City of South Gate

WATER MASTER PLAN

Final Report • June 2019

Prepared by:
Kennedy/Jenks Consultants, Inc.

KJ Project Number: **1744508*00**

Kennedy Jenks

Kennedy/Jenks Consultants

300 N. Lake Ave, Suite 1020
Pasadena, CA 91101
626-568-4300
FAX: 626-683-8938

Water Master Plan

20 June 2019

Prepared for

City of South Gate
8650 California Avenue
South Gate, CA 90280

K/J Project No. 1744508*00

Table of Contents

Table of Contents (cont'd)

List of Tables

List of Figures

Table of Contents (cont'd)

List of Appendices

Executive Summary

The City of South Gate provides water service to a population of approximately 99,000. This Water Master Plan Report is organized into the following five sections:

Section 1 – Introduction provides a brief background of the City of South Gate, the objectives of the project, and a description of the general report organization.

Section 2 – Service Area, Land Use, and Existing System describes the existing land use of the City and the existing water distribution system including pump stations, pipelines, tanks, and system operation.

Section 3 – Water Demands and Supplies describes the historical and current water demands, demands variations and peaking, and future demands. Additionally, the section describes the City's water supply sources including groundwater and interconnections with other agencies.

Section 4 – System Evaluation presents a discussion on the hydraulic model creation including planning/evaluation criteria, system evaluation results and recommendations.

Section 5 – Capital Improvement Program presents the recommended capital improvement projects including the pipeline replacement program, infrastructure improvements, and other city-planned improvement projects, in addition to planning-level capital cost estimates.

The City of South Gate (City) encompasses 7.4 square miles of the south-central Los Angeles County area and is bounded by an unincorporated area of Los Angeles County to the west; by the cities of Huntington Park, Cudahy, Bell and Bell Gardens to the north; by City of Downey to the east, by City of Lynwood to the south, and by City of Paramount to the southeast. It is located in the coastal plain at the confluence of the Los Angeles River (LA River), which flows from north to south through the City and the Rio Hondo Channel, which flows from northeast to southwest into the LA River. The topography of the City is largely determined by these two rivers. The portion of the City located west of the LA River slopes toward the LA River, and the portion east of the LA River slopes toward either the LA River or the Rio Hondo Channel. The terrain is gently sloping, ranging from 80 to 135 feet in elevation above sea level.

The City provides water to the majority of customers within its municipal boundary via local groundwater wells with the exception of the Hollydale area, which is served by Golden State Water Company. Though it possesses connections with MWD, these have not been utilized for supply in recent years. The City also maintains interconnections with nearby purveyors and is able to sell to them from its pumping surplus. The City's municipal and water service boundaries are shown on Figure ES- 1.

L:\2017\1744508 00_South Gate-Water, RW & Sewer Master Plans\09-Reports\9.06-Modeling\GIS\Potable Water\MXD\Fig1-2_City Service Area.mxd Printed by: MelanieRivera

Legend

City Service Area Limits

N

0 0.5 1

Miles

Kennedy/Jenks Consultants

City of South Gate Water Master Plan
South Gate, California

South Gate City Service Area

K/J 1744508*00
July 2018

Figure ES-1

The City began as a small agricultural outpost but has become an increasingly urbanized city, with a prevalent Spanish and Latino heritage[1]. Currently, South Gate is home to approximately 99,000 people, which is double the City's population in 1960 and about 4 percent higher than the population in 2010[2]. The City is largely made up of families and residential neighborhoods but does still retain areas dedicated to manufacturing and industrial uses. Because the City is nearly built out, the population is not expected to grow more than 2% every five years until 2040[2]. As such, the City's water demands are not expected to increase dramatically. Table ES-1 shows the water demand from 2013-2017.

Table ES- 1: City of South Gate Water Demands

	2013	2014	2015	2016	2017
Annual Demand (AF)	8,380[1]		7,322	6,756	
Annual Supply (AF)	8,380	8,081	7,691		
Water Loss	0%		4.8%		

[1] 2013 demand is the amount of groundwater pumped. This value was taken from the City's UWMP (2015).

The City is nearly built out, with approximately 60 acres of developable vacant land. The vacant land is planned to be developed into several different land uses including commercial, residential, industrial, and schools. The City's total demand at buildout was estimated as sum of the following demand components: Existing (2013 scaled) Demands; Future Demands Associated with Known Developments (Gateway Specific Plan and Garfield Avenue Apartments); Demand Increase Due to Change in Land Use

The City's water distribution system was then analyzed under normal demand, supply and operating conditions using the City's InfoWater hydraulic model software. The model was updated and calibrated prior to use. Desktop evaluations were also performed to evaluate the pressure zones' supply and storage capacities. In summary, the analysis showed that the existing system for the most part has adequate hydraulic capacity to meet the projected maximum day demands under buildout conditions. Demand peaking factors used in the model are shown in Table ES- 2.

Table ES- 2: City of South Gate Demand Peaking Factors

Demand Condition	Peaking Factor
ADD	1.0
MDD	1.8
PHD	1.8 x 1.4 = 2.5

A Capital Improvement Plan (CIP) consisting of the improvement projects recommended as part of this Water Master Plan was prepared. The CIP provides project IDs, names, descriptions, locations, justification, deficiency type, priority, and estimated construction and capital costs. The total capital cost for the recommended projects was estimated at about $6,500,000.

Section 1: Introduction

This section provides a brief background of the City of South Gate, the objectives of the project, and a description of the general report organization.

1.1 City Description

The City of South Gate (South Gate or the City) was incorporated in January of 1923 and is part of the Gateway Cities region of southeastern Los Angeles County. The City is currently the 17th largest city in the County of Los Angeles with a population of approximately 99,000 as of 2017[1]. The City's location is shown in Figure 1-1.

The City encompasses 7.4 square miles of the south-central Los Angeles County area and is bounded by an unincorporated area of Los Angeles County to the west; by the cities of Huntington Park, Cudahy, Bell and Bell Gardens to the north; by City of Downey to the east, by City of Lynwood to the south, and by City of Paramount to the southeast.

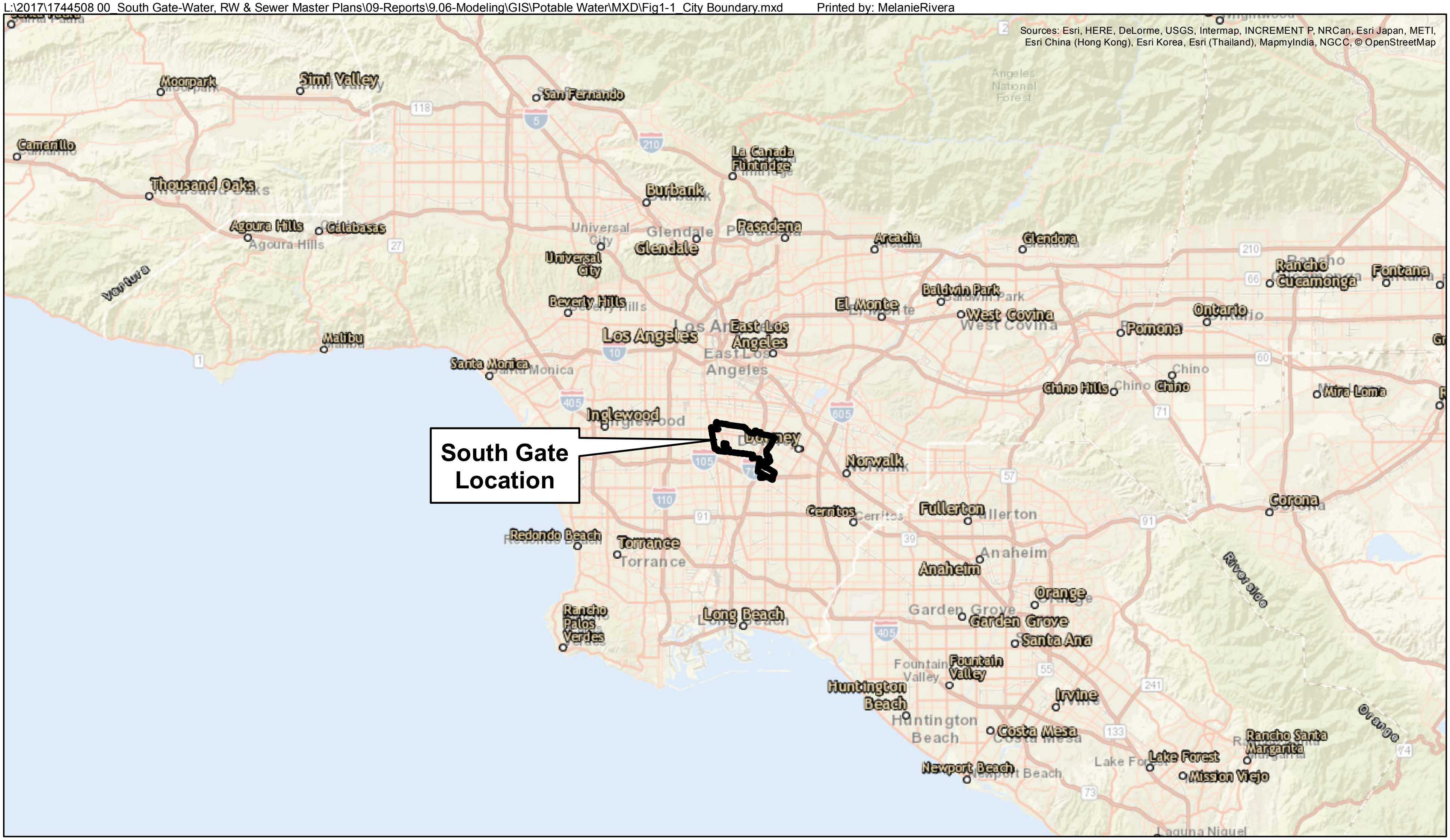
South Gate is located in the coastal plain at the confluence of the Los Angeles River (LA River), which flows from north to south through the City and the Rio Hondo Channel, which flows from northeast to southwest into the LA River. The topography of the City is largely determined by these two rivers. The portion of the City located west of the LA River slopes toward the LA River, and the portion east of the LA River slopes toward either the LA River or the Rio Hondo Channel. The terrain is gently sloping, ranging from 80 to 135 feet in elevation above sea level.

The City is located in the desert climate of Southern California in the County of Los Angeles. South Gate has a semiarid Mediterranean climate with mild winters and hot, dry summers. Temperatures range from a low of 40 °F to a high of 110 °F. The average daily temperatures range from 56 °F to 75 °F. The average annual precipitation is 14.92 inches per year with most occurring between November and April[2].

South Gate's population since 2000 has declined by less than 1 percent per year, however, the city has been increasing in population since 2012. Vacant industrial areas are the most likely locations for additional population growth. Redevelopment of these areas is expected to increase South Gate's population to approximately 105,000 by year 2040[2].

[1] https://www.cityofsouthgate.org/258/City-Statistics
[2] City of South Gate 2015 Urban Water Management Plan (2016)

L:\2017\1744508.00_South Gate-Water, RW & Sewer Master Plans\09-Reports\9.06-Modeling\GIS\Potable Water\MXD\Fig1-1_City Boundary.mxd Printed by: MelanieRivera



Legend

City Location

N

0.5

Miles

Kennedy/Jenks Consultants

City of South Gate Water Master Plan
South Gate, California

South Gate City Location

K/J 1744508*00
July 2018

Figure 1-1

1.2 Project Objectives

Kennedy/Jenks Consultants (Kennedy/Jenks) was contracted by the City in March of 2017 to concurrently update or create the City's potable, recycled and sewer master plans. The present report, which is an update to the City's 2005 Water Master Plan (Kennedy/Jenks, 2005), will provide a road map for future water supply and infrastructure improvement projects.

The primary focus of this master plan update is to evaluate the City's distribution system capacity to meet existing and future potable water demands and to recommend a cast-iron pipeline replacement program over the next 30 years. In addition to the pipeline replacement program, an objective of the master plan is to confirm the adequacy of well supply, reservoir storage, and pump station capacities to meet the existing and future water demands. A steady-state hydraulic model of the City's distribution system was developed to perform these evaluations.

1.3 Report Organization

The information documented in the body of this Master Plan is organized into the following five sections.

Section 1 – Introduction provides a brief background of the City of South Gate, the objectives of the project, and a description of the general report organization.

Section 2 – Service Area, Land Use, and Existing System describes the existing land use of the City and the existing water distribution system including pump stations, pipelines, tanks, and system operation.

Section 3 – Water Demands and Supplies describes the historical and current water demands, demands variations and peaking, and future demands. Additionally, the section describes the City's water supply sources including groundwater and interconnections with other agencies.

Section 4 – System Evaluation presents a discussion on the hydraulic model creation including planning/evaluation criteria, system evaluation results and recommendations.

Section 5 – Capital Improvement Program presents the recommended capital improvement projects including the pipeline replacement program, infrastructure improvements, and other city-planned improvement projects, in addition to planning-level capital cost estimates.

Section 2: Service Area, Land Use, and Existing System

This section describes the City's service area and land use. Additionally, it describes the existing water distribution system including pump stations, tanks, pipelines, and the existing system operation.

2.1 Water Service Area

The City provides water to the majority of customers within its municipal boundary with the exception of the Hollydale area, which is served by Golden State Water Company. The City's municipal and water service boundaries are shown on Figure 2-1.

2.2 Land Use

Land uses within the City include residential, commercial, general industrial, and several public/institutional categories. However, residential land uses comprise over 50 percent of the City under both existing and buildout cases. The City is almost built out, with only two areas currently planned for development: the Gateway Specific Plan mixed use development, and the Garfield Avenue residential development.

The size in acres and the percentages of each land use category within City boundaries are shown in Table 2-1. The City's existing and future land use distributions are shown on Figure 2-2 and Figure 2-3, respectively.

Table 2-1: Size and Percentages of Land Use Categories

Land Use	Existing Area (acres)	Existing Fraction (%)	Buildout Area (acres)	Buildout Fraction (%)
SINGLE-FAMILY RESIDENTIAL	1374	36.7	1370	36.6
MULTI-FAMILY RESIDENTIAL	571	15.2	569	15.2
RESIDENTIAL/LANDSCAPING	6	0.2	6	0.2
COMMERCIAL 1	114	3.1	108	2.9
COMMERCIAL 2	228	6.1	240	6.4
GENERAL INDUSTRIAL	719	19.2	677	18.1
MIXED USE	-	-	29[1]	0.8[1]
RAILROAD	72	1.9	72	1.9
FLOOD CONTROL EASEMENT	158	4.2	158	4.2
EASEMENT	93	2.5	73	2.0
CIVIC/INSTITUTIONAL	73	1.9	73	1.9
PUBLIC WORKS	10	0.3	10	0.3
SCHOOL	72	1.9	133	3.6
SCHOOL WITH GREEN AREA	69	1.9	80	2.1
PARK	128	3.4	147	3.9
VACANT	60	1.6	- [1]	- [1]
TOTAL	**3747**	**100**	**3747**	**100**

[1] Vacant land will be converted to mixed use or other land use categories.

