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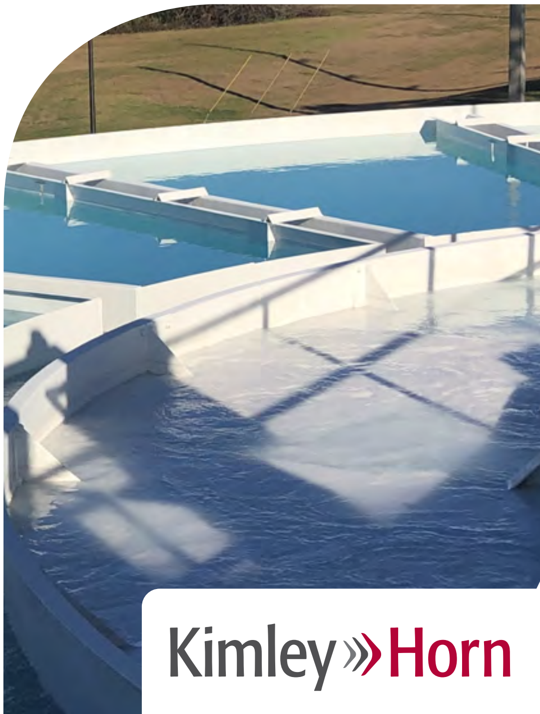
Water Resource Plan

Volume II: Water



Kimley»Horn

WATER RESOURCE PLAN

CITY OF OCALA

VOLUME II: WATER

THIS IS TO CERTIFY THAT THE ENCLOSED ENGINEERING CALCULATIONS WERE PERFORMED BY ME OR UNDER MY DIRECT SUPERVISION.

Prepared for:

City of Ocala

Prepared by:

Kimley-Horn and Associates, Inc.

142371003
July 2019

101 E Silver Springs Boulevard, Suite 400
Ocala, FL 34470
352 438 3000

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ALAN J. GARRI, P.E.

Florida Registration Number #70674

CA No. 00000696

EXECUTIVE SUMMARY

The primary objective of this report is to identify water treatment plant (WTP) and distribution system improvements required to meet future potable water demands for the City of Ocala public water system (PWS) service territory. The intent is to provide guidance for anticipated future improvements based on certain simplifying assumptions. The analysis presented herein is based on those simplifying assumptions and should be updated as conditions change over time.

The analytic approach was to build a distribution system hydraulic model based on the 20-year projected demands and configuration of the service area. Once improvements were identified and properly sized based on the 20-year demand projects, then the 5-year and 10-year demands were applied, and improvements associated with each timeline were identified. In using this method, the sizing of water lines and plant expansions can take the ultimate system configuration into account while development is occurring. A total of eight different scenarios were modeled to evaluate the anticipated growth and system expansion:

- **Scenario 1:** Present Day
- **Scenario 2:** 5-year with City planned improvements
- **Scenario 3:** 5-Year Demands with City Planned Improvements and WTP-2 Online
- **Scenario 4:** 5-Year Demands with City Planned Improvements, WTP-2 Online, and HSP upgrades at WTP-1
- **Scenario 5**: 10-Year Projected Demands
- **Scenario 6:** 10-Year Projected Demands with required improvements
- **Scenario 7**: 20-Year Projected Demands
- **Scenario 8:** 20-Year Projected Demands with required improvements

The following hydraulic parameters were used to evaluate the model for deficiencies:

- Minimum system pressure during Max Day plus Fire Flow Demand — 20 psig
- Maximum system pressure — 100 psig
- Max Day Demand Peaking Factor (MDD:ADD) — 1.35
- Peak Hour Demand Peaking Factor (PHD:ADD) — 2.70
- Minimum Fire Flow Demand — 1,000 gpm

The above water demand scenarios were analyzed using InfoWater Suite 11.0 hydraulic modeling software:

PRESENT DAY SYSTEM DEMANDS

This scenario consisted of a present day (2018) analysis of the WTP and distribution system. The existing distribution piping system and annual average water demands were used to calibrate the model to within 10% of observed system flows and pressures. The present-day model results demonstrated that all the fire hydrants within the system were able to flow at a minimum of 1,000 gpm with a residual pressure of 20 psig. In addition, the minimum system pressure during peak hour remained above 35 psig.

5-YEAR DEMANDS

The 5-year demand scenario analysis modeled the City's water distribution system with the projected 5-year average day demands (ADD) of 18.31 MGD. Significant growth is anticipated over the 5-year time frame within infill areas and the known future developments. The 5-year scenarios assumed that the City's water main improvement projects (**PWS Improvement No.1**, **No. 2**, and **No. 3**) have been constructed. These projects were identified by the City and were designed and budgeted prior to the development of this master plan. The hydraulic model results demonstrated that in addition to the City's planned water main improvements (**PWS Improvement No.1**, **No. 2**, and **No. 3**), that WTP-2 would need to operate as an active facility rather than as a stand-by facility and would need to operate at a discharge pressure of 58 psig (**PWS Improvement No. 4**). Also, the firm high service pump (HSP) capacity at WTP-1 would need to be increased to 16.50 MGD MDD (22,900 gpm) (**PWS Improvement No. 5A or No. 5B**).

10-YEAR DEMANDS

The 10-year demand scenario analysis modeled the City's water distribution system with the projected 10-year average day demands of 19.22 MGD. The anticipated demand growth over the 10-year time frame is within the identified infill areas and the physical expansion of the city's distribution system. The hydraulic model results demonstrated that in addition to the 5-year improvements, that WTP-2 would need to be expanded to a minimum max day operating capacity of 5.00 MGD (**PWS Improvement No. 6**), the firm high service pump (HSP) capacity at the Downtown repump station would need to be increased to 2.88 MGD MDD (4,000 gpm) (**PWS Improvement No. 7**), and the SW 32nd Ave water main would need to be constructed (**PWS Improvement No. 8**).

20-YEAR DEMANDS

The 20-year demand scenario analysis modeled the City's water distribution system with the projected 20-year average day demands of 21.00 MGD. The anticipated demand growth over the 20-year time frame is within the identified infill areas and the physical expansion of the city's distribution system. The hydraulic model results demonstrated that in addition to the 10-year improvements, that WTP-2 would need to be expanded to a minimum max day operating capacity of 11.20 MGD (**PWS Improvement No. 10**) and the SW 7th Ave water main would need to be constructed (**PWS Improvement No. 9**).

Table ES-1: City of Ocala Water System Capital Improvements Summary		
Improvement No.	**Project Description**	**Engineer's Opinion of Probable Cost**
5-Year Capital Improvement Projects		
4	Install 2 hydropneumatic tanks at WTP-2	$ 319,000.00
5A	Purchase a backup high service pump for WTP-1	$ 250,000.00
5B	Replace high service pumps No.1, No.2 and No.4 at WTP-1	$ 1,740,000.00
10-Year Capital Improvement Projects		
6	Expand WTP-2 to have a permitted MDD capacity of 5.00 MGD	See WTF Feasibility Analysis
7	Replace the existing high service pumps at the Downtown repump station to have a capacity of 4,000 gpm (2.88 MGD MDD)	$ 725,000.00
8	SW 32nd Ave. 24-inch and SW 27th Ave. 12-inch water main extension	$ 4,089,000.00
20-Year Capital Improvement Projects		
9	SW 7th Ave. 16-inch water main extension	$ 942,500.00
10	Expand WTP-2 to have a permitted MDD capacity of 11.20 MGD	See WTF Feasibility Analysis

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INTRODUCTION

BACKGROUND

The City of Ocala (City) overall utility service area encompasses approximately 64.5 square miles within central Marion County. The City is anticipating future growth within and around the City's utility service area. This growth will provide the City with the opportunity to expand its existing utility systems and provide potable water service to new customers. In response to this anticipated future demand, the City desires to have a master plan for identifying improvement projects that will need to be constructed as growth occurs. In addition to identifying improvement projects, the City desires to approach the system improvements with a long-range vision and prioritize projects to help ensure continued service to existing customers and sufficient service capacity for new customers.

OBJECTIVES, SCOPE, AND ASSUMPTIONS

OBJECTIVES

The primary objective of this report is to identify the Water Treatment Plant (WTP) and distribution system improvements needed to meet future potable water demands and identify hydraulic capabilities and limitations of the City of Ocala's water system. The Master Plan provides guidance for system improvements that are needed to adequately meet the City's service area water demands for the specific scenarios presented in this report. The analyses presented herein are based on certain assumptions, hydraulic requirements, and standards and should be updated as conditions change with time.

This Master Plan provides a basis for the City to develop preliminary project scopes, budgetary estimates, and schedules. Improvement projects identified herein will enable the City to forecast capital needs based on capacity requirements and system reliability.

SCOPE

The scope of this report is limited to creating and calibrating the City's potable water system hydraulic model and producing alternatives for meeting the future demands in the City's service area. This report will focus on planning level system alternatives for meeting service area demands at 5, 10, and 20-years. Existing private utility systems within the City's service territory are not included in the analysis. Specific scope elements are described below.

- Create and calibrate an InfoWater Suite 11.0 hydraulic model of the City's existing water distribution system. The InfoWater model was created using GIS data provided by the City and calibration will be based on fire hydrant flow testing performed by the City.
- Analyze present demands and project future water demands placed on the distribution system. Future demands consist of additional demands on the existing water system infrastructure (infill) and demands on proposed water system infrastructure (expansion).
- Identify limiting factors of the existing WTP and existing distribution system, including WTP capacities and low-pressure areas in the distribution system.
- Recommend water distribution system improvements for 5-year, 10-year, and 20-year timelines based on the hydraulic model.

ASSUMPTIONS

- The existing pipe network layout for the public water supply systems was determined using previously developed GIS mapping.
- The existing demand distribution was determined in the following manner:
  - The City provided one year of billing information from November 2016 – October 2017.
  - The existing billing data provided the demands per active water service. To avoid over complicating the model, groups of individual demands within the vicinity of a junction node were assigned to that junction.
- The following hydraulic parameters were used to evaluate the model for deficiencies:

Minimum system pressure during Max Day plus Fire Flow Demand	20 psig
Maximum system pressure	100 psig
Max Day Demand Peaking Factor (MDD:ADD)	1.35
Peak Hour Demand Peaking Factor (PHD:ADD)	2.70
Minimum Fire Flow Demand	1,000 gpm

PROJECT APPROACH

The City's potable water system analysis was accomplished by constructing and calibrating a distribution system hydraulic model based on the existing WTP production, distribution system piping configurations, and demands of the service area. Then full buildout estimated demands and assumed piping configurations were constructed in the service area. Different scenarios were modeled to evaluate the impact of growth and system expansion. The following buildout projections and associated water demand scenarios were considered for the City's service area.

EXISTING SYSTEM ANALYSIS – The existing system analysis used water billing data provided by the City of Ocala from November 2016 through October 2017 and monthly WTP operating reports from January 2013 through May 2018 to develop the current average day water demand estimates. City GIS mapping was used to develop the piping configuration. The existing system scenario was used to calibrate the model to within 10% of observed system flows and pressures.

5 YEAR ANALYSIS – The 5-year analysis used the projected 5-year water demands to evaluate system performance and identify the necessary improvements to meet the anticipated system demands.

10 YEAR ANALYSIS - The 10-year analysis used the projected 10-year water demands to evaluate system performance and identify the necessary improvements to meet the anticipated system demands.

20 YEAR ANALYSIS - The 20-year analysis used the projected 20-year water demands to evaluate system performance and identify the necessary improvements to meet the anticipated system demands.

DEMAND PROJECTIONS

INTRODUCTION

This section presents a discussion of the demand projections within the City utility service area for the water distribution system. The future water demands must first be estimated to properly determine whether the current water system can support the projected demands and if necessary, identify improvements that are required to meet these future demands. The key element in evaluating the future demands within a utility system is population growth as it determines the basis for the demands that will be placed on the utility infrastructure. Identifying, quantifying, and locating these demands allows for proper analysis and planning of capital improvements that can efficiently and cost-effectively service existing and new customers.

Increases in demands within the City's utility system are anticipated to occur in four ways: (1) growth within the areas currently served by the City resulting from new connections in areas where infrastructure exists (existing and infill demands), (2) increased demands from the physical expansion of the utility system to bring existing non-served customers onto the network (expansion demands), (3) demand increases driven by new development (development demands), and (4) septic to sewer conversion and well elimination projects.

METHODOLOGY FOR ESTIMATING POPULATION

The basis for determining the future population and growth rates was the SWFWMD population projections and the City's future land use designations.

The population projections for the City's service area are based on the *Small-Area Population Projection Methodology provided by SWFWMD* (2014). The following analysis was performed to determine the 5, 10, and 20-year population projections.

- The population values for each parcel were obtained from the SWFWMD population projections spatial data
- These population values were summarized for the years 2020, 2025, 2030, 2035 and 2040.
- The total population values for each parcel were then interpolated to find the population values for the years 2023 (5-year), 2028 (10-year), and 2038 (20-year).

METHODOLOGY FOR ESTIMATING WATER DEMANDS

The water demands are linked to population and land use. The City of Ocala service area generally consists of the following major land use categories:

- Residential
- Commercial and Industrial

A specific demand calculation methodology was applied for each land use category. The following is a discussion of each methodology.

RESIDENTIAL

One of two approaches below were used to calculate the residential potable water demands.

1. **Approach 1: Property with current billing data** – For residential properties with current billing data, the parcel specific annual average demands from the City billing information was used. It was assumed the parcel was fully developed and the existing and full buildout demand was set equal to the calculated annual average demand for each specific parcel.
2. **Approach 2: Property without current billing data** – For residential properties without current billing data, existing water demands were set equal to zero. To calculate the demand for 5, 10, and 20 years, the projected population for each parcel was divided by a value of 2.35 people per ERU. The ERU value for each parcel was then multiplied by the City's level of service standard for water of 300 gpd/ERU.

Projected Demand = [(Projected Population/2.35 people per ERU) x City's Level of Service (gpd/ERU)]

COMMERCIAL AND INDUSTRIAL

Future land use designations were used as the basis for calculating future commercial and industrial water demands. The City's future land use GIS mapping was used to determine the future land use for each Commercial and Industrial parcel. For Commercial and Industrial property demand calculations, one of two approaches below were used to calculate the demands.

1. **Approach 3: Commercial property with current billing data** – For commercial property with current billing data, the parcel specific annual average demand from City billing information was used. It was assumed the parcel was fully built out and the existing and full buildout demand was set equal to the calculated annual average demand for each specific parcel.

2. **Approach 4: Commercial property with no current billing data** – For Commercial and Industrial property with no current billing data, existing water demand was considered zero. Full buildout water demands were determined by multiplying the parcels area in acres by the max number allowable ERUs per acre, according to the City's comprehensive plan. The resulting number of ERUs was then multiplied by the City's level of service standard for water of 300 gpd/ERU.

Buildout Demand = [Parcel Area (Acre) x Max Allowable ERUs x City's Level of Service (gpd/ERU)]

The 5, 10, and 20-year demands were calculated by multiplying the buildout demand by the ratio of the 5, 10, and 20-year projected population growth as calculated using the SWFWMD population projections.

KNOWN FUTURE DEVELOPMENTS

Future demands were based on development projections provided by either the City of Ocala planning department or by the developer. The future demands were then calculated by multiplying the City's level of service by the projected development ERUs.

SEPTIC TANK AND WELL ELIMINATION PROGRAM (STAWEP)

Demands were based on the estimated number of parcels that would be converted from septic to sewer. These values were provided by the City's Water Resources department. The projected number of parcels were then multiplied by the City's water level of service.

DEMAND CALCULATIONS

Potable water demands for the City's system were calculated for the following general categories. The demands for each category were calculated using one or more of the approaches discussed above.

EXISTING CUSTOMERS

To establish demands for existing customers, the present year average day demands for each individual parcel were calculated as the average of the November 2016 to October 2017 billing data provided by the City. Approach 1 was then used to calculate the 5, 10, and 20-year demands for each parcel. **Figure 1** shows the existing areas served. See **Appendix A** for the water demand allocation and calculation summary.

INFILL AREAS

To establish the infill demand growth, unoccupied parcels that were within 200 feet of existing utility infrastructure were selected and considered infill areas. The future infill area demands were calculated using either approach 2 or 4. **Figure 2** shows the expansion areas to be served. See **Appendix A** for the complete water demand allocation and calculation summary.

