Protect the Environment: Trenchless Technology for the Rehabilitation of Large Diameter Sewers

Celina Perez
September 14, 2009

Agenda

- Background
- Condition Assessment
- Rehabilitation Options
- Design Considerations
- Lessons Learned
- Questions
Background
Patapsco Sewershed

- Approximately 29 square miles in Baltimore, Howard and Anne Arundel Counties
- Estimated population of 115,000
- More than 256 miles of sewer

Background
Project Drives

- Consent Decree
- Interceptor and Relief have never been inspected
- Located near environmentally sensitive areas
Background

Project Location

- **Patapsco Interceptor**
  - Concrete tiles, 1950s
  - 100 LF of 21-inch
  - 7,250 LF of 42-inch
  - 7,850 LF of 48-inch
  - 4,070 LF of 54-inch
  - 42 MH Structures

- **Patapsco Relief**
  - RCP, 1980s
  - 4,580 LF of 48-inch
  - 14,740 LF of 66-inch
  - 240 LF of 72-inch
  - 32 MH Structures

Condition Assessment

Project Scope

- **Phase I – Preliminary Evaluation**
  - Preliminary Mapping
  - System Condition
  - Site Conditions

- **Phase II – Data Analysis**
  - Supplemental Survey
  - Evaluation of System
  - Analysis of Field Findings
  - Rehabilitation Alternatives

- **Phase III - Design**
  - Develop Construction Documents
  - Preparation of Required Permits
Condition Assessment

Tools used

- CCTV
- PACP
- Manhole Inspections
- Site Specific

Priority Ratings

Manhole

Design

Pipeline

Condition Assessment

Survey

- Verification of as-built information
- Manhole locations and elevations
- Large trees/canopy
- Wetland/stream location
Condition Assessment

Manhole Inspection Findings

- Structural
  - Deterioration
  - Wall Cracks
  - Frame and Covers
- Inflow/Infiltration
  - Active Inflow/Infiltration Evidence
  - Rain/River Induced I/I
  - Inflow Point Sources
- Rim Elevation
  - Below Desired Grade

Active Infiltration and Loose Frame. Interceptor Manhole 6343

Condition Assessment

CCTV Inspection Findings

- Structural
  - Pipe Deterioration
  - Missing Concrete Tiles
  - Longitudinal Cracks At 12, 3 and 9 o’clock
- Infiltration
  - Active infiltration/Infiltration Evidence
  - Constant High Water Table due to proximity to River
- Construction Related
  - Negative Slopes Observed
  - Settling of Pipelines
  - Poor soils

High Depth of Flow Interceptor Manhole 6333

Missing Concrete Tile Interceptor Section 6318 – 6319
Condition Assessment

Environmental Site Assessment

- Site conditions
- Access to the system through existing and proposed temporary access paths
- Need to minimize disturbance to waterways, forest stands, and the wildlife habitat
- Maintain a canopy closure to prevent excessive rain impact and to minimize disturbance to Forest Interior Dwelling Bird (FIDS) habitat

Condition Assessment

Wetland Delineation

- Need to minimize disturbance to wetlands
- Eight (8) defined wetland areas may be impacted by project
- To minimize impact, the route of the temporary access path was designed to minimize impacts on wetlands
Rehabilitation Options

Criteria

- Rehabilitate the Patapsco Interceptor to reclaim 14,300 LF of abandoned pipeline
- Extend the useful life of the Patapsco Interceptor and Relief Conveyance System
- Reduce the amount of extraneous flows entering the system and thereby preventing system overflows
- Economies of scale

Rehabilitation Options

Rehabilitation Evaluation

- Sewer Rehabilitation
  - Evaluation Considerations
  - Rehabilitation Alternatives
  - Unsuitable Alternatives
  - Suitable Alternatives
- Manhole Rehabilitation
  - Structural
  - Elimination of I/I
  - Preventive Maintenance
  - Exterior Flow Protection
Rehabilitation Options

Rehabilitation Considerations

- Deteriorating System
- Site Access
- Limited Hydraulic Capacity
- Joint Alignment
- Flow Diversion
- Life Cycle Cost
- Environmental Concerns

Active Infiltration of Existing System
Patapsco Interceptors

Rehabilitation Options

Available Sewer Rehabilitation Technologies

- Chemical Grouting
- Specialty Coatings
- Pipe Bursting
- Fold and Form
- Cured-in-Place Pipe Lining
- Slip Lining
- Open Cut Replacement
- Spiral Wound PVC
## Rehabilitation Options

### Unsuitable Rehabilitation Alternatives

<table>
<thead>
<tr>
<th>REHABILITATION ALTERNATIVE</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical Grouting</td>
<td>Best utilized for eliminating infiltration at pipe joints. Does not improve structural integrity of the pipe. Provides only a short-term solution.</td>
</tr>
<tr>
<td>Specialty Grouting/Coatings</td>
<td>Appropriate as a protective measure for preventing hydrogen sulfide corrosion. Does not improve structural integrity of the pipe.</td>
</tr>
<tr>
<td>Pipe Bursting</td>
<td>Best utilized to upsize pipe diameters, typically for smaller diameter pipe sizes up to 18-inch. Also, not conducive for pipes in concrete encasements.</td>
</tr>
<tr>
<td>Fold and Formed/Deformed Lining</td>
<td>Best utilities for pipes up to 12-inches in diameter</td>
</tr>
</tbody>
</table>

