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# City of Phoenix Embraces Five Year Rehabilitation Program for the Val Vista Transmission Main

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**The Val Vista water transmission main conveys water** from the Val Vista Water Treatment Plant (WTP) to the Cities of Phoenix, AZ and Mesa, AZ. At nearly 15 miles in length and ranging in diameter between 72-inch and 108-inch, this pipeline is the longest and largest pipeline in the Phoenix metro area. About one-third of water delivered to the City of Phoenix (City) is supplied through this non-redundant pipeline. The pipeline was constructed in 1975 of embedded prestressed concrete cylinder pipe (PCCP). Although the pipeline once traversed largely undeveloped land, growth in the Phoenix metro area in the past 30 years has brought residential and commercial development immediately adjacent to and directly above the waterline easement.

In 2003 the City initiated a condition assessment program of its large diameter water transmission mains. The investigation began with the Val Vista Water Transmission Main due to its criticality and lack of redundancy. Previous inspections of the Val Vista Water Transmission Main had been limited to visual inspections of the interior of the pipeline. The City began the project by assessing a 1,100-foot section of the pipeline using electromagnetic inspection and performing a forensic analysis of the exterior of the pipeline. Three pipe sections were removed for petrographic and metallurigical analysis. Petrographic examination revealed each mortar sample to be carbonated through its entire thickness. Carbonation indicates the mortar is no longer protecting the prestress wires from corrosion. Chloride concentrations in the mortar greatly exceeded those considered necessary to initiate and sustain corrosion. These results lead to immediately initiating plans to shutdown and inspect the entire 15-miles of pipeline.

The entire pipeline investigation included a comprehensive series of state-of-the-art inspection techniques. Electromagnetic inspections were performed to identify broken prestress wires. Visual and sounding surveys identified pipe sections with longitudinal cracking or hollows indicative of delamination of the inner concrete core, which has been correlated with broken prestress wires. Metallurgical and petrographic testing was again performed on several excavated pipe sections. Finally, soils samples were collect at approximately 0.6-mile intervals along the alignment and tested for pH, chlorides, and sulfates, common indicators of corrosive soils. These inspections revealed 19 pipe sections in need of immediate repair. These pipe sections were generally non-contiguous and ranged in diameter from 72-inch to 96-inch. An internally-applied carbon-fiber reinforced polymer system (carbon fiber) was designed to restore the structural integrity of the deteriorated pipe sections.

To mitigate the risk of catastrophic pipeline failure while the City investigated options for a long-term rehabilitation program, the Val Vista Water Transmission Main was again inspected in 2004 and 2005. Visual and sounding surveys and electromagnetic inspections were performed on the entire pipeline alignment. Electromagnetic inspection results demonstrated a significant increase in the number of prestress wire breaks from year to year. Between 2004 and 2005 six additional pipe sections were

identified to be in danger of immediate failure and were repaired using carbon fiber.

During these annual investigations the need for a long-term rehabilitation program had become apparent to the pipeline stakeholders. In the summer 2005, the City initiated a program to rehabilitate the entire pipeline using steel split can sliplining. Split can liners are typically steel plate rolled to the required pipe diameter, but not factory-welded longitudinally. The split cans are collapsed and banded to a diameter about 10 inches less than the host pipe diameter. This configuration allows the liners to negotiate curves and pulled joints.

Having never used steel sliplining to rehabilitate a large diameter water transmission main, the City sought to gain experience by beginning the program with the rehabilitation of a relatively short, straight section of pipeline located along the less developed area of the pipeline alignment. The 6,300-foot section of 72-inch PCCP immediately upstream of the Rio Salado Booster Pump Station, as shown in Figure 1, was selected.

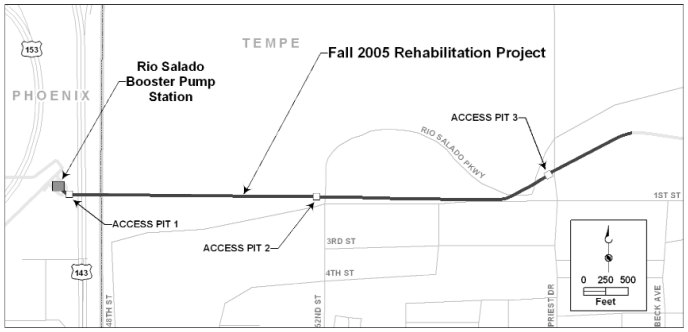


*Figure 1 — Fall 2005 Rehabilitation Project Limits*

Slipliners are installed through access pits spaced at approximately 2,500-foot to 3,000-foot intervals. Access pit spacing was determined by surface improvements along the pipeline alignment, pipeline geometry, and to some extent the length of welding leads available to the contractor. Typically two pipe sections are removed at each access pit, and steel liners are installed in each direction from the access pit.

A cradle, as shown in Figure 2, was installed between the PCCP sections at each access pit. Liners were individually lifted into the cradle. A cart was used to lift each pipe section and transport it to the correct position within the host PCCP. Figure 3 shows the cart prior to installation in the cradle. The wheels on each end of the cart straddle the liner section. Lifts installed at intervals along the cart lift the liner section for transport through the pipe.

Once in place in the host PCCP, bands were cut from the collapsed steel liners. The liners were expanded into place and tack welded. After several liners had been fitted into place, the liners were welded longitudinally and circumferentially. The average liner installation rate was about 10-12 liners per day. The annular space between the finished liner and host PCCP was then grouted.

Finally, the pipe was mortar lined. Mortar was conveyed to a hopper cart located in the access pit. The hopper cart transported the mortar to the spraying and troweling machine


*Figure 2 – Cradle with Collapsed Liner Ready for Installation*

*Figure 3 – Pipe Cart*

located in the pipe. This machine, as shown in Figure 4, sprayed the mortar on the pipe interior and used double spring-loaded trowels to bring the mortar to a thickness of 0.5 inch.

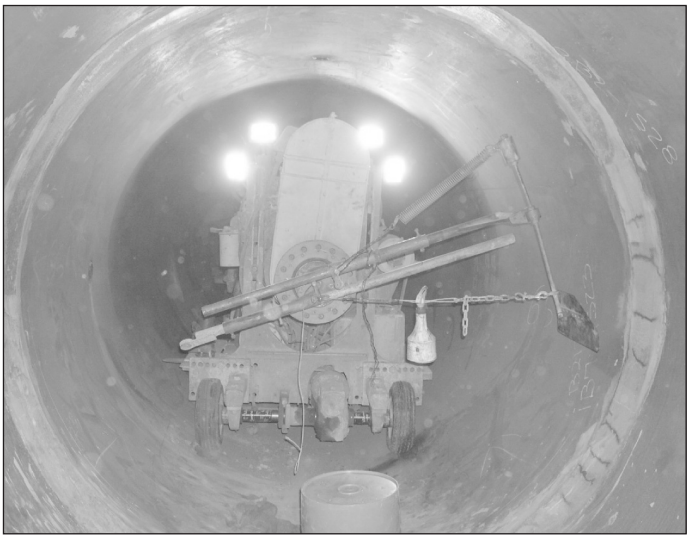

*Figure 4 – Mortar Troweling*

The remaining 72-inch, 90-inch, and 96-inch sections of the Val Vista Water Transmission Main are scheduled to be sliplined over the next five years. When complete, this project will rehabilitate 13.3 miles of pipeline.