L:\2017\1744508.00_South Gate-Water, RW & Sewer Master Plans\09-Reports\9.06-Modeling\GIS\Potable Water\MXD\Fig1-2_City Service Area.mxd Printed by: MelanieRivera

Legend

City Service Area Limits

N

0 0.5 1

Miles

Kennedy/Jenks Consultants

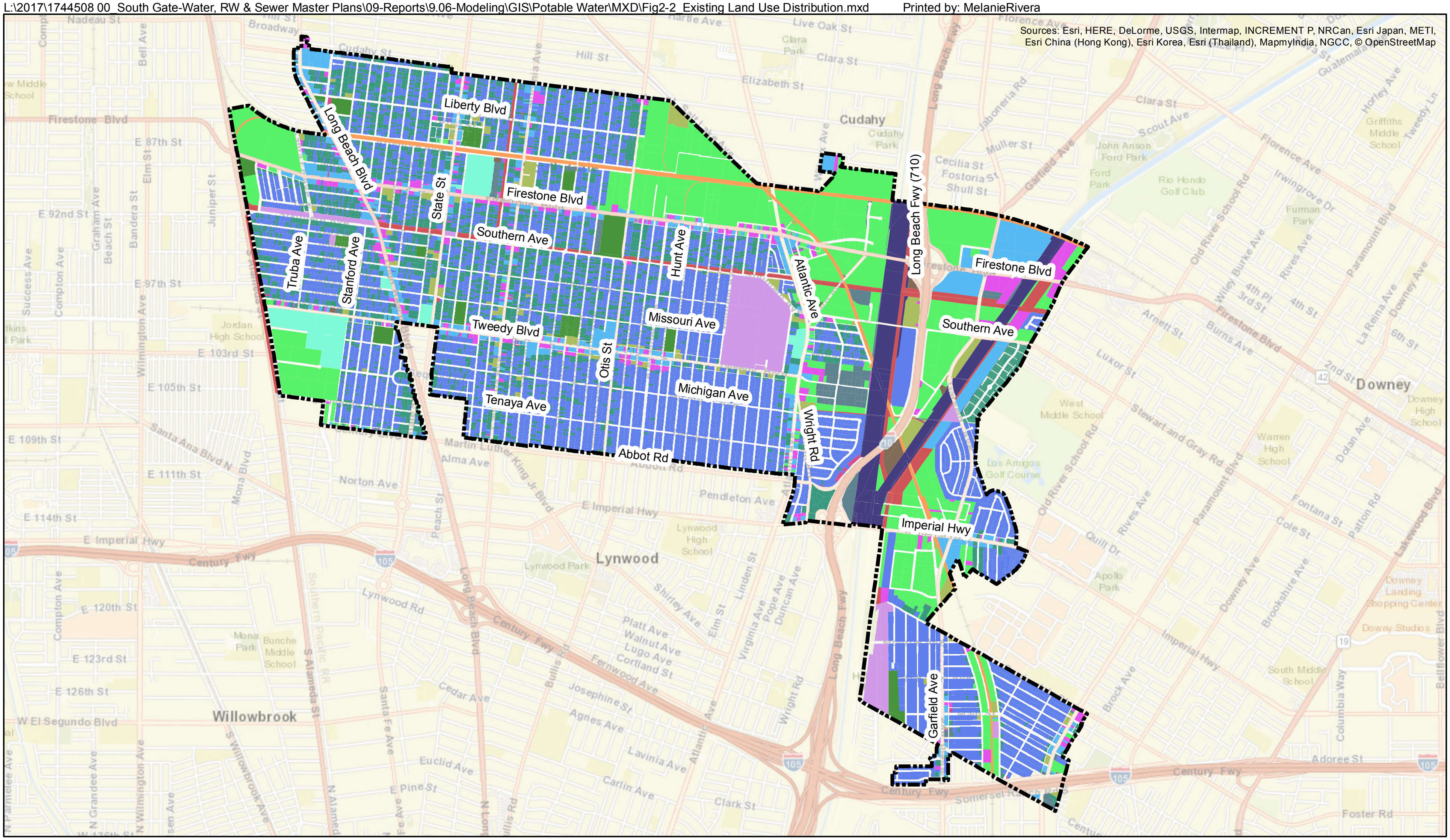
City of South Gate Water Master Plan
South Gate, California

South Gate City Service Area

K/J 1744508*00
July 2018

Figure 2-1

L:\2017\1744508 00_South Gate-Water, RW & Sewer Master Plans\09-Reports\9.06-Modeling\GIS\Potable Water\MXD\Fig2-2_Existing Land Use Distribution.mxd Printed by: MelanieRivera



Legend

City Limits

Existing Landuse

- CIVIC/INSTITUTIONAL
- COMMERCIAL 1
- COMMERCIAL 2
- EASEMENT
- FLOOD CONTROL EASEMENT
- GENERAL INDUSTRIAL
- MULTI-FAMILY RESIDENTIAL
- PARK
- PUBLIC WORKS
- RAILROAD
- RESIDENTIAL/LANDSCAPING
- SCHOOL
- SCHOOL WITH GREEN AREA
- SINGLE-FAMILY RESIDENTIAL
- VACANT

N

0 0.5 1

Miles

Kennedy/Jenks Consultants

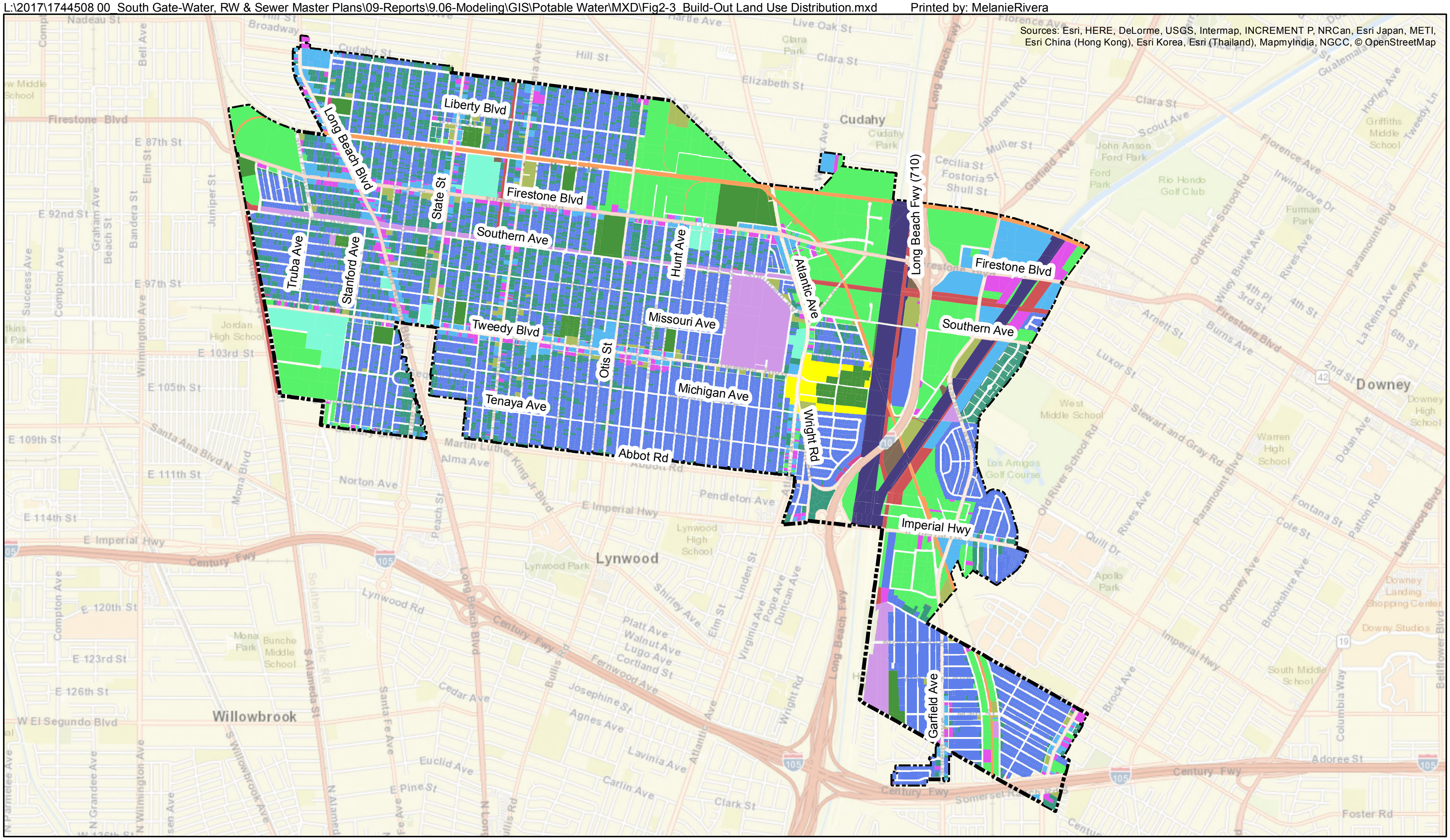
City of South Gate Water Master Plan
South Gate, California

Existing Land Use Distribution

K/J 1744508*00
July 2018

Figure 2-2

L:\2017\1744508 00_South Gate-Water, RW & Sewer Master Plans\09-Reports\9.06-Modeling\GIS\Potable Water\MXD\Fig2-3_Build-Out Land Use Distribution.mxd Printed by: MelanieRivera



Legend

City Limits

Build-Out Landuse

- CIVIC/INSTITUTIONAL
- COMMERCIAL 1
- COMMERCIAL 2
- EASEMENT
- FLOOD CONTROL EASEMENT
- GENERAL INDUSTRIAL
- MIXED USE
- MULTI-FAMILY RESIDENTIAL
- PARK
- PUBLIC WORKS
- RAILROAD
- RESIDENTIAL/LANDSCAPING
- SCHOOL
- SCHOOL WITH GREEN AREA
- SINGLE-FAMILY RESIDENTIAL

N

0 0.5 1
Miles

Kennedy/Jenks Consultants

City of South Gate Water Master Plan
South Gate, California

Build-Out Land Use Distribution

K/J 1744508*00
July 2018

Figure 2-3

2.3 Existing Distribution System

This section provides a brief description of the City's major distribution system components including pump stations, storage tanks, and pipelines. An overall map of the system is depicted in Figure 2-4.

2.3.1 Pump Stations and Storage Tanks

South Gate currently utilizes several storage tank/booster pump station sites for water supply and storage. There are six sites containing storage reservoirs, two of which are inactive. The inactive tanks (Santa Fe and Salt Lake) are both elevated tanks that are no longer in service.

The following are general descriptions of the remaining four pump station/tank sites. Storage tanks and booster pump station summaries are presented in Table 2-2 and Table 2-3, respectively.

2.3.1.1 Hawkins Tank Site

The Hawkins Tank Site contains two interconnected 2.5 MG steel tanks built in 1985. Each tank is 43 feet tall and 106 feet in diameter, with base elevations of approximately 107.5 feet. The maximum high water level is 38.0 feet or 145.5 feet. Wells 24 and 25 supply the tanks. The tank discharge pipeline supplies suction to the Hawkins booster pump station, located in a building. Well 25 is currently on standby.

The Hawkins booster pump station consists of four vertical turbine pumps (including one standby unit), with total and firm flow capacities of 9,500 gpm and 7,500 gpm, respectively. Three of the four pumps have a capacity of 2,500 gpm and one pump has a capacity of 2,000 gpm. If the 2,000 gpm pump were out of service, this would lead to the firm capacity of 7,500 gpm. Two of the four pumps are equipped with variable frequency drives (VFDs) and the station is operated on pressure generally set at approximately 64.0 psi.

2.3.1.2 South Gate Park Reservoir Site

The South Gate Park Reservoir was constructed in 1994 and has a storage capacity of 4.2 MG. The reservoir is rectangular-shaped, buried, cast-in-place concrete reservoir with a hopper bottom. The reservoir floor elevation is 70.5 feet; the maximum water depth is 25.3 feet or 95.8 feet. The corresponding booster station, in a CMU block building adjacent to the reservoir. The reservoir is supplied from Wells 13, 14, 18, and 19. Well 13 is currently on standby.

Given the presence of volatile organic chemicals (VOCs), TCE and PCE, in the supply wells serving the reservoir, the reservoir is equipped with an air stripping treatment system consisting of a blower (in an adjacent Blower and Chlorine Building) and spray diffusers above the high water level. This PVC-pipe and nozzle treatment system within the reservoir was replaced in early 2018 with stainless steel pipe ranging in diameter from 3-inch to 12-inch serving 36 spray aeration nozzles. The flow rate of the treatment system approved by DDW (in the current Operating Permit) is 2,000 gpm of well supply. For this reason, only one well is operated at any time, typically running continuously as a base supply to this site.

