Chapter 4 - Water Storage

Introduction

This chapter presents information on the City's water storage facilities. The purpose for storage in municipal water systems is discussed. The condition and needs of the City's existing storage reservoirs are outlined, and recommended storage requirements to meet current and 2037 design criteria are presented.

General

Water storage facilities are constructed to serve several purposes. First, storage reservoirs are often used to provide control for well or booster pump system operation. When a reservoir drops a few feet or more from the full level, the water level can be used as a control for well pump or booster pump activation. The amount of storage required for this type of control is called "operating storage." Second, stored water must be available to supply water during periods in which the demand for water exceeds the available water supply. This reserve is called "equalization storage." Third, reserve storage is usually provided to supply unusually high, short-duration demands, such as fire flows. This is referred to as "fire reserve." Finally, reserve storage is also often provided for emergencies that may arise and interfere with production from water supply sources. Such emergencies could be created by power outages, mechanical equipment failure, or sudden water contamination. The amount of storage to be provided for an emergency depends on the likelihood and the impact of such an occurrence. The amount of emergency storage provided usually becomes a balance between what is needed and what can be afforded. This storage allowance is called "emergency reserve."

Storage facilities can be located at approximately the same elevation as the water distribution system. Storage facilities of this type require continuous operation of a booster pump system to maintain distribution system pressure. Storage facilities can also be elevated, in which case the water is stored at an elevation considerably above the distribution system to generate adequate system pressure. For example, a water elevation of 120 feet above a distribution system would be required to generate a distribution system static pressure of approximately 50 pounds per square inch. Reservoirs may be elevated by locating them on natural ground high enough above the service area or by construction on top of a steel support frame.

Storage reservoirs are generally constructed of steel, reinforced concrete, or prestressed concrete. The choice is usually based on an economic analysis made for the particular installation. Reservoirs may be constructed either above or below ground, with the choice based on cost, location, and community acceptance. The remainder of this chapter reviews the City's existing storage facilities and presents a discussion of future storage needs.

Existing Facilities

Reservoir No. 1

The City's water storage consists of three storage reservoirs, two of which are actively used, with a total available storage volume of 1,625,000 gallons. Reservoir No. 1 is a 50,000-gallon elevated steel reservoir constructed in 1920 as part of the original water system. Due to issues with leaks and

structural integrity concerns, this elevated reservoir is no longer used as a part of the City's water system. However, it is the City's desire to rehabilitate the structure and maintain the reservoir as a landmark.

To restore Reservoir No. 1 as a landmark, the City must complete some preliminary analysis. The recommended steps are as follows:

- Hire a qualified structural engineer to assess the current structural condition of the reservoir and determine the required actions and improvements needed to restore the structure.
- Other components of restoration include coating the tank and any aesthetic features the City may choose to incorporate. Due to the tank's age, it is likely the outer paint contains lead. The City will be required to follow regulatory guidelines for removing or covering the lead paint.
- After the required restoration tasks are documented and estimated costs determined, the City will need to pursue funding for the project. Possible funding opportunities may exist based on whether or not the reservoir is considered a historical structure.
- Lastly, the City will need to prepare Bidding and Contract Documents, Plans, and Technical Specifications, to retain the services of a contractor and complete construction of the required structural and aesthetic improvements.

Reservoir No. 2

Reservoir No. 2 is a 625,000-gallon ground-level welded steel storage reservoir constructed in 1976, which was recently recoated as part of the 2013 improvements project. It is located in North Stanfield in the southwest corner of the Stanfield Heights Subdivision. This reservoir is 50 feet in height and has a diameter of 46.5 feet. The full water level in Reservoir No. 2 is at an elevation of approximately 700 feet above mean sea level. Reservoir No. 2 is filled by water either from Reservoir No. 3 via the South Stanfield booster pump station or by Well No. 4. Water from the reservoir is then pumped by the North Stanfield booster pump station into the distribution system. The North Stanfield booster pump station supplies water to the Stanfield Secondary School and the Stanfield Heights, Vantage North, and Panoramic Ridge Subdivisions.

