Ashley Interceptor Rehabilitation – Phase 8

“Surprises and Successes”

for

North Charleston Sewer District

James C Reigart, PE¹ and Jarred R Jones, PE, MBA²

¹ Senior Project Manager, WK Dickson and Company, 162 Seven Farms Drive, Suite 210, Charleston, SC 29492; PH (843) 416-5560; e-mail: jreigart@wkdickson.com

² District Manager, North Charleston Sewer District, PO Box 63009, North Charleston, SC 29419; PH (843) 764-3072; e-mail: jarred.jones@ncsd.sc.gov

ABSTRACT

The Ashley Interceptor Rehabilitation – Phase 8 differed from previous phases of the Sewer District’s interceptor rehabilitation program because in addition to the sections of the interceptor that was laid in the marshes associated with the Ashley River, other portions were constructed within narrow, live oak lined roads in an upscale neighborhood. The setting(s) proved to provide interesting challenges including public relations management, difficult access issues and protection of private properties as well as environmental resources. This case study of the Phase 8 cured-in-place pipe (CIPP) rehabilitation of 4,650 linear feet (LF) of reinforced concrete pipe (RCP) highlights the unique challenges presented to an experienced team comprised of the NCSD, the consultant engineer and the contractor.

The project was bid in May of 2018, with eight qualified contractors and bids ranging from $1.83 to $3.97 million. The contract was awarded to SAK Construction, LLC as the lowest qualified bidder. Prior to the commencement of construction, The NCSD, the engineer and the contractor presented the project scope to the neighborhood to elicit acceptance. Their understanding of the necessity of the project allowed their patience with the disruptions.

Construction began in August, with completion scheduled for January 2019. In addition to the interceptor rehab, fourteen manholes and the force main receiving junction box (JB) at the downstream end of the project were rehabilitated. Several service and main laterals were reinstated in the interceptor after the new pipe was cured.
**EXISTING SYSTEM**

The North Charleston Sewer District (NCSD) System includes 60 pump stations and approximately 500 miles of gravity and force main piping. The infrastructure serves approximately 32,000 customers and a total population over 100,000. The Felix C Davis Wastewater Treatment Plant (WWTP) is permitted to treat 32 million gallons per day (MGD) and is the only plant utilized by NCSD. Currently, the plant averages approximately 18 MGD from the 59-square-mile service area.

The backbones of NCSD’s collection system are two interceptor lines, the Cooper and the Ashley, shown in Figure 1. The interceptors were named for the two large rivers flowing into Charleston Harbor. In doing so, they form the peninsula where the City of Charleston is located as well as the “neck” area of the peninsula which separates the City of Charleston and the City of North Charleston. The “neck” is also the location of NCSD’s Felix C. Davis (WWTP). The two interceptors transport wastewater flows from the North Charleston sewer service area. The Cooper Interceptor flows along the south and west side of the Cooper River, and the Ashley Interceptor along the north and east side of the Ashley River, until they combine into a single (Combined) Interceptor sewer flowing nearly two miles in a southeastern direction to the WWTP. This is a case study of the rehabilitation of approximately 4,650 linear feet (LF) of the Ashley Interceptor.

**REHABILITATION HISTORY**

The main arteries of the system, the Cooper, Ashley, and Combined Interceptors are RCP sewers that were originally constructed primarily between 1966 and 1969 in conjunction with the WWTP. Several factors contribute to high hydrogen sulfide (H₂S) production in the interceptors: 1) the sewers are laid on a shallow grade, i.e. little slope, 2) they accept flows from many long force mains, and 3) the hot, humid lowcountry of South Carolina creates a conducive environment in the pipelines. As would be expected, this environment has resulted in significant corrosion and deterioration of the interceptor sewers. The Cooper, Ashley, and Combined Interceptors are comprised of 36-inch to 66-inch RCP totaling approximately 19 miles.

NCSD has utilized cured-in-place pipe (CIPP) rehabilitation since the early 90s on 8-inch, 10-inch, and 12-inch diameter lines that pre-date the treatment plant. NCSD focused on these lines because of their over-50-year age and material, mainly vitrified clay or concrete. However, during this same time, the RCP interceptor lines were unknowingly and rapidly deteriorating from H₂S corrosion.
In 2005, the top portion of a section of 42-inch diameter RCP Cooper Interceptor running along a CSX railroad collapsed. This section was immediately downstream of 8-inch and 30-inch diameter force main discharges. Closed-circuit television (CCTV) footage revealed 3,000 feet of pipe in this area needing replacement. Since the pipe was in an open area forty (40) feet away from the tracks and extremely deteriorated, this section was replaced with ductile iron pipe as required by CSX.

