Engineering Feasibility Study of a Water Pressure Booster Station

submitted to the City of Gladstone
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Background

The City of Gladstone is in the process of building a natatorium in the municipal park on 70th and North Holmes, across from City Hall. In order to ensure an adequate water supply for the new facility, the construction of a booster station in the area is being considered.

Requested Pressures and Flows

Henderson Engineering of Lenexa, KS is the design engineer with regard to the plumbing system for the natatorium. They have requested water pressure of 80 psi at the connection to the distribution system.

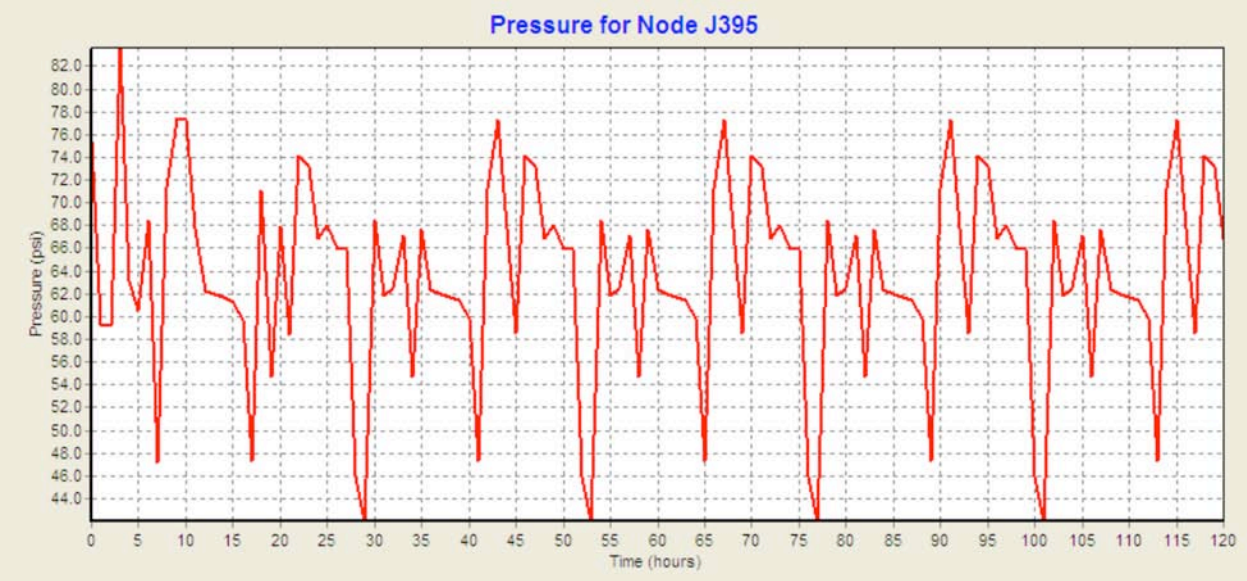
It has been estimated that a maximum flow of 300 gpm will be required to fill an empty pool and provide filter backwash water.

Existing Pressures and Flows: Measured

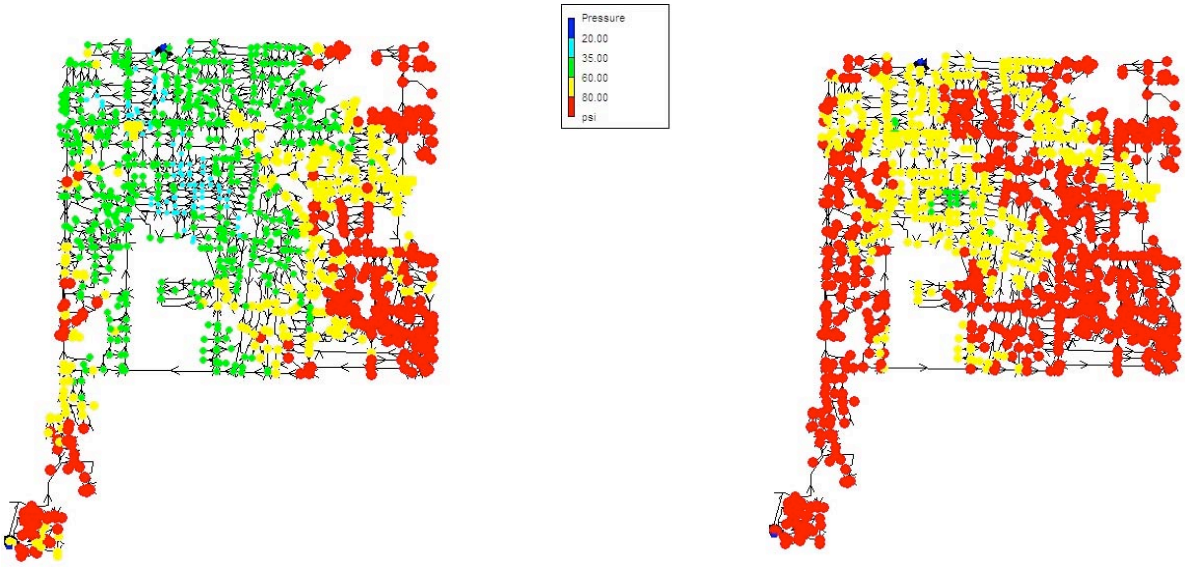
It is anticipated that the new facility will be fed by a new 8” service line off of an existing 16” water main at 69th and Holmes. Recent pressure and flow testing by the Gladstone Water Department indicated a static pressure of 72 psi in the region. With two hydrants open and flowing approximately 1,000 gpm, the pressure dropped to 64 psi on the 16” main and 60 psi on a nearby 8” main.

