2021 Water Master Plan

FINAL Submitted: May 2021

Prepared For:
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Abbreviations

Abbreviation	Description
ACP	Asbestos Cement Pipe
ADD	Average Day Demand
AF	Acre-Feet
AFY	Acre-Feet Per Year
AMSL	Above Mean Sea Level
BPS	Booster Pump Station
CDWC	California Domestic Water Company
CFS	Cubic Feet Per Second
CI	Cast Iron
CIP	Capital Improvement Program
City	City of Brea
CML	Cement Mortar Lined
DIP	Ductile Iron Pipe
EPS	Extended Period Simulation
fps	Feet Per Second
ft	Feet
GIS	Geographic Information System
gpm	Gallons Per Minute
HGL	Hydraulic Grade Line
hp	Horsepower
LF	Linear Feet
MDD	Maximum Day Demand
MDD+FF	Maximum Day Demand + Fire Flow
MG	Million Gallons
MGD	Million Gallons Per Day
MWD	Metropolitan Water District of Southern California
MWDOC	Municipal Water District of Orange County
OC Feeder	Orange County Feeder
OCFA	Orange County Fire Authority
PHD	Peak Hour Demand
PRV	Pressure Reducing Valve
psi	Pounds Per Square Inch
PVC	Poly-Vinyl Chloride
SCAG	Southern California Association of Governments
SCE	Southern California Edison
SOI	Sphere of Influence
TAZ	Traffic Analysis Zone
TDH	Total Dynamic Head
UWMP	Urban Water Management Plan
VFD	Variable Frequency Drives
WMP	Water Master Plan
WMPU	Water Master Plan Update

Executive Summary

0.1 General

The City of Brea (City) encompasses 12.1 square miles of residential, commercial, industrial, and some agriculture and oil producing land. The City owns and operates their potable water system within the City's boundaries and Sphere of Influence (SOI) see Figure 1-1 for more information. Due to the lack of potable groundwater in the City, the majority of the City's water supply comes from two wholesale water producers, the California Domestic Water Company (CDWC) and Municipal Water District of Orange County (MWDOC).

The 2009 Water Master Plan Update (WMPU) was limited to the existing City water distribution system, its SOI, and existing water demands. The 2021 Water Master Plan (WMP) was needed to address planned developments and associated demands defined by zoning, the General Plan, and Traffic Analysis Zone (TAZ) areas. The 2021 WMP completed a supply analysis, demand analysis, and updated the City's hydraulic model. Following the completion of model calibration and analysis, the project team investigated system issues, performed "stress-tests" on the system, and addressed issues or concerns of City staff involved in the operation of the water system. A complete list of potential capital improvement program projects was developed, cost benefit analysis performed, and projects prioritized.

To accomplish the objectives of the 2021 WMP, the following tasks were performed.

1. **Existing Facilities Information Update.** As-built plans of newly constructed projects since 2009 were obtained for all new water facilities (pipelines, reservoirs, booster pumps, pressure reducing stations, etc.).

2. **Water Supply Update.** An analysis was performed on water purchased from 2009 to the 2019 and updated information relating to supply allocation, ownership and capacity of delivery systems and connections.

3. **Water Demand Update.** Meter billing summary data was obtained by year (2015 to 2019) for the City, including the 30 largest users. Also obtained maximum day water production for 2015 to 2019.

4. **Computer Model Update.** Information from Tasks 1, 2, and 3 above were utilized to update the computer model.

5. **Water Model Testing.** The updated model was tested against the 2009 WMPU model calibration and investigated and corrected any anomalies. Following calibration of the model, the existing water system was analyzed to identify any deficiencies.

6. **Capital Improvement Program Development.** Recommendations, priorities and cost estimates were prepared for existing water system improvements.

7. **2021 WMP Preparation.** A water master plan report was prepared with tables, graphics, maps and appendices.

0.2 Model Results

The water model was updated to reflect all improvements to the system. The total system demand was analyzed and reported as 8,615 gpm or 12.4 million gallons per day (MGD) under the Maximum Day Demand (MDD) scenario. The results from this simulation are approximately 1/3 less than the demand from the 2009 WMPU's MDD scenario, of 12,903 gpm (18.6 MGD).

System pressures and pipeline velocities did not vary much from the previous modeling results.

0.2.1 Valencia Reservoir

The inlet/outlet line from Valencia Reservoir along Valencia Avenue from the reservoir to Sandpiper Way is a 12-inch pipeline, which then connects to a 24-inch pipe. Velocities in the 12-inch segment exceed the velocity criteria during both fill cycles to the reservoir and during Maximum Day Demand + Fire Flow (MDD+FF). Upsizing this pipeline from 12-inch to 24-inch will reduce the velocity in the pipelines to acceptable levels and allow for more flow into and out of the reservoir.

0.3 Analysis Results

All facilities were analyzed to determine if they had sufficient capacity to meet the peak system demands. The analysis showed that there was sufficient capacity for supply (imported water connection capacity), storage (reservoir capacity), and pressure reducing stations (valve capacity).

However, there is insufficient booster pump capacity for the 515 and 790 zones. Both zones are served solely by the Berry Street Booster Pump Station. The booster pumping stations should be sized to supply dependent MDD, with the largest pump out of service. The dependent MDD is the total of the zone's MDD and the subzones that rely on the higher zone for water. Table 0-1 shows the results of the primary booster station analysis.

Table 0-1: Primary Booster Pump Analysis

Pressure Zone	Initial Capacity (gpm)	Existing Dependent MDD (gpm)	Surplus Capacity (gpm)
1400	598	1	597
1000	668	117	551
830	1,200	389	811
790	4,000	5,191	(1,191)
515	2,000	3,424	(1,424)

0.3.1 Berry Street Booster Pump Station

In order to meet the dependent MDD in the 790-pressure zone, all the pumps must be active. An additional high-pressure pump should be added to the station with a minimum capacity of 1,191 gpm to address this issue. To meet the dependent MDD in the 515-pressure zone, an additional low-pressure pump should be added to this station with a minimum capacity of 1,424 gpm.

Additionally, the operations team verified that it is difficult to fill the Valencia Reservoir during peak demand months as predicted in the 2002 WMP and 2009 WMPU. As stated in the 2009 WMPU, the system was designed for Valencia Reservoir to be filled by the MWD connection, which is on the east side of the system near Valencia Reservoir. Since the City has transitioned to primarily receiving supply from CDWC, which is on the west side of the system, water now must be pumped from Berry Street Booster Pump Station across the system to the Valencia Reservoir. A pipeline improvement project on Valencia Avenue (as identified in Section 6.14.1) has been recommended to improve flow to the reservoir. However, increasing the discharge pressure at Berry Street Booster Pump Station may be a better solution if the areas downstream of the pump station can handle the increased pressure.

It is recommended that a study of the pump station be conducted to review the appropriate pumping capacity and total dynamic head (TDH) of the high-pressure pumps. If the pump station is unable to maintain pressure to the Valencia Reservoir under current conditions, increasing the discharge pressure at the pump station would provide additional head to overcome the pressure loss to the Valencia Reservoir. The study should also ensure that the high-pressure pumps would have the flow capacity to address the pumping deficiency that has been identified.

0.4 Pipeline Life Expectancy Analysis

All pipelines in the system were reviewed to determine if they need to be considered for replacement due to age. Pipeline life expectancy varies depending on the material of the pipe. Ductile iron pipe (DIP) has an approximate life expectancy of 100 years, while cement mortar line (CML) steel has 70 years, and cast iron (CI) pipelines has 50-60 years on average. Once pipelines meet their life expectancy, they can begin to fail or have excessive leaks. Table 0-2 below shows a comparison of material by age within the City.

Table 0-2: Pipe Summary – Age and Material

Decade	ACP	CI	CML	CU	DI	PVC	STEEL	Unknown	Total (ft)
Unknown	-	45,864	15,074	-	3,414	-	-	16,840	81,192
1940-1949	-	928	-	-	1,972	-	-	-	2,900
1950-1959	-	14,441	-	-	3,570	-	-	13,594	31,605
1960-1969	-	101,362	5,434	-	22,101	-	50	18,075	147,022
1970-1979	373	115,923	26,174	-	105,730	-	7,948	2,465	258,613
1980-1989	-	51,253	6,906	-	143,693	135	-	10,903	212,890
1990-1999	-	36,364	1,017	-	118,492	11,965	-	3,390	171,228
2000-2009	-	2,878	219	-	73,088	398	7,172	-	83,755
2010-2020	-	3,470	-	47	104,038	29,401	337	-	137,293
Total	373	372,483	54,824	47	576,098	41,899	15,507	65,267	1,126,498

Reviewing the City's pipeline infrastructure, CI pipelines that were installed before 1970 are the primary pipelines that have exceeded their life expectancy and should be considered for replacement. This includes approximately 162,000 Linear Feet (LF) of pipeline within the City. Each section of pipeline was reviewed and prioritized as part of the Capital Improvement Plan.

0.5 Recommended Projects

Based on all of the analysis performed, a list of recommended projects has been identified. The recommended projects are broken down into three categories: *Existing Deficiencies*, *System Reliability,* and *Potential Developments*. Appendix D in this WMP shows the location of the recommended projects according to type of category.

Recommended Projects to Meet Existing Deficiencies are projects that address current issues in the system and are recommended to be completed when funding is available. This is shown in Table 0-3. The total cost to implement the Recommended Projects to Meet Existing Deficiencies is estimated at $18,818,000 in 2020 dollars.

Recommended Projects for System Reliability are optional projects that do not address a deficiency, but will improve the system, reduce operations costs, or provide other system benefits. This is shown in Table 0-4. The total cost to implement the Recommended Projects to System Reliability is estimated at $2,688,000 in 2020 dollars.

Recommended Projects for Potential Development are projects that will be necessary to provide water to undeveloped areas of the City. These projects should be implemented as the areas are developed. This is shown in Table 0-5. The total cost to implement the Recommended Projects for Potential Development is estimated at $103,833,000 in 2020 dollars.

Table 0-3: Recommended Projects to Meet Existing Deficiencies

Priority	Project #	Recommended Improvement	Quantity	Unit Cost	Cost
High	1	Berry Street High Pressure Pump	1 EA	$350,000/EA	$ 350,000
Medium	2	Valencia Ave Transmission Improvement	3,325 LF	$650/LF for 24-inch	$ 2,162,000
Medium	3	Puente Street, Site Drive, and State College Boulevard Replacements	12,212 LF	$430/LF for 8-inch and $375/LF for 12-inch	$ 4,738,000
Medium	4	Valencia Pipeline Replacement	9,560 LF	$430/LF for 8-inch	$ 4,111,000
Medium	5	Decommission Puente Pump Station	1 EA	$200,000/EA	$ 200,000
Low	6	Lotus Place Pipe Improvements	6,970 LF	$430/LF for 8-inch and $375/LF for 12-inch	$ 2,947,000
Low	7	Roscoe St Pipe Improvements	1,108 LF	$375/LF for 12-inch	$ 416,000
Low	8	Brea Corsica Villas Improvement	7,160 LF	$375/LF for 8-inch and $430/LF for 12-inch	$ 2,867,000
Low	9	Olinda Village Pipe Improvements	2,388 LF	$430/LF for 12-inch	$ 1,027,000
TOTAL COST FOR RECOMMENDED PROJECTS TO MEET EXISTING DEFICIENCIES					**$18,818,000**

Table 0-4: Recommended Projects for System Reliability

Project #	Recommended Improvement	Quantity	Unit Cost	Cost	
SR #1	Carbon Canyon Reservoir Disinfection System	1 LF	$350,000/EA	$	350,000
SR #2	Replace Generator at Berry Street Booster Pump Station	1 EA	$300,000/EA	$	300,000
SR #3	Berry Street Low Pressure Pump	1 EA	$350,000/EA	$	350,000
SR #4	790 Zone Loop Completion	3,750 LF	$450/LF for 12-inch	$	1,688,000
TOTAL COST FOR RECOMMENDED PROJECTS TO IMPROVE SYSTEM RELIABILITY				**$**	**2,688,000**

Table 0-5: Recommended Projects For Potential Developments

Project #	Recommended Improvement	Quantity	Unit Cost	Cost
1A	Expand 790 Zone Transmission/ Distribution Piping	26,285 LF of 16-inch and 1,010 LF of 24-inch	$550/LF for 16-inch and $600/LF for 24-inch	$ 15,114,000
1B		1 Imported Water Connection Valve	$200,000/Emergency Conn.	$ 200,000
1C		1 Pump Station (2 pumps)	$850,000/pump	$ 1,700,000
2A	Eastside 900 Zone Transmission Pipelines	13,982 LF of 12-inch and 24,655 LF of 16-inch	$375/LF for 12-inch and $550/LF for 16-inch	$ 18,804,000
2B		2 Pumps	$650,000/pump	$ 1,300,000
2C		1 Pump Station (2 pumps)	$650,000/pump	$ 1,300,000
2D		4.0 MG	$1.5M/MG	$ 6,000,000
2E		4.5 MG	$1.5M/MG	$ 6,750,000
2F		1 PRS and 1 Emergency Connection	$200,000/Emergency Conn and $200,000/PRS	$ 400,000
3A	1050 Zone Improvements	3,687 LF	$375/LF for 12-inch	$ 1,383,000
3B		1 Pump Station (3 pumps)	$1.7M/pump	$ 5,100,000
4A	Expansion of CC 1000 Zone System	557 LF of 8-inch and 18,858 LF of 12-inch	$430/LF for 8-inch and $375/LF for 12-inch	$ 7,312,000
4B		1 Pump Station (3 pumps)	$850,000/pump	$ 2,550,000
4C		7.5 MG	$150,000/MG	$ 11,250,000
5A	CC 1200 Zone Improvements	2,200 LF	$375/LF for 12-inch	$ 825,000
5B		1 Pump Station (2 pumps)	$750,000/pump	$ 1,500,000
6A	CC 1400 Zone Improvements	23,720 LF	$375/LF for 12-inch	$ 8,895,000
6B		1 Pump Station (3 pumps)	$150,000/pump	$ 450,000
6C		2 Pumps	$750,000/pump	$ 1,500,000
6D		9.3 MG	$150,000/MG	$ 10,700,000
6E		4 PRS	$200,000/PRS	$ 800,000
TOTAL COST FOR RECOMMENDED PROJECTS TO MEET BUILD-OUT DEMAND				**$103,833,000**

Chapter 1 - Introduction

1.1 General Description

The City of Brea (City) encompasses 12.1 square miles of residential, commercial, industrial, and some agriculture and oil producing land. The City is thriving with 48,583 residents and more than 120,000 people visiting daily to work, shop or play. Conveniently located in the northeast corner of Orange County, the City connects major transportation routes and employment centers across Orange, Los Angeles, Riverside, and San Bernardino counties. Development activities and economic impacts within the City and the extended SOI, have risen.

