FINAL REPORT

FOR

THE COLONY
City by the Lake

WATER MASTER PLAN UPDATE

SEPTEMBER 2010

ALAN PLUMMER ASSOCIATES, INC.
ENVIRONMENTAL ENGINEERS AND SCIENTISTS
TBPE Firm Registration No. 13

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Executive Summary

The water master plan for The Colony was updated by utilizing current system GIS data, operational controls, as-built facility data, historical daily pumping and monthly billing data. A calibrated hydraulic model was used to aid in the analyses of the existing water system and to develop recommendations for proposed improvements.

The existing system model performs well hydraulically. Modeled minimum pressures and available fire flows are all above required values and are generally above recommended values throughout the system. Headlosses in the system are all acceptably below recommended maximum limits. In addition, the existing system provides sufficient ground storage, elevated storage, and firm pumping capacity.

The transmission lines in the City have numerous direct connections to smaller diameter distribution lines. This lack of a true transmission system throughout the City contributes to potential blending and water age concerns. Simulations of water age with the water system model suggest that changes in pump station operation (location, frequency and volume) may positively influence blending and water age throughout the system. Additional studies could provide insight into operational adjustments that may produce lower water ages and different blending zones.

The majority of the capital improvements plan (CIP) projects identified are growth-driven projects. By 2020, additional elevated storage in the Wynnwood pressure plane is recommended, along with projects to allow service to the south along SH 121, as well as other targeted developments in the City. The modeled 2060 system builds on the 2020 system with service to continued development along SH 121. This system also provides service to all of Austin Ranch, including any newly developed areas as well as all existing portions of the development currently served by Plano. A redundant surface water connection to Dallas Water Utilities (DWU) via the Southern Pump Station is also provided. Modeled pressures, headlosses, and fire flows throughout the 2020 and 2060 systems are all adequate and are comparable to those found in the existing system.

Planning level cost estimates were calculated for each of the recommended water master plan projects. A list of these projects along with a brief description and cost estimate are shown **Table E.1**.

Table E.1 Summary of All Water System Master Plan Projects

Project No.	Planning Period	Project Description	Est. Cost
1	2010-2020	New well at OCPS (presently under construction)	n.a.
2	2010-2020	2,100 LF 16-in transmission main	$365,000
3	2010-2020	Wynnwood 0.5 MG Elevated Storage Tank	$2,193,000
4	2010-2020	1,700 LF 18-in transmission main	$340,000
5	2010-2020	6,400 LF 16-in transmission main	$1,085,000
6	2010-2020	2,500 LF of 16-in transmission main	$434,000
7	2010-2020	5,300 LF of 20-in transmission main	$1,106,000
8	2020-2060	2,100 LF of 18-in transmission main	$427,000
9	2020-2060	Southern Pump Station Facilities: Two - 2 MG GST, 8 MGD pumps, & 11,000 LF of 30-in main	$11,960,000
10	2020-2060	Austin Ranch Pump Station: 0.75 MG EST, 2 MG GST, 5 MGD pumps, & 3,200 LF 20-in main	$8,440,000
11	2020-2060	Southern Pump Station Facilities (Phase 2): 2 MG GST & 4 MGD pump expansion	$3,250,000
Total Costs, 2010-2020 Planning Period			**$ 5,523,000**
Total Costs, 2020-2060 Planning Period			**$15,637,000**
Total Costs, All Planning Periods			**$21,160,000**

Total estimated recommended project costs are $5,523,000 for the 2010-2020 planning period and $15,637,000 for the 2020-2060 planning period.

1 Introduction

1.1 PURPOSE AND BACKGROUND

The City of The Colony, located in Denton County in north central Texas, last updated its water master plan in 2004. Since that plan, the City has experienced an average population growth of approximately 4.6% (calendar year 2005 through 2009). During this same period, Denton County and the urbanized counties[1] of the North Central Texas Council of Governments (NCTCOG) grew an average of 2.9% and 2.2%, respectively. Due to recent market and climate conditions, the average daily water demands for The Colony have decreased 3.2% during the same time period. A location and service area map of The Colony is provided as **Figure 1.1**. The purpose of this water master plan update is to reevaluate existing and projected water demands and provide recommendations to address existing and projected water system needs for the City.

1.2 SCOPE OF WORK

The scope of work is broadly defined and grouped into three phases:

A. Data collection and development of a hydraulic model
B. Hydraulic model calibration and simulations
C. Identification of recommended improvements

Data collected under Phase A included distribution system GIS data, as-built facility data and historical pumping and billing data. Future demands were estimated based on normalized historical demographic data and projected growth.

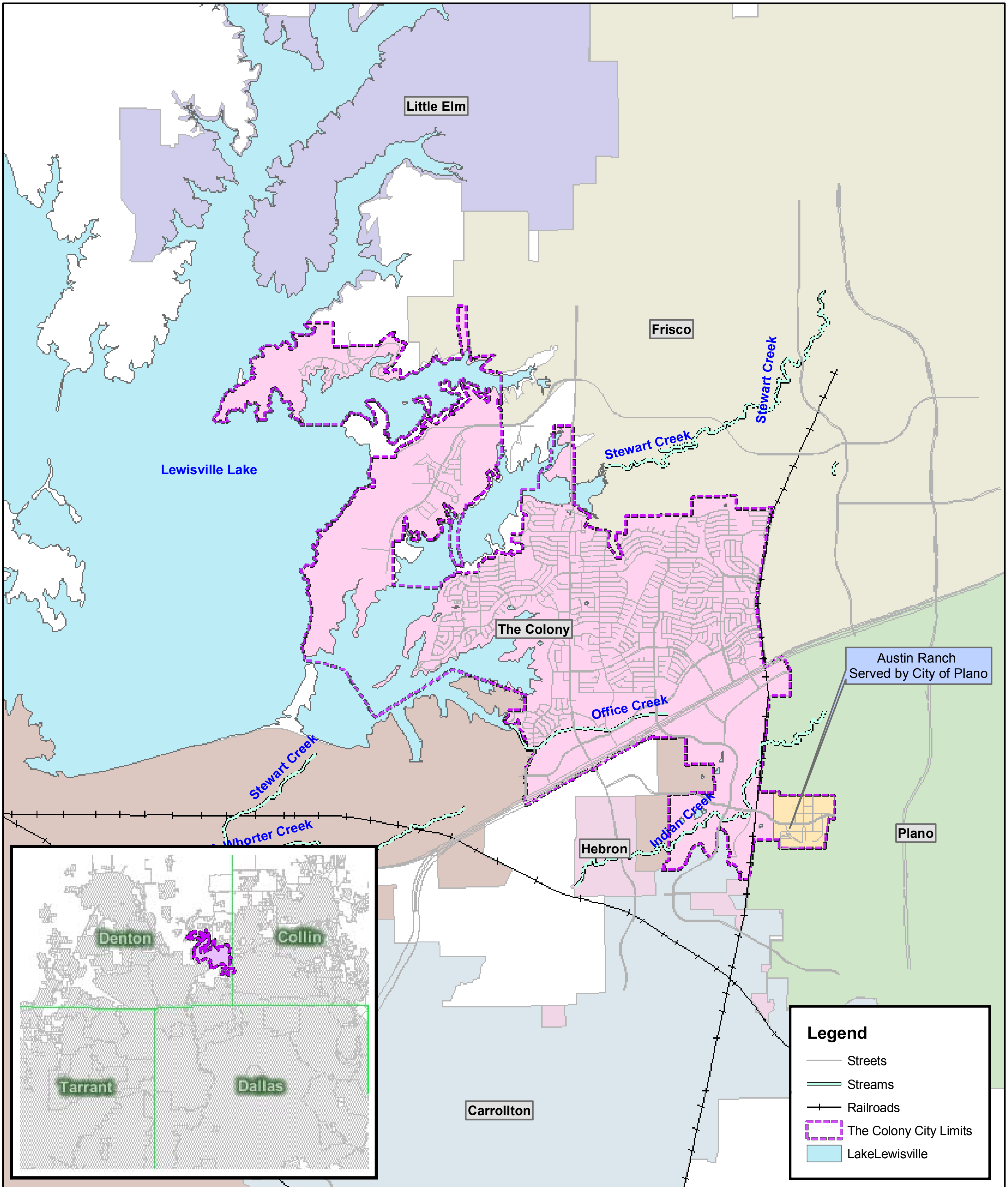
In Phase B, a hydraulic model was created using the data collected in Phase A and calibrated with field data, including tank levels and pump flow rates. The model was further verified by comparing existing system simulations of the City water system with city staff.

Phase C consisted of future hydraulic model simulations, which were created from the existing model. Recommended improvements to meet future demands and address potential system deficiencies were sized and phased based on modeling results and City staff input.

The remainder of this report is organized as follows:

- **Section 2** describes the population and development trends of the City.
- **Section 3** presents historical billing and pumping data and uses this data to predict future demands for the City.
- **Section 4** presents the methodology and calibration of the model used to evaluate the water system. This section then evaluates the existing system under maximum day usage, including a water quality analysis of the distribution system.
- **Section 5** discusses infrastructure improvements for the capital improvements plan for 2010, 2020, and 2060 and presents a cost estimate for each recommended project.
- **Section 6** presents a summary of the project results and final recommendations.

[1] Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Rockwall and Tarrant counties.



N

0 3,500 7,000 Feet

SEPTEMBER 2010
APAI 1438-001-01

THE COLONY City by the Lake

FIGURE 1.1
CITY OF THE COLONY
WATER MASTER PLAN UPDATE
WATER SERVICE AREA

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2 Population and Non-Residential Development Trends

The City currently provides water service to the majority of its incorporated city limits, with the exception of certain portions of Austin Ranch, a mixed-use development that receives water service from the City of Plano (**Figure 1.1**). Unless specified, all information presented in this section pertains only to portions of the City that receive water service.

2.1 HISTORICAL DEMOGRAPHIC DATA

Trends in historical population, employment, and non-residential building area data provide the basis for allocating existing demand as well as projecting the location and magnitude of future growth. Data were obtained from The Colony Planning Department, US Census records, North Central Texas Council of Governments records, and previous City master planning efforts. **Table 2.1** summarizes the available historical data.

Table 2.1 - Historical Water Service Area Demographic Data

Data	Planning Year								
	1990	2000	2004	2005	2006	2007	2008	2009	2010
Population (NCTCOG)	22,113	26,531	35,100	38,400	38,700	39,300	39,850	40,100	40,500[c]
Population (US Census)			b	b	b	b	42,281	b	b
Population (2004 CP&Y)	b	b	b	37,387	b	40,785	b	b	b
Employment (NCTCOG)	1,650	3,510	5,674[a]	6,215	6,680[a]	7,181[a]	7,719[a]	8,297[a]	8,919
Non-Residential Area (NCTCOG: 1,000 SF)	800[a]	1,700[a]	2,660[a]	2,900	3,200[a]	3,500[a]	3,700[a]	4,000[a]	4,250

(a) Estimated from 2005 and 2010 data
(b) Data not collected for the planning year.
(c) Data is from the Draft 2011 Region C Initially Prepared Plan

Recent rates in population and commercial development have slowed based on economic factors, which have slowed growth locally in The Colony as well as throughout the area. Normalized demographic data, such as people per connection and connections per acre, have not appreciably changed from 2005 through 2010. This normalized data is utilized to develop future demand projections and discussed in more detail in **Section 3**.

2.2 PROJECTED DEMOGRAPHIC DATA

Projections of population, employment, and non-residential area were based on analysis of historical demographic data and review of previous projected city growth. A summary of these data is displayed in **Table 2.2**. For this analysis, the entire potential future city service area is subdivided into: existing city limits, existing city extraterritorial jurisdiction (ETJ), and the Austin Ranch development. Future water service options explore providing service to the existing Austin Ranch development, which is currently served by the City of Plano.

Table 2.2 - Projected Water Service Area Demographic Data

Data	Location	Year 2010	2020	2060
Population	City[1]	34,500	43,200	45,100
	Austin Ranch	6,000	12,000	20,000
	ETJ[2]	0	800	2,500
	Total	40,500	56,000	67,600
Employment	City[1]	8,769	12,062	12,630
	Austin Ranch	150	400	1,250
	ETJ[2]	0	0	20
	Total	8,919	12,462	13,900
Non-Residential Area (1,000 SF)	City[1]	4,000	5,000	6,500
	Austin Ranch	250	500	1,500
	ETJ[2]	0	0	50
	Total	4,250	5,500	8,050

(1) Includes only portions of the City that receive water service.

(2) Includes areas outside existing city limits. Will receive water service by date indicated.

Total populations for each planning year are equal to those included in the Draft 2011 Region C Initially Prepared Plan (IPP). In response to recent reductions in growth rates, the Draft 2011 Region C IPP reduced the 2010 City population from 42,800 to 40,500. Similarly, this 2010 population is also less than what was predicted by the previous master plan as well as NCTCOG. The other planning year population projections were not changed.

Employment and non-residential area numbers are not utilized in Region C planning efforts. APAI used this demographic data to make more specific non-residential growth projections based on known developments, existing vacant land area (and respective assigned land use), and estimated floor-to-area ratios (defined as the ratio of building area to total land area). The 2010 ratios of population to employment and population to non-residential area were held nearly constant in each subsequent planning period, as displayed in **Table 2.2**. APAI used the population projections shown in Table 2.2, combined with a historical average per capita residential water use of 110 gpcd to calculate the future residential water demands.

These projections are used to estimate future water demands, described in **Section 3**.

3 Water Demands

Water usage trends were estimated from daily pumping data and monthly billing data provided by the City. Daily pumping data provide a historical record of the volume of water obtained from surface water and groundwater sources. A comparison of billed and pumped volumes also provides an estimate of non-revenue water used within the City. Hourly SCADA data for the five highest demand days in 2009 were used to estimate the current composite diurnal curve for the City. **Appendix A** provides compiled graphical representations of the five maximum demand days from 2009, the maximum day diurnal curve derived from these data, historical billing and pumping data from October 2004 through December 2009, and the historical relationship between total system demand and the percent of groundwater supplied.

3.1 HISTORICAL WATER DEMANDS

Pumping and billing data for the period 2004-2009 were reviewed and normalized based on available demographic data and are summarized in **Table 3.1**. The annualized average percent non-revenue water (which includes real[2] and apparent[3] losses) is approximately 4%. Residential demands range from 68 to 87 gallons per capita per day (GPCD), with an average of 75 GPCD. Non-residential demands vary from 0.7 to 1.2 gallons per square foot of building area per day (GPSFD), with an average of 0.9 GPSFD. The ratio of maximum day demands to average day demands in any given year ranges from 1.7 to 2.3, with an average of 2.0. Both total and normalized residential and non-residential demands increase from 2004 through 2006 and then decrease through 2009. The normalized data trends correlate with average temperature and rainfall variations for the area.

Peak hour data is not currently recorded for the system, and SCADA records are not available prior to 2007. As such, 2009 peak hour demands were estimated at 11.7 million gallons per day (MGD) based on hourly data collected for this project and recorded on the day of maximum demand in 2009 (July 15, 2009). Based on this data, the ratio of peak hour demand to maximum day demand for 2009 is approximately 1.5. Applying this ratio to the historical maximum day demand (2006) yields an estimated historical peak hour demand of 14.6 MGD. Discussions with staff confirm this magnitude as a potential historical peak hour event.

Table 3.1 Historical Water Usage

Year	Annual Pumping (MG)	Annual Billing (MG)	% Loss	Average Overall GPCD	Average Residential GPCD	Average Non-Residential GPSFD	Average Day Demand (MGD)	Max Day Demand (MGD)
2004	1,548	320 P	P	120	72	0.7	4.2	8.0
2005	1,626	1,607	1%	116	82	1.0	4.5	8.3
2006	1,747	1,715	2%	124	87	1.2	4.8	9.7
2007	1,359	1,286	5%	95	68	0.7	3.7	6.4
2008	1,573	1,453	8%	108	72	1.1	4.3	8.9
2009	1,461	1,345	8%	105	66	0.7	3.5	7.9
Average	1,528	1,414	4% P	110	75	0.9	4.2	8.2

P Partial year data

[2] A real loss is water lost physically from the distribution system, like through pipe leaks or storage tank overflows. This waters financial loss is calculated using the production cost of water.
[3] An apparent loss is water not paid for because it is "lost" due to metering inaccuracies, unauthorized consumption or water theft, or billing data errors. This waters financial loss is calculated using the retail cost of water.

3.2 PROJECTED WATER DEMANDS

Projected annual average residential and non-residential demands are based on selected historical normalized demands and projected future growth. **Table 3.2** lists the factors and relevant assumptions used in the calculation of future year demands. A value of 2.0 was selected for the projected ratio of maximum day to average day demands, based on the historical average. Due to the lack of historical peak hour data, the ratio of peak hour demand to maximum day demand was increased from 1.5 to a more conservative estimate of 1.8.

