City of Port St. Lucie Asbestos Cement Pipe Bursting: A Programmatic Approach

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The City of Port St. Lucie (city) has been proactively replacing its potable water distribution system for several years. Prior to 2014, the city utilized traditional open-cut construction methods to replace the existing potable water distribution system; however, the city sought innovative methods to replace the infrastructure with less detriment to the environment and its customers.

The city's staff evaluated the trenchless technology method of pipe bursting and moved forward with comparing the economics of pipe bursting versus traditional open-cut construction. The staff was very satisfied with the use of pipe bursting and continued to build a programmatic approach to continue replacing its potable water distribution system. The city just completed its fourth phase of pipe bursting projects and has worked to develop a clear path to complying with the regulations surrounding the pipe bursting of asbestos cement (AC) pipe.

Background

The city provides water, wastewater, and reclaimed water service to the vibrant Treasure Coast community. The city's utility service area is comprised of approximately 132 sq mi, including most of the city limits and some unincorporated areas of St. Lucie County. The utility system, as of February 2017, is comprised of approximately 70,500 active water connections and 50,000 active wastewater connections. The existing potable water system consists of three water treatment facilities, four water storage and repump stations, and 1,201 mi of transmission and distribution infrastructure.

Between 2012 and 2013, the city replaced 249,165 lin ft of AC pipe through traditional open-cut construction; however, the city recognized the trenchless technology method of pipe bursting as a suitable method to replace its existing potable water distribution system. In 2014, the city bid a traditional open-cut construction project and allowed pipe bursting to be bid as an alternate to directly compare the economics of the two replacement methods. The bid for pipe bursting was less than 1.5 percent more costly than the lowest open cut-construction bid, but city staff recognized the social and environmental benefits of using pipe bursting versus traditional open-cut construction and convinced city management that pipe bursting should be awarded the bid.

Benefits of Pipe Bursting

Many studies have already recognized the benefits of utilizing pipe bursting (or other trenchless technology methods) versus traditional open-cut construction methods, especially in developed urban or suburban areas for pipeline rehabilitation. The Florida Department of Environmental Protection (FDEP) approved prechlorinated potable water main pipe bursting as an in-place pipe rehabilitation method that does not require a permit to increase the diameter of the replacement pipe up to two sizes larger (Ambler, et. al, 2014).

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Often, design costs are dramatically reduced for pipe bursting projects over traditional open-cut replacement projects because the pipeline is occupying the same location as the original. Pipe bursting projects can often be designed and bid from geographic information system (GIS) drawings or as-built drawings, or openly negotiated with a qualified pipe bursting contractor. Utilization of the existing pipe location reduces infrastructure congestion (Figure 1) of existing rights of way. Third-party utility relocation is also made irrelevant by using pipe bursting (Ambler, et. al, 2014.)

Less excavation and removal of unsuitable material is required during pipe bursting projects versus traditional open-cut excavation projects. With successful preliminary planning, excavations for a pipe bursting project can be executed as "surgical excavations," subsequently avoiding major above ground and established landscape or other high-cost restoration items. Pipe bursting only excavates entrance and exit pits, pits for service connections, and other pipe connections, which dramatically reduces the amount of excavation (Figure 2) required over a traditional open-cut construction project (Ambler, et. al, 2014).

Studies conducted by the U.S. Environmental Protection Agency (EPA) have proven that pipe bursting reduces greenhouse gas emissions over traditional open-cut between 75 and 90 percent. Less construction equipment is necessary on the project, and therefore, carbon dioxide emissions are also reduced. Since the overall construction schedule is shorter, the construction

Figure 1. Utility Congestion

Figure 2. Minimized Excavation

equipment is on the project site for less time, thus further reducing emissions. The EPA published a document about the potential for reducing greenhouse gases in the construction sector that states that water and sewer line construction is the third largest in the United States for greenhouse gas emission intensity (EPA, 2009).

National Emissions Standards for Hazardous Air Pollutants

The city, in conjunction with contractors, regulators, and other municipalities, has developed a working procedure in Florida to support pipe bursting of AC pipe while meeting the requirements of the National Emissions Standards for Hazardous Air Pollutants (NESHAP). There are significant technical publications available to date that further discuss the applicability of NESHAP and the established regulatory requirements. This procedure complies with each element of NESHAP, which are briefly described (Ambler, et. al, 2012).