Housing options are abundant throughout the City, including workforce and executive housing neighborhoods. The commercial and industrial businesses form a diverse economic base with easy access to the 57, 60 and 91 Freeways. The Brea Mall spans over 1.3 million square feet and attracts more than 14 million visitors annually. The City is also home to the Civic and Cultural Center, three regional parks, 13 community parks, a 26-acre multi-sport park, two public golf courses, a senior center, community center, dog park, and the historic Brea Plunge, an Olympic-sized swimming pool.

The City owns and operates their potable water system within the City's boundaries and SOI (see Figure 1-1). Due to the lack of potable groundwater in the City, a majority of the City's water supply comes from two wholesale water producers, the CDWC and MWDOC. Residential customers account for a majority of the City's water connections. City Council establishes water rates and charges, and the City's Public Works Department is responsible for the water system's day-to-day operations and maintenance.

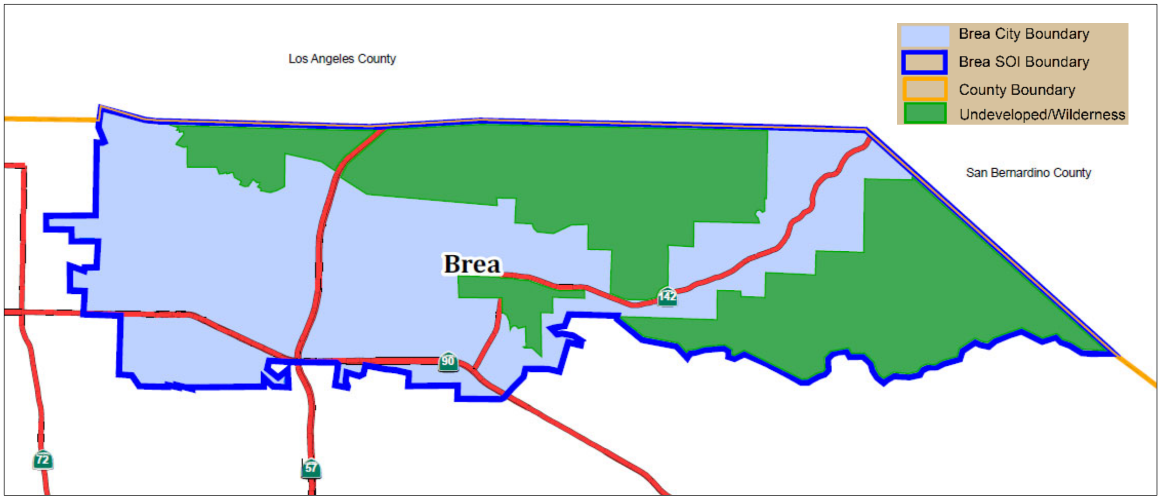
1.2 Study Area

The water system encompasses the entire City located in northern Orange County, California, bounded by the cities of La Habra to the west, Fullerton to the southwest, Yorba Linda to the southeast and unincorporated County of Los Angeles to the north. The study area includes the City and its SOI (see Figure 1-1).

1.2.1 Sphere of Influence (SOI)

Figure 1-1 illustrates the City boundaries and SOI, the region supplied by the City. The SOI is the geographic extend to which the City can expand by annexation. According to the Southern California Association of Governments (SCAG), the City's SOI reaches the county border of both San Bernardino County and Los Angeles County. However, the City boundary does not extend to the SOI boundary, due to undeveloped and wilderness areas to the north and east of the City.

Figure 1-1: Boundary Map



1.2.2 Population

The City publishes population projections every five years in their Urban Water Management Plan (UWMP). According to the City's 2015 UWMP, the 2015 population was calculated to be 43,093 and projected to reach 50,458 in 2040. Table 1-1 shows the projected populations per the 2015 UWMP. The area experienced a development boom from 2000 to 2007 and, more recently, the economy and development activity has soared resulting in a need to address future development and associated demands.

Table 1-1: Current and Future Population

Population	2015	2020	2025	2030	2035	2040
	43,093	48,583	48,793	49,129	50,507	50,458

1.3 Purpose

The previous WMPU was completed in 2009. The City has decided to update their water master plan for multiple reasons. Factors include the escalating cost of imported water; improvements made to the distribution system since the 2009 WMPU; and anticipated increase in economy and development activities. After years of design, planning and securing funding, the Highway 57 and Lambert Road interchange entered construction and the City completed an Active Transportation Plan in 2019. This is anticipated to further support the economic development of the Brea Core Plan. The City wants to ensure their water system will be capable of meeting all the future water demands of the City.

1.4 Scope

The 2009 WMPU was limited to the existing City water distribution system, its SOI, and existing water demands. The 2021 WMP was needed to address planned developments and associated demands defined by zoning, the General Plan, and TAZ areas. The 2021 WMP completed a supply analysis, demand analysis, and updated the City's hydraulic model. Following the completion of model calibration and analysis, the project team investigated system issues, performed "stress-tests" on the system, and addressed issues or concerns of City staff involved in the operation of the water system. A complete list of potential capital improvement program projects was developed, cost benefit analysis performed, and projects prioritized.

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1. **Existing Facilities Information Update.** As-built plans of newly constructed projects since 2009 were obtained for all new water facilities (pipelines, reservoirs, booster pumps, pressure reducing stations, etc.).

2. **Water Supply Update.** An analysis was performed on water purchased from 2009 to the 2019 and updated information relating to supply allocation, ownership and capacity of delivery systems and connections.

3. **Water Demand Update.** Meter billing summary data was obtained by year (2015 to 2019) for the City, including the 30 largest users. Also obtained maximum day water production for 2015 to 2019.

4. **Computer Model Update.** Information from Tasks 1, 2, and 3 above were utilized to update the computer model.

5. **Water Model Testing.** The updated model was tested against the 2009 WMPU model calibration and investigated and corrected any anomalies. Following calibration of the model, the existing water system was analyzed to identify any deficiencies.

6. **Capital Improvement Program Development.** Recommendations, priorities and cost estimates were prepared for existing water system improvements.

7. **2021 WMP Preparation.** A water master plan report was prepared with tables, graphics, maps and appendices.

1.5 Design Criteria

Design and planning criteria are used as a benchmark for evaluating the capacity of the existing water distribution system and as a guide for recommending improvements to meet future conditions. Design criteria is used to evaluate the hydraulic capacity of the water distribution system. The City desires a public water system with adequate street widths for all new developments, to the review and approval of the Director of Public Works. Design details for water facilities can be found in the latest edition of the "City of Brea Public Works Standard Plans." The primary goal is to establish a minimum level of service to ensure a safe and dependable supply of water to the entire services area. This evaluation is quantitative and compares field measurements or engineering calculations (specifically the results generated by the hydraulic water model) with a series of benchmarks that reflect customer expectations, the regulatory environment, sustainable design, redundancy, reliability, functionality, emergency preparedness, efficiency, economics, and other issues of importance to the City.

Design criteria was developed and detailed, including the underlying driving forces, for the following:

1.5.1 Minimum Service Requirements for the Water System

The water provided to the consumers shall meet all federal, state and local regulations governing water quality for potable use.

The water system shall be capable of providing the minimum fire flow as determined in the water master plan with the minimal residual pressure of 20 pounds per square inch (psi) in the distribution system pipelines.

1.5.2 System Pressures

Goal for static system pressure range: 40 psi to 125 psi

The water system shall be capable of providing at least 40 psi for the following demand periods: average day, maximum day and peak hour. A maximum static pressure should be maintained at below 80 psi.

Where the maximum pressure exceeds 80 psi, individual pressure regulators should be equipped at connection in accordance with the Uniform Plumbing Code.

The maximum pressure at any connection should be limited to 125 psi, where practicable.

1.5.3 Fire Flow

Goal for minimum pressure during fire flow event: 20 psi.

Under fire flow conditions, residual pressures should not fall below 20 psi when delivering the required fire flow rate. The minimum residual pressure requirement is established by the California Dept. of Public Health. This threshold provides a buffer against the possibility of negative pressure in the distribution system which could result in contamination ingress.

An exception to the 20-psi minimum is allowed for fire hydrants that are located so close to reservoirs as to not be able to achieve the requirement for pressure residual. These hydrants shall be designated as "draft hydrants" and piping shall be sized from the reservoir to the hydrant to provide the fire flow requirement as close to the local static pressure as possible.

Fire Flow Requirements per Land Usage

For purposes of testing the adequacy of the existing system, the following fire flows are applied based on Land Use as shown in the table below. These apply to any structure that is being altered, as required by City, County, State, and Federal codes and ordinances. Existing structures that are not being altered are grandfathered in based on the regulations at the time of their construction.

Fire Flow Requirements per Land Usage

Land Use Description	Zoning Designation	Minimum Fire Flow (gpm)	Minimum Duration (hrs)
Single Family Residential	HR, R1-H, R-1, R-1(5000)	1,500	2
Multi-Family Residential	R-2, P-C	2,500	2
High Density Residential	R-3	4,000	4
Schools	N/A	3,500	4
Business/ Commercial	C-P, C-N, C-G, C-C, PF	2,500	2
Industrial	BISP, C-M, M-1, M-2, M-P	4,000	4
Mixed-use	MU-I, MU-II, MU-III	4,000	4

1.5.4 Pipeline Criteria

Distribution Mains

Distribution mains carry water to service connections and fire hydrants. Fire flow is typically the governing factor in sizing distribution mains, although normal operations under peak demand conditions should also be examined for efficiency.

Maximum velocity in any proposed pipeline should be in accordance with the following guidelines:

- For Average Day Analysis:
  - Desired Range: 0 to 5 feet per second (fps)
  - Questionable Range: 5 to 7 fps
  - Deficient Range: Over 7 fps
- For Maximum Day and Peak Hour Analysis:
  - Desired Range: 0 to 7 fps
  - Questionable Range: 7 to 10 fps
  - Deficient Range: Over 10 fps
- For Fire Flow Analysis:
  - Desired Range: 0 to 15 fps
  - Deficient Range: Over 15 fps

Pipes with velocities in the Questionable Range should be revied on an individual basis. Those with velocities in the deficient range should be considered for replacement or paralleling.

New Pipeline Criteria

To meet pressure and velocity objectives, the minimum diameter for new pipelines shall be 8 inch, except in short cul-de-sac streets where 6 inch pipe may be used beyond the last hydrant. In commercial and business areas the minimum diameter for new pipelines shall be 12 inch.

These diameters shall not preclude the use of larger diameters when needed to meet the minimum fire flows or other criteria. All pipelines shall be looped (excluding short cul-de-sac streets) to prevent one pipeline outage from disrupting service to an area.

1.5.5 Supply

The water system and each pressure zone shall have at least two independent supply sources as recommended by AWWA. Where water is pumped from another zone or from an imported supply source, the booster pumping station shall have a backup pump online and equal in size to the largest pump in the station. The station shall also have a backup (or secondary) power source. A portable generator can be considered acceptable as a backup power source for the booster station.

Where two sources of supply are not practicable, the zone should have sufficient storage to meet all emergency criteria with the supply out of service.

Primary Supply Design

The primary supply design criteria evaluates the system's combined production capacity with the largest single source of supply out of service.

This level of redundancy will allow the City to maintain normal deliveries with the temporary loss of a source of supply. Minimum production capacity is driven by the merits of redundancy and economics.

Secondary Supply Design

The secondary supply design criteria evaluates the pump station's ability to refill emergency and fire storage in 2 days (48 hours) under MDD conditions.

A depletion of emergency and fire storage creates a temporary vulnerability to immediate, ongoing or subsequent events that would otherwise be mitigated. This vulnerability can be minimized by rapid replenishment of storage.

1.5.6 Storage

Primary Storage Design

The primary storage design criteria evaluates the fire, emergency, and operational storage by pressure zone.

Storage analysis compares the storage capacity to the storage requirements in each pressure zone that is served via gravity storage. Storage requirements are based on demand and fire flow requirements.

The principal functions of storage are:

1. To equalize fluctuations in instantaneous demand so that extreme and rapid variations in demand are not imposed on the sources of supply;
2. To provide water for firefighting; and
3. To meet demand during an emergency such as disruption of the major source of supply, a power outage, a pipe break, or another unforeseen emergency or maintenance issue.