Table 3.2 Factors Utilized in Water Demand Projections

Type	Residential GPCD	People per acre	People per unit	Units per acre	FAR[b]	MD:AD[c]	PH:MD[d]
Single Family	110	16.0	3.1	5.2	n.a.	2.0	1.8
Multi Family	110	25.5	2.3	11.1			
Weighted Residential[e]	110	17.0	2.9	5.8			
Non Residential	0.03[a]	n.a.			0.6		

(a) Gallons per square foot per day for non-residential demands.
(b) Floor to area ratio: defined as the amount of enclosed non-residential area requiring water service divided by the total land area of the development. Used as an average if more detailed data not available.
(c) Maximum day multiplier on average day.
(d) Peak hour multiplier on maximum day.
(e) Based on existing projected total populations of single and multi family homes: for reference.

Projected maximum day and peak hour demands are calculated based on the values referenced in **Table 3.2** and the projected demographics in **Table 2.2**. **Table 3.3** displays projected water demands used in this study. To account for inherent uncertainties in future demand projections, the calculated overall per capita usage for future planning years ranges from 142 to 145 GPCD, approximately 15% higher than the historical values.

Historical billing information was available for residential and non-residential customers, from which estimates of normalized demand were computed for both land use types. As a result, projected future demands could be spatially allocated according to projected land use types. Future demands for known or existing developments were placed at the model node nearest to the proposed development location. Since a majority of the City has been developed, most future demands were allocated to specific vacant areas based on future zoning. The remainder of the projected demands was distributed throughout the City to represent infill and small unidentified growth. **Figure 3.1** displays the allocation of projected demands throughout the City.

Table 3.3 Projected Water Demands

Data			2010	2020	2060
Population	City(1)		34,500	43,200	45,100
	Austin Ranch		6,000	12,000	20,000
	ETJ(2)		0	800	2,500
	Total		40,500	56,000	67,600
Employment	City(1)		8,769	12,062	12,630
	Austin Ranch		150	400	1,250
	ETJ(2)		0	0	20
	Total		8,919	12,462	13,900
Non-Residential Area (1,000 SF)	City(1)		4,000	5,000	6,500
	Austin Ranch		250	500	1,500
	ETJ(2)		0	0	50
	Total		4,250	5,500	8,050
Avg. Day Demand (MGD)	City(1)	Residential	3.8	4.8	5.0
		Non-Residential	1.2	1.5	2.0
	Austin Ranch	Residential	0.7	1.3	2.2
		Non-Residential	0.1	0.2	0.5
	ETJ(2)	Residential	0.0	0.1	0.3
		Non-Residential	0.0	0.0	0.0
	Total(3)	Residential	3.8	5.5	7.4
		Non-Residential	1.2	1.6	2.4
		Total	5.0	7.1	9.9
Max Day Demand (MGD)	Residential		7.6	11.0	14.9
	Non-Residential		2.4	3.2	4.8
	Total		10.0	14.2	19.7
Peak Hour Demand (MGD)	Residential		13.7	19.8	26.8
	Non-Residential		4.3	5.7	8.7
	Total		18.0	25.5	35.5

1. Includes only portions of the City that receive water service.
2. Includes areas outside the city limits. Will receive water service by date indicated.
3. 2010 includes only existing City water service area. 2020 includes only the Austin Ranch area growth. 2060 includes all of City, ETJ and Austin Ranch.

4 Water System Analyses

4.1 EXISTING WATER DISTRIBUTION SYSTEM

The water distribution system of The Colony is comprised of approximately 780,000 feet of water mains ranging in size from 4-inch to 30-inch, with additional service lines ranging from 0.75-inch to 4-inch. The system is comprised of one main pressure plane that serves a majority of the city, and one secondary pressure plane that serves development in the Wynnwood Peninsula within the northwest city limits. Both pressure planes currently operate within the same pressure range, typically between 50 and 80 psi. Due to hydraulic limitations, the City does not currently serve development east of Indian Creek (the Austin Ranch Development, currently served by the City of Plano).

The City has three existing groundwater sites, each with groundwater wells, ground storage, and high service pump stations. Demands are also met through a 36-inch connection supplying purchased surface water from the City of Dallas (Dallas Water Utilities, DWU). **Figure 4.1** displays the existing City of The Colony water distribution system.

4.2 SUPPLY, STORAGE, AND PUMPING EVALUATION

The existing supply, storage, and pumping facilities of The Colony were reviewed and compared with current state regulations and recommended operating ranges in an effort to assess the system.

4.2.1 <u>Supply</u>

The Colony receives treated water from DWU at the Office Creek Pump Station (OCPS). The City also currently operates three groundwater well sites at three different locations (Pump Stations 1, 2, and 3), with a fourth site currently under construction at the OCPS. The existing DWU contract with The Colony is for 6 MGD with an option for additional water, and contains a base (fixed) cost and a unit volume cost. Whenever possible, The Colony operates the OCPS so as to minimize the unit cost of water from DWU. The historical ratio of groundwater to surface water usage has been approximately 40:60 under maximum day conditions and 10:90 under average day conditions (**Appendix A**). The City has future plans to take additional DWU surface water from a recently completed 36-inch line near the Bobby Ballard Pump Station. The existing and projected usage of surface water and ground water supplies is displayed in **Figure 4.2.** Future project details are described in more detail in **Section 5**.

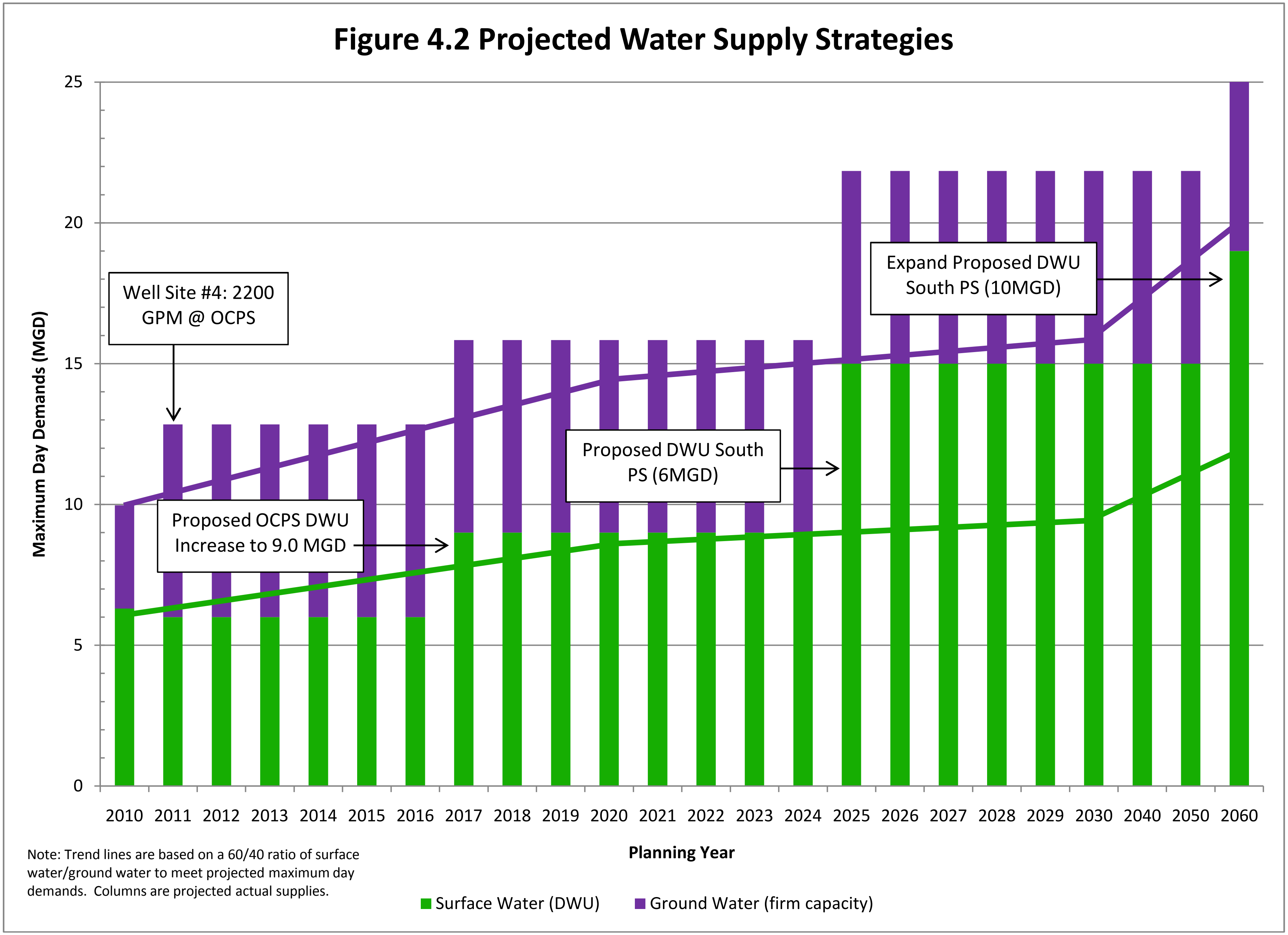
4.2.2 <u>Storage</u>

TCEQ requirements for storage are based on elevated and total storage in gallons per connection. The total number of existing connections for The Colony is estimated to be 13,452. **Table 4.1** displays the total storage and storage per connection. The City exceeds the TCEQ minimum guidelines for elevated and total storage. **Figure 4.3** and **Figure 4.4** show existing and projected elevated and ground storage requirements, respectively. Future project details are described in more detail in **Section 5**.

Table 4.1 Storage Facilities Summary

Storage Type	Location	Volume (million gallons)	Gallons per Connection	
			Existing	TCEQ Required
Elevated Storage	Tank 1	0.5	149	100-200
	Tank 2	0.5		
	Tank 3	1.0		
	TOTAL	2.0		
Ground Storage	PS 1	0.4	847	varies based on available elevated storage
	PS 2	1.0		
	PS 3	1.0		
	Office Creek PS	6.0		
	Wynnwood PS	1.0		
	TOTAL	9.4		
Total Storage		11.4	996	200

The Wynnwood Pump Station provides water to the Wynnwood Peninsula development, which currently has no elevated storage, but fewer than 250 connections. The pressure from the pump station is currently regulated by a hydropnuematic tank, which will be replaced with a future elevated storage tank. TCEQ requires elevated storage for systems with more than 250 connections. Further discussion of elevated storage recommendations for the Wynnwood Peninsula is provided in **Section 5**.



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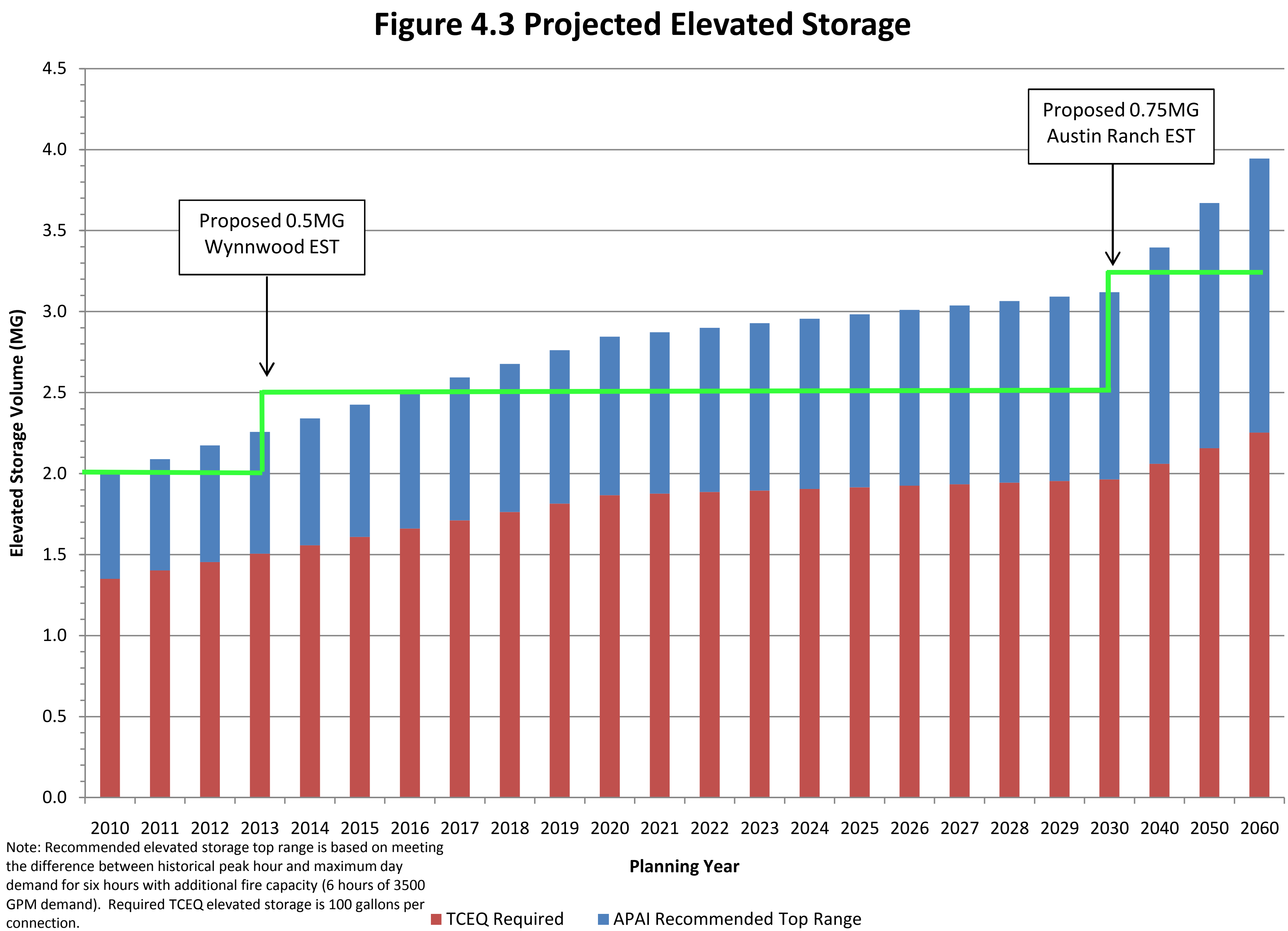

Note: Recommended elevated storage top range is based on meeting the difference between historical peak hour and maximum day demand for six hours with additional fire capacity (6 hours of 3500 GPM demand). Required TCEQ elevated storage is 100 gallons per connection.

