Quiet Warriors and Silent Sentinels

Meeting the Water Infrastructure Challenge in Baltimore

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Two decades ago, a Baltimore public works director, when asked what he would do with unlimited funding, responded, "I'd dig up every street and replace everything." Ideally, every older municipality wants to be able to at least clean and line its aging water, sewer and storm pipes. Replacement is, literally, a pipe dream. Traditionally a new road would get a ribbon-cutting and probably a good chunk of federal funding; a new sewer would get a flush?

Baltimore's underground is a myriad of pipes, conduits and tunnels. The city's system provides water to 1.8 million customers who live in the city and surrounding areas. The wastewater system treats the influent from 1.6 million people.

Our citizens are familiar with infrastructure failure. On average the Department of Public Works' Bureau of Water and Wastewater (DPW-W&WW) responds to more than a thousand water main breaks annually. Most neighborhoods have been impacted with at least a brief service interruption; others have been more severely affected.

Age is the Main Issue

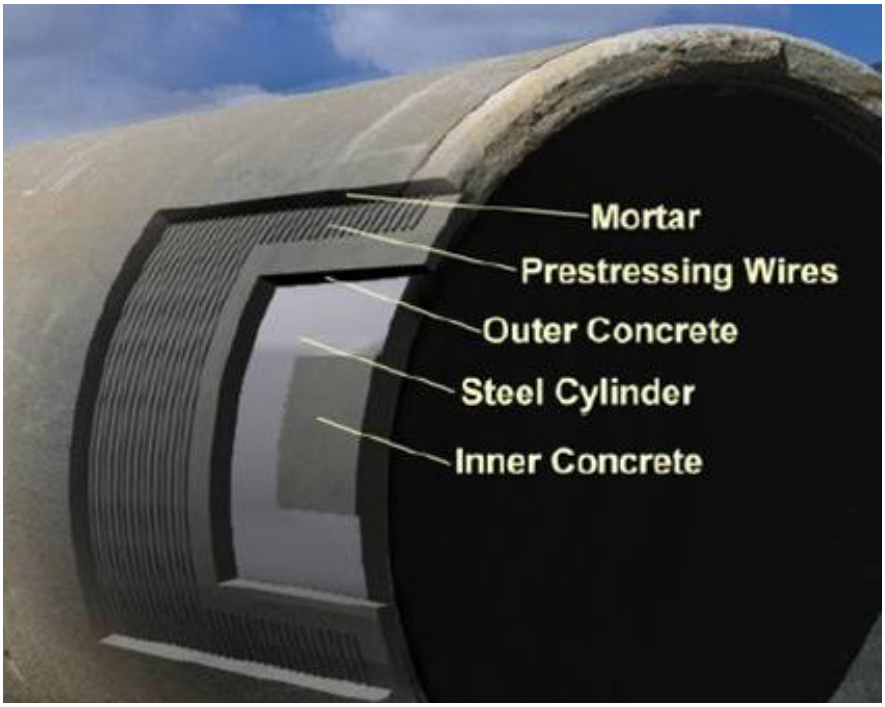
Most infrastructure failures are due to age. Of the almost 1,600 miles of water mains in Baltimore, more than half are over 80 years old. Fifty-four miles were installed in the 19th century.

The year 2009 was especially troublesome. In February, a 16-inch main flooded an uptown neighborhood, causing extensive damage to a state office building and other structures. In April, a 20-inch cast-iron main erupted, flooding portions of downtown, closing businesses and government offices. Both of these mains date back to 1921. The very next day, a 36-inch concrete main erupted along the train tracks in Halethorpe, southwest of the city, disrupting east-coast rail traffic for several hours. And in September, a 72-inch concrete main burst in the Dundalk community of Baltimore County, flooding scores of basements.

Installation Year	Footage	Miles
Prior to 1900	287,028	54.36
1901 - 1930	4,449,270	842.66
1931 - 1960	2,705,075	512.32
1961 - 1990	773,151	146.43
After 1990 [1]	146,101	27.67
TOTAL	**8,360,625**	**1,583.45**

The last two were not particularly ancient 74) but they were of a specific type, Class IV pre-stressed concrete pipe (PCCP). PCCP has proved problematic throughout the nation because the outer wires become brittle and break; a manufacturing defect found in these large, high-pressure mains installed almost a half-century ago. There are approximately 130 miles of pre-stressed mains in Baltimore's system, ranging from 30 to 144 inches in diameter; approximately 15 percent are Class IV PCCP.