File a Notice to EPA or Its Designee (61.145(b))

A notification form, FDEP form 62-257.900(1), is required to be submitted 10 days prior to execution of the project.

Provide for Emission Control During Renovation and Disposal (61.145(c))/61.150)

Qualified pipe bursting contractors are intimately familiar with safe handling practices and procedures that are proven to suppress the potential release for asbestos fibers during rehablitation. Municipalities can often require the provision of a Negative Exposure Assessment (NEA) by potential pipe bursting contractors that illustrates safe handling procedures are ensured.

Comply with Inactive/Active Waste Disposal Site Requirements (61.151/61.154)

The NESHAP provides for disposing of regulated asbestos-containing material (RACM) on the site of the demolition or renovation work, or the RACM can be disposed of at a waste disposal site. Currently, for pipe bursting projects, regulators interpret NESHAP such that the work site is considered a waste disposal site. It is recommended that 2 ft of cover is maintained above the remaining AC pipe fragments, as that provision would meet the NESHAP requirements for adequate land barrier between the general public and the remaining AC pipe fragments.

Comply With Inactive Waste Disposal Site Deed Notation and Alternative (61.151(e))

The NESHAP requires that a notation to the deed of a facility property be recorded within 60 days of a waste disposal site becoming inactive. A site is deemed inactive when disposal of RACM is completed. Applying this to pipe bursting projects means a site is deemed inactive when the project is completed. The notation is to contain the following information (Ambler, et. al, 2012):

1. The land has been used for the disposal of asbestos-containing waste material.
2. The survey plot and record of the location and quantity of asbestos-containing waste disposed of within the disposal site required in Sec. 61.154(f) have been filed with the administrator.
3. The site is subject to 40 CFR part 61, subpart M.

RESOLUTION 16–R20

A RESOLUTION OF THE CITY OF PORT ST. LUCIE TO BE RECORDED IN THE OFFICIAL RECORDS IN ORDER TO PUT THE PUBLIC ON NOTICE OF THE EXISTENCE OF A WASTE SITE IN ACCORDANCE WITH NATIONAL EMISSIONS STANDARDS FOR HAZARDOUS AIR POLLUTANTS (NESHAP) IN THE RIGHT-OF-WAY ON THE SOUTH SIDE OF FLORESTA DRIVE BETWEEN HUTCHINS STREET AND AIROSO BOULEVARD, AND ALONG THE SOUTH SIDE OF AIROSO BOULEVARD BETWEEN AVENS STREET AND ST. JAMES DRIVE, IN THE RIGHT-OF-WAY ON THE WEST SIDE OF RAVENSWOOD LANE TO FERRIS DRIVE AND ON THE NORTH SIDE OF FERRIS DRIVE TO RAYMOND LANE IN THE CITY OF PORT ST. LUCIE, FLORIDA; PROVIDING AN EFFECTIVE DATE.

Figure 3. Example Resolution

Recent NEA studies conducted on projects in Florida clearly indicate there is no risk of asbestos exposure to workers performing the pipe rehabilitation. Some regulators, utility providers, and engineers still have concerns that the remaining pipe fragments will be excavated and expose others to the risk of asbestos inhalation, but future excavation of the fragments of AC pipe that remain buried would typically be limited to utility crossings. Subsequently, the remaining fragments of AC pipe would closely surround the new replacement pipeline and excavators would likely stop digging once the replacement pipe was discovered (Ambler, et. al, 2014).

Occasionally, other utility companies may be required to perform excavation in the vicinity of the remaining fragments of AC pipe at specific areas where their installed utility crosses the location of the rehabilitated water main. Utility companies do not typically install parallel facilities in close proximity to water mains, so these areas of future excavation will be limited to small segments where the utilities potentially cross. These locations would typically be a smaller excavation pit, thus exposing a small amount of the remaining AC fragments. The NESHAP maintains a provision that if less than 260 lin ft of AC pipe is encountered, it can be removed as regular construction debris. It is highly unlikely that other utility companies will encounter more than 260 lin ft of remaining AC fragments during construction of utility crossings and thus not encountering enough AC pipe fragments to be hazardous to their workers (Ambler, et. al, 2014).