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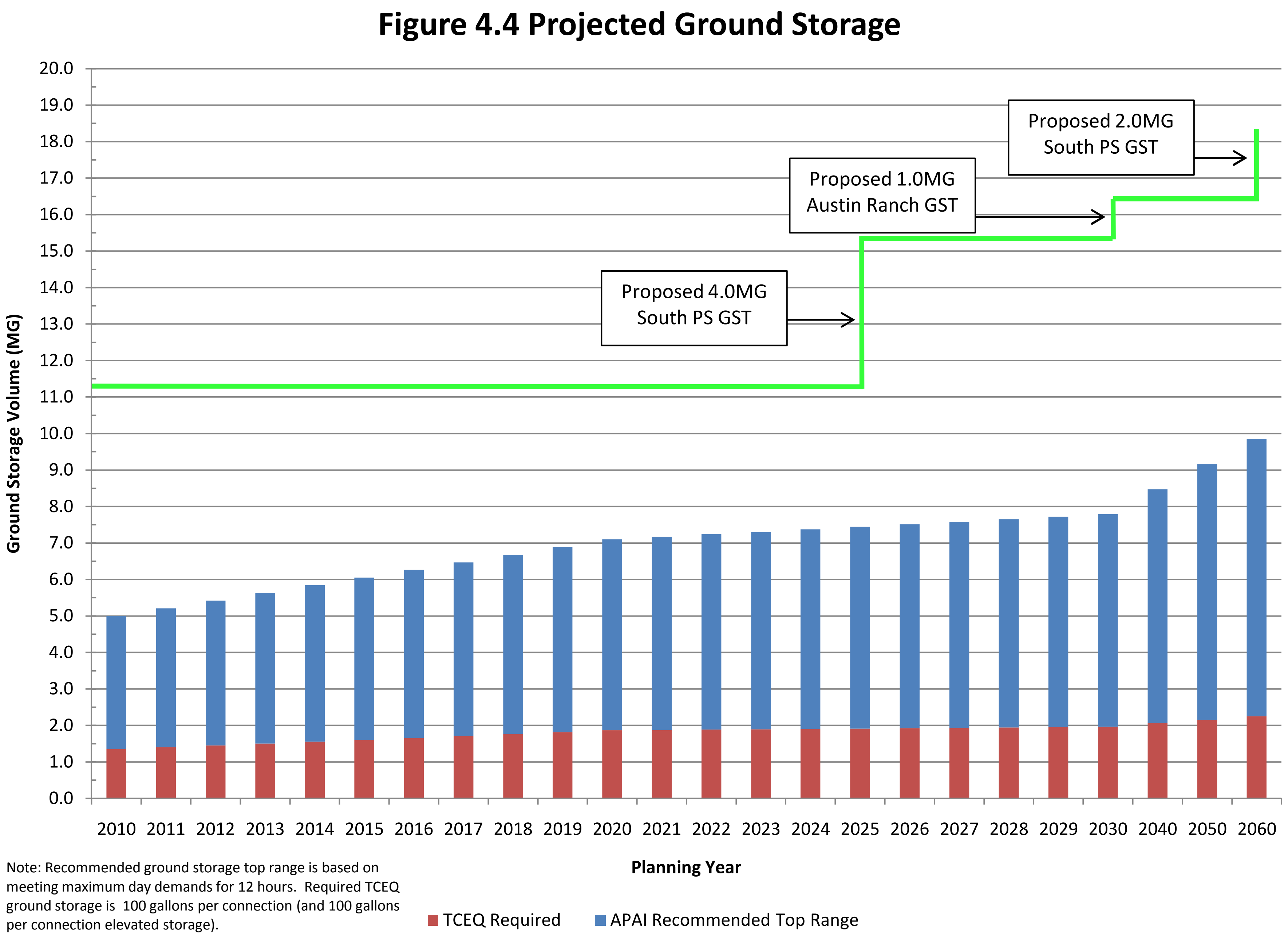

Note: Recommended ground storage top range is based on meeting maximum day demands for 12 hours. Required TCEQ ground storage is 100 gallons per connection (and 100 gallons per connection elevated storage).

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4.2.3 Pumping

TCEQ requirements for pumping are dependent on available elevated storage. The Colony has between 100 and 200 gallons per connection of elevated storage, so the required firm pumping is the lesser of 2.0 gallons per minute per connection or the ability to meet peak hour demands with firm pumping capacity. Both the estimated historical peak hour demand of 14.6 MGD (10,140 GPM) and the estimated 2010 peak hour demand of 18 MGD (12,500 GPM) are significantly less than the calculated demand (based on 2.0 gpm per connection) of 21,802 GPM. **Table 4.2** displays the existing pumping facility information and TCEQ pumping requirements for both existing pressure planes. The Colony exceeds the TCEQ minimum guidelines for pumping capacity, but firm capacity is currently not far above the requirement in the main pressure plane. Current construction of additional facilities at Office Creek Pump Station, discussed in **Section 5.1**, will provide additional capacity. **Figure 4.5** displays a plot of existing and projected firm pumping requirements. Future project details are detailed in **Section 5**.

Table 4.2 Pumping Facilities Summary

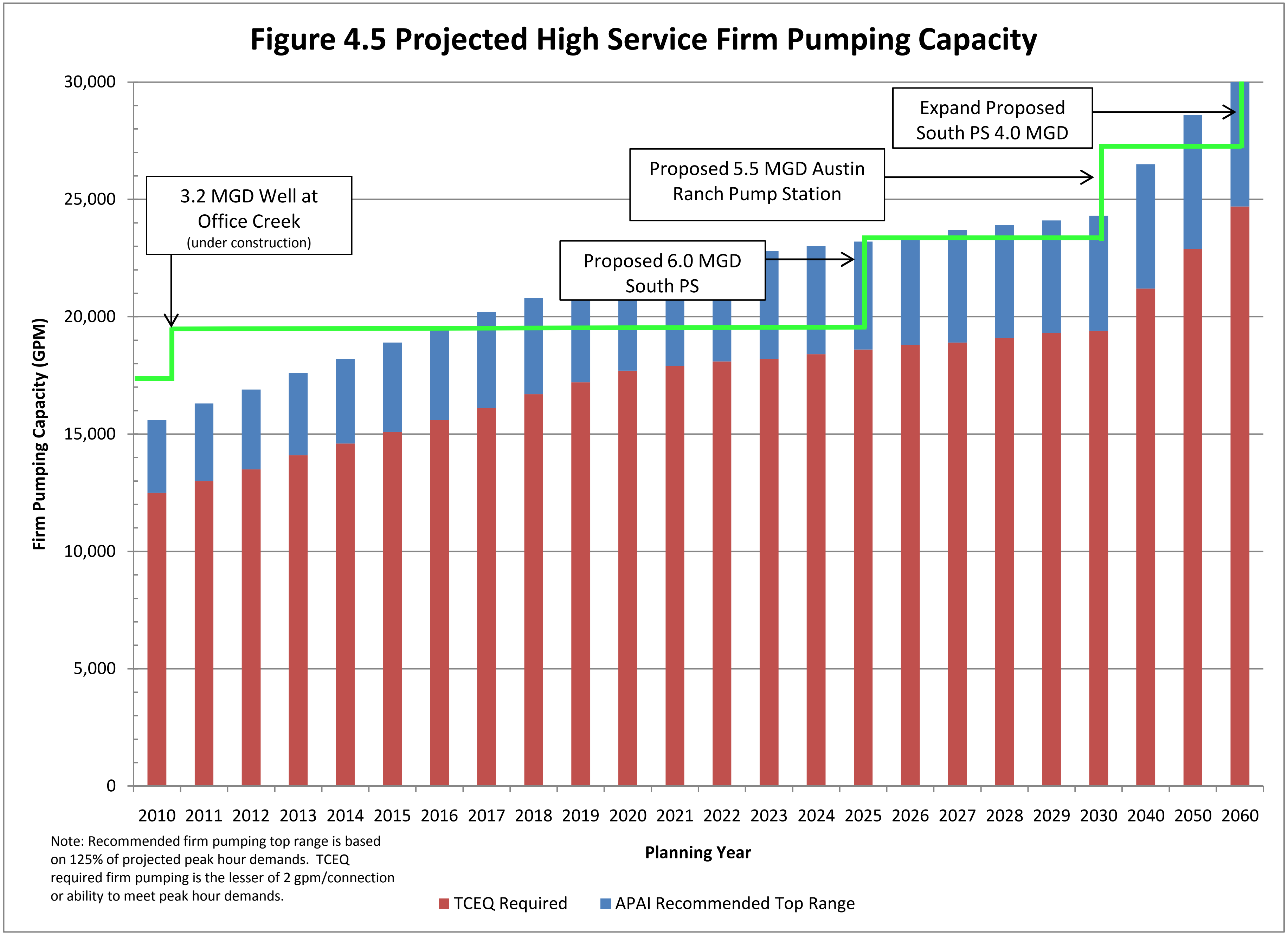
Pressure Plane	Location	Station Capacity (gpm)		TCEQ Required Capacity (gpm) [a]
		Total	Firm	
Main	PS 1	2,400	1,000	n.a.
	PS 2	3,800	2,400	
	PS 3	4,200	2,100	
	Office Creek PS	11,440	5,440	
	TOTAL	**21,840**	**10,940**	**9,940**
Wynnwood	**TOTAL**	**2,800**	**1,800**	**200**
TOTAL		**24,640**	**12,740**	**10,140**

(a) Based on peak hour demands.

4.3 WATER MODEL DEVELOPMENT

A new water distribution system model was produced for this project, using the most current data available from the City. The model of existing transmission and distribution water lines was created from GIS data provided by the City. Storage and pumping facility data were obtained from as-built plans and included in the existing system model. In addition, operational controls for pumps and valves were input to the model based on discussions with City staff. Existing demands were calculated and allocated using historical monthly City billing account information tied directly to billing addresses. Additional guidelines used in the water model analyses are:

- Recommended maximum head loss (feet per thousand feet, ft/1k ft): 7 ft/1k ft
- Required minimum pressure: 35 psi
- Recommended minimum pressure: 40 psi
- Recommended minimum fire flow (residential): 1,000 gpm
- Recommended minimum fire flow (commercial): 2,500 gpm



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4.4 WATER MODEL CALIBRATION

Static and residual calibration runs were conducted on the newly created model. Pressure and flow data were collected at seven hydrant sites throughout the City on December 10, 2009. Four hydrants, two recording pressure and two recording flow, were utilized at each site. City SCADA data, including all pump station flows and pressures and elevated tank levels, were also collected during the same period. **Figure 4.6** displays the locations of the hydrants for each testing site.

A static calibration is performed at each location when no flow is drawn through any hydrants. The goal of this calibration run is to accurately represent field pressure data in the model under the same conditions seen in the field at the time of data collection. This first level of calibration is useful in validating major connectivity and operational boundary conditions in the model.

The second calibration step (residual calibration) performed at each site involved opening hydrants to draw larger localized flow at each of the seven locations. The duration and timing of flow and pressure hydrants is conceptually displayed in **Table 4.3**. Flows in excess of 3000 gallons per minute were produced in many areas when both of the test hydrants were flowing. These flows are higher at these pressure testing locations than would be expected during any peak hour demands. The higher flows used in the residual calibration tests further assist in evaluating model connectivity and pump operation as well as roughness factors and system response times.

Table 4.3 Hydrant Flow Testing Operation

Hydrant	Time Period				
	Prior to Hydrant Test	0-5 Minutes	5-10 Minutes	10-15 Minutes	After Hydrant Test
Pressure #1	Record Static Pressure	Recording Residual Calibration Data			Record Static Pressure
Flow #1	OFF	ON	ON	OFF	OFF
Flow #2	OFF	OFF	ON	ON	OFF
Pressure #2	Record Static Pressure	Recording Residual Calibration Data			Record Static Pressure

Pipe friction factors (Hazen Williams C-Factors) were adjusted so that the model represented data collected in the field. Final existing C-Factors are displayed in **Table 4.4** under the 2010 heading. In general, the model calibrated well in each location with minimal adjustments. Hazen-Williams C-Factors were initially assigned based on the modeled year and line diameter. C-factor values decrease in each future scenario, thus modeling the system as it would age.

Table 4.4 Hazen Williams C-Factors

Year	Water Line Diameter		
	<8	10-12	>12
2010	155	145	135
2020	145	140	130
2060	140	135	130

Static calibration results are displayed in **Table 4.5**. Initial elevated tank levels and active pump station flows are also displayed for reference. Exhibits showing detailed model and field calibration locations and output from the static and residual calibration are displayed in **Appendix B**.

Table 4.5 Static Calibration Results for December 10, 2009

Group	Hydrant	Start Time	End Time	Base				Initial Conditions Tank Levels (ft)				Initial Conditions Pump Station Discharge (GPM)	
				Field Pressure	Model Pressure	Diff. (abs)	Diff. (%)	ET1	ET2	ET3	Wynnwood GST	Office Creek	Wynnwood PS
1	P1	14:55	15:10	57.3	56.44	0.8	1.5%	30.0	26.5	29.2	13.0	4,310	0
	P2			56.8	56.85	0.1	0.1%						
2	P1	14:19	14:33	56.6	55.49	1.1	2.0%	27.4	24.5	27.4	12.0	4,371	0
	P2			57.0	58.07	1.1	1.9%						
3	P1	9:57	10:10	42.0	43.70	1.7	4.0%	19.8	18.5	22.5	11.5	0	0
	P2			41.4	42.95	1.6	3.7%						
4	P1	11:10	11:23	58.6	57.67	0.9	1.6%	17.6	15.9	20.1	13.0	4,690	0
	P2			56.4	56.45	0.0	0.0%						
5	P1	11:40	11:55	78.6	80.21	1.6	2.0%	19.9	17.1	20.6	13.0	4,639	0
	P2			79.7	79.78	0.1	0.1%						
6	P1	13:34	13:52	75.2	75.30	0.1	0.1%	25.8	22.5	25.8	13.0	4,447	0
	P2			79.4	75.00	4.4	5.5%						
7	P1	9:03	9:16	(a)	66.60	(a)	(a)	22.0	20.8	24.6	11.7	0	1,150
	P2			66.6	66.60	0.0	0.0%						

(a) The meter used to record field pressure failed during this test.

4.5 EXISTING SYSTEM MODEL EVALUATION

The calibrated water model was used to analyze the existing water distribution system for potential deficiencies. A projected 2010 maximum day demand scenario was applied to the calibrated model. The projected operation of the elevated storage tanks is displayed as **Figure 4.7**. Model results were evaluated for: peak hour minimum node pressures and maximum line head losses, maximum day available fire protection, and average and minimum day water age. Each is described in more detail in the following sections.

4.5.1 <u>Pressure and Headloss</u>

The existing distribution system functions well under peak hour conditions, with pressures always above 35 psi and typically above 60 psi. A small area, generally bounded by South Colony Blvd. to the west, State Highway 121 to the south, The Colony City limits to the east, and Elevated Tank 3 to the north, shows potential for pressures near 40 psi under peak hour conditions. The elevations of this area are the highest in the current service area. Static pressures in this area are maintained by Elevated Tank 3. This area is hydraulically closest to the Office Creek Pump Station, but there is not a true transmission line from Office Creek to the area or to Elevated Tank 3. **Figure 4.8** displays projected existing system peak hour minimum pressures.

Pressures in the system do not vary much, either spatially or temporally. Minimum hour, maximum pressures are generally between 60 psi and 85 psi throughout the distribution system with a localized area around Tank 3 showing minimum pressures of 40 psi.

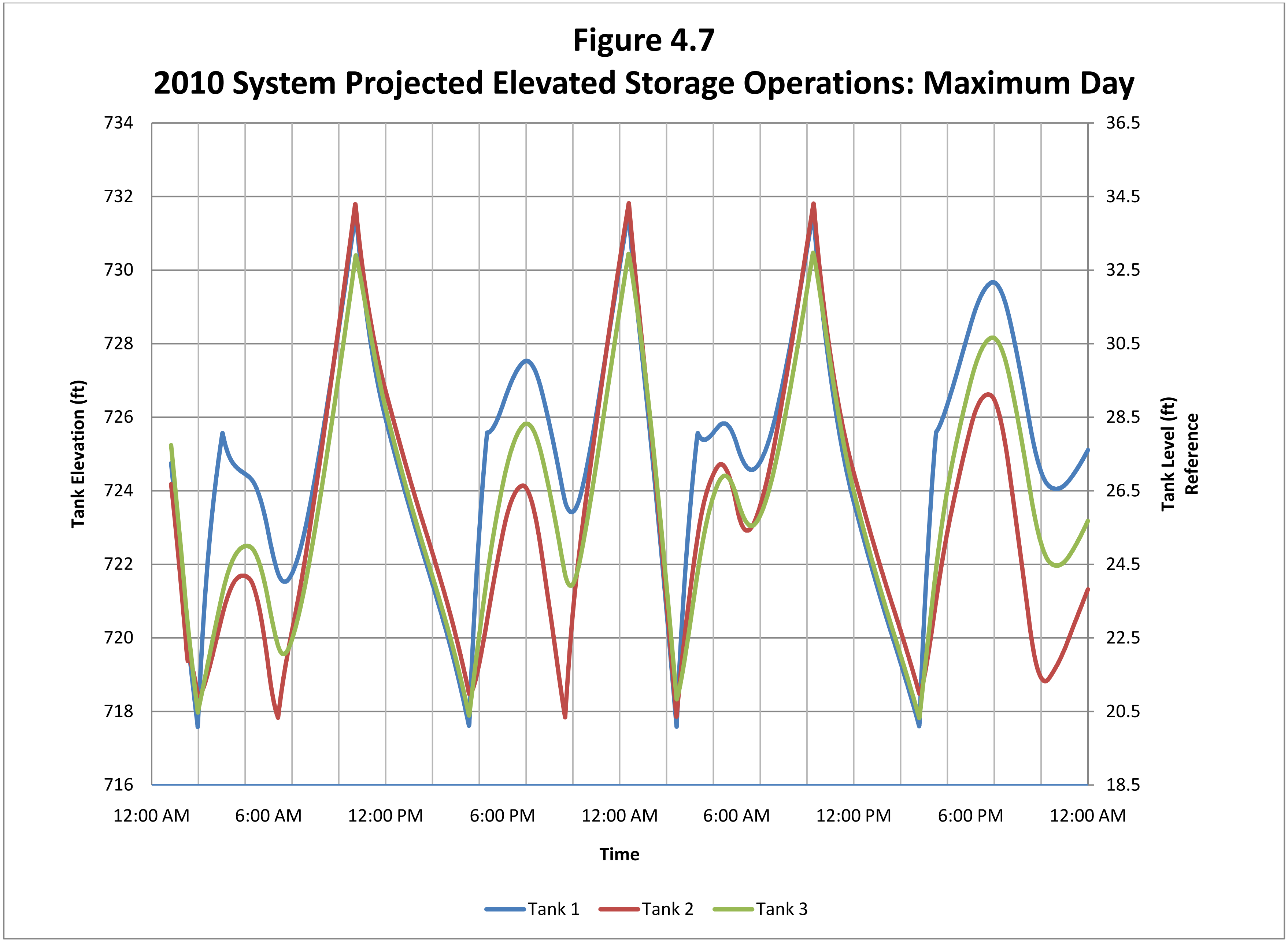
Peak hour headlosses throughout the distribution system fall within an acceptable range of 3-6 feet per thousand feet. The existing system appears to operate well hydraulically, with no extreme bottlenecks.

