TECHNICAL MEMORANDUM

DATE: May 7, 2019

TO: Stan Gryzko, City of Davis

FROM: Kambria Tiano, PE, RCE #84129

REVIEWED BY: Jim Connell, PE, RCE #63052

SUBJECT: Evaluation of University Mall Development Water Demands

The purpose of this Technical Memorandum (TM) is to summarize the water demand and hydraulic evaluation performed by West Yost Associates (West Yost) for the proposed changes to the University Mall development within the City of Davis (City). The results from West Yost’s hydraulic evaluation are described in the following sections:

- Proposed Development
- Governing Assumptions
- Estimated Potable Water Demand
- Hydraulic Analysis and Evaluation Results
- Recommendations

PROPOSED DEVELOPMENT

The proposed University Mall development consists of the redevelopment of 8.16 acres of commercial property between Anderson Road, Russell Boulevard, and Sycamore Lane. The project will leave the existing Trader Joe’s in service, along with the Arco Gas Station. Neither of those two businesses are part of the project.

The proposed University Mall development consists of 412,500 square feet (SF) of multi-family residential with 894 dwelling units and 136,800 SF of new commercial development. The existing Trader Joe’s consists of 13,200 SF and will remain. The proposed commercial development includes a mix of retail, restaurants, services and entertainment venues.

Tie-ins to existing water distribution mains are proposed at the existing 12-inch diameter water line in Sycamore Lane (where Trader Joe’s is served), and at the existing 10-inch diameter water line in Anderson Road (where the Arco Gas Station is served). The City’s existing elevated 200,000-gallon potable water storage tank, which regulates pressure in the City water system, is located less than 0.5 miles to the northeast of the University Mall.
GOVERNING ASSUMPTIONS

The design and performance criteria used to evaluate the potable water distribution system capacity to serve the proposed development were taken from the City’s Water Distribution System Optimization Plan, dated May 2011, and the City’s Public Works Design Standards. The City’s potable water performance criteria governing West Yost’s potable water hydraulic evaluation are listed below:

- Fire flow requirements indicate that 3,500 gpm must be supplied to High-Density Residential land uses during maximum day demand conditions with a minimum residual pressure of 20 pounds per square inch (psi). Sprinklered buildings allow for a 50 percent reduction in the required total fire flow, at the Fire Marshal’s discretion.
- Maximum allowed water velocity in pipelines is 10 feet per second (fps).
- Maximum day demand peaking factor equals 2.0 times average day demand.
- Peak hour demand peaking factor equals 1.88 times maximum day demand.1
- Minimum pressure allowed during peak hour demand is 35 psi.

The revised future (2030) demand conditions and system operations were assumed based on: (1) the existing conditions provided in the model; (2) feedback from the City;2 and (3) West Yost’s 2018 hydraulic evaluation of the proposed North Davis Meadows service. The assumed operations governing West Yost’s potable water hydraulic evaluation of the proposed University Mall redevelopment are listed below:

- Surface water supply is fixed at 10.2 million gallons per day (MGD).
- Demands are set to the 2030 maximum day demands, as provided in the model, which represents buildout conditions.
- Davis Deep Wells are energized to balance the maximum day demand. Though well 30 is not intended to be energized in all instances under existing operations, all deep wells except 28 and 29 would be needed to supply the 2030 maximum day demand conditions.
- Fire flow is initially provided by the elevated tank. Once the water level in the elevated tank declines or local pressures in the system fall below a set point, the East Area Tank pumps and the West Area Tank pumps energize to supplement flows from the elevated tank.

1 The peak hour demand peaking factor was based on a maximum hour peaking factor of 1.88 at hour 7, as presented in Table 4-1 of the City’s 2011 Water Distribution System Optimization Plan. This is slightly more conservative than the peak hour demand peaking factor of 1.8 times the maximum day demand, as outlined in the City’s 1991 Public Works Design Standards.

2 City feedback on potable water distribution system operations was provided to West Yost on November 21, 2017, during the hydraulic evaluation of the proposed North Davis Meadows connection.
North Davis Meadows is served by the City potable water system. The North Davis Meadows maximum day demand is approximately 424 gpm.

ESTIMATED POTABLE WATER DEMAND

Average day demands were projected by the developer’s consultant for the proposed residential and commercial components of the University Mall redevelopment. These values were calculated in accordance with the City’s Design Procedures Manual and the USBGC Building Area per Employee by Business Type (dated May 2008) and were provided to West Yost. The existing and proposed site demands are described in the following sections.

Existing Site Maximum Day Demand

The TM provided by the developer estimated the existing site water demands based on the current retail, grocery, restaurant, and medical building land uses on the University Mall project site. The total existing average day demand estimated for the site is 7,170 gallons per day (gpd).

The existing site maximum day demand was estimated by applying a peaking factor of 2.0 to the existing average day demand. The demands provided by the developer total an existing site maximum day demand of 14,340 gpd, or 9.96 gallons per minute (gpm).

Proposed Site Maximum Day Demand

The TM provided by the developer projected the proposed site water demands based on the proposed retail, grocery, restaurant, and multi-family land uses on the University Mall project site. The projected average day residential and commercial demands are 50,958 gpd and 12,420 gpd, respectively, for a total projected average day demand of 63,378 gpd.

The projected site maximum day demand was calculated by applying a peaking factor of 2.0 to the projected average day demand. The demands provided by the developer total a projected site maximum day demand of 126,756 gpd, or 88 gpm.