Much of the existing AC pipe is located within an existing public right of way that abuts residential lots. Another potential risk is exposure to the general public by private individuals excavating the remaining fragments of AC pipe. Potable water distribution pipe generally maintains a depth of 2 ft or greater. A property owner excavating, for instance, to plant a new tree, would not typically excavate deeper than 2 ft or wider than 5 ft in diameter. Typically, homeowners do not excavate within the road right of way, and in the city, they have to receive permission to do so. The amount of remaining AC pipe fragments exposed would still fall under the 260-lin-ft category that can be removed as regular construction debris (Ambler, et. al, 2014).

Utility providers performing AC pipe bursting must acknowledge the future handling requirements for the AC pipe fragments in the event that the pipe replacing the AC pipe requires maintenance or replacement. Emergency repair procedures performed on newer pipe will typically disturb less than 260 lin ft of the remaining AC pipe fragments, and the risk is clearly mitigated; however, if the utility provider chooses to replace the replacement pipe, it must appropriately handle the remaining AC pipe fragments (Ambler, et. al, 2014).

Tracking Areas of Remaining Asbestos Cement Pipe Fragments

Although guidance and direction were formally sought from EPA in Washington, D.C., concerning memorialization of remaining frag-

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ments of AC pipe after performing pipe bursting, no official written guidance has been provided. A working process has been developed and approved by FDEP within the state of Florida, which was detailed previously. This process has been proven in the city, and also Boynton Beach, Sunrise, Casselberry, Altamonte Springs, Tamarac, Lake Wales, Hillsborough Beach, North Miami Beach, St. Augustine, and many other municipalities throughout the state, as well as Jacksonville Electric Authority. In particular, the city has worked internally with its legal department and engineering management to develop a mechanism to track the remaining fragments of AC pipe after performing pipe bursting.

The city has drafted a resolution that successfully memorializes the locations of remaining AC pipe fragments in accordance with NESHAP. The resolution language is straight forward and succinct and combines with as-built documentation and right-of-way maps to illustrate the locations of the AC pipe fragments that remain after performing pipe bursting. The city adopted this resolution after the completion of a successful AC pipe bursting project that also includes documentation of the required NESHAP notification form submitted 10 days prior to beginning the project. An example of the language of the adopted resolution is shown as Figure 3 and an example of the recorded right-of-way maps is included as Figure 4.