EXPANSION AREAS

Expansion areas are parcels that will be served by future expansion of the utility infrastructure system, but do not include known future developments. Known future developments are listed separately and are discussed in the next section. The expansion area demands were calculated using either approach 2 or 4 discussed above. Based on the specific condition for each separate parcel, the appropriate demand calculation approach was used to determine the future demand for each parcel. **Figure 2** shows the expansion areas to be served. See **Appendix A** for the complete water demand allocation and calculation summary.

SEPTIC TANK AND WELL ELIMINATION PROGRAM (STAWEP)

Septic tanks are a major contributor to excessive nutrient loading and other pollutants in local surface waters and springs. The City, in partnership with Florida Department of Environmental Protection (FDEP) and the St. Johns River Water Management District (SJRWMD), has developed a new program to eliminate septic tanks and residential wells in areas where existing City infrastructure is available for connection. To estimate the future demands that would develop because of this program, the number of wells and septic tanks were multiplied by the City's water and wastewater levels of service, respectively. The number of ERU's were determined by the City and is summarized in the complete water demand allocation and calculation summary in **Appendix A.** The City's targeted areas for the septic tank and well elimination program is shown in **Figure 1.**

FUTURE DEVELOPMENTS

The City developed a list of residential and non-residential developments along with projections based on known project entitlements anticipated to start within 20 years. The following future developments in **Table 1**Table 1 were identified within the City's service area as "future developments". **Figure 2** shows the expansion areas to be served See **Appendix A** for the complete water demand allocation and calculation summary.

Table 1 - Known Future Developments	
Name	**Total Projected ERUs**
Heath Preserve	414
Winding Oaks Commercial	525
AutoZone Shipping Facility	16
Chewy Shipping Facility	17
McClain Industrial	17
Windstream, Carriage Hill, and Bellwether	150
Total	**1,139**

SUMMARY OF GROWTH PROJECTIONS

The detailed projected water demands are included in **Appendix A.** The water demands for each category were calculated using one or more of the approaches discussed above. The capacity analysis of the water distribution system was based on the projected demands that are summarized in **Table 2**.

Table 2 - Water Demand Projections				
Projected Demands	**2018 ADD (MGD)**	**2023 ADD (5-Year) (MGD)**	**2028 ADD (10-Year) (MGD)**	**2038 ADD (20-Year) (MGD)**
Existing	11.50	11.50	11.50	11.50
Infill	0.00	3.75	4.39	5.62
Expansion	0.00	2.59	2.86	3.40
New Development	0.00	0.34	0.34	0.34
Septic to Sewer	0.00	0.12	0.12	0.12
Total	**11.50**	**18.31**	**19.22**	**21.00**

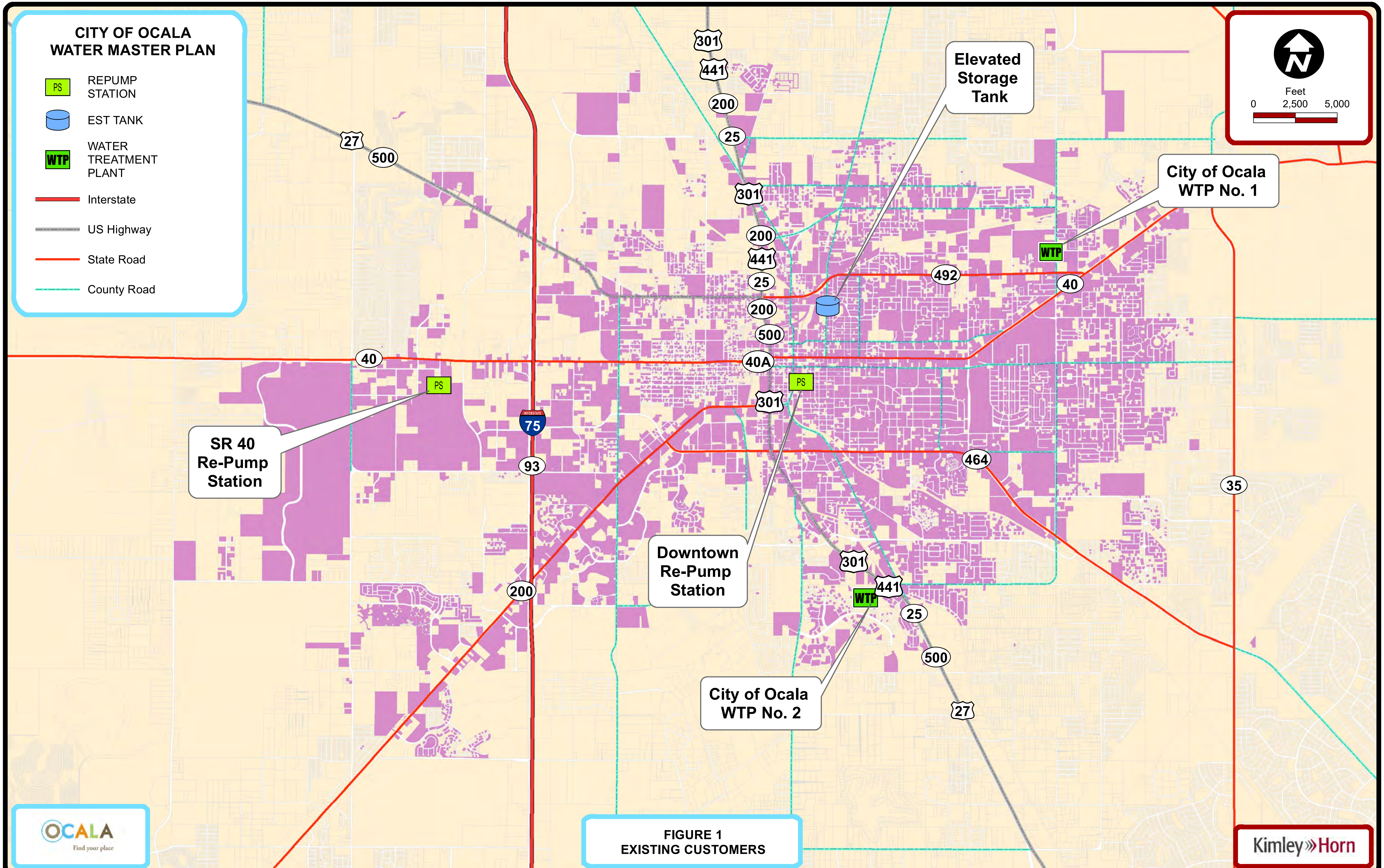


FIGURE 1
EXISTING CUSTOMERS

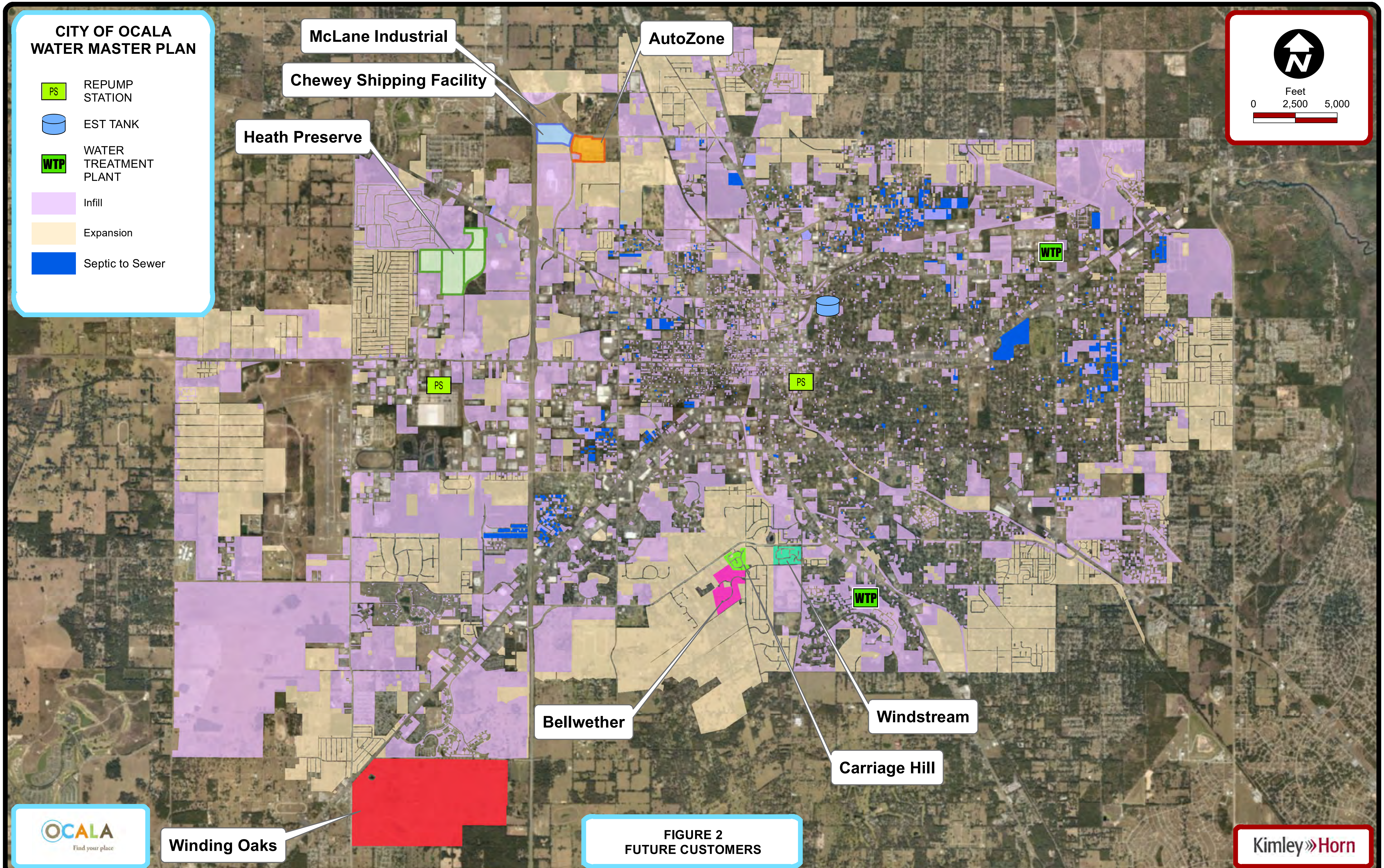


FIGURE 2
FUTURE CUSTOMERS

EXISTING WATER SYSTEM

This section discusses the location, facilities, and capacity of the City's existing Public Water System (PWS) within the City's service area. See **Figure 3** for a map of the Ocala PWS service territory and existing water distribution system. A summary of the permitted capacity and regulatory issues of the WTP and the Ocala PWS, including distribution limitations, WTP limitations, permit compliance issues, and fire flow concerns, are included in this section.

WATER PERMITTING AGENCIES

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

The FDEP is responsible for permitting the design and construction of new PWS components that provide potable water service to systems serving 25 or more people for at least 60 days each year or serve 15 or more service connections. After a WTP has been built, the FDEP is responsible for monitoring the plant for compliance with drinking water standards. The FDEP also inspects the plants at regular times and generates a sanitary survey report. All the components of the plant are inspected during the sanitary survey, including the wellheads, disinfection systems, storage facilities, high service pumps, treatment components, and the records that are required on-site.

The City of Ocala water system is identified by the FDEP as PWS-ID No. 3420922. According to the May 2018 FDEP Monthly Operating Report (MOR), the total population served by the system is 56,198 with approximately 24,434 connections to the distribution system.

EXISTING WATER DEMAND DATA

The MOR data for the City's utility system for the 12-month period from June 2017 to May 2018 was used to calculate the individual and combined WTP Annual Average Daily Flow (AADF) and Maximum Day Flow (MDF). The AADF were determined by dividing the total flows for 12 months by 365 days. The MDF were determined by identifying the maximum daily flow over the 12-month period. **Table 3** summarizes the individual WTP AADF and MDF and **Figure 4** shows the daily flow of finished water from the City of Ocala WTP.

Table 3 - Existing Potable Water Flows for Ocala PWS

PWS	Actual Flows (GPD) 06/2017 - 05/2018		Permitted Flows (GPD)	Percent Permitted MDF
	Average Day	Maximum Day	Maximum Day	
City of Ocala PS	11,276,102	14,653,000	24,420,000	**60.0%**

Based on the MOR data gathered from 2013 through 2018, the City of Ocala is currently operating at 60% of their permitted capacity. Per Rule 62-555.348, F.A.C., the City must submit a capacity analysis report as the total maximum-day quantity of finished water produced by all treatment plants connected to the PWS, including water produced to meet any fire-flow demand but excluding water produced to meet any demand that the PWS documents to be highly unusual and nonrecurring, exceeds 75 percent of the total permitted maximum-day operating capacity of the plants.

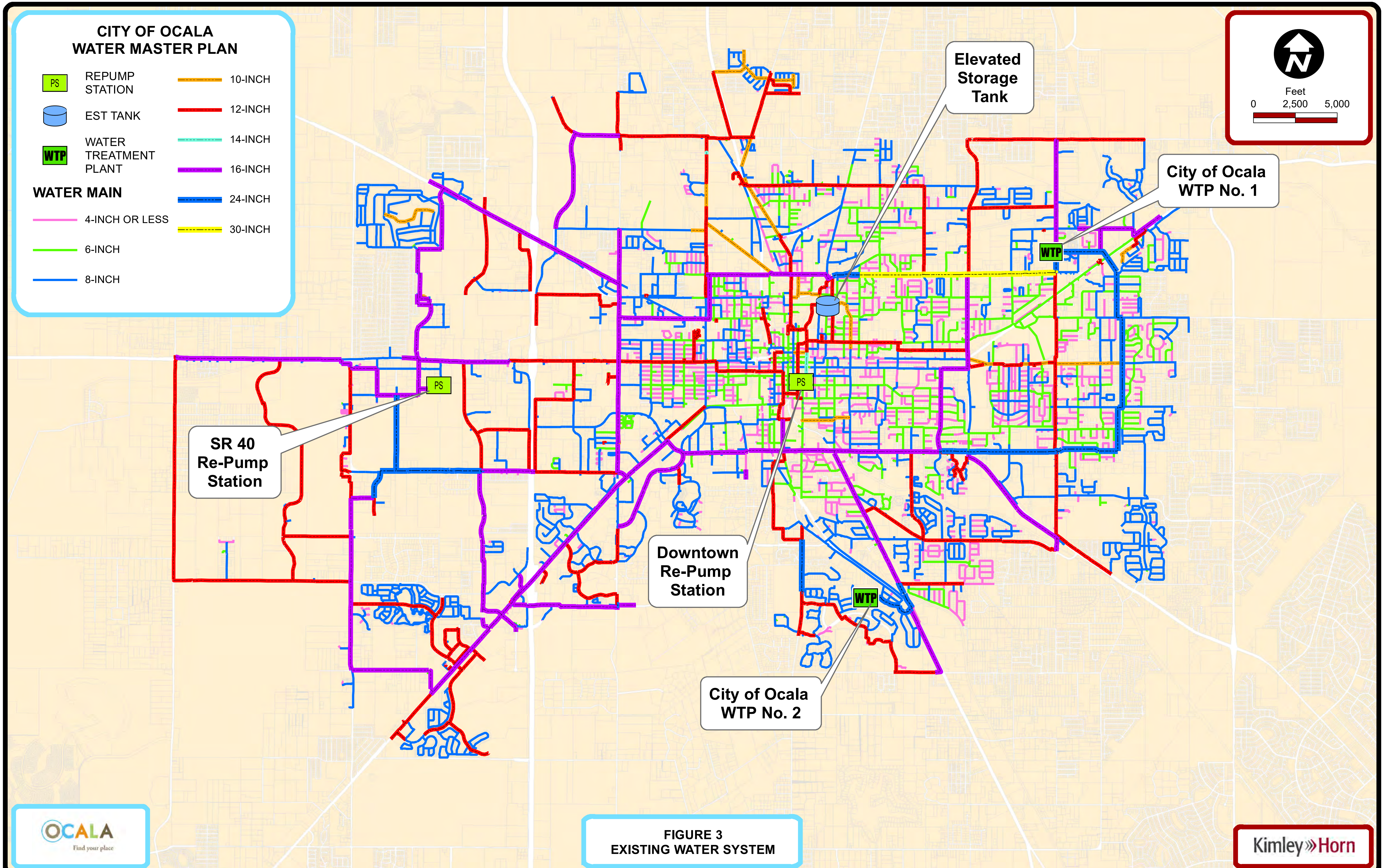
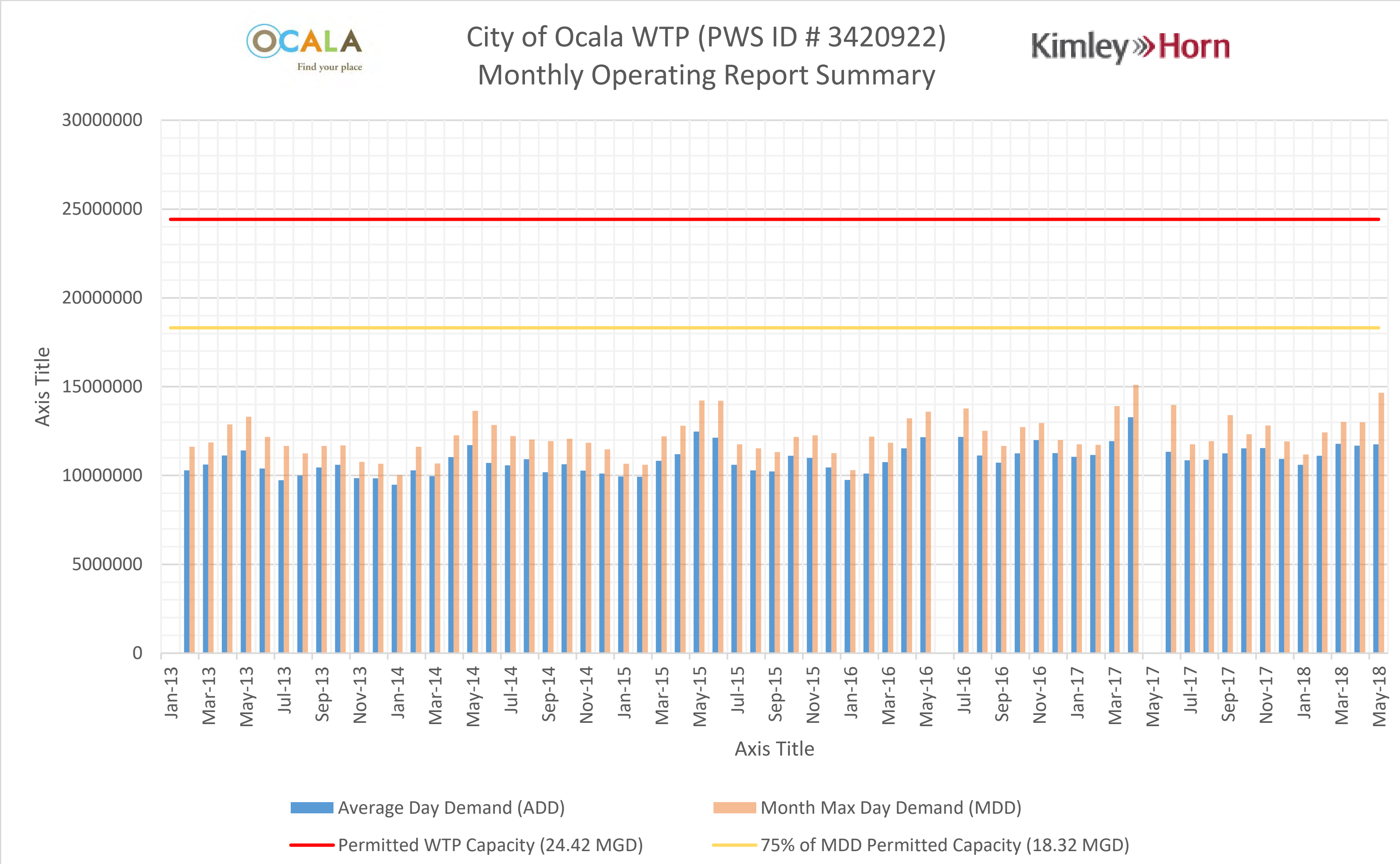


