

AGING INFRASTRUCTURE HULL, MA MANHOLE REHABILITATION

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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.

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

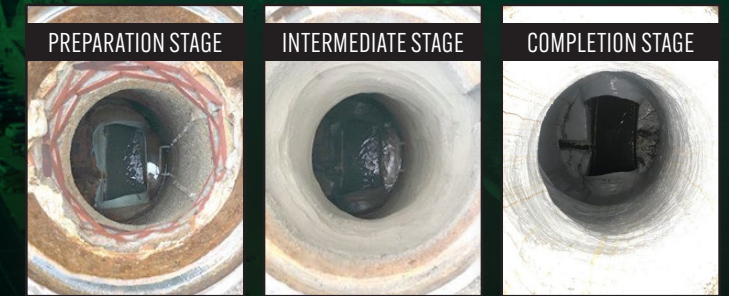
Strong Seal® QSR for manhole patching and repair and Strong-Seal® High Performance Mix was used to rehabilitate the manhole walls. Green Mountain Pipeline Services has been using The Strong Company's products with tremendous success since 1992.

Because of high H2S 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.



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 ½ inch layer of Strong-Seal® High Performance Mix was applied, troweled smooth, and brushed to increase surface area for better epoxy adhesion.

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.