4.5.2 <u>Fire Protection</u>

Maximum day available fire flow in the existing distribution system was reviewed for residential and non-residential land use types. Overall the available fire flow in the existing distribution system is good for both land use types. No residential areas were modeled with less than 1000 gpm available fire flow, and only a few isolated dead-end lines showed less than 1500 gpm. All other residential areas show fire flow above 1500 gpm. No commercial areas were modeled with less than 1500 gpm, and only two dead end lines showed less than 2000 gpm. An additional seven non-residential nodes were modeled with less than 3000 gpm available fire flow. All other non residential areas show available fire flow above 3000 gpm.

In each instance where the available flow is less than typical, the hydrants are located at the end of dead end lines, and in most cases the lines are along Highway 121. It is anticipated that, as additional development occurs in the corridor, future lines will be built to connect the existing dead ends. In many instances the existing hydrants are located along existing vacant property.

Figure 4.9 displays the results of the existing system available fire flow modeling.



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4.5.3 Water Quality Indicators

The scope of this master plan update does not include detailed water quality modeling or analyses. However, a planning level review of potential water quality concerns provides insight into potential areas for improvement. A more detailed future study could lead to additional understanding of water quality interactions in the City's water distribution system.

Blending Zone Analysis

Blending zone analyses were completed on the existing City distribution system to determine zones of influence for pump stations under average and maximum day demand conditions. The hydraulic model can estimate the percentage of water coming from each source at any time and any given location within the system. The four sources of water in the distribution system (each groundwater pump station and the OCPS) were traced for every node in the system. The model was run for three weeks to facilitate reaching hydraulic equilibrium. After this time period, a 24-hour average source composition was calculated for each node. **Figure 4.10** displays the model source composition output for average day demands. **Figure 4.11** displays the model source composition output for maximum day demands. Both scenarios assume operation of City pump stations that achieves a 60/40 ratio of surface water to groundwater.

In the average day scenario shown in Figure **4.10**, the majority of all demands are predictably met through groundwater sources. The zone of influence of OCPS is limited to areas south of Arbor Glenn Road. As discussed in **Section 4.2** the average day demands of the system are typically met through only surface water so this scenario is infrequently encountered. The 60/40 ratio is more often encountered under maximum day demand conditions, and shows a zone of influence of OCPS typically south of Pump Station 1 (PS 1) and Tank 3. As discussed in **Section 4.5.1** there are no true transmission lines to allow OCPS to efficiently move water throughout the system.

This physical constraint, combined with the typical operating scenario of running only OCPS, has the potential to lead to increased water age in the distribution system.

Water Age Analysis

A water age analysis was also completed on the existing distribution system. High water age can indicate potential low chlorine residuals. The hydraulic model can estimate average water age for any node in the system by running an extended period analysis and determining the age of water based on travel time and model demands. This analysis is highly dependent on the system demand and the operational controls of the system, of which there are limitless combinations. Two scenarios were selected that represent a majority of the conditions in the existing system. Both utilize average day demands, but one provides water via only the OCPS and the other via a combination of all pump stations. The output from the operation of only OCPS is displayed as **Figure 4.12** and the output from operation of all pump stations is displayed as **Figure 4.13**.

As expected, the average age in the system is reduced when operating pump stations that provide new sources of water. The Wynnwood Peninsula shows potential for high water age regardless of operational controls. It should also be noted that The Colony operates chlorination facilities at each source point and also has the ability to re-chlorinate distribution system water at the Wynnwood PS and PS 3, which are not modeled directly in this analysis. The results of the water age analysis are most effectively used for relative comparison of age under different operational conditions.

Four areas were selected for detailed review of high water age under multiple demand and operational scenarios. For identification in this report these areas are called: Northeast Colony, North Colony, Wynnwood and Highway 121. For each area, a water age scenario was calculated with the following pump station combinations: only the OCPS, OCPS and Pump Station 2 (PS 2), all pump stations, and only the closest pump station to the area (varies by location). In addition, the demands specific to the area were varied based on historical billing data as described in **Appendix C**. The locations and results of these analyses are described in more detail below.

a) Northeast Colony

The Northeast Colony area, located east of Stewart Creek along and including Turner Road, is the most northeast portion of the existing service area. This area did not show a strong water age response to increased demands through the localized area for any operational condition, likely due to a bottleneck effect from the small diameter lines feeding the localized area. However, this area did show a large variation in age between the different operational conditions for every demand condition. As expected, the lowest water age was from operating only PS 3 (the closest station to the area). Surprisingly the second lowest age occurred from operating only OCPS: other combinations of groundwater pump stations and OCPS generated the highest relative water age. These results are likely due to modeling constraints on operational rules of pumps based on elevated tank levels.

b) North Colony

The North Colony area, west of Main Street and north of Lake Highlands, is located relatively near PS 2. This area showed a stronger response to increased demands when operating OCPS. The response diminished when operating groundwater wells. As with the Northeast Colony location, the largest change in age occurs from different operational conditions. In this area the lowest water age results occurred from operating either only PS 2 (the closest station to the area) or a combination of PS 2 and OCPS. Scenarios where PS 2 was not run led to relatively high water ages regardless of demand conditions.

c) Wynnwood

The Wynnwood Peninsula is located west of Main Street and north of the main water system. This area showed a stronger response to increased demands for all operating conditions than the other areas reviewed. Unlike the other locations, the largest change in age results from variations in additional demand. Like the North Colony area, the lowest water age results in this area arose from operating either only PS 2 (the closest station to the area) or a combination of PS 2 and OCPS. The City has the ability to bypass the Wynnwood Pump Station, which was also modeled. In each case, a significant reduction in water age occurred, due to elimination of ground storage tank residence time, when the Wynnwood Peninsula was fed directly from the main system. The existing chlorination facilities will reduce the impact of tank residence times in this analysis.

d) Highway 121

The Highway 121 area, in the southwest sector of the City, includes miscellaneous dead end lines located north along State Highway 121. In each location, the water age is tied to the interconnectivity of the lines, and was only improved by interconnection. As described in **Section 4.5.2,** this area will see improvements in hydraulic and water quality indicator performance as infrastructure is built to meet future demands.

Appendix C provides graphical output from the detailed water age hydraulic simulations and a more detailed description of methodology. It should again be noted that The Colony operates chlorination facilities at each source point and also has the ability to re-chlorinate distribution system water at the Wynnwood PS and PS 3 which are not modeled directly in this analysis. The results of the water age analysis are most effectively used for relative comparison of age under different operational conditions.

4.6 FUTURE SYSTEM ANALYSES

The calibrated existing system model was used to create future condition models for the City. The City selected the 2020 (ten year) and 2060 (ultimate) planning periods for review in this study effort. Future demands are based on data shown in **Figure 3.1** and recommended infrastructure is sized based on the general criteria discussed in **Section 4.3**. As discussed throughout **Section 4**, there are limited existing hydraulic performance issues in the system. As such, most of the future system scenarios also do not show potential for deficiencies, and the majority of future capital projects would provide service to future development.

The individual planning periods are discussed in more detail below.

4.6.1 <u>2020 System</u>

The system demand is expected to increase by nearly 50% from 2010 to 2020. Major infrastructure improvements recommended for the 2020 system include the Wynnwood elevated tank and a potential small, higher pressure plane to provide future service along the eastern side of SH 121 within the City limits. Additional water line projects will also be required to serve the projected future demands. Pressures, headlosses and fire flows throughout the modeled 2020 system are all acceptable and are comparable to those found in the existing system.

More detail on specific projects and costs is provided in **Section 5**. **Figure 4.14** displays the projected operation of the elevated storage tanks in the 2020 system under maximum day demand conditions.

4.6.2 <u>2060 System</u>

The system demand is expected to roughly double from 2010 to 2060. Major infrastructure improvements recommended for the 2060 system include the new supply from DWU (the Southern Pump Station) as well as the potential for a new pressure plane to serve the portion of Austin Ranch currently served by Plano. Additional water line projects will also be required to serve the projected future demands. Pressures, headlosses and fire flows throughout the modeled 2060 system are all comparable to those found in the existing system.

More detail on specific projects and costs is provided in **Section 5**. **Figure 4.15** displays the projected operation of the elevated storage tanks in the 2060 system under maximum day demand conditions.

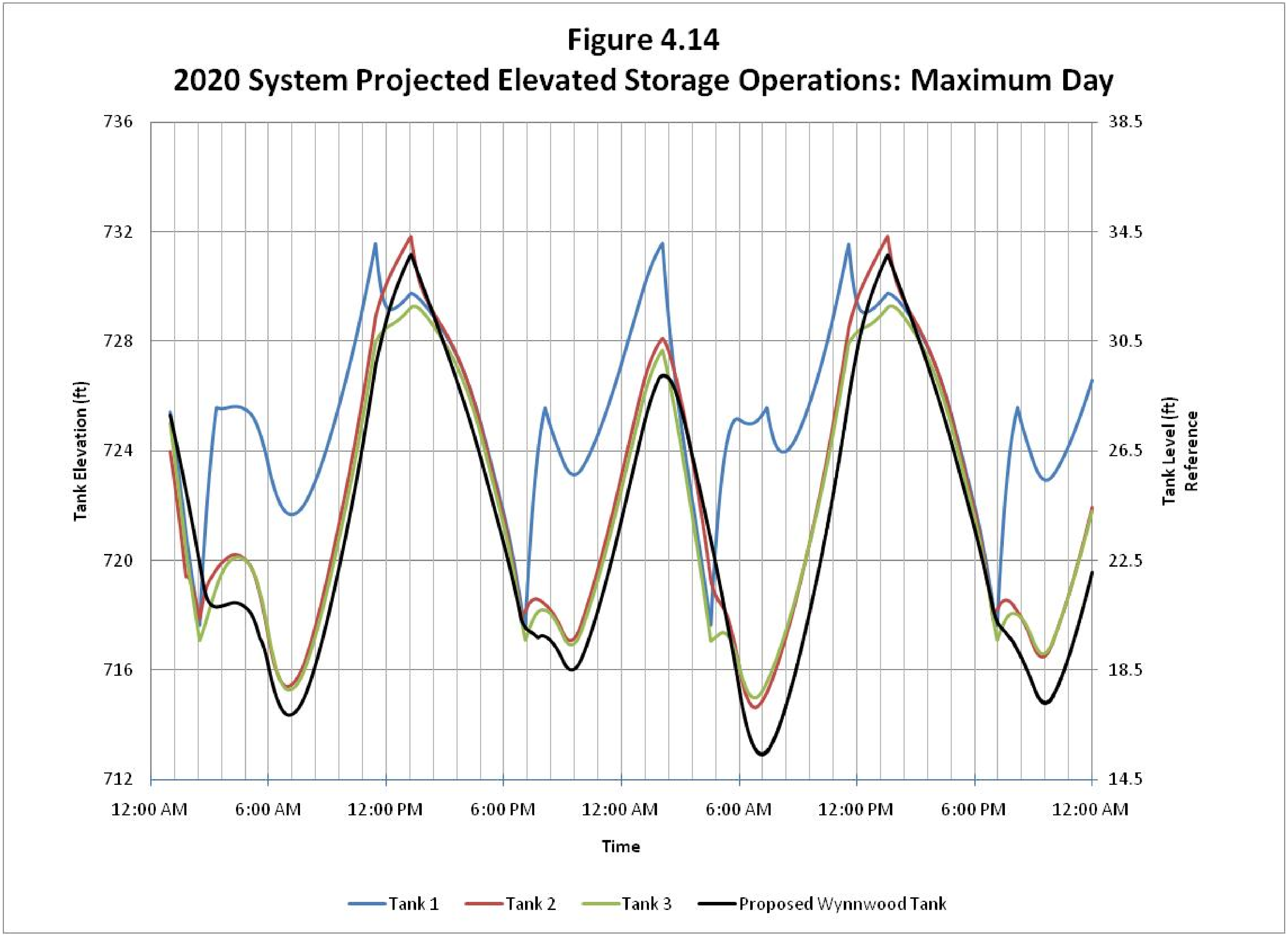

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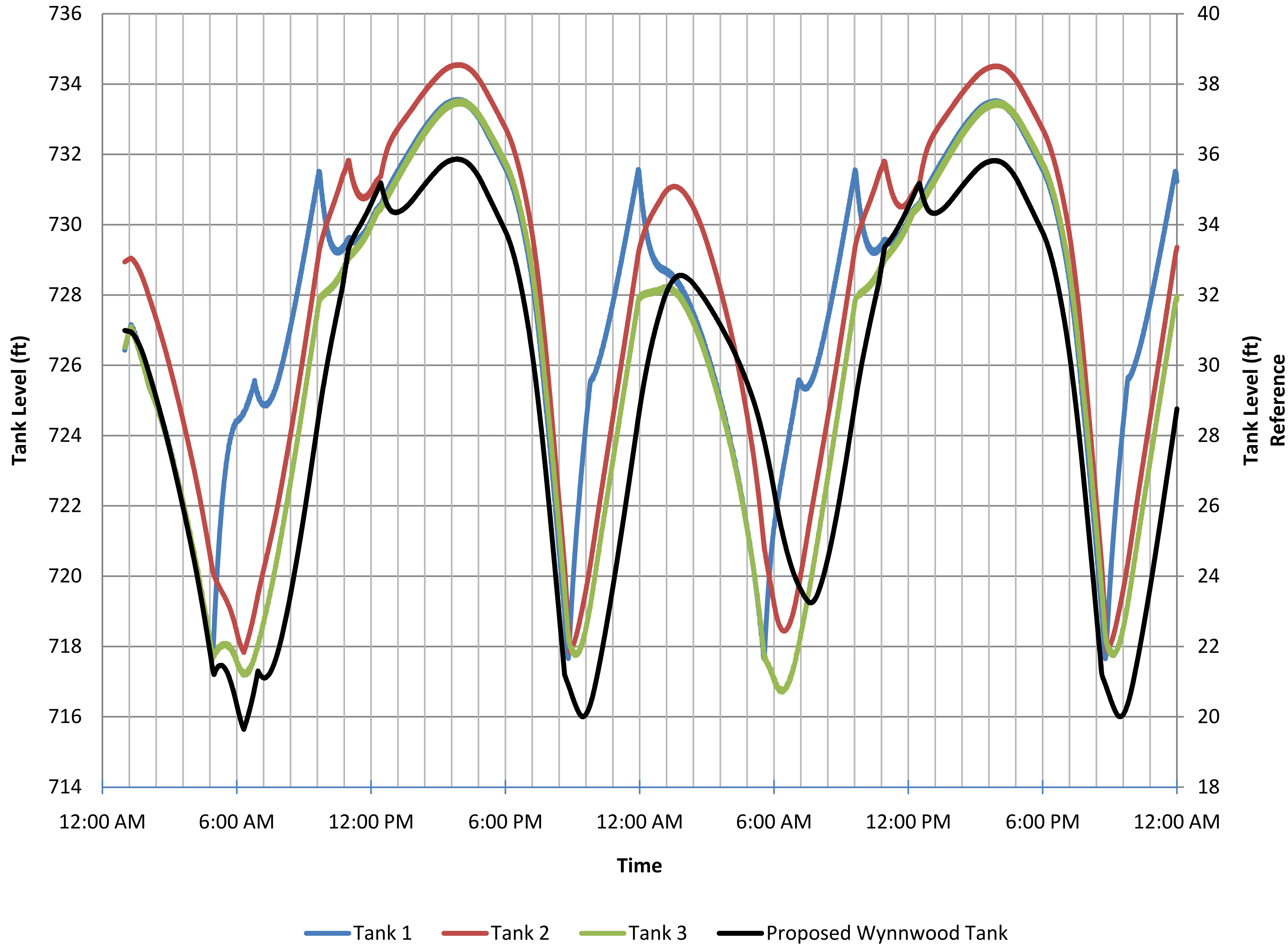
Figure 4.15
2060 System Projected Elevated Storage Operations: Maximum Day



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5 Water System Capital Improvements Plan

A water system capital improvements plan (CIP) has been created to meet the demands of projected growth in the City. **Figure 5.1** displays all of the water system master plan projects.

