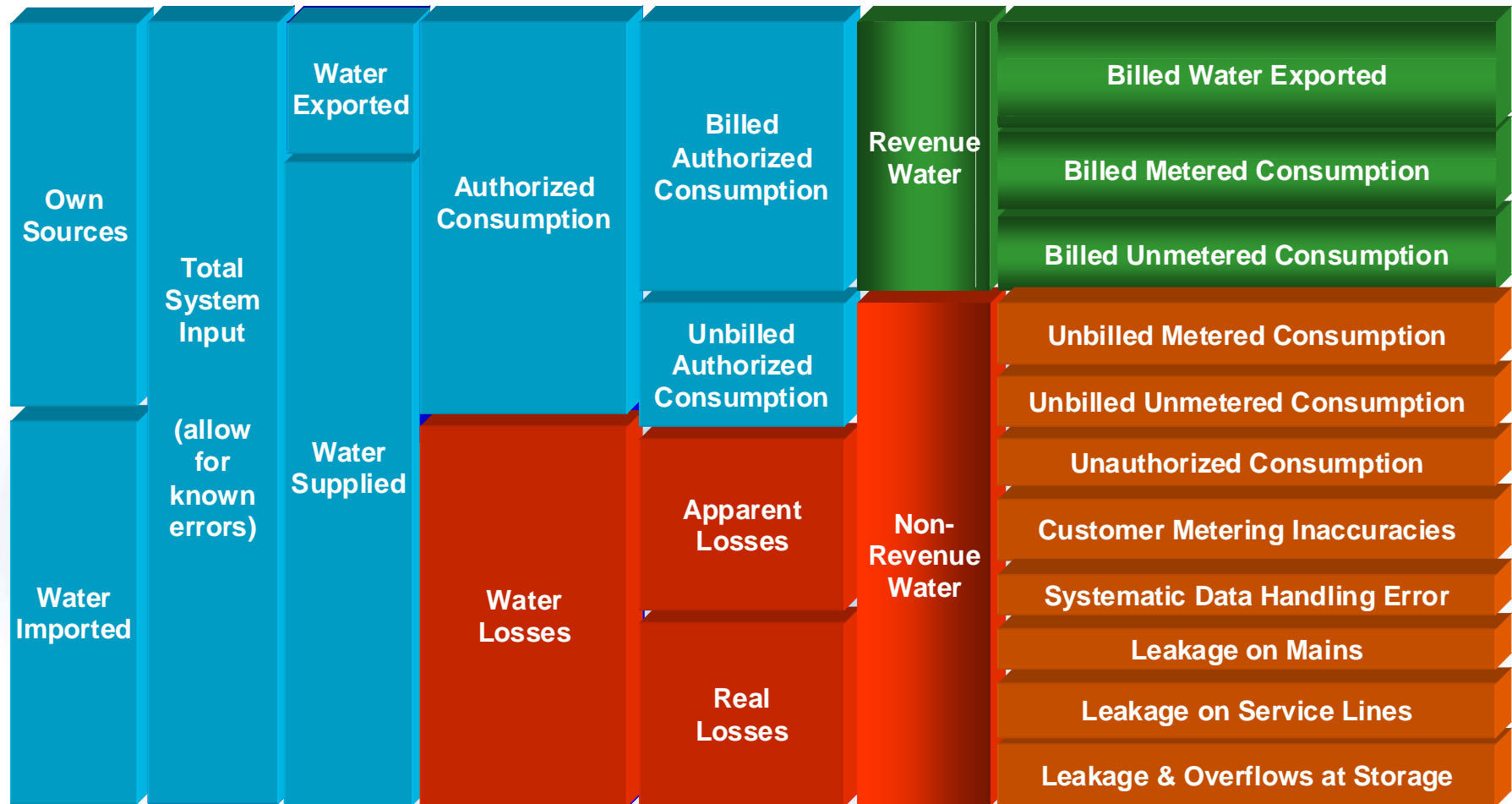
Obtaining & using AWWA's Free Water Audit Software©

⬤ How is the software obtained?

Obtaining & using AWWA's Free Water Audit Software©

🌢 Follow the search results

Obtaining & using AWWA's Free Water Audit Software©

🌢 Follow the link …..

🌢 ….. and accept

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Obtaining & using AWWA's Free Water Audit Software©

💧..... and "SAVE AS"

Using AWWA's Free Water Audit Software©

- ⬥ Read the instructions provided in the software
- ⬥ Follow the tabs

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

What data is needed?