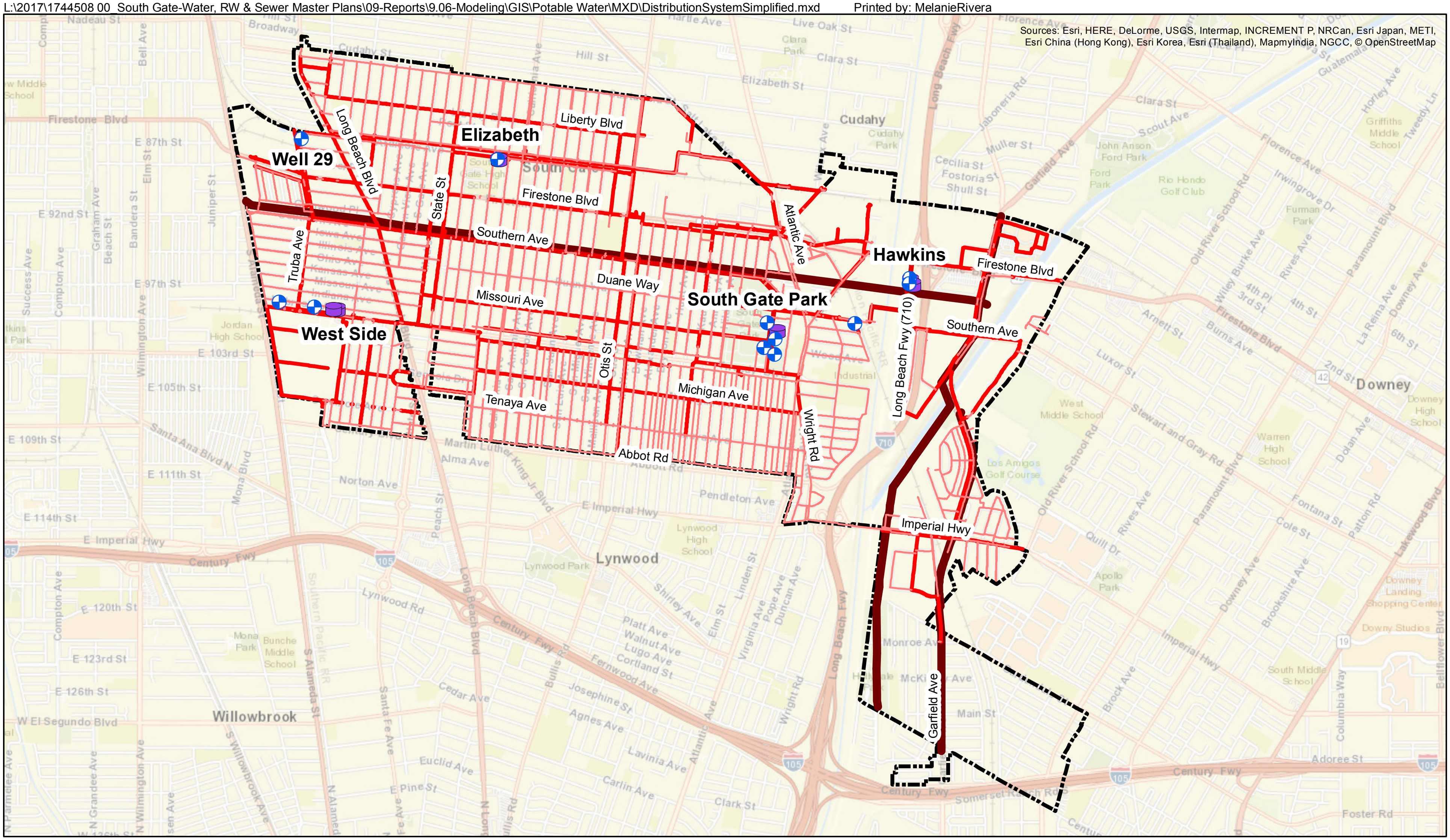
The South Gate Park booster pump station consists of four vertical turbine pumps equipped with constant speed motors, including one standby unit. Its total and firm capacities are 12,000 gpm and 9,000 gpm, respectively. However, since the well supply to the reservoir is limited to 2,000 gpm by the VOC treatment system, generally only one or two booster pumps are operated. The discharge pressure from the South Gate Park booster pump station is generally operated to maintain approximately 65.0 psi.

2.3.1.3 West Side Tank Site

The West Side Tank Site contains two interconnected 1.66 MG steel tanks built in 2000. Each tank is 32 feet tall and 100 feet in diameter, with base elevations of approximately 106.6 feet. The maximum high water level is 28.3 feet or 134.9 feet. The tanks are supplied by Wells 26 and 27; however, Well 26 is currently on standby.

The West Side booster pump station is located in a building onsite and consists of four vertical turbine pumps with VFDs, including one standby unit. The total and firm capacities are 12,000 gpm and 9,000 gpm, respectively. The booster pump station discharge pressure SCADA setpoint is 67.0 psi.

L:\2017\1744508.00_South Gate-Water, RW & Sewer Master Plans\09-Reports\9.06-Modeling\GIS\Potable Water\MXD\DistributionSystemSimplified.mxd   Printed by: MelanieRivera



Legend

- Wells
- Active Tanks
- City Limits

Main Line

- 1" - 8"
- 8" - 16"
- 16" - 24"
- 24" - 48"
- 48" - 79"

N

0 0.5 1
Miles

Kennedy/Jenks Consultants

City of South Gate Water Master Plan
South Gate, California

Existing Distribution System

K/J 1744508*00
July 2018

Figure 2-4

2.3.1.4 Elizabeth Tank Site

The Elizabeth Tank Site includes one 1.8 MG steel tank built in 2017. The tank is 88 feet in diameter and has a base elevation of approximately 106.7 feet. The Elizabeth booster pump station is located in a CMU block building adjacent to the tank and consists of three centrifugal pumps with VFDs, including one standby unit. The total and firm capacities are 4,500 gpm and 3,000 gpm, respectively. The tank is supplied from Well 28, which pumped directly into the distribution system prior to construction on the new on-site tank. For flexibility, the City has maintained the capability to by-pass the tank and pump directly into the distribution system, but normally pumps through a PRV to the tank. The booster pump station discharge SCADA setpoint is 63.0 psi.

Table 2-2: Storage Tank Size and Capacity Descriptions

Active Tank Site	# of Tanks	Tank Type	Capacity (MG, per tank)	High Water Level (ft)	Tank Geometry	Base El. (ft)	Year Built
Hawkins	2	Steel tank	2.5	38	Height: 43' Diameter: 106'	107.5	1985
South Gate Park	1	Rectangular, cast-in-place concrete with hopper bottom	4.2	25.3	Length: 176' Width: 136'	70.5	1994
West Side	2	Steel tank	1.66	28.3	Height: 32' Diameter: 100'	106.6	2000
Elizabeth	1	Steel tank	1.8	39.5	Height: 41' Diameter: 88'	106.7	2017
Total			16.1				

[1] The hopper is assumed to have a 5:1 slope with a 1.0' ledge, and 17 feet or 3.4 feet in depth to the toe of slope (depth 24.9 feet).

Table 2-3: Pump Station Size and Capacity Descriptions

Pump Station	No of Pumps	Type	Approximate Discharge Elevation (ft)	Flow Capacity per Pump (GPM)	Total Station Capacity (GPM)	Firm Station Capacity (GPM)
Hawkins	3 + 1	2/4 VFD[1]	109.7	2,500 or 2,000	9,500	7,500
South Gate Park B	3 + 1	All Constant Speed	108.7	3,000	12,000	9,000
Westside	3 + 1	All VFD	109.0	3,000	12,000	9,000
Elizabeth	2 + 1	All VFD	126.1	1,500	4,500	3,000
Total	**15**	**-**	**-**	**-**	**38,000**	**28,000**

1. Of 4 pumps on site, 2 are VFD and 2 are constant speed

2.3.2 Distribution System Pipelines

South Gate's water distribution system consists of 135 miles of water mains ranging from 2 to 24 inches in diameter. The gridded pipeline network consists mainly of 4- to 12-inch pipelines (94.8 percent). As the City became more developed over the decades, pipelines were installed to fit the growing needs of its residents. This led to a wide variety in pipeline diameter, material, and age. The distribution of system pipelines by size, age, and material are shown on Figure 2-5 through Figure 2-7, respectively.

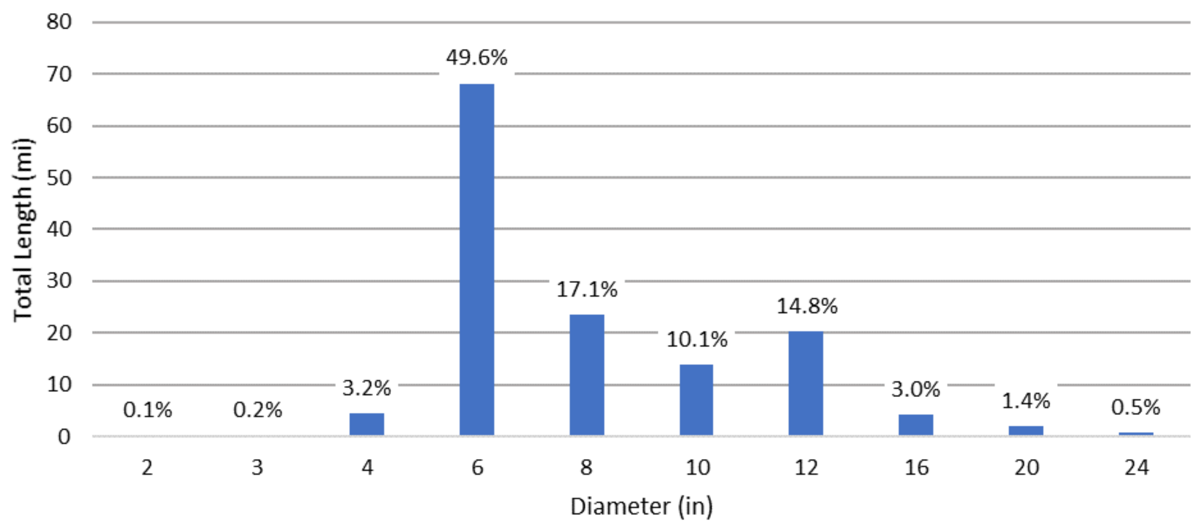


Figure 2-5: Total Pipeline Length Distribution by Diameter

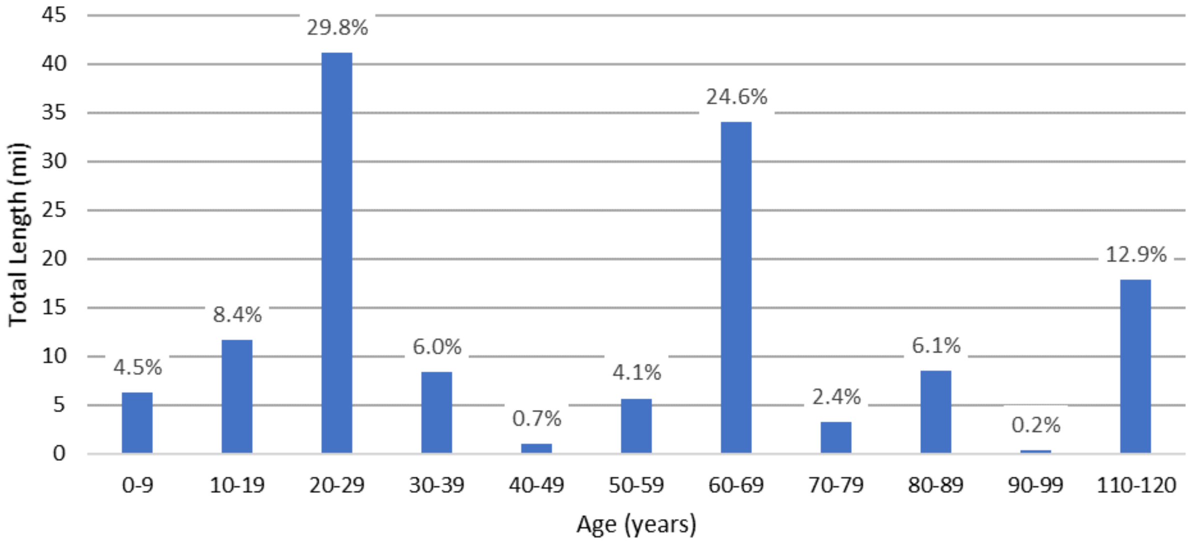


Figure 2-6: Total Pipeline Length Distribution by Age

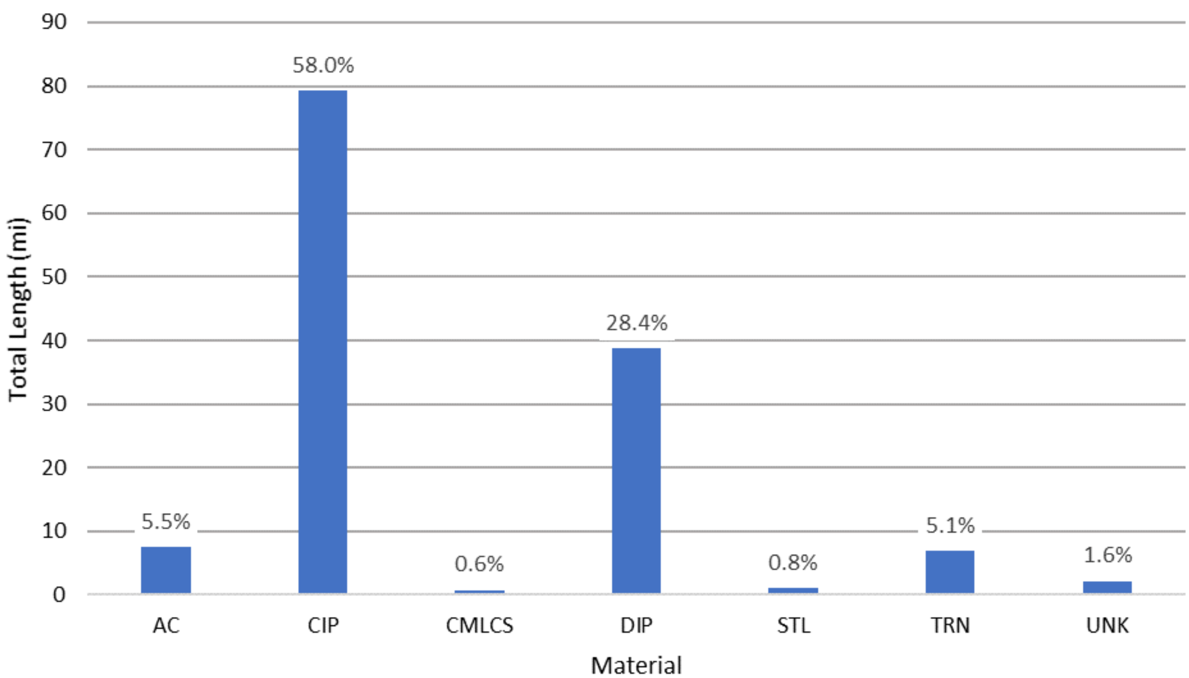


Figure 2-7: Total Pipeline Length Distribution by Material

Much of the development in the City occurred several years before the 1970's and 1980's, during a time in which cast iron pipelines were installed unlined. Although cast iron pipelines may last over 50 years, unlined cast iron pipelines are susceptible to corrosion, scaling, and accelerated deterioration. This may eventually lead to increased energy loss, pipe breaks, and water quality degradation. As such, the City is currently planning to replace all unlined cast iron pipelines within the coming years as part of a Pipeline Replacement Program. The Pipeline Replacement Program is further described in Section 5.2.1.

2.4 System Operation

The City's distribution system consists of a single pressure zone. In order to maintain sufficient system pressures, each of the City's booster pump stations (with the exception of South Gate Park) are equipped with VFDs. Each of the VFDs are set to maintain pressures within the range of 63-67 psi on a daily basis. Additionally, Well 29, which pumps directly into the distribution system, is operated with a pressure-driven VFD, set at 60.0 psi.

The well system operates automatically from telemetry signals corresponding to either system pressures or reservoir levels. Pressure gauges at each reservoir monitor the pressure in the reservoir discharge pipe. Operational response of the City's water system can be characterized as both a stepped response system and a regional response system. System response to an increasing or decreasing demand can be seen as a stepped system when booster stations respond to the changing pressure systematically across geographic regions. For example, if a fire or another high demand event occurs in the western part of the City, decreasing system pressures would first be sensed by the booster station in West Side Reservoir, activating these pumps in response. As the water level in the West Side Reservoir, the telemetry system signals for the westerly wells to activate. As pressure continues to drop, the booster stations at South Gate Reservoir and Hawkins Reservoir Sites will be signaled to operate, hence stepping across the City from east to west. As the water levels in the reservoirs drop, the telemetry system signals the easterly wells to activate.