5.1 2010 SYSTEM

There are no major hydraulic deficiencies in the existing system. The first project in the master plan is construction of Well Site #4 at the Office Creek Pump Station (Project 1). This project will provide additional groundwater capacity and will allow for blending at the surface water source. The wells have been constructed and the pumps and motors are scheduled to be installed within one year. In addition, permanent booster chlorination is currently being installed at the Wynnwood Pump Station.

The existing system has multiple chlorination facilities and does not typically produce low chlorine residuals. However, as described in **Section 4.5.3**, there is potential for changes in pump station operation to influence blending and water age throughout the system. The existing DWU contract format provides fiscal limits on the probable amount of existing flow from groundwater sources. Additional studies could provide insight into options, such as valve closures to route pump station flows or running higher percentages of groundwater for shorter durations (keeping the total volume of groundwater effectively the same as the current volume), that could produce lower water ages and different blending zones.

5.2 2010-2020 SYSTEM

The major projects of the 2020 system provide service to State Highway 121 (Projects 4-6), improve hydraulic capacity through the existing system (Project 2), and add elevated storage at the Wynnwood Pump Station (Project 3). The size of the currently proposed Wynnwood elevated tank (500,000 gallons) is based on projected future population and demands. This tank would provide elevated storage for 5000 connections, or 15,500 people, based on TCEQ connection requirements. The City may elect to construct a larger tank to provide elevated storage for a larger number of connections to prevent requesting an elevated storage variance from TCEQ. It is not recommended that a tank larger than 750,000 gallons be constructed unless it is demonstrated that a suitable number of connections and demand are expected in the area. Existing firm pumping capacity in the pressure plane can support approximately 6,500 connections based on criteria in **Table 3.2**. If the projected number of connections increases above 6,500, the final pump slot should be utilized at the station.

The other projects of note during this planning period are the construction of transmission lines to bring service across to the south of State Highway 121. The lines will initially be used to provide service from the OCPS, but will also be utilized by the Southern Pump Station in the 2060 system to provide pressure and flow back into the system from the south. The elevation increases along SH 121 from west to east, requiring development of a new pressure plane to provide adequate pressure to the easternmost portion of SH 121. If the City elects not to pursue this option, the area potentially could be served with adequate pressure from the Plano system in a manner similar to the existing Austin Ranch development.

5.3 2020-2060 SYSTEM

The major projects of the 2060 system provide a new connection to DWU (Projects 9 and 11), the option to provide service to the existing Austin Ranch development (Project 10), and increase hydraulic efficiency of the Office Creek Pump Station (Project 8). The proposed Southern Pump Station includes ground storage and pumping facilities at a location currently owned by the City. DWU water would be provided from a connection at the Bobby Ballard Pump Station, in neighboring Carrollton, to the proposed station, where it would be lifted to provide new service to the southern portion of the City. This proposed station will provide a redundant surface water connection for the City.

The 2060 plan provides service to all of Austin Ranch, including any newly developed areas and existing portions of the development currently served by Plano. This project includes a 20-inch line along Windhaven Parkway to a new ground storage tank and pump station as well as an elevated storage tank to provide pressurized volume to the existing Austin Ranch area.

Planning level costs were developed as part of the master planning process. **Table 5.1** displays a summary of all of the recommended water master plan projects along with a brief project description and a planning level cost estimate. Planning level cost breakdowns for each project are provided in **Appendix D**.

Table 5.1 Summary of All Water System Master Plan Projects

Project No.	Planning Period	Project Description	Est. Cost
1	2010-2020	New well at OCPS (presently under construction)	n.a.
2	2010-2020	2,100 LF 16-in transmission main	$365,000
3	2010-2020	Wynnwood 0.5 MG Elevated Storage Tank	$2,193,000
4	2010-2020	1,700 LF 18-in transmission main	$340,000
5	2010-2020	6,400 LF 16-in transmission main	$1,085,000
6	2010-2020	2,500 LF of 16-in transmission main	$434,000
7	2010-2020	5,300 LF of 20-in transmission main	$1,106,000
8	2020-2060	2,100 LF of 18-in transmission main	$427,000
9	2020-2060	Southern Pump Station Facilities: Two - 2 MG GST, 8 MGD pumps, & 11,000 LF of 30-in main	$11,960,000
10	2020-2060	Austin Ranch Pump Station: 0.75 MG EST, 2 MG GST, 5 MGD pumps, & 3,200 LF 20-in main	$8,440,000
11	2020-2060	Southern Pump Station Facilities (Phase 2): 2 MG GST & 4 MGD pump expansion	$3,250,000
Total Costs, 2010-2020 Planning Period			**$ 5,523,000**
Total Costs, 2020-2060 Planning Period			**$15,637,000**
Total Costs, All Planning Periods			**$21,160,000**

6 Summary and Conclusions

The water master plan for The Colony was updated by utilizing current system GIS data, operational controls and as-built facility data, and historical daily pumping and monthly billing data. A calibrated hydraulic model was used to aid in the analyses of the existing water system and recommendation of proposed improvements.

The existing system model performs well hydraulically. Modeled minimum pressures and available fire flows are all above required and generally above recommended values throughout the system. Headlosses in the system are acceptably below recommended maximum limits. The existing system also has sufficient existing ground and elevated storage and firm pumping capacity. The lack of a true transmission system throughout the city leads to potential blending and water age concerns.

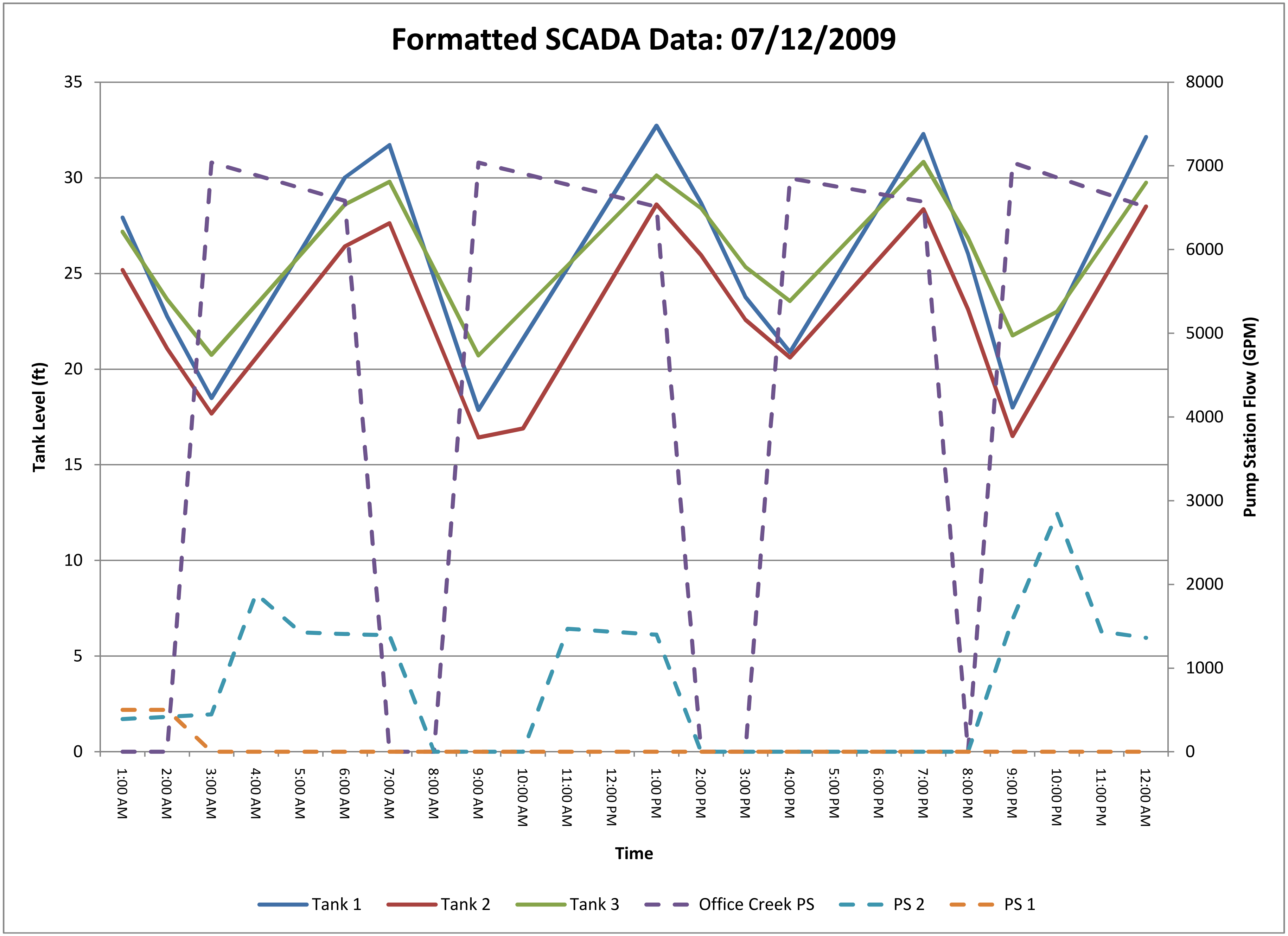
The existing system has multiple chlorination facilities and does not typically produce low chlorine residuals. However, there are potential for changes in pump station operation that might influence blending and water age throughout the system. The existing DWU contract format provides fiscal limits on the probable amount of existing flow from groundwater sources. This will be alleviated as system demands increase and a higher percentage of groundwater can be used to supply system demands. Additional studies could provide insight into options, such as valve closures to route pump station flows to specific areas or running higher percentage of groundwater for shorter durations, which could produce lower water ages and different blending zones.

The final size of the Wynnwood elevated storage tank should take into account projected total connection counts on the peninsula as well as hydraulic performance. The current proposed size of 500,000 gallons works well hydraulically based on projected demands in the area and provides enough elevated storage for roughly double the expected connections as defined in this project. However, if future plans determine more than 5000 connections will be present and the City does not wish to apply for a TCEQ variance, a larger tank may be required. Based on potential hydraulic and water quality concerns, it is not recommended that the tank be larger than 750,000 gallons.

The majority of the water master plan and CIP projects are growth-driven projects. The 2020 system provides additional elevated storage to Wynnwood and serves the south area along SH 121 as well as providing water service to targeted developments in the city. The 2060 system builds on the 2020 system and continues development along the southeast area of SH 121 and provides a redundant surface water connection to DWU via the Southern Pump Station. The 2060 system also provides water service to targeted developments in the city. Pressures, headlosses, and fire flows throughout the modeled 2020 and 2060 systems are all comparable to those found in the existing system. The addition of the Southern Pump Station actually improves pressures around Tank 3 by serving the demands in the large growth area south of SH 121.

Cost estimates were performed for the water mast plan projects. The total estimated projects costs are $5,523,000 for projects in the 2010-2020 planning window and $15,637,000 for projects in the 2020-2060 planning window. Total project costs for all planning periods in the study are estimated at $21,160,000.

APPENDIX A



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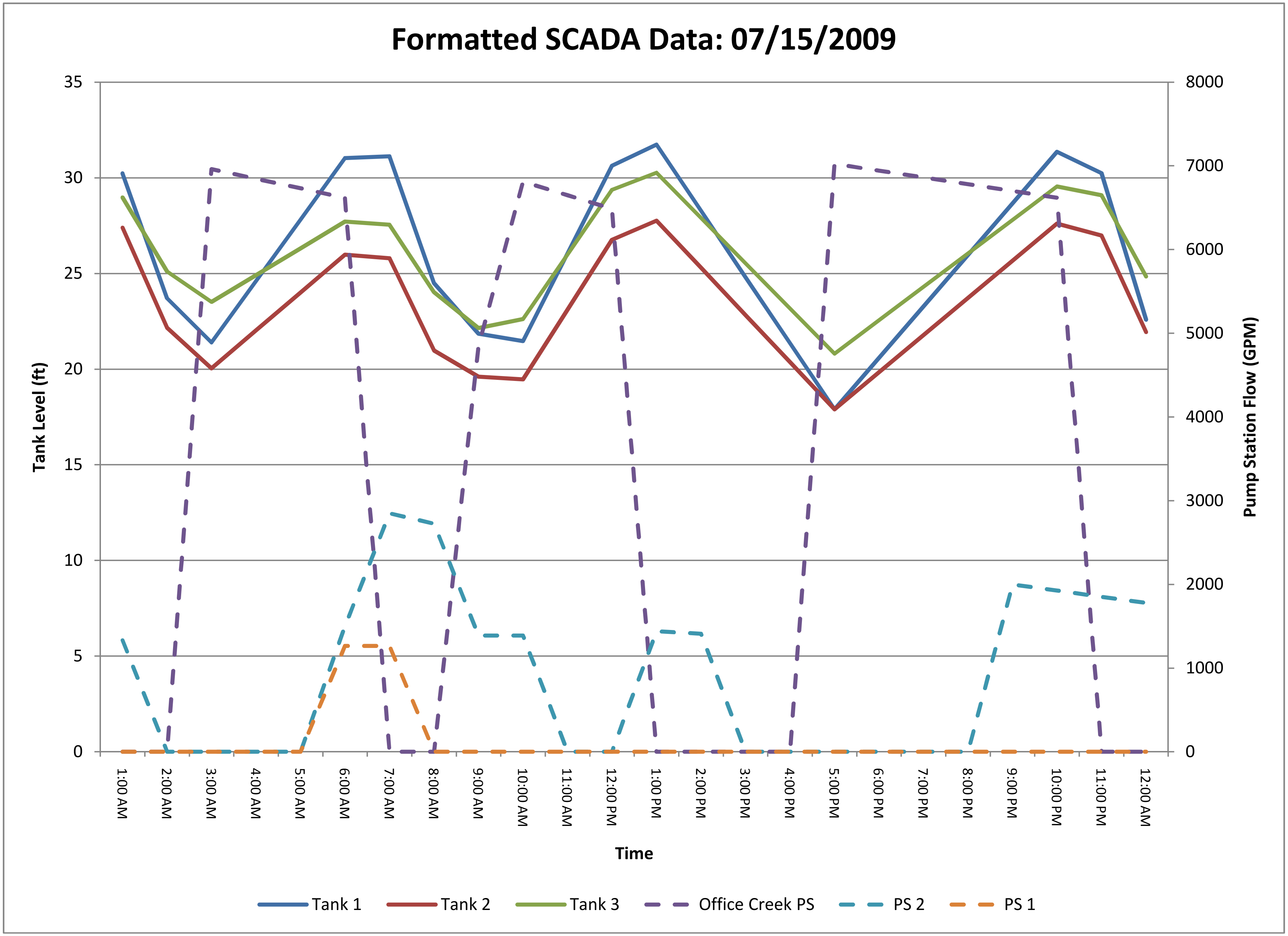

