American Water Works Association

Philadelphia Water Department

DRBC Workshop
Water System Audits and Water Loss Control

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Module 2 Session 3

Organizing the Water Audit Data Collection Process in your Water Utility

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Water Auditing & Efficiency are attained Incrementally: take the long-term outlook

- See AWWA M36 publication: Chapter 6
- Start auditing today – don't wait until the data looks "right"
- Initial focus should be on "process" rather than "outputs"
- Take a long-term outlook in improving water data validity and loss control efforts
- Identify key data sources for the water audit and roles/responsibilities for annual data collection
- Start with a top-down approach and gradually increase the number of bottom-up activities year-by-year
- Track audit results each year and compare with the long-term trend in your system

Philadelphia Water Audit Summary Statistics
Fiscal Years 2001 - 2010

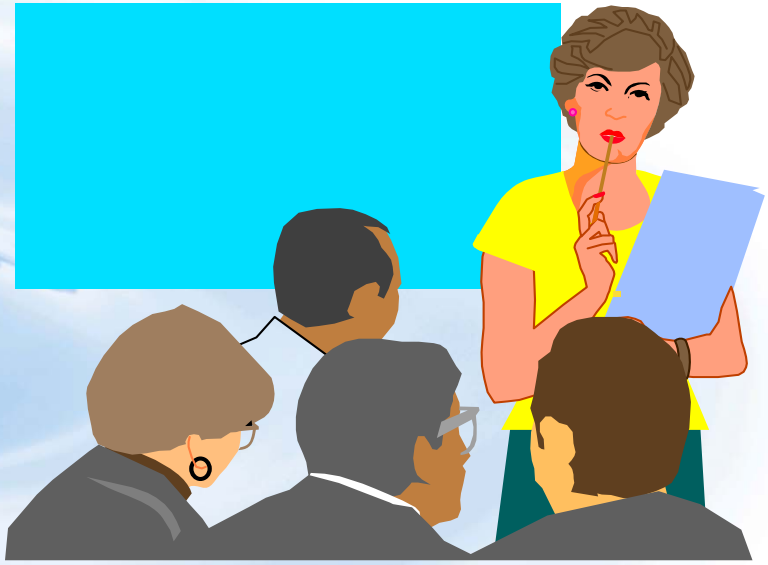
	Fiscal Year										
	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000
Water Supplied											
Water Supplied from Rivers, mgd	266.9	268.0	273.6	278.7	276.9	283.0	286.0	294.3	286.5	294.3	308.7
(minus treatment plant usage)											
Water System Input Volume, mgd	244.4	245.8	250.7	255.3	253.8	260.3	263.0	270.2	263.0	267.5	277.7
Service Area Population	1,736,006	1,660,900	1,660,534	1,642,634	1,656,212	1,653,301	1,622,740	1,629,400	1,640,771	1,653,262	1,671,550
Per capita water supplied, gpcd	153.7	161.4	164.8	169.7	167.2	171.2	176.2	180.6	174.6	178.0	184.7
Authorized Consumption											
Billed Consumption, mgd	165.8	172.4	175.8	169.5	177.0	176.9	176.9	183.4	178.2	181.7	185.8
Unbilled Unmetered (firefighting, etc.), mgd	2.0	2.1	2.1	2.3	2.4	2.3	2.4	3.1	2.4	2.3	3.0
Unbilled Unmetered water cost	$779,394	$713,802	$717,246	$214,310	$192,260	$155,165	$159,715	$180,376	$145,984	$134,517	$148,991
Authorized Consumption, mgd	167.8	174.5	177.9	171.8	179.4	179.2	179.3	186.4	180.6	184.0	188.8
Per capita water consumed, gpcd	95.5	103.8	105.9	103.2	106.9	107.0	109.0	112.6	108.6	109.9	111.2
Water Losses											
Apparent Losses (billing data error, unauthorized consumption, customer metering inaccuracies), mgd	17.0	15.0	19.0	21.8	15.1	14.1	11.1	13.3	13.1	14.5	18.6
Apparent Loss unit retail cost/mg	$6,071	$5,429	$4,971	$4,799	$4,500	$4,132	$3,945	$3,671	$3,285	$3,103	$3,120
Apparent Loss Cost	$30,034,457	$22,255,068	$27,328,369	$30,844,309	$20,276,611	$19,093,984	$10,937,852	$10,013,610	$9,036,037	$11,588,741	$13,750,895
Real Losses (Leakage), mgd	59.6	56.2	53.8	61.6	59.2	66.9	72.6	70.5	69.2	68.9	70.1
Variable Production Cost, per mg	$235.00	$229.41	$215.50	$193.82	$160.48	$130.54	$133.58	$126.60	$121.70	$116.12	$110.25
Real Loss (leakage) Cost	$5,867,776	$4,843,686	$4,960,676	$5,117,778	$4,228,646	$3,948,821	$4,074,864	$3,682,258	$3,369,029	$2,499,146	$2,965,128
Non-revenue Water Volume, mgd = Unbilled, Unmetered Consumption + Apparent Loss + Real Loss	78.6	73.4	74.9	85.7	76.7	83.3	86.1	86.9	84.7	85.7	91.8
Non-revenue Water Cost Total	$36,681,627	$27,098,754	$33,006,291	$36,176,397	$24,697,517	$23,197,970	$15,172,431	$13,876,244	$12,551,050	$14,222,404	$16,865,014
Key Performance Indicators											
Apparent Losses per connection, gal/service connection/day	30.8	25.8	35.2	39.6	27.4	25.5	22.8	24.2	23.9	26.3	33.9
Real Losses (leakage) per connection, gal/service connection/day	107.7	96.6	96.7	112	107.3	121.2	132.5	154.6	149.8	125.1	127.7
Infrastructure Leakage Index (ILI)	9.9	8.9	9.0	10.3	8.9	11.0	12.1	11.9	13.1	12.7	12.3
Non-revenue Water by Volume, %	34.9%	32.3%	32.4%	36.3%	32.2%	34.6%	35.4%	32.1%	32.2%	32.1%	33.1%
Non-revenue Water by Cost, %	16.3%	12.5%	15.2%	17.5%	13.0%	12.4%	9.05%	8.28%	8.09%	9.18%	11.50%

