
MEMORANDUM

TO: Jason Eichler, P.E., Lower Colorado River Authority
FROM: David Allen, P.E.
SUBJECT: Glenlake Water System Evaluation - Update
DATE: 12/8/02
CC: Jeff Crawford, P.E.

Executive Summary

Baker-Aicklen and Associates, Inc. (BA) is pleased to present this report for the Glenlake Water System Evaluation. The Glenlake system serves Glenlake and the Westminster Glen Subdivision. The system currently receives all of its water from River Place M.U.D. One of the primary purposes of this evaluation was to determine the required storage volume to meet peak hour demand for the Glenlake service area. In this regard, BA was requested to assess the impact of delivery rates from River Place M.U.D of 1.3, 1.5, 1.7, and 2.0 gpm/connection. Other issues that were evaluated included: (1) the elimination of wide variations in system pressures due to operation of existing control valve on High Gate; (2) the elimination of the existing hydro-pneumatic tank; (3) use of existing high service pumps and ground storage to supplement flows during peak periods; and, (4) elimination of high system pressures.

The results for the primary task are summarized in Table 1. Note, the elevated tank volumes are based upon the nearest available standard tank volume. Included are preliminary

	Flow From River Place (gpm/connection)				
	1.3 gpm	1.3 gpm	1.5 gpm	1.7 gpm	2.0 gpm
Required Capacity (gal) *	318,000	318,000	234,000	189,000	126,000
Elevated Storage					
Capacity (gal)	400,000	300,000	250,000	200,000	150,000
Cost	\$441,000	\$374,000	\$346,000	\$316,000	\$277,000
Ground Storage					
Total Capacity (gal)	636,000	600,000	343,675	321,145	219,952
Effective Capacity (gal)	318,000	300,000	238,000	189,000	126,000
Cost	\$306,000	\$297,000	\$264,000	\$239,000	\$206,000

opinions of probable costs for ground and elevated tanks to provide the required storage. It must be noted that historical water consumption data indicate the maximum day flow is between 1.4 and 1.5 gpm/connection. *Because the historical maximum day flow exceeds the lowest delivery*

rate evaluated from River Place (1.3 gpm/connection), either conservation measures that will reduce overall water consumption by approximately 15 % (i.e., from 1.45 gpm/connection to 1.3 gpm/connection) will require implementation or a supplemental source of water will be required.

The required effective (useable) storage ranged from 318,000 gallons based upon a delivery rate of 1.3 gpm/connection to 126,000 gallons based upon a delivery rate of 2.0 gpm/connection. Resulting capital costs not including engineering, surveying and contingencies ranged from \$206,000 for the 126,000-gallon ground storage tank (effective volume) to over \$441,000 for the elevated storage tank. Because elevated storage is not readily available in an intermediate capacity (i.e., between 300,000 and 400,000 gallons), the costs for a 300,000 gallon elevated tank are also shown. Results from the model run indicate a 300,000 gallon tank will provide sufficient storage to furnish the systems needs for approximately a 45 hour period using the algorithm developed by LCRA staff for the Glenlake water system demand.

In our opinion, construction of a large ground storage tank, although less costly than an elevated tank, presents the risk of developing water quality problems due to long turnover times in the tank. This may be exacerbated in during the majority of the year when the demands are much less. If the available flow rate from River Place is limited to 1.3 gpm/connection, we recommend installation of the elevated tank. Should higher flow rates be available, the decision on whether to construct an elevated versus ground tank should be investigated further.

The results of this investigation regarding the remaining issues may be summarized as follows:

- Elimination of the large pressure variations in the system can be accomplished through the installation of a pressure reducing valve at the intersection of High Gate and Westminster Glen. A dual action, pressure reducing valve/rate of flow controller can be installed to control downstream pressures and limit the flow received from River Place. The cost for a 6-inch valve is approximately \$7,500 if it can be installed in the existing valve box.
- The existing hydropneumatic tank cannot be eliminated without producing excessive system pressures (greater than 115 psig) in a major portion of the distribution system. BA therefore recommends continuing to operate the existing pressure tank.
- Use of the existing high service pumps to supplement peak hour demands is possible, although, operationally, it will be a challenge to implement. For the time being, we do not recommend pursuing this option. However, this could remain an option in the future should system demand continue to minimally exceed what is available from River Place.
- High pressures in the system can be eliminated by implementing the pressure reducing valve in the supply line from River Place as previously indicated. Additionally, based upon an operating HGL of 1010 ft m.s.l., a pressure reducing station will need to be installed near the intersection of Turkey Creek and Glenlake Drive. The estimated capital cost for the pressure reducing station is approximately \$11,500.