Operational Storage

Operational storage describes the volume needed to equalize the cumulative difference between supply and demand over the course of a day. Maximum operational storage would typically occur under MDD conditions. The operational storage requirement is driven by system functionality. The volume of operational storage, as an industry standard, averages between 20 to 30% of MDD. For consistency with the 2009 WMPU, the operational storage for the City is considered 30% of the MDD.

Fire Storage

The water system must be capable of meeting MDD and firefighting requirements simultaneously. The fire storage requirement is driven by the Orange County Fire Authority and is based upon the highest fire flow requirement and duration in each pressure zone. The fire storage requirements are driven by emergency preparedness.

1.5.7 Emergency Storage

Emergency storage is required to meet demands during times of planned and unplanned equipment outages such as pump breakdown, power failure, pipeline rupture, etc. The reservoir should have sufficient capacity to supply 48 hours of Average Day Demand (ADD). The emergency storage requirement is driven by emergency preparedness.

Secondary Storage Design

Secondary storage design criteria require storage capacity for 7 days of average demand.

1.5.8 Booster Pump

Each individual pump should have an efficiency of 65% or higher. In addition, the primary booster design criteria evaluates that all zones must have sufficient capacity to meet their dependent MDD with the largest unit out of service.

Secondary booster design criteria evaluates that they can meet dependent MDD plus refill the fire and emergency storage within two days.

Primary Booster Pump Design Criteria

The primary booster pumping stations specific to each zone must satisfy these design criteria:

- All zones must have sufficient capacity to meet their zones MDD plus the MDD of dependent zones with the largest unit out of service.
- Terminal zones (i.e. zones that do not provide flow to other zones) must have sufficient capacity to meet MDD with the largest unit out of service.

Booster pumping stations should be sized to supply dependent MDD, with the largest pump out of service. A dependent MDD is the total of the zone's MDD and the subzones that rely on the higher zone for water.

Secondary Booster Pump Design Criteria

The secondary booster pumping stations specific to each zone must have sufficient capacity to meet their own MDD, plus the MDD of all dependent zones, plus the refill rate of depleted fire and emergency storage within two days. Refill Rate is the required flowrate to provide the fire storage and emergency storage in 48 hours. Dependent MDD and refill rate are combined to provide the total requirement for the pressure zone.

1.5.9 Pressure Reducing Valves (PRV)

The primary criteria evaluates that the valves have the capacity to provide dependent MDD plus fire flow. The secondary criteria evaluates that the valves can provide MDD at continuous capacity.

Chapter 2 - Existing Facilities

2.1 General Description

This chapter details the assets of the existing water system, including pipelines, reservoirs, booster pump stations, pressure reducing stations, flow control stations, pressure zones, imported water connections, and emergency interconnections. Appendix A contains a map showing the location of the City's existing water system facilities and Appendix E contains the hydraulic profile schematic of the water system.

2.2 Pressure Zones

Pressure zones are important to a water system to deliver appropriate pressures to its customers. A total of 18 pressure zones are delineated within the water system, ranging from a hydraulic grade of 515 feet to 1,400 feet above mean sea level (ASML). Table 2-1 lists all current pressure zones and their sources. The designation of each respective pressure zone represents the hydraulic grade line (HGL) of the pressure zone. Appendix A illustrates the 18 existing pressure zones. Zone 750 and 605 contains "ABC zones" however, these "ABC zones" have the same HGL but are not interconnected. These zones simply reside in different parts of the water system.

The 790 pressure zone is crucial to water distribution as the central zone. It receives most of the City's imported water from the Berry Street Booster Pump Station and distributes it to a large portion of the City and the entire Carbon Canyon area through pressure reducing stations and booster pump stations. The only zone that does not receive water through the 790 pressure zone is the 515 pressure zone. Appendix A illustrates the pressure zones utilized in the City.

Table 2-1: Pressure Zone Summary

Pressure Zone	Source of Supply
515	Berry Street Booster Pump Station (Low Pressure), Pressure Zones 540, 575, 605, 615, and 790 (via PRV)
530	Pressure Zones 605 and 635 (via PRV)
540	Pressure Zone 605 (via PRV)
560	Pressure Zones 635 and 790 (via PRV)
575	Pressure Zones 605 and 650 (via PRV)
605	Pressure Zones 635, 750, and 790 (via PRV)
625	Pressure Zone 605
635	Pressure Zones 700, 725, and 790 (via PRV)
650	CDWC Northwood, CDWC Midbury, and Pressure Zone 750 (via PRV)
685	Carbon Canyon Regional Park (via PRV No.434-1)
700	Pressure Zones 750 and 790 (via PRV)
725	Pressure Zone 790 (via PRV)
750	Westside Reservoir, Puente Booster Pump Station, Eastside Reservoir, and Pressure Zone 790 (via PRV)
790	Berry Street Booster Pump Station (High Pressure), Valencia Reservoir, Pressure Zone 830 (via PRV) and OC-29
830	Tonner Booster Pump Station and Tonner Hills Reservoir
925	Pressure Zone 1000 (via PRV)

Pressure Zone	Source of Supply
1000	Pressure Zones 1400 (via PRV) and Carbon Canyon Booster Pump Station No. 2
1400	Carbon Canyon Reservoir, Carbon Canyon Booster Pump Station No. 3

2.3 Transmission and Distribution Mains

Transmission mains are generally larger in diameter and move a large volume of water. The City uses transmission mains to move water to reservoirs and booster stations. There are a total of approximately 23 miles of transmission mains in the system which range from 16-inch to 36-inches in diameter. The transmission mains primarily consist of ductile iron pipe (DI) and cement mortar lined pipe (CML).

Distribution pipelines are generally smaller in diameter and distribute water to individual customers. Distribution pipelines are constructed with DIP, CI, and poly-vinyl chloride (PVC). Pipeline diameters of the distribution mains within the system range from less than 4-inchs to 14-inches and approximately 190 miles. Table 2-2 summarizes the materials based on pipe diameters and materials in linear feet (LF).

A total of 789,753 LF of pipelines were installed from 1960 to 2000, which is approximately 70% of the mains within the system. Table 2-3 summarizes the materials based on pipe age and materials in LF.

Table 2-2: Pipe Summary – Size and Material

Size (in)	ACP	CI	CML	CU	DIP	PVC	STEEL	Unknown	Total
<4	-	-	-	47	911	1,143	-	492	2,593
4	-	190	66	-	1,714	412	-	-	2,382
5	-	-	-	-	115	-	129	-	244
6	373	99,505	38	-	17,323	605	-	5,183	123,027
8	-	121,098	-	-	330,678	30,093	-	3,031	484,900
10	-	26,672	-	-	10,248	6,639	337	6,809	50,705
12	-	124,491	20,921	-	185,883	3,007	50	2,525	336,877
14	-	-	-	-	-	-	-	1,394	1,394
16	-	476	-	-	-	-	-	-	476
18	-	-	5,482	-	17,867	-	-	1,542	24,891
>18	-	51	28,317	-	11,359	-	14,991	44,291	99,009
Total	373	372,483	54,824	47	576,098	41,899	15,507	65,267	1,126,498

Table 2-3: Pipe Summary – Age and Material

Decade	ACP	CI	CML	CU	DIP	PVC	STEEL	Unknown	Total
Unknown	-	45,864	15,074	-	3,414	-	-	16,840	81,192
1940-1949	-	928	-	-	1,972	-	-	-	2,900
1950-1959	-	14,441	-	-	3,570	-	-	13,594	31,605
1960-1969	-	101,362	5,434	-	22,101	-	50	18,075	147,022
1970-1979	373	115,923	26,174	-	105,730	-	7,948	2,465	258,613
1980-1989	-	51,253	6,906	-	143,693	135	-	10,903	212,890
1990-1999	-	36,364	1,017	-	118,492	11,965	-	3,390	171,228
2000-2009	-	2,878	219	-	73,088	398	7,172	-	83,755
2010-2020	-	3,470	-	47	104,038	29,401	337	-	137,293
Total	373	372,483	54,824	47	576,098	41,899	15,507	65,267	1,126,498

2.4 Storage Reservoirs

The City has a total of seven reservoirs with a combined storage capacity of 69.5 million gallons (MG).

Berry Street Reservoir is the largest reservoir with 30 MG in storage. The Berry Street Reservoir does not directly serve a pressure zone but is critical to the City as emergency storage and a staging tank for the entire system. The Berry Street Reservoir receives its supply from CDWC through a 30-inch transmission main. It supplies the Berry Street Booster Pump Station, which provides water to the northern portions of the system through the 790 pressure zone via the Valencia Reservoir (10 MG). The Valencia Reservoir supplies the Westside Reservoir (15 MG) and Eastside Reservoir (10 MG) via gravity flow. The Westside and Eastside Reservoirs supply the 750 pressure zone and the majority of the City through PRVs. The Tonner Booster Pump Station pumps from the Eastside Reservoir and supplies the Tonner Hills Reservoir, which provides water to the 830 zone. The Carbon Canyon Reservoirs are two equal reservoirs (each 1.25 MG) that serve the 1400 pressure zone and are supplied by Carbon Canyon Booster Pump Station No. 2 and No. 3.

These reservoirs are located at the following addresses.

- **Berry Street Reservoir**: 545 North Berry Street
- **Westside Reservoir**: 1390 Site Drive
- **Eastside Reservoir**: 601 North Belridge Terrace
- **Valencia Reservoir**: 915 North Valencia Avenue
- **Tonner Hills Reservoir**: 915 North Valencia Avenue
- **Carbon Canyon Reservoir #1 and #2**: 0.9 miles north of 399 Olinda Drive, between North Tank Road and Lions Motorway

Exhibit A illustrates the location and existing storage of the reservoirs and the layout of the distribution system.

The reservoirs, excluding the Berry Street Reservoir, hydraulically “float” the upper zones of the distribution system and are filled during off-peak demand periods from the imported water supply. The reservoirs supply all the lower zones in the system via gravity and pressures zones are created through the PRVs. The Berry Street Booster Pump Station then pumps water from the 30.0 MG reservoir into the 515 and 790 pressure zones. Table 2-4 illustrates a summary of the reservoirs and their attributes.

Table 2-4: Reservoir Summary

Description	Capacity (MG)	Pressure Zone Served	Diameter (feet)	Base Elevation (feet-MSL)	Overflow Level (feet)
Berry Street	30	-	508	364	26
Westside	15	750	252	710	38
Eastside	10	750	208	710	38
Valencia	10	790	200	750	38
Tonner Hills	2	830	118	806	24
Carbon Canyon Tank #1	1.25	1400	75	1362	38
Carbon Canyon Tank #2	1.25	1400	75	1362	38

2.5 Booster Pump Stations

The City has a total of five booster pump stations with a total pumping capacity of approximately 14,800 gallons per minute (gpm).

The Berry Street Booster Pump Station has six pumps that pump from the Berry Street Reservoir. The low-pressure pumps (Nos. 1, 2 and 3) have variable frequency drives (VFD) and supply the 515 pressure zone. The 515 pressure zone is also served by PRVs from higher zones. The high-pressure pumps (Nos. 4, 5 and 6) supply the Valencia Reservoir, which feeds the 790 pressure zones.

Carbon Canyon Booster Pump Stations Nos. 2 and 3 have two pumps at each station with a pumping capacity of 650 gpm. Carbon Canyon Booster Pump Station No. 2 pumps into the 1000 pressure zone and Carbon Canyon Booster Pump Station No. 3 pumps into 1400 pressure zone. Carbon Canyon Booster Pump Station No. 2 must be in operation before Booster Pump Station No. 3 can engage in order to maintain suction pressure for Pump Station No. 3. When Carbon Canyon Booster Pump Station No. 2 is off, a pressure reducing station at Carbon Canyon Booster Pump Station No. 3 will feed water to the 1000 pressure zone from the Carbon Canyon Reservoir. Pressure zone 1000 does not have dedicated storage.

Constructed in 1963, the Puente Booster Pump Station is able to pump water from the CDWC Lift No. 2 system or 650 pressure zone and supply water into the Westside Reservoir and 750 zone. There are two pumps that have a capacity of 650 gpm each. In January 2015, the Puente Booster Pump Station was deactivated due to maintenance difficulty and age.

The Tonner Booster Pump Station was constructed in September 2012 and provides water to the 830 pressure zone. This pump station receives supply from the Eastside Reservoir and discharges to the 830 pressure zone. There are three pumps discharging into the 830 pressure zone and there is a PRV (No. 431-8 located along Tonner Ridge Drive) that allows water from the 830 pressure zone to the 750 pressure zone.

Table 2-5 illustrates the summary of the booster pump stations, including their individual horsepower (hp), ground elevation, TDH, and pumping rate. The TDH and pumping rates are based on the latest Southern California Edison (SCE) efficiency tests.