Annual Water System Input volume peaked at 370 mgd in 1955
Historic annual Non-revenue Water Volumes exceeded 100 mgd until being reduced below this level starting in FY1996

AWWA M36 Publication – Chapter 6
Planning & Sustaining the 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



Planning & Sustaining the Loss Control Program: Chapter 6

Short, medium and long-term planning horizons

Potential Activities of a Water Loss Control Program (Not all of the activities are necessary for every water utility; system-specific needs should be considered)						
Water Auditing			Intervention Activities			
			Apparent Loss Control		Real Loss Control	
Time	Activity		Time	Activity	Time	Activity
S	Top-down Water Audit		S	Calibrate production flowmeters (***this is a very important activity to conduct!***)	S	Review maintenance records, summarize statistics on breaks and leaks
M	Start Bottom- up Water Audit; outline processes	Start Bottom- up Water Audit; outline processes	S	Flowchart the Customer Billing Process: compile general demographics of the customer/meter population	S	Review policies for customer service connection piping ownership and maintenance; and opportunity to reduce customer service connection piping leakage durations
Ongoing	Bottom-up Water Audit: Detailed investigations of metering, meter reading and billing operations	Bottom-up Water Audit: Field measurements and nightflow leakage analysis Component analysis of leakage	S	Perform meter accuracy testing on a small sample of customer meters*	S	Establish a pilot District Metered Area; perform nightflow leakage analysis
			S	Audit billing records and visit premises of a small number of customer accounts to determine the potential for missed billings or unauthorized consumption	S	Compile data on the variation of water pressure throughout the water distribution system
			M	Investigate the potential costs and savings of instituting an Automatic Meter Reading (AMR) system to reduce missing or erroneous customer meter readings*	S	Launch a pilot leak detection survey, perhaps via a consultant; consider use of leak noise monitors
			M	Review/implement policies to thwart unauthorized consumption	M	Create a leak detection squad, or hire a leak detection contractor, to regularly survey the distribution system for unreported leakage
			M	Install, upgrade or replace production flowmeters	M	Install Pressure Management areas and/or deploy leak noise monitors
			L	Install an Automatic Meter Reading system and institute monthly billing based upon meter readings*	L	Implement a Maintenance Management Information System
			L	Install a new Customer Billing System*	L	Create additional District Metered Areas
			L	Conduct wholesale customer meter replacement*	L	Institute capital replacement program for water main infrastructure

Timeframe: S – Short-term M – Medium-term L – Long-term

Monthly Summary Data Tracking

- Can track and compare monthly system input volume vs. total authorized billed consumption
- Must use the rolling 12-month average values of these volumes

Philadelphia Water Department

Monthly Water Statistics Report

	Water Delivery (System Input) (mgd)	Billed Consumption (mgd)		Non-revenue Water (mgd)	Number of Customer Billing Accounts	
		City	Exports		Large	Small
8/04– 7/05	260.7	156.9	18.8	**85.0**	13,355	458,339
9/04– 8/05	261.3	159.4	19.1	**82.9**	13,332	458,251
10/04– 9/05	261.5	160.5	18.8	**82.2**	13,312	458,144
11/04– 10/05	261.4	159.9	18.8	**82.7**	13,292	458,056
12/04– 11/05	260.9	159.4	18.9	**82.6**	13,274	457,966
1/05– 12/05	260.3	159.4	19.1	**81.8**	13,253	457,906
2/05– 1/06	258.8	160.6	19.4	**78.8**	13,237	457,922
3/05– 2/06	256.9	159.6	19.3	**78.0**	13,217	457,949
405– 3/06	255.6	158.5	19.3	**77.8**	13,194	457,956
505– 4/06	254.8	158.0	19.4	**77.4**	13,176	457,946
605– 5/06	254.5	157.7	19.5	**77.3**	13,156	457,972
705– 6/06	253.8	157.8	19.7	**76.3**	13,137	458,043

Leading the Water Loss Control Program is like Conducting an Orchestra

Directing multiple activities to achieve harmonious performance