A schematic view of the City's SCADA system during a typical demand day is shown on Figure 2-8.

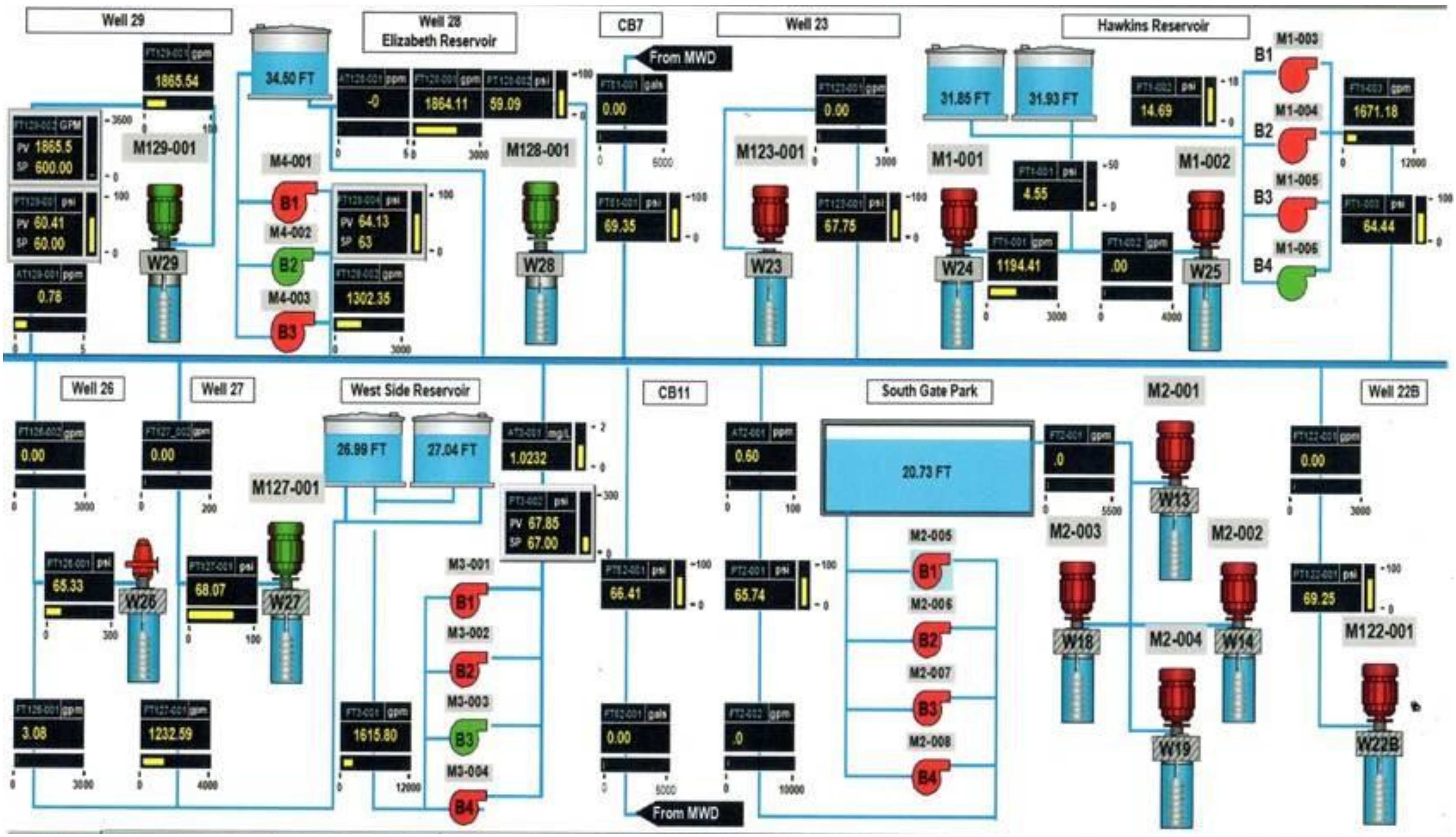


Figure 2-8: SCADA Water System Layout

Section 3: Water Demands and Supplies

This section describes South Gate's existing water supply sources, which mainly consists of groundwater pumped via the City's wells. Additionally, this section describes existing and future water demands as well as peaking and unit water duty factors.

3.1 Water Demands

The City began as a small agricultural outpost but has become an increasingly urbanized city, with a prevalent Spanish and Latino heritage[1]. Currently, South Gate is home to approximately 99,000 people, which is double the City's population in 1960 and about 4 percent higher than the population in 2010[2]. The City is largely made up of families and residential neighborhoods but does still retain areas dedicated to manufacturing and industrial uses. Because the City is nearly built out, the population is not expected to grow more than 2% every five years until 2040[2]. As such, the City's water demands are not expected to increase dramatically.

3.1.1 Existing Demands and Peaking

Demands may vary from year to year due to drought conditions, water use restrictions, etc. Therefore, it is crucial to examine water demands over several years to accurately characterize average and maximum day conditions. Table 3-1 shows the City's water demands over the past five years, which includes both drought and non-drought conditions.

Table 3-1: South Gate Annual Water Demands from 2013-2017

	2013	2014	2015	2016	2017
Annual Demand (AF)	8,380[1]		7,322	6,756	
Annual Supply (AF)	8,380	8,081	7,691		
Water Loss	0%		4.8%		

[1] 2013 demand is the amount of groundwater pumped. This value was taken from the City's UWMP (2015).

Water demands may vary each year due to changes in service area population, climate, conservation efforts, among many other reasons. Additionally, water demands may vary on a daily and hourly basis due to changing usage patterns or seasonal variability. In order to appropriately assess system performance and plan for future infrastructure, it is critical to establish this variability by determining average day, maximum day, and peak hour flows.

Average day demand (ADD) is the average water demand over a given year. In order to calculate the ADD, the City provided an Excel spreadsheet containing demand data for the year 2016 in the form of monthly meter readings. The full year of monthly meter readings in 2016 was utilized in determining peaking factors and unit water duty factors.

The maximum day demand (MDD) is the largest volume of water consumed by the system in a single day. The MDD for the City was calculated by using the same peaking factor (1.8) as the previous WMP.

Peak hour demand (PHD) is the maximum amount of water the system is expected to deliver in a single hour. In order to establish the system's diurnal pattern and the hourly peaking factor, City provided hourly flows for August 31, 2017 from its SCADA system. The City's diurnal pattern is shown on Figure 3-1. As shown, the hourly peaking factor is 1.4 resulting in a combined peaking factor of 1.8 x 1.4 or 2.5 to scale average day to peak hour demands.

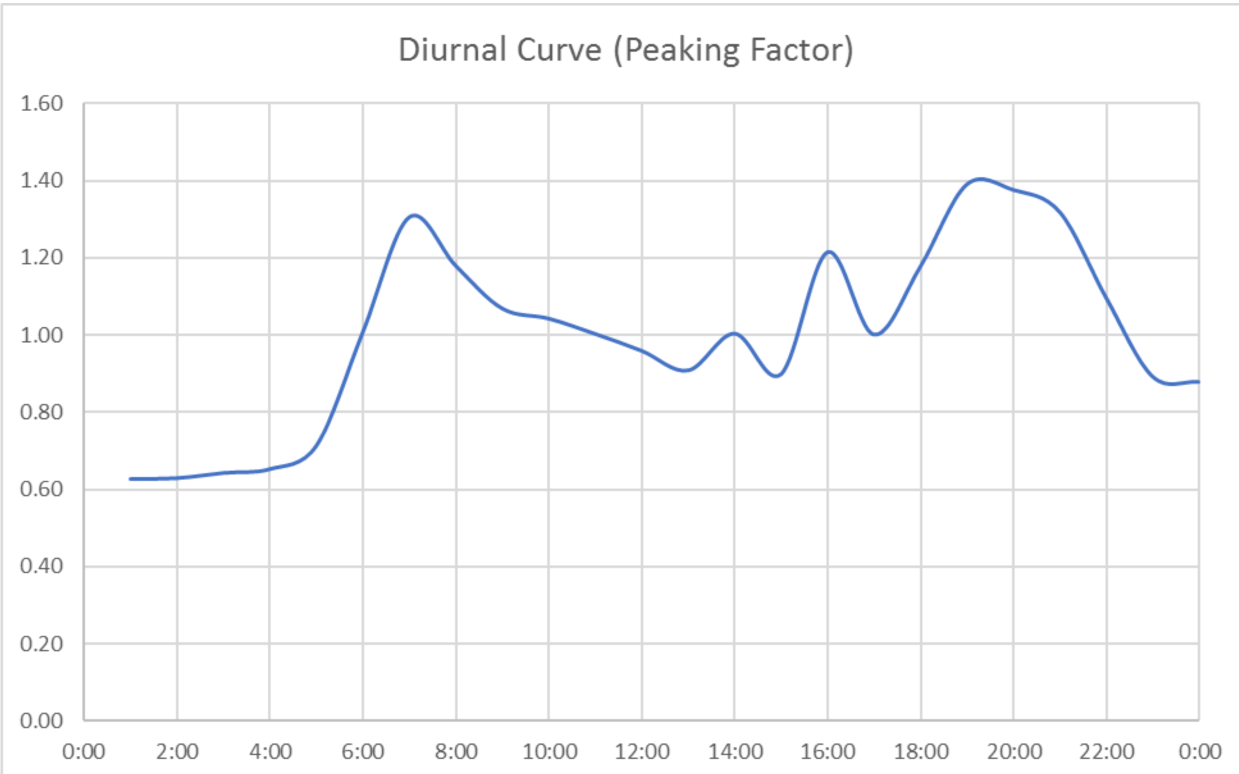


Figure 3-1: System Diurnal Curve for August 31st, 2017

Table 3-2: ADD, MDD, and PHD Peaking Factors

Demand Condition	Peaking Factor
ADD	1.0
MDD	1.8
PHD	1.8 x 1.4 = 2.5

3.1.2 Unit Water Duty Factors

In order to estimate unit water duty factors, 2016-2017 billing records were utilized in conjunction with the land use shapefile provided by the City. First, the total 2016-2017 demands were aggregated by land use. The area for each land use was then totaled. Then, the demands per land use were divided by the land use's respective area to obtain the calculated demand factors in gallon per day per acre (gpd/ac). Mixed Use parcels do not exist in current land uses, so the nominal unit water duty factor was estimated based on typical values for other systems . The water duty factors for easements, railroads and vacant were assumed to be zero. Nominal values for each land use's unit water duty factors are shown in Table 3-3.

Table 3-3: Unit Water Duty Factors by Land Use

Existing Land Use	Existing Demand[1] (gpd)	Area (ac)	Nominal Water Duty Factor (gpd/ac)
GENERAL INDUSTRIAL	875,973	519	1,700
CIVIC/INSTITUTIONAL	52,284	28	1,900
SCHOOL	34,557	40	900
SCHOOL WITH GREEN AREA	91,969	41	2,300
COMMERCIAL 1	141,776	66	2,200
COMMERCIAL 2	669,507	173	3,900
Mixed Use	NA	NA	4,000
PUBLIC WORKS	NA	NA	0
MULTI-FAMILY RESIDENTIAL	2,706,646	515	5,300
RESIDENTIAL/LANDSCAPING	1,108	1	1,500
SINGLE-FAMILY RESIDENTIAL	2,832,890	1,142	2,500
EASEMENT	NA	NA	200
FLOOD CONTROL EASEMENT	NA	NA	0
PARK	2,434	28	2,000
RAILROAD	NA	NA	0
VACANT	NA	NA	0
TOTAL/AVERAGE	7,409,144	2553	2900

[1] Year 2013 was used for water duty factor calculations because it had the highest demand in recent years.

3.1.3 Future Demands

The City is nearly built out, with approximately 60 acres of developable vacant land. The vacant land is planned to be developed into several different land uses including commercial, residential, industrial, and schools. The City's total demand at buildout was estimated as sum of the following demand components:

- Existing (2013 scaled) Demands
- Future Demands Associated with Known Developments (Gateway Specific Plan and Garfield Avenue Apartments)
- Demand Increase Due to Change in Land Use

The first demand addition that was analyzed was the Gateway District Specific Plan. The Gateway District Specific Plan spans approximately 59 acres within the northeastern section of the City at the northeast corner of Firestone Blvd and Atlantic Ave. The site includes a transit station and is intended to be a "transit village" with a high level of pedestrian activity[3]. The

[3] City of South Gate Gateway District Specific Plan Public Review Draft (2017)

community will be a mixed-use area and will incorporate cultural, public and green spaces. In order to estimate the water demand for this area, the mixed-use demand factor was multiplied by the Specific Plan area and the calculated demand was added to the parcel. The result is a 164 gpm increase in demand.

The next demand addition was the Garfield Avenue Apartments. The apartments are estimated to house approximately 433 people within the complex. To estimate the amount of water demand required at this site, the per capita water demand of 100 gpcd (2020 target per 2015 UWMP) was multiplied by the number of people expected to populate the apartment area to achieve a total demand for the site, which increased by 30 gpm. The water demand was then added to the Garfield Avenue parcel. The location of the Garfield Avenue Apartments development in addition to the Gateway Specific Plan location is shown Figure 3-2.

Lastly, to estimate future demands based on changes in land use, both existing and future land use data provided by the City was analyzed. The unit water duty factors (gpd/acre) described in Section 3.1.2 were multiplied by each parcel's area in accordance with the parcel's land use. This calculation was applied to both the existing and build-out scenarios. Next, the difference in water demand between the two scenarios was calculated. For parcels that converted to a land use with higher water usage, the incremental demands were added to the baseline existing demands. Across General Industrial, Commercial 1, Easement, and Vacant land, total demand increased by 149 gpm.

The City is essentially built out, so the incremental demands based on land use change in addition to the new developments do not significantly increase the existing demands in the future scenario. Table 3-4 shows the calculation of build out demands, which is the sum of existing scaled demands, incremental demands due to land use change, and two new development demands. Based on these calculations, the 6,919 gpm future demand represents a 5.23 percent increase over the existing demand.

