Water Transmission & Sewer Force
Main Renewal – 16” through 60”

North American Operations
1973 S 91st Street
Milwaukee WI 53227

4700 N Pearl Street
Jacksonville FL 32206

office 414.321.2247 • fax 414.321.2297

www.swagelining.com
Our History

- Millions of feet of static pipe bursting & Swagelining™ experience world wide
- North America’s most diverse and experienced trenchless technology management team
- Granted sole partnership for Swagelining™ in North America
- 2003 Trenchless Project of the Year Nominee
- 2005 Trenchless Project of the Year Nominee
- 2008 CSX Rail Performance & Safety Awards
- 2009 APWA Environmental Project of the Year
- 2010 UCTA Most Valuable Professional – Andy Mayer
- Lead instructor and advisor to the AWWA, EPA, state regulatory agencies and trenchless equipment manufactures
Our Services

- Trenchless Design
  - Design Build
  - Feasibility study
  - Cost analysis
  - Evaluation of replacement / refurbishment alternatives
  - Engineering

- Trenchless Construction
  - Swagelining™
  - Slip lining
  - Pipe bursting
  - Pre-chlorinated Pipe bursting
  - Pipe splitting
United Kingdom – British Gas
Development of Swagelining™ & Pipe bursting in 1970’s
Swagelining™ History

- **History**
  - Method developed by British Gas (1970’s) and patented for gas distribution
  - Success led to potable water crossover
  - Swagelining™ over 17,300,000 feet installed in the past 28 years

- **Today**
  - Currently used to renew water, force main, gas, oil, mining, slurry, chemical, industrial, salt water and off-shore pipelines world wide
Swagelining™ Process
Swagelining™ Engineering Overview

- Follows path of the existing utility
  - Reduces 3rd party utility damage
  - Reduces infrastructure congestion
  - Engineering design hours reduced
- Maintains or possibly increases flow capacity
  - C-factor of 150 for life of HDPE
  - No grouting required due to ‘tight’ fit of HDPE
- HDPE
  - Long term design life
  - Corrosion protection
  - Increased operating efficiency
  - Unmatched Fatigue Resistance
  - Resistance to RCP
Swagelining™ Engineering Overview

- Install HDPE pipe wall thickness that is Solution to the Problem (DR 11 through DR 51)
  - Fully structural HDPE
  - Interactive HDPE
  - Thin walled HDPE
Swagelining™ Construction Overview

- Insertion lengths up to 5,000 feet
- Pipe sizes of 4” through 60”
  - Oil, Gas & Mining Pipelines most suitable 4” through 16”
  - Water Transmission & Sewer Force Mains most suitable 16” through 60”
- Negotiates field bends
- Surgical excavations
- Environmentally sensitive
- Undertake projects year round
- Social costs reduced
Integrated Lining System

- Polymer Materials Specification
- Liner System Design
- Insertion Technology
- Specialized Connectors
Swagelining™ Process – Preparation of Host Pipe

- Camera inspection
- Cleaning
Swagelining™ Process – Preparation of Host Pipe

- Proving pig sent through host pipe to ensure free bore path
Swagelining™ Process – Butt Fusion

- Sections of HDPE pipe are butt fused together
- External bead removed
Swagelining™ Process – Job site aesthetics for Urban areas
Swagelining™ Process - Shuttle Rods through host pipe
Swagelining™ Process –
Attach pipe once rods reach entry pit
**Swagelining™ Process – Reducing Die**

- HDPE pipe has an OD slightly larger than the ID of the pipe to be renewed
- Pipe is pulled through a reduction die which temporarily reduces its diameter
Reducing Die
Swagelining™ Process –
Rods recovered at exit pit

- Rods are removed from the exit pit as pipe is pulled into place
- For the next pull the exit pit becomes new entry pit
Swagelining™ Process – HDPE enters receiving pit

- Pulling force removed
- Natural relaxation of HDPE
- 90% of reversion occurs in 2 hours
- Remaining reversion occurs overnight
Swagelining™ Process – Results

- No gaps - all annular space is eliminated
- Fully structural pipe
- Interactive pipe
- Thin walled liner
Swagelining™ Process – Final Connections
Most Applicable

- 2” – 16” pipe bursting
- 16” – 60” Swagelining™
- Rapid installation
- Cost effective
- Solution to problem
- Long term design life
- Rural areas – environmentally friendly
- Urban areas – reduced social costs
General background information about large diameter Swagelining projects