FIGURE 3
EXISTING WATER SYSTEM

Figure 4 - City of Ocala WTP Flows



SAINT JOHNS RIVER WATER MANAGEMENT DISTRICT

The Saint Johns River Water Management District (SJRWMD) is responsible for permitting and monitoring the quantities of groundwater pumped to the PWS. The City has one consolidated Consumptive Use Permit (CUP) issued by SJRWMD for the Ocala PWS. The City's six active wells are permitted under this single CUP (Permit Number 50324-8), to withdrawal a maximum annual withdrawal of 5,409 MGY (14.82 MGD ADF) for 2018 of ground water from the Upper Floridian aquifer (UFA) for public supply type use. The City also constructed a Lower Floridan aquifer (LFA) test well (Well No.7) in 2011 to evaluate the potential of utilizing the LFA as a future water supply source. Well No.7 is currently not listed as an active well on the City's existing CUP. The City's CUP is summarized below in **Table 4**.

Table 4 - Consumptive Use Permit

Permit Number	Permit Type	Issuing Agency	No. of Wells	Date of Expiration	Average Daily Withdraw (MGD) (Year: 2018)	Average Daily Withdraw (MGD) (2017-2018)
50324-8	Consumptive Use Permit	SJRWMD	6	8/7/2027	14.82	11.28

A summary of the CUP and the City of Ocala's MOR data from 2013 through 2018 is shown below in **Table 5**. Based on the data the City of Ocala is currently operating at 76% of their permitted withdrawal capacity. Based on the projected average demands as summarized in **Table 5** and the City's existing CUP, the City is at risk of exceeding the systems permitted withdrawals by 2023. In partnership with the SJRWMD, the City of Ocala constructed a lower Floridan aquifer (LFA) test well (Well No. 7) at WTP-2 to exam the feasibility of utilizing the LFA as an alternative water supply source. The LFA test well acceptable as alternative water supply source to the upper Floridan aquifer. Though, there are currently no capacities assigned to Well No.7, the City plans to utilize Well No.7 and expand WTP-2 within the next 5 years. Utilizing Well No.7 would allow the City to increase their permitted withdrawal capacity without increasing the demand on the upper Floridan aquifer.

Table 5 - CUP Capacity Projections

	2018	2023	2028
Projected Demands (ADD)	11,504,201	18,310,673	19,223,296
Permitted CUP Withdrawals (ADD)	14,820,000	16,400,000	17,540,000
Remaining Permitted CUP Capacity	3,315,799	(1,910,673)	(1,683,296)

DISTRIBUTION SYSTEM DESCRIPTION

The City's distribution system covers an area totaling approximately 64 square miles.

Table 6 below is a summary of the existing distribution system pipe sizes (diameter) and lengths.

Table 6 - Existing Distribution System Pipe Size and Length[1]

Pipe Size (diameter)	Total Length of Pipe (feet)
30 – inch	11,850
24 – inch	51,200
16 – inch	229,211
14 – inch	2,312
12 – inch	379,981
10 – inch	47,945
8 – inch	1,097,156
6 – inch	534,533
4 – inch or less	734,259

[1] Pipe diameters and lengths were obtained from the City of Ocala's GIS database.

EXISTING WATER SYSTEM FACILITIES

This section contains a detailed discussion of the City's water treatment plant and repump stations; including wells, storage systems, disinfection systems, and high service pump stations. To determine the existing utilization of each WTP, the MOR data from January 2013 through May 2018 were reviewed. The system capacity was calculated using the rules and criteria established by the FAC Section 62-555. See the *Capacity Analysis* section of the report and **Appendix B** for a summary of the capacity analysis criteria and calculations.

The City's water supply, treatment, and storage system consists of one WTP (WTP-1) with five public supply wells and two ground storage tanks (GST), one 500,000-gallon elevated storage tank, and two repump stations. The City also has one emergency WTP (WTP-2) equipped with one public supply well (Well No.6). The Water Treatment Plants and repump stations that serve the City's water system are described below.

CITY OF OCALA WTP-1

The City's WTP-1 is a Category 1, Class A WTP located at 1805 NE 36th Ave., Ocala, FL 34470 and is identified by the FDEP as PWS-ID No. 3420922-1. The City's WTP-1 facility consists of five water supply wells, two GSTs, one elevated storage tank, and a high service pumping facility.

The raw water source for the City's WTP-1 is groundwater from the Floridan aquifer. Groundwater is pumped into the plant using five groundwater wells. See **Table 7** for a summary of the wells and well pumps.

Table 7 - City of Ocala WTP-1 Plant Wells							
Well Number	Dia. (in.)	Total Depth (ft.)	Casing Depth (ft.)	Well Yield (gpm)	Pump Type	Pump Horse-power	Pump Capacity (gpm)
1 (AAE0112) VFD	24	240	85	3,500	Vertical Turbine	100	3,500
2 (AAE0113)	24	265	85	3,500	Vertical Turbine	100	3,500
3 (AAE0114) VFD	24	187	140	3,500	Vertical Turbine	100	3,500
4 (AAE0115)	24	198	110	3,500	Vertical Turbine	100	3,500
5 (AAE0116) VFD	24	230	104	3,000	Vertical Turbine	N/A	3,000

Treatment of the groundwater and reduction in hardness is achieved through a conventional lime-softening process. Flocculation and the addition of lime simultaneously takes place in two mixing basins each with a rated capacity of 15.00 MGD. Stabilization of the treated water is achieved with the addition of Carbon Dioxide. The target pH of the effluent water from the stabilization basin is 8.50. Suspended solids are removed through filtration with six mixed media filters with a total capacity of 24.42 MGD.

Finished water storage is provided by two 2,000,000-gallon GSTs and one off-site 500,000-gallon elevated storage tank. Disinfection for this plant is provided by a flow proportional sodium hypochlorite liquid injection. Sodium hypochlorite is injected into the raw water for disinfection prior to entering the re-carbonation basin.

The City's WTP-1 facility is equipped with four high service pumps (HSP) to provide final delivery of water into the City's service area. See **Table 8** below for a summary of the pump capacities. The firm pumping capacity (capacity when the largest installed HSP is out of service) of the WTP is 22.896 MGD (15,900 gpm).

Table 8 - City of Ocala WTP-1 HSP Pump Capacities			
Pump Number	Pump Type	Horsepower	Capacity (gpm)
HSP 1	Horizontal Split Case	500	6,000
HSP 2	Horizontal Split Case	350	5,000
HSP 3	Horizontal Split Case	500	7,000
HSP 4	Horizontal Split Case	300	4,900

The max-day permitted capacity for this plant is 24.42 MGD MDF. Based on the most recent MOR data from June 2017 to May 2018, the plant produces an AADF of approximately 11.307 MGD and a MDF of 14.653 MGD. The AADF of 11.307 MGD produced at the Ocala WTP-1 facility represents 99.4% of the total combined AADF production of 11.375 MGD from the two WTPs owned and operated by the City. Since WTP-2 is an emergency plant and rarely supplies water for the system, WTP-1 is considered the primary facility for the service area. The MDF of 14.653 MGD produced at WTP-1 represents approximately 60.0% of the max-day permitted capacity of the plant.

CITY OF OCALA WTP-2

The City's WTP-2 (Well No.6) is located at 3800 S Pine Ave., Ocala, FL 34470 and is a Category 5 Class C facility. This plant is identified by the FDEP as PWS-ID No. 3420922-2. The City's WTP-2 facility consists of a UFA public supply well (Well No.6) and a LFA test well (Well No.7). The raw water source for the City's WTP-2 is groundwater from the upper Floridan aquifer (Well No.6). Groundwater is pumped directly into the distribution system from Well No. 6 following chlorination. Well No.7 does not have a well pump installed and is not connected to the existing treatment facility or to the City's distribution system.

See **Table 9** for a summary of the well pumping facilities at WTP-2. Currently WTP-2 operates as a stand-by emergency facility and does not normally operate. The plant is currently only operated once a week to sample and flush the well.

Table 9 - City of Ocala WTP-2 Plant Well

Well Number	Dia. (in.)	Total Depth (ft.)	Casing Depth (ft.)	Well Yield (gpm)	Pump Type	Pump Horse-power	Pump Capacity (gpm)
6 (AAH2587)	36	225	84	3,500	Vertical Turbine	300	3,500
M-0811 (TW-1) (LFA)	24	1,277	810	N/A	N/A	N/A	N/A

WTP-2 does not have any on-site storage facilities. Disinfection for this plant is provided by a flow proportional gas chlorination system. The City utilizes gaseous chlorine due to the plant's status as an emergency facility and the ability for gaseous chlorine to be stored for long periods of time compared to that of sodium hypochlorite.

DOWNTOWN REPUMP STATION

The Downtown repump station is located at the corner of SW 3rd Avenue and SW 5th Street and consists of one ground storage tank and two high service pumps. The on-site storage for this repump station is a 1,000,000-gallon concrete ground storage tank. The Downtown repump station operates to increase the system pressure and peak hour pump capabilities in the central section of the City's distribution system. The repump station is equipped with two horizontal split case high service pumps. See **Table 10** for a summary of the pumping capacities.

Table 10 - Downtown Repump Station Pump Capacities

Pump Number	Pump Type	Horsepower	Capacity (gpm)
HSP 1	Horizontal Split Case	100	1,500
HSP 2	Horizontal Split Case	100	1,500

SR-40 REPUMP STATION

The SR 40 repump station is located on SW 49th Avenue just south of SR 40. The SR 40 repump station consists of a single ground storage tank, one jockey pump, and four high service pumps. On-site storage for this repump station is provided by a 1,000,000-gallon concrete ground storage tank. The SR 40 repump station operates to increase the system pressure during fire flow and peak hour events in the western section of the City's distribution system. See **Table 11** for a summary of the pumping capacities.

Table 11 - SR 40 and SW 49th St. Repump Station Pump Capacities

Pump Number	Pump Type	Horsepower	Capacity (gpm)
Jockey	Vertical Turbine	50	700
HSP 1	Vertical Turbine	100	1,500
HSP 2	Vertical Turbine	100	1,500
HSP 3	Vertical Turbine	100	1,500
HSP 4	Vertical Turbine	100	1,500

CAPACITY ANALYSIS

As part of the analysis of the City of Ocala Water System Master Plan, a capacity analysis of the system was performed using the rules as specified by FAC 62-555 and assuming that WTP-2 contributes capacity to the existing system. The detailed capacity calculation for the City's water system is included in **Appendix B.** A summary of the capacity analysis is below in **Table 12.**

Table 12 - City of Ocala PWS Capacities

System Capacity	Capacity Evaluation (GPD MDD)
Well Capacity	29,340,000
Finish Water Storage Capacity	23,757,257
Pumping Capacity	21,948,000
Limiting Water System Capacity	**21,948,000**

Based on the capacity analysis the City's limiting system component is the pumping capacity, specifically the City's ability to meet the peak hour demand for four consecutive hours. Therefore, the total system has max day capacity of 21,948,000 gpd as shown in **Table 13** below.

Table 13 - PWS Capacity Projections

Year	2018	2023	2028	2038
City of Ocala PWS Capacity (GPD MDD)	21,948,000	21,948,000	21,948,000	21,948,000
Demands (GPD MDD)	15,530,671	24,719,409	25,951,450	28,358,963
Remaining Capacity	**6,417,329**	**(2,771,409)**	**(4,003,450)**	**(6,410,963)**

Currently, the existing demand on the system based on the last years of billing data is 11,276,102 GPD ADD and 15,530,671 GPD MDD. Based on the consolidated capacity analysis, the City's PWS has the capacity to support the current demands on the system, but the City will need to make system component capacity upgrades to increase the system's overall capacity to meet the 5, 10, and 20-year demand projections. The recommended system and component upgrades are discussed in detail in the *Water System Improvements* section of this report.

WATER SYSTEM ANALYSIS AND METHODOLOGY

INTRODUCTION

The hydraulic modeling software used in this analysis is InfoWater Suite 11.0. InfoWater is a GIS based water distribution modelling program that, with user input, calculates a wide variety of system parameters. Useful outputs from the program include pressure and available fire flow. These results assist designers in identifying locations in the system where the pressures or available fire flows are below minimum acceptable values. The model can be used to assess the existing system as–is and how the system will respond to future increases in demand. It also allows the designer to modify system components (WTP pressures, line sizes, line locations, etc.) and establish how the water system responds to the changes.

The City provided existing GIS water main data for use in the model preparation. The water system elements in the City's GIS database (i.e. - pipes, valves, junctions, WTP, demands, etc.) were input into the model. The piping network was verified by the City staff to be an accurate representation of existing conditions. Model calibration was accomplished using fire hydrant flow and pressure information measured by City staff at 13 locations. The fire flow demands were input into the model and the corresponding pressures were checked to help verify that the model was reasonably predicting what was observed in the field.