Reservoir No. 3

Reservoir No. 3 is a 1,000,000-gallon ground-level welded steel storage reservoir constructed in 2014. This reservoir is located in South Stanfield near the Pilot Travel Center. The reservoir is 43 feet tall and has a diameter of 66 feet. Water from Well No. 5 and the Pilot Well is used to fill Reservoir No. 3. Water from Reservoir No. 3 is provided to the distribution system via the booster pump station located adjacent to the reservoir (South Stanfield booster pump station).

Storage Requirements

Water storage is usually provided for several purposes. Various methods are used to calculate the volumes of each type of storage component required. Most involve a rational approach to estimating the volume of each storage component consisting of operation, equalization, fire reserve, and emergency. The decision can then be made as to which component controls and storage volumes will

actually be necessary. For example, the decision may be made to provide storage for operating, equalization, and fire reserve only, assuming any emergency storage would be available from the fire reserve. If this option were selected, there may not be adequate fire storage available if there is a sustained power outage or if a well pump is out of service. For this reason, it is recommended that all four of the storage components listed below be considered when evaluating the City's potential storage needs.

Operating Storage

Operating storage is generally provided to facilitate operation of wells or booster pumps in a water system. For example, when water system demands result in the water level lowering in a reservoir, the water level will reach a certain point that can be used to trigger activation of well pumps to refill the reservoir. The storage needed to activate water supply sources is typically referred to as operating storage. This zone of operation can be set as desired but is often set to help ensure circulation occurs during each pump run cycle, allowing water to cycle through the reservoir to help maintain water quality while keeping the reservoir as full as possible.

Pumping is currently set to begin operation when the water level of the Reservoir No. 2 reaches 33.2 feet and to cease operation when the reservoir water level reaches 36 feet. A drop of 2.8 feet in the Reservoir No. 2 level would result in an existing operating storage of approximately 36,000 gallons. During operation of the South Stanfield booster pump station, Reservoir No. 3 operates between 40 feet and 45 feet. This results in another 64,000 gallons of operating storage, for a total of approximately 100,000 gallons.

Equalization Storage

Equalization storage must be provided to balance the difference between peak hourly demand and water supply capacity during a peak day demand period. An empirical method for estimating the required equalization storage uses the difference between the peak hourly flow and the water supply availability for a specific number of peak hours per day. Based on providing the current estimated peak hourly flow of 2,450 gallons per minute (gpm) for two and a half hours and using the current supply of 2,150 gpm available, equalization storage of approximately 45,000 gallons is currently required. Based on the year 2037 estimated peak hourly flow of approximately 2,580 gpm for two and a half hours, the City's year 2037 equalization storage needs to be approximately 64,500 gallons.

Fire Reserve

Reserve storage for fire suppression is usually determined from either Insurance Services Office, Inc. (ISO) recommended fire flow or the fire flow recommended by the City's fire chief. Based on the typical maximum fire flow recommended by ISO, a 3,500 gpm fire flow with a two-hour duration has been set as the design fire flow for the City. A total of 420,000 gallons of fire reserve storage is needed to sustain a fire flow of 3,500 gpm for a two-hour duration.

Emergency Reserve

Emergency storage is usually provided for a minimum of one to three days' supply in the event of a power outage, mechanical problems, or other problems that would interrupt the reliable supply of water. In most cases, this would be the minimum amount of time to repair or replace a well pump

or other equipment. To serve the City for a full day at the average daily demand, approximately 585,800 gallons would be needed for existing emergency reserve and approximately 619,300 gallons would be needed for the year 2037.

Storage Requirements Summary

Totaling the four storage components described herein indicates a total of approximately 1,150,800 gallons of storage is needed to meet current demands, and 1,203,800 gallons of storage is needed to meet the year 2037 design criteria. Currently, the City's storage capacity meets the total recommended current and future required storage for operating storage, equalization storage, fire reserve, and emergency reserve.

Summary

The City currently has two operating storage reservoirs, the 625,000-gallon ground-level reservoir (Reservoir No. 2) and a 1,000,000-gallon ground-level reservoir (Reservoir No. 3). The needed storage for the 2037 design population is approximately 1,150,800 gallons. The current storage volume is adequate to meet these projected requirements. The conditions of both reservoirs are also adequate for the 20-year planning period. Currently, there are no recommendations to increase or make changes to the current storage available to the City's water system. To maintain Reservoir No. 1 as a landmark, it is recommended the City retain the services of a licensed structural engineer to address structural improvements needed, as well as coat and maintain the current structure.