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## Innovative Solutions in the Water Industry: Leak Detection

### Introduction

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Meeting current water demand and supplying water for future generations is a significant challenge for the water industry. The availability of water is not a given, especially when some regions are already experiencing water scarcity.<sup>1</sup> By the year 2013, it is estimated that at least 36 states will face serious water shortages,<sup>2</sup> and water demand is expected to outpace supply by 50 percent in the next 15 years.<sup>3</sup>

Considering these facts, one of our most critical questions for the future centers on how communities can significantly reduce consumption and ease the strain on our nation's water supply. With approximately 7 billion gallons of treated drinking water "lost" each day primarily due to leaks in drinking water pipelines throughout the U.S.,<sup>4</sup> one viable solution is leak detection.

### Background

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For water utilities, detecting and repairing leaks is one of their main components for water conservation. Results of deteriorating infrastructure, fluctuating water temperatures, soil movement, vibrations and water pressure changes are just some of the factors contributing to water leakage. And not only do leaks account for lost water, but they can also allow contaminants into the system that can endanger public health. It is estimated that up to 10 billion gallons of raw sewage is released into our waterways every year as a result of blocked or broken pipes.<sup>5</sup>

According to the American Society of Civil Engineers Report Card for America's Infrastructure, national drinking water/wastewater systems received a grade of a D.<sup>6</sup> Over the last several years, many studies have been undertaken to estimate water loss. Regions of developing countries are experiencing greater water loss than regions in developed countries and North America alone is experiencing 12.3 percent of non-revenue water.<sup>7,8</sup>

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<sup>1</sup> The American Water White Paper: "Challenges in the Water Industry: Meeting Demand in the West" highlights scarcity challenges in Western United States.

<sup>2</sup> U.S. Government Accountability Office. "Natural Resources, Energy, and the Environmental Challenges for the 21st Century." February 2005.

<sup>3</sup> Morgan, Wayne D. "Preserving our Vital Resources: How Advanced Leak Detection Technologies Support Water Conservation." Under ground Infrastructure Management. March 2010.

<sup>4</sup> American Society of Civil Engineers. "Report Card for America's Infrastructure." 2009.

<sup>5</sup> ITT Corporation, "The Value of Water Survey: Americans on the U.S. Water Crisis," 2010

<sup>6</sup> American Society of Civil Engineers. "Report Card for America's Infrastructure." 2013.

<sup>7</sup> Global Water Intelligence. "Global Water Market 2008 Opportunities in Scarcity and Environmental Regulation." 2008.

<sup>8</sup> Non-revenue water is water that has been produced and is "lost" before it reaches the customer.

To combat water loss, it's up to utilities and municipalities to adopt and implement technologies to more effectively manage and conserve water supplies by developing methods to detect, locate and stop leaks. A leak detection program can be highly proactive, helping water utilities automate water systems, detecting problem areas earlier, giving customers tools to monitor water use, providing more accurate rates and reducing demand.

Water utility customers also have an important role in leakage control, because the amount of water leaked from U.S. water customers can exceed more than 1 trillion gallons per year.<sup>9</sup> It is essential that this resource can be captured— not only because it is an increasing scarce supply but also because of its embedded energy and the greenhouse gas footprint it represents. Although in many parts of the country water might be considered the cheapest utility commodity, water loss is still very costly to customers and water utilities.

The U.S. Environmental Protection Agency has a program called “WaterSense”<sup>10</sup> to promote education and adoption of water saving devices. WaterSense and partner agencies, including American Water, annually sponsor a “Fix a Leak Week” to raise customer awareness on leak detection and conservation.

### Benefits of Leak Detection

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The economic benefits of leak detection and repair can be easily estimated. By pinpointing the leak before the main breaks, a utility can prevent drastic amounts of water loss and property damage. Without the detection tools, leaks could turn ugly.

Minimizing leakage in water systems has many benefits for water customers and their suppliers. These benefits include:<sup>11</sup>

- Extended life of pumping and treatment facilities.
- Improved operational efficiency.
- Less disruption for business and highways.
- Lowered water system operational costs.
- Reduced potential for contamination.
- Reduced potential property damage and water system liability.
- Reduced water outage events.

According to the U.S. Environmental Protection Agency if we decreased the approximate 650 water main breaks every day by only 0.5% we would save 270 million gallons of water a day.<sup>12</sup>

### Technology in Practice

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To ensure water is available for future generations, water industry experts have developed comprehensive water preservation and efficiency strategies utilizing leak detection technologies that support conservation and consumption changes significantly impacting overall supply.

Some water loss and leak control technologies include:

- Automatic Meter Reading □ Advances in water meter technology can automatically record and report leakage within the customer-owned portion of the plumbing by detecting a constant flow of water. Such technology not only helps to conserve water, but helps the customer avoid unnecessarily high water bills.

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<sup>9</sup> Environmental Protection Agency WaterSense Fact Sheet: Fix a Leak Week

<sup>10</sup> Refer to WaterSense Web site: <http://www.epa.gov/WaterSense/>.

<sup>11</sup> Georgia Environmental Protection Division. “Water Leak Detection and Repair Program.” August 2007.