Prior to performing a system analysis, the existing model was calibrated using fire hydrant flow data, which includes pressure and flow.

HYDRAULIC MODEL

To create a new hydraulic model using the GIS data provided by the City, the following steps were taken:

- The water main distribution system was simplified for model representation. All service connections were removed. Service lines 2" and greater that served more than one connection were not removed. Pipes segments of the same size were merged to reduce the total number of pipe segments. Junctions were provided only where three or more pipes meet each other or where pipes change size.
- The fire hydrant locations were provided by the City. Junctions were added at all fire hydrant locations within the model.
- The existing pipe network layout was reviewed for completeness by City staff. Any apparent missing pipes were identified and added to the model based on the data provided by the City. Pipe sizes and materials were also provided by City and used in the model. Pipe sizes and locations were not field verified.
- Model junction elevations were assigned using the Digital Elevation Model (DEM) obtained from the USGS National Map Viewer 2.0.
- The existing demand distribution was assigned to each specific parcel based on the billing data provided by the City. To simplify the model, groups of individual demands were assigned to the nearest logical junction.

The WTP operating pressures were obtained from City of Ocala staff. **Table 14** shows the operating parameters used in the model:

Table 14 - Existing System Operating Pressures				
WTP/Pump Station/EST	Operating Parameters		Model Setting	Model WTP HGL (ft.)
	ON*	OFF		
WTP-1	81 PSIG	-	81 PSIG	260.41
WTP-2 (Well #6)	-	-	-	-
SR-40 Repump Station	71 PSIG	76 PSIG	71 PSIG	242.01
Downtown Repump Station	Operated Manually through SCADA		57 PSIG	248.67
Elevated Storage Tank**	35 FT	37 FT	36 FT	250.70

** Operates to maintain a user specified pressure*
*** Altitude valve level settings for EST*

After updating the physical components of the hydraulic model, a calibration was performed to ensure that the model accurately reflected the conditions of the system in the field. The following steps were taken to calibrate the model:

1. Data Collection:

   Kimley-Horn and City of Ocala staff conducted fire hydrant flow/pressure tests at 13 locations in the system on April 26, 2018. Each test used two hydrants (one pressure hydrant and one flow hydrant). Three readings were recorded for each pair of hydrants. First, the flow hydrant was completely closed, and a static pressure reading was taken at the pressure hydrant. Second, the flow hydrant was opened fully and allowed to flow for at least five minutes to allow the WTPs to respond to the increased demand on the system. A flow reading, and the residual pressure measurement were recorded for the full flow condition. Finally, the flow hydrant was partially closed so the hydrant flowed at approximately half of full flow for one minute. The partial flow and corresponding residual pressure were recorded. See **Appendix C** for the hydrant flow/pressure results.

2. Model Calibration:

   The fire hydrant test data was used for calibration of the hydraulic model. First, the fire hydrant flow data were entered in the model and the model was simulated to check the resulting pressures at the pressure hydrants. The model predictions were then checked against the field results. Model predictions that were within 10% of the actual collected data were considered acceptable. The data points outside of the acceptable range were analyzed to determine the cause of the variation. See **Appendix C** for the results and detailed discussion of the model calibration.

PEAKING FACTORS

The calculated water demands represent ADD conditions. For the modeling analysis, MDD and PHD conditions need to be approximated. It is common practice to approximate the MDD and PHD conditions by multiplying the ADD by a factor. The FDEP estimates these factors as 2.25 for the ADD to MDD conversion and 2.0 for the MDD to PHD conversion. The FDEP factors may be used when little or no information is available for the system being analyzed. The FDEP allows alternative factors to be used provided that sufficient historical information is available to accurately determine the peaking factors. FDEP MOR data was evaluated from 2013 through May of 2018 to determine an ADD to MDD peaking factor of 1.35 for the City of Ocala PWS. A 2.7 ADD to PHD peaking factor was calculated by multiplying the MDD peaking factor by 2.0.

SYSTEM HYDRAULIC STANDARDS

The hydraulic standards set forth in the *Ocala Code of Ordinances* and the City of Ocala *Standard Specifications for Water & Sewer Construction,* along with the design requirements of *FAC 62-555,* were used for evaluating the system for deficiencies. More specifically, the following hydraulic standards were used to evaluate the hydraulic model:

- Minimum System Pressure with Max Day plus Fire Flow Demand: 20 psig
- Minimum System Pressure with Peak Hour Demand: 35 psig
- Maximum System Pressure: 100 psig
- Typical Network Operating Pressure Range: 45-80 psig
- Fire Flow Demand: 1,000 gpm (minimum)

METHODOLOGY

The primary objective of this report is to identify the WTP and distribution system improvements needed to meet future water demands in the Ocala service area. The approach for determining these improvements was to first input the existing demands and evaluate the existing system and then input the future demands and evaluate the system for the future conditions.

A total of eight scenarios were analyzed to determine the improvements required for the 5-year, 10-year, and 20-year conditions. Each scenario modeled the MDD, MDD+FF, and PHD with different combinations of WTPs, demands, and system improvements. The minimum system pressures and available fire flows for each model run were compared to the hydraulic standards presented above to determine adequacy of the system. Special attention was paid to the net flows coming from each plant in the various scenarios. Since each plant has a given maximum capacity, the model results were checked against those capacities to ensure the scenario stayed within those limits. Any scenario with flow set to be greater than the available capacity would require the plant to be expanded to accommodate the additional demand.

A matrix of the modeled scenarios with the system demands, WTP flows, minimum pressure, maximum pressure, average pressure, and fire flows with the various system improvements are shown in **Appendix D.**

MODEL RESULTS

PRESENT DAY ANALYSIS

Included in this section are the results for the existing system configuration and existing system demands:

Scenario 1 - Present Day

Scenario 1 modeled the existing conditions of the City's PWS at ADD, MDD, MDD+FF, and PHD. In this scenario, WTP-1, both repump stations and the elevated storage tank were connected to the distribution system and were operating at the normal operating pressures, while WTP-2 was offline. This scenario was used for calibration and is the basis for system pressure and fire flow analysis. **Table 15** summarizes the results of the scenario.

Table 15 - Present Day with Existing System

Demands	Min. System Pressure (psig)	Avg. System Pressure (psig)	Min. Available Fire Flow (gpm)
ADD	42	74	N/A
MDD	39	72	N/A
MDD + FF	20	70	1,303
PHD	36	67	N/A

The model results show the existing City's PWS is operating within the minimum system parameters established by FDEP and by the City of Ocala. The available fire flow coverage meets the minimum hydraulic parameters and all of the hydrants had a minimum available flow of 1,000 gpm during a max day demand with a minimum residual pressure of 20 psig. Though the City's system is operating within in the minimum system parameters, there are areas that have low pressures during a peak hour demand scenario. **Appendix E** illustrates the pressure contours throughout the City's system and shows the low-pressure areas within the City.

5-YEAR (2023) ANALYSIS

This scenario includes the anticipated additional demands from the existing service area, infill areas, new developments and septic tank and well elimination program (STAWEP). Separate scenarios were modeled to determine which scenario triggers the need for each individual system improvement to be constructed between 2019 and 2023. Each water main improvement was also evaluated in the 20-year scenario, so that it was properly sized to meet the 20-year projected demands.

Scenario 2 - 5-Year Demands with City Planned Improvements

Scenario 2 modeled the City's existing PWS at MDD, MDD+FF, and PHD with the projected 5-year demands and the City's water system improvements that are planned to be completed before the year 2023. These improvements were identified and designed prior to the beginning of this master plan and were not identified as part of this hydraulic analysis. **Table 16** summarizes the results of the scenario. The City's planned water system improvements are shown in Figure 5 and listed below.

- **PWS Improvement No. 1:** NE 35th Street Roadway Improvement: 13,000 LF of 12-inch PVC water main
- **PWS Improvement No. 2:** WTP No. 1 Loop: 3,600 LF of 24-inch PVC water main
- **PWS Improvement No. 3:** WTP No. 2 Loop: 4,300 LF of 24-inch PVC water main

Table 16 - Scenario 2 Model Results

Demands	Min. System Pressure (psig)	Avg. System Pressure (psig)	Min. Available Fire Flow (gpm)
MDD	36	70	N/A
MDD+FF	20	68	974
PHD	34	64	N/A

The model results, including the City's planned improvements, show the existing City's PWS is operating within the minimum system pressure standard established by FDEP, but is not operating within the minimum pressure standards established by the City of Ocala. During the peak hour scenario WTP-1 is operating at maximum firm pump capacity. The average system pressure is above the minimum of 55 psig during MDD, but the system has pressures below 35 psig during PHD. The available fire flow coverage meets the minimum hydraulic parameters with the exception of one fire hydrant that is not capable of meeting the minimum 1,000 gpm fire flow during a max day demand with a minimum residual pressure of 20 psig. The single hydrant that cannot meet minimum hydraulic standard is located on NE 28th Avenue and the ID number is FH03095.

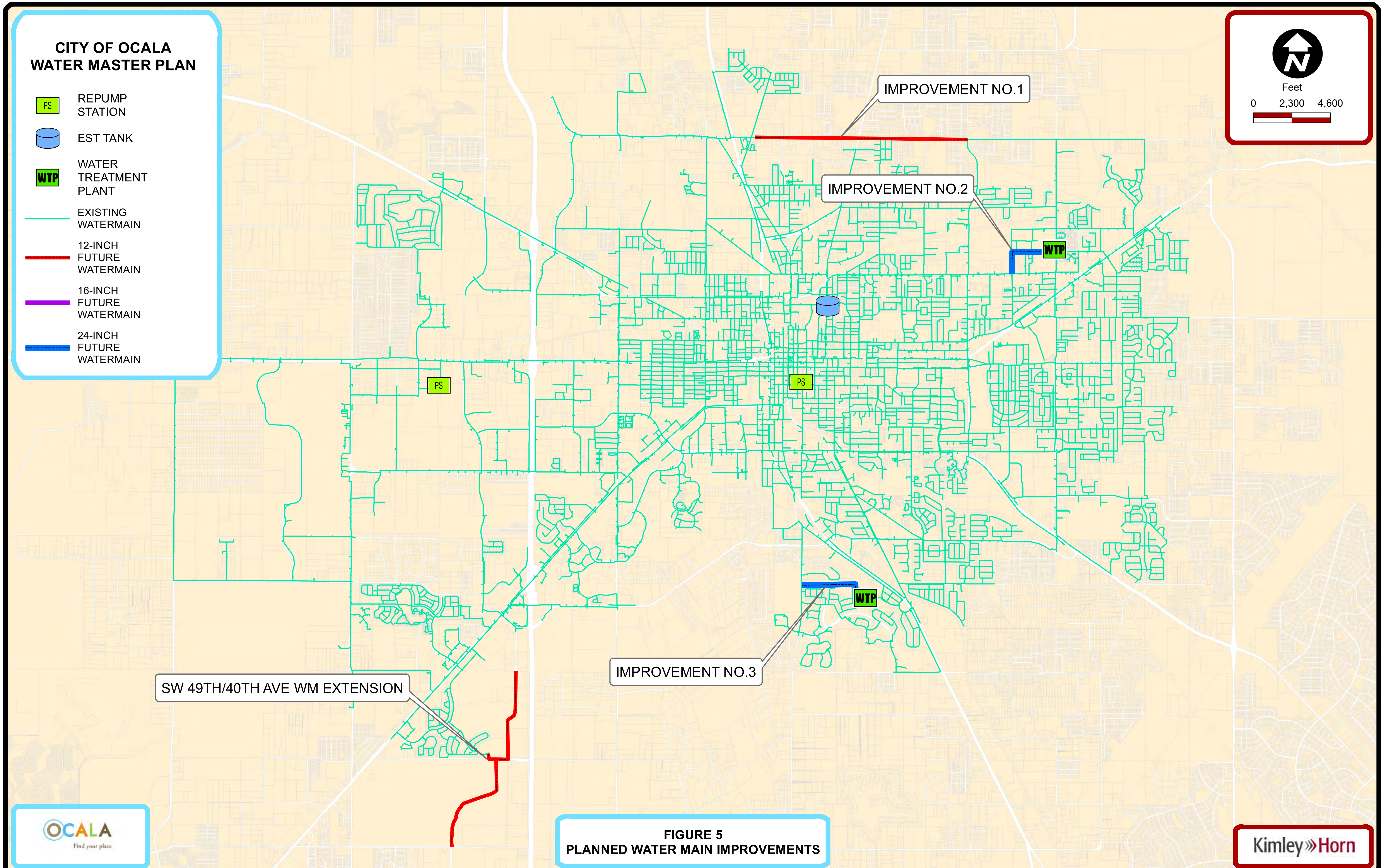


FIGURE 5
PLANNED WATER MAIN IMPROVEMENTS

Scenario 3 - 5-Year Demands with City Planned Improvements and WTP-2 Online

Scenario 3 modeled the City's PWS from *Scenario 2* at MDD, MDD+FF, and PHD with the projected 5-year demands, but also included the WTP-2 online. ***Scenario 3*** assumes that WTP-2 is operating to maintain a pressure of 58 psig. **Table 17** summarizes the results of the scenario.

- **PWS Improvement No. 4 -** Operate WTP-2 (Well No.6) to maintain a pressure of 58 psig. Install two (2) 10,000-gallon hydropneumatic tanks to minimize pump run times and cycling.

Table 17 - Scenario 3 Model Results

Demands	Min. System Pressure (psig)	Avg. System Pressure (psig)	Min. Available Fire Flow (gpm)
MDD	40	71	N/A
MDD+FF	20	68	991
PHD	37	67	N/A

The model results show that with WTP-2 online, the City of Ocala PWS is operating within the minimum system parameters established by FDEP and by the City of Ocala, however WTP-1 is still operating at maximum firm high service pumping capacity. The available fire flow coverage meets the minimum hydraulic parameters with the exception of one fire hydrant that is not capable of meeting the minimum 1,000 gpm fire flow during a max day demand with a minimum residual pressure of 20 psig. The single hydrant that cannot meet minimum hydraulic standard is located on NE 28th Avenue and the ID number is FH03095.

Scenario 4 - 5-Year Demands with City Planned Improvements, WTP-2 Online, and HSP upgrades at WTP-1

Scenario 4 modeled the City's PWS from Scenario 3 at MDD, MDD+FF, and PHD with the projected 5-year demands, WTP-2 online and high service pump upgrades at WTP-1. Scenario 4 assumes that WTP-2 is operating to maintain a pressure of 58 psig and the firm HSP capacity at WTP-1 has been upgraded to 24.43 MGD MDD. **Table 18** summarizes the results of the scenario.

- **PWS Improvement No. 5A -** Purchase a back-up high service pump to increase the un-installed firm high service pump capacity at WTP-1 to 16.50 MGD to meet the projected peak hour demands.
- **PWS Improvement No. 5B -** Install new high service pump to increase the installed firm high service pump capacity at WTP-1 to 16.50 MGD MDD to meet the 20-year projected peak hour demands.

Table 18 - Scenario 4 Model Results

Demands	Min. System Pressure (psig)	Avg. System Pressure (psig)	Min. Available Fire Flow (gpm)
MDD	40	71	N/A
MDD+FF	20	68	991
PHD	38	67	N/A

The model results show that with WTP-2 online and with HSP upgrades at WTP-1 the City of Ocala PWS is operating within the minimum system parameters established by FDEP and by the City of Ocala. Both WTPs are operating within their capacities. The available fire flow coverage meets the minimum hydraulic parameters with the exception of one fire hydrant that is not capable of meeting the minimum 1,000 gpm fire flow during a max day demand with a minimum residual pressure of 20 psig. The single hydrant that cannot meet minimum hydraulic standard is located on NE 28th Avenue and the ID number is FH03095.

10-YEAR (2027) ANALYSIS

This scenario includes the anticipated additional demands from the existing service area, infill areas, new developments and STAWEP. Separate scenarios were modeled to determine which scenario triggers the need for each individual system improvement to be constructed between 2023 and 2027. Each water main improvement was also evaluated in the 20-year scenario, so that it was properly sized to meet the 20-year projected demands.

Scenario 5 - 10-Year Projected Demands

Scenario 5 modeled the City's PWS from Scenario 4 at MDD, MDD+FF, and PHD with the projected 10-year demands. **Table 19** summarizes the results of the scenario.