- ◊ **System input including**
  - – Volume from you own supplies
  - – Bulk water imported (purchased) and/or exported (sold)
- ◊ **Billed Water Consumption**
  - – Metered consumption: billed and unbilled
  - – Unmetered consumption: billed and unbilled
- ◊ **Quantity of water lost to unauthorized consumption**
- ◊ **Quantity of water not registered due to customer meter error or inaccuracy**
- ◊ **Quantity of water consumption not properly recorded due to systematic data handling errors in the customer billing system**
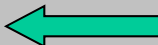
What data is needed?

– Physical parameters of the water system
   - Length of mains
   - Number of service connections
   - Average length of customer service line
   - Average system operating pressure
– Financial data on the system
   - Annual operating costs to supply drinking water
   - Retail cost per unit charged to customers
   - Marginal production cost per unit

Where is water quantity data entered?

– Water quantities are entered in the large white boxes

Where is water quantity data entered?

– Look for the white boxes in the spreadsheet

SYSTEM DATA

Length of mains:	
Number of <u>active AND inactive</u> service connections:	
Connection density:	
<u>Average</u> length of customer service line:	(pipe length between curbstop and customer meter or property boundary)
Average operating pressure:	

COST DATA

Total annual cost of operating water system:	$/Year
Customer retail unit cost (applied to Apparent Losses):	
Variable production cost (applied to Real Losses):	$/

– That was easy, but what about those small white boxes?

Grading the <u>validity</u> of the water quantity data

– How many miles of mains are in the system?

Length of mains: [?] [ ] [   ] miles

1. Poorly assembled and maintained paper as-built records of existing water main installations makes accurate determination of system pipe length impossible. Length of mains is guesstimated.
2. Paper records in poor condition (no annual tracking of installations & abandonments). Poor procedures to ensure that new water mains installed by developers are accurately documented.
3. Conditions between 2 and 4
4. Sound policy and procedures for permitting and documenting new water main installations, but gaps in management result in a uncertain degree of error in tabulation of mains length.
5. Conditions between 4 and 6
6. Sound policy and procedures exist for permitting and commissioning new water mains. Highly accurate paper records with regular field validation; or electronic records and asset management system in good condition. Includes system backup.
7. Conditions between 6 and 8
8. Sound policy and procedures exist for permitting and commissioning new water mains. Electronic recordkeeping and asset management system are used to store and manage data.
9. Conditions between 8 and 10
10. Sound policy exists for managing water mains extensions and replacements. Geographic Information System (GIS) data and asset management database agree and random field validation proves truth of databases.

Calculated Performance Indicators

–Performance Indicators
  - NRW% by volume
  - Volumetric losses
  - Losses per connection per day
  - Losses per mile of main
  - Unavoidable annual real losses (UARL)
  - Infrastructure Leakage Index (ILI)

Calculated Performance Indicators

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]:

Special Features

- ⬥ All calculations are performed by the software
- ⬥ Default values are offered for several components
- ⬥ Be mindful of units selected for volumes and customer retail cost
- ⬥ Gross data error checks are built-in
  – Ex: can't report Authorized Consumption volume greater than Water Supplied volume

Example Data Sheets

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

  - The Philadelphia Water Department (US) audit shows units of million gallons (US)

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

AWWA WLCC Free Water Audit Software: Reporting Worksheet

WAS v4.0

Back to Instructions

| ? | 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:	?	7	94,536.900	Million gallons (US)/yr (MG/Yr)	
Master meter error adjustment:	?	10	2,779.300	over-registered	MG/Yr
Water imported:	?	n/a		MG/Yr	
Water exported:	?	10	7,100.400	MG/Yr	
WATER SUPPLIED:			84,657.200	MG/Yr	

AUTHORIZED CONSUMPTION

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

Billed metered:	?	7	57,242.400	MG/Yr	
Billed unmetered:	?	n/a		MG/Yr	
Unbilled metered:	?	n/a		MG/Yr	
Unbilled unmetered:	?	8	764.200	MG/Yr	

Pcnt: Value:
○ ◉   764.200

AUTHORIZED CONSUMPTION:	?		58,006.600	MG/Yr

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

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

Apparent Losses

Pcnt: Value:

Unauthorized consumption:	?	8	2,086.300	MG/Yr

○ ◉   2,086.300

Customer metering inaccuracies:	?	8	190.300	MG/Yr
Systematic data handling errors:	?	5	4,674.400	MG/Yr

○ ◉   190.300

Apparent Losses:	?		6,951.000	MG/Yr

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:	?	9	3,137.0 miles
Number of <u>active AND inactive</u> service connections:	?	7	547,932
Connection density:			175 conn./mile main
<u>Average</u> length of customer service line:	?	7	12.0 ft
Average operating pressure:	?	10	55.0 psi

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

COST DATA

Total annual cost of operating water system:	?	10	$219,182,339 $/Year
Customer retail unit cost (applied to Apparent Losses):	?	9	$4.97 $/1000 gallons (US)
Variable production cost (applied to Real Losses):	?	9	$215.50 $/Million gallons

PERFORMANCE INDICATORS

Financial Indicators

Non-revenue water as percent by volume of Water Supplied:	32.4%
Non-revenue water as percent by cost of operating system:	17.8%
Annual cost of Apparent Losses:	$34,546,470
Annual cost of Real Losses:	$4,245,264

Operational Efficiency Indicators

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

Assessing the Composite Data Validity Score

Functional Focus Area	Water Audit Data Validity Level / Score				
	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.