A summary of our opinion of probable costs for all improvements at each of the alternative flow rates is presented in Table 2. Costs include a 35 % allowance for engineering, surveying, and contingencies. The costs range from \$328,000 for a 126,000-gallon ground storage tank (effective volume required for River Place delivery of 2.0 gpm/connection) to \$645,000 for a 400,000 gallon elevated storage tank (effective volume required for a River Place

delivery rate of 1.3 gpm/connection). A 300,000 gallon elevated tank with associated improvements is \$555,000. The final selection of the required tank capacity and the decision to use either ground or elevated will be dependent upon the available delivery rate from River Place.

Effective Volume	400,000	300,000	234,000	189,000	126,000
Ground		\$451,000	\$406,000	\$373,000	\$328,000
Elevated	\$645,000	\$555,000	\$517,000	\$477,000	\$424,000

Includes 35 % allowance for engineering, surveying, and contingencies.

Background

The Glenlake Water System was acquired by the LCRA approximately 2 years ago. At the time of the acquisition, Glenlake was operating a small water treatment plant and receiving supplemental water from River Place M.U.D. When the LCRA acquired the Glenlake system, LCRA assumed two existing agreements with River Place that provided for River Place M.U.D. furnishing a maximum of 0.784 mgd.

The existing Glenlake water treatment plant is approximately 25 years old, with some of the unit processes showing a lot of wear, such as the filter vessels on which a number of corrosion tubercles are present. Because of the age of the units and the ever-increasing drinking water regulations, the LCRA elected to cease operating this facility and purchase the systems water needs wholesale from River Place.

The existing Glenlake system actually contains three pressure planes. The upper pressure plane is located upstream of the existing flow control valve and floats on the existing River Place elevated storage tank. The middle pressure plane serves approximately 15 lots near the existing Glenlake ground storage tank. The lower pressure plane, which serves the majority of the system, is operated off the ground storage tank that has an overflow of approximately 979 ft m.s.l.

The existing flow control valve located near High Gate and Westminster Glen is actuated off the level in the ground storage tank. When the level drops approximately 1 foot, a signal is sent to open the control valve. When the level rises to 979 ft m.s.l., the valve is closed. When the flow control valve is open, the entire system (with the exception of the 15 lots served by the hydro-pneumatic tank) is exposed to the River Place 1198 HGL (less pressure loss across the flow control valve); when the valve is closed the system operates at 979 HGL. This results in large fluctuations in pressure for the majority of the water system.

One further problem with the system is the marginal pressures that are present at a couple of high points. Most severely affected is at the intersection of Westminster Glen and City Park Road where the pressure with the Glenlake storage tank full is 35 psig.

Baker-Aicklen & Associates, Inc. was retained by the LCRA to evaluate alternatives to correct these deficiencies. Specifically, our scope for this project included the following major tasks:

1. Run the Glenlake Water Model to evaluate the storage required to meet peak hour demand at four different delivery rates from River Place Municipal Utility District (M.U.D.).

2. Evaluate alternatives required to eliminate wide swings in system pressure.
3. Evaluate elimination of the hydropneumatic tank and booster pumping system.
4. Investigate the feasibility of utilizing the existing high service pump station located at the Glenlake water treatment plant.
5. Provide recommendations for eliminating high pressures.

Results of this investigation are discussed in the following sections.

Methodology

In order to accomplish this, BA ran the water model for the Glenlake system and inserted a rate of flow control valve into the delivery line from River Place M.U.D. Currently, the system has a control valve located near the intersection of High Gate Road and Westminster Glen; however, this valve is open/close only and thus, does not control the flow to a preset rate. Due to this configuration, the Glenlake system experiences large variations in system pressures; when the valve opens, downstream users are exposed to the 1198 hydraulic grade line (HGL) from the River Place storage tank; when the valve closes, the system operates off the Glenlake storage tank HGL which is approximately 979 ft m.s.l.

BA was requested to assess the required storage volumes for four different delivery rates from River Place M.U.D; 1.3 gpm/connection; 1.5 gpm/connection; 1.7 gpm/connection; and 2.0 gpm/connection. For the purposes of this simulation, it was assumed that the 43 houses upstream of the existing flow control valve would continue to be served off the River Place pressure plane, i.e., 1198 HGL.

The set value for the rate of flow controller was determined by subtracting these 43 lots from the total planned buildout of 416 lots and multiplying by the unit flow rate. For example, to model the 1.3 gpm/connection delivery rate, the rate of flow controller was set as follows:

$$\text{ROF Controller Flow Rate} = [(416-43)*1.3] = 485 \text{ gpm}$$

The resulting delivery rates from River Place M.U.D. are summarized in Table 1.