Table 19 - Scenario 5 Model Results			
Demands	Min. System Pressure (psig)	Avg. System Pressure (psig)	Min. Available Fire Flow (gpm)
MDD	40	70	N/A
MDD+FF	20	67	988
PHD	36	67	N/A

The model results show that under Scenario 5 the City's PWS is operating within the minimum system parameters established by FDEP and by the City of Ocala. The available fire flow coverage meets the minimum hydraulic parameters with the exception of one fire hydrant that is not capable of meeting the minimum 1,000 gpm fire flow during a max day demand with a minimum residual pressure of 20 psig. The single hydrant that cannot meet minimum hydraulic standard is located on NE 28th Avenue and the ID number is FH03095. Though the City's system is meeting the minimum hydraulic standards, WTP-2 is operating at the plants maximum pumping capacity, the Downtown repump station is operating at max pumping capacity without backup redundancy (firm capacity), and the Downtown and SR-40 repump stations do not have the storage capacity to meet the peak hour demands for four consecutive hours (FAC 62-555.320) based on their discharge flow rates.

Scenario 6 - 10-Year Projected Demands with required improvements

Scenario 6 modeled the City's PWS from Scenario 5 at MDD, MDD+FF, and PHD, but with the required improvements to meet the projected 10-Year demands. **Table 20** summarizes the results of the scenario. The required improvements to meet the projected 10-year demands are listed below and shown in **Figure 6**:

- **PWS Improvement No. 6:** Expand WTP-2 (Well No.6) to have a minimum max day operating capacity of 5.00 MGD and an operating discharge pressure of 65 psig.
- **PWS Improvement No. 7:** Expand the firm high service pumping capacity of the Downtown repump station to 2.88 MGD MDD (4,000 gpm).
- **PWS Improvement No. 8:** Construct 3,400 LF of 24-inch PVC water main and 8,600 LF of 20" PVC water main along SW 32nd Ave from SE 3rd Ave to SW 27th Ave. Construct 2,000 LF of 12" PVC water main along SW 27th Ave from SW 41st St to SW 24th Ave.

Table 20 - Scenario 6 Model Results			
Demands	Min. System Pressure (psig)	Avg. System Pressure (psig)	Min. Available Fire Flow (gpm)
MDD	40	70	N/A
MDD+FF	20	67	988
PHD	36	66	N/A

The model results show that under Scenario 6 all the City's WTPs and repump stations are operating within their design capacity and the City's PWS is operating within the minimum system parameters established by FDEP and by the City of Ocala. The available fire flow coverage meets the minimum hydraulic parameters with the exception of one fire hydrant that is not capable of meeting the minimum 1,000 gpm fire flow during a max day demand with a minimum residual pressure of 20 psig. The single hydrant that cannot meet minimum hydraulic standard is located on NE 28th Avenue and the ID number is FH03095.

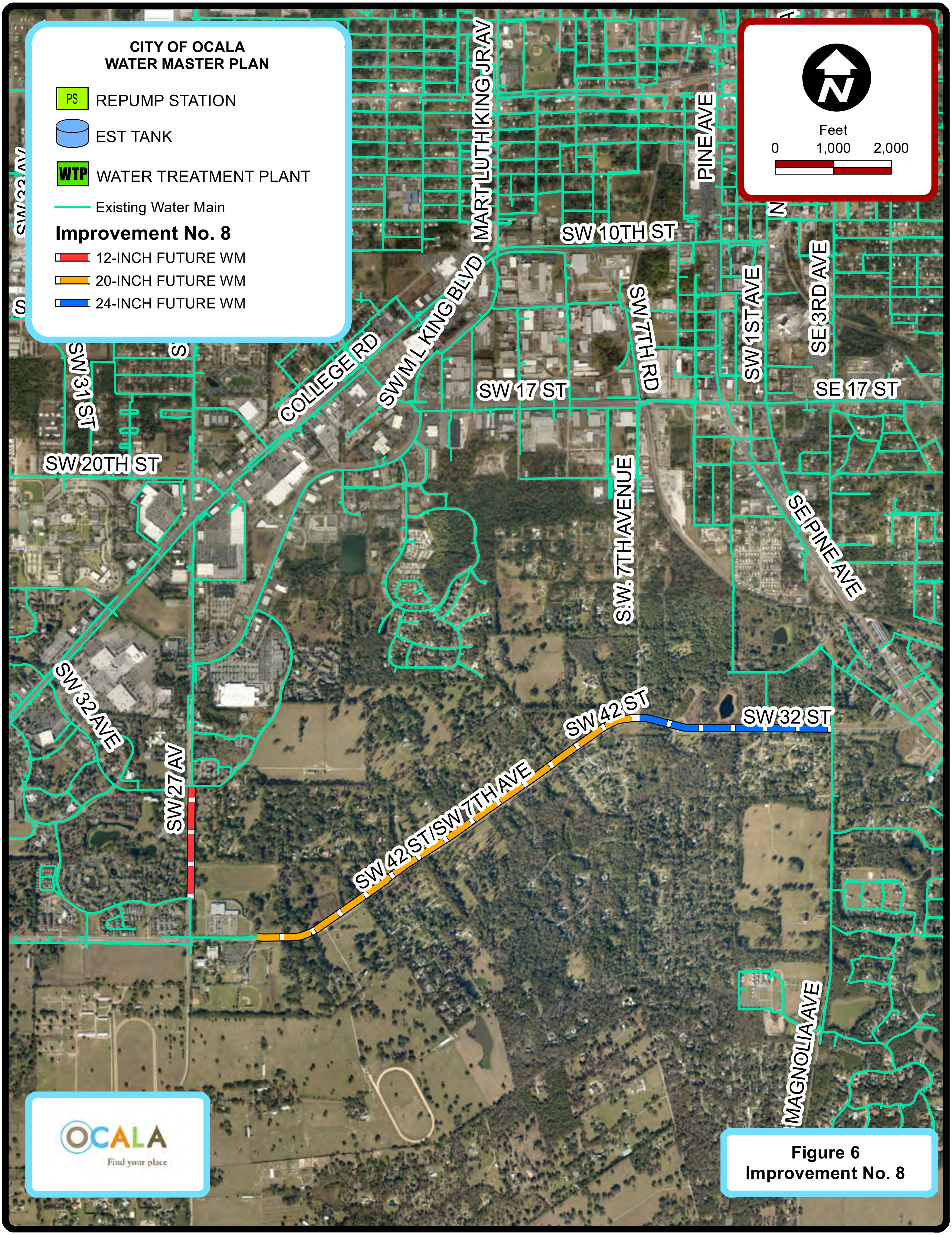


Figure 6
Improvement No. 8

20-YEAR (2037) ANALYSIS

Scenario 7 - 20-Year Projected Demands

Scenario 7 modeled the City's PWS from **Scenario 6** at MDD, MDD+FF, and PHD with the projected 20-year demands. **Table 21** summarizes the results of the scenario. The required improvements to meet the projected 20-year demands are listed below:

Table 21 - Scenario 7 Model Results			
Demands	Min. System Pressure (psig)	Avg. System Pressure (psig)	Min. Available Fire Flow (gpm)
MDD	40	72	N/A
MDD+FF	20	70	989
PHD	26	58	N/A

The model results show the existing City's PWS is not operating within the minimum system pressure standard established by the City of Ocala during a peak hour scenario. The available fire flow coverage meets the minimum hydraulic parameters with the exception of one fire hydrant that is not capable of meeting the minimum 1,000 gpm fire flow during a max day demand with a minimum residual pressure of 20 psig.

Scenario 8: 20-Year Projected Demands with required improvements

Scenario 8 modeled the City's PWS from Scenario 7 at MDD, MDD+FF, and PHD but with the required improvements to meet the projected 20-Year demands. **Table 22** summarizes the results of the scenario. The required improvements to meet the projected 20-year demands are listed below and shown in **Figure 7**:

- **PWS Improvement No. 9:** Construct 3,700 LF of 16-inch PVC water main along SW 7th Ave from SW 32nd Ave to SW 20th St.
- **PWS Improvement No. 10:** Expand WTP-2 (Well No.6) to have a minimum max day operating capacity of 11.20 MGD and an operating discharge pressure of 75 psig.

Table 22 - Scenario 8 Model Results			
Demands	Min. System Pressure (psig)	Avg. System Pressure (psig)	Min. Available Fire Flow (gpm)
MDD	44	73	N/A
MDD+FF	20	70	997
PHD	35	62	N/A

The model results show that under **Scenario 8** all the City's WTPs and repump stations are operating within their capacity and the City's PWS is operating within the minimum system parameters established by FDEP and by the City of Ocala. The available fire flow coverage meets the minimum hydraulic parameters with the exception of one fire hydrant that is not capable of meeting the minimum 1,000 gpm fire flow during a max day demand with a minimum residual pressure of 20 psig. The single hydrant that cannot meet minimum hydraulic standard is located on NE 28th Avenue and the ID number is FH03095.

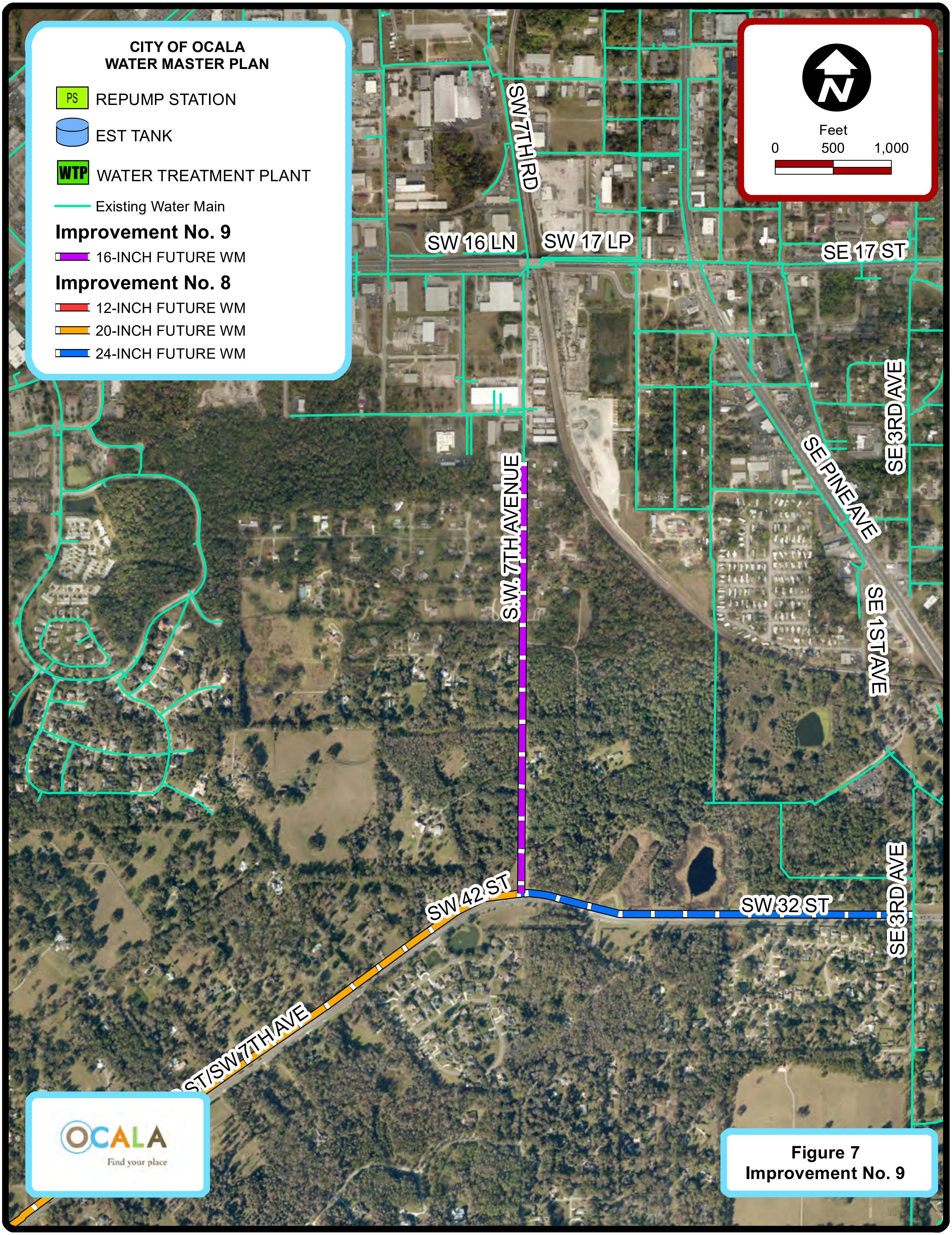


Figure 7
Improvement No. 9

WATER SYSTEM IMPROVEMENTS

INTRODUCTION

This section provides a discussion of the improvement projects necessary to address current deficiencies and meet future potable water demands. Included in this section is project list with probably costs of construction for recommended projects at the present, 5-year, 10-year, and 20-year planning horizon. The proposed improvements were developed through system modeling and discussions and coordination with City staff. Please see **Appendix F** for an opinion of probable cost for each individual improvement listed below.

WATER SYSTEM IMPROVEMENTS

WITHIN THE NEXT 5 YEARS

PWS Improvement No. 4

Operate WTP-2 (Well No.6) to maintain a pressure of 58 psig. Install two 10,000-gallon Hydroneumatic tanks to minimize pump run times and cycling. The estimated design, permitting, and construction cost for this project is approximately $319,000.

PWS Improvement No. 5A

Purchase a back-up high service pump to increase the un-installed firm high service pumping capacity at WTP-1 to 16.50 MGD to meet the projected peak hour demands. The estimated cost for this project is $250,000.

PWS Improvement No. 5B

Replace high service pumps No.1, No.2, and No.4 and associated drives (as required) to increase the installed firm high service pump capacity at WTP-1 to 16.50 MGD MDD (23,000 gpm) to meet the 20-year projected peak hour demands. The estimated design, permitting, and construction cost for this project is approximately $1,740,000.

WITHIN THE NEXT 10 YEARS

PWS Improvement No. 6

Expand WTP-2 to have a max day operating capacity of 5.00 MGD and an operating discharge pressure of 65 psig. See the *City of Ocala Water Treatment Facility Feasibility Analysis* for final sizing and opinion of probable cost

PWS Improvement No. 7

Replace the existing high service pumps at the Downtown repump station and expand the firm high service pumping capacity of the Downtown repump station to 2.88 MGD MDD (4,000 gpm). The estimated design, permitting, and construction cost for this project is approximately $725,000.

PWS Improvement No. 8

Construct 3,400 LF of 24-inch PVC water main and 8,600 LF of 20" PVC water main along SW 32nd Ave from SE 3rd Ave to SW 27th Ave. Construct 2,000 LF of 12" PVC water main along SW 27th Ave from SW 41st St to SW 24th Ave. The estimated design, permitting, and construction cost for this project is approximately $4,089,000.

WITHIN THE NEXT 20 YEARS

PWS Improvement No. 9

Construct 3,700 LF of 16-inch PVC water main along SW 7th Ave from SW 32nd Ave to SW 20th St. The estimated design, permitting, and construction cost for this project is approximately $942,500.

PWS Improvement No. 10

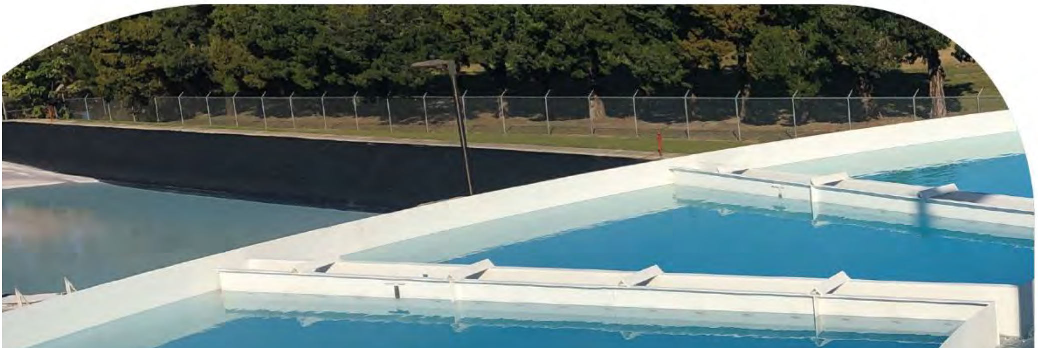
Expand WTP-2 to have at least a max day operating capacity of 11.20 MGD and an operating discharge pressure of 75 psig. See the *City of Ocala Water Treatment Facility Feasibility Analysis* for final sizing and opinion of probable cost.

