



# REVIVING AGING INFRASTRUCTURE

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Sustainable approaches to repairing and protecting  
sewer and storm systems

# SEWER SYSTEM DETERIORATION

## PUBLIC HEALTH CONCERNS AND ENVIRONMENTAL IMPACT

**As municipalities contend** with the critical issue of aging sewer systems, they are confronted with a myriad of challenges. These range from gradual deterioration to damage caused by roots and misuse, resulting in unwanted infiltration and exfiltration. These events take place throughout the country, **posing significant environmental and public health risks**, as well as substantial financial costs and community disruption associated with repairing the sewer system.

According to the Environmental Protection Agency (EPA), sanitary sewer overflows (SSOs) are a frequent occurrence. It estimates between 23,000 and 75,000 SSOs occur each year in the United States, resulting in **releases of between 3 billion and 10 billion gallons of untreated wastewater**. Simultaneously, the repercussions of Inflow and Infiltration (I&I) can lead to unfavorable environmental consequences, regulatory non-compliance concerns, increased treatment expenditures, basement flooding incidents, and heightened strain on a municipalities' collection infrastructure.

### ENVIRONMENTAL IMPACT

The infiltration and exfiltration of wastewater from deteriorated and broken sewer lines **pose a significant threat to the environment**. The EPA reports that SSOs can contaminate surface waters with pathogens, harmful nutrients, and other pollutants, endangering aquatic life and compromising water quality. SSOs contribute to the degradation of ecosystems, disrupt the balance of aquatic habitats, and harm wildlife populations.

### PUBLIC HEALTH CONCERNS

The EPA notes that **children are at a greater risk to water contaminants** due to their developing immune systems and increased likelihood of exposure. The presence of pathogens and viruses in untreated sewage presents grave public health risks, including gastrointestinal illnesses, respiratory infections, and other serious health effects. Additionally, elderly individuals and **those with weakened immune systems are more susceptible** to waterborne diseases transmitted through contaminated waterways.



# THE DISRUPTIVE AND COSTLY CONSEQUENCES

## THE COST AND IMPACT OF I&I

According to EPA, the cost of collecting and treating wastewater typically falls between \$2 to \$5 per thousand gallons of water. As a result, if a community experiences an annual I&I volume of 150 million gallons of water, it could **incur expenses ranging from \$300,000 to \$750,000 per year** for transporting and treating the flow at treatment plants.