<sup>12</sup> ITT Corporation's 2010 Value of Water Survey

- Continuous Acoustic Monitoring of Water Mains via Valves – American Water has installed on water main valves or water services leak detecting sensors that record sound vibrations overnight. Trained staff periodically download the information into specially designed software to analyze the pipe noise for the sound of leaks.
- GIS Analysis – Reviewing historical leak information via GIS mapping helps clearly identify leak-prone areas, which typically occur in smaller-diameter pipes installed more than 50 years ago.
- Improved Pressure Control – Reducing and modulating water pressure in water systems lowers the amount of water leaking out of pipes and reduces stress on pipes while still providing customers with needed supply.
- Large Transmission Main Testing – American Water is currently evaluating several complex methods to detect leaks on large pipes such as inserting leak-finding sensors inside water pipes and sensing noise transmitted by running water.
- Leakage Control Zones – Some systems are subdivided into separate “zones of supply” monitored by master meters that periodically measure water use in a particular area. Higher-than-expected water flow in the middle of the night is a tip-off that a certain spot requires further investigation.
- Main Replacement Program – American Water routinely collects and evaluates water system data, especially main breaks, to identify and replace aging mains.

### Finding Solutions

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In some cases, advanced metering infrastructure (AMI) and continuous acoustic monitoring (CAM) technologies work to detect hard-to-find leaks in a timely manner and better manage water loss. AMI involves a two-way communication device that automatically collects and transmits consumption and interval data from smart meters to a computer network. The utility then analyzes this data to uncover irregularities that likely signal a leak, meter tampering or water theft.

By deploying these technologies throughout distribution systems, water utilities are able to survey for pipeline leaks every day. The acoustic monitors, whether installed on the service line or placed on valves in the distribution system, can relay the data back through the AMI telemetry system to operators using an analytic software package. The software processes the data and alerts the system operator when a monitor is detecting a “noise” indicative of a leak.

Sophisticated vendor software displayed via Web sites interprets changes and the magnitude of sounds to rank the possible source locations and to identify the exact location of the leak. The leak can then be repaired, or the infrastructure replaced, as required. In the end, using these technologies to find leaks and better record water usage improves customer service, conserves water and keeps rates down.

Some notable communities where American Water’s use of leak detection technology has provided significant benefits include:

- **Connellsville, Pa.** – This was the first pilot program using MLOG acoustic leak detectors and an AMI system, resulting in non-revenue water dropping by more than half, from over 25 percent within six months, saving about \$175,000 in annual water purchase costs in just the first year. The average cost of repairing leaks found before they surfaced amounted to about one quarter less than surfacing leaks, resulting in fewer emergencies.
- **Fayette County, W.Va.** – In West Virginia, a system that will use AMI and CAM was installed to link together water meters via wireless mesh technology to create an automatic metering infrastructure that enables two-way communication and provides real-time information about water usage. This technology illustrates how smart water technology can help residents and municipalities not only stop wasting water, but also save money. In a pilot version of the program, payback was noticed in about two years.

- **Irvington, N.J.** - With a water system dating back to the 1880s, pipe deterioration in Irvington had led to non-revenue water loss of over 23 percent. After integrating an acoustic monitoring program, 24 leaks were identified and repaired, resulting in a savings of an estimated 250,000 gallons of water per day, all in just nine months.
- **Monterey, Calif.** - American Water continues to deploy the drive-by (or mobile) option for acoustic monitors. An MLOG mobile system was deployed in Monterey's system. Many of the utility's vehicles are equipped with collectors that gather data, which is stored up to 11 days. The software allows the operators to see if any areas have been missed during the month to be sure recent data is collected.
- **Valley View, Ill.** - In one of American Water's Chicago districts, a pilot program employing acoustic monitors is being combined with an AMI system designed to enable the system operator to instruct adjacent units to correlate around a suspicious leak noise. If successful, the system will be better able to differentiate between leak noise and extraneous noise and pinpoint the leak location along the pipe before dispatching anyone into the area.

The effective use of technologies that protect water supplies and manage non-revenue loss also promotes the importance of conservation among customers. Public awareness programs are crucial for educating customers about how to use water more wisely, and AMI data can serve as a communication tool for informing customers about their current water use patterns.

As with any resolution, leak detection is just one part of the solution to our nation's water challenges. Ensuring adequate supply in America also requires making people aware of just how essential water is to our every day life, educating people about conservation and promoting water saving methods.

By detecting and repairing leaks, utilities can save water and energy. Households and businesses can do their part by installing low-flow household faucets and toilets, stormwater collection systems and timed or climate-controlled irrigation systems as a means of limiting water usage.<sup>13</sup> Becoming more informed about water use habits will enable the population to make better and more conscious decisions about our water use in the future.

### Conclusion

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As discussed in this paper, leak detection plays an increasingly important role in water conservation. In light of what many see as a water crisis, states across the U.S. are putting strict water use restrictions into practice. Thus, adopting water conservation methods and technologies that support water preservation and management is an area of increased priority. By investing in such technologies and systems now, communities can significantly reduce consumption and ease the strain on our nation's water supplies.

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<sup>13</sup> Greener Buildings. "Water Efficiency Backgrounder."