Table 2-5: Booster Pump Summary

Description	Pump (No.)	Pumps From	Pumps To	hp	Ground Elevation (ft-MSL)	TDH (ft)	Pumping Rate (gpm)
Berry Street (Low Pressure)	1	Berry Street Reservoir	515 Zone	100	375	160.4	1,500
	2			100	375	161.5	1,500
	3			40	375	166.8	500
Berry Street (High Pressure)	4		Valencia Reservoir (790 Zone)	300	375	410	2,000
	5			300	375	410	2,000
	6			400	375	430	3,000
Puente Street (near CDWC Connection)	1	CDWC or 650 Zone	750 Zone	40	650	123	911
	2			40	650	119	811
Carbon Canyon Booster Pump Station No. 2	1	790 Pressure Zone	1000 Zone	75	740	318.7	672
	2			75	740	325.7	668
Carbon Canyon Booster Pump Station No. 3	1	1000 Zone	1400 Zone	75	1000	332.6	626
	2			75	1000	344.2	598
Tonner Booster Pump Station	1	Eastside Reservoir	830 Zone	40	661	110	900
	2			40	661	110	900
	3			15	661	121	300

2.6 Pressure Reducing Stations

Pressure reducing stations are used to regulate the 18 different pressure zones. The distribution system includes a total of 95 different pressure reducing stations. These stations typically have either a 3-inch or 4-inch PRV for low flow periods and a 6-inch or 8-inch PRV for high flow periods. Table 2-6 shows a summary of all the pressure reducing stations.

Table 2-6: Pressure Reducing Stations Data Summary

Vault No.	Location	From Pressure Zone	To Pressure Zone	Large Valve Setting	Bypass Valve Setting	Valve Sizes
124-1	1670 Sandalwood Drive	750	650	45psi		8”
124-2	Puente and Northwood Streets	750	650	50psi	58psi	8”,3”
125-1	1199 Woodcrest Avenue	750	650	38psi	47psi	8”, 3”
125-2	1322 Wardman Drive	750	625	48psi	53psi	4”,3”
125-3	1012 Ethelinda Way	750	625	45psi	43psi	4”,3”
125-4	Steele Drive south of Wardman Drive	625	605	72psi	80psi	8”,4”
126-1	SE corner of Berry and Northwood Streets	790	750	72psi	80psi	8”,3”
126-2	Berry Street north of Stonebridge Drive	750	700		116psi	12”

Vault No.	Location	From Pressure Zone	To Pressure Zone	Large Valve Setting	Bypass Valve Setting	Valve Sizes
224-1	1207 Havenhurst Drive	650	575	38psi	42psi	4”,3”
224-2	1209 Puente Street	650	575	49psi	44psi	8”, 4”
225-1	900 Wardman Drive	625	575	40psi	60psi	4”,3”
225-2	1280 Fawnridge Drive	750	625	46psi	54psi	4”,3”
225-3	1271 Beechwood Drive	750	625	57psi	50psi	8”,3”
225-4	Berry Street and Stonebridge Drive	750	605	40psi	47psi	4”,3”
226-1	Site Drive north of Glenoaks Street	750	635	71psi		8”
226-2	388 Glenoaks Street	750	605	55psi	60psi	8”,4”
226-3	1200 Tamarack Avenue	750	605	42psi	46psi	4”,3”
226-4	Site Drive and Tamarack Village	750	605	63psi	69psi	4”,2”
226-5	Site Drive north of Central Avenue	750	605	68psi	75psi	8”,4”
227-1	1240 Ponderosa Avenue	750	605	57psi	63psi	4”,3”
227-2	Canyon Country Road and Niguel Canyon Way	635	605	50psi	55psi	8”,3”
228-1	Canyon Country Road north of Stone Canyon Way	700	635	48psi	53psi	8”,3”
228-2	824 Driftwood Avenue	790	700	85psi	92psi	8”,3”
239-1	Carbon Canyon Booster Pump Station No. 3	1400	1000	Before pump val. 150psi	After pump val. 300psi	6”,6”
324-1	Central Avenue and Roscoe Street	575	515	59psi	65psi	8”,4”
324-2	660 Puente Street	605	515	61psi	66psi	8”,3”
325-2	610 Neptune Avenue	605	515	60psi	67psi	8”,3”
326-2	Berry Street and Central Avenue	790	605	63psi	70psi	8”,4”
326-3	581 Tamarack Avenue	605	515	62psi	66psi	8”,3”
327-1	720 North Brea Boulevard	605	515	65psi		4”
327-2	215 Blossom Place	605	530	76psi		8”
327-3	798 Brea Boulevard	605	515	73psi	68psi	8”,3”
327-4	298 Buttonwood Drive	635	530	60psi		3”
327-5	SW corner of State College Boulevard and Live Oak Street	635	560	50psi	55psi	8”,3”
328-1	893 Kings Canyon Road	790	635	37psi	41psi	8”,3”
328-2	585 Bonita Canyon Way	790	635	20psi	23psi	4”,3”
328-3	814 Forbes Drive	790	635	40psi	43psi	6”,3”
328-4	Carmichael Drive and Cameron Court	790	725	51psi	54psi	6”,3”
328-5	Carmichael Drive south of Davidson Court	725	635	43psi	48psi	6”,3”
328-6	563 Cliffwood Avenue	635	515	50psi		6”
328-7	Balsa Avenue south of State College Boulevard	635	515	40psi		6”
328-8	NE corner of State College Boulevard and Citrus Place	790	635	77psi	84psi	4”,3”
329-1	Pointe Drive (Olen Property Upper)	790	700	61psi	66psi	8”,4”
329-2	Pointe Drive (Olen Property Lower)	790	700	87psi	84psi	8”,4”
329-3	60 Pointe Drive and Wildcat Way	790	700	52psi	63psi	8”,4”

Vault No.	Location	From Pressure Zone	To Pressure Zone	Large Valve Setting	Bypass Valve Setting	Valve Sizes
329-4	10 Pointe Drive and Wildcat Way	790	700	77psi	82psi	8”,4”
337-1	Carbon Canyon Road and Ruby Street	1000	925	35psi	40psi	6”,2”
425-1	SE corner of Puente Street and Lambert Road	790	515	85psi	80psi	8”,3”
425-2	NW corner of Imperial Highway and Berry Street	790	515	80psi	85psi	8”,3”
425-3	Arovista Park Phase One	Well Water	515	75psi		4”
425-4	Arovista Park Phase Two	Well Water	515	85psi		3”
427-1	330 East Lambert Road	790	560	84psi	90psi	8”,3”
427-3	835 East Birch Street	650	515	67psi	71psi	8”,4”
428-1	190 South State College Boulevard	790	515	56psi	63psi	8”,3”
429-2	Associated Road south of Cloverdale Drive	605	515	63psi	70psi	8”,3”
429-3	Associated Road south of Meadow Creek Road	605	515	55psi	62psi	6”,3”
430-1	Lambert Road, 50 feet east of Sommerset Drive	790	700	72psi	77psi	8”,3”
430-2	Lambert Road, 100 feet east of Sunrise Road	790	700	68psi	72psi	8”,3”
430-3	SW corner of Lambert Road and Kraemer Boulevard	750	605	45psi	52psi	8”,4”
430-4	Edgemont Lane west of Kraemer Boulevard	750	605	55psi	62psi	4”,2”
430-5	Country Hills Road west of Kraemer Boulevard	750	605	72psi	77psi	8”,3”
430-6	Birch Street west of Associated Road	650	515	53psi	57psi	8”,3”
430-7	Associated Road north of Birch Street	650	605	53psi	57psi	8”,3”
430-8	Birch Street west of Kraemer Boulevard	750	650	75psi	82psi	8”,4”
431-1	Lambert and Walden Roads	750	605	50psi	55psi	8”,4”
431-2	Lambert Road and Sunflower Street	750	605	58psi	61psi	8”,3”
431-3	Country Hills Road east of Kraemer Boulevard	750	605	72psi	78psi	8”,4”
431-4	East side of Kraemer Boulevard north of Birch Street	790	750	125psi	132psi	8”,4”
431-5	Birch Street east of Kraemer Boulevard	790	605	74psi	80psi	8”,3”
431-6	West side of Kraemer Boulevard north of Birch Street	750	605	62psi	67psi	8”,6”
431-7	NW corner of Santa Fe and Lambert Roads	790	750	97psi	-	12”
431-8	Tonner Ridge Drive north of Santa Fe Road	830	790	75psi	87psi	6”,4”

Vault No.	Location	From Pressure Zone	To Pressure Zone	Large Valve Setting	Bypass Valve Setting	Valve Sizes
432-1	NW corner of Birch Street and Valencia Avenue	790	605	62psi	68psi	8”,4”
432-2	Sports Park on Birch Street	790	605	70psi		4”
432-3	Sports Park on Birch Street	790	605	70psi		3”
434-1	Carbon Canyon Regional Park	790	685	78psi	71psi	4”,2”
435-1	Santa Fe Road and Condor Avenue	790	750	50psi	55psi	8”,4”
435-2	Santa Fe Road and Cardinal Street	790	750	55psi	60psi	8”,4”
435-3	Valley Crossing and Santa Fe Roads	790	750	43psi	49psi	8”,4”
435-4	Railway Avenue and Santa Fe Road	790	750	41psi	47psi	8”,4”
435-5	4091 Cedarwood Court	790	750	60psi	65psi	8”,4”
435-6	474 Orange Grove Lane	790	750	38psi	44psi	8”,4”
435-7	NE corner of Carbon Canyon Road and Brea Hills Avenue	790	750	70psi	78psi	8”,4”
436-2	Valencia Reservoir	830	790	If needed 60psi		8”
436-3	Carbon Canyon Road east of Valencia Avenue and west of Santa Fe Road	790	685	80psi		4”
436-4	4449 Carbon Canyon Road	790	685	76psi		6”
436-5	Olinda Drive and Gate	1400	1000	11psi	12psi	8”,4”
436-6	7351 Carbon Canyon Road	1000	Hills of Hope Water Tank on Property		120psi	2”
436-7	Carbon Canyon Booster Pump Station No. 2	1000	790	Before pump val. 135psi	After pump val. 250psi	6”
529-1	Amberwick Circle	605	515	76psi	81psi	4”,2”
530-1	Imperial Highway east of Placentia Avenue	540	515	83psi	78psi	8”,4”
531-1	Kraemer Boulevard north of Imperial Highway	605	540	68psi	72psi	8”,4”
627-1	NW corner of Elm Street and State College Boulevard	650	515	80psi	85psi	8”,3”
632-1	NE corner of Valencia Avenue and Imperial Highway	605	540	63psi	67psi	8”,3”
632-2	3570 East Elm Street	605	540	85 psi	62psi	3”

2.7 Imported Water Connections

Water is purchased from two agencies, Metropolitan Water District of Southern California (MWD) and CDWC. There are three MWD connections that are metered using flow control valves. In addition, there is one CDWC connection that uses gravity to feed the system. Table 2-7 summarizes the imported water connections.

Table 2-7: Imported Water Connections Summary

Connections	Location	Capacity (cfs)	Size (in)	Supplied Pressure Zone	Outlet Pressure Setting (psi)
MWD					
OC-6	Lambert Road and State College Boulevard	10	12	790	175
OC-29 (Vault 436-1)	Valencia Avenue south of Birch Street	15	12	790	175
OC-62 (Vault 427-3)	Birch Street north of Civic Center Circle	10	12	515	82
CDWC					
I-Line	Berry Street Reservoir	11.1 to 20	30	515/790	63/ 175
Midbury	Puente and Midbury Streets	Not used	-	-	-
Northwood	Puente and Northwood Streets	Not used	-	-	-

2.8 Emergency Interconnections

The City has installed and maintained five emergency interconnections with neighboring water purveyors as shown in Table 2-8.

Table 2-8: Emergency Interconnection Summary

Vault No.	Connections	Source	Zone(s) Served	Valve Size & Pressure Setting (psi)	Valve Size & Pressure Setting (psi)	Pressure Relief Valve Setting (psi)
325-1	Central Avenue and Puente Street	La Habra	605	3”@ 96	8”@ 91	111
OC-4 (Vault 328-9)	Cliffwood Avenue and Buttonwood Drive	La Habra	635	12”@N/A	None	None
N/A	Placentia Ave	City of Fullerton	515	8”@ N/A	None	None
N/A	Kraemer Boulevard north of Imperial Highway	GSWC	605	12”@N/A	None	None
N/A	Vesuvius Drive	YLWD	605	8”@N/A	None	None

2.9 Proposed System Pressure Zones

The City has the ability to expand the water system to undeveloped areas within its sphere of influence and Orange County limits. Potential pressures zones have been delineated in accordance with pressures ranging from 40 psi to 125 psi as defined by the design criteria for system service pressure. These zones are bounded by existing topography elevations within the undeveloped areas that correlates to the HGL for a zone's service pressure range. The City's proposed system pressure zones is represented in Appendix B and may be utilized to assess Water Impact Fees for developers.

Chapter 3 - Sources of Supply

3.1 General Description

Due to the lack of potable groundwater in the City, the City's water supply comes from two wholesale water producers, the CDWC and MWD. The City also operates a non-potable well that pumps from the La Habra Groundwater Basin. This well delivers water for irrigation to the Brea Creek Golf Course and Arovista Park.

3.2 Historic Water Production

Between 2015 and 2019 the City purchased an average of 9,309-acre-feet per year (AFY). Table 3-1 represents imported water from the three sources of supply over the last 5 years.

Table 3-1: Production Data for Supply Sources

Supply Sources	Production Data (AFY)					
	2015	2016	2017	2018	2019	Average
MWD	2,406	1,177	1,207	1,828	57	1,335
CDWC	7,084	7,725	8,139	8,069	8,851	7,974
Well (Non-Potable)	24	86	103	105	90	82
Total (AFY) Potable and Non-Potable	**9,514**	**8,988**	**9,449**	**10,002**	**8,998**	**9,390**
Total Potable (AFY)	**9,490**	**8,902**	**9,346**	**9,897**	**8,908**	**9,309**

Since 2019 almost all of the City's water has been supplied by CDWC. Over the past 20 years, the use of the MWD connections has decreased. The City's purchase of water supplied by MWD has dropped from 50% in 2001 to around 1% in 2019.