Because of this collapse, a H₂S study was performed at various locations along the Cooper and Ashley Interceptor lines. Utilizing this information, and the assumption H₂S would be concentrated near force main discharges, CCTV was performed on approximately five miles of the interceptor lines. This information was then used to develop a rehabilitation plan for the most critical areas needing rehabilitation. This was followed by 13 miles of Interceptor inspection in 2010 for future capital planning purposes.
Since 2006, 67,000 LF of the Cooper, Ashley, and Combined Interceptors have been rehabilitated by sliplining or CIPP. The 2018 budget year called for this portion of the Ashley Interceptor to be rehabilitated in Phase 8 of the overall rehabilitation project.

**PROJECT BACKGROUND**

The Phase 8 project rehabilitated 4,650 LF of 42-inch diameter RCP using CIPP. The CIPP and manhole rehabilitation create a watertight system with no joints and a probable service life of over fifty years. A total of 110 vertical feet of manholes and the 250 square feet force main receiving junction box were restored using a “Level C” rehabilitation specification requiring a cementitious structural base covered with a 250-mil polymer resin-based or epoxy topcoat, as shown in Figure 2. The original 42-inch wide sluice gate at the downstream Brickyard Pump Station was removed, as it was rarely used and served only as a nuisance to the operations and maintenance staff.

![Figure 2 – “Level C” manhole rehabilitation](image)

The project was bid in May 2018. Eight general contractors were pre-qualified to bid and attended the required pre-bid meeting at the end of April. All eight of these contractors submitted bids. The low bid was $1.83 million, with the next at $2.00 million and the highest bid at $3.97 million, which was the only bid above the engineer’s estimate of $3.30 million. SAK Construction, LLC submitted the low bid and was selected to construct the project. The contract was awarded in May 2018 and the Notice to Proceed was issued on June 20th, with a commencement date of September 10th. The start of construction was delayed because a pump in the upstream Watkins Pump Station had to be replaced. This was significant because the bypass plan called for the temporary bypass to be driven by this station. The bypass
plan called for a connection assembly installed on the Watkins Force Main just upstream of the receiving junction box, the beginning location for the Phase 8 project.

The Phase 8 section of the Ashley Interceptor, constructed in the late 1960s, parallels the Ashley River. Portions of its route lie within marshes associated with the river, or just upland of the marshland (critical line) boundary. As expected, this riverfront property is highly valued, meaning that portions of the interceptor meandered through an upscale neighborhood.

![Figure 3 – Bypass piping installed along and beneath Holbird Avenue](image)

**BYPASS (and a surprise)**

The bypass and the bypass route are usually the most complicated technical issues to for large diameter CIPP projects. As described previously, this bypass was designed to utilize the Sewer District’s pump station to drive the bypass flows. This strategy has proven successful on previous phases, because it eliminates the necessity of utilizing engine-driven pumps which can drive up the cost of the bypass pumping.

The route of the bypass in this case did not follow the sewer within the sewer easement associated with the interceptor, because this would have meant that the first 2,000 LF of the bypass would have been laid within the environmentally sensitive salt marshes and beneath the docks of some of the more affluent residents of the neighborhood. Instead, the bypass was routed along and beneath more upland roads. This however, meant avoiding multiple utilities and storm drains. It also involved cuts and replacements of numerous roads and driveways. The layout of the bypass piping (24-inch HDPE) however, went well, as evidenced in Figure 3.

The primary bypass for the Holbird Drive Segment was laid out, fused, pressure tested and ready to accept flows by October 31st. The primary bypass for this section was approximately 4,200 LF in length. The bypass included seven (7) secondary bypasses that manifolded into the primary bypass to detour flows tying
latterally into the interceptor. The NCSD and the contractor planned a short shut-down of the pump station on that day as a trial run to determine the time period for flow subsidence and drain-back to the pump station.

A six-hour shutdown was scheduled for the following day to cut-in the bypass connection, a 24-inch sleeved tee with two knife gate valves. When the pumps were shut down, while the tide was outgoing but still elevated, the flow out of the force main into the receiving junction box did not subside. A bucket sample out of the junction box revealed clean, i.e. not grey water. The flow was river water flowing by gravity through the force main and into the junction box. The Watkins Pump Station force main lies almost entirely beneath the marsh on its 1,300 LF path from the pump station to the junction box.

A review of current aerial photography for the location revealed an unusual pond or pool 50-60 ft in diameter, located in the marsh centered at a point directly over the force main. It is not clear how long the hole in force main had been there, but once it was accessed it was observed that flows into and out of the force main both occurred. Only at lower tides and high pump heads did wastewater flow out of the force main. When the pumps were operating slower at a lower pressure, or were off, the river water flowed into the force main. The “leak pond “that formed around the hole location formed due to the vortex of flows into the pipe and due to flows out of the main.

