ALAFAYA UTILITIES WWTF
RECLAIMED WATER DISTRIBUTIOIN MODEL

FOR:

ALAFAYA UTILITIES, INC.
200 WEATHERSFIELD AVENUE
ALTAMONTE SPRINGS, FL 32714

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EXISTING CONDITIONS

Alafaya Utilities, Inc. owns and operates a wastewater treatment facility (WWTF) in southern Seminole County, with a permitted annual average daily flow (AADF) of 2.4 MGD. The service area is comprised of approximately 1,100 acres of developable land.

The facility treats its raw wastewater with two (2) ring steel package plants. The treatment process is performed by aeration, clarification, filtration, and disinfection. The finished product is reclaimed quality water used for irrigation by several communities and a golf course. The reclaimed water is stored in a 1.5 MG ground storage tank and pumped out by two (2) high service distribution pumps. The pumps have a design capacity of 800 gpm at 160 TDH each for a total capacity of 1,600 gpm (2.304 MGD).

The current subdivisions receiving reclaimed water from Alafaya Utilities are the Sanctuary, Live Oak, Waverlee Woods, and Ekana Green. The plant also provides reclaimed water to Twin Rivers Golf Course through a 10-inch reclaimed water main. The existing 10-inch reclaimed water main exiting the plant is proposed to be increased to a 20-inch reclaimed water main. In the future models, this 20-inch reclaimed main was used in the modeling process. The historic reclaimed flows used for this analysis can be viewed in Table 1.

Table 1: Historic Reclaimed Water Flows

ALAFAYA HISTORIC RECLAIMED WATER FLOWS			
Date	Flow (MGD)	Connections	Per Connection Demand
May-04	0.595	425	1400
Jun-04	0.488	479	1019
Jul-04	0.427	525	813
Aug-04	0.208	551	377
Sep-04	0.242	574	422
Oct-04	0.407	597	682
Nov-04	0.558	621	899
Dec-04	0.488	640	763
Jan-05	0.505	650	777
Feb-05	0.509	678	751
Mar-05	0.422	715	590
Apr-05	0.624	758	823
Average	0.456	-	**776**

A seen in Table 1, the average per connection reclaimed demand is 776 gallons per day (gpd). However, a per connection reclaimed demand of **800** gpd was utilized for a conservative analysis. Several peaking factors were utilized in the modeling process. A peaking factor of 3 assumes an irrigation period of 8 hours, best case scenario. A peaking factor of 4 assumes an irrigation period of 6 hours. A peaking factor of 5 assumes an irrigation period of 4.8 hours, while a peaking factor of 6 assumes a 4 hour irrigation time. Any peaking factor above 3 places the distribution system in a worst case scenario.

A higher peaking factor assumes more connections are irrigating at once, which may decrease system pressures. Typically, a distribution system will see an increasing peaking factor in drought conditions.

METHIDOLOGY

Hydraulic models are used as tools in planning water system improvements or modifications. Typically, hydraulic models utilize the following activities in the planning process:

- Assign water demands to existing or proposed water distribution systems.
- Provide hydraulic calculations that are used to determine pressures based on specified demands.
- Sum the demands in a service area to determine the required water plant capacities and high service pumping requirements.
- Analyze alternative future configurations or interconnections to improve the distribution system in order to meet peak demand conditions.

The WaterCAD model used in this planning effort. WaterCAD works in a Windows interactive format and allows graphical representation of the hydraulic system by manual construction. Data is contained within the WaterCAD file and viewed through the Model Control Center (MCC). WaterCAD is limited to the number of pipes purchased with the software. Output options include computer-generated reports, color coded graphics, and pressure contours.
The basic elements of the hydraulic model are pipe and nodes. A junction node is where two or more pipes meet. Flows entering and leaving the junction nodes are called demands. Pressure is calculated only for the junction nodes with elevations specified as input. A boundary node is a point where the hydraulic grade is known. The boundary node serves as a connection to a storage tank, static node, or a known pressure source discharge point.

WaterCAD also models the operation of pumps based on head vs. flow data, as specified by the pump manufacturer or by recent pump tests. With the input of appropriate data the model can be run as Steady State, a "snapshot" condition with set demands, or Extended Period, based on time variant demands. The Extended Period simulation can be used to model chlorine or contaminant concentrations throughout the distribution system.

WaterCAD input consists of a network of pipes, nodes and pumps. Necessary inputs include demands, junction elevations, pump curves, and pipe diameters. Default system settings that must be determined include: the pipe friction method and constant; kinematic viscosity; flow units; maximum number of trials; relative accuracy; and specific gravity of the fluid.

MODELED SCENARIOS

This report analyzes the reclaimed water distribution system for the Alafaya WWTF. Two models were constructed to analyze the distribution system under different flow conditions. The first model analyzes the system under the current flow condition at varying peaking factors. The second model analyzes the distribution system under its anticipated future flow conditions at varying peaking factors.