3.2.1 Metropolitan Water District of Southern California (MWD)

The MWD is a regional wholesaler that delivers water to 26-member public agencies serving approximately 19 million people in various Southern California counties. MWD has 11 municipal water districts to serve its member agencies. Of those 11 districts, MWDOC delivers water to the City.

MWDOC serves all of Orange County through 28 retail water agencies, except for the cities of Anaheim, Fullerton, and Santa Ana. More than half of the MWDOC water source is purchased by local water supplies and the remaining portion is purchased as imported water from the Colorado River and the California State Water Project.

The City has three connections with MWDOC. Two connections (OC-6 and OC-29) join the MWDOC 96-inch Lower Feeder, and the third (OC-62) is connected to MWDOC's 36-inch Orange County Feeder (OC Feeder) as shown in Table 3-2:.

The Lower Feeder is supplied by the R.B. Deimer Filtration Plant. This feeder crosses the City near Carbon Canyon Road. The OC Feeder is supplied by the Orange County Reservoir, which has a capacity of approximately 150 acre feet (AF) and a high-water elevation of 663.

Table 3-2: Metropolitan Connections

Connections	Location	MWD Supply Pipeline	Capacities (cfs)	HGL Range (ft)
OC-6	Lambert Road and State College Boulevard	Lower Feeder	10	750 to 782
OC-29	Valencia Avenue south of Birch Street	Lower Feeder	15	775 to 791
OC-62	Birch Street north of Civic Center Circle	OC Feeder	10	615 to 635

MWDOC sets restrictions on these connections for the City. These restrictions include the following:

1. Within a 24-hour period, changes in rate of flow shall not vary more than 10% above or below the average for the previous 24-hour period.
2. Average flow during any one month shall not exceed 32% above the annual average flow.
3. When flow through a connection is reduced below 10% of the requested flow or 10% of the design capacity of the meter, whichever is less, the City will be charged for the flow at 10% of the capacity of the meter.

3.2.2 California Domestic Water Company (CDWC)

The City purchases imported groundwater supply from CDWC which is taken from the Main San Gabriel Basin. Each stockholder receives an allotment of water based upon the number of shares owned or leased. There are two classes of entitlement with CDWC, "common stock entitlement" and "other entitlement".

The City owns and leases entitlements from CDWC. As of 2020, the breakdown of entitlements for the City is as follows:

- Common Stock Entitlement, Owned: 2208.50 shares;
- Common Stock Entitlement, Leased: 188.00 shares;
- Other Entitlements, Class A Preferred Entitlement: 687.85 shares; and
- Other Entitlements, Main San Gabriel Basin Prescriptive Rights: 1,502.72 shares.

The amount of water per share varies year by year depending on the condition of the Main San Gabriel Basin. As of 2020, one share of "common stock entitlement" converts to 1.45 AF and one share of "other entitlements" converts to 0.759 AF. The City owns and leases approximately 3,475 AF under common stock entitlement and has an additional 1,663 AF under other entitlements.

Table 3-3: CDWC Entitlements

Entitlement	Shares/AF
Common Stock Entitlement	2,396.5 / 3475
Other Entitlements	2,190.57 / 1,663

The City purchases more water than its entitled each year. To obtain the excess water beyond their entitlement, the City leases additional shares of CDWD stock from member agencies that do not use their maximum allotment. In addition, CDWC allows member agencies to purchase additional water at a discounted price once they have exhausted their entitlement.

The three City CDWC connections are metered and gravity fed by two CDWC hydraulic lift stations as described below in Table 3-4. Additional information on these lift stations are as follows:

- Lift No. 1 supplies the I-line (a 30-inch transmission main), which has a HGL of approximately 500 feet. This lift is fed from the CDWC Plant No. 6 Reservoir in La Habra. This water is used to supply the Berry Street Reservoir. The transmission main has 8,000 gpm in capacity. The average City use in the winter months is 2,300 gpm and 7,300 gpm in the summer. This large capacity allows the City to obtain all water from this connection, without using the Lift No. 2 Connections (Midbury and Northwood Streets).
- Lift No. 2 is at a higher HGL, normally between 625 feet and 650 feet. This lift is supplied by the CDWD Plant No. 6 Booster Pump Station and the CDWD 2.5 MG Reservoir located north of the City limits. This lift station has a higher cost basis compared to Lift No. 1 so the City tries to minimize its use under normal operating conditions.

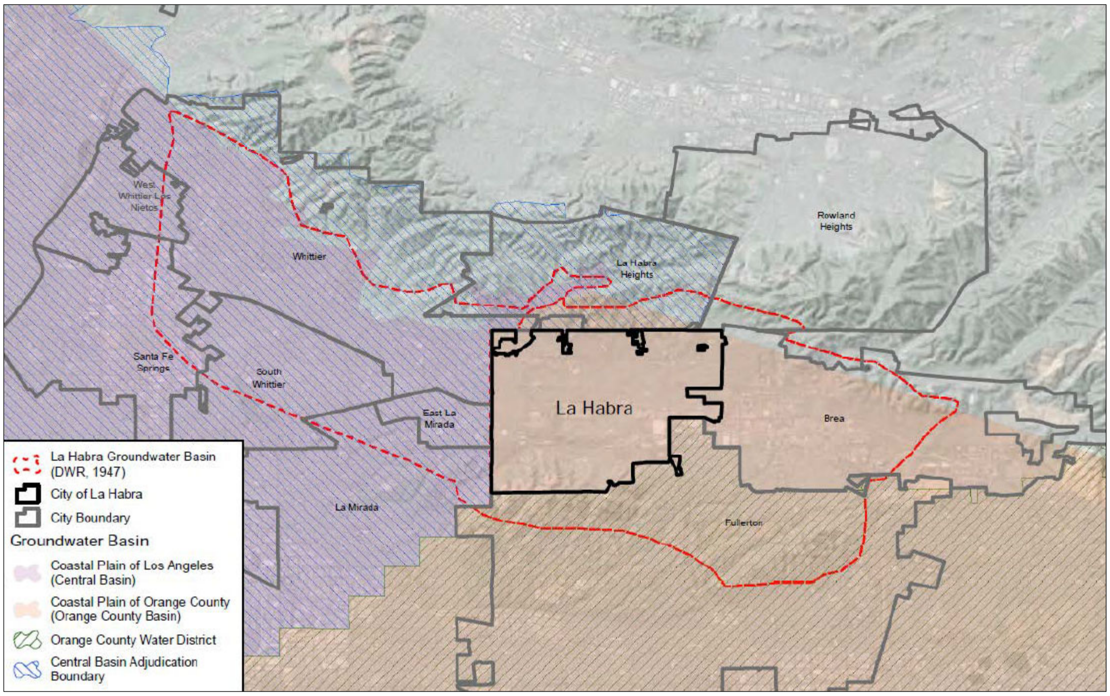
Table 3-4: CDWC Connections

Connections	Location	MWD Supply Pipeline	Capacities (gpm)	HGL Range (ft)
I-Line	Berry Street Reservoir	Lift No. 1	7,989	420-432
Midbury	Puente and Midbury Streets	Lift No. 2	Not Used	625-650
Northwood	Puente and Northwood Streets	Lift No. 2	Not Used	625-650

3.3 La Habra Groundwater Basin

The La Habra Groundwater Basin covers part of Los Angeles County and Orange County. It is part of the Central Basin and Orange County Basin which lies entirely within the Coyote Creek Watershed as shown in Figure 3-1.

Figure 3-1: La Habra Groundwater Basin



The City uses the La Habra Groundwater Basin to provide non-potable water for irrigation to the Brea Creek Golf Course and Arovista Park. A summary of the supply is shown in Table 3-5

Table 3-5: Groundwater Production

Year	2015	2016	2017	2018	2019
Well (Non-Potable) (AF)	24	86	103	105	90

Chapter 4 - Land Usage and Water Demands

4.1 General Description

The purpose of this chapter is to understand and characterize the water demands of the system. Water demand is all water leaving the system, typically delivered to customers through their water meters. It also includes water loss and other intentional uses of water, such as flushing hydrants, maintenance, and other water uses. The water demand in the system will be identified by location within the City and by land use.

4.2 Existing Water Demand

The City provided water consumption based on the billed water usage from their billing system for the last five years. Historical water demand from 2015 to 2019 has been compared to water purchased as shown in Table 4-1.

Table 4-1: Existing Historical Purchased Water and Consumption (AFY)

Year	Water Production (AFY)	Water Demand (AFY)	Water Loss (AFY)	Water Loss (%)
2015	9,490	8,541	949	10%
2016	8,902	8,551	351	4%
2017	9,346	8,587	759	8%
2018	9,898	9,379	519	5%
2019	8,908	8,740	168	2%
Average	**9,309**	**8,760**	**549**	**6%**

Table 4-2: Existing Historical Purchased Water and Consumption (gpm)

Year	Water Production (gpm)	Water Demand (gpm)	Water Loss (gpm)	Water Loss (%)
2015	5,883	5,295	588	10%
2016	5,519	5,301	218	4%
2017	5,794	5,324	470	8%
2018	6,136	5,815	321	5%
2019	5,523	5,418	105	2%
Average	**5,771**	**5,431**	**351**	**6%**

4.2.1 Water Loss

Water loss is the difference between water produced and water consumed. Water losses include flushing, hydrant testing, leaks and pipe breaks, inaccurate meters, unauthorized uses and undocumented maintenance. Table 4-1 and Table 4-2 represent the percentage of average water loss which has steadily decreased in recent years apart from 2017. In recent years, California has emphasized water conservation efforts across the state. The City has played an important part in conservation by reducing water loss which reached 2% in 2019.

4.3 Peaking Factors

Demand peaking factors represent the fluctuation in demand on a daily or hourly basis. Peaking factors are used in the planning process to ensure the water system is capable of the maximum demands the system may encounter beyond the ADD. Common peaking factors used are MDD and peak hour demand (PHD). MDD represents the maximum volume of water delivered to the system in a single day which typically occurs in the middle of summer. PHD represents the maximum water used in one hour during the year. For planning purposes, the peaking factors were based on production and consumption data. The study period was from 2015 through 2019.

4.3.1 Average Day Demand (ADD)

ADD serves as a benchmark and planning tool for long-term issues at the system level, such as supply acquisition and integrated resource management. ADD is calculated by averaging consumption of each meter, which is taken from the historical water usage data for each year, as provided by the City. The ADD for the system in 2019 is calculated to be 7.80 MGD, 23.94 AF/day or 5,418 gpm.

4.3.2 Maximum Day Demand (MDD)

MDD is used in planning to ensure the system's infrastructure is capable of maintaining a high-level of service on the days of largest demand.

Daily consumption data was not available, but consumption data was recorded on a monthly basis. Daily operator logs were available that included reservoir levels and meter reads for imported water connections and booster pump stations. MDD was calculated from the difference between the daily total volume of water taken from the imported water connections and the daily total volume of water drawn down from all reservoirs. This calculation was applied for the months of June, July and August through each year of the study period. MDD in 2019 is 38.01 AF which occurred on August 13, 2019.

The maximum production day was compared to the average production on the year to calculate the MDD Peaking factor. Using this factor, 1,59, the MDD for the overall system in 2019 was calculated to be 12.39 MG, 38.01 AF/day or 8,615 gpm.

Table 4-3: Historical Water Demands and ADD/MDD Production

Year	Water Demand (AFY)	Average Daily Production (AF)	Max Day Production (AF)	Max Day Date	Max Day Factor MD:AD
2015	8,541	23.40	38.13	7/10/2015	1.63
2016	8,551	23.43	42.52	7/16/2016	1.81
2017	8,587	23.46	37.36	8/8/2017	1.59
2018	9,379	25.70	40.64	7/17/2018	1.58
2019	8,740	23.94	38.01	8/13/2019	1.59[1]
Average	**8,760**	**23.99**	**39.33**	-	**1.64**

[1] *Since the Representative year for the 2021 WMP is the year 2019, we determined 1.59 to be the Maximum Day Factor for analysis purposes within this WMP. This is derived by taking the maximum production day in that year over its average daily production in the same year.*

4.3.3 Representative Year and Peaking Factors

A representative year refers to the year within the study period that best reflects the demand of the system (total demand and MDD). 2019 was determined to be the representative year as being closest to the average of the 5-year period and includes the most recent data that was available.

The MDD peaking factor is expressed as a ratio of MDD to ADD, which calculated to be 1.59 for 2019.

The maximum flow rate delivered by the distribution system on any single hour during the year is defined as the PHD. The peaking factor is expressed as a ratio of PHD to ADD. PHD could not be determined due to the absence of hourly data, therefore a PHD peaking factor of 3.0 was used. California Code of Regulations allows for a PHD peaking factor of 1.5 times the MDD peaking factor, which comes to a value of 2.385. The peaking factor of 3.0 allows the City to stay conservative for future analysis. Table 4-4 below contains the summary of demands and its associated peaking factors.

Table 4-4: City Demands and Peaking Factors

Demand Type	2019 Demands (AFY)	2019 Demands (gpm)	Average Demands (AFY)	Average Demands (gpm)	Peaking Factor
ADD	8,740	5,418	8,760	5,431	1.00
MDD	13,895	8,615	13,928	8,635	1.59
PHD	-	16,254	-	16,293	3.00

4.4 Top Users

Top water system users within the City were determined from 2019 billing data provided. These users were identified and ranked by their annual water consumption. The top 15 users account for 16% of the water consumed. Table 4-5 summarizes each user and their associated water consumption in the year 2019.