When the leak was found, the Phase 8 rehabilitation was delayed long enough to repair the leak in the force main. The force main leak was in the salt marsh, approximately 100 yards from the dead end of Apple Street where the junction box is located. The first step to repair the main was building access to the leak location for the necessary equipment. The excavation subcontractor on the project used wetland

Figure 4 – “Leak Pond” Found in the Marsh with Abandoned 8” Force Main and Access Matting in the Background
protection matting to install an access road to the leak location and a platform around the leak from which to perform the repair operations.

![Figure 5 – Access and Operations Platform Built in the Marsh](image)

Using steel sheeting and a trench box, the broken force main location was dewatered once a day during the low tides. Operations had to be suspended when the tides reached levels where the dewatering was not possible, and the matting began to float. The force main leak shown in Figure 6 was repaired using an over-the-joint clamp.

The leak was completely stopped on November 9th, two weeks after it was discovered. During the time the force main was dewatered for the repair, the NCSD inserted a video camera into the pipe. The video revealed two other quarter-sized leaks in the bottom of the force main. As a result of that condition assessment, the decision was made to abandon the plan to insert a bypass connection and utilize the Watkins Pump Station pumps to drive the bypass flows. The increased head would more than likely enlarge the holes in the compromised force main and could destroy it completely. Since the existing junction box was small, the team developed a plan to build a temporary bypass well. The existing trench box around the force main was lined with plastic, a wood frame with wire mesh, and coated with shotcrete.

PERMITTING AND PUBLIC RELATIONS

Permitting for the project was required from the South Carolina Department of Transportation (SCDOT) for the numerous road cuts and encroachments and a detour around the project site. Encroachment permits were also needed from SC
Electric and Gas (SCE&G) where the bypass installation and construction activities crossed numerous high-pressure gas mains including an eight-inch diameter line above the force main adjacent to the receiving junction box.

![Image](image.png)

*Figure 6 – The Force Main Hole Before and During Repair Operation*

An informational public meeting was held prior to commencement of the project to inform the Wando Woods Subdivision residents and to encourage cooperation. The residents’ city councilman was in attendance and helped to facilitate the meeting and exchange information.

CONSTRUCTION ISSUES

Construction for the most part went smooth. However, with any large diameter CIPP project, there are always unforeseen circumstances. The longest shot was a 1,284 LF inversion from the existing junction box. The set-up is shown in Figure 7. The construction space was tight and while the truck was maneuvering into position the liner shifted, making it difficult to roll onto the conveyor.

During the set up for the fourth inversion, a large sinkhole was discovered next to a manhole. Two holes were discovered in the 42” pipe adjacent to a separated joint of a storm drain. Over several years, storm water moved soil into the sanitary sewer creating a large void underneath the roadway. The SCDOT repaired the storm drain and flowable filled the void before SAK repaved the road.
In order to facilitate the future force main replacement, the NCSD executed a change order to rehabilitate the last twenty feet of the existing 24-inch cast iron force main entering the junction box. Figure 8 shows the temporary bypass well with the CIPP inversion at curing temperature inside the force main. Following curing, the end was cut to provide a clean end and an end seal was installed before the force main was reinstated.

CONCLUSIONS

The success of the project, despite the difficult aspects of the site and the work completed can be attributed to the spirit of teamwork demonstrably applied during every stage of the project. The teamwork began with the relationship between the NCSD (Owner) and WK Dickson (Engineering Consultant), who have undertaken numerous challenging projects involving their collection system over the past several years. These projects require early planning, an intimate familiarity with the route of the host pipe and alternative for the bypass in the design and construction. Adjustments and field revisions on the fly are the norm, rather than the exception.
The CIPP rehabilitation of other large diameter sections of the Cooper and Ashley Interceptors served as training for rehabilitation of this section of the Ashley Interceptor. The initial planning by engineers from the NCSD and WK Dickson along with the feasibility analysis by Jacobs Engineering Group’s (sub-consultant) sewer rehabilitation specialist, Stephen Lindsey, gave the confidence that the project would be successful. Mr. Lindsey also performed resident project representation services, interacting, coordinating and observing operations by the Contractor throughout the rehabilitation construction phase. The affected property owners and regulatory agencies cooperated and assisted as they could to facilitate finalization of the plans, permits, and regulatory agreements to allow the project to commence.

Lastly, the contractor joined the project with a cooperative, team-oriented approach and proceeded to construct the project in an efficient and professional manner. SAK demonstrated their desire to accept the challenges and execute the project. The contractor, their subcontractors the regulatory participants and stakeholders pulled together with cooperative efforts to complete this rather large and complex project.