Model Enabled Water Flow Using Gravity

The goal of this project was to determine if the relocation of a supply source had the potential to reduce the City of Newark, New Jersey’s, annual cost of $750,000 to pump 20 MGD of water. Using Bentley’s WaterGEMS water distribution modeling, analysis, and design software product, Hatch Mott MacDonald engineers determined that the water could be supplied at a location where the flow could be achieved through gravity during a portion of the year, and where the total dynamic head (TDH) of a pump required to meet demand during summer would be substantially less than the current pumping arrangement, saving hundreds of thousands of dollars annually.

Current Pumping Situation

Currently, pumping is done at a remote site outside of Newark. Water is then brought into the city and delivered to the 260-A zone through the use of pressure regulating valves (PRVs). It was determined that a supply line in closer proximity to the 260-A zone would allow for gravity flow or low head pumping directly to the zone at less TDH. However, engineers needed to use a hydraulic model to ensure that adequate flow and pressure could be delivered through the transmission network from a new supply location.

Water System Modeling using WaterGEMS

The analysis of the city’s water network using WaterGEMS identified that an existing 36-inch diameter transmission main could be transferred from the 360 zone to the 260-A zone (see figure 2), and would provide adequate flow and pressure for domestic and fire protection purposes (see figure 1).

Using WaterGEMS directly within ArcGIS to geo-code customer billing information identified significant leakage between the higher and lower pressure zones of the city’s water system.

Immediate Return on Software Investment and Positive Environmental Impact

Based upon this analysis, it was determined that 10 MGD could be supplied at this new location at an annual cost of approximately 80 percent less than the current cost to pump water. It was further determined that based upon the proximity of an existing PRV, which transfers 25 MGD and currently burns 100 feet of head, a small hydro-turbine could be used to power the proposed pump station, thereby eliminating all purchased power costs, with the added potential to sell excess electricity to the utility.
significant leakage between the higher and lower pressure zones of the city's water system. A field investigation to review the location and open/closed status of zone "division" valves resulted in adjustments that would reduce pumping requirements at the existing booster station by an additional 5 MGD. It would also take advantage of the ability to supply additional water via gravity to the lower elevation zones.

This would result in reducing overall pumping at this station from 20 MGD to 5 MGD of water on an annual basis, greatly reducing annual pumping costs from approximately $750,000 to $187,500.

Based upon the costs to secure low-interest financing for the construction of a new booster pump and hydro-turbine facility, and to make minor piping infrastructure improvements, the electrical savings would exceed the debt servicing costs, and the return on investment (ROI) would be immediate.

Using WaterGEMS, the concept was quickly validated, and based upon the anticipated ROI, the software paid for itself in one analysis.

From an environmental perspective, developing the hydro-power generation potential at an existing PRV location will provide a renewable source to generate electricity, reducing the city's energy costs and overall carbon footprint.

Figure 2: Transfer of 36" and 24" water mains from 360 to 260-A zone

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