Follow-up Actions

- Monitor and Manage
- Incrementally improve the extent and validity of the data over successive water audit periods
- Move into a "bottom-up" auditing approach incrementally
- Refer to M36 and other reference publications, IWA and privately authored
- Review case studies
- Software Support: send comments/questions/problems to **wlc@awwa.org**

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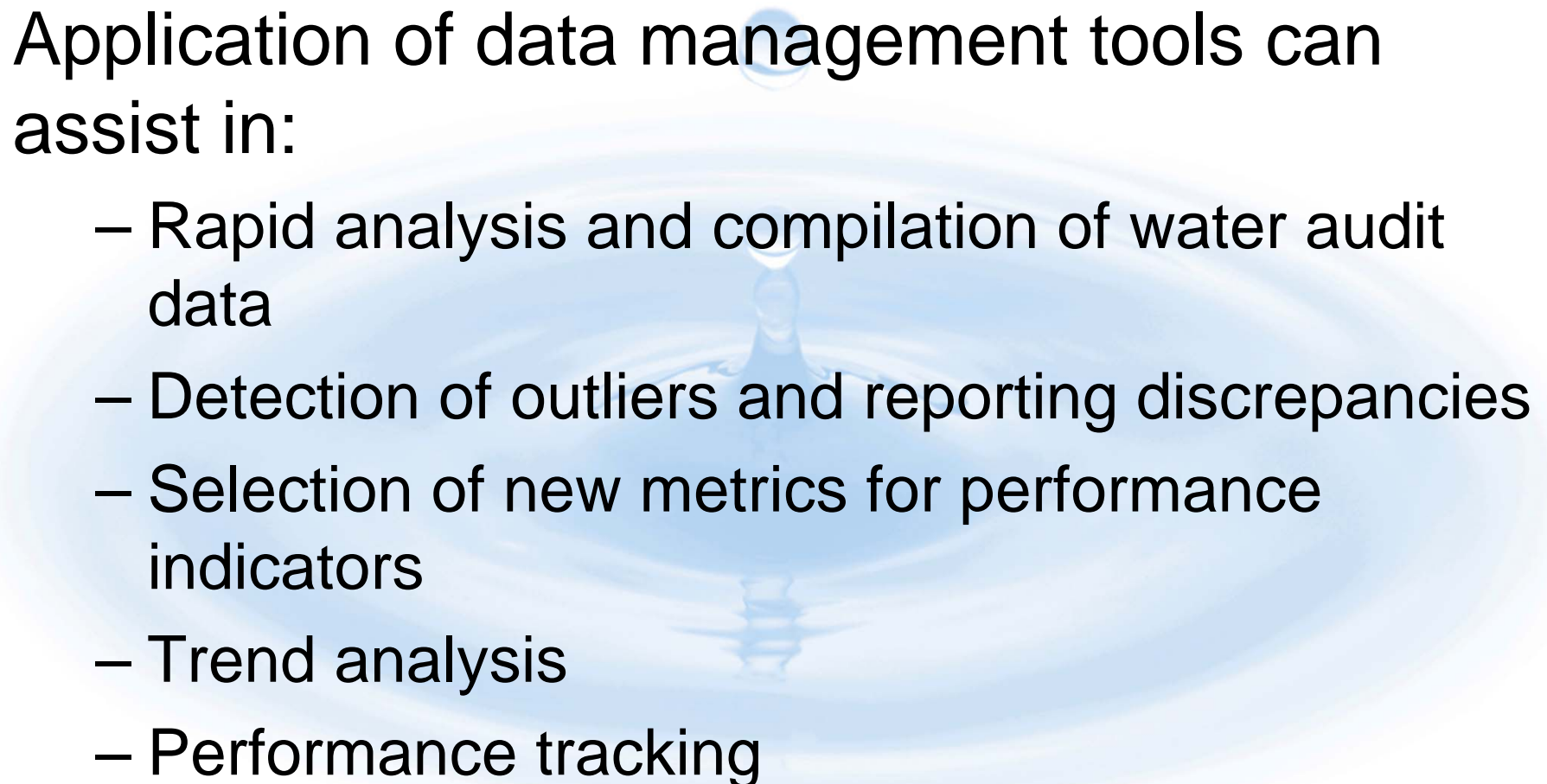
April 13, 2011