## COMMUNITY DISRUPTION

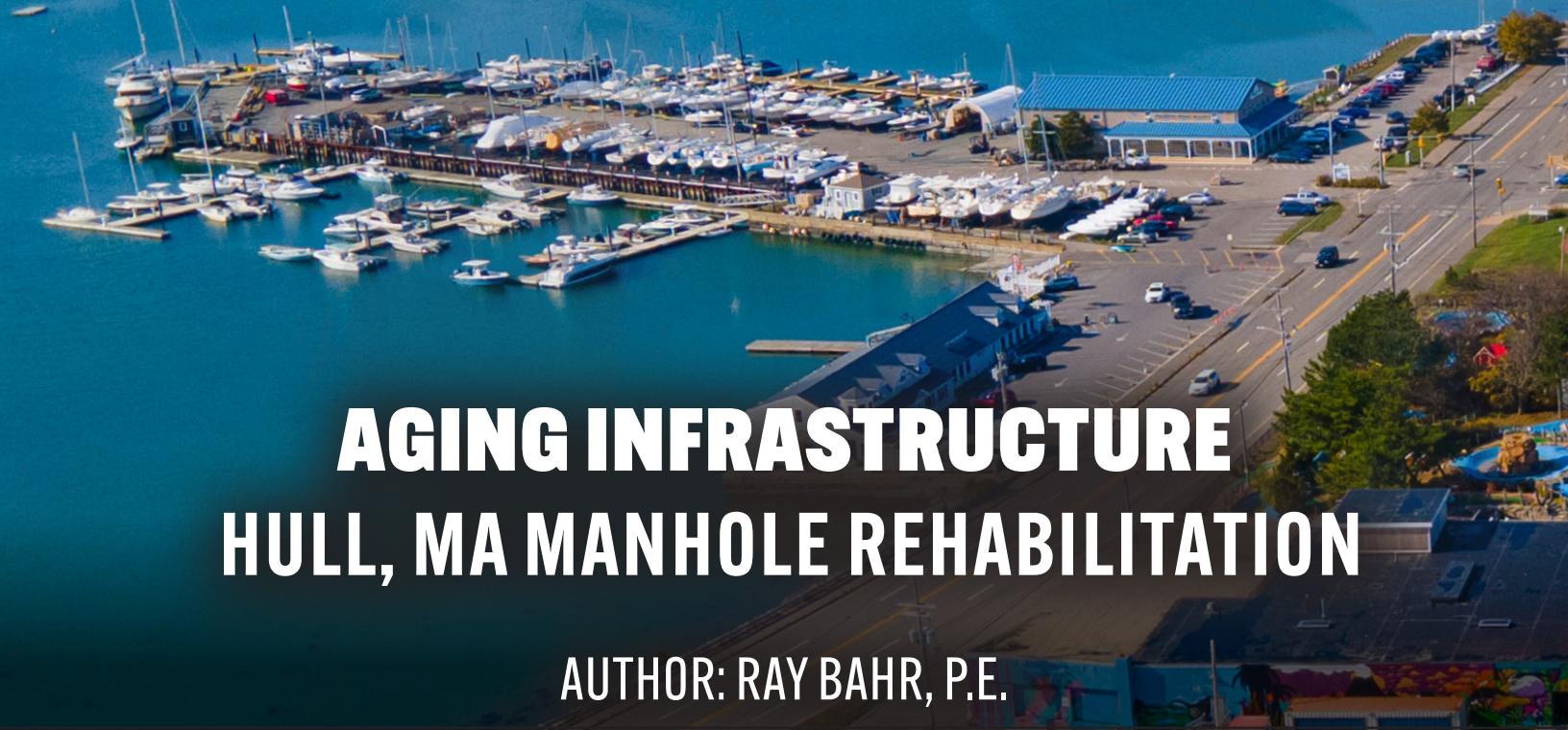
The traditional method of sewer repair, which typically requires extensive excavation, not only disrupts the daily lives of citizens, but also **imposes significant challenges on local businesses**. Trenching operations often result in road closures, traffic diversions, and disturbances to both residential and commercial areas, exacerbating community frustration and inconvenience.

## MINIMIZING THE COSTS AND DISRUPTIONS OF INFILTRATION AND INFLOW

Municipal sanitary sewer collection and conveyance systems are vital components of the nation's infrastructure, encompassing pipelines, conduits, pumping stations, force mains, and other facilities. These systems collect wastewater from residential, industrial, and commercial sources, transporting it to treatment facilities before discharge into the environment.

**The proper functioning of these wastewater systems is paramount for maintaining public health and well-being in the United States.** Despite their critical role, many members of the public often take for granted the seamless operation of these systems, unaware of their intricate design and technical workings.

Considering these pressing challenges, municipalities must explore innovative solutions to address sewer system deterioration effectively. **Trenchless technologies** offer a sustainable, cost-effective alternative that **minimizes disruption to communities** while safeguarding the environment and public health.



# AGING INFRASTRUCTURE HULL, MA MANHOLE REHABILITATION

AUTHOR: RAY BAHR, P.E.

New England, being one of the first parts of the country settled, has some of the oldest infrastructure. This is no different for the Town of Hull, MA. **Recently the town put out a multi-million-dollar sewer rehabilitation bid for CIPP, which also included extensive manhole and structure rehabilitation.** This sanitary sewer infrastructure was only 45 years old and is certainly not as old as other sewer systems in New England. Hull is a coastal community with high brackish ground water and minimal pipe grades, so hydrogen sulfide has been an issue in the collection system, which has increased the rate of deterioration of the system.