Table 4-5: Top 15 Users

Rank	Acct Number	Water Meter Type	Water Demand (AF)	Water Demand (gpm)	% of Total Demand
1	222-1540/222-1903	Government Outside City	600.92	372.57	6.73%
2	222-1550	Other Government	120.62	74.78	1.35%
3	132-4810	Golf Courses	89.41	55.43	1.00%
4	221-6935	Multiple Residential	82.38	51.08	0.92%
5	221-7487	Commercial	78.19	48.48	0.88%
6	102-0011	Brea Golf Course	65.22	40.44	0.73%
7	210-6126	Other Government	62.20	38.56	0.70%
8	210-6128	Other Government	58.93	36.54	0.66%
9	216-1700	Multiple Residential	54.44	33.75	0.61%
10	221-6970	Other Government	54.27	33.65	0.61%
11	221-5520	Commercial	45.84	28.42	0.51%
12	221-6180	Industrial	40.28	24.97	0.45%
13	127-0001	Multiple Residential	37.08	22.99	0.42%
14	210-6143	Multiple Residential	34.26	21.24	0.38%
15	220-0491	Industrial	32.45	20.12	0.36%

4.5 Land Usage Analysis

The City provided geographic information system (GIS) database information containing different types of the land usage according to SCAG. The land usage in the City is divided into the following categories:

HR: Hillside Residential
R-1: Single Family Residential
R1-H: Single Family Residential – Hillside
R-1 (5000): Single Family Residential
R-2: Multiple Family
P-C: Planned Communities
R-3: Multiple Family
C-G: General Commercial
C-C: Major Shopping Center
C-P: Administrative and Professional Office
C-N: Neighborhood Commercial
BISP: Brea Industrial Specific Plan
C-M: Industrial Commercial
M-1: Light Industrial
M-2: General Industrial
M-P: Planned Industrial
MU-I: Mixed Use -I
MU-II: Mixed Use -II
MU-III: Mixed Use -III

4.6 Water Duty Factors

To understand and project water use for each type of land use, water duty factors were created. Water consumption established from customer meter readings were compared with specific parcel land use. If there were any discrepancies with the SCAG land use and billing database, the parcels were reviewed individually and classified based on inspection of Google aerial imagery and the provided consumption data.

The duty factor is a ratio of the water demand and the size of the parcel expressed as acre-feet per acre (AF/ac). The parcel sizes were determined using the City GIS database. Duty factors are also commonly expressed as acre-feet per dwelling unit or acre feet per square foot for residential lots. The City did not have the number of dwelling units available, so AF/ac was calculated for each land use.

4.6.1 Single Family Residential

Table 4-6 represents all four types of zone classifications designated from aerial imagery and the GIS databases for single family residential homes. The zone designations HR, R-1, R1-H, and R-1 (5000) are similar, so they were combined to create a water duty factor for all single-family homes. These areas are located throughout the City.

Table 4-6: Single Family Residential Zone Designation Classifications

Water Duty Factor	AFY	gpm	Acre	AFY/ac	gpm/ac
Single Family Residential	1563.30	969.25	760	2.06	1.28

4.6.2 Multi-Family Residential

The multi-family residential land usage includes residential complexes of four units or less and planned communities. These areas are generally located south of Lambert Road, east of Highway 57, and portions west of Puente Street. The zone designations included in this category are R-2 and P-C (see Table 4-7).

Table 4-7: Multi-family Residential Zone Designation Classifications

Water Duty Factor	AFY	gpm	Acre	AFY/ac	gpm/ac
Multi-Family Residential	216.45	134.20	93	2.33	1.44

4.6.3 High Density Residential

The high-density residential land usage is typically apartment complexes, senior complexes, and cluster condominiums homes. These areas are generally located west of Puente Street and Central Avenue, in areas south of the Tracks at Brea, and areas near Central Avenue and Brea Boulevard. The zone designation included in this category is R-3 (see Table 4-8).

Table 4-8: High Density Residential Zone Designation Classifications

Water Duty Factor	AFY	gpm	Acre	AFY/ac	gpm/ac
High Density Residential	245.30	152.09	71	3.45	2.14

4.6.4 Schools

There are eight public schools within the City. They include six elementary, one junior high, and one high school with one school district transport (see Table 4-9). Only public schools were considered under this duty factor. Private schools are classified as residential (R-1) per the zoning designation areas.

Table 4-9: School Zone Designation Classifications

Water Duty Factor	AFY	gpm	Acre	AFY/ac	gpm/ac
Schools	143.40	88.90	107	1.34	0.83

4.6.5 Business / Commercial

Business/Commercial land usage area is along Imperial Highway and parts of Brea Boulevard. These areas contain locations such as the Brea Mall, Brea Mall Executive Plaza, and other shopping and business/professional plazas. The zone designations included in this category are C-G, C-C, C-P, and C-N (see Table 4-10).

Table 4-10: Business / Commercial Zone Designation Classifications

Water Duty Factor	AFY	gpm	Acre	AFY/ac	gpm/ac
Business / Commercial	164.35	101.90	172	0.96	0.59

4.6.6 Industrial

The Industrial land usage area is spread out in areas north and south of Lambert Road, west of Highway 57, and in areas south of Central Avenue, and north of Imperial Highway. These areas contain various manufacturing plants, distribution centers, public utilities, development facilities and warehouses. The zone designations included in this category are BISP, C-M, M-1, M-2, and M-P (see Table 4-11).

Table 4-11: Industrial Zone Designation Classifications

Water Duty Factor	AFY	gpm	Acre	AFY/ac	gpm/ac
Industrial	200.28	124.17	153	1.31	0.81

4.6.7 Mixed-use

Mixed Use land usage area is distributed in areas along Brea Boulevard, south of Lambert Road, and portions east of Valencia Avenue, north of Imperial Highway. These areas contain markets, local restaurants/taverns, coffee shops and new residential developments. The zone designations included in this category are MU-I, MU-II, and MU-III (see Table 4-12).

Table 4-12: Mixed-use Zone Designation Classifications

Water Duty Factor	AFY	gpm	Acre	AFY/ac	gpm/ac
Mixed-use	51.78	32.10	35	1.48	0.92

4.6.8 Water Duty Factor Summary

The water duty factors for each land use type shown in Table 4-6 through Table 4-12 are summarized below in Table 4-13.

Table 4-13: Water Duty Factor Summary

Water Duty Factor	AFY	gpm	Acre	AFY/ac	gpm/ac
Single Family Residential	1563.30	969.25	760	2.06	1.28
Multi-Family Residential	216.45	134.20	93	2.33	1.44
High Density Residential	245.30	152.09	71	3.45	2.14
Schools	143.40	88.90	107	1.34	0.83
Business / Commercial	164.35	101.90	172	0.96	0.59
Industrial	200.28	124.17	153	1.31	0.81
Mixed-use	51.78	32.10	35	1.48	0.92

4.7 Use of Water Duty Factors

Water duty factors can be used to estimate future demand for new proposed developments in the City. To identify the future demands for new developments, the water duty factors can be multiplied by the size of the development. In the case of redevelopment or densification, the existing demand needs to be subtracted from the estimated future demand to find the incremental increase in demand associated with the development.

4.8 Impact of Pending Developments

Table 4-14 lists the current project developments in the planning stage with the City. These proposed developments along with 2002 WMP outstanding development areas are shown in Appendix C as part of this WMP. The future demands are estimated based on the duty factors and land size of the development.

Table 4-14: Pending Project Developments – Projected Demands

Project Type	Project Name	Location	Land Usage	Area (AC)	Proposed Zone	Proposed Demand (GPY)	Proposed Demand (AFY)
Under Construction	Central Park Village – Trumark	400 West Central Avenue	M-P	4.61	605A	1,967,863	6.04
	La Floresta (PA 1)	East of Valencia Avenue, North of Imperial Highway	MU-II	2.70	605C	1,302,112	4.00
	Brea Place	NW corner of State College Boulevard and Birch Street	MU-I	5.79	515	2,792,306	8.57
	Brea Plumbing	340 North Orange Avenue	M-2	0.25	515	106,717	0.33
	295 Lilac Lane	295 Lilac Lane	R-1	5.24	1000	3,517,396	10.79
Approved for Entitlement	201 North Berry Street	201 North Berry Street	M-2	7.92	515	3,380,798	10.38
	Brandywine Homes	251 South Randolph Avenue	C-P	1.92	515	600,614	1.84
	Self-Storage	2700 East Imperial Highway	M-1	1.97	540	840,931	2.58
	Industrial Building	3075 East Imperial Highway	M-1	3.66	605C	1,562,338	4.79
	109 Lilac Lane	109 Lilac Lane	PF	8.66	1000	5,813,101	17.84
	240 North Madrona Avenue	240 North Madrona Avenue	R-3	0.18	515	202,355	0.62
	Brea Imperial Center (In-N-Out)	2500 East Imperial Highway	C-G	0.26	540	81,333	0.25
	Mercury Apartment	2110 West Mercury Lane, SE corner of North Berry Street and Mercury Lane	C-M	1.01	515	315,948	0.97

Project Type	Project Name	Location	Land Usage	Area (AC)	Proposed Zone	Proposed Demand (GPY)	Proposed Demand (AFY)
Under Entitlement Review	Raising Canes	255 East Imperial Highway	MU	0.81	515	390,633	1.20
	Brea Imperial Center – Fogo De Chao	SW corner of State College Boulevard and Imperial Highway	MU	0.26	515	125,389	0.38
	214 ½ Madrona Avenue	214 ½ Madrona Avenue	R-3	0.09	515	101,178	0.31
	Pacific Communities	Carbon Canyon Road and Brea Hills Avenue	R-1	0.48	750	322,204	0.99
	Brea Mall Expansion	1065 Brea Mall	C-C	2.28	515	713,229	2.19
	Brea 265 (AERA Energy)	East and west of Valencia Avenue, south of Lambert Road/Carbon Canyon Road	R-1	265	605C	177,883,562	545.90
	Hampton Inn (Tower Record Building)	220 South Brea Boulevard	C-G	0.38	515	118,871	0.36
					TOTAL	**202,138,877**	**620.34**

4.9 Fire Flow Requirements

Every water system must provide adequate supply for fire-fighting capabilities. To determine if the water system has adequate capacity to provide fire flows, it is necessary to establish the minimum fire flow requirements in the distribution system.

Under fire flow conditions, residual pressures cannot fall below 20 psi when delivering the required fire flows. The minimum residual pressure is established by the Title 22 of the California Code of Regulations, Division, Chapter 16, Article 8, Section 64602. This threshold provides a buffer from negative pressure in the distribution system that could result in an ingress of contaminants. Guidance on fire flow requirements for new construction is provided by the Orange County Fire Authority (OCFA) Fire Master Plans for Commercial and Residential Developments (Attachment 23 for Fire Flow Requirements, and Attachment 24 for Spacing Requirements).

Typically, the fire flow requirements are based on the type of land usage in the area of the fire flow. The criteria provided in the 2009 Brea WMPU are still current, as shown in Table 4-15 below.

Table 4-15: Fire Flow Requirements per Land Usage

Land Use Description	Zoning Designation	Minimum Fire Flow (gpm)	Minimum Duration (hrs)
Single Family Residential	HR, R1-H, R-1, R-1(5000)	1,500	2
Multi-Family Residential	R-2, P-C	2,500	2
High Density Residential	R-3	4,000	4
Schools	N/A	3,500	4
Business/ Commercial	C-P, C-N, C-G, C-C, PF	2,500	2
Industrial	BISP, C-M, M-1, M-2, M-P	4,000	4
Mixed-use	MU-I, MU-II, MU-III	4,000	4

Chapter 5 - Model Update

5.1 General Description

A hydraulic model of the water distribution system is an important tool for any analysis of the water system, especially for master planning. The hydraulic model of the City's system has been updated as part of this master plan and is utilized to analyze the existing system performance, service to future developments, operational improvements, and for determining the size and timing of required new facilities.

The City had an existing water system model in H2Onet Innovyze software, that was updated as part of the 2009 WMPU. The model had previously been constructed in H2Onet as part of the 2002 Water Master Plan. Also, the City has developed a GIS of the water distribution system that has been updated in conjunction with this master planning effort. It is desirable to maintain the City's water system model within the same platform as the GIS data, specifically ArcGIS. As such, for this master plan update, the model was converted from H2Onet, which uses AutoCAD as the graphical interface, to InfoWater, which is also an Innovyze software product that uses ArcGIS with ArcMap as the graphical interface.

5.2 Water Model Development Methodology

The first step in the model update was to import the existing H2Onet model into InfoWater software and correct for connectivity issues. All new facilities since the previous model update were imported from the updated GIS and incorporated into the system model. These facilities included distribution pipelines for new developments, including La Floresta, Blackstone, and Olinda Drive, replacement pipelines, and the new Tonner Booster Pump Station and Tonner Hills Reservoir, which when combined create the new 830 pressure zone serving the upper elevations of the Blackstone community. Existing model pipelines were evaluated for consistency with the updated GIS with edits made to the model pipelines as needed.

The updated computer model contains approximately 2,500 pipe segments ranging in size from 3-inch to 96-inch in diameter, representing the pipelines throughout the City's distribution system and pipelines belonging to MWD, CDWC and La Habra that connect to the City's distribution system. Junction nodes are placed in the model where two or more pipelines connect, at locations where a change in diameter occurs, and where water enters or exits the system, at a minimum. In addition to these minimum node locations, there are other nodes or junctions within the model that represent key locations. Elevations for existing junctions were maintained and were originally based on topography maps provided by the City. The elevations for new junctions imported into the model from GIS were determined based on plans provided by the City. The updated GIS does not contain elevation data of pipelines, structures, or existing grade.