Table 3-4: Build Out Demand Summary

Land Use	Scaled Existing Demand (gpm)	Gateway Spec. Plan (gpm)	Garfield Apartments (gpm)	Incremental Demand[1] (gpm)	Buildout Demand (gpm)
GENERAL INDUSTRIAL	849	0	0	41	890
CIVIC/INSTITUTIONAL	96	0	0	0	96
SCHOOL	45	0	0	0	45
SCHOOL WITH GREEN AREA	111	0	0	0	111
COMMERCIAL 1	175	0	0	15	190
COMMERCIAL 2	616	0	0	0	617
MIXED USE	0	164	0	0	164
PUBLIC WORKS	0	0	0	0	0
MULTI-FAMILY RESIDENTIAL	2,100	0	30	0	2,130
RESIDENTIAL/LANDSCAPING	7	0	0	0	7
SINGLE-FAMILY RESIDENTIAL	2,385	0	0	0	2,385
EASEMENT	13	0	0	26	39
FLOOD CONTROL EASEMENT	0	0	0	0	0
PARK	178	0	0	0	178
RAILROAD	0	0	0	0	0
VACANT	0	0	0	67	67
TOTAL	**6,575**	**164**	**30**	**149**	**6,919**

[1] Due to change in land use in areas other than known developments

Figure 3-2: Gateway Specific Plan and Garfield Avenue Apartments Locations

3.2 Water Supply Sources

The City currently receives all of its water supply via local groundwater wells. Though it possesses connections with MWD, these have not been utilized for supply in recent years. The City also maintains interconnections with nearby purveyors and is able to sell to them from its pumping surplus.

3.2.1 Groundwater Wells

Of its twelve groundwater wells, eight are active, one is inactive, and three are on standby. The active wells are well numbers 14, 18, 19, 24, 26, 27, 28, and 29. Combined, these wells have a flow capacity of 17,500 gpm or approximately 25 MGD. The following subsections contain general descriptions of each of the City's wells and Table 3-5 provides a summary of City wells.

Well No. 13 (Standby): Well 13 was installed in 1940 and is located at 9615 Pinehurst Ave, near the southwest corner of South Gate Park. The well supplies the South Gate Park Tank and is equipped with a Byron Jackson 7-stage constant speed vertical turbine pump. Well 13 was last tested in 2000 and was found to have a flow rating of 2,133 gpm and a specific capacity of 118 gpm/ft. Its overall efficiency rating was 38 percent. Currently, the well is used as a standby due to the presence of chlorinated solvents including TCE and PCE.

Well No. 14: Well 14 was installed in 1944 and is also located at 9615 Pinehurst Ave, near the middle of South Gate Park. The well also connects to the South Gate Park Tank but is equipped with a Layne and Bowler 4-stage constant speed vertical turbine pump. SCE performed tests on the well in 2000 and it was found to have a flow capacity of 3,233 gpm and a specific capacity of 118 gpm/ft. It's overall efficiency rating was 53 percent.

Well No. 18: Well 18 was installed in 1945 and is located in South Gate Park. The well also connects to South Gate Park Tank and is equipped with an Aurora constant speed vertical turbine pump. Well 18 was tested in 2001 by SCE and is estimated to have a flow capacity of 1,500 gpm and a specific capacity of 56 gpm/ft. Its overall efficiency rating was found to be 73 percent.

Well No. 19: Well 19 was drilled in 1947 and is located in South Gate Park. The well connects to the South Gate Park Tank and is equipped with a Layne and Bowler 6-stage constant speed vertical turbine pump. This well also was tested in 2001 by SCE and was found to have a flow capacity of 1,500 gpm and a specific capacity of 88 gpm/ft. Its overall efficiency rating was found to be 66 percent.

Well No. 22B (Inactive): Well 22B was drilled in 1948 and is located at 10740 Lee Lane, near the intersection of Garfield Avenue and Southern Avenue. This well has been inactive since the fall of 1985 due to PCE contamination and reliability issues.

Well No. 23 (Standby): Well 23 was installed in 1952 and is now used as a standby due to sand production issues and manganese contamination. Because of a lack of disinfection facilities, the well will remain as a standby. The well is located near the intersection of Salt Lake Avenue and Southern Avenue, on the Salt Lake Tank site, which is no longer in use. SCE performed tests on the well in 2000 and it was found to have a flow capacity of 622 gpm

Well No. 24: Well 24 was drilled in 1985 and is located at 9021 West Frontage Road on the Hawkins Tank site. The well connects to the Hawkins Tank and is equipped with an Aurora 3-stage constant speed vertical turbine pump. The well was tested by SCE in 2000 and was found to have a flow capacity of 1,500 gpm and specific capacity of 112 gpm/ft. Its overall efficiency rating was found to be 64 percent. The Hawkins well site is equipped with sodium hypochlorite disinfection facilities that connect to both well 24 and well 25.

Well No. 25 (Standby): Well 25 was also drilled in 1985 and also located at the Hawkins Tank site. Well 25 is used as a standby due to XXX.., however it is connected to the sodium hypochlorite disinfection facilities in the case that it returns online. The well is equipped with an Aurora 3-stage constant speed vertical turbine bump and was last tested by SCE in 2000. It was found to have a flow capacity of 3,080 gpm and a specific capacity of 112 gpm/ft. Its overall efficiency rating was found to be 64 percent.

Well No. 26: Well 26 is located near 2541 Tweedy Blvd. The well was drilled in 1987 and normally serves the West Side Tank site. Well 26 is equipped with a Floway 5-stage vertical turbine pump. The well was not tested by SCE, however installation tests show that the pump has a flow capacity of 2,720 gpm at 224 feet TDH and an overall efficiency rating of 83 percent. The site also includes sodium hypochlorite disinfection facilities.

Well No. 27: Well 27 was installed in 1989 and is located at 2645 Tweedy Blvd near the West Side Tank site. The well is equipped with an Ingersill-Rand 4-stage constant speed vertical turbine pump. In addition to sodium hypochlorite disinfection facilities, the well has been equipped with an iron and manganese treatment facility due to manganese contamination. The well has not been tested by SCE, but installation tests show that the pump has a flow capacity of 1,500 gpm at 240 feet TDH and an overall efficiency rating of 85 percent.

Well No. 28: Well 28 was installed in 2003, at which time it connected directly to the City's distribution system. However, since the construction of the Elizabeth tank, the well now pumps into the tank with the option of flowing directly into the distribution system. The well is equipped with a vertical turbine pump and has a flow capacity of 2,500 gpm and an estimated specific capacity of 59 gpm/ft. The well site also includes an emergency diesel generator and a sodium hypochlorite disinfection facility.

Well No. 29: Well 29 was installed in 2017 and is located at 2700 Ardmore Ave near the inactive Santa Fe Tank Site. The well is equipped with a Flowserve 5-stage variable speed vertical turbine pump and has a flow capacity of 1,500 gpm.

Table 3-5: South Gate Well Summary and Details

Well No.	Status	Year Drilled	Depth (ft)	Casing Diameter (in)	Flow Capacity (gpm)	Specific Capacity (gpm/ft)	Last SCE Test Year
13	Standby	1940	810	16	2,133	118	2000
14	Active	1944	813	18	3,233	129	2000
18	Active	1945	792	18	1,500	56	2001
19	Active	1947	794	18	3,065	88	2001
22-B	Inactive	1948	578	16	-	-	-
23	Standby	1952	856	18	622	-	2000
24	Active	1985	1,290	16, 20	1,500	112	2000
25	Standby	1985	1,331	16, 20	3,080	112	2000
26	Active	1987	1,226	16, 18	2,710	-	-
27	Active	1989	1,200	16, 18	1,500	-	-
28	Active	2003	1,095	16, 18	2,500	59	-
29	Under Construction						

3.2.2 MWD Connections

The City has two connections to the MWD transmission pipelines. Connection CB-7 is located at Southern Avenue and State Street, and CB-11 is located at Southern Avenue and Kauffman Avenue. Each connection consists of a 16-inch outlet from MWD's Middle Cross Feeder. The outlets branch into two 10-inch parallel lines, each having a 10-inch combination rate-of-flow, pressure-reducing and check valves. Connection CB-7 is connected to a 16-inch pipeline in State Street and CB-11 is connected to a 20-inch pipeline in Kauffman Avenue.

Each connection has a rated capacity of 15 cfs (9.7 mgd), but the required pressure-reduction settings restrict actual capacity for CB-7 and CB-11 to 4.25 cfs (2.75 mgd) and 2.9 cfs (1.9 mgd), respectively. Prior to 1989, the City used MWD water to supplement well production during the peak summertime months. The MWD connections have not been used since 1989 but remain available for emergency or future use.

3.2.3 Other Purveyors

The City has five interconnections with adjacent water systems. These interconnections are with the City of Downey, the City of Lynwood, the Walnut Park Mutual Water Company, the City of Huntington Park, and the Southern California Water Company (SCWC). All interconnections are bi-directional, allowing water transfers to or from the City. The location and size of each interconnection is provided in Table 3-6.

The interconnection with the City of Lynwood is an automatic connection. It is set to operate such that if local pressure in one of the two systems drops below 20 psi and there is adequate pressure differential between the two systems, the interconnection will flow. Water will then flow from the system with higher pressure to the system with lower pressure. The connection to the

Southern California Water Company is automatic as well, set to open at 40 psi. The other connections are operated manually.

Although all interconnections are bi-directional, the City is the more frequent seller. The City currently has sufficient pumping rights to supply their residents and sell water to the neighboring agencies. However, these interconnections provide the essential backup supply needed during emergencies.

Table 3-6: Connections with Other Purveyors Summary

Interconnection	Pipe Size (Inches)	Location
City of Downey	6	De Palma St and Mitla St
City of Lynwood	12	Santa Fe Ave and Seminole Ave
Walnut Park Mutual Water Company	6	Santa Ana Ave and Mountain View Ave
City of Hunington Park	6	Santa Ana Ave and Salt Lake Ave
Southern California Water Company	8	Garfield Ave and Monroe Ave

Section 4: System Evaluation

This section describes the criteria used in evaluating the water distribution system pipelines and major supply facilities. Additionally, it provides a summary of the hydraulic model development process and modeling evaluation results.

4.1 Water Demands and System Evaluation Criteria

This subsection describes the sizing and performance evaluation criteria for the distribution system storage tanks, supply facilities and pipelines. System planning criteria such as water demand factors, peaking factors and fire flows and durations are also described. The water demand and system evaluation criteria are summarized in Table 4-1 and Table 4-2, respectively.

4.1.1 Water Demands

Future demands for planned developments and redevelopments are estimated based on the water duty factors described in Section 3.1.2. These factors are based on land uses for each parcel and are appropriate for future planning. The systemwide maximum day peaking factor of 1.8 was used to scale average demands to maximum day demands (same factor as 2005 WMP). The systemwide hourly peaking factor is estimated at 2.5 times the average day demand.

4.1.2 Storage Tanks

Storage tanks are used to provide operational, fire flow, and emergency storage. The following storage criteria are recommended for the City:

- Operational Storage: 50 percent of System's MDD
- Fire Flow Storage: 2 x largest single fire flow x duration
- Emergency Storage: 25 percent of System's MDD

4.1.3 Wells and Booster Pump Stations

Given the lack of gravity storage within the City, the booster pump stations should be large enough to meet the system's peak hourly demand with their firm capacity (i.e., total capacity minus the largest pumping unit). In addition, each pump station should be equipped with on-site power generator with diesel-fuel tank.

Similarly, the City should be able to meet the system's maximum day demand with the largest well out of service.

4.1.4 Distribution Pipelines

Distribution system pipelines are typically sized to minimize wear on valves and fittings, protect pipeline lining, limit headloss and lower the potential for pressure surge (water hammer). Existing pipelines with flow velocities greater than 10 feet per second (ft/s) under PHD condition and greater than 15 ft/s under maximum day demand plus fire flow (MDD+FF) condition are considered deficient.

Exceeding these criteria alone does not necessarily warrant replacement, however. Pipeline replacement decisions should be made on a case-by-case basis by taking into account system pressures and pipeline characteristics such as age, material, physical condition and location.

The recommended maximum velocity for new pipelines is 7.5 ft/s under PHD condition. The recommended maximum unit headloss for new pipelines is 5 ft per 1,000 ft of pipeline under MDD condition. New distribution pipelines serving fire hydrants should be 8 inches in diameter or larger.

4.1.5 Water Pressures

For the existing system and under normal operating conditions, the recommended minimum hourly pressure is 40 pounds per square inch (psi). The recommended minimum pressure for new developments is 50 psi. Under emergency conditions such as fire events, the minimum required pressure is 20 psi.

The maximum allowable pressure is 150 psi for the majority of the system. Several areas within the system have static pressures of no more than 82 psi, so pipelines with pressure ratings over 150 psi are not necessary.

The recommended static pressure range for new developments and/or pressure zones is 60 to 135 psi (providing a headloss allowance of 10 psi and pressure surge allowance of 15 psi).

Per the California Plumbing Code, individual pressure regulators are required for service pressures exceeding 80 psi.

Table 4-1: Water Demand Criteria

2018 Water Master Plan Recommended Criteria	
Water Demand Factors	
GENERAL INDUSTRIAL	1,700
CIVIC/INSTITUTIONAL	1,900
SCHOOL	900
SCHOOL WITH GREEN AREA	2,300
COMMERCIAL 1	2,200
COMMERCIAL 2	3,900
Mixed Use	4,000
PUBLIC WORKS	0

2018 Water Master Plan Recommended Criteria	
MULTI-FAMILY RESIDENTIAL	5,300
RESIDENTIAL/LANDSCAPING	1,500
SINGLE-FAMILY RESIDENTIAL	2,500
EASEMENT	200
FLOOD CONTROL EASEMENT	0
PARK	2,000
RAILROAD	0
Peaking Factors	
MDD	1.8 x ADD
PHD	1.8 x 1.4 x ADD
Fire Flow Demands	
GENERAL INDUSTRIAL	4,000 @ 4 hrs
CIVIC/INSTITUTIONAL	4,000 @ 4 hrs
SCHOOL	4,000 @ 4 hrs
SCHOOL WITH GREEN AREA	4,000 @ 4 hrs
COMMERCIAL 1	3,000 @ 3 hrs
COMMERCIAL 2	3,000 @ 3 hrs
Mixed Use	3,000 @ 3 hrs
PUBLIC WORKS	3,000 @ 3 hrs
MULTI-FAMILY RESIDENTIAL	2,500 @ 3 hrs
RESIDENTIAL/LANDSCAPING	1,500 @ 2 hrs
SINGLE-FAMILY RESIDENTIAL	1,500 @ 2 hrs
EASEMENT	-
FLOOD CONTROL EASEMENT	-
PARK	-
RAILROAD	-

Table 4-2: Water Supply Criteria

Storage Capacity	
Operational Storage	50% of MDD
Fire Flow Storage	2 x largest single FF @ specified duration
Emergency Storage	25% of MDD
Supply Capacity	
Minimum booster pump station capacity	- PHD met with firm capacity - PHD + FF (met with total capacity)
Minimum supply well capacity	MDD met with largest well out of service
PRESSURES	
Minimum pressure - normal operating conditions	40 psi (MDD/PHD) 50 psi (ADD)

Maximum pressure - normal operating conditions	125 psi
Minimum pressure - emergencies (eg, fire events)	20 psi
DISTRIBUTION SIZE PIPELINES	
Minimum size for new distribution pipes	8-inch diameter
Velocity	
Maximum velocity - MDD/PHD	Existing Pipes: 10 ft/s New Pipes: 7 ft/s
Maximum velocity - MDD+FF	15 ft/s
Headloss	
Maximum unit headloss - MDD	5 ft/1,000 ft (new pipes only)

4.2 Model Development and Calibration

A hydraulic model of the City's distribution system was initially created as part of the 2005 Water Master Plan (Kennedy/Jenks, 2005) using Innovyze's H2ONet software. However, the City has recently updated its GIS database of pipelines and facilities. The updated GIS files, in addition to existing atlas maps and record drawings provided by the City, were used to develop a new model. The following steps were taken to create the hydraulic model:

- Pipelines and facilities included in the City's updated GIS file were used to develop a new model using Innovyze's InfoWater model.
- Abandoned pipelines were removed prior to importing pipelines into the model.
- Unidentified pipeline ages and materials were updated in the model based on additional information received from the city.
- Surface elevations were assigned to model nodes.
- Pump curves were confirmed and/or updated based on recent Southern California Edison (SCE) pump efficiency tests.
- 2016 water consumption data were spatially allocated to model nodes and scaled up by 24 percent to match 2013 average day demand total. This adds a safety factor in the case of non-drought years, which are often correlated with higher water usage.
- Fire flow demands were assigned to hydrants based on land use.