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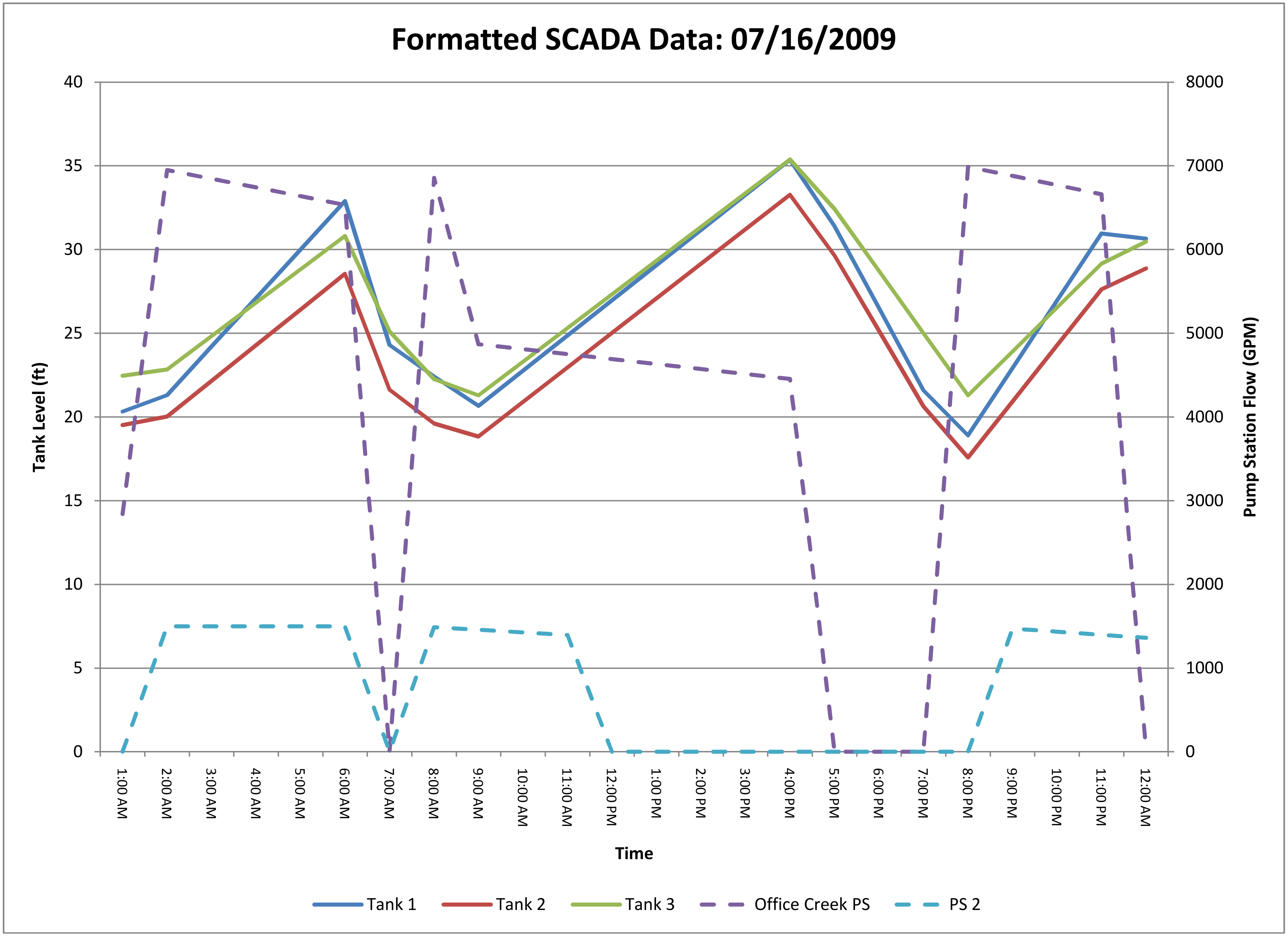

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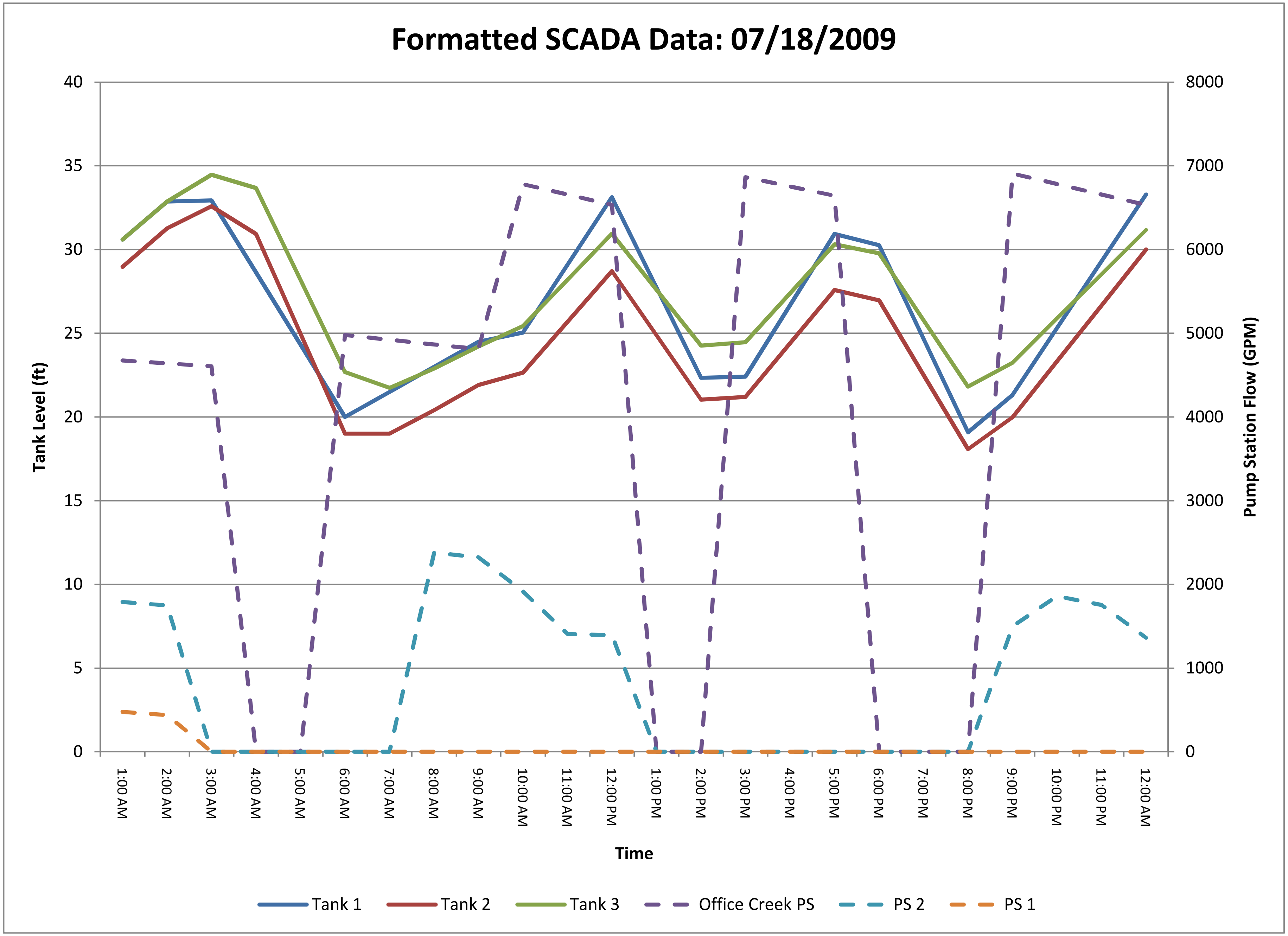
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Tank Level (ft)
40
35
30
25
20
15
10
5
0
Pump Station Flow (GPM)
8000
7000
6000
5000
4000
3000
2000
1000
0
1:00 AM
2:00 AM
3:00 AM
4:00 AM
5:00 AM
6:00 AM
7:00 AM
8:00 AM
9:00 AM
10:00 AM
11:00 AM
12:00 PM
1:00 PM
2:00 PM
3:00 PM
4:00 PM
5:00 PM
6:00 PM
7:00 PM
8:00 PM
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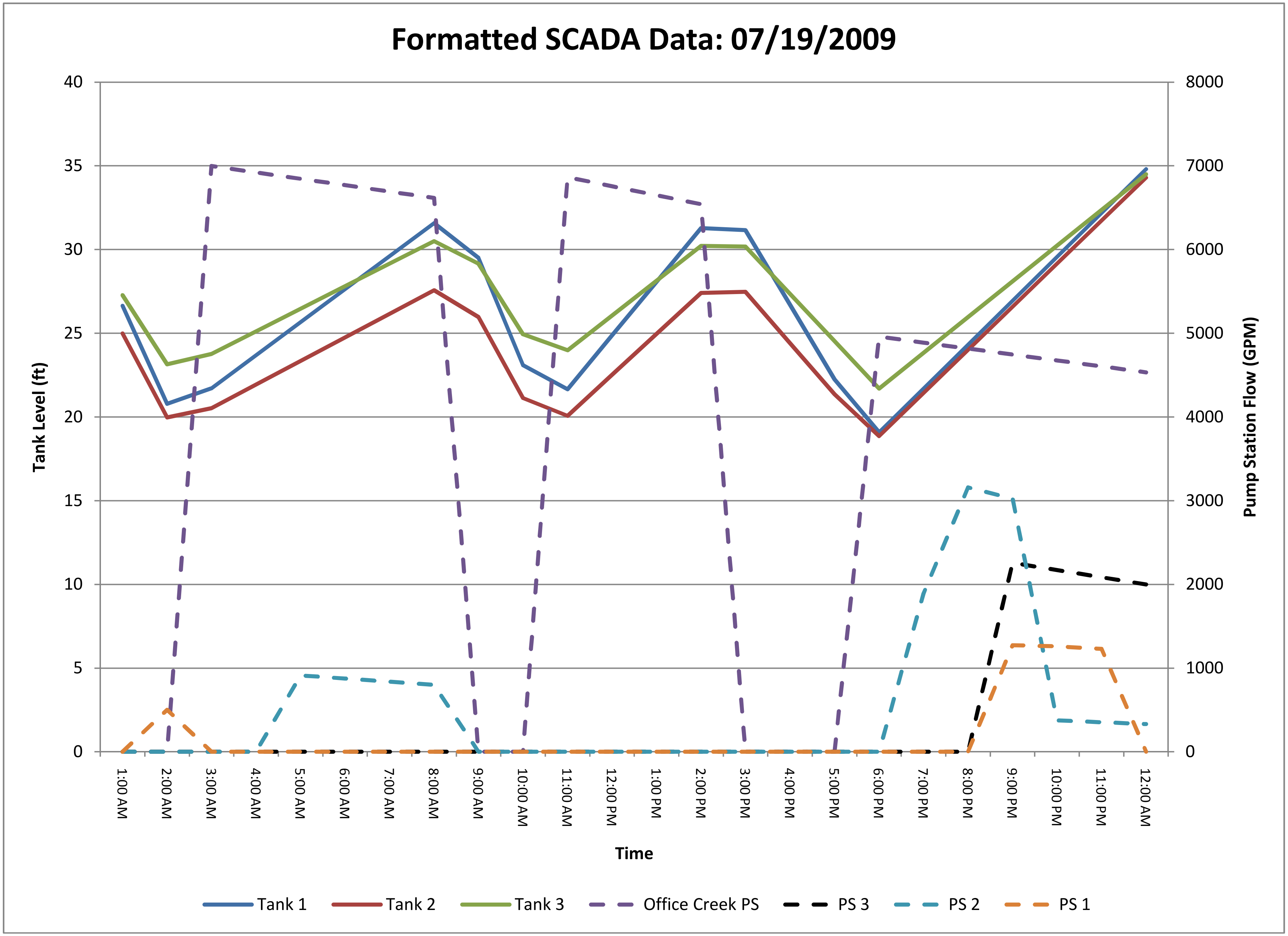
Time
Tank 1
Tank 2
Tank 3
Office Creek PS
PS 2
PS 1



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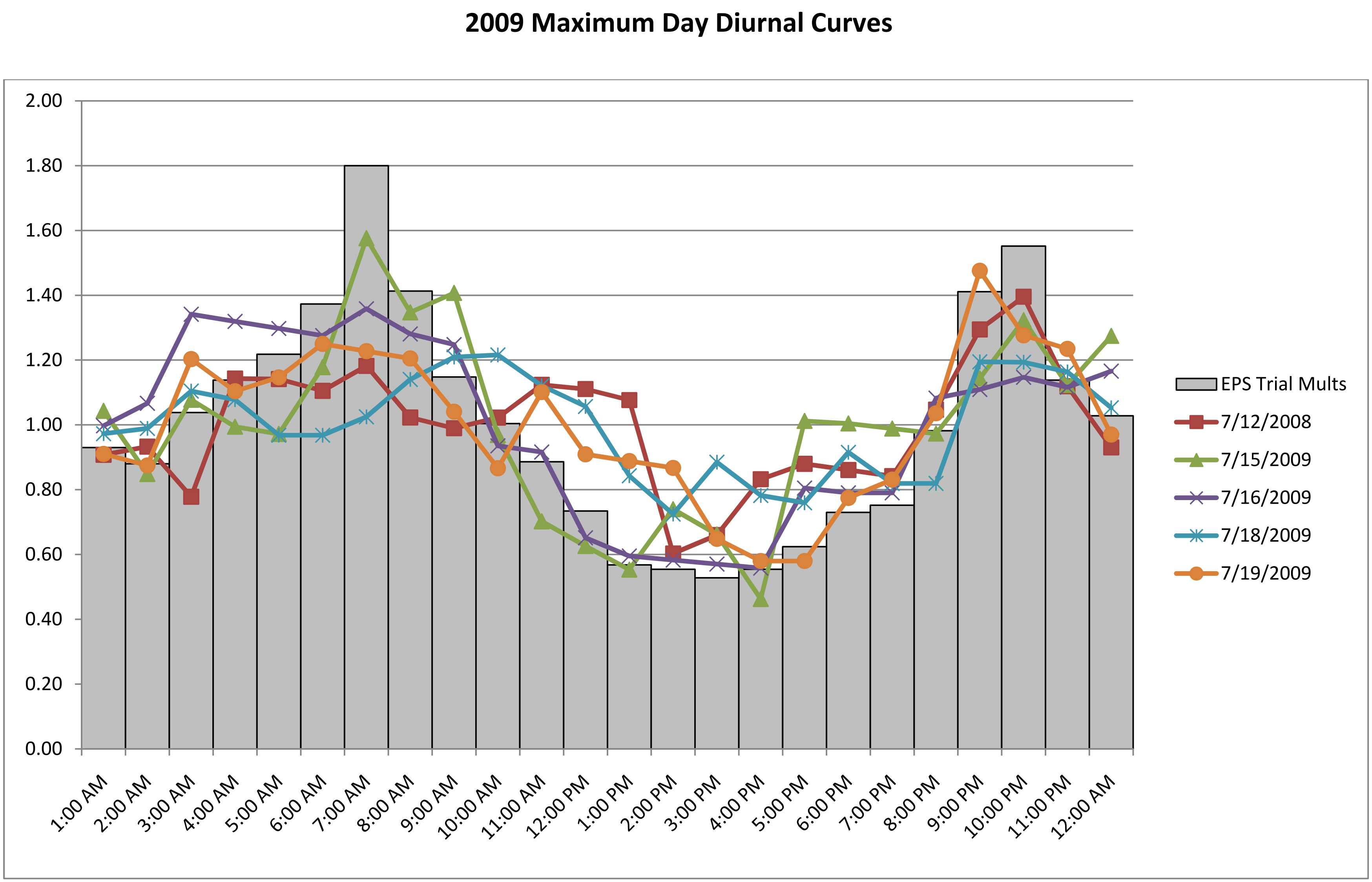

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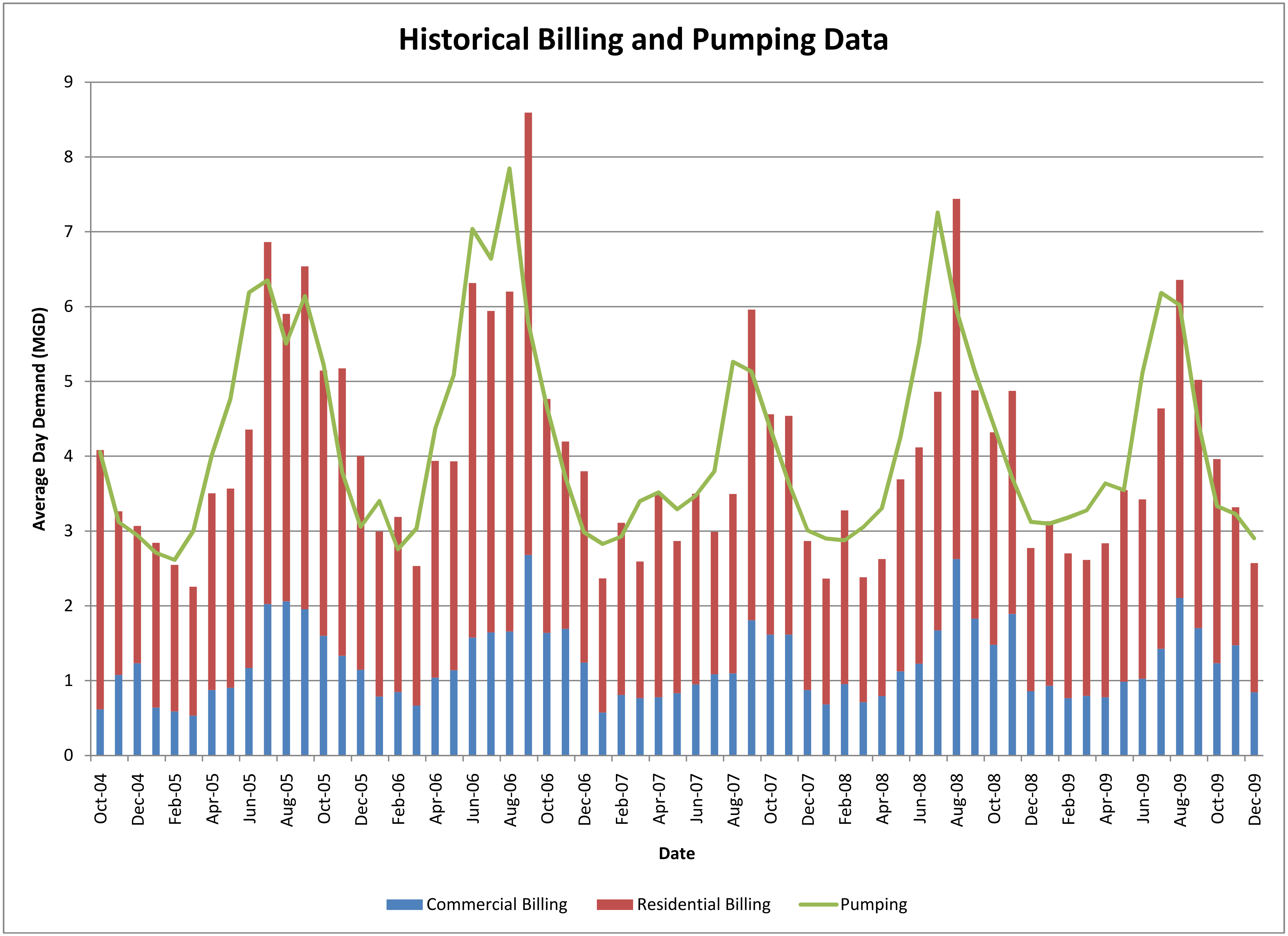