Table 1 – Glenlake Storage Required To Supply Peak Hour Demands

Delivery Rate (gpm/con.)	1.3	1.5	1.7	2
Delivery Rate (gpm)	485	560	634	746

Storage Requirements to Meet Peak Hour Demand

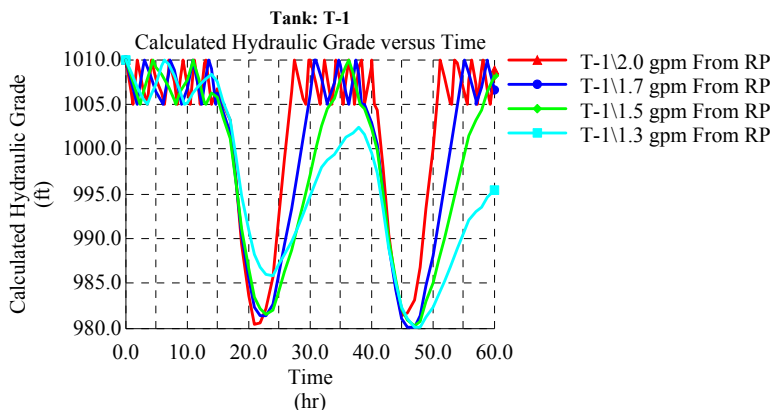
The intent of this effort was to determine the required storage volume to meet peak hour demands at four different delivery rates from River Place. Storage tank reports generated by WCAD® are included as an attachment to this memorandum. The method used to size the tank was to run an extended period simulation over a total of 60 hours with the diurnal usage pattern developed by LCRA staff. This pattern was developed from actual data collected from the Glenlake system.

It was assumed that the proposed tank would operate over a 30-foot range with a maximum water level of 1010 ft m.s.l. This elevation was chosen because it was considered the minimum level necessary to ensure adequate pressures over the tank operating range at the intersection of Westminster Glen and City Park Road. The tank volume was the minimum volume that could satisfy peak hour flows without falling below the 980 HGL set as the minimum operating level.

The model was run with a flow control valve and a pressure reducing valve. The flow control valve was used to throttle the flow to a maximum delivery rate based upon the unit delivery rate being evaluated, i.e., 1.3, 1.5, 1.7, or 2.0 gpm/connection. The downstream HGL of the pressure reducing valve was set at 10 ft above the maximum tank operating level or 1020. This ensured proper operation of the flow control valve. The line supplying Glenlake from River Place was opened when the tank level fell to 1005 ft m.s.l. and closed when the tank level rose to 1010 ft m.s.l.

The required volumes for the various flow rates were as indicated in Table 1. The volumes ranged from a minimum of 126,000 gallons based upon a 2.0 gpm/connection delivery rate to 318,000 gallons based upon 1.3 gpm/connection delivery rate. A graph illustrating the fluctuation in HGL over the extended period simulation is shown in Figure 1. The fluctuation in HGL between 1005 and 1010 is the result of the valve opening and closing.

Figure 1



Close inspection of the graph indicates that even with the a tank volume of 318,000 gallons for the 1.3 gpm/connection delivery rate from River Place, the tank is not able to be refilled over the 60-hour period. The reason for this is that the modeled maximum day flow is approximately 1.46 gpm/connection, which exceeds the 1.3 gpm/connection delivery rate. From the available data and analyses performed by LCRA staff, it appears that the 1.46 gpm/connection is a realistic unit consumption for the subdivision. This being the case, either the existing agreement(s) with River Place need to be revised to provide additional water or effective water conservation measures must be implemented to reduce the resident's water consumption.

Elimination of Wide Swings in System Pressure

Wide swings in system pressure were the result of exposing the system to the River Place HGL of 1198 when the flow control valve on High Gate was open to fill the ground storage tank. Our recommendation for both eliminating these wide swings and controlling the flow from River Place is to install a dual function valve such as a Cla-Val™ which can function both as a pressure reducing valve (PRV) and a rate of flow controller. To ensure the delivery rate is maximized over the full operating range of the PRV, we recommend that the downstream set pressure of the PRV be 10 feet above the HGL of the proposed storage tank, or 1020. The orifice plate for the rate of flow controller can then be sized to provide 10 feet of headloss at the design delivery point, effectively producing an HGL downstream of the rate of flow controller at the maximum

tank operating level, or 1010. These valves can be field adjusted to ensure efficient operation and compensate for line losses between the rate of flow controller and storage tank as necessary.