OCALA
Find your place

CITY OF OCALA

Water Resource Plan

APPENDICES



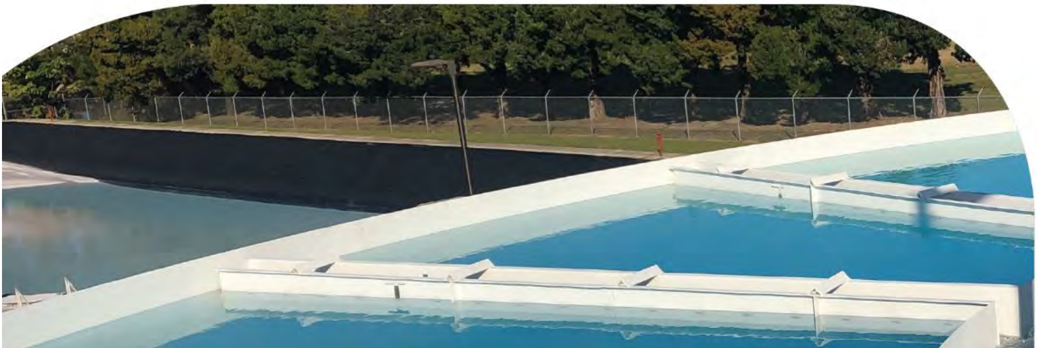
Kimley»Horn

CITY OF OCALA

Water Resource Plan

OCALA
Find your place

APPENDIX A:
WATER AND WASTEWATER DEMAND PROJECTIONS



Kimley»Horn

	AREA	2018			2022 5-Year			2028 10-Year			2038 20-Year		
		ERU	W ADD (GPD)[2]	WW ADD (GPD)[3]	ERU	W ADD (GPD)[2]	WW ADD (GPD)[3]	ERU	W ADD (GPD)[2]	WW ADD (GPD)[3]	ERU	W ADD (GPD)[2]	WW ADD (GPD)[3]
EXISTING	Existing Utility Service Area[1]	58,362	11,504,201	5,784,000	58,362	11,504,201	5,784,000	58,362	11,504,201	5,784,000	58,362	11,504,201	5,784,000
INFILL	Residential	-	-	-	6,570	1,971,133	1,642,611	7,967	2,390,098	1,991,748	10,202	3,060,571	2,550,476
	Commercial/Industrial	-	-	-	2,114	634,202	528,502	4,228	1,268,404	1,057,003	8,456	2,536,808	2,114,007
	Subtotal	58,362	11,504,201	5,784,000	67,046	14,109,536	7,955,112	70,557	15,162,703	8,832,751	77,020	17,101,581	10,448,483
EXPANSION	Residential	-	-	-	6,573	1,971,902	1,643,252	7,980	2,394,124	1,995,103	9,438	2,831,257	2,359,381
	Commercial/Industrial	-	-	-	565	169,498	141,248	1,130	338,996	282,497	2,260	677,993	564,994
	Subtotal	-	-	-	7,138	2,141,400	1,784,500	9,110	2,733,120	2,277,600	11,697	3,509,250	2,924,375
DEVELOPMENT	Heath Preserve	-	-	-	414	124,200	103,500	414	124,200	103,500	414	124,200	103,500
	Winding Oaks Commercial	-	-	-	525	157,505	131,254	525	157,505	131,254	525	157,505	131,254
	AutoZone Shipping Facility	-	-	-	16	4,910	4,092	16	4,910	4,092	16	4,910	4,092
	Chewy Shipping Facility	-	-	-	17	5,000	4,167	17	5,000	4,167	17	5,000	4,167
	McClain Industrial	-	-	-	17	5,000	4,167	17	5,000	4,167	17	5,000	4,167
	Windstream, Carriage Hill, Bellwither	-	-	-	150	45,000	37,500	150	45,000	37,500	150	45,000	37,500
	Subtotal	-	-	-	1,139	341,615	284,679	1,139	341,615	284,679	1,139	341,615	284,679
STAWEP	Future Connections	-	-	-	412	123,745	103,120	430	128,974	107,478	446	133,687	111,406
	Subtotal	-	-	-	412	123,745	103,120	430	128,974	107,478	446	133,687	111,406
	Total	58,362	11,504,201	5,784,000	75,736	16,716,296	10,127,412	81,236	18,366,412	11,502,509	90,302	21,086,132	13,768,942

1 *From Historical FDEP MOR and DMR Data*
2 *300 gpd/ERU City of Ocala Level of Service*
3 *250 gpd/ERU City of Ocala WW Level of Service*
4 Assumed 2.35 people per ERU

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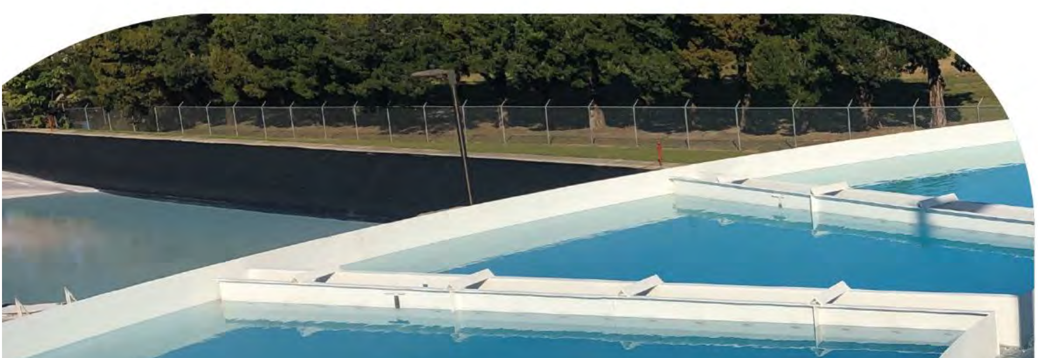
APPENDIX B:
CAPACITY ANALYSIS



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CAPACITY ANALYSIS SUMMARY AND CALCULATIONS

INTRODUCTION

The capacity analysis evaluates the capacity of source, treatment and storage facilities connected to a water system. This capacity analysis evaluates the existing capacity of the consolidated City of Ocala PWS. Operating data from 2018 was utilized in the analysis. Specific WTP information was obtained from the latest Sanitary Survey and in coordination with City staff. The FAC Chapter 62-555 (Permitting, Construction, Operation, and Maintenance of Public Water Systems) was used in evaluating the capacity of the wells, finished water storage, and pumping capacity.

CAPACITY EVALUATION CRITERIA

The individual plant capacities were determined by applying strict conformance with FDEP Rule 62-555. The following assumptions were used in the capacity evaluation calculations:

1. For all individual WTP capacity analyses, it was assumed that the standby pump requirement of 62-555.320 (15) (c) was met by an installed standby pump at each WTP.
2. Peaking factors of 1.35 MDD: ADD, and 2.70 PHF: ADD were used.
3. The combined system capacity was determined by the sum of the active individual WTP and booster pump station capacities.

WELL CAPACITY

Criteria #1

According to FDEP Rule 62-555.315 (3), the total well capacity for a water system using only ground water shall equal at least the system’s design maximum day water demand (including design fire flow demand if fire protection is being provided).

In the case of a well providing source water for a ground storage tank system, the required fire flow demand is the fire flow replenishment rate (flow required to replenish the required fire storage volume in a 24-hour period).

Criteria #2

In addition, for community systems serving 350 or more persons (or 150 or more service connections), the total well capacity with the largest producing well out of operation shall be equal to the design average daily flow (ADF) and preferably the design maximum daily flow (MDF).

FINISHED WATER STORAGE CAPACITY

Criteria #1

According to FDEP Rule 62-555.320 (19), the total useful finished-water storage capacity (excluding any storage capacity for fire protection) connected to a water system shall at least equal 25 percent of the system's maximum-day water demand, excluding any design fire flow demand.

The assumed fire flow rate is 1,000 gpm and the design fire flow duration is two hours. Therefore, the fire flow rate multiplied by fire flow duration is 120,000 gallons.

Criteria #2

FDEP Rule 62-555.320 (19) also requires additional finished water storage capacity to meet the design fire flow rate for the design fire flow duration.

PUMPING CAPACITY

Criteria #1 – Without Elevated Storage Tank

FDEP Rule 62-555.320 (a) provides HSP requirements for systems that do not have elevated storage capacity. Since the City of Ocala PWS has an elevated storage tank (EST), the requirements of 62-555.320 (a) do not apply.

According to FDEP Rule 62-555.320 (15) (a), unless elevated finished drinking water storage is provided, the total capacity of all high-service pumping stations connected to a water system, or the capacity of booster pumping stations, shall be sufficient to meet at least the water systems, or booster station services areas, peak-hour water demand (and if fire protection is being provided, meet at least the water systems, or booster station service areas, design fire-flow rate plus a background water demand equivalent to the maximum-day demand other than fire-flow demand); and maintain a minimum system pressure of 20 pounds per square inch.

Criteria #2 and #3 – With Elevated Storage Tank

FDEP Rule 62-555.320 (15) (b), where elevated finished drinking water storage is provided, the total capacity of all high service pumping stations shall be sufficient to meet the maximum day water demand (including design fire flow demand) and to maintain a minimum system pressure of 20 pounds per square inch.

In addition, per FDEP Rule 62-555.320 (15) (b), the total capacity of the high-service pumping stations, or the capacity of the booster pumping station, combined with the useful elevated finished-water storage capacity shall be sufficient to meet the water systems, or the booster station service areas, peak-hour water demand for at least four consecutive hours (and if fire protection is being provided, shall be sufficient to meet the water systems, or the booster station service areas, design fire-flow rate plus a background water demand equivalent to the maximum-day demand other than fire-flow demand for the design fire-flow duration).

CALCULATIONS

See the next section containing the capacity analysis calculations for the consolidated City of Ocala PWS.

CITY OF OCALA WITH EST

Facility Type - High Service Pump w/ Ground Storage

SYSTEM PARAMETERS

Fire Flow Rate	1,500	gpm
Fire Flow Duration	2	hrs
Fire Flow Demand[1]	180,000	gallons
Fire Flow Replenishment Rate[2]	125	gpm
Average Day Demand	11,306,657	gpd
Average Day Demand	7,852	gpm
Maximum Day Demand	15,263,987	gpd
Maximum Day Demand	10,600	gpm
Max Day Factor (MDF/ADF)[4]	1.35	
Peak Hour Factor[4]	2.70	
Peak Hour Demand	30,527,974	gpd
Peak Hour Demand	21,200	gpm
Is Elevated Storage Available?	yes	"yes" or "no"
Total EST Storage Available to WTP's Service Area	500,000	gallons

NOTES:

[1] Fire-flow demand as defined by 62-555.520(4)(a)3c is fire-flow rate times duration.

[2] Fire replenishment rate is the fire-flow demand divided by 24 hours.

[3] Maxium day demands were taken from the 2018 MOR Data.

[4] FDEP peaking factors 1.3 ADD/MDD, 2.6 ADD/PHF were used based on MORs Historical Data

WELL CAPACITY

Criteria #1 According to FDEP Rule 62-555.315 (3), the total well capacity for a water system using only ground water shall equal at least the system's design maximum day water demand (including design fire flow demand if fire protection is being provided).

Criteria #2 In addition, for community systems serving 350 or more persons (or 150 or more service connections), the total well capacity with the largest producing well out of operation shall be equal to the design average daily flow (ADF) and preferably the design maximum daily flow (MDF).

Well Name	Pumping Capacity (gpm)
1 (AAE0012) (WTP-1)	3,500
2 (AAE0113) (WTP-1)	3,500
3 (AAE0113) (WTP-1)	3,500
4 (AAE0015) (WTP-1)	3,500
5 (AAE00116) (WTP-1)	3,000
6 (AAH2587) (WTP-2)	3,500

Criteria #1

	Well Capacity	
Total Available Well Capacity	20,500	gpm
Fire-flow Demand (EST replenishment rate)	125	gpm
Net Available Total Well Capacity	20,375	gpm
Available Max Day Demand	29,340,000	gpd
Rated Capacity (MDF)	20,375	gpm
Rated Capacity (MDF)	**29,340,000**	**gpd**

Criteria #2

Total Well Capacity	20,500	gpm
Largest Well	3,500	gpm
Well Capacity w/ Largest Well Out of Service	17,000	gpm
Rated Capacity (ADF or MDF)	17,000	gpm
Rated Capacity Assuming ADF is met with largest well out of service (MDF)	**33,048,000**	**GPD**
Rated Capacity Assuming MDF is met with largest well out of service (MDF)	**24,480,000**	**GPD**

FINISHED WATER STORAGE CAPACITY

According to FDEP Rule 62-555.320 (19) - Finished-Drinking-Water Storage Capacity. This subsection addresses finished-water storage capacity necessary for operational equalization to meet peak water demand. (If fire protection is being provided, additional finished-water storage capacity shall be provided as necessary to meet the design fire-flow rate for the design fire-flow duration.) The finished-water storage capacity necessary to meet the peak water demand for a consecutive system may be provided by the consecutive system or by a wholesale system delivering water to the consecutive system.

(a) Except as noted in paragraph (b) below, the total useful finished-water storage capacity (excluding any storage capacity for fire protection) connected to a water system shall at least equal 25 percent of the system's maximum-day water demand, excluding any design fire-flow demand.
(b) A total useful finished-water storage capacity less than that specified in paragraph (a) above is acceptable if the supplier of water or construction permit applicant makes one of the following demonstrations:

Criteria #1

1. A demonstration consistent with Section 10.6.3 in Water Distribution Systems Handbook as incorporated into Rule 62-555.330, F.A.C., showing that the water system's total useful finished-water storage capacity (excluding any storage capacity for fire protection) is sufficient for operational equalization.
2. A demonstration showing that, in conjunction with the capacity of the water system's source, treatment, and finished-water pumping facilities, the water system's total useful finished-water storage capacity (excluding any storage capacity for fire protection) is sufficient to meet the water system's peak-hour water demand for at least four consecutive hours. For small water systems with hydropneumatic tanks that are installed under a construction permit for which the Department receives a complete application on or after August 28, 2003, the supplier of water or construction permit applicant also shall demonstrate that, in conjunction with the capacity of the water system's source, treatment, and finished-water pumping facilities, the water system's total useful finished-water storage capacity (i.e., the water system's total effective hydropneumatic tank volume) is sufficient to meet the water system's peak instantaneous water demand for at least 20 consecutive minutes.

Storage Tank Name	Location	Type of Storage	Capacity (gallons)
G1	Ocala WTP	GST	2,000,000
G2	Ocala WTP	GST	2,000,000
Ee	City of Ocala	EST	500,000
G3	SR-40	GST	1,000,000
G4	Downtown	EST	1,000,000

Criteria #1 (a)

Total Finished Water Storage Avaliable	6,500,000	gallons
Additional Storage Required for Fire Flow Rate x Duration	180,000	gallons
Additional Storage Required for Vortex Prevention	380,686	gallons
Total Useful Finished Water Storage Capacity	5,939,314	gallons
Rated Capacity (Based on 25% of MDF)	**23,757,257**	**gpd**

Criteria #1 (b) **Demonstration 2**

Total Finished Water Storage Avaliable	6,500,000	gallons
Fire Flow Storage Required	180,000	gallons
Additional Storage Required for Vortex Prevention	380,686	gallons
Useful Finished Water Storage Capacity	5,939,314	gallons
Firm Pump Capacity	17,000	gpm
Combined pump and useful storage capacity for 4 hours	10,019,314	gallons
Combined pump and useful storage capacity for 4 hours	41,747	gpm
Peak Hour Demand	21,200	gpm
Peak Hour Demand for 4 Hours	5,087,996	gallons
MDF Rated Capacity (Based on meeting PHD for 4 hours)	**60,115,886**	**gpd**

PUMPING CAPACITY

Criteria #1

According to FDEP Rule 62-555.320 (15) (a), unless elevated finished drinking water storage is provided, the total capacity of all high-service pumping stations connected to a water system, or the capacity of booster pumping stations, shall be sufficient to meet at least the water system's, or booster station services area's, peak-hour water demand (and if fire protection is being provided, meet at least the water system's, or booster station service area's, design fire-flow rate plus a background water demand equivalent to the maximum-day demand other than fire-flow demand); and maintain a minimum system pressure of 20 pounds per square inch.

Criteria #2

According to FDEP Rule 62-555.320 (15) (b), where elevated finished drinking water storage is provided, the total capacity of all high service pumping stations shall be sufficient to meet the maximum day water demand (including design fire flow demand) and to maintain a minimum system pressure of 20 pounds per square inch.