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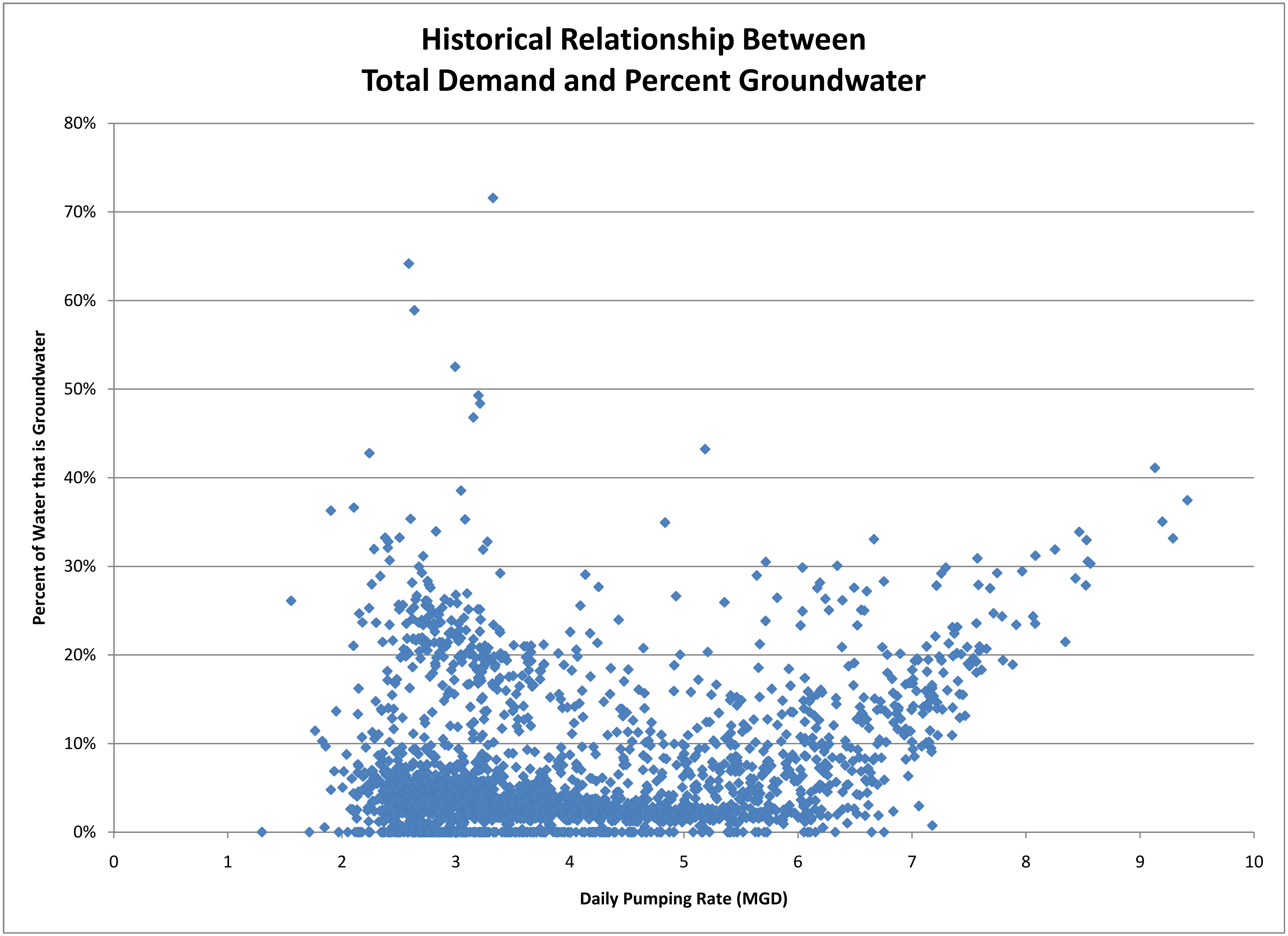

Historical Relationship Between
Total Demand and Percent Groundwater
Percent of Water that is Groundwater
0%
10%
20%
30%
40%
50%
60%
70%
80%
0
1
2
3
4
5
6
7
8
9
10
Daily Pumping Rate (MGD)

APPENDIX B

APPENDIX C

Background

Four areas were selected for detailed review of high water age under multiple demand and operational scenarios. For identification in this report these areas are called: Northeast Colony, North Colony, Wynnwood and Highway 121. For each area a water age scenario was calculated with the following pump station combination: only the Office Creek Pump Station, Office Creek and Pump Station 2, all pump stations, and only the closest pump station to the area (varies by location). In addition the demands specific to the area were varied based on historical billing data. The locations are results of these analyses are described in more detail below.

a) Northeast Colony

This area, east of Stewart Creek along and including Turner Road, is the most northeast portion of the existing service area. This area did not show a strong response to increased demands through the localized area for any operational condition, likely due to a bottleneck effect from the small diameter lines feeding the localized area relative to the transmission line diameters. However, this area did show a large variation in age between the different operational conditions for every demand condition. As expected, the lowest water age was from operating only PS 3 (the closest station to the area). Surprisingly the second lowest age was from operating only Office Creek: other combinations of groundwater pump stations and Office Creek were the highest relative water age. This is likely due to modeling constraints on operational rules of pumps based on elevated tank levels.

b) North Colony

This area, west of Main Street and north of Lake Highlands, is located relatively near Pump Station 2. This area showed a stronger response to increased demands when operating Office Creek. The response diminished when operating groundwater wells. As with the Northeast Colony location, the largest change in age is from different operational conditions. In this area the lowest water age results were from operating either only PS 2 (the closest station to the area) or a combination of PS 2 and Office Creek. Scenarios where PS 2 was not run led to relatively high water ages regardless of demand conditions.

c) Wynnwood

This area, west of Main Street and north of the main water system, is known as the Wynnwood Peninsula. This area showed a stronger response to increased demands for all operating conditions. Unlike the other locations, the largest change in age is from additional demands. In this area, similar to the North Colony area, the lowest water age results were from operating either only PS 2 (the closest station to the area) or a combination of PS 2 and Office Creek. The city has the ability to bypass the Wynnwood Pump Station, which was also modeled. In each case a significant reduction in water age occurred when the Wynnwood Peninsula was fed directly from the main system.

d) Highway 121

This area includes miscellaneous dead end lines located north along State Highway 121. In each location the water age is tied to the hydraulics of the lines, and was only improved by interconnection. As described in the report body this area will see improvements in hydraulic and water quality indicator performance as additional infrastructure is built to meet future demands.

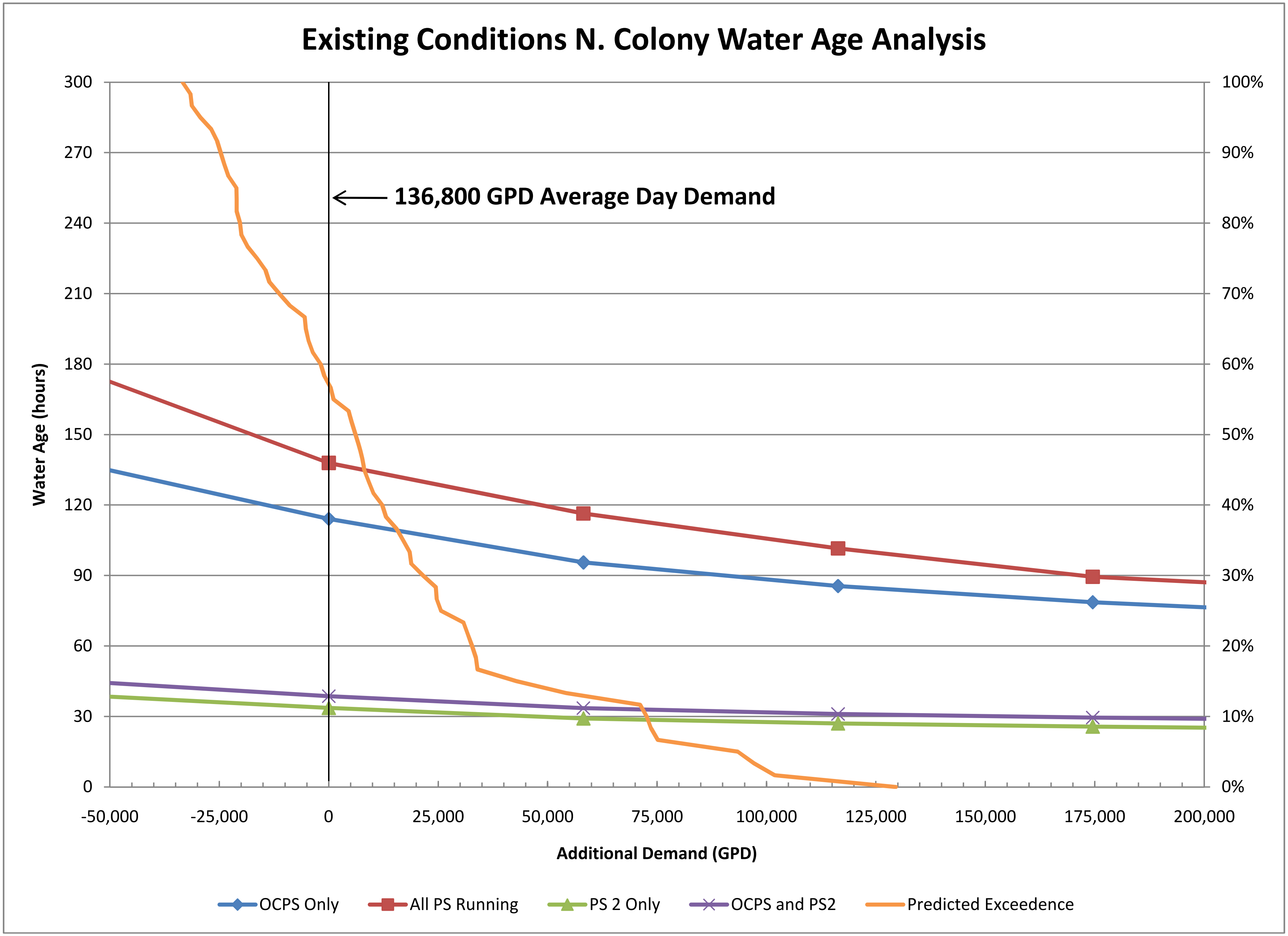
Description of Data Contained in Graphs

The principal y-axis is the hydraulic model output of water age, in hours. It is the average water age calculated between 3 and approximately 9 weeks (504 and 1500 hours) of simulation time. A dead end line with no demands would be modeled with infinite water age, which would appear as 1000 hours in these scenarios. Existing dead end lines with no demand were removed from analyses to prevent data skew.

The x-axis is the demand in the area of interest relative to average day demands, which are calculated from historical billing data. The zero crossing at the x-axis corresponds to average day: values to the right of this point are above average day demands and to the left are below average day demands. As these demands are meant to replicate flushing activities they are specific to the area of interest and not inclusive of the entire system.

The solid color (blue, red, green and purple) lines represent individual pump station operation conditions in the hydraulic model. Each mark along the line indicates a water age scenario. Thus, for each of the four types of operational runs discussed above, a single demand is used in the area of interest and the model is executed. The demand is then changed (increased or decreased) and all four operational runs are re-executed. The trends of each operational scenario are plotted as the solid colored lines.

The orange line is a plot of all historical available billing data. It is read from the secondary y-axis as a percent exceedance. The orange line crosses the 0 x-axis at approximately (rounding error) 50 percent exceedance (average): moving right moves towards higher demands, which are exceeded less frequently while moving left has the opposite effect. The orange line is provided for reference to the viewer to give historical context to the demand scenarios utilized in the hydraulic model: it is not an input in the model.



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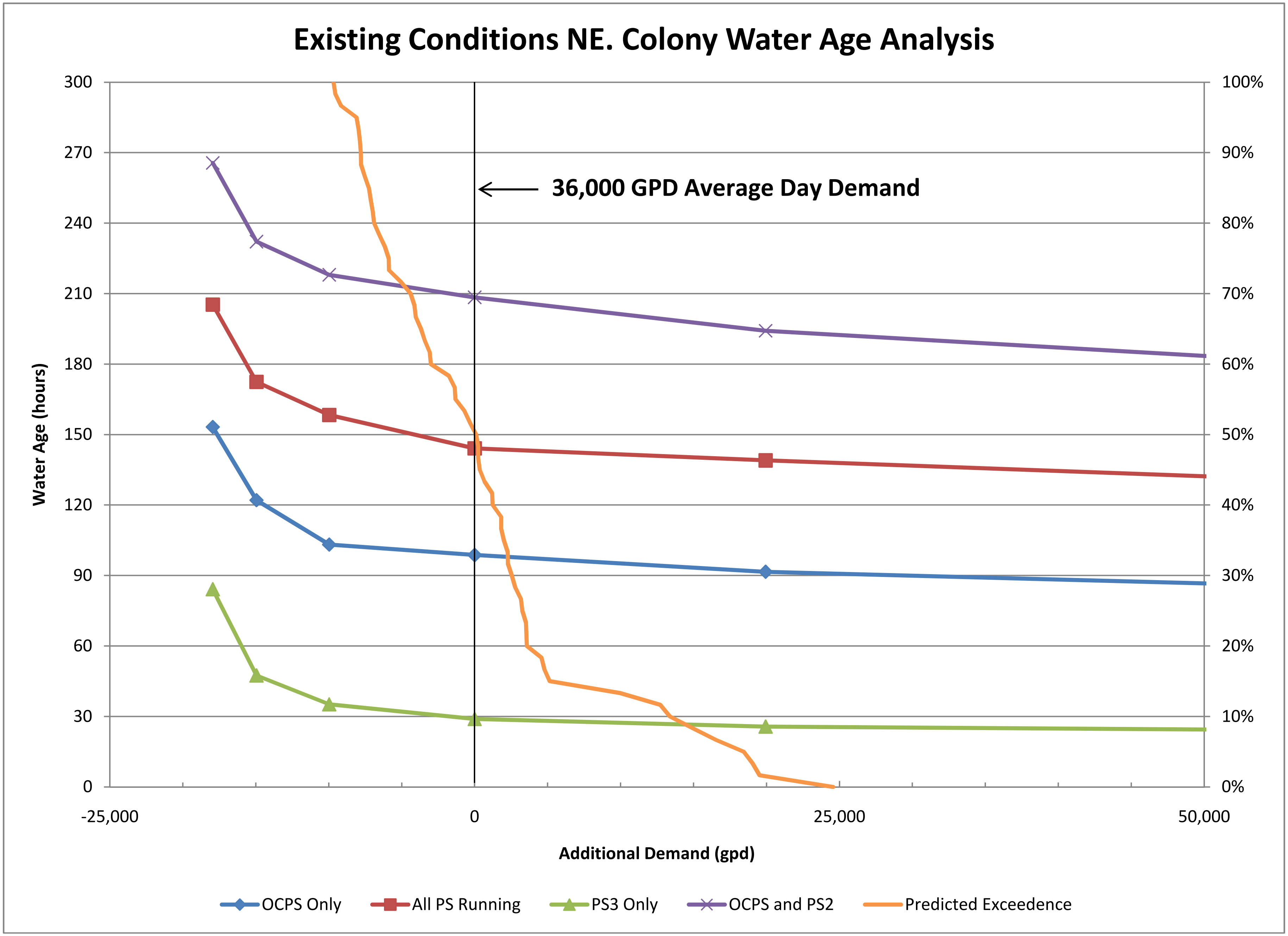

