BYU | CIVIL & ENVIRONMENTAL ENGINEERING

IRA A. FULTON COLLEGE

CAPSTONE

PRESSURE ZONES ANALYSIS

CEEn - 2016CPST - 06

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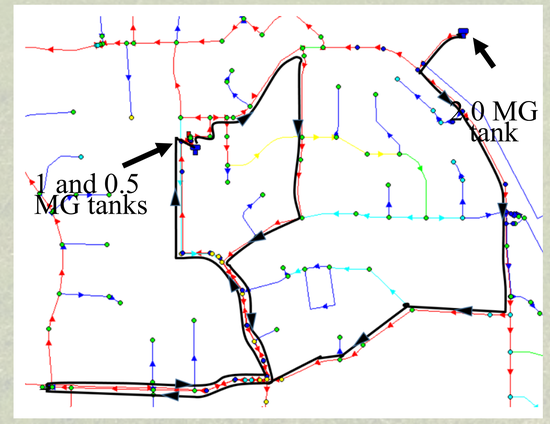
Background and Scope

In 2015, J-U-B Engineering analyzed the City of Lindon's culinary water storage needs and recommended a minimum of 0.88 million gallons of additional storage be provided by the year 2024. Our task was to analyze different locations for a future culinary tank and its effect on the existing pressure zones of the city.

Challenges

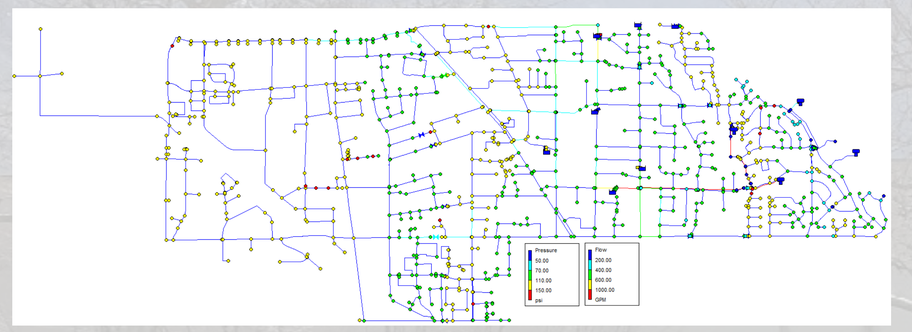
The first model had several errors which caused modeling issues. After meeting with the sponsor and several email correspondence, we fixed the issues with the model and were able to proceed with the analysis.

Repeated trial and error in analysis led to the discovery of a loop in the water path of a few main lines. The existing 0.5 MG and 1 MG tanks empty into a pipeline used to refill the 2 MG tank and supply the upper zone. The water then descends down to refill the 0.5 MG and 1 MG tanks. This means the 0.5 and 1.0 MG tanks were not actually providing for the lower zones but rather kept in a loop with the upper zones and being refilled by the 2 MG tank. This loop caused pressure failures in every model.