Water Audit Data Management

David Sayers,

Supervisor, Information Technology & Water Use, DRBC

Water Audit Data Management

Application of data management tools can assist in:

- Rapid analysis and compilation of water audit data
- Detection of outliers and reporting discrepancies
- Selection of new metrics for performance indicators
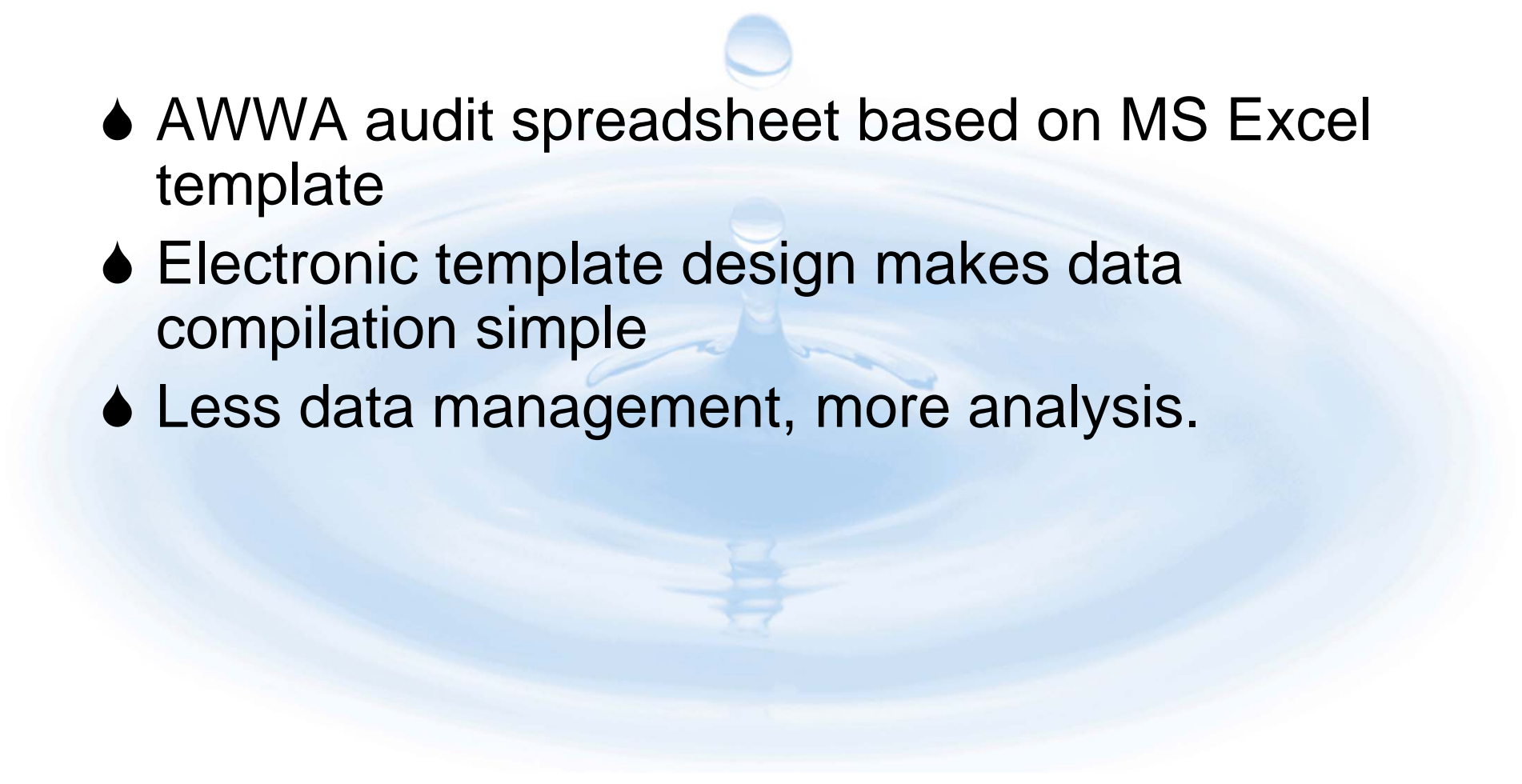- Trend analysis
- Performance tracking

Water Audit Data Management

AWWA Water Loss Control Committee developed a data management tool for multiple purposes:

- The Compiler -

- DRBC program
- PAPUC pilot program
- Other regulatory programs
- AWWA paper / presentation June 2011
- Individual utilities with multiple, separate systems

Data Collection & Analysis

- AWWA audit spreadsheet based on MS Excel template
- Electronic template design makes data compilation simple
- Less data management, more analysis.

Managing Water Audit Data

Go to audit
management
software…