Criteria #3

In addition, per FDEP Rule 62-555.320 (15) (b), the total capacity of the high-service pumping stations, or the capacity of the booster pumping station, ***combined*** with the useful elevated finished-water storage capacity shall be sufficient to meet the water system's, or the booster station service area's, peak-hour water demand for at least four consecutive hours (and if fire protection is being provided, shall be sufficient to meet the water system's, or the booster station service area's, design fire-flow rate plus a background water demand equivalent to the maximum-day demand other than fire-flow demand for the design fire-flow duration).

Pump Name	Location	Capacity (gpm)		
1	Ocala WTP	6,000		
2	Ocala WTP	5,000		
3	Ocala WTP	7,000		
4	Ocala WTP	4,900	22,900	15,900
1	Downtown Pump Station	1,500	7,633.33	
2	Downtown Pump Station	1,500		
1	SR 40 Pump Station	1,500		
2	SR 40 Pump Station	1,500		
3	SR 40 Pump Station	1,500		
4	SR 40 Pump Station	1,500		
6 (AAH2587)	WTP-2	3,500		

Criteria #1

Total HSP Pumping Capacity	N/A	gpm
HSP Pumping Capacity with Largest Unit Out of Service	N/A	gpm
Fire Flow Rate	N/A	gpm
Max Day Factor	N/A	
Peak Hour Factor	N/A	
Capacity Based on Meeting Peak Hour Demand (MDF)	**N/A**	**gpm**
Capacity Based on Meeting Fire Flow @ Max Day Demand	**N/A**	**gpm**

Criteria #2

Total HSP Pumping Capacity	35,400	gpm
HSP Pumping Capacity with Largest Unit Out of Service	28,400	gpm
Fire Flow Demand (Replenishment Rate)	125	gpm
Net Available Pumping Capacity	28,275	gpm
Potentinal Rated Capacity (MDF)	**40,716,000**	**gpd**

Criteria #3a

Total HSP Pumping Capacity	35,400	gpm
HSP Pumping Capacity with Largest Unit Out of Service	28,400	gpm
Useful EST Storage Capacity (Total)	500,000	gallons
Useful EST Storage Capacity (gpm for 4 hours)	2,083	gpm
Combined Useful EST and HSP Capacity Available for Peak Hour Flow for 4 Hours	30,483	gpm
Capacity Based on Meeting Peak Hour Flow for 4 Consecutive Hours (MDF)	**21,948,000**	**gpd**

Criteria #3b

Total HSP Pumping Capacity	35,400	gpm
HSP Pumping Capacity with Largest Unit Out of Service	28,400	gpm
Elevated Storage Available to WTP's Service Area	500,000	gallons
Useful EST Storage Capacity Available for Max Day Demand for the Fire Flow Duration	4,167	gpm
Combined Useful EST and HSP Capacity Available for MDF and Fire Flow Rate for Fire Flow Duration	32,567	gpm
Capacity Based on Meeting Fire Flow Rate plus MDF for Fire Flow Duration (MDF)	**46,896,000**	**gpd**

NOTE: At each high-service or booster pumping station that is constructed or altered under a construction permit for which the Department receives a complete application on or after August 28, 2003, and that is connected to a community water system (CWS) serving, or designed to serve, 350 or more persons or 150 or more service connections, the supplier of water shall provide an installed or uninstalled standby pump of sufficient capacity to replace the largest pump. However, for CWSs that have multiple interconnected pumping stations subject to this requirement, the supplier of water may provide one uninstalled standby pump for each size of high-service or booster pump installed in the water system instead of providing a standby pump on site at each high-service or booster pumping station; and for water systems that have only one pumping station subject to this requirement and that are designed to serve 10,000 or fewer persons, as many as three water systems located in the same county, or within 50 miles of one another, may enter into a mutual aid agreement to share one appropriately sized, uninstalled standby pump instead of providing a standby pump on site at each water system's high-service or booster pumping station.

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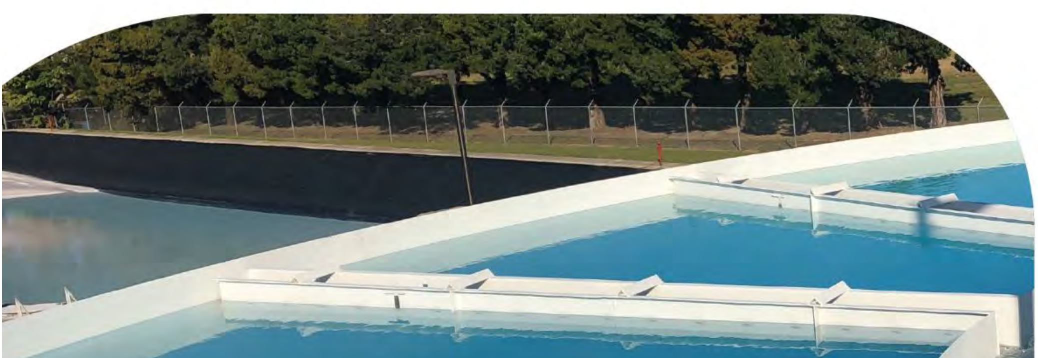
APPENDIX C:
MODEL CALIBRATION SUMMARY



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MODEL CALIBRATION

BACKGROUND

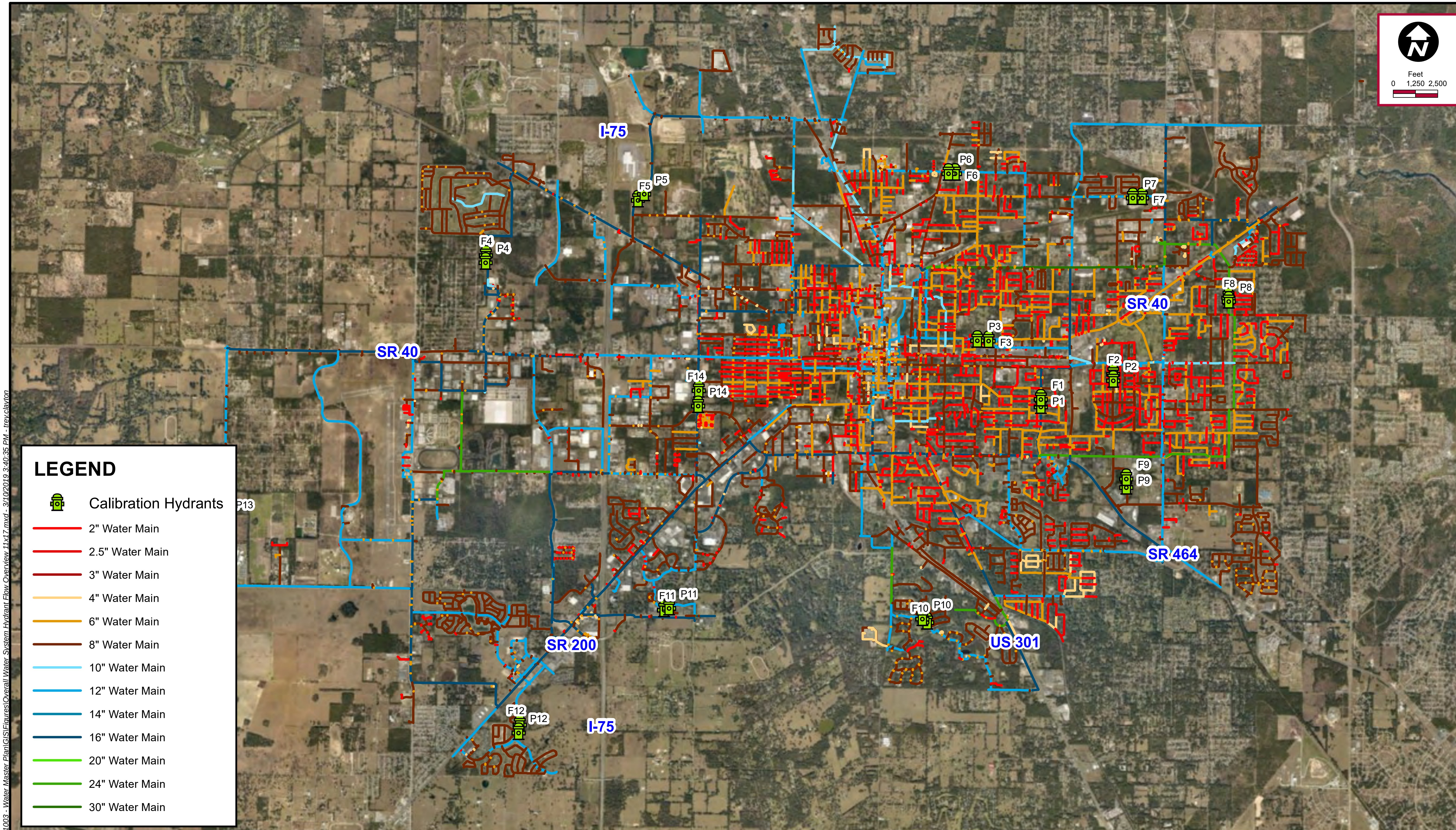
The hydraulic model was calibrated by conducting fire hydrant flow tests, simulating each hydrant flow test in the model, comparing the field results against model results, and making adjustments or corrections to the model as required. Each test used two hydrants (one flow hydrant and one pressure hydrant). Fire hydrant flow tests were conducted by first measuring the static pressure at the pressure hydrant. Then, the flow hydrant was completely opened and allowed to flow for five minutes. Flow and the corresponding residual pressure were measured and recorded. Finally, the flow hydrant was partially closed so the hydrant flowed at approximately half of full flow for one minute. During each hydrant flow tests, operating pressures and flows were recorded at the City's WTP and pump stations so that during the model calibration process not only are the hydrants calibrated, by the operating pressures and flows at the water treatment plants are calibrated as well.

The fire flow demands were input into the model and simulated one at a time and corresponding pressures are checked at the corresponding pressure hydrants to ensure that the model is reasonably predicting what was observed in the field. In the calibration process, elements within the model (i.e. demands, operating pressure, C value) may be adjusted to tune the model against field observations. For the City of Ocala model, a C value of 130 was used for all piping infrastructure in the model. All water treatment plants were set to the operating pressures that were observed in the field. For each separate hydrant test that was run in the model, a separate demand set was created to accurately reflect the demand on the City of Ocala system during that specific hydrant test. A model is generally considered calibrated when it is able to simulate a pressure drop and flow within 10% of those measured in the field. Kimley-Horn performed 13 fire hydrant flow tests in the City of Ocala PWS at 13 different locations (See Figure 1). The results of the fire hydrant flow tests and calibration are shown in Table 1.

RECONCILE DISCREPANCIES

Kimley-Horn reviewed all discrepancies between model and field results greater than 10%. The differences between measured and predicted values were analyzed to see how close the model reflects the actual system. When the differences were greater than 10%, the model was reviewed for possible errors in connectivity or other unknown conditions in the distribution system. Possible errors in the model were reviewed by conducting coordination meetings with City of Ocala staff, reviewing system maps, and considering discrepancies in operating conditions of the system during the fire hydrant flow test days. After review, errors found in the model were corrected and fire flow test calibration was rerun.

Following the iterative calibration process, 11 of 13 of the static and residual pressures from the fire hydrant flows were within 10% of the simulated pressures in the model and the other 2 were within 15% of the simulated model pressures.



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101 E Silver Springs Blvd, Suite 400, Ocala FL 34470
Phone: 352 438 3000
www.kimley-horn.com CA 00000696

FIGURE 1:
HYDRANT FLOW LOCATIONS

WATER MASTER PLAN
CITY OF OCALA

Project No. 142371002
SCALE AS NOTED
JULY 2019
DRAWN BY: KHA

Table 1 : CALIBRATION RESULTS

Flow Hydrant	Flow Rate (gpm)	Fire Flow Tests Pressure (psi)	Model Results Pressure (psi)	% Error	% Difference	Time
		P1	P1			
F1	0	58	62	-6.9%	6.5%	10:16
	475	56	58	-3.6%	3.4%	
	950	54	59	-9.3%	8.5%	
		P2	P2			
F2	0	58	60	-3.4%	3.3%	10:01
	575	56	56.9	-1.6%	1.6%	
	1150	55	55.9	-1.6%	1.6%	
		P3	P3			
F3	0	54	53	1.9%	-1.9%	10:51
	540	53	57	-7.5%	7.0%	
	1080	52	56	-7.7%	7.1%	
		P4	P4			
F4	0	68	70	-2.9%	2.9%	9:49
	600	64	63	1.6%	-1.6%	
	1200	60	61	-1.7%	1.6%	
		P5	P5			
F5	0	71	73	-2.8%	2.7%	9:24
	750	69	71	-2.9%	2.8%	
	1150	66	63	4.5%	-4.8%	
		P6	P6			
F6	0	79	80.4	-1.8%	1.7%	8:46
	675	75	78	-4.0%	3.8%	
	1300	73	73.4	-0.5%	0.5%	
		P7	P7			
F7	0	86	82	4.7%	-4.9%	9:22
	650	83	81.4	1.9%	-2.0%	
	1325	82	78	4.9%	-5.1%	
		P8	P8			
F8	0	84	83	1.2%	-1.2%	9:43
	675	83	82.4	0.7%	-0.7%	
	1350	82	81.44	0.7%	-0.7%	
		P9	P9			
F9	0	82	83	-1.2%	1.2%	10:30
	650	80	81	-1.3%	1.2%	
	1300	77	77	0.0%	0.0%	
		P10	P10			
F10	0	56	57	-1.8%	1.8%	10:52
	530	56	54	3.6%	-3.7%	
	1060	49	48	2.0%	-2.1%	
		P11	P11			
F11	0	70	74	-5.7%	5.4%	10:34
	600	67	70	-4.5%	4.3%	
	1200	60	67	-11.7%	10.4%	
		P12	P12			
F12	0	68	68	0.0%	0.0%	N/A
	650	63.5	66	-3.9%	3.8%	
	1200	57.5	60	-4.3%	4.2%	
		P14	P14			
F14	0	69.5	74	-6.5%	6.1%	12:14
	640	64.5	73	-13.2%	11.6%	
	1250	68	72	-5.9%	5.6%	

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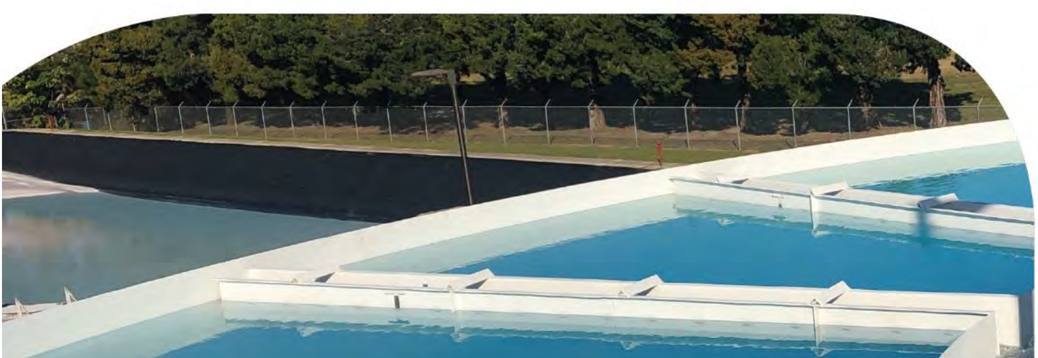
APPENDIX D:
SCENARIO MATRIX



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City of Ocala
Water System Master Plan
Scenario Analysis