SWAGELINING™
LIFE EXTENDING TECHNOLOGY
FOR NEW AND EXISTING PIPELINES

A summary of project references from the USA and around the world
<table>
<thead>
<tr>
<th>Year</th>
<th>Application</th>
<th>Location</th>
<th>Diameter</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>Water Transmission</td>
<td>USA</td>
<td>24”-27”</td>
<td>18,500 feet</td>
</tr>
<tr>
<td>2012</td>
<td>Water Transmission</td>
<td>UK</td>
<td>40”</td>
<td>60,000 feet</td>
</tr>
<tr>
<td>2012</td>
<td>Water Injection</td>
<td>Norway</td>
<td>10”</td>
<td>37,800 feet</td>
</tr>
<tr>
<td>2012</td>
<td>Chilled Water Line</td>
<td>USA</td>
<td>18”-20”</td>
<td>6,400 feet</td>
</tr>
<tr>
<td>2011/2012</td>
<td>Water Transmission</td>
<td>USA</td>
<td>30”</td>
<td>5,300 feet</td>
</tr>
<tr>
<td>2010</td>
<td>Water Transmission</td>
<td>France</td>
<td>27”</td>
<td>4,600 feet</td>
</tr>
<tr>
<td>2010</td>
<td>Water Transmission</td>
<td>Australia</td>
<td>24”</td>
<td>7,250 feet</td>
</tr>
<tr>
<td>2009</td>
<td>Water Injection</td>
<td>Republic of Congo</td>
<td>24”</td>
<td>180,400 feet</td>
</tr>
<tr>
<td>2008</td>
<td>Water Transmission</td>
<td>Germany</td>
<td>54”</td>
<td>2,200 feet</td>
</tr>
<tr>
<td>2006</td>
<td>Water Injection</td>
<td>Norway</td>
<td>16”</td>
<td>31,200 feet</td>
</tr>
<tr>
<td>2005</td>
<td>Sewer Force Main</td>
<td>Germany</td>
<td>32”</td>
<td>3,280 feet</td>
</tr>
<tr>
<td>2004</td>
<td>Sewer Force Main</td>
<td>Singapore</td>
<td>18”</td>
<td>3,100 feet</td>
</tr>
<tr>
<td>2002</td>
<td>Water Irrigation</td>
<td>Abu Dhabi</td>
<td>20”</td>
<td>62,300 feet</td>
</tr>
<tr>
<td>1999</td>
<td>Sewer Force Main</td>
<td>Poland</td>
<td>16”</td>
<td>4,600 feet</td>
</tr>
<tr>
<td>1996-2001</td>
<td>Water Transmission/Sewer Force Main</td>
<td>USA</td>
<td>20”, 27”, 30”, 36”</td>
<td>45,700 feet</td>
</tr>
<tr>
<td>1992-1993</td>
<td>Water Transmission</td>
<td>UK</td>
<td>42”</td>
<td>4,850 feet</td>
</tr>
</tbody>
</table>
Swagelining Case Study
Amarillo, TX

Challenge

- Phase 1: 2,100 feet of 30” Cast Iron Water Transmission Main installed in 1927 – completed 2011
- Phase 2: 3,200 feet of 30” Cast iron Water Transmission Main installed in 1927 – completed 2012
- Leaking lead joints
- Tight easement, under homes and through busy roads
- Shut down limited to dry weather
- Flow capacity needed to be maintained
Swagelining Case Study

Solution

- Several Methods Analyzed – with Swagelining selected to maximize flow capacity, limit excavation, follow the existing utility path and speed of installation

- Liner System Design
  - 32” Outside Diameter DR 32.5 HDPE DR 4710
  - 1,800 feet average pull distances to minimize connections
Swagelining Case Study

Impact

- Small footprint to reduce social and environmental costs
- 90% less excavation than open cut
- Rapid installation to complete project within dry weather shut down period
- ‘Tight’ fitting HDPE will provide
  - 100 year design life
  - Corrosion Protection barrier
  - Prevent future leaks
Water Transmission & Sewer Force
Main Renewal – 16” through 60”

North American Operations
1973 S 91st Street
Milwaukee WI 53227

4700 N Pearl Street
Jacksonville FL 32206

office 414.321.2247 • fax 414.321.2297

www.swagelining.com