Additionally, C factors were assigned to all pipelines based on pipeline material, diameter, and year of installation. Many pipelines within the City's Pipeline Replacement Program are cast iron pipeline installed before the year 1973, which tend to have a life of 25-30 years. So, assigning the correct C factors to these pipelines are crucial to accurately developing the model. XX shows the C factors assigned to cast iron pipelines within the model. All C factors assigned within the model can be found in Appendix X.

Once the model was constructed, it was validated against field data from July 15th, November 28th, and November 30th, 2017. For all three days, the following data from the City's SCADA system was collected:

- Hourly well production flows for Well 29
- Hourly flows for the Hawkins, South Gate Park, Westside, and Elizabeth booster stations
- Hourly total flows for all facilities combined
- System pressures at each time of reading
- Reservoir water levels at each time of reading

Water demands within the model were assigned diurnal patterns using three SCADA screenshots from different days of the year in order to simulate various flow scenarios. To accomplish this, pump station flows and reservoir water levels from the SCADA screenshots were input into the model for each calibration day. The model was then run, and diurnal curves were verified for each calibration scenario. The hourly diurnal patterns verified from this process were then assigned to demand nodes throughout the model.

4.3 System Evaluation

Since the City's existing and future demands are very similar, pipeline capacities were evaluated under future demands alone. The following scenarios were run to determine deficiencies in the distribution system: Future ADD, using 1.2 as the 2013 demand scaling factor; Future MDD, using 1.8 as the peaking factor; and Future MDD + FF. In addition, storage, supply well, and booster pump station capabilities were evaluated using desktop analyses. The evaluations in the following sections are based on each of the demand scenarios.

4.3.1 Storage and Supply Capacity Evaluation

The water system's storage capacity was evaluated based on the storage criteria presented in Section 4.1. Required storage is calculated as the summation of fire flow storage, operational storage, and emergency storage. The required fire storage is calculated as two times the largest fire flow, the operational storage is 50 percent of the maximum day demand, and emergency storage is 25 percent of maximum day demand. The operational and emergency storage calculations utilized the future average day demand of 5,535 gpm to estimate required storage.

As shown in Table 4-3, the combined capacity of all storage tanks (14.3 MGD) is greater than the total required storage (12.7 MGD). Because the City currently meets storage requirements with existing tanks, construction of new storage tanks is unnecessary.

Table 4-3: Storage Tank Capacity Evaluation

	Criteria	Value (MG)
Operational Storage	50% of MDD[1]	7.2
Fire Flow Storage	2 x Largest FF @ Specified Duration[2]	1.92
Emergency Storage	25% of MDD[1]	3.6
Total Storage Required		**12.7**
Total Storage Available		**14.3**
Surplus (+) /Deficit (-)		**1.6**

1. Based on future ADD of 8.0 MGD and maximum day peaking factor of 1.8
2. Based on fire flow of 4,000 gpm @ 4 hours

Next, supply capacity was evaluated. To evaluate supply capacity, the combined firm capacity of all pump stations was compared to the water system's peak hour demand. The firm capacity of the system is calculated by subtracting the system's largest supply unit from the total capacity. For the City of South Gate, the supply capacity almost doubles the peak hour demand required. Table 4-4 shows the capacity criteria as well as calculations used in the supply capacity evaluation.

Table 4-4: Booster Pumping Capacity Evaluation

Supply Criteria	Value	Unit
Criteria No. 1 (PHD met with total capacity)		
Average Day Demand (Future)	5,535	gpm
Hourly Peaking Factor (PHD/ADD)	2.5	-
Peak Hour Demand (Future)	13,840	gpm
Combined Firm Pumping Capacity	29,500	gpm
Surplus (+) / Deficit (-)	15,660	gpm
Criteria No. 2 (PHD+ 2 x max FF met with firm capacity)		
Max Fire Flow	4,000	gpm
PHD + 2 x Max FF	21,840	gpm
Combined Total Pumping Capacity	39,500	gpm
Surplus (+) / Deficit (-)	17,660	gpm

Supply well capacity is broken down in Table 4-5 below. The groundwater wells within the City are sufficient in meeting the aforementioned criteria and in meeting the City's demands.

Table 4-5: Supply Well Capacity

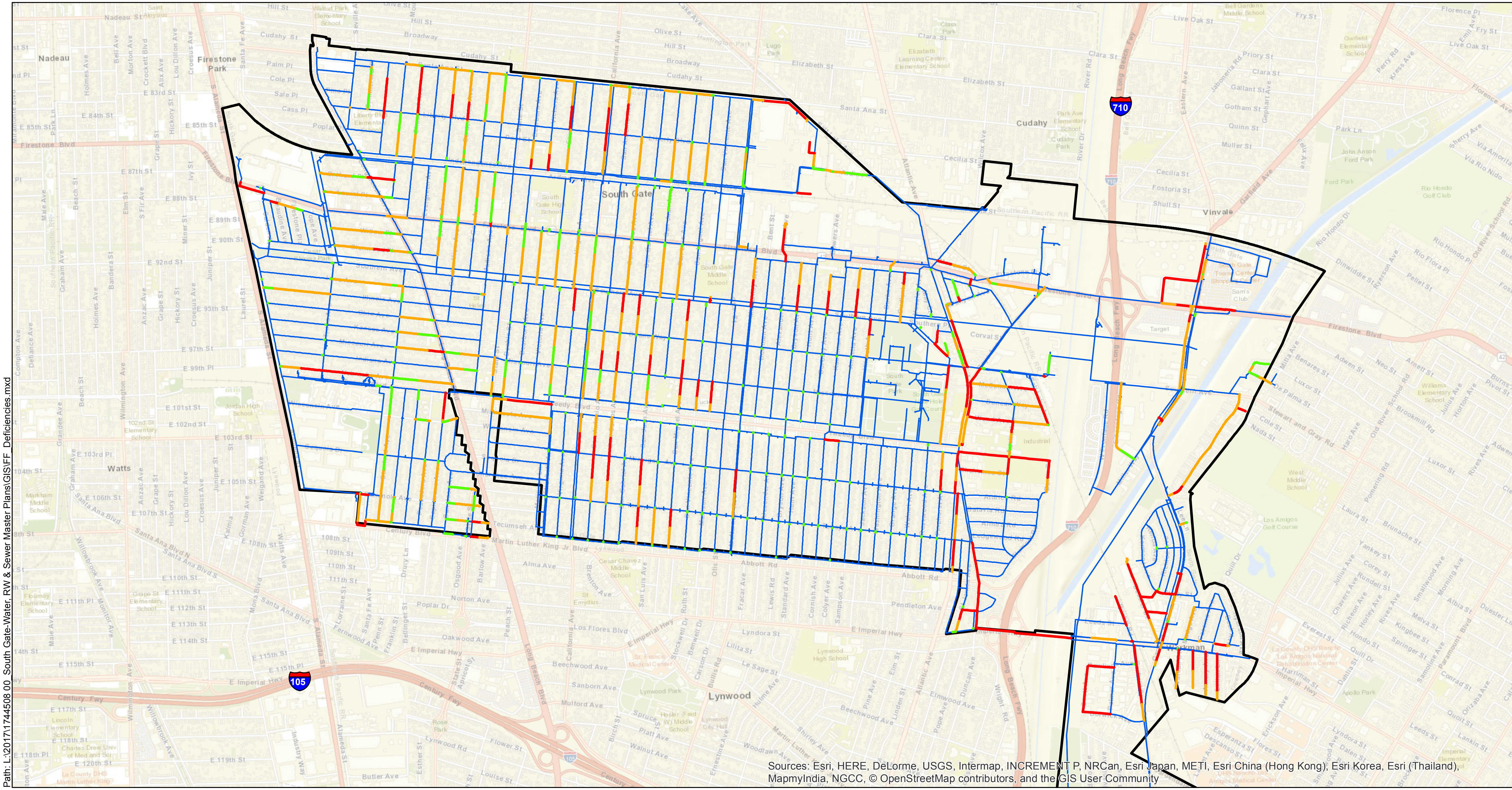
Supply Criteria	Value	Unit

4.3.2 Pipeline Capacity Evaluation

The distribution pipeline capacities were evaluated for the buildout system based on system pressures, pipeline velocities, and fire flow availabilities. A summary of the evaluation results is discussed below.

System pressures under the PHD scenario are generally within the 50-80 psi range. For the fire flow scenarios however, pressures within the vicinity of deficient fire hydrants are out of operating range, meaning that some fire hydrants within the system will not be able to meet their demands in the case of a fire. This could be due to the pipelines being undersized or due to the age and material of the pipeline. Figure 4-1 shows the locations of the deficient pipelines during the fire flow scenario and Figure 4-2 shows the range of system pressures . Hydrant laterals were modeled as points along the distribution lines. Therefore, fire flow availabilities are at the distribution system upstream of the hydrant lateral.

As shown in the figures, system pressures are generally within the criteria range with the exception of pipelines located in the vicinity of deficient fire hydrants. These pipelines have the potential to break, so the City could consider upsizing them as necessary. Further detail about the replacement of the deficient pipelines is presented in Section 5.2.1.



Path: L:\2017\1744508.00_South Gate-Water, RW & Sewer Master Plans\GIS\FF_Deficiencies.mxd

Deficiency Type

- FF1 - 20 psi Residual Pressure Not Met
- FF2A - 15 fps Velocity Criterion Not Met
- FF2B - Pipes Associated with FF2A

- South Gate City Boundary
- Other Pipes

N

0 3,000

Scale: Feet

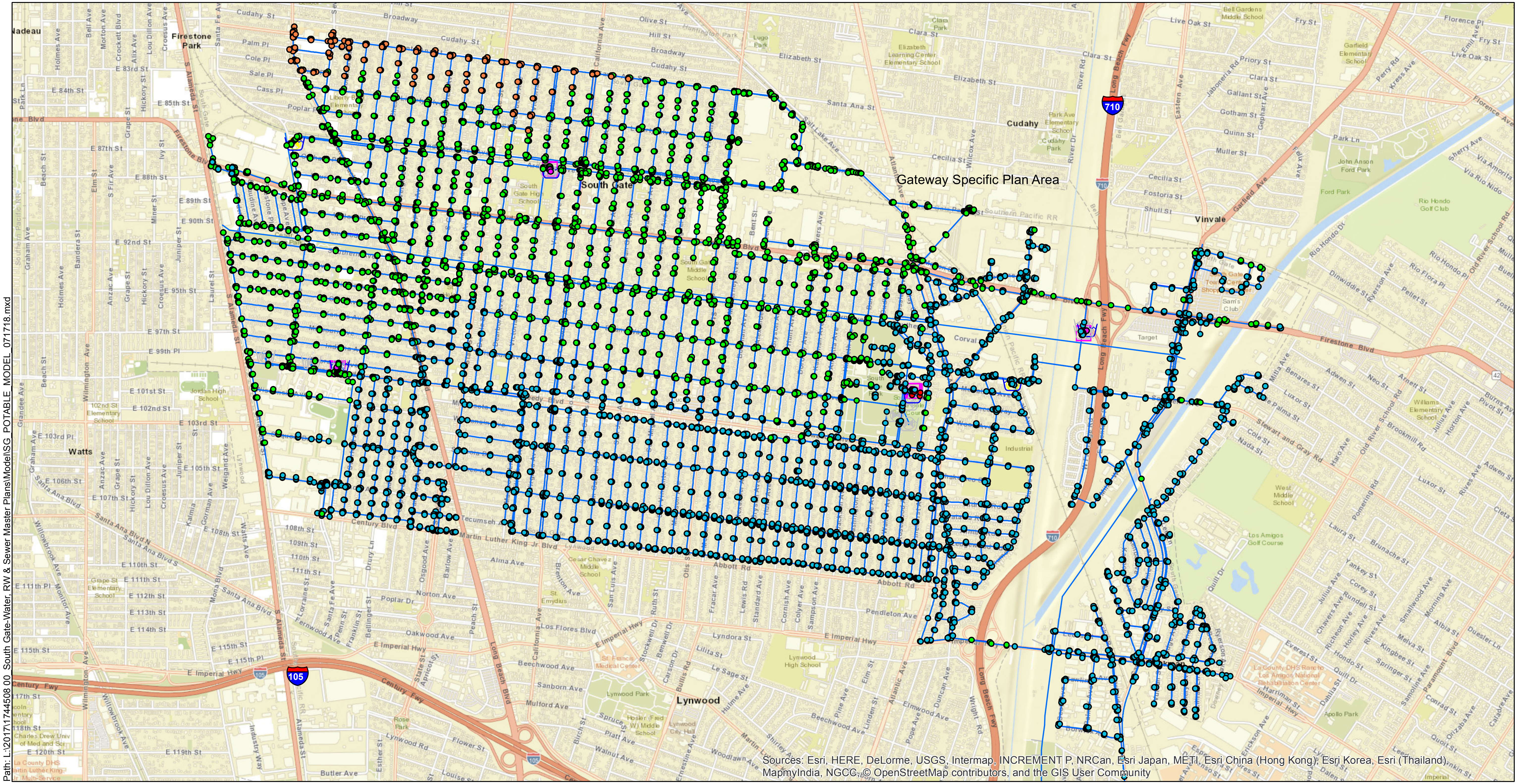
Kennedy/Jenks Consultants

2018 Water Master Plan
City of South Gate, California

Water Main Replacement Program
Fire Flow Deficiencies

1744508*00
October 2018

Figure 1



Path: L:\2017\1744508.00_South Gate-Water, RW & Sewer Master Plans\Model\SG_POTABLE_MODEL_071718.mxd

Pipelines

PRESSURE

- less than 0.00
- 0.00 ~ 20.00
- 20.00 ~ 50.00
- 50.00 ~ 60.00
- 60.00 ~ 70.00
- 70.00 ~ 90.00

N

0 3,000

Scale: Feet

Kennedy/Jenks Consultants

2018 Water Master Plan
City of South Gate, California

Water Main Replacement Program
Fire Flow System Pressures

1744508*00
October 2018

Figure 1

Section 5: Capital Improvement Program

This section describes the recommended Capital Improvement Plan (CIP) for the City of South Gate's (City's) water distribution system based on the evaluations performed and findings of this Master Plan. The recommended CIP is organized into annual plans for each of the next 10 years, followed by plans every 5 years until 2048. Planning-level capital cost estimates and assumptions are also presented in this section. Prior to design and construction of the recommended projects, the City should consider conducting preliminary engineering evaluations to assess the projects feasibility and develop more detailed cost estimates.