CURRENT CONDITIONS

As of May 2005, there are 758 reclaimed connections. The majority of these connections are in the Sanctuary and Live Oak subdivisions. Unfortunately, there is no way to determine the location of every connection. Therefore, it is assumed that 80 percent of the reclaimed connections are in the Sanctuary and Live Oak subdivisions. The other 20 percent were placed in the Waverlee Woods and Ekana Green subdivisions. It was also assumed in the model that the plant does not provide reclaimed water to the golf course during irrigation periods. The model was constructed to analyze the current conditions of the reclaimed distribution system using several peaking factors. The first model analyzes the system with a peaking factor of 3. As previously mentioned a peaking factor of 3 assumes an 8 hour irrigation period. This demand is equivalent to 50% of the users irrigating during a 4 hour irrigation cycle. When a majority of the residents adhere to the St. Johns River Water Management District (SJRWMD) watering restrictions a peaking factor of 3 is a more accurate representation.

Figure 1, demonstrates the distribution system when it is experiencing a peaking factor of 3. The pressure range is illustrated through contours. Pressures 20 psi and below are represented by *red* contour lines. Pressures between 20 and 50 psi are represented by *green* contour lines, while pressures greater than 50 psi are represented by *magenta* contour lines. As detailed in Figure 1 the distribution system should not experience any pressure concerns under a peaking factor of 3. However, the Utility placed pressure chart recorders throughout Live Oak Phases 2 and 3. These chart recorders illustrate that both Live Oak Phases 2 and 3 experience low pressures during peak conditions. Comparing this model to the pressure chart recorders, it can be safe to assume that more than 50% of the residents are irrigating at the same time, which would increase the system peaking factor.

However, another concern is the pipe velocities through the reclaimed mains. The higher the pipe velocity becomes, the more friction loss through the pipe. This occurs in the 10-inch main exiting the plant and the 6-inch reclaimed water main entering the Live Oak subdivision. At a peaking factor of 3 both mains operate at approximately 5.5 fps. However, as the irrigation demand increases the velocities through these mains will increase as well.

The second scenario analyzes the system under a peaking factor of 4. This peaking factor generates a per connection demand of 3,200 gpd. At 758 connections, the total demand becomes 2.426 MGD. As demonstrated in Figure 3, Live Oak Phases 2 and 3 experience

low pressures when the system experiences a peaking factor of 4. The readings from the pressure chart recorders and this model appear to be very similar. In peak demand periods, the model and the pressure recorders illustrate low pressure conditions. Therefore, it is safe to assume that the system operates approximately at a peaking factor of 4 and more than 50% of the residents are irrigating at the same time.

This model also illustrates the velocity concerns in the aforementioned reclaimed mains. The velocity in the 10-inch main exiting the plant increases to approximately 7 fps, while the entire 6-inch main through Live Oak into Phase 3 operates above 6 fps. The 10-inch main exiting the plant is planned to be increased to a 20-inch reclaimed main, which would alleviate the velocity concerns through that main. As the irrigation demand increases and Phases 4 and 5 begin to connect to the system, the velocity though the 6-inch will continue to increase.

The final scenario analyzed the system under a peaking factor of 6. A peaking factor of 6 assumes a worst case scenario for the distribution system, because 100% of the residents are irrigating at the same time. When this peaking factor is applied to the historic demands, it generates a per connection flow of 4,800 gpd or 3.638 MGD total. According to the model, when the system experiences a 6 peaking factor, the entire system operates below 20 psi. Figure 4 illustrates this scenario.

FUTURE CONDITIONS

A separate model was constructed to analyze the system under its anticipated future condition. This model assumed every subdivision would be 100% connected to the system. The subdivisions are Sanctuary, Live Oak (all phases), Waverlee Woods, Ekana Green, Twin Rivers, Little Creek, and Oviedo Forest. Combined these seven (7) subdivisions generate approximately 2,650 connections. This yields an average flow of approximately 2.12 MGD.

In order to meet the future demands the Utility will have to make some anticipated modifications to their existing pumping distribution system and storage. The Utility has the capability to add a second 1.5 MG storage tank and three (3) additional distribution pumps. These anticipated modifications were assumed in the future model. As previously mentioned the 10-inch reclaimed main exiting the plant is scheduled to be increased to a 20-inch. The future model was constructed to show this anticipated improvement.

The first model analyzed the system under a peaking factor of 3. As previously mentioned, a peaking factor of 3 assumes an 8 hour irrigation period and 50% of the residents are irrigating at once. At 2,650 connections and assuming a peaking factor of 3, the irrigation demand generated is 6.36 MGD. This calculated demand assumes an 800 gpd per connection rate. Figure 5 demonstrates the pressure ranges generated from this model. As demonstrated in the figure, the entire Live Oak subdivision operates below 20 psi. Also the 6-inch main from the entrance of Live Oak leading into phase 3 operates above 9 fps.

The second model analyzed the system at a peaking factor of 4 (existing conditions), Figure 6 illustrates the results. As demonstrated in Figure 5, the entire distribution system operates above 20 psi except for the Live Oak subdivision. At 2,650 connections, the anticipated flow is 8.48 MGD (3,200 gpd per connection).

