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INNOVATIONS
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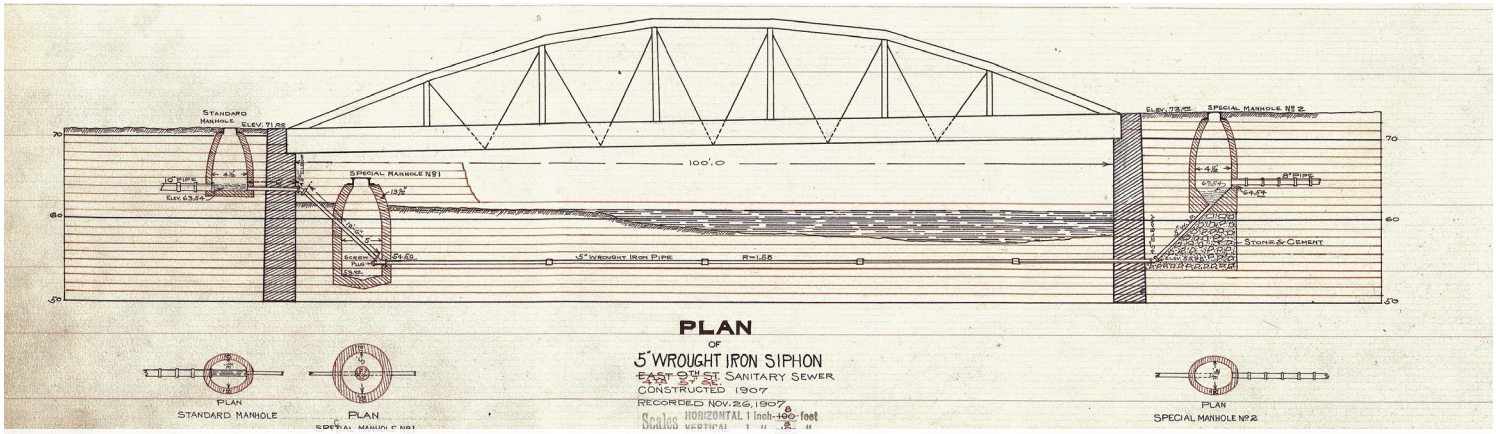

The original 1907 design for the East 9th Street siphon in the City of Canton.

THE CITY OF CANTON NAVIGATES SANITARY SEWER RIVER CROSSING WITH UPDATED SIPHON DESIGN

For a utility, the least costly method of transporting wastewater to treatment plants is by using gravity to move flow downhill with gravity sewers. However, accomplishing this with an entire collection system is usually impossible.

A municipality will need to use a combination of gravity sewers, pump and lift stations, force mains, aerial crossings, and sometimes inverted siphons to ensure all wastewater flows make it to a treatment plant.

An inverted siphon is a sewer that dips below an obstruction and will normally form a U-shaped flow path. The liquid flowing in one end must flow with enough force to push liquid up and out the other end. Inverted siphons are commonly used when a sewer pipe must be routed under a river or other deep obstructions.

The City of Canton, Ohio has five siphons in its collection system which have been operating since the early 1900s. Siphons of this age typically feature a single barrel design and are no longer sized correctly for the amount of flows coming through the system, making maintenance and upkeep difficult.

The City proposed a project to upgrade a portion of its collection system which has two river crossing siphons. The project first wanted to evaluate whether one of the crossings could be diverted and eliminated and whether the second could be accomplished using an aerial sewer over a newly constructed bridge.

After a preliminary study, the bridge was found to be under the 100-year flood line of the river and was not feasible for an aerial crossing. However, it was feasible to divert the flows and eliminate one of the siphons.

Inverted siphons or “depressed sewers” are chosen to navigate obstacles in a collection system because they do not require electrical or equipment maintenance like a pump or lift station, however, they come with their own set of technical and maintenance challenges.

To operate with enough velocity to ensure flows are pushed up the other side, a siphon must be sized using meticulous flow data to ensure there will always be enough wastewater flow to travel at a scouring velocity of 3ft/second. With this minimum velocity, solids are usually unable to accumulate at the bottom of the pipes during periods of low flow.

The unique aspect of designing a siphon is the criticality of calculating accurate flows. Flow velocities are managed through careful selection of pipe sizes and design of flow entry configurations that hinge on an accurate estimation of what “average” flow will be daily through the siphon as well as how much water can be expected during periods of high flow and wet weather.

Ten State Standards now recommends a siphon to feature a multiple barrel design to handle a higher range of flows. A flow splitter chamber directs average flows to one barrel with a series of adjustable weir gates to direct higher flow rates to other or multiple barrels intended to achieve the required scouring velocity in each pipe during various flow scenarios.

In addition, it is also critical for the areas upstream and downstream of the siphon to have adequate space for easy jet/vacuum truck access with a vault and weir gate infrastructure to facilitate easily diverting the flow from one barrel to another while jetting and vacuuming debris from an offline barrel.

While an uncommon type of sewer, the benefits of a properly designed siphon means the City of Canton can continue to cross rivers by gravity without the cost of mechanical electrical equipment, using infrastructure and simple technology that should last for the next one hundred years.