5.1 Cost Estimating Assumptions

The primary cost estimating assumptions used in developing the City's CIP are presented in Table 5-1. The presented unit costs are developed based on an analysis of numerous bid tabs and actual project costs for other similar projects in Southern California.

The planning-level cost estimates presented in this section are based on limited information and are intended to provide guidance for project evaluation and budgeting only. The final project costs will depend on actual labor and material costs, competitive market conditions, specific site conditions, final project scope, implementation schedule, and other variables. Therefore, final project costs may vary from the estimates presented in this section.

Table 5-1: Pipeline Cost Estimating Assumptions

Description	Unit[1]
Unit Construction Costs	
8-in diameter pipe	$180 per ft
12-in diameter pipe	$240 per ft
16-in diameter pipe	$290 per ft
Markups	
Design	8%
Construction Management	8%
Administrative and Legal	4%
Subtotal	*20%*
Contingency	25%
Total	*(1+0.20) x (1+0.25) -1 = 50%*

1. Unit costs correspond to ENR's CCI of 10,873 (20-City Average / December 2017)

5.2 Capital Improvement Plan

The Capital Improvement Plan is based on two sources of data: the water main replacement program and a list of capital improvement projects provided by the City. All capital improvement projects are described in the following sections.

5.2.1 Water Main Replacement Program

The City originally requested the development of this program to replace its network of small and aging unlined cast iron pipes. However, Kennedy/Jenks Consultants also included other types of pipes in need of replacement for this program: pipelines with break history, fire flow-deficient pipelines in proximity of critical infrastructure such as schools and hospitals, pipelines reaching their useful life within the next 30 years, and other undersized pipelines. This set of criteria was later modified into phases of high-priority pipeline replacements based on their physical proximity. While more pipes met the criteria than the final Pipeline Replacement program presents below, affordability was maintained by keeping total replacement length to about 1.5 miles per year. Of the 80 miles of cast iron pipes in the City's system, 41 miles will be replaced in the next 30 years due to age and deterioration due to a lack of pipeline lining.

The Pipeline Replacement Program is to be implemented in the City starting 2019 and will replace approximately 1.5 – 2.0 miles of pipeline per year over the proceeding 30 years. The water main replacements are based on deficiencies found in the hydraulic model in addition to a list of recent main breaks/leaks provided by the City. The replacements within the first 5 years of the Pipeline Replacement Program are categorized to meet several types of deficiencies. These hydraulic deficiencies include the following, which are ranked in order of importance:

1. Experienced a recent main break/leak
2. Inability to convey full fire hydrant flows to critical facilities (e.g. schools, hospitals, etc.)
3. Poor hydraulic performance due to pipeline age
4. Inefficient critical velocities

Pipeline breaks and leaks can cause a loss in pressure for surrounding customers as well as reduce the ability of the pipelines to meet daily demands. Hence, recent main breaks and leaks are prioritized first within the Pipeline Replacement Program to resolve any current water delivery issues within the system. The next replacement priority includes pipelines that are unable to meet full fire flow deliveries at critical facilities such as hospital and schools. These replacements are mainly spread out over the first two years of the pipeline replacement program. Pipeline age is next on the priority list, as the age greatly affects hydraulic performance. More specifically, the C factor of the pipeline decreases as the pipelines age. Pipeline age is more of a concern for the larger water mains such as the pipeline in Firestone Blvd that is to be replaced over the span of years 7-9.

In order to improve hydraulic performance within the City's water system, the majority of the replacement pipelines are 12 inches in diameter. The next most populous replacement pipelines are 8 inches in diameter. A few select locations within the system require 16-inch pipeline replacements.

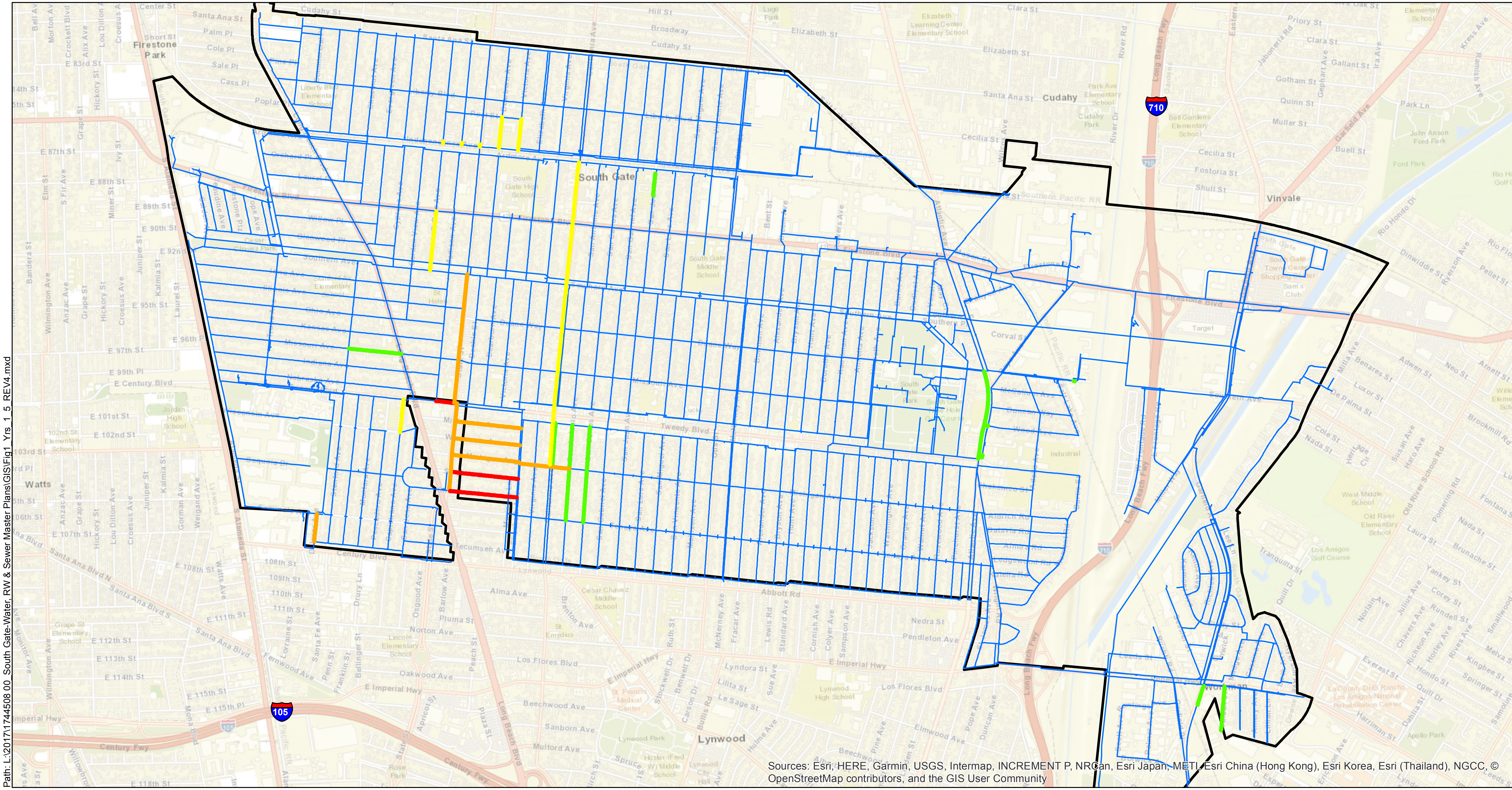
Total capital costs over the first 5 years for the water main replacements are $1 million for the first two years, $3 million for the third year, and $4 million for years 4 and 5. Further details are shown in Table 5-2. Table 5-3 shows the composition of pipelines by material that must be replaced. Figure 5-1 shows the location of each of the replacement pipelines over the first five years, and Figure 5-2 shows their locations for years 6-30.

Table 5-2: Water Main Replacement Program Summary

Year	Replacement Length (ft) 8-inch	12-inch	16-inch	Construction Cost ($M)	Capital Cost
1				0.0	0.0
2		2,810		0.7	1.0
3	3,300	6,050		2.0	3.1
4	1,200	10,160		2.7	4.0
5	540	10,980		2.7	4.1
6-10	7,470	47,770		12.8	19.2
11-15	640	43,200	1,170	10.8	16.2
16-20	25,240	7,430	4,160	7.5	11.3
21-25	34,450	8,520		8.2	12.4
26-30	15,940	29,230	1,340	10.3	15.4
Total	**88,780**	**166,150**	**6,670**	**57.8**	**86.7**

Table 5-3: Water Main Replacement Program Summary by Pipeline Material

Year	Replacement Lengths by Material CIP	DIP	Other	Total Length (ft)	Total Length (mile)
1				0	0.0
2	2,780	30		2,810	0.5
3	8,470	20	850	9,340	1.8
4	9,050	690	1,610	11,350	2.1
5	11,110	410		11,520	2.2
6-10	49,920	2,590	2,730	55,240	10.5
11-15	30,570	9,830	4,620	45,020	8.5
16-20	30,670	1,770	4,390	36,830	7.0
21-25	42,940		30	42,970	8.1
26-30	45,660	290	560	46,510	8.8
Total (ft)	**231,170**	**18,220**	**17,520**	**261,590**	**-**
Total (mile)	**43.8**	**3.5**	**3.3**	**-**	**49.5**



Path: L:\2017\1744508.00_South Gate-Water, RW & Sewer Master Plans\GIS\Fig1_Yrs_1_5_REV4.mxd

Replacement Pipes Year

- 2
- 3
- 4
- 5

South Gate City Boundary

Other Pipes

N

0 3,000

Scale: Feet

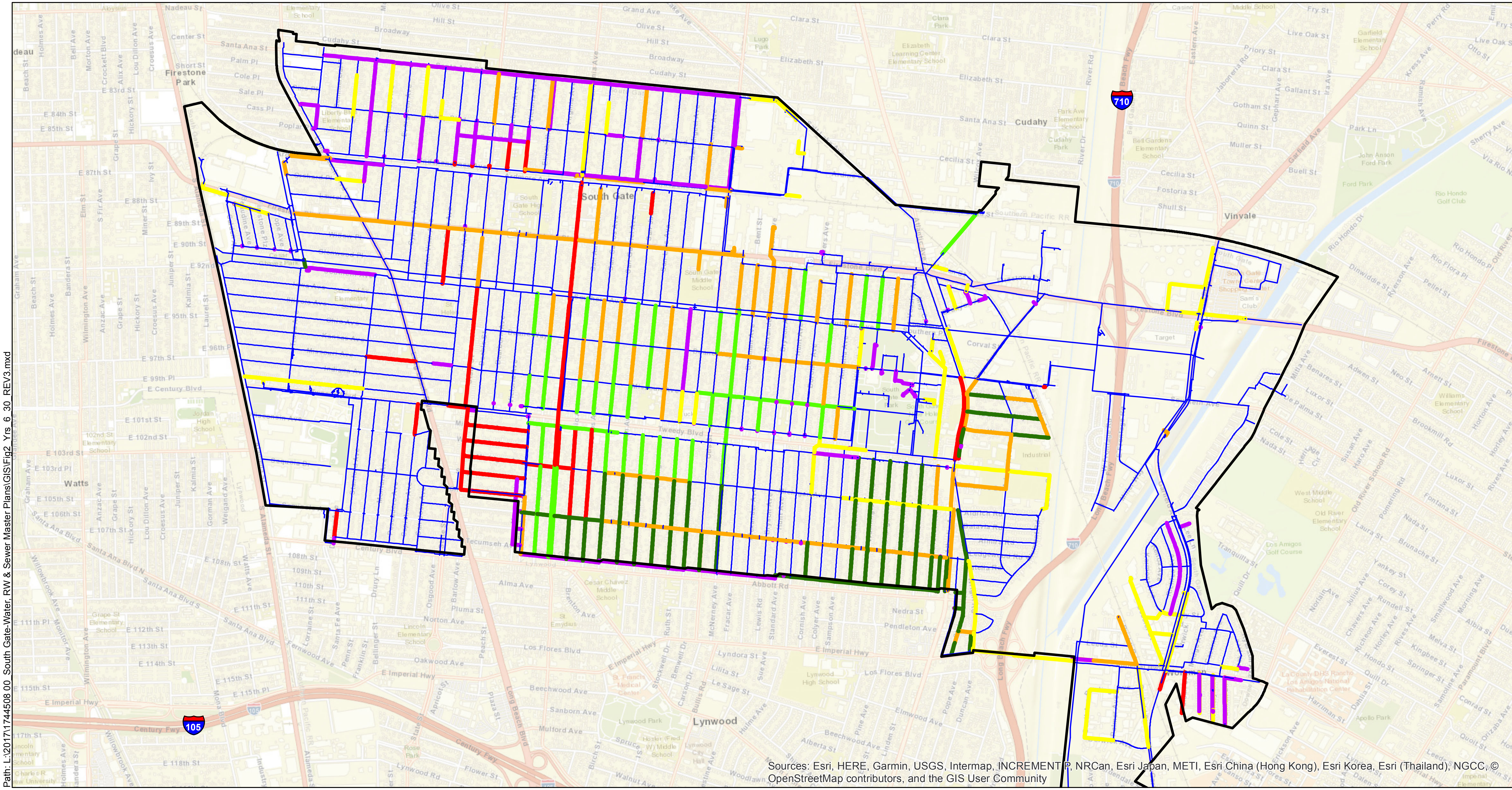
Kennedy/Jenks Consultants

2018 Water Master Plan
City of South Gate, California

Water Main Replacement Program Overview Map (Years 1 through 5)

1744508*00
May 2019

Figure 5-1



Path: L:\2017\1744508.00_South Gate-Water, RW & Sewer Master Plans\GIS\Fig2_Yrs_6_30_REV3.mxd

Replacement Pipes Year

- Other Pipes
- 2-5
- 6-10
- 11-15
- 16-20
- 21-25
- 26-30

South Gate City Boundary

N

0 — 3,000

Scale: Feet

Kennedy/Jenks Consultants

2018 Water Master Plan
City of South Gate, California

Water Main Replacement Program Overview Map (Years 6 through 30)

1744508*00
May 2019

Figure 5-2

5.2.2 Other Improvement Projects

The City is also planning other water infrastructure improvements in addition to those outlined in this report. With $7.4 million invested over the next 5 years, along with $8.5 million in long-term projects, these CIPs will focus on non-pipeline aspects of the system. CIP projects include meter and valve replacements, inter-tie construction, storm drain upgrades, well rehabilitation, and repairs to water treatment components like the chlorination system. These City programs will operate concurrently with the pipeline improvements.