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SCENARIO		Design Flows and Model Settings for WTP, Pump Station, and EST												Improvements								Model Results											
		WTP (gpm)					Flow Summary		Discharge Pressure Setting													WTP, Pump Station, EST Flow					Flow Summary		Pressures Results			Fire Flow Results		
		Ocala WTP No.1	SR 40	Downtown	EST	WTP No.2	GPM	MGD	Ocala WTP No.1	SR 40	Downtown	EST (ft)	WTP No.2	No. 1, 2, & 3	No.4	No.5	No.6	No.7	No.8	No.9	No.10	Ocala WTP No.1	SR 40	Downtown	EST	WTP No.2	Total Flow (gpm)	Total Flow (MGD)	Minimum System Pressure	Average System Pressure	Maximum System Pressure	Min. Fire Flow (gpm)	# of Fire Flow Less than 750 gpm	# of Fire Flow Less than 1000 gpm
1	Present Day ADD	15,900	x	x	x	x	15,900	11.04	81.61	71.00	57.00	x	x									6,944.83	-	-	-	x	6945	10.00	42.1	74.32	94.52			
1	Present Day MDD+FF	15,900	x	x	x	x	15,900	11.04				35-37	x									9,733.36	960.99	-	20.03	x	10714	15.43	39.16	72	93.5	1,303	-	-
1	Present Day PHF (Firm Capacity)	15,900	x	x	x	x	15,900	11.04	81.61	71.00	57.00	35-37	x									13,267.21	4,320.00	781.00	3,193.88	x	21562	31.05	36	67	92.01			
1	Present Day PHF (HSP on shelf)	22,900	x	x	x	x	22,900	15.90	81.61	71.00	57.00	x	x													x	0							
							-	-																			0	0.00						
2	5-Year MDD/MDD + FF	15,900					15,900	11.04	81.61	71.00	57.00	35-37	x	X								12,336.00	1,235.18	2,035.52	-	-	15607	22.47	38.8			974	-	1
2	5-Year PHF	15,900					15,900	11.04	81.61	71.00	57.00	35-37	x	X								15,884.00	7,343.10	4,762.05	3,007.00		30996	44.63	34.32	66.51	90.07			
							-	-																			0	0.00						
3	5-Year MDD/MDD + FF	15,900	x	x	x	3,500	19,400	13.47	81.61	71.00	57.00	35-37	58.00	X	X							11,604.37	1,012.90	1,029.87	386.74	1,573.05	15607	22.47	40.01	70.5	92	991	-	1
3	5-Year PHF	15,900	x	x	x	3,500	19,400	13.47	81.61	71.00	57.00	35-37	58.00	X	X							15,900.00	7,063.46	4,054.00	490.00	3,489.40	30997	44.64	37.1	67	89.76			
																											0	0.00						
4	5-Year MDD/MDD + FF	22,900	x	x	x	3,500	26,400	18.33	81.61	71.00	57.00	35-37	58.00	X	X	X											0	0.00				991	-	1
4	5-Year PHF	22,900	x	x	x	3,500	26,400	18.33	81.61	71.00	57.00	35-37	58.00	X	X	X						16,315.82				3,482.15	19798	28.51	37.1	67.7	90			
5	10-Year MDD/MDD + FF	22,900	x	x	x	3,500	26,400	18.33	81.61	71.00	57.00	35-37	58.00	X	X	X						11,918.45	1,492.00	1,280.61	602.00	1,785.00	17078	24.59	40	70	92	988	-	1
5	10-Year PHF	22,900	x	x	x	3,500	26,400	18.33	81.61	71.00	57.00	35-37	58.00	X	X	X						15,793.27	7,917.15	4,743.54	2,080.00	3,500.00	34034	49.01	36.24	67.2	90			
																											0	0.00						
6	10-Year MDD/MDD + FF	22,900	x	x	x	Unlimited	22,900	15.90	81.61	71.00	57.00	35-37	58.00	X	X	X	X	X	X			11,918.45	1,492.00	1,280.61	602.00	1,785.00	17078	24.59	45	73	93	988	-	1
6	10-Year PHF	22,900	x	x	x	Unlimited	22,900	15.90	81.61	71.00	57.00	35-37	58.00	X	X	X	X	X	X			16,882.56	4,166.00	4,166.00	2,080.00	6,740.33	34035	49.01	36	66	90			
																											0	0.00						
7	20-Year MDD/MDD + FF	22,900	x	x	x	Unlimited	22,900	15.90	81.61	71.00	57.00	35-37	58.00	X	X	X	X	X	X			11,979.00	1,006.00	958.00	1,005.00	4,989.00	19937	28.71	40	72	93	989	-	1
7	20-Year PHF	22,900	x	x	x	Unlimited	22,900	15.90	81.61	71.00	57.00	35-37	58.00	X	X	X	X	X	X			20,536.23	4,166.00	4,166.00	2,080.00	8,092.76	39041	56.22	25.5	58	89			
																											0	0.00						
8	20-Year MDD/MDD + FF	22,900	x	x	x	Unlimited	22,900	15.90	81.61	71.00	57.00	35-37	58.00	X	X	X	X	X	X	X	X	11,427.88	143.82	-	195.00	7,753.00	19520	28.11	44	73	94	997	-	1
8	20-Year PHF	22,900	x	x	x	Unlimited	22,900	15.90	81.61	71.00	57.00	35-37	58.00	X	X	X	X	X	X	X	X	18,587.44	4,166.00	4,166.00	2,080.00	9,979.90	38979	56.13	35	62	88.65			

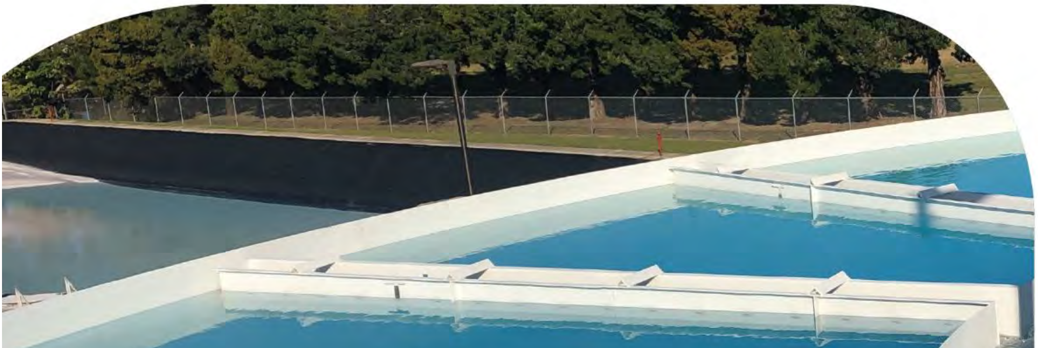
OCALA

Find your place

CITY OF OCALA

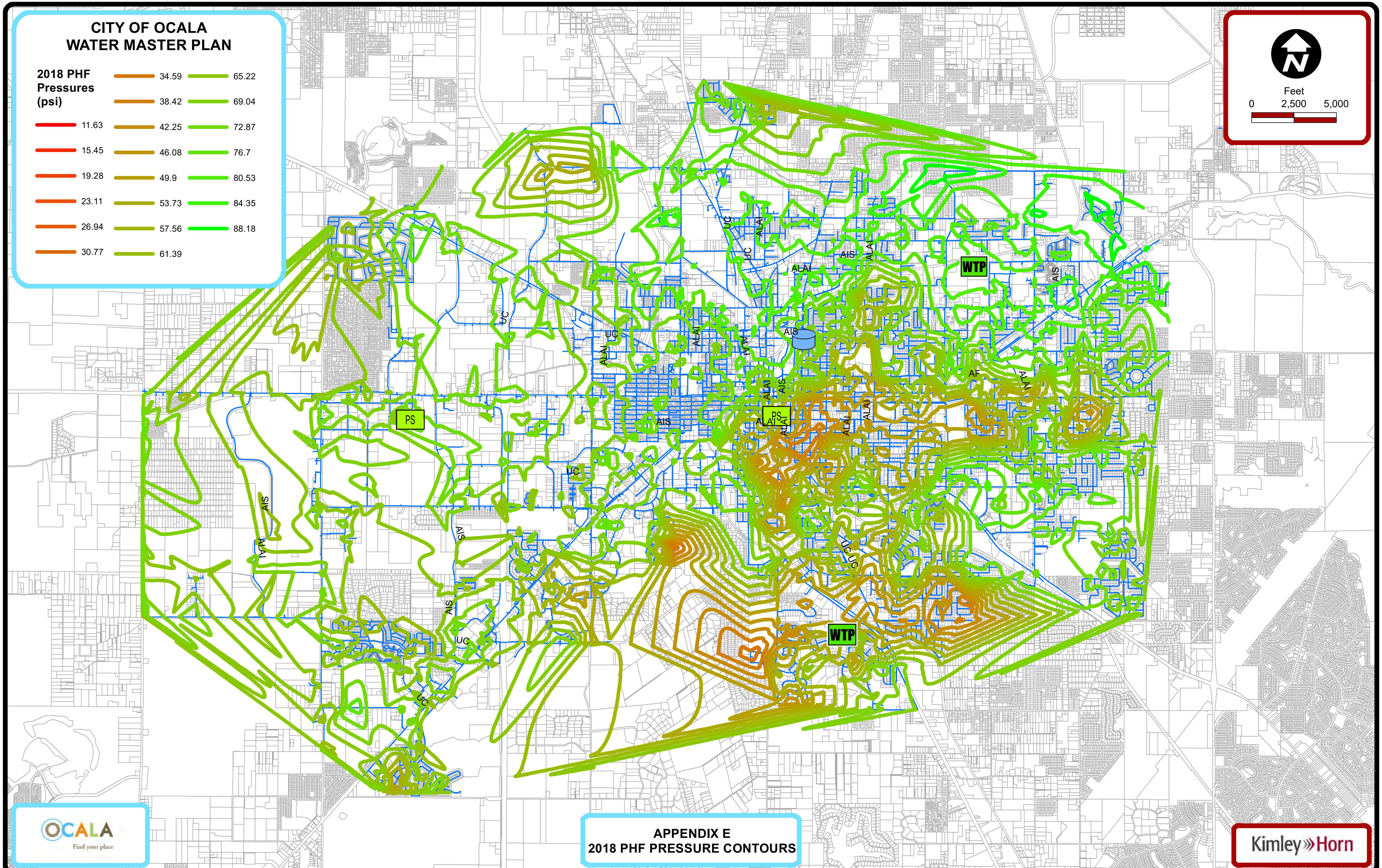
Water Resource Plan

APPENDIX E:
PRESSURE CONTOUR MAP



Kimley»Horn

CITY OF OCALA
WATER MASTER PLAN



APPENDIX E
2018 PHF PRESSURE CONTOURS

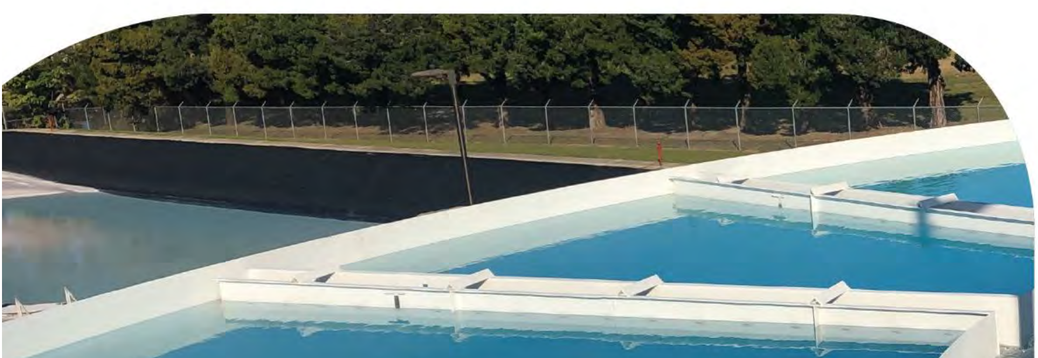
OCALA

Find your place

CITY OF OCALA

Water Resource Plan

APPENDIX F:
RECOMMENDED WATER SYSTEM IMPROVEMENTS OPINION OF PROBABLE COST



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CITY OF OCALA WATER MASTER PLAN

ENGINEER'S OPINION OF PROBABLE COST

FOR

The City of Ocala

PWS Improvement No.4: Install two Hydropneumatic Tanks at WTP-2 to Minimize Pump Run Times and Cycling

ITEM #	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
1	Install two 10,000-gallon hydropneumatic tanks at WTP-2 including all piping, fittings and appurtenances.	LS	1	$ 220,000	$ 220,000
				SUBTOTAL	$ 220,000
				DESIGN AND PERMITTING (15%)	$ 33,000
				CONTINGENCY (30%)	$ 66,000
				TOTAL	$ 319,000

The Engineer has no control over the cost of labor, materials, equipment, or over the Contractor's methods of determining prices or over competitive bidding or market conditions. Opinions of probable costs provided herein are based on the information known to Engineer at this time and represent only the Engineer's judgment as a design professional familiar with the construction industry. The Engineer cannot and does not guarantee that proposals, bids, or actual construction costs will not vary from its opinions of probable costs.

CITY OF OCALA WATER MASTER PLAN

ENGINEER'S OPINION OF PROBABLE COST

FOR

The City of Ocala

PWS Improvement No.5A: Purchase a Back-Up High Service Pump to Increase Un-Installed Firm Pumping Capacity at WTP-1

ITEM #	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
1	Purchase a back-up high service pump for Water Treatment Plant No.1	LS	1	$ 195,500	$ 195,500
				SUBTOTAL	$ 195,500
				CONTINGENCY (30%)	$ 58,650
				TOTAL	$ 250,000

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CITY OF OCALA WATER MASTER PLAN

ENGINEER'S OPINION OF PROBABLE COST

FOR

The City of Ocala

PWS Improvement No.5B: Replace High Service Pumps at WTP-1 to Increase the Installed Firm Pumping Capacity

ITEM #	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
1	Replace High Service pumps No. 1, No. 2, and No. 3 at WTP-1 to increase firm pumping capacity to 23,000 gpm (Includes pump replacements and required electrical upgrades)	LS	3	$ 400,000	$ 1,200,000
				SUBTOTAL	$ 1,200,000
				DESIGN AND PERMITTING (15%)	$ 180,000
				CONTINGENCY (30%)	$ 360,000
				TOTAL	$ 1,740,000

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CITY OF OCALA WATER MASTER PLAN

ENGINEER'S OPINION OF PROBABLE COST

FOR

The City of Ocala

PWS Improvement No.7: Install Additional High Service Pumps at the Downtown Pump Station to Increase the Firm Pumping Capacity to 2.88 MGD

ITEM #	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
1	Replace the existing high service pumps and install two new high service pumps (including VFDs, controls, and misc. electrical)	LS	1	$ 500,000	$ 500,000
				SUBTOTAL	$ 500,000
				DESIGN AND PERMITTING (15%)	$ 75,000
				CONTINGENCY (30%)	$ 150,000
				TOTAL	$ 725,000

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CITY OF OCALA WATER MASTER PLAN

ENGINEER'S OPINION OF PROBABLE COST

FOR

The City of Ocala

PWS Improvement No.8: Construct 24-Inch PVC WM and 20-Inch PVC WM Along SW 32nd Ave and Construct 12-Inch PVC WM Along SW 27th Ave

ITEM #	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
1	Install 3,400 LF of 24-Inch PVC DR-18 WM and appurtenances along SW 32nd Ave and connect to proposed 20-Inch WM along SW 32nd Ave.	LF	3,400	$ 250	$ 850,000
2	Install 8,600 LF of 20-Inch PVC DR-18 WM and appurtenances along SW 32nd Ave and connect to proposed 12-Inch WM at SW 32nd Ave and SW 27th Ave.	LF	8,600	$ 200	$ 1,720,000
3	Install 2,000 LF of 12-Inch PVC DR-18 WM and appurtenances along SW 27th Ave and connect to existing WM along SW 27th Ave.	LF	2,000	$ 125	$ 250,000
				SUBTOTAL	$ 2,820,000
				DESIGN AND PERMITTING (15%)	$ 423,000
				CONTINGENCY (30%)	$ 846,000
				TOTAL	$ 4,089,000

The Engineer has no control over the cost of labor, materials, equipment, or over the Contractor's methods of determining prices or over competitive bidding or market conditions. Opinions of probable costs provided herein are based on the information known to Engineer at this time and represent only the Engineer's judgment as a design professional familiar with the construction industry. The Engineer cannot and does not guarantee that proposals, bids, or actual construction costs will not vary from its opinions of probable costs.

CITY OF OCALA WATER MASTER PLAN
ENGINEER'S OPINION OF PROBABLE COST
FOR
The City of Ocala
PWS Improvement No.9: Construct 16-Inch PVC WM Along SW 7th Ave

ITEM #	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
1	Install 3,700 LF of 16-Inch PVC DR-18 WM and appurtenances along SW 7th Ave and connect to existing WM along SW 7th Ave.	LF	3,700	$ 175	$ 647,500
				SUBTOTAL	$ 650,000
				DESIGN AND PERMITTING (15%)	$ 97,500
				CONTINGENCY (30%)	$ 195,000
				TOTAL	$ 942,500

The Engineer has no control over the cost of labor, materials, equipment, or over the Contractor's methods of determining prices or over competitive bidding or market conditions. Opinions of probable costs provided herein are based on the information known to Engineer at this time and represent only the Engineer's judgment as a design professional familiar with the construction industry. The Engineer cannot and does not guarantee that proposals, bids, or actual construction costs will not vary from its opinions of probable costs.