The Town's 36-inch RCP sanitary sewer interceptor exhibited both corrosion of the concrete due to the presence of hydrogen sulfide gas and infiltration due to high groundwater. This was also the case in the precast concrete manholes on the project. **The work included trenchless technologies such as cured-in-place lining of 10,000 ft. of 36-inch gravity piping, grouting of service connections as well as the rehabilitation of over 1,000 vertical feet of precast manhole structures.** Also included was the rehabilitation of a 4-barrel inverted siphon, 2-barrel lagoon crossings and the concrete structures associated with them. All of the work proposed was required to be completed utilizing trenchless technologies.

The manholes to be rehabilitated all showed signs of corrosion due to saltwater intrusion and microbiological H2S induced corrosion. Exposed rebar and visible aggregate as well as heavy infiltration were present in most of the manholes.

The project specifications required the contractor to have a professional engineer prepare, certify, and submit engineering design calculations for the structural rehabilitation of all manholes.

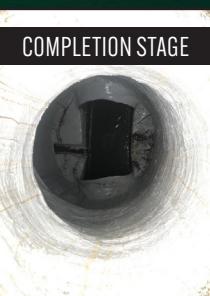
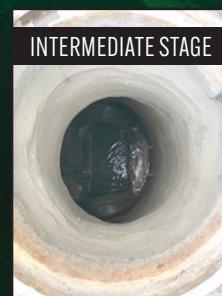
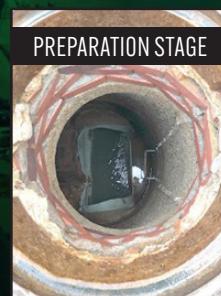
The specifications required the cementitious coating product to have the following minimum structural values based on 28 days curing:

Comprehensive Strength	ASTM C109 >9,000 psi
Flexural Strength	ASTM C293 >1,600 psi
Tensile Strength	ASTM C496 >800 psi
Modulus of Elasticity	ASTM C469 >4,500,000 psi
Permeability	ASTM C1202 < 300 coulombs
Bond	ASTM C882 >2,000 psi
Shrinkage	ASTM C596 0.0% (at 90% RH)
Freeze/Thaw	ASTM C666 300 cycles
Sulfide Resistance	ASTM C267 No loss after 90 days

The project specifications also called for the rehabilitation of the manhole inverts. All inverts needed to be scheduled when the manholes were bypassed for the CIPP lining unless the liner went through the manhole invert. Other manholes without a CIPP liner needed to have the inverts bypassed with flow through plugs. For the remaining portion of the manhole work, the crews had to go back to each manhole and complete the preparation, infiltration elimination, cementitious coating, and epoxy lining.

All incoming infiltration needed to be eliminated. Green Mountain Pipeline Services (GMPS) used acrylamide grout on all aspects of this project.

One of the most important aspects of manhole rehabilitation is preparation. If the manhole is not cleaned and prepared properly no coating or product will last as long as intended.



Preparation involved stopping infiltration, pressure washing the walls to a sound substrate, and addressing corrosion with exposed aggregate. The manhole, containing a CIPP liner, had its bench rebuilt to slope correctly. During the intermediate stage, leaks were sealed and patching completed with Strong-Seal® QSR. A  $\frac{1}{2}$  inch layer of Strong-Seal® High Performance Mix was applied, troweled smooth, and brushed to increase surface area for better epoxy adhesion.

### **The proper preparation of the manhole walls is key to a successful project.**

Strong Seal® QSR for manhole patching and repair and Strong-Seal® High Performance Mix was used to rehabilitate the manhole walls. Green Mountain Pipeline Services has been using The Strong Company's products with tremendous success since 1992.

Because of high H<sub>2</sub>S levels, the project called for the cementitious liner to have an epoxy applied as a second coat to further protect the manhole from future hydrogen sulfide damage.