The third model analyzed the system under a peaking factor of 6. As previously mentioned a peaking factor of 6 would place the distribution system in its worst case scenario. This peaking factor assumes that 100% of the residents are irrigating at one time in a 4 hour period. A peaking of 6 should generate an irrigation demand of 12.72 MGD. According to the model the entire system would operate below 20 psi. However, it is anticipated that the system will be interconnected with the Iron Bridge WWTF and possibly Chuluota Utilities in the future. These interconnects will assist the Alafaya plant in meeting these high peaks.

RECOMMENDATIONS

A third model was constructed to determine the necessary recommendations to alleviate the pressure concerns in Live Oak. Live Oak currently experiences pressure problems and would have significant pressure concerns in the future if some modifications are not made to the reclaimed piping infrastructure. The future model was used to determine what modifications are necessary since the final phases (4 & 5) for Live Oak are planned for construction.

The model was analyzed under a system peaking factor of 3. As previously mentioned a peaking factor of 3 generates a system irrigation demand of 6.36 MGD, assuming everyone is connected. According to the model, a 12-inch reclaimed main from the west entrance of Sanctuary to the east entrance of Live Oak should alleviate all pressure concerns in the Live Oak subdivision. This loop will allow more reclaimed water to enter into the Live Oak subdivision, therefore increasing the system pressure throughout. Figure 7 demonstrates the increased pressures throughout the Live Oak subdivision. This 12-inch main would be approximately 4,000 feet in length and cost approximately $150,000.00 to construct.

When this model is analyzed under a peaking factor of 4, the southern portions of Live Oak operates below 20 psi. Figure 8 demonstrates the pressures through the distribution system. According to the model, this issue could be resolved by increasing the proposed 8-inch reclaimed main through phases 4 and 5 to a 10-inch reclaimed main. This modification would allow the Alafaya plant alone to meet the anticipated future demands at a peaking factor of 4.

CONCLUSIONS

Currently, the Alafaya WWTF provides reclaimed quality water to approximately 758 residential customers and the Twin Rivers Golf Course. The reclaimed water is stored in a 1.5 MG ground storage tank and delivered into the system by two (2) 800 gpm high service pumps. The reclaimed demands were analyzed from May 2004 to April 2005. It

was determined that the system maintains a per connection demand of approximately 800 gpd.

The distribution system was constructed in WaterCAD to analyze the current and anticipated future conditions. The current model analyzed the distribution system under varying peaking factors, 3, 4, and 6. In the current model the only subdivisions connected to the system are Sanctuary, Live Oak (phases 1, 2, and 3), Ekana Green, and Waverlee Woods. Currently, the WWTF also provides reclaimed water to the Twin Rivers Golf Course (0.200 MGD on average). However, this demand was not applied to the model since the Utility has the ability to fill the golf course storage pond during non-peak periods.

Currently, a peaking factor of 3 places no strain on the distribution system. The only concern is the existing 10-inch main exiting the plant and the 6-inch main entering Live Oak. The model shows these mains operating above 5 fps. When the model was analyzed under a peaking factor of 4, the model illustrates low pressures in Live Oak Phases 2 and 3, similar to what the pressure chart recorders show. Also the velocities in the aforementioned mains increase to approximately 7 fps. A worst case scenario (peaking factor of 6) makes the system inoperable. The model constructed to analyze the system under a peaking factor of 6 places the entire distribution system under pressures of 20 psi.

The distribution system was also analyzed under the anticipated future conditions. The future model analyzed every subdivision anticipated to connect to the reclaimed distribution system. These subdivisions include the current ones as well as Twin Rivers, Little Creek, Oviedo Forest, and Live Oak Phases 4 and 5. Combined these seven (7) subdivisions could potentially generate 2,650 irrigation connections (2.12 MGD on average).

When the future model was analyzed under a peaking factor of 3, the Alafaya plant alone can provide sufficient pressures throughout a majority of the service area. The only portion of the distribution system that operates below 20 psi is Live Oak. This is due to insufficient main sizes through the subdivision. By installing a 12-inch loop into the back of Live Oak should alleviate all the pressure concerns throughout the subdivision. This 12-inch loop will allow the Utility to meet the future conditions at a peaking factor of 3 in Live Oak without any assistance from other utilities. However, this 12-inch loop will not allow the Alafaya Utilities to meet higher peaking factors.

The future model was also analyzed under a peaking factor of 4, assuming the 12-inch loop was constructed. In this model the southern portion of Live Oak (phase 3) operates below 20 psi. This could be alleviated by constructing two (2) parallel main at both entrances of Live Oak.

When the future model was analyzed at a peaking factor of 6, the entire distribution system operates below pressures of 20 psi. This peaking factor generates an irrigation demand of 12.72 MGD. However, by the time all the subdivisions connect to the system, the Utility should have a reclaimed water interconnect with the Iron Bridge WWTF and

possibly Chuluota Utilities. These two connections will help maintain adequate pressures throughout by allowing the system to operate at higher peaking factor.

FIGURES