HYDRAULIC ANALYSIS AND EVALUATION RESULTS

The scope of this analysis involved evaluating the capacity of the existing potable water system under buildout demand conditions to convey the maximum day demand plus fire and peak hour demand conditions associated with the proposed University Mall redevelopment, described in the “Proposed Development” section of this TM.

To simulate the higher water demands associated with the proposed University Mall redevelopment, the existing maximum day demand of 9.96 gpm was replaced by the proposed maximum day demand of 88 gpm at the site location. Existing maximum day demand in the model was globally scaled to peak hour demand by applying the peaking factor of 1.88 times the maximum day demand, resulting in a proposed peak hour demand of 165.4 gpm at the University Mall site.

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An additional connection to the 10-inch diameter water line in Anderson Road was also added in the model based on the project’s proposed site plan provided by the developer. The new 10-inch diameter loop created by the proposed fire water line will include backflow preventers that will prohibit water from flowing through the site (through private water lines) back into the public water system. The model accounted for the backflow preventers by modeling the 10-inch diameter fire water line with check valves at the property boundaries.

**Maximum Day Demand plus Fire Flow**

As described under the “Governing Assumptions” section, fire flow would be initially provided by the elevated tank. Once the water level in the tank declines or local pressures in the system fall below a set point, the East Area Tank pumps and the West Area Tank pumps are energized to supplement flows from the elevated tank and raise pressures in the system. To confirm that fire flow requirements can be met at the University Mall site under both operations, West Yost modeled the following conditions: (1) fire flow provided exclusively by the elevated tank; and (2) fire flow provided by a combination of the elevated tank and the East Area Tank and West Area Tank pumps.

Under the first condition, West Yost modeled the elevated tank at a water level of 28.7 feet, which is 0.2 feet above the set point that turns on Pump 1 at the West Area Tank. Fire flow is provided exclusively by the elevated tank, and system pressures and supply were shown to be capable of serving the required fire flow. The modeled available fire flow at the University Mall site under the first condition is 4,867 gpm, which is above the required fire flow of 3,500 gpm.

Under the second condition, West Yost modeled the elevated tank at a water level of 25.5 feet. This elevated tank water level triggers on Pump 1 at the West Area Tank and Pump 1 and the East Area Tank to supplement the supply, which raises pressures in the system. Additional lower elevated tank levels were modeled, but elevated tank levels less than 25.5 feet triggers additional pumps to turn on at the West Area Tank and East Area Tank, which boosts the system pressures such that an elevated tank level of 25.5 feet is the limiting condition. The modeled available fire flow at the University Mall site under the second condition is 4,805 gpm, which again is above the required fire flow of 3,500 gpm.

Figure 1 displays the fire flow available at the University Mall site under the second, more conservative condition.

**Peak Hour Demand**

Under peak hour demand, the system draws from storage and begins draining the elevated storage tank. To model these conditions, West Yost set the elevated tank water level at 21.5 feet. This elevated tank water level triggers on Pumps 1 through 3 at the West Area Tank and Pumps 1 through 3 at the East Area Tank.

The increase in demands during peak hour conditions decrease pressures systemwide by less than 0.5 psi, and some locations on the southern border of the City’s potable water service area drop just below 35 psi. However, these reduced system pressures may be an artifact of the modeling and may not accurately represent field conditions. There are no identifiable infrastructure improvements that would alleviate the slight drop in pressures across the system.
As shown in Figure 1, system pressures in the vicinity of the University Mall redevelopment project remain above the 35 psi minimum during peak hour demand conditions. The model indicated a peak hour demand pressure of 39.4 psi at the University Mall site.

**RECOMMENDATIONS**

Based on the hydraulic modeling results, additional water demands for the proposed University Mall redevelopment can be accommodated by the existing potable water system infrastructure under buildout demand conditions. The maximum day demand plus fire flow and peak hour demand results, as shown on Figure 1, indicate that the existing potable water pipelines have sufficient capacity to accommodate the increased demands, and no improvements will be required, provided the water system is operated as described above. Differing system operations may produce different results.

The TM provided by the developer references a City Fire Flow test along Russell Boulevard, performed on April 21, 2018, that generated a static pressure of 47 psi and a residual pressure of 42 psi at a total test flow rate of 1,350 gpm. The TM also provides a calculation of 3,356 gpm as the maximum available fire flow at 20 psi. The hydraulic model confirms the City’s fire flow test results and indicates that a fire flow of 1,350 gpm along Russell Boulevard would drop local pressures by 3-5 psi, depending on the fire flow location (greater pressure drops are experienced when the 1,350 gpm fire flow is added to locations on the east end of Russell Boulevard). However, the hydraulic model cannot replicate the calculated maximum available fire flow at 20 psi, and instead yields a residual pressure greater than 30 psi when a 3,500 gpm fire flow is applied along Russell Boulevard, adjacent to the University Mall project site.

Prior to approval of the University Mall redevelopment project, West Yost recommends that the City conduct an additional fire flow test along Russell Boulevard near the existing University Mall to confirm fire flow availability. It is recommended that the additional fire flow test is to be performed at a higher flow rate to increase the localized drop in system pressures, which could be attained by adding a second flowing hydrant. The static and residual pressure measurements would be taken at a non-flowing test hydrant.
Figure 1

Modeling Results

Potable Water Evaluation

City of Davis
University Mall Project
Proposed Redevelopment Project