5.3 Water Model Update

5.3.1 Existing Storage Facilities

The model includes the City's seven existing storage tanks as shown in Table 5-1. The two tanks located at Carbon Canyon Road are represented in the model as a single tank with an equivalent diameter of the two tanks. The Tonner Hills Reservoir is a new storage facility that was added to the model as part of this update.

Table 5-1: Storage Reservoir Model Data

Reservoir	Pressure Zone	Model ID	Diameter (ft)	Base Elevation (ft)	Maximum Level (ft)	Initial Level (ft)
Berry Street	515 & 790	R-1	508	360	22.5	22
Westside	750	R-2	252	710	40.0	27
Eastside	750B	R-3	208	710	40.0	27
Tonner Hills	830	R-9	118	800	31	20
Valencia	790	R-4	200	750	40.0	27
Carbon Canyon Road*	1,400	R-5	125	1,362	37.0	25

* Note: This location is representative of 2 separate reservoir tanks

5.3.2 Booster Pump Stations

The model includes the City's five booster pump stations as shown in Table 5-2. Berry Street includes pumps that boost to two different pressure zones, the 515 pressure zone and the 790 pressure zone. The Tonner Booster Pump Station is a new facility added to the model as part of this WMP. The pump hydraulic data in the model was updated based on SCE efficiency tests conducted in 2017 that were provided by the City. The Puente Street Booster Pump Station is still included in the model but is no longer in use.

Table 5-2: Booster Pump Station Model Data

Name	Model ID	Model Type	Ground Elevation (ft)	Pump Head (ft)	Pump Flow Rate (gpm)
Berry Street 515 Pressure Zone	BP-01	Multiple Point Curve	375	160	1,500
	BP-02	Multiple Point Curve		162	1,500
	BP-03	Multiple Point Curve		167	500
Berry Street 790 Pressure Zone	BP-04	Multiple Point Curve	375	410	2,000
	BP-05	Multiple Point Curve		410	2,000
	BP-06	Design Point		414	3,050
Puente Street	BP-08	Design Point	539	123	911
	BP-09	Design Point		119	811
Carbon Canyon Booster Pump Station No. 2	BP-11	Multiple Point Curve	502	319	672
	BP-12	Multiple Point Curve		326	668
Carbon Canyon Booster Pump Station No. 3	BP-21	Design Point	730	333	626
	BP-22	Design Point		344	598
Tonner	U7000	Multiple Point Curve	661	110	900
	U7002	Multiple Point Curve		110	900
	U7004	Design Point		121	300

Pumps Operated per Scenario

There are four scenarios that were created for under the WMP update: ADD, MDD, MDD+FF, and PHD. Table 5-3 contains a summary of each pump's status and it corresponding controls under each corresponding modeling scenario. The Berry Street 515 Pressure Zone (Berry Street Lower Zone) pumps are operated by VFD but the model was programmed without VFD controls since the calibration efforts only included steady state scenarios, not extended period simulations.

Table 5-3: Booster Pump Operated

Name	Model ID	ADD	MDD/PHD	MDD+FF
Berry Street 515 Pressure Zone	BP-01	ON	ON	ON
	BP-02	OFF	ON	ON
	BP-03	OFF	ON	ON
Berry Street 790 Pressure Zone	BP-04	ON	ON	ON
	BP-05	OFF	ON	ON
	BP-06	OFF	ON	ON
Puente Street	BP-08	OFF	OFF	OFF
	BP-09	OFF	OFF	OFF
Carbon Canyon Booster Pump Station No. 2	BP-11	ON	ON	ON
	BP-12	ON	ON	ON
Carbon Canyon Booster Pump Station No. 3	BP-21	ON	ON	ON
	BP-22	OFF	OFF	OFF
Tonner	U7000	ON	ON	ON
	U7002	OFF	ON	ON
	U7004	OFF	OFF	OFF

5.3.3 Pressure Reducing Stations

There are 95 pressure reducing stations throughout the City water system. Most pressure reducing stations are equipped with a small (2 to 4-inch) and a large (4 to 8-inch) PRV running in parallel, and a pressure relief valve connected to the downstream piping. Both the small and large PRVs at each station have been included in the model, however, only one valve is modeled as active because operating parallel valves in a hydraulic model can lead to system imbalance errors. The pressure reducing station's large valve is assumed active for most simulations due to the typically more conservative (lower) pressure setting. The smaller valve within the pressure reducing station is for low demands and the model scenarios are not set to run under low demands. In addition, the large valve acts as a primary source of supply once pressure does drop below the valve pressure setting. The pressure relief valves were not included in the model as they do not impact the hydraulic analysis of the system.

City staff provided pressure settings for the PRVs throughout the system which were input into the model. New PRVs were added to the model based on the updated GIS and the data provided by City staff. The valve data raised questions regarding the setup of the pressure zones within the system. Numerous discussions with City staff helped to clarify the zone breaks and develop an accurate representation of the City's current system. The data provided by the City, and utilized in the model, is presented in Table 5-4. Changes to the upstream and downstream pressure zones are highlighted in Table 5-4.

Table 5-4: Existing Valve Settings

PRS ID	Location	Upstream Pressure Zone (1)	Downstream Pressure Zone (1)	Large Valve setting	Small Valve Setting	Valve Sizes
124-1	1670 Sandalwood Drive	750	650	45psi		8"
124-2	Puente and Northwood Streets	750	650	50psi	58psi	8",3"
125-1	1199 Woodcrest Avenue	750	650	38psi	47psi	8", 3"
125-2	1322 Wardman Drive	750	625	48psi	53psi	4",3"
125-3	1012 Ethelinda Way	750	625	45psi	43psi	4",3"
125-4	Steele Drive south of Wardman Drive	625	605	72psi	80psi	8",4"
126-1	Berry and Northwood Streets S/E corner	790	750	72psi	80psi	8",3"
126-2	Berry Street north of Stonebridge Drive	750	700		116psi	12"
224-1	1207 Havenhurst Drive	650	575	38psi	42psi	4",3"
224-2	1209 Puente Street	650	575	49psi	44psi	8",4"
225-1	900 Wardman Drive	625	575	40psi	60psi	4",3"
225-2	1280 Fawnridge Drive	750	625	46psi	54psi	4",3"
225-3	1271 Beechwood Drive	750	625	57psi	50psi	8",3"
225-4	Berry Street and Stonebridge Drive	750	605A	40psi	47psi	4",3"
226-1	Site Drive north of Glenoaks Street	750	635	71psi		8"
226-2	388 Glenoaks Street	750	605A	55psi	60psi	8",4"
226-3	1200 Tamarack Avenue	750	605A	42psi	46psi	4",3"
226-4	Site Drive and Tamarack Village	750	605A	63psi	69psi	4",2"
226-5	Site Drive north of Central Avenue	750	605	68psi	75psi	8",4"
227-1	1240 Ponderosa Avenue	750	605A	57psi	63psi	4",3"
227-2	Canyon Country and Niguel Canyon Way	635	605A	50psi	55psi	8",3"
228-1	Canyon Country north of Stone Canyon Way	700	635	48psi	53psi	8",3"
228-2	824 Driftwood Avenue	790	700	85psi	92psi	8",3"
239-1	Carbon Canyon Booster Pump Station No. 3	1400	1000	Before Pump 150psi	After Pump 300psi	6",6"
324-1	Central Avenue and Roscoe Street	575	515	59psi	65psi	8",4"
324-2	660 Puente Street	605A	515	61psi	66psi	8",3"
325-2	610 Neptune Avenue	605	515	60psi	67psi	8",3"
326-2	Berry Street and Central Avenue	790	605A	63psi	70psi	8",4"
326-3	581 Tamarack Avenue	605	515	62psi	66psi	8",3"
327-1	720 North Brea Boulevard	605	515	65psi		4"

PRS ID	Location	Upstream Pressure Zone (1)	Downstream Pressure Zone (1)	Large Valve setting	Small Valve Setting	Valve Sizes
327-2	215 Blossom Place	605	530	76psi		8”
327-3	798 Brea Boulevard	605	515	73psi	68psi	8”,3”
327-4	298 Buttonwood Drive	635	530	60psi		3”
327-5	SW corner of State College Boulevard and Live Oak Street	635	560	50psi	55psi	8”,3”
328-1	893 Kings Canyon Road	790	635	37psi	41psi	8”,3”
328-2	585 Bonita Canyon Way	790	635	20psi	23psi	4”,3”
328-3	814 Forbes Drive	790	635	40psi	43psi	6”,3”
328-4	Carmichael Drive and Cameron Court	790	725	51psi	54psi	6”,3”
328-5	Carmichael Drive south of Davidson Court	725	635	43psi	48psi	6”,3”
328-6	563 Cliffwood Avenue	635	515	50psi		6”
328-7	Balsa Avenue south of State College Boulevard	635	515	40psi		6”
328-8	NE corner of State College Boulevard and Citrus Place	790	635	77psi	84psi	4”,3”
329-1	Pointe Drive (Olen Property Upper)	790	700	61psi	66psi	8”,4”
329-2	Pointe Drive (Olen Property Lower)	790	700	87psi	84psi	8”,4”
329-3	60 Pointe Drive and Wildcat Way	790	700	52psi	63psi	8”,4”
329-4	10 Pointe Drive and Wildcat Way	790	700	77psi	82psi	8”,4”
337-1	Carbon Canyon Road and Ruby Street	1000	925	35psi	40psi	6”,2”
425-1	SE corner of Puente Street and Lambert Road	790	515	85psi	80psi	8”,3”
425-2	NW corner of Imperial Highway and Berry Street	790	515	80psi	85psi	8”,3”
425-3	Arovista Park Phase One	WELL	515	75psi		4”
425-4	Arovista Park Phase Two	WELL	515	85psi		3”
427-1	330 East Lambert Road	790	560	84psi	90psi	8”,3”
427-3	835 East Birch Street	650	515	67psi	71psi	8”,4”
428-1	190 South State College Boulevard	790	515	56psi	63psi	8”,3”
429-2	Associated Road south of Cloverdale Drive	605	515	63psi	70psi	8”,3”
429-3	Associated Road south of Meadow Creek Road	605	515	55psi	62psi	6”,3”

PRS ID	Location	Upstream Pressure Zone (1)	Downstream Pressure Zone (1)	Large Valve setting	Small Valve Setting	Valve Sizes
430-1	Lambert Road 50 feet east of Sommerset Drive	790	700	72psi	77psi	8”,3”
430-2	Lambert Road 100 feet east of Sunrise Road	790	700	68psi	72psi	8”,3”
430-3	Lambert Road and Kraemer Boulevard SW corner	750	605	45psi	52psi	8”,4”
430-4	Edgemont Lane west of Kraemer Boulevard	750	605	55psi	62psi	4”,2”
430-5	Country Hills Road west of Kraemer Boulevard	750	605	72psi	77psi	8”,3”
430-6	Birch Street west of north Associated Road	650	515	53psi	57psi	8”,3”
430-7	Birch Street west of Associated Road	650	605	53psi	57psi	8”,3”
430-8	Birch Street west of Kraemer Boulevard	750	650	75psi	82psi	8”,4”
431-1	Lambert Road and Walden	750	605	50psi	55psi	8”,4”
431-2	Lambert Road and Sunflower Street	750	605	58psi	61psi	8”,3”
431-3	Country Hills Road east of Kraemer Boulevard	750	605	72psi	78psi	8”,4”
431-4	East side of Kraemer Boulevard north of Birch Street	790	750	125psi	132psi	8”,4”
431-5	Birch Street east of Kraemer Boulevard	790	605	74psi	80psi	8”,3”
431-6	Kraemer Boulevard west side, north of Birch Street	750	605	62psi	67psi	8”,6”
431-7	NW corner of Santa Fe and Lambert Roads	790	750	97psi		12”
431-8	Tonner Ridge Drive north of Santa Fe Road	830	790	75psi	87psi	6”,4”
432-1	NW corner of Birch Street and Valencia Avenue	790	605	62psi	68psi	8”,4”
432-2	Sports Park on Birch Street	790	605	70psi		4”
432-3	Sports Park on Birch Street	790	605	70psi		3”
434-1	Carbon Canyon Regional Park	790	685	78psi	71psi	4”,2”
435-1	Santa Fe Road and Condor Avenue	790	750	50psi	55psi	8”,4”

PRS ID	Location	Upstream Pressure Zone (1)	Downstream Pressure Zone (1)	Large Valve setting	Small Valve Setting	Valve Sizes
435-2	Santa Fe Road and Cardinal Street	790	750	55psi	60psi	8”,4”
435-3	Valley Crossing and Santa Fe Roads	790	750	43psi	49psi	8”,4”
435-4	Railway Avenue and Santa Fe Road	790	750	41psi	47psi	8”,4”
435-5	4091 Cedarwood Court	790	750	60psi	65psi	8”,4”
435-6	474 Orange Grove Lane	790	750	38psi	44psi	8”,4”
435-7	NE corner of Carbon Canyon Road and Brea Hills Avenue	790	750	70psi	78psi	8”,4”
436-2	Valencia Reservoir	830	790	If needed 60psi		8”
436-3	Carbon Canyon Road east of Valencia Avenue west of Santa Fe Road	790	685	80psi		4”
436-4	4449 Carbon Canyon Road	790	685	76psi		6”
436-5	Olinda Drive / Gate	1400	1000	11psi	12psi	8”,4”
436-6	7351 Carbon Canyon Road	1000	Hills of Hope Water Tank on Property		120psi	2”
436-7	Carbon Canyon Booster Pump Station No. 2	790	1000	Before Pump 135psi	After Pump 250psi	6”
529-1	Amberwick Circle	605	515	76psi	81psi	4”,2”
530-1	Imperial Highway east of Placentia Avenue	540	515	83psi	78psi	8”,4”
531-1	Kraemer Boulevard north of Imperial Highway	605	540	68psi	72psi	8”,4”
627-1	NW corner of Elm Street and State College Boulevard	650	515	80psi	85psi	8”,3”
632-1	Valencia Avenue and Imperial Highway NE corner	605	540	63psi	67psi	8”,3”
632-2	3570 East Elm Street	605	540	85psi	62psi	3”

(1) Highlighted pressure zones have been adjusted in the model based on connecting pipelines and discussion with City staff.