In December 2009, a 42-inch cast-iron main ruptured beneath Argonne Drive in Baltimore.



This cutaway diagram shows the components found in PCCP pipe.

Although Class IV is a small part of the city's system, it is embedded in the large transmission mains. Because these are major conveyors of water to regional customers, they present special challenges. With their troubling history there is a need to inspect, repair, replace, and monitor them.

Inspections Are Key

Inspections can be done in a number of ways. Mains can be shut down and physically examined from the inside using hand-held detection devices and cameras. Because these are major carriers of water, the shutdown might impact water supply.

Advances in technology now allow inspections without disruptions. Some of these technologies use the water flow to propel the device through the main.

Beginning in 2008, acoustic fiber-optic cable was installed in a 5.8 mile section of Baltimore's critical southwest transmission main to listen for real-time breaks of the outer wires on the Class IV pipe. In March 2012, another piece of equipment was utilized as the main was inspected by a PipeDiver,™ a tool that looks like a 12-foot long, worm-like, fishing lure. Inserted into the north end of the main, it was propelled southward by its fins using the water flow. As it travelled it generated electromagnetic fields to energize the outer wires of the main, creating "snapshots" of each 16-20 foot section of pipe.

The collected data was was downloaded, extensively analyzed, and checked against other data, including readings taken by the fiber-optic cable. While the information gathered was troubling, it was not unexpected.

Collected data indicated severe wire breakage in one section of the main. The breakage was located in the southwestern portion of the city below vacant railroad property. If the information was correct then immediate action was necessary to avoid a catastrophic main failure.

Repair Before Failure

On July 9, 2012, Public Works Director Alfred H. Foxx, announced water conservation measures as the southwest transmission main would be shut down because it was in danger of failing. The shutdown occurred, without disruptions to customers, and excavation of the main began July 16.

By July 23, new sections of main were in place and the line recharged. When that section of main was exposed it was instantly clear that the technologies worked. Approximately 30 percent of the pipe section had failed wires; a very dangerous situation on a large, high-pressure main.

These technologies will enable Baltimore to plan ahead; and through carbon-fiber lining and replacement of questionable sections, the mains can remain in service for decades.

The challenge to address the Class IV PCCP mains is being met, but what of smaller mains?

A 123-year-old, 20-inch, water main broke in the heart of downtown Baltimore on the same day that work began on the southwestern transmission main.

Days later, a 10-foot storm drain tunnel failure in East Baltimore opened a massive hole in the street. Closed-circuit TV and ground-penetrating radar were employed to survey the extent of the damage.

Baltimore is using the best technology in the infrastructure challenge; however, the greatest tool is the ability to identify and evaluate the condition of all infrastructure and assets toward the initiating appropriate upkeep, repair and replacement; otherwise known as asset management. A commitment to dedicated, consistent yearly funding coupled with a sound asset management strategy, will enable Baltimore City to safeguard its assets and infrastructure for decades.

Baltimore plans to increase the number of miles of main rehabilitation from the current less than five miles to 40 miles annually, a commitment of $300 million over the next five years.

Is that enough to address the needs of an excellent but aging water system?

In an era of tight-budgets the answer is a qualified yes. More needs to be done; and upgrades and improvements to increase efficiency will require ratepayer support. Baltimore has kept its increases in the single digits each year, balancing the system's needs and customers' burdens.

Out of sight is not out of mind to the Baltimore City Department of Public Works. As in war there is a strategy to win. The quiet warriors and strategists are the engineers, working tirelessly on the plan of attack so that the soldiers in the field, the maintenance crews, can concentrate on prevention rather than reaction. The silent sentinels are the detection devices and data collection systems generating images that map the battlefield in preparation for winning the war.

A challenge? Of course, but challenges are meant to be met.

Broken wires on a PCCP main can be seen in this photo.

A storm drain failure on Light Street forced the closure of this East Baltimore street i n July 2012.