### Rehabilitation Options

#### Cured-in-Place Pipe (CIPP)

**ADVANTAGES**
- No excavations
- Various shaped pipes
- Laterals reinstated internally and remotely
- Jointless solution
- Designed for loads that the host pipe cannot support
- Hydraulic capacity maintained
- Steam-curing can allow for shorter installation times

**DISADVANTAGES**
- Flow diversion
- Protruding laterals must be removed prior to installation
- Cleaning important
- Installation and cure times may exceed 24 hours per reach
- Typically more expensive than other trenchless rehabilitation technologies
Rehabilitation Options

Slip Lining

**ADVANTAGES**
- Minimal excavation
- Designed for loads that the host pipe cannot support
- Relatively quick and easy installation
- Extremely competitive
- By-pass pumping is not typically required

**DISADVANTAGES**
- Excavation of insertion pits needed
- Most suitable for circular pipes
- May require several joints
- Annular space between liner and host pipe
- Reduction in hydraulic capacity and flow area

Rehabilitation Options

Open Cut Replacement

**ADVANTAGES**
- Corrects pipe sags and misalignments
- Improve hydraulics
- Elimination of direct sources of inflow
- Removal of I/I sources
- New service life for system components
- Increase pipe capacity
- Select most appropriate pipe material

**DISADVANTAGES**
- Potential disruption and damage to public and private properties
- Significant restoration costs
- Impact other existing utilities
- Need to assess geotechnical conditions
- Shoring requirements and impacts of shoring
- Nuisance noise and dust
- Bypass pumping
- Permitting requirements
Rehabilitation Options
Spiral Wound PVC

**ADVANTAGES**
- Various shaped pipes
- Relatively rapid installation period compared to open cut replacement
- Hydraulic capacity maintained

**DISADVANTAGES**
- Bypass pumping
- Insertion pits required every 800 feet
- Laterals reinstated internally and remotely
- Cleaning important
- Diameter reduction
- Requires man-entry of pipes

Rehabilitation Options
Available Manhole Rehabilitation Technologies

- **Structural Rehabilitation**
  - Grouting and Lining
  - Raising cones/stacks

- **Elimination of Infiltration**
  - Grouting and Coating

- **Exterior Flow Protection**
Rehabilitation Options

Available Manhole Rehabilitation Technologies

- Preventative Maintenance
  - Clean interior surfaces
  - Adjust/replace frame and cover
  - Install internal chimney seal
  - Remove Steps
  - Rebuild bench/channel area
  - Inject chemical grout
  - Install liner or coatings
  - Coat exterior surface of exposed cones above grade

Rehabilitation Options

Alternatives

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Patapsco Interceptor</th>
<th>Relief</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Post Repair, LF</td>
<td>Replacement, LF</td>
</tr>
<tr>
<td>Alternative 1: Provide Rehabilitation/Replacement of Priority Pipeline Segments on the Patapsco Interceptor</td>
<td>8</td>
<td>6,800</td>
</tr>
<tr>
<td>Alternative 2: Provide Rehabilitation/Replacement of Priority Pipeline Segments on the Patapsco Interceptor and Relief</td>
<td>3</td>
<td>6.5M</td>
</tr>
<tr>
<td>Alternative 3: Provide Rehabilitation by Cure-in-Place Pipe on the Patapsco Interceptor</td>
<td>19,000</td>
<td></td>
</tr>
<tr>
<td>Alternative 4: Provide Rehabilitation by Cure-in-Place Pipe on the Patapsco Interceptor and Relief</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Rehabilitation Options

Solution: Alternative 4

- Reclaim Interceptor
- Extend Useful Life of System
- Reduce Extraneous Flows by Approximately 26 MG during a 2yr-24hr Rain Event
- Reduce or Eliminate Pump Station Wet Weather Related Problems
- Reduce or Eliminate Overflows
- Economies of Scale

Design Considerations

Permitting with Environmental Agencies

- MDE (Joint Application)
- MDE (Water Appropriation)
- US Army Corps. of Engineer
- Department of Natural Resources
- Patapsco Valley State Park (DNR)
- MD Critical Area Commission (DNR)
- Wildlife and Heritage (DNR)
- Maryland Historical Trust
- Big Tree Program
- DEPRM
Design Considerations

Temporary Right-of-Entry

- Patapsco Valley State Park (DNR)
- Amtrak/CSX Transportation, Inc
- Maryland State Highway Administration
- Baltimore Gas & Electric Company
- Diageo
- Maryland Environmental Service

Design Considerations

Constructability

- Multiple Agency Coordination
- Access Roads
  - Existing
  - Improved
  - Temporary
- Contractors’ Assessment
- Construction Timeline (CD Deadline)
Design Considerations

The Design

[Map and images related to Baltimore County and design considerations]
Design Considerations
Lessons Learned

- Initiate Contact with Local Permitting Agencies as early as possible
- Continue communication with all agencies as the project evolves
- Seek input from Multiple Contractors
- Focus on minimizing environmental impacts and keep an open mind for creative solutions

Conclusion

- Project is currently under construction
- Currently one of the largest rehabilitation project in the country
- Careful planning and coordination with all involved allows for the project to be successful
Questions?

Celina_perez@urscorp.com