Photo 1: Utility congestion

The City of Port St. Lucie's programmatic approach to asbestos cement pipe bursting

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Introduction

The City of Port St. Lucie has been proactively replacing its potable water distribution mains for several years. Prior to 2014, the City utilized traditional open cut construction methods to replace mains. However, City staff sought innovative methods to replace the infrastructure with fewer social and environmental impacts. The City was satisfied with the construction of a pipe bursting project and pushed to build a programmatic approach to replacing their system.

The City provides water, wastewater and reclaimed water service to a vibrant Treasure Coast community. The current utility system is comprised of approximately 65,000 active water connections and 46,000 active wastewater connections. In 2012-2013, the City had replaced 249,165 LF of AC pipe through traditional open cut construction. However, the City recognized pipe bursting as a suitable method to replace their existing system. In 2014, the City bid a traditional open cut construction project and allowed pipe bursting to be bid as an alternate. Pipe bursting was awarded the bid and City staff members have been very pleased with pipe bursting. The City recently completed its fourth phase of pipe bursting projects.

Benefits of Pipe Bursting

Many studies have already recognized the benefits of utilizing pipe bursting 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).

Design costs are reduced for pipe bursting projects over open cut replacement projects because the pipeline is occupying the same location. Pipe bursting projects can often be designed and bid from GIS drawings or openly negotiated with a qualified pipe bursting contractor. Utilization of the existing pipe location reduces infrastructure congestion and third-party utility relocation (see Photo 1) (Ambler, et. al, 2014).

Less excavation and removal of material is required during pipe bursting projects. With successful preliminary planning, excavations for a pipe bursting project can be executed as "surgical excavation" avoiding major above ground established landscape or other high restoration cost items. Pipe bursting only excavates entrance and exit pits (approximately 4'x15'), pits for service connections and other pipe connections thus dramatically reducing restoration costs (see Photo 2) (Ambler, et. al, 2014.)

Studies conducted by the Environmental Protection Agency have proven that pipe bursting is found to reduce greenhouse gas emissions over open cut between 75% and 90%. Less construction equipment and schedule is necessary on the project and therefore carbon dioxide emissions are reduced (EPA, 2009).

Photo 2: Minimized excavation

Failure #1				
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	5 LF		$10	$50
Total Cost				**$2,025**
Total Cost per Linear Foot				**$506.25**

Proactive Rehabilitation Program

City crews spent significant time responding to AC water main breaks that were costly and disruptive, affecting residents' quality of life and not reflecting well on the City. It is not easy to directly evaluate the cost benefit of proactively replacing infrastructure versus emergency response. Below are various cost scenarios for an escalating level of water main failure impacts. Three failure scenarios are presented here.

The first failure analyzed is a small circumferential AC pipe failure that was detected as a growing leak. The crew that responded was able to isolate the section of water main by locating existing valves that were operational. The failure only impacted four water customers so water loss, social and environmental impact were minimal. The first cost evaluation was limited to man-hour, equipment and material costs. Economic analysis of the water main failure is provided in the Table above.

Only four linear feet of pipeline were replaced so the cost was $506.25 per linear foot.

The second failure analyzed is failure of a 13' section of AC pipe with inability to isolate the main due to valve failure. Social and environmental costs were also calculated. Economic analysis of the water main failure is provided in the table on p. 109.

Only 15 linear feet of actual pipeline were replaced so the cost was $3,470 per linear foot. It is clear that emergency replacement is simply not cost effective. Luckily, the City of Port St. Lucie had not experienced AC pipe failures that could be considered catastrophic. However, the potential for this to occur was not decreasing.

Literature review was conducted in an attempt to analyze the potential social, environmental and economic costs of catastrophic failure. Recent failure of a 93-year-old 30" steel potable water main was evaluated as a potential worse case scenario for the City of Los Angeles (see Photo 3). This failure attracted national news coverage and caused significant environmental, social and economic damage. It took four hours to shut off the main due to inoperable valves. Over 160 firefighters responded to the water main break to search over 200 cars. Flooding from lost water occurred in a historic basketball court. It was estimated that approximately 48 million gallons of water were released. The overall costs of failure are estimated in the table on p. 110. (Piratla, 2015).

It is assumed that only 75 linear feet of actual pipeline were replaced so the cost of replacement was $481,333 per linear foot.

Failure #2

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 Linear Foot				**$3,470**


Static pipe bursting process

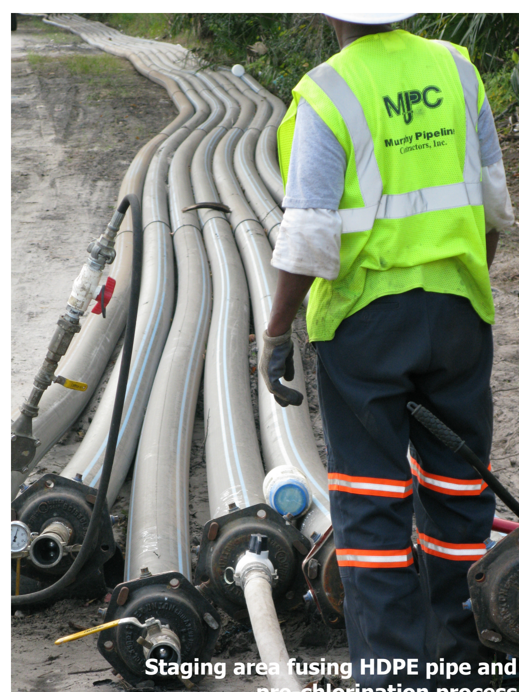
Staging area fusing HDPE pipe and pre-chlorination process

Photo 3: UCLA 30" steel pipe failure

UCLA Catastrophic Failure Example Analysis	
Date	**July 2014**
Pipe Size/Material	30" Steel
Pipeline Operating Pressure	200 psi
Time required to isolate water main	4 hours
Water loss	48 Million Gallons
Hours to complete repair	238 hours
Total Cost	**$36.1 Million**
Total Cost per linear foot	**$481,333**

Conclusion

The City of Port St. Lucie has switched from open cut construction to embrace pipe bursting, when appropriate, with great success. The City has recognized the social, environmental and economic benefits of pipe bursting versus traditional open cut and has taken steps to build a recurring program for potable water distribution pipe replacement. The City understands reacting to emergency repairs is not cost effective in comparison to proactive rehabilitation programs and is moving towards a programmatic approach to pipe rehabilitation.

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