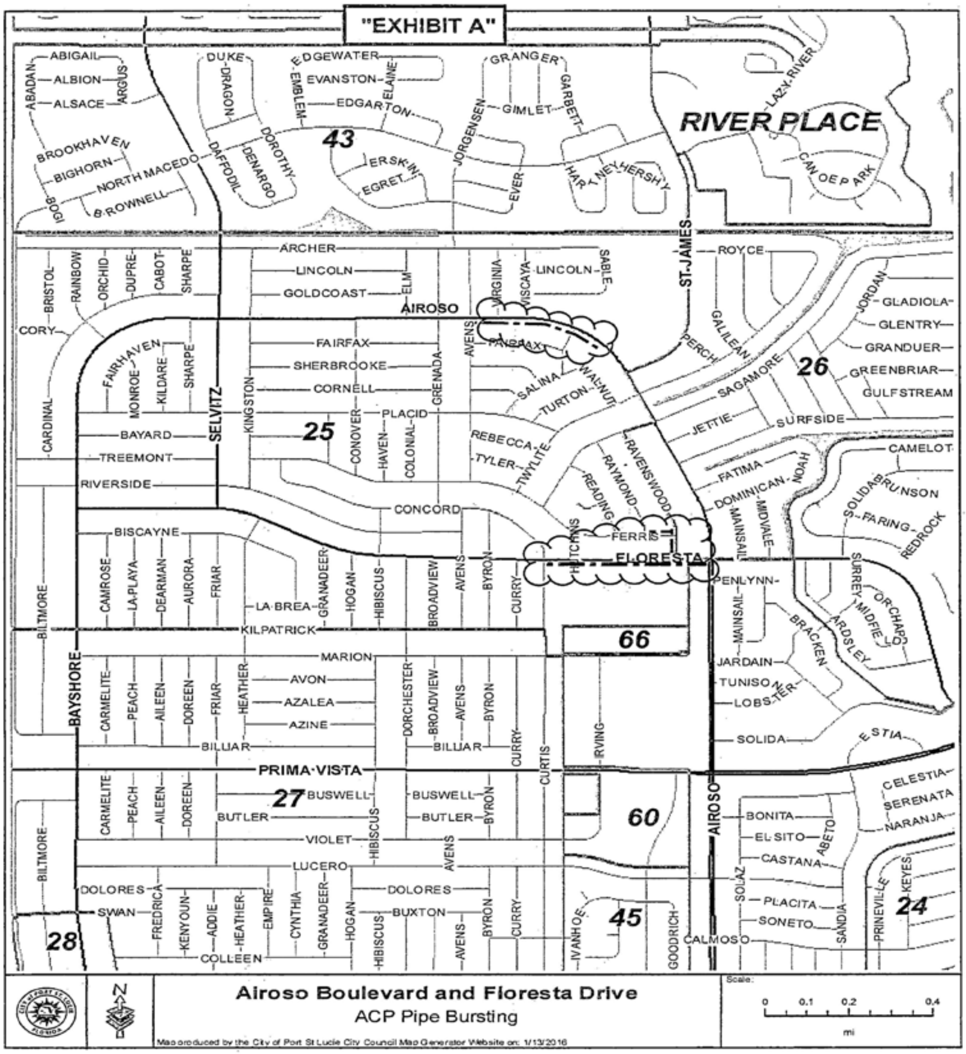

Figure 4. Example Right-of-Way Map

Proactive Rehabilitation Program

It became apparent to city management that its crews spent significant time responding to AC water main breaks. These breaks can be costly and disruptive, affecting residents' quality of life and leaving them with a negative impression of the public utility and city operations. Most municipalities that have been maintaining aging infrastructure for decades simply absorb the effort and costs required to repair the water main breaks when they occur; seldom do many municipalities make the efforts required to track the costs and determine the cost/benefit of proactively rehabilitating the existing pipe line versus continuing to repair emergency breaks. The costs of the emergency breaks on larger systems can grow quickly and exponentially. The city was aware of the increasing costs of emergency repairs and quickly moved to implement a pipe bursting program to rehabilitate its existing potable water main system.

For the purpose of relevant comparison, various cost scenarios for an escalating level of water main failure impacts were prepared. Two lesser-cost failure scenarios that many utilities often encounter were evaluated for their social, environmental, and economic impacts, and a third scenario was reviewed from available technical literature for the potential for a much more catastrophic failure. The failure scenarios are presented here.

Scenario 1

The first water main failure scenario is of a more routine nature. The failure of the AC pipe in question is more of a small section circumferential failure that is often detected as a growing leak from the distribution system. Initially, a small two-person crew would be dispatched to the site to evaluate the full extent of the required repair work. Initial evaluation of the failure by the crew indicated that the water main in the area required decommissioning, excavation to the failed pipeline, installation of mechanical adapters, and a replacement of a 4-lin-ft pipe section.

The crew that responded to the initial work order was able to isolate the section of water main relatively easily by locating existing valves that were still operational. The isolated section of the water main only affected four water customers, so social impact was relatively minimal; also, the water loss from the leak was minimal, so no efforts were made to quantify the water lost. No direct environmental damage was observed that was not easily restored by the crew; therefore, the cost evaluation for the first scenario was primarily limited to man-hour, equipment, and material costs. The economic analysis of the water main failure is provided in Table 1.

It is useful to note that the actual replaced section of existing pipeline was limited to approximately 4 lin ft of AC pipe and the cost per lin ft of replacement was $506.25. When the replaced amount is compared to a proactive approach to replacing the existing pipeline, it is easily observed that emergency replacement is simply not cost-effective when compared to a proactive replacement program.

Scenario 2

The second water main failure scenario is less of a routine nature. The AC pipe in ques-

Figure 5. 30-in. Steel Pipe Failure at University of California at Los Angeles

Table 1. Scenario 1: Economic Analysis of Water Main Failure

Potable Water Distribution Pipe Failure Example Analysis				
Cost Item	Number of Items	Hours per Item	Cost per Hour	Total Cost
Service Worker	4	5	$20	$400
Service Truck	2	5	$75	$750
Mini Excavator	1	4	$100	$400
Sod				$150
Fill				$50
Megalug Adapters	2			$225
Replacement Pipe	4 LIN FT		$10	$50
TOTAL COST				**$2,025**
TOTAL COST PER LIN FT				**$506.25**