5.2.3 Capital Improvement Project Summary

Overall, the combination of water main replacements and hydrant lateral replacements make up the Pipeline Replacement Program. Using the costs presented in Section 5.2, Table 5-4 presents the overall capital costs for the Pipeline Replacement Program. The costs show individual yearly costs from years 1-5 and group 5-year total costs from years 6-30. Figure 5-3 gives a visual representation of the overall capital costs over the 30-year analysis period.

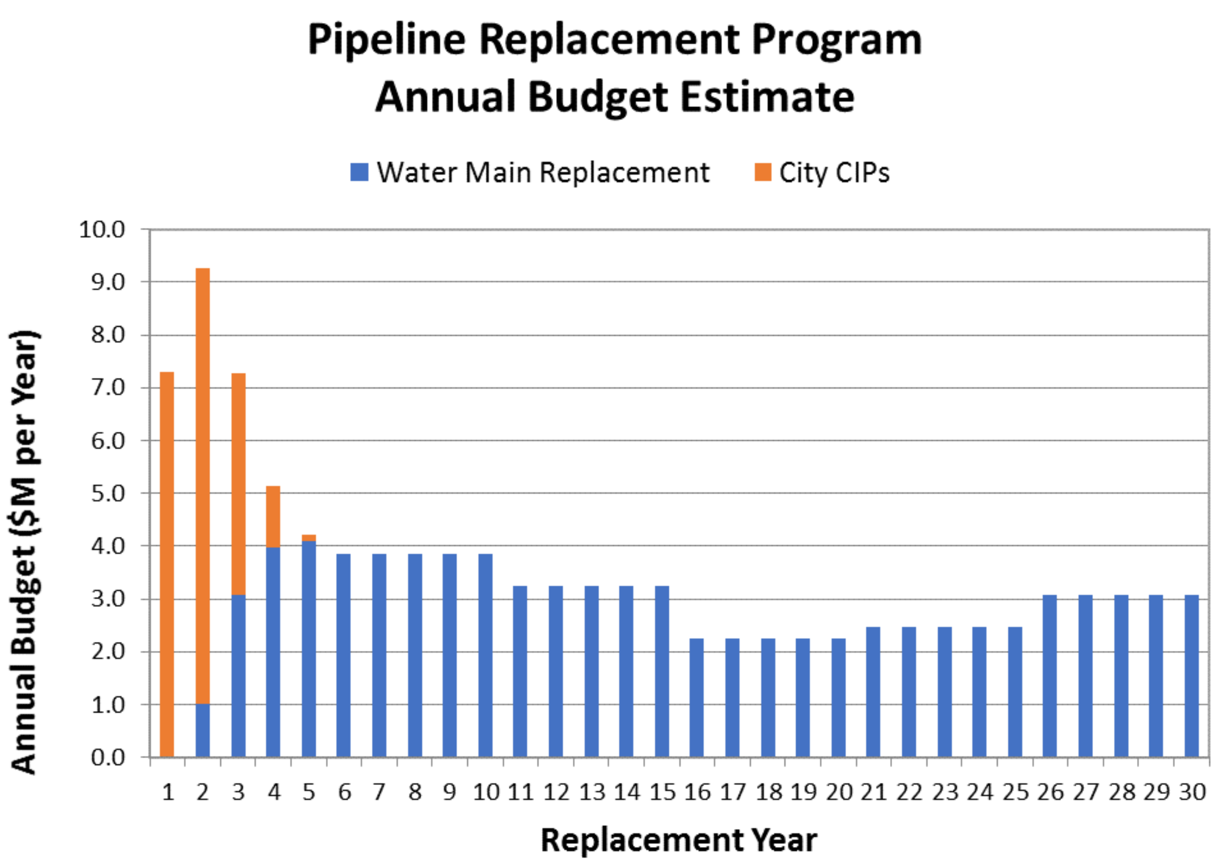


Figure 5-3: 30-Year Pipeline Replacement Program Costs

Table 5-4: Pipeline Replacement Program Cost Summary

Year	Water Main Capital Cost ($M)	City Projects Cost ($M)	Total Capital Cost ($M)
1	0.0	7.3	7.3
2	1.0	8.2	9.3
3	3.1	4.2	7.3
4	4.0	1.2	5.1
5	4.1	0.1	4.2
6-10	19.2	-	19.2
11-15	16.2	-	16.2
16-20	11.3	-	11.3
21-25	12.4	-	12.4
26-30	15.4	-	15.4
Long-term[1]	74.3	-	74.3
Total	**81.3**	**15.9**	**97.2**

1. City improvements after 5 years are grouped together as “long-term”

This section presents specific capital improvement projects in two parts: detailed pipeline replacement projects for the Pipeline Replacement Program, and City-planned capital improvement projects for other infrastructure including wells, tanks, appurtenances, and more. Total costs for each portion of the Capital Improvement Program are presented in Table 5-5 and Table 5-6.

Table 5-5: Water Main Replacement Program Specific Projects

Project ID	Project Description	Project Location	Deficiency Type	Length (ft)	Installation Year(s)	Material	Existing Size	Replace-ment Size	Construction Cost ($)	Capital Cost ($)
ML 1	Sequoia Dr and Cherokee Ave Main Line Replacement	Along Sequoia and Cherokee between Elizabeth and State St	Fire Flow/Main Break	2469	-	CIP	4"/6"	12"	$592,560	$888,840
ML 2	Tweedy Blvd Main Line Replacement	Tweedy Blvd between State St and Madison Ave	Main Break	342	1998	CIP	12"	12"	$82,080	$123,120
Year 2 Subtotal				**2,811**					**$674,640**	**$1,011,960**
ML 3	Wisconsin Ave and Michigan Ave West Main Line Replacement	Along Wisconsin Ave and Michigan Ave between Elizabeth Ave and State St	Fire Flow/Main Break	2776	2001	CIP	4"/6"	8"	$499,680	$749,520
ML 4	State St Loop Connections	Along State St between Minnesota Ave and Sequoia Dr	Fire Flow/Main Break	1524	-	-	-	12"	$365,760	$548,640
ML 5	Minnesota Ave Main Line Replacement	Along Minnesota Ave between Elizabeth Ave and State St	Fire Flow/Main Break	1185	2001	CIP	4"/6"	12"	$284,400	$426,600
ML 6	Dolores Ave Main Line Replacement	Dolores Ave between	Main Break	524	2002	CIP	4"	8"	$94,320	$141,480
ML 7	Michigan Ave East Main Line Replacement	Michigan Ave between Elizabeth Ave and San Antonio Ave	Main Break	932	1957/ Unknown	CIP	10"	12"	$223,680	$335,520
ML 8	State St Main Line Replacement 1	State St north of Tweedy Blvd	Age/Fire Flow/School	440	1928/Unknown	CIP	6"	12"	$105,600	$158,400
ML 9	State St Main Line Replacement 2		Age/Fire Flow/School	1967	1928/Unknown	CIP	10"	12"	$472,080	$708,120
Year 3 Subtotal				**9,348**					**$2,045,520**	**$3,068,280**
ML 10	California Ave Main Line Replacement 3	California Ave between Michigan Ave and Firestone Blvd	Undersized	3299	1926/1993/Unknown	CIP/STL	6"/8"	12"	$791,760	$1,187,640
ML 11	California Ave Main Line Replacement 1	California Ave between Firestone Blvd and Ardmore Ave	Undersized	2350	1991/1993/2015	CIP/DIP/STL	4"/6"	12"	$564,000	$846,000
ML 12	4" Replacement Lines	Independence Avenue between South Gate Ave and Victoria Ave	Undersized	142	1928/Unknown	CIP	4"	12"	$34,080	$51,120
ML 13	Capistrano Ave Main Line Replacement	Capistrano Ave between Tweedy Blvd and Wisconsin Ave	Fire Flow/School	614	2002	DIP	6"	12"	$147,360	$221,040
ML 14	Dearborn Ave Main Line Replacement	Dearborn Ave between Post St and Independence Ave	Fire Flow/School	588	1988	CIP	6"/8"	12"	$141,107	$211,661
ML 15	Victoria Ave Main Line Replacement	Victoria Ave between Post St and Independence Ave	Fire Flow/School	587	1988	CIP	6"	12"	$140,814	$211,220
ML 16	South Gate Ave Main Line Replacement	South Gate Ave between Firestone Blvd and Southern Ave	Fire Flow	1123	1990	CIP	6"	12"	$269,520	$404,280
ML 17	Missouri Ave Main Line Replacement	Missouri Ave between Long Beach Blvd and Stanford Ave	Fire Flow/School	989	1994	CIP	6"	12"	$237,445	$356,167
ML 18	Atlantic Ave Northwest Main Line Replacement	West of Atlantic Ave between Southern Ave and Tweedy Blvd	Fire Flow/School	1661	1953	CIP	8"	12"	$398,640	$597,960
Year 4 Subtotal				**11,353**					**$2,724,726**	**$4,087,088**
ML 19	San Juan Ave Main Line Replacement	San Juan Ave south of Ardmore Ave	Fire Flow/School	409	1994	DIP	6"	12"	$98,160	$147,240
ML 20	San Antonio Ave South Main Line Replacement	San Antonio Ave between Tweedy Blvd and Tenaya Ave	Fire Flow	1789	1956/1967/Unknown	CIP	6"	12"	$429,360	$644,040
ML 21	San Carlos Ave South Main Line Replacement	San Carlos Ave between Tweedy Blvd and Tenaya Ave	Fire Flow	1789	1956/1967/Unknown	CIP	6"	12"	$429,360	$644,040
ML 22	California Ave Main Line Replacement 2	California Ave between Tweedy Blvd and Michigan Ave	Fire Flow	817	1956	CIP	6"	12"	$196,080	$294,120
ML 23	Garfield Ave Main Line Replacement	Garfield Ave south of Imperial Highway	Fire Flow	371	1950/Unknown	CIP	6"/8"	12"	$89,040	$133,560
ML 24	San Miguel Ave Main Line Replacement	San Miguel Ave between and Missouri Ave	Fire Flow	2240	1954	CIP	6"	12"	$537,600	$806,400
ML 25	Pinehurst Ave Main Line Replacement	Pinehurst Ave between Tweedy Blvd and Michigan Ave	Fire Flow	828	1954/1992	CIP	6"	12"	$198,720	$298,080
ML 26	Atlantic Ave South Main Line Replacement	Atlantic Ave between Tweedy Blvd and Michigan Ave	Fire Flow	830	1957	CIP	6"	12"	$199,200	$298,800
ML 27	Chakemco St Main Line Replacement	Chakemco St between Adella Ave and Atlantic Ave	Fire Flow	999	1956/Unknown	CIP	6"	12"	$239,760	$359,640
ML 28	Mccallum Ave Main Line Replacement	Mccallum Ave between Adella Ave and Salt Lake Ave	Fire Flow	536	1957	CIP	6"	8"	$96,480	$144,720
ML 29	Vulcan St Main Line Replacement	Vulcan St south of Imperial Highway	Fire Flow	820	1948/1952/Unknown	CIP	6"	12"	$196,800	$295,200
Year 5 Subtotal				**11,428**					**$2,710,560**	**$4,065,840**

The following table shows the City-specified capital improvement projects including infrastructure, water supplies/wells, and recycled water for the next five years. The long-term projects are assumed to be implemented within 6 and 30 years.

Table 5-6: Capital Improvement Program Specific Projects

	Description	2019/20	2020/21	2021/22	2022/23	2023/24	Long Term (Years 6-30)	5-Year Total
Capital Improvement Projects - Pipeline Replacement								
	Water Mains							
1	Water Main Replacement Program		$1,000,000	$3,000,000	$4,100,000	$4,100,000	$74,300,000	**$12,200,000**
2	Long Beach Boulevard Plastic Service Lateral Replacement	$1,000,000						**$1,000,000**
Capital Improvement Projects - City Specified								
	Infrastructure							
3	AMI Meter Replacement Project	$500,000	$3,500,000	$4,000,000	$50,000			**$8,050,000**
4	Well Meter Replacement Project			$20,000	$20,000	$20,000		**$60,000**
5	Citywide Backflow Prevention System Upgrades				$300,000			**$300,000**
6	Upgrades to MWD Inter-ties	$50,000						**$50,000**
7	Miscellaneous Water Main Repairs	$50,000	$50,000	$50,000	$50,000	$50,000		**$250,000**
8	GIS Upgrades for Water/Sewer/Storm Drains	$20,000	$20,000	$20,000	$20,000	$20,000		**$100,000**
9	Citywide valve Turning Project		$300,000					**$300,000**
	Water Supply, Reservoirs, & Wells							
10	Water System Chlorination System Repairs/Upgrades	$3,300,000						**$3,300,000**
11	Tank Cathodic Protection		$100,000	$100,000				**$200,000**
12	External Recoating and Logos 7 tanks	$750,000	$750,000					**$1,500,000**
13	Salt Lake Tank Blight Mitigation	$400,000						**$400,000**
14	Seismic Upgrades to Water Tanks		$500,000		$500,000			**$1,000,000**
15	Well No. 18 Rehabilitation							
16	Abandonment of Wells 13, 22, and 23	$200,000						**$200,000**
17	Well No. 28 Rehabilitation				$200,000			**$200,000**
18	Construction of New Well No. 30 - 7-Acre Site	$2,000,000	$3,000,000					**$5,000,000**
	Recycled Water							
19	Recycled Water Main Retrofits: 2020-2025							
20	Recycled Water Main Retrofits: 2025-2030							
21	Recycled Water Retrofits	$20,000	$20,000	$20,000	$20,000	$20,000		**$100,000**
CIP Grand Total		**$8,290,000**	**$9,20,000**	**$7,210,000**	**$5,260,000**	**$4,210,000**	**$74,300,000**	**$34,210,000**

References

To be updated

Kennedy/Jenks Consultants, Inc.

300 N. Lake Avenue, Suite 1020
Pasadena, CA 91101
(626) 568-4300

www.kennedyjenks.com