**WATER EFFICIENCY**

Water Loss Control

**Water Audits and Proactive Programs Bring High-Level Benefits**

### Quick Facts

- Water Losses are comprised of Real Losses (leaks) and Apparent Losses (theft and meter under-registration).
- Water Loss Control Programs promote overall water efficiency by reducing leaks and increasing revenue recovery.
- Small breaks may go unnoticed for a long time, causing more loss than a main break.
- Leakage is a key indicator of distribution system performance.

### Overview

Continuing droughts and increasing frequency of main breaks have led utilities, regulatory agencies, and stakeholders to focus on water efficiency and water loss control programs. Media attention is focused on leakage, yet leading water utilities are focusing on overall water efficiency, which means reducing distribution of water where no revenue generation occurs, including Real Losses (leaks) and Apparent Losses (water theft or meter under-registration). Many resources have been published recently to meet this challenge.

### Estimating Water Losses

There are no federal regulations requiring utilities to provide detailed reporting of water use, so finding an accurate estimate of water losses (both Real and Apparent Losses) is difficult. The following estimates must include some assumptions. The U.S. Environmental Protection Agency (EPA) and the American Water Works Association (AWWA) have estimated that “as much as 18% of water might be lost each year to leakage, metering inaccuracies, data handling errors, and unauthorized consumption,” amounting to “approximately 5.9 billion gallons per day” (CNT 2013). Another estimate is from
The goal of water loss control programs is not to reduce Real and Apparent Losses to zero, but to determine the appropriate actions to cost effectively reduce leaks and increase revenue recovery.

the American Society of Civil Engineers, which cites 240,000 main breaks per year and gives the U.S. drinking water infrastructure a D grading (ASCE 2016). With an estimated water infrastructure spending shortfall of $17 billion per year (AWWA 2012), it is estimated there is a rising backlog of unreported failures and increased losses from leakage.

More accurate estimates of break rates and water losses come from research. Based on a literature review, Sturm et al. (2014) found that the average pipe failure frequency is approximately 25 failures/100 miles/year. The most robust water audit data set to date is from Georgia, and the median value of Apparent Losses was 5.96 gallons per service connection per day and the median value of Real Losses was 52 gallons per service connection per day or 1,730 gallons per mile of main per day (Sturm et al. 2015).

Proactive Water Loss Control Programs
Most North American utilities employ a reactive strategy—repairing failures in a timely manner. However, proactive water loss control programs can bring high-level benefits because they don't just focus on leaks, but rather on utility efficiency of distributing treated water to the customer and generating revenue from that action. A comprehensive approach can include improving meter and record accuracy, leak detection surveys, and repairing and replacing infrastructure.

Anticipated benefits include limiting wasteful source water withdrawals, optimizing revenue recovery, increasing reliability and efficiency, preventing contamination, and improving system integrity (AWWA 2016b). Halifax Water’s loss control program reduced system leakage by 9 million gallons per day, with an annual savings of Can$550,000 (Kunkel et al. 2006).

Water Audits
A water audit is a thorough examination of a water utility’s data, records, accounts, and procedures regarding the volumes of water moved from input through the distribution system to the customer. AWWA recommends their water audit methodology as a best practice and it is defined in M36 Water Audits and Loss Control Programs (AWWA 2016b). AWWA’s M36 and the Water Research Foundation’s (WRF) Real Loss Component Analysis (Sturm et al. 2014) provide the guidance and tools to build a water loss control program.

First Level: Top-Down Water Audit
A top-down water audit is an initial desktop assessment of records and should be performed annually and can be performed using the “AWWA Free Water Audit Software” (AWWA 2016a) (see Figure 1). An example of the information that can be determined is Philadelphia’s 2006 water audit. It revealed considerable Apparent Losses and, of 12,000 customer accounts with zero consumption, 22% had meter malfunctions and 46% were vandalized by tampering (AWWA 2009).

Fewer than ten states currently require an annual water loss report or audit using the AWWA methodology. A top-down audit contains performance indicators for financial and operational efficiency. AWWA states that the infrastructure leakage index (ILI) and real losses (gal/service connection or mile of mains/day/psi) are the most appropriate for utility comparisons (AWWA 2016b). In an analysis of 812 water audits from five regions, the median ILI was 2.48 and median real losses were 39.88 gallons per service connection per day (Sturm et al. 2014). A utility should compare its own audits from year to year, working to improve the data validity score.

Second Level: Component Analysis of Losses (Looking for Leaks)
After a top-down audit, a more in-depth analysis may be performed on either Real or Apparent Losses. This section focuses on reducing Real Losses because a free tool has been created for that purpose. It requires a year of collected data on reported, unreported, and background leakage (see Table 1). Real Losses are primarily comprised of leaks from mains and service connections.

WRF’s report, Real Loss Component Analysis, and its accompanying software tool, the “Leak Repair Data
Table 1. Types of leakage

<table>
<thead>
<tr>
<th>Type of Leakage</th>
<th>Definition</th>
<th>Tools/Solutions</th>
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<tbody>
<tr>
<td>Background Leakage</td>
<td>Not detectable using traditional acoustic equipment</td>
<td>• Pressure stabilization</td>
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<td></td>
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<td>• Pressure reduction</td>
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<td>• Main replacement</td>
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<td></td>
<td></td>
<td>• Reduce number of joints/fittings</td>
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<tr>
<td>Unreported Leaks and Breaks</td>
<td>Often doesn’t surface; is detectable with traditional acoustic</td>
<td>• Pressure stabilization</td>
</tr>
<tr>
<td></td>
<td>equipment</td>
<td>• Pressure reduction</td>
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<td></td>
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<td>• Main replacement</td>
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<td></td>
<td></td>
<td>• Reduce number of joints/fittings</td>
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<tr>
<td></td>
<td></td>
<td>• Proactive leak detection and repair</td>
</tr>
<tr>
<td>Reported Leaks and Breaks</td>
<td>Usually surfaces and is reported to utilities by the public</td>
<td>• Pressure stabilization</td>
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<td>• Pressure reduction</td>
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<td>• Main replacement</td>
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<tr>
<td></td>
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<td>• Optimized repair time</td>
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</tbody>
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Source: data from Filho 2004

**Actions to Reduce Water Losses and Increase Revenue Recovery**
Pressure management is one leak management tool. Pressure-reducing valves can reduce breaks and losses. In Halifax’s district metered areas, pressure-reducing valves resulted in a 10–30% reduction of breaks (Fanner et al. 2007).

Leak identification is another important leak management tool. An acoustic survey is the traditional method for finding a specific leak. More expensive methods may be worthwhile, such as continuous acoustic monitoring, or satellite image analysis that detects a spectral signature of potable water touching soil (Schumi 2016).

**Conclusion**
Since the 1990s, the United Kingdom’s Leakage Initiative, International Water Association, the AWWA Water Loss Control Committee, and WRF have furthered the concepts and practices of water loss control and water audits. Conservation has typically focused on the utility customer, but strides in water efficiency can be achieved through utility water loss control programs. AWWA advocates the use of the their water audit method and performance indicators because they have shown success internationally and have the promise to improve the state of practice in North America (WLCC 2003). Using best management practices and multiple levels of water audits, utilities can employ proactive strategies to discover and repair leaks, become more efficient, reduce water losses (both Apparent and Real Losses), and increase revenue recovery.

**References**