Table 2. Scenario 2: Economic Analysis of Water Main Failure

Potable Water Distribution Pipe Example Analysis				
Cost Item	Number	Quantity per Number	Cost per Hour	Total Cost
Service Worker	10	20	$20	$4,000
Service Truck	4	20	$75	$6,000
Backhoe	1	20	$125	$2,500
Vacuum Truck	1	6	$125	$750
Loader	1	10	$100	$1,000
Water Loss	30 minutes	2,500 gpm		$225
Restoration				$22,500
Social Costs				$15,000
TOTAL COST				**$52,050**
TOTAL COST PER LIN FT				**$3,470**

tion is a larger and more substantial water main failure. A full length of AC pipe failed and isolation valves were not as readily available to shut down the water during the failure. This scenario required 10 service workers, four service trucks, a backhoe, a vacuum truck, and a loader. There were more-significant environmental and social impacts here, and efforts were made to quantify them. Economic analysis of the water main failure is provided in Table 2.

It is useful to note that the actual replaced section of existing pipeline was limited to approximately 15 lin ft of AC pipe and the cost of replacement was $3,470 per lin ft. When the replaced amount is compared to a proactive approach to replacing the existing pipeline, it is easily observed that emergency replacement is simply not cost-effective when compared to a proactive replacement program.

Luckily, the city had not experienced AC pipe failures that could be considered catastrophic; however, the potential for this to occur was not decreasing. The existing AC potable water mains were deteriorating at a higher rate and are now more likely to fail more catastrophically. A literature review was conducted in an attempt to analyze the potential social, environmental, and economic costs of larger-diameter water main failure in order to ascertain the potential outcome of large diameter failure within the city's system. Multiple catastrophic failure scenarios were evaluated, but a recent failure of a 30-in. steel potable water main (Figure 5) was evaluated as a potential worst-case scenario for the city (Piratla, 2015).

The 30-in. steel potable water failure that was analyzed was a 2014 pipe failure that occurred on the University of California at Los Angeles (UCLA) campus. This water main failure attracted national news coverage and caused significant environmental, social, and economic damage. The failed potable water main was 93 years old, far beyond the predicted service life of AC pipe. The crews that responded to the break required four hours to shut the water off to the section of pipe due to inoperable and nonlocatable valves.

In addition to the utility crews, over 160 firefighters responded to the water main break to search over 200 cars that were in nearby basement parking garages that had flooded, as there was concern that people may have been trapped in some of the cars (Piratla, 2015). The social impact of the water main failure was enormous, including flooding that occurred in a historical basketball court (Figure 6).

It was estimated that almost 75,000 gal per minute (gpm) of water loss occurred, for a total of approximately 48 mil gal (MG) of treated water released during the break. Evaluation of the economics of this scenario for potable water main failure was provided for lost treated water, cost, time to repair and return to service, travel delay for the surrounding public, supply outage and substitution costs, potential health risk, and property damage, and is shown in Table 3 (Piratla, 2015).

Scenario 3

Unfortunately, additional crew time, restoration, and social and environmental costs were not available to directly present the third catastrophic failure scenario in the same format as the first two scenarios; however, it was assumed that only 75 lin ft of the existing 30-in. steel main were replaced, and therefore, the cost per lin ft of replacement was $481,333. When the replaced amount is compared to a proactive approach to replacing the existing pipeline, it is easily observed that emergency replacement is simply not cost-effective when compared to a proactive replacement program. The city recognized the immediate need to dramatically increase its water main rehabilitation program and continued implementation through pipe bursting with a proven successful contractor.

Conclusion

The city has switched from traditional open-cut construction to embrace the trenchless technology method of pipe bursting with great success. It has worked to develop a stan-

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Table 3. Economic Analysis of Water Main Failure at University of California at Los Angeles

UCLA Catastrophic Failure Example Analysis	
Date	July 2014
Pipe Size/Material	30-in. steel
Pipeline Operating Pressure	200 psi
Time to Isolate Water Main	4 hours
Water Loss	48 MG
Hours to Complete Repair	238 hours
TOTAL COST	**$36.1 Million**
TOTAL COST PER LIN FT	**$481,333**

Figure 6. Historic Pauley's Pavilion Court

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dard process for complying with regulations that govern pipe bursting of AC pipe for others within the state of Florida to adopt. The city has recognized the social, environmental, and economical benefits of pipe bursting and has taken steps to build a recurring program for potable water distribution pipe replacement.

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