The epoxy needed to be solvent-free, 100% solids by volume, corrosion resistant formulated for immersion and atmospheric service and needed to exhibit the following properties.

Tensile Strength	ASTM D638 >6,900 psi
Tensile Ultimate Elongation	ASTM D638 >1.4%
Compressive Strength	ASTM D695 >11,900 psi
Flexural Strength	ASTM D790 >10,900 psi
Flexural Modulus	ASTM D790 >499,000 psi
Shore D Hardness	ASTM D2240 >82
Adhesion to Concrete	ASTM D4541 Substrate Failure

The final testing of the work consisted of cementitious material physical testing, visual inspection, film thickness measurements, and Holiday or spark testing.

**The project was completed on time and on budget.** The Town of Hull was very pleased with all the work performed by GMPS and included additional change order work onto the contract, consisting of cleaning and inspection of the remaining portions of the interceptor, manhole rehabilitation in other areas of the interceptor, and other CIPP work. As a result of the full-length liner and complete manhole rehabilitation, it is evident that **groundwater infiltration has been significantly reduced over the course of the project** based on trend data using average daily flows measured at the wastewater treatment facility.

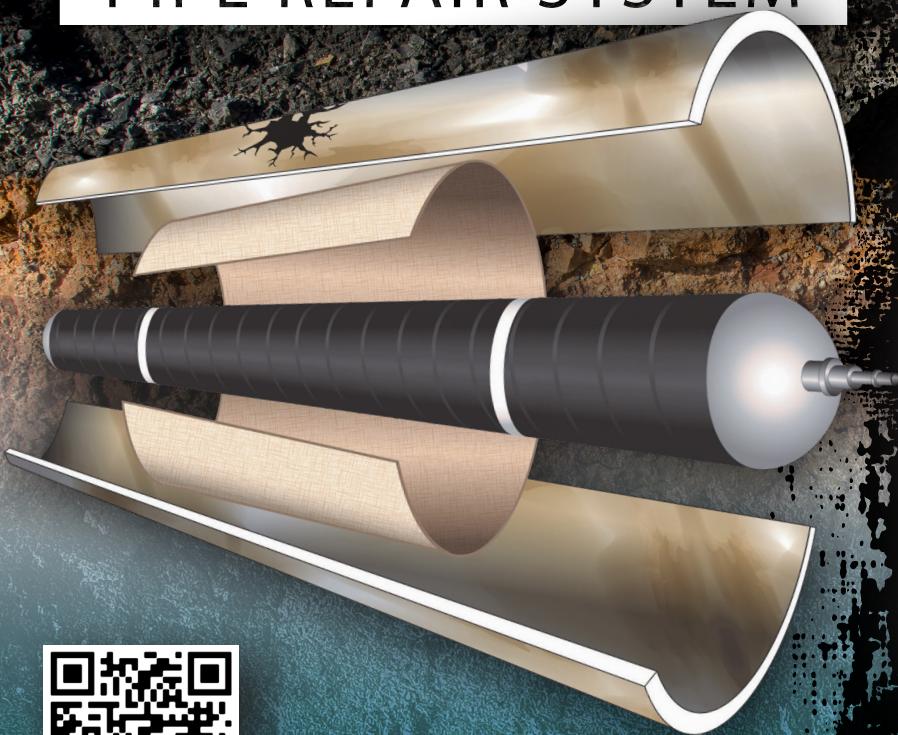
The work was performed for the Town of Hull Sewer Department with engineering services provided by Woodard & Curran.





# NO DIG

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MORE PRODUCTION.

Complete trenchless repairs quickly, **reducing downtime** and minimizing site disturbance.

COST SAVINGS

Save on labor, equipment, and restoration with targeted, **no-dig repairs** versus traditional excavation.