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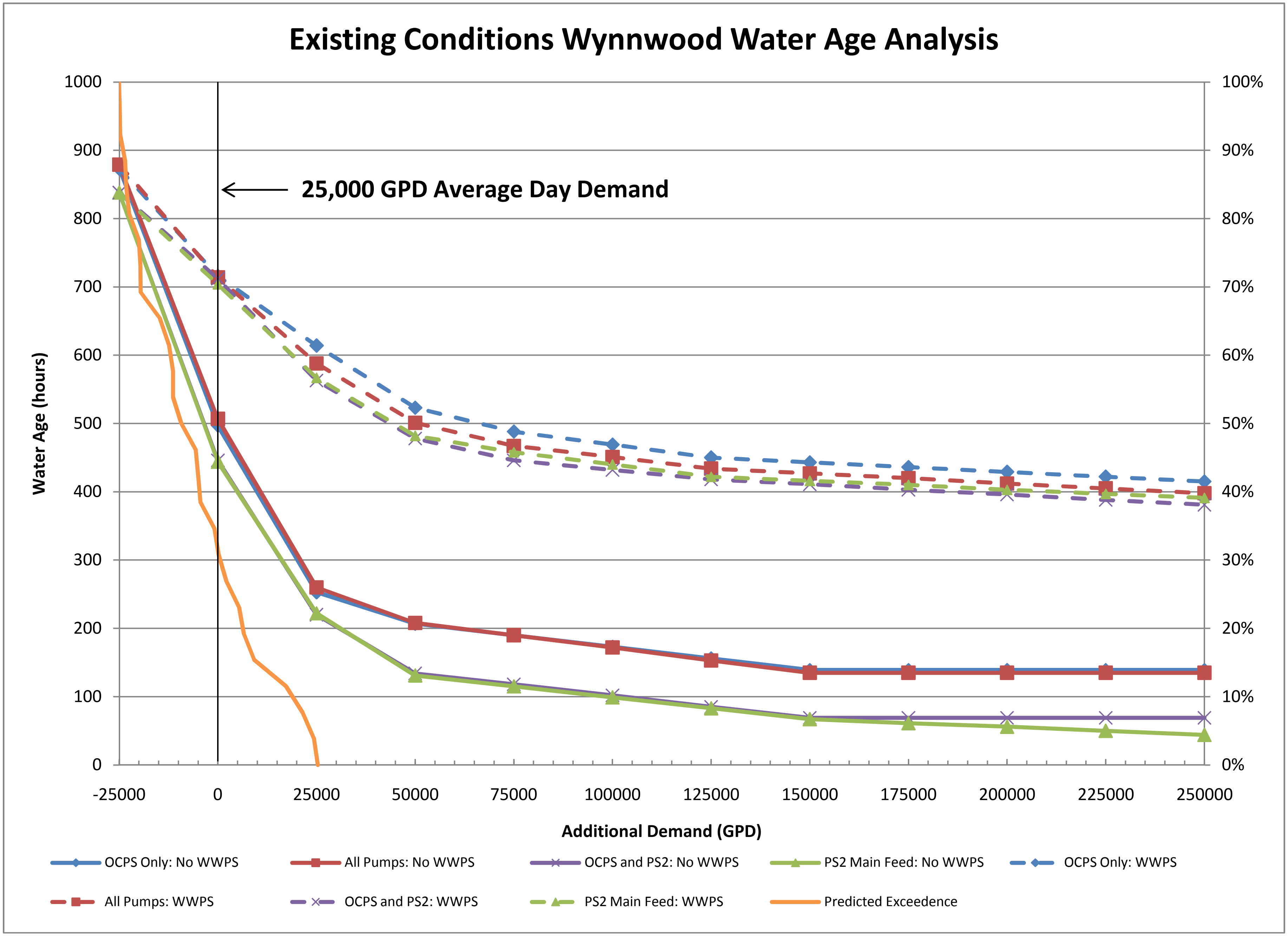

F:\projects\1438\001-01\Wrk\Water Age\water-age-scenarios.xlsxChart-wynnwood

APPENDIX D

Planning Window	Estimated Costs
2010-2020	$ 5,523,000
2020-2060	$ 15,637,000
Total	$ 21,160,000

Notes

General:

These costs are as of August 2010 and include estimates for contractor overhead, profit or mobilization but do not include escalation or amortization.
Overall project background and purposes are included in **Section 5** of report. See **Figure 5.1** for project locations.

Cost Assumptions:

ALL:

Raw cost is for labor and material WITHOUT contingency, engineering, survey, etc
Does not include costs for right-of-way (ROW) or ROW acquisition

Pipes:

Costs are for typical quantities at average installation depth of 8'
Future lines constructed concurrently with roadway projects. Replacement lines located outside of roadways unless indicated.
Assumed PVC for <24"

Pump Stations:

Costs are for actual station size indicated and do not include construction for future expansion and does not include ancillary building costs

Pump Station Expansions:

Costs assume that station has appropriate clear well capacity unless noted - cost is for additional pumping and yard pipe (if applicable) only

Elevated Storage Tanks

Costs are for average construction (no interior office space, etc) at a height < 180ft

Ground Storage Tanks

Cost is for concrete tank ONLY - no site work or buildings.

Percent Engineering vs Project Size

The estimating design services are based on construction amount and are adapted from ASCE work for FEMA Public Assistance Guide 322

The Colony Water Master Plan Upate

OPINION OF PROBABLE CONSTRUCTION COST — AUGUST 2, 2010

ESTIMATOR	CHECKED BY	PROJECT NO
SMS	AR	1438-001-01

Master Plan Project Number 1

Estimated Construction Year 2010

Project Description

Office Creek Groundwater Well Site

Detailed Description

New groundwater wells, including well casings, pumps and appurtenances to connect to existing clear wells at Office Creek Pump Station.

Purpose

Provide additional groundwater capacity and ability to blend with surface water at existing Office Creek Pump Station.

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
	CURRENTLY UNDER CONSTRUCTION				

SUBTOTAL:		
CONTINGENCY		
SUBTOTAL:		
ENG/SURVEY		
SUBTOTAL:		

PROJECT TOTAL

Master Plan Project Number 2

Estimated Construction Year 2012

Project Description

16-inch Transmission Main

Detailed Description

2,100 LF of transmission line along Memorial Drive from Worley Dr. to South Colony Boulevard.

Purpose

Increase hydraulic capacity between Office Creek PS and Elevated Tank 3, which maintains pressure in the highest elevation of the existing service area.

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	16" Pipe	2,100	LF	$119.00	249,900
2	Pavement Repair	150	SY	$62.00	9,300

SUBTOTAL:		$259,200
CONTINGENCY	20%	$52,000
SUBTOTAL:		$311,200
ENG/SURVEY	17%	$53,000
SUBTOTAL:		$364,200

PROJECT TOTAL **$365,000**

The Colony Water Master Plan Update

OPINION OF PROBABLE CONSTRUCTION COST — AUGUST 2, 2010

ESTIMATOR	CHECKED BY	PROJECT NO
SMS	AR	1438-001-01

Master Plan Project Number 3 — Estimated Construction Year 2013

Project Description

Wynnwood elevated storage tank.

Detailed Description

Construct 500,000 gallon elevated storage tank at the existing Wynnwood pumping station.

Purpose

Provide required TCEQ elevated storage and replace existing hydropneumatic tank.

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	500,000 Gal Elevated Tank	1	EA	$1,612,000.00	1,612,000

SUBTOTAL:		$1,612,000
CONTINGENCY	20%	$323,000
SUBTOTAL:		$1,935,000
ENG/SURVEY	13%	$258,000
SUBTOTAL:		$2,193,000

PROJECT TOTAL **$2,193,000**

Master Plan Project Number 4 — Estimated Construction Year 2014

Project Description

18-inch Transmission Main

Detailed Description

Project begins 2,000 LF south of SH 121 where the existing 18-inch line ends. The new 18-inch line will be constructed along S. Plano Pkwy. until 215-feet before the intersection with the Headquarters Dr. extension.

Purpose

Meet the future growth of the Austin Ranch area and the transportation corridors leading to the Austin Ranch development. Also, it is necessary to increase the capacity of the mains in this area for the when the Southern Pump Station comes on-line.

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	18" Pipe	1,700	LF	$136.00	231,200
2	Pavement Repair	150	SY	$62.00	9,300

SUBTOTAL:		$240,500
CONTINGENCY	20%	$49,000
SUBTOTAL:		$289,500
ENG/SURVEY	17%	$50,000
SUBTOTAL:		$339,500

PROJECT TOTAL **$340,000**

The Colony Water Master Plan Update

OPINION OF PROBABLE CONSTRUCTION COST — AUGUST 2, 2010

ESTIMATOR	CHECKED BY	PROJECT NO
SMS	AR	1438-001-01

Master Plan Project Number 5

Estimated Construction Year 2015

Project Description

16-inch Transmission Main

Detailed Description

Construct 4,100 LF of 16-inch line along Headquarter Dr. extension. Construct 1,900 LF of 16-inch line along Morningstar Dr. extension & along the SH 121 frontage road. Construct 400 LF of 16-inch line under SH 121 within the existing steel casing.

Purpose

These new transmission mains will follow along future roads described in the 2008 Master Thoroughfare Plan. These lines will provide service to the large vacant area south of SH 121 in the eastern side of the City.

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	16" Pipe	6,400	LF	$119.00	761,600
2	Pavement Repair	500	SY	$62.00	31,000

SUBTOTAL:		$792,600
CONTINGENCY	20%	$159,000
SUBTOTAL:		$951,600
ENG/SURVEY	14%	$133,000
SUBTOTAL:		$1,084,600

PROJECT TOTAL **$1,085,000**

Master Plan Project Number 6

Estimated Construction Year 2017

Project Description

16-in Transmission Main

Detailed Description

2,500 LF of 16-inch line will be constructed below SH 121 in the existing 24-inch steel casing at S. Colony Blvd. & then extend west along the SH 121 frontage road before turning south along the S. Colony Blvd. road extension until it intersects Headquarters Dr.

Purpose

These new transmission mains will follow along future roads described in the 2008 Master Thoroughfare Plan. These lines will provide service to the large vacant area south of SH 121 in the eastern side of the City.

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	16" Pipe	2,500	LF	$119.00	297,500
2	Pavement Repair	200	SY	$62.00	12,400

SUBTOTAL:		$309,900
CONTINGENCY	20%	$62,000
SUBTOTAL:		$371,900
ENG/SURVEY	16%	$62,000
SUBTOTAL:		$433,900

PROJECT TOTAL **$434,000**

The Colony Water Master Plan Update

OPINION OF PROBABLE CONSTRUCTION COST — AUGUST 2, 2010

ESTIMATOR	CHECKED BY	PROJECT NO
SMS	AR	1438-001-01

Master Plan Project Number 7

Estimated Construction Year 2019

Project Description

20-inch Transmission Main

Detailed Description

Construct 5,300 LF of 20-inch transmission line. Project limits begin at Headquarters Dr., then extend just west of S. Plano Pkwy. & south along the city limits until reaching Windhaven Pkwy. where the line turns east 950-feet & intersects S. Plano Pkwy.

Purpose

This project will increase the size of the transmission main along S. Plano Pkwy. so that when the Southern Pump Station comes online, there will be adequate capacity.

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	20" Pipe	5,300	LF	$149.00	789,700
2	Pavement Repair	300	SY	$62.00	18,600

SUBTOTAL:		$808,300
CONTINGENCY	20%	$162,000
SUBTOTAL:		$970,300
ENG/SURVEY	14%	$135,000
SUBTOTAL:		$1,105,300

PROJECT TOTAL **$1,106,000**

Master Plan Project Number 8

Estimated Construction Year 2022

Project Description

18-inch Transmission Main

Detailed Description

2,100 LF of 18-inch line along Cougar Alley from Main Street to Blair Oaks Drive.

Purpose

The existing 12-in line ties into an 18-in line, which continues south down Blair Oaks Dr. This line is a main pathway for flow from OCPS to reach the southeast service area & alleviates potential pressure problems.

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	18" Pipe	2,100	LF	$136.00	285,600
2	Pavement Repair	300	SY	$62.00	18,600

SUBTOTAL:		$304,200
CONTINGENCY	20%	$61,000
SUBTOTAL:		$365,200
ENG/SURVEY	16%	$61,000
SUBTOTAL:		$426,200

PROJECT TOTAL **$427,000**

The Colony Water Master Plan Update

OPINION OF PROBABLE CONSTRUCTION COST — AUGUST 2, 2010

ESTIMATOR	CHECKED BY	PROJECT NO
SMS	AR	1438-001-01

Master Plan Project Number 9

Estimated Construction Year 2025

Project Description

Southern Pump Station Facilities - Phase 1

Detailed Description

Construct 2 - 2 MG ground storage tanks, 8 MGD pump station, & yard piping. Construct 8,600 LF of 30-inch main along S. Plano Pkwy from Southern Pump Station up to the Windhaven Pkwy. intersection. Construct 2,400 LF of 30-inch main from Bobby Ballard Pump Station to proposed Southern Pump Station.

Purpose

This new pump station & associated transmission main along S. Plano Pkwy will provide a secondary source of water from DWU to the system other than the Office Creek Pump Station. This line will feed the growing southeast sector of the City Limits. An Carollton pump station (Bobby Ballard) has already been constructed along with a transmission main from DWU.

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	30" Pipe	11,000	LF	$223.00	2,453,000
2	2.0 MG Ground Tank	2	EA	$1,860,000.00	3,720,000
3	Pump Station - New 8 MGD	1.00	EA	$2,480,000.00	2,480,000
4	Pavement Repair	700	SY	$62.00	43,400

SUBTOTAL:		$8,696,400
CONTINGENCY	25%	$2,175,000
SUBTOTAL:		$10,871,400
ENG/SURVEY	10%	$1,088,000
SUBTOTAL:		$11,959,400

PROJECT TOTAL **$11,960,000**

Master Plan Project Number 10

Estimated Construction Year 2030

Project Description

20-inch Transmission Main, Pump Station, Elevated Storage Facilities to Serve New Growth & Existing Austin Ranch

Detailed Description

Construct a 20-inch line from Plano Parkway (South Pump Station) line along Windhaven to a proposed pump station. Proposed station will include ground storage and pumping facilities to serve Austin Ranch area currently severd from the Plano pressure plane. Construct elevated tank in existing Austin Ranch to provide pressurized volume and TCEQ required storage to existing development.

Purpose

Provide service to existing and proposed Austin Ranch developments at elevations above current city pressure plane lijmits.

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	20" Pipe	3,200	LF	$149.00	476,800
2	Pump Station - New 5 MGD	1	LS	$1,860,000.00	1,860,000
3	2.0 MG Ground Tank	1	EA	$1,860,000.00	1,860,000
4	750,000 Gal Elevated Tank	1	EA	$1,860,000.00	1,860,000
5	Pavement Repair	500	SY	$62.00	31,000

SUBTOTAL:		$6,087,800
CONTINGENCY	25%	$1,522,000
SUBTOTAL:		$7,609,800
ENG/SURVEY	11%	$830,000
SUBTOTAL:		$8,439,800

PROJECT TOTAL **$8,440,000**

The Colony Water Master Plan Update

OPINION OF PROBABLE CONSTRUCTION COST — AUGUST 2, 2010

ESTIMATOR	CHECKED BY	PROJECT NO
SMS	AR	1438-001-01

Master Plan Project Number **11** — **Estimated Construction Year** **2050/2060**

Project Description

Southern Pump Station Facilities - Phase 2

Detailed Description

Construct 1 - 2 MG ground storage tank and expand proposed pump station 4 MGD.

Purpose

This new pump station & associated transmission main along S. Plano Pkwy will provide a secondary source of water from DWU to the system other than the Office Creek Pump Station. This project expands the initial phase of 8MGD to ultimate conditions (12MGD).

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	2.0 MG Ground Tank	1	EA	$1,860,000.00	1,860,000
2	Pump Station - Expans 4 MGD	1	LS	$442,680.00	442,680

SUBTOTAL:		$2,302,680
CONTINGENCY	25%	$576,000
SUBTOTAL:		$2,878,680
ENG/SURVEY	13%	$371,000
SUBTOTAL:		$3,249,680

PROJECT TOTAL **$3,250,000**