Elimination of the Hydro-pneumatic Tank

The existing hydro-pneumatic tank serves approximately 15 lots located at the highest elevations in the Glenlake subdivision. The existing tank has a volume of 10,000 gallons and service pumps rated at approximately 32 gpm. Elimination of this system would require that the proposed tank maximum operating level be raised approximately 35 feet to provide a minimum pressure of 35 psig. This significantly increases the cost of the tank and results in the over-pressuring (i.e., > 115 psig) of a major portion of the subdivision. The system currently functions satisfactorily, therefore, we do not recommend eliminating the existing tank. It should be noted that the existing hydro-pneumatic tank is significantly oversized. Should it require replacement in the future, it is likely that a tank with a volume of as little as 750 gallons would perform satisfactorily.

Investigate the Feasibility of Using Existing High Service Pumps at the Glenlake Water Treatment Plant

The existing high service pumps at the water treatment plant are rated at 250 gpm at 250 ft total dynamic head. The ground elevation at the plant is approximately 794 ft m.s.l. and the pumps take suction from a 55,000 gallon clearwell. Although technically feasible to use these pumps and clearwell to offset the storage required to meet peak hourly demand, in our opinion, not only the cost of the controls required to integrate these existing facilities into the overall system, but also the resulting increase in system operating complexity, and the age of the existing equipment make this option undesirable. We recommend against pursuing this option.

Elimination of High System Pressures

In order to evaluate high pressures in the system at the proposed maximum operating level of the tank, 1010 ft m.s.l., the Glenlake water model was run at zero demand. The resulting pressures and our proposed recommendations are illustrated on Figure 2. Inspection of Figure 2 indicates two primary areas where pressures will exceed the LCRA maximum design pressure of 115 psig. There are approximately 20 homes in Westminster Glen at the end of Muddy Ridge View which exceed this criteria, although, these lots float on the River Place HGL of 1198. Unless there have been complaints of high pressure from the affected residents, we would not recommend installing a pressure reducing valve(s). An alternative for these residents is the installation of PRV's on the customer side of the meter.

The other area where pressures exceed 115 psig is on Turkey Creek Drive, south of Glenlake Drive in the vicinity of Junctions 2, 3, and 8 in the water model. The highest pressure observed was approximately 140 psig at Junction 8. This can be corrected by installing dual pressure reducing valves either at the intersection of Ranch Creek Drive and Glenlake or Turkey Creek Drive and Glenlake. We recommend the installation of a normally closed gate valve at either end of this loop. The dual pressure reducing valves are required to provide for normal flow through the small PRV, and higher flows, such as fire flow, through the larger PRV. A pressure relief valve is required downstream of the PRVs to relieve any excess pressure transmitted through the PRVs as they close. We also recommend locating the normally closed gate valve close to an existing fire hydrant, if possible, to allow flushing of the line. If this is not possible, we recommend installing a flushing valve at this location. It should be noted that the dual PRVs provide redundancy to the system; ensuring backup is available when either is removed for maintenance.

Summary of Recommendations

The results of this evaluation lead us to make the following recommendations:

1. Install a new storage ground storage tank with a maximum operating level of 1010 ft m.s.l. The volume of this storage tank will be determined after further negotiations with River Place to determine a mutually agreeable delivery rate and associated details, such as the cost of water.
2. Install a combination rate of flow and pressure reducing valve at the location of the existing flow control valve. The proposed valve should not be oversized. We recommend installation of a 6-inch valve.
3. Use the existing SCADA system to operate the valve based upon the proposed tank maximum operating level. A five-foot drop in the tank level will ensure there is sufficient water in the tank to meet peak hourly demands.
4. Install a solenoid controlled altitude valve in the fill line to the proposed tank.
5. Install a pressure reducing station near either the intersection of Ranch Creek Drive and Glenlake Drive or Turkey Creek and Glenlake. Install a normally closed gate valve with flush valve (if necessary) at the intersection (either Ranch Creek or Turkey Creek and Glenlake) that does not have the pressure reducing station.

Preliminary Opinion of Probable Costs

The opinions of probable construction costs for the range of storage tank volumes recommended and controls are summarized in the Tables 3 and 4 below.

Table 3 - Preliminary Opinion of Probable Construction Cost Reservoirs

Effective Volume	400,000	300,000	234,000	189,000	126,000
Ground Storage Tank		\$297,000	\$264,000	\$239,000	\$206,000
Elevated Storage Tank	\$441,000	\$374,000	\$346,000	\$316,000	\$277,000

Table 4 - Preliminary Opinion of Probable Construction Cost Equipment

Rate of Flow Controller*	\$7,500
Altitude Valve	\$8,500
Pressure Control Assembly	\$11,500
8" Gate Valve	\$1,600
Level Controls	\$3,500
SCADA Modifications**	\$4,000
Total Equipment	\$36,600

* Cost assumes we can use existing valve vault

** This is an allowance, costs indeterminable at this point.

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WATER MODEL RESULTS