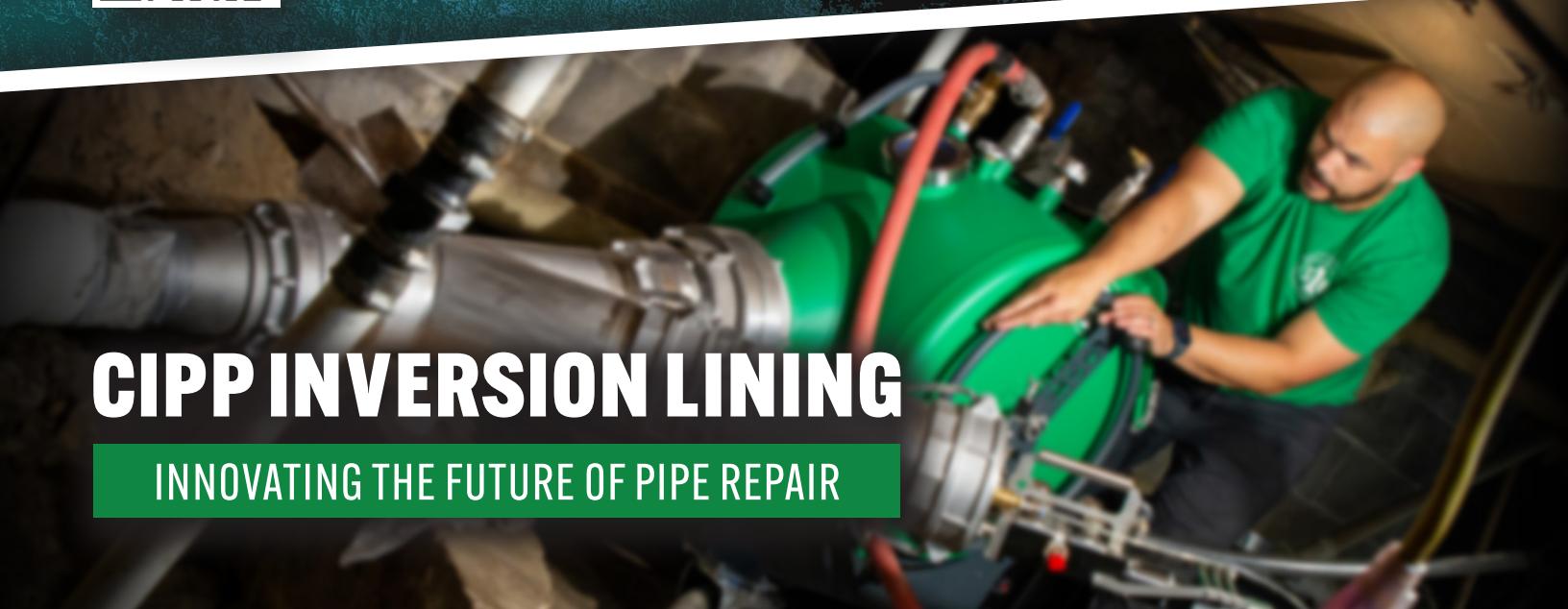
A PERMANENT  
SOLUTION

Stronger than the original pipe, PipePatch® resists household oils and chemicals, offering an odorless, **safe repair with no toxic fumes**.



## CIPP INVERSION LINING

INNOVATING THE FUTURE OF PIPE REPAIR



# STRONG-SEAL® MANHOLE SOLUTIONS

REVITALIZING INFRASTRUCTURE FOR SUSTAINABLE LONGEVITY

## REVITALIZATION AND LONGEVITY

Strong-Seal® Manhole solutions rejuvenate manhole structures, extending their life and maintaining the critical integrity of the sewer system.

## COST-EFFECTIVE REHABILITATION

Provides an efficient solution to reduce inflow and infiltration (I/I), addressing up to 30% of issues through manhole restoration.

## RAPID WATER CONTROL

Strong-Seal® Manhole solutions deliver quick, high-strength repairs to stop water and infiltration in minimal time.



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