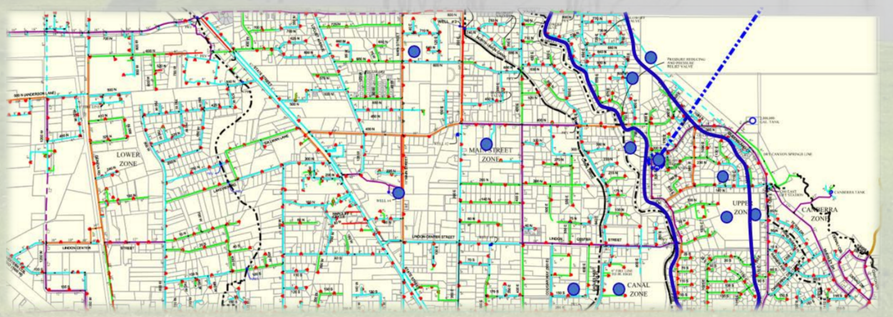


Analysis

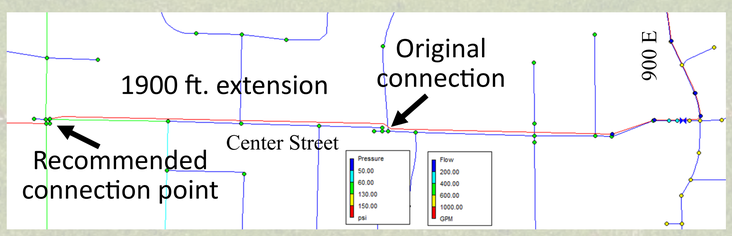
All modeling was performed using EPANET 2. Potential tank locations were determined by elevation with preference given to land owned by Lindon City. Each location was tested for running indefinitely with a daily demand of 1,687 gallons per minute (gpm) with a peaking factor of 1.86 and maximum and minimum pressures of 150 and 40 psi, respectively.



We determined the required elevation for a tank to supply the system without a pump and at what elevation a tank would be inefficient for the pumps. The lowest elevation is the left-most blue line shown in the below image. Also shown are all the tested locations.

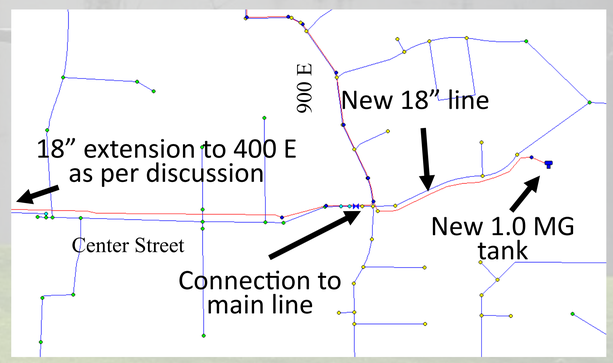


In order to resolve the loop issue, we found it was necessary to extend the connection point, of the 0.5 MG and 1 MG tanks to the main line on Center street from 700 E and 400 E. This provided an access point for the water where it wouldn't be immediately transferred to the upper zones. The image below shows the extension of the 18" pipe from 700 E to 400 E.



Recommended Design

The low cost of tank in the Sumac Hollow division makes this design highly viable. The tank would have 1 MG capacity with an 18" pipe extending to the water main on the corner of Center and 900 E. Advantages of this tank is its close proximity to a main line, it provides more storage redundancy, it would be on land that's ready for future development, and its capability to feed the 0.5 MG and 1.0 MG tanks and the main lines. The image below shows the main components of this design.



Design Comparison

A major concern for Lindon in building a new tank was cost. The table below shows the cost comparison of all the working tank locations and reasons why other locations failed.

TESTS						
Test Locations	Provide Zones	Status	Initial Cost	Yearly Cost	Supplemental Notes	Tested Designs
1) Sumac Hollow	1, 2, 3	Pass	$ 2,282,000	$ 137,900	Inefficient at Low Demands	2
2) Expansion of Tank	1, 2, 3, 4	Pass	$ 2,556,000	$ 137,200	Inefficient at Low Demands	2
3) Oak Canyon J. High	1	Pass	$ 4,414,000	$ 132,800	Inefficient at Low Demands	2
4) City Center Park	1	Pass	$4,346,000	$ 138,100	Requires High Water Tower	4
Murdock Canal Trail Head	1	Fail	N/A	N/A	Pump Failure - Neg Pressure	4
Squaw Hollow Park	1, 2	Fail	N/A	N/A	Pump Failure - Neg Pressure	2
Pioneer Park	1	Fail	N/A	N/A	Insufficient Head	1
Hollow Park	1	Fail	N/A	N/A	Pump Failure - Neg Pressure	4
Fryer Park	1	Fail	N/A	N/A	Feeds N. Area - Pump Failure	2