Existing Pressures and Flows: Modeled

Gladstone's EPANET hydraulic model was used to estimate the daily fluctuation in pressure at a point on the 16" main that will serve the natatorium. The model estimates pressures in the 60's the majority of the day, with dips to 44 psi and peaks to 77 psi.



Maximum and minimum daily pressures (modeled) are depicted in the following maps.



Minimum Daily Pressures

Peak Daily Pressures

Booster Station

A booster station in the system would essentially be defining a second pressure zone. This zone would need to be isolated from the rest of the system (with pressure-reducing valves) in order to avoid increasing the already excessive pressures in the southeast part of town. The area of this pressure zone would need to be defined.

Options for the pressure zone include:

1) the natatorium only
2) the area of downtown slated for redevelopment (approximately 16 city blocks)

1) A booster station for the natatorium alone could be purchased as a self-contained, prefabricated unit. It would consist of two pumps, a hydropneumatic pressure tank, and all necessary controls and appurtenances. The system would be delivered on a skid and could be either be housed in a fiberglass building or buried in the ground. Approximate cost of this system would be $30,000. (Budgetary figure provided by Hydro-Kinetics of St. Louis.)

2) A booster station for the area downtown slated for redevelopment was also considered. However, based on the aforementioned existing pressures and flows in the area and the type of development being considered (low-rise, without intensive water usage), it was deemed to be currently unnecessary.

While investigating the option of establishing multiple pressure zones, consideration should also be given to separating the southeast (lower elevation) portion of town. From our 2003 report:

Multiple Pressure Zones

The MDNR Design Standards for Community Water Systems states:

> *Areas with elevation differences of more than one hundred-fifty (150) feet should be divided into multiple pressure zones so that each zone has pressure between thirty-five (35) and one hundred (100) pounds per square inch gage (psig). Multiple pressure zone systems should have separate storage facilities for each zone and should be equipped so that water can be transferred between zones with pump stations and pressure control valves.*

Elevations within Gladstone's water distribution system range from 810' to 1030' msl, a difference of 220', which represents a difference in hydrostatic pressure of 95 psi. However, 90.5% of the distribution system is within the elevation range from 851' to 1000'. The remainder breaks down as: 2.4% of the system below 850'; 7.1% above 1000'.

Consideration should be given to the possibility of establishing a separate pressure zone for the southeast portion of the distribution system. This would involve the installation of several pressure reducing valves (PRV) at a cost of $3,000 to $4,000 per valve. Additional modifications may be necessary to secure MDNR approval.

Linden Water Tower

Consideration was given to returning Linden water tower into service in an effort to achieve the desired 80 psi.

Linden water tower was taken out of service in 2002 in an effort to reduce main breaks. The Water Department reports that this has been effective and has saved the city hundreds of thousands of dollars. It is anticipated that returning Linden to service would increase the number of main breaks.

Additionally, the 50-year-old Linden tower is considered to be near the end of its useful life (2000 inspection) and would likely require rehabilitation before being placed back into regular service. It is also served by 8" piping which restricts filling and drawdown rates.

Finally, at a water height of 150', the Linden tower is not tall enough to provide static pressures of 80 psi at the natatorium.

Conclusion

In order to provide pressure of 80 psi to the natatorium, a booster station serving only that facility is the most feasible option.