5.3.4 Import Water Connections

There are six imported water connections from which the City may receive water from CDWC and MWD. All six connections are included in the hydraulic model. The City’s primary source of supply is from CDWC through the I-line that feeds directly into the Berry Street Reservoir. The remaining connections include two connections to CDWC’s Lift 2 system and three connections to MWD. These are secondary sources that are rarely, if at all, utilized. Table 5-5 provides a listing of the imported water connections in the model.

Table 5-5: Import Water Connections

Connection	Location	Model ID
CDWC Connections		
I-Line	Berry Street Reservoir	CD-01
2nd Lift	Puente and Midbury Streets	CD-02
2nd Lift	Puente and Northwood Streets	CD-03
MWD Connections		
OC-6	Lambert Road and State College Boulevard	OC-6
OC-29 (Vault 436-1)	Valencia Avenue south of Birch Street	OC-29
OC-62 (Vault 427-3)	Birch Street north of Civic Center Circle	OC-62

5.3.5 Emergency Interconnections

The City has five emergency interconnections with adjacent agencies. One emergency interconnection is with the City of La Habra and is located near the intersection of Central Avenue and Puente Street. The interconnection is a pressure reducing station and is modeled as such. The remaining emergency interconnections were modeled as a single PRV. Since these stations are used only in cases of an emergency, the valves were closed for most simulations.

Following the model update, the water system model was thoroughly checked and verified to assure all pipes are connected properly and the model produces results within a range of reasonableness.

5.3.6 Demand Allocation for Simulation

Demand allocation is a crucial portion within a hydraulic water model. Determining accurate consumption data and the spatial distribution of that consumption throughout a water system is a key element of water distribution modeling.

For the WMP, billing records from January 2015 through December 2019 were used as consumption data. The billing records provided an account number, customer number, service address, service type, account status, water rate type, and the demands produced each month during a fiscal year time frame in units of hundred cubic feet.

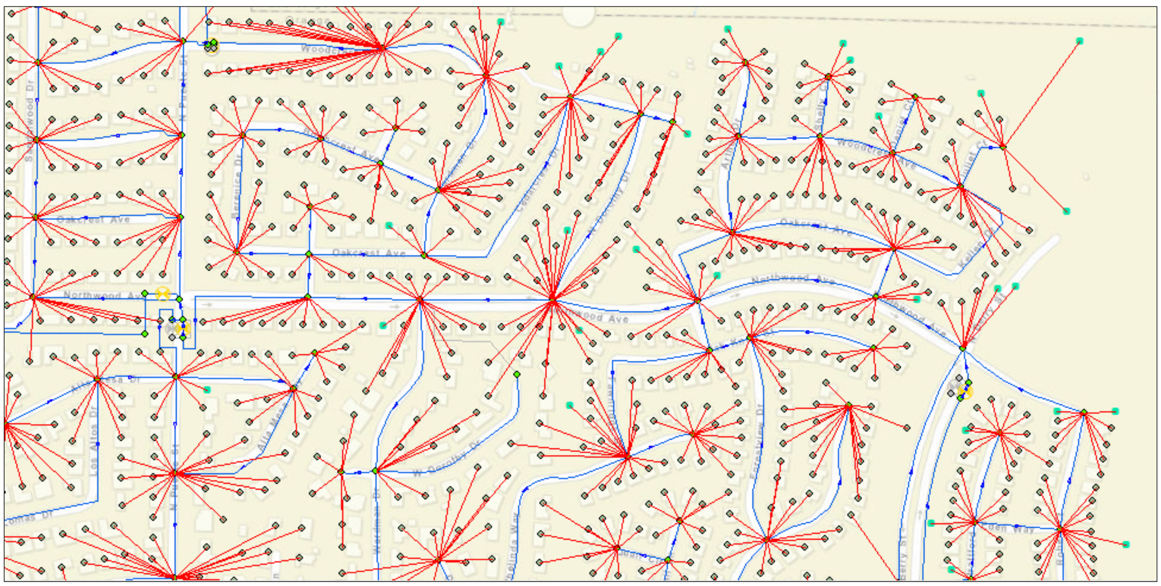
The City was able to provide a spreadsheet containing the account numbers, service addresses and usage of each corresponding account, but no meter information. To create a meter database, an imported geodatabase containing polygons of the parcels within the City's boundaries that were provided from the City's GIS department was used to create meters based on the centroid coordinates of each individual parcels.

When the meter geodatabase was created, which contained APN numbers, parcel areas, site addresses, and zoning classifications, the billing data was able to be geospatially merged to its site address. By merging those two geodatabases, all the billing data for the year 2019 was imported based on site address. Once this procedure was completed, the compiled billing meter/consumption data was exported into a shapefile for the demand allocation per location.

InfoWater contains a master planning tool called "Demand Allocator". This tool provides the flexibility to calculate, distribute and manage consumption data into a hydraulic model. It fully automates the geographical allocation of junction node demands to ensure the development and simulation of credible hydraulic models. The billing meter/ consumption data shapefile was imported into this tool and allocated to the water model junctions using the "Closest Junction" method. This method allocated the demands provided by the billing meter within the consumption data to the nearest junction node in the water model as shown in Figure 5-1. The allocation of the demands to the junctions were manually reviewed for accuracy. Demands were manually allocated to different junctions in a few areas to create a more accurate representation of the City's water distribution system, mainly near pressure zone boundaries.

Once complete, the consumption data was summarized per pressure zone and junction databases were created for average day, max day, and peak hour. Steady state model scenarios were developed for ADD, MDD, PHD, and MDD+FF demands.

Figure 5-1: Demand Allocation Using "Closet Junction" Method



5.3.7 Model Calibration

The MDD steady state scenario was utilized when the model was updated and calibrated. The scenario was programmed to contain a data set which was based on 2019 billing data. First, the top users mentioned in Section 0 we inputted into the model based on its approximate meter location. Second, the remaining billing data was allocated based on their meter location. Once all the billing data was programmed, the demand set was increased by a factor of 2% to account for water losses throughout the system.

Model calibration is the process of fine tuning the model to achieve model predictions in agreement with real world observations for a given set of conditions. Field flow tests record both static pressure prior to flowing a hydrant and the residual pressure resulting from a measured flow rate. Calibration of the flow test data generally consists of adjusting pipe friction factors to simulate observed residual pressures. Other conditions that have a direct bearing on static pressure may also be adjusted, including reservoir levels, pump operation, and valve settings; particularly if these conditions are unknown during the test period. More complex models are likely to produce a greater differential between predictions and observations. One of the likely reasons for this is the size of the system and the number of pressure regulating valves and pressure zones being investigated concurrently. In a model of the complexity of the City's water system, pressure predictions with an average deviation of no more than 10% are expected. The existing model, prepared prior to this WMP, was calibrated to flow tests conducted at nine locations. At that time, there was no data available on pipeline age and material to base variations in pipeline roughness. The updated GIS now includes this data, and it was utilized in the updated calibration process.

The City keeps flow test data for one year for all flow tests that they observe. There were four flow tests conducted within the past year that were provided by City staff. One of the flow tests was performed for a private on-site system and was therefore not used in the calibration. Two of the flow tests were in the largest 515 pressure zone. Another flow test was in the 575 pressure zone, one that is a small pressure zone but contains some of the oldest pipelines throughout the zone making it useful for calibrating pipeline roughness.

There was extensive flow testing conducted as part of the original model calibration in the 2002 Master Plan. The pipeline infrastructure in most of the flow test areas has not changed significantly since these field tests were conducted, other than system ageing. This is particularly the case in the largest 515 pressure zone. This historical field data was revisited to update the model calibration, this time using pipeline age to adjust pipeline roughness factors. The previous calibration was achieved by adjusting valve and booster pump station operation with pipeline roughness maintained at a consistent Hazen-Williams coefficient of 130 throughout the model. The flow tests in areas where new infrastructure and/or new PRVs have been installed were not included in the calibration. Six of the nine flow test locations were utilized including four flow tests in the 515 pressure zone.

In calibrating the pipeline roughness, the pipelines were grouped into four age categories shown in Table 5-6. Matching the static pressure was not a priority when calibrating to historical flow test data as the pressure settings at the PRVs have changed since the flow tests were conducted. In general, the PRVs have been set to lower pressures when compared to the previous master plan. The pipeline roughness by age category was adjusted to calibrate to the residual pressures and the change in pressure caused by a stress on the system from the added flow during the flow test. The drop in pressure is attributed to friction loss, i.e., pipeline roughness. The roughness of each age category was manipulated until a good match to flow test data was achieved. The calibrated Hazen-Williams coefficient by pipeline age is summarized in Table 5-6. These calibrated roughness factors were applied throughout the model.

Table 5-6: Pipeline Roughness Calibration Data

Pipeline Age Category	Hazen-Williams Coefficient
1948 to 1960	80 to 90
1960 to 1975	100
1975 to 1990	110
1990 to 2020	130

A summary of the calibration results is shown in Table 5-7. This table lists the location and results of each field test and the corresponding computer model results. Model pressures are within 9% and 7 psi of the field measurements and are considered acceptable. As discussed, these results include calibration to field tests that were conducted as part of the original model development. The percent deviation from the field tests were much greater during that initial calibration, up to 40%, as there were no adjustments made to pipeline roughness based on age. When calibrating to historic field test data, the modeled pressures are lower to be conservative and account for the ageing of the system. The model is felt to be adequately and conservatively calibrated for planning purposes. It is recommended that the City keep a copy of all flow tests conducted in their service area going forward, so it is available for future use in model calibration. The hydraulic model is a working tool with periodic updates recommended as additional data becomes available.

Table 5-7: Flow Test Calibration Data

Location	Pressure Zone	FH #	Flow (gpm)	Field Pressure (psi)		Model Pressure (psi)		% Difference	
				Static	Residual	Static	Residual	Static	Residual
2020 Flow Test Data									
Puente Street and Central Avenue	575	575-48	1,547	65	48	70	52	8%	8%
Imperial Highway and Flower Avenue	515	515-288	1,087	66	61	67	64	2%	5%
Imperial Highway and Brea Boulevard	515	515-531	1,163	78	73	75	71	-4%	-3%
2002 Master Plan Flow Test Data									
Skywood Street and Lotus Place	515	515-4	2,505	78	36	74	35	-5%	-3%
Puente Street and Linden Way	515	515-82	2,275	90	46	84	42	-7%	-9%
Brea Boulevard and Juniper Street	515	515-520	4,020	90	77	85	70	-6%	-9%
Aurora Avenue and Hillhaven Drive	515	N/A	3,635	80	64	78	60	-3%	-6%
Orbiter and Saturn Streets	605	605-234	4,190	95	75	88	70	-7%	-7%
Evergreen Drive and Nutwood Street	750	750-69	3,080	75	50	73	46	-3%	-8%

Chapter 6 - Existing System Analysis

6.1 General Description

The 2021 Water Master Plan has updated the analysis of the system infrastructure using the updated demands and water model to analyze the system.

6.2 Maximum Day Simulation

This analysis investigates the distribution system's capability to provide satisfactory supply for the entire system on the day of the year with the highest demand, as identified in Section 4.3. In this scenario, pipeline velocities are expected to be higher during average day demand, and the system should still maintain at least 40 psi throughout the service area, even if system pressures are typically lower than the average day scenario.

The total system demand for the maximum day simulation was calculated in the model as 8,615 gpm (12.4 MGD). The results from this simulation are approximately 1/3 less than the demand from the 2009 WMPU of 12,903 gpm (18.6 MGD). The water demands under the maximum day simulation utilized an increased system-wide peaking factor of 1.59.

6.2.1 Results

System pressures and pipeline velocities did not vary much from the previous 2009 WMPU modeling results.

A new zone, the 830 pressure zone, has been established to serve the Olinda Ranch development, located above Carbon Canyon Road and east of Valencia Avenue. This new pressure zone is served by the Tonner Hills Reservoir and Tonner Booster Pump Station. Along the transmission line traveling north of Shepherd Lane running east towards the Eastside Reservoir. This pipeline is a transmission main and does not directly serve any customer. Although the design criteria establishes a minimum pressure of 40 psi, transmission mains are not tied to this criteria as evidenced by mains that are connected in the vicinity of gravity reservoirs. The high elevations (approximately 750 feet ASML) in this area fall below 40 psi and range between 14 psi to 39 psi.

Aside from these areas, the model indicates that the existing system meets or exceeds the minimum criteria established for pressures and velocities during maximum day demand.

6.3 Peak Hour Simulation

During a peak hour scenario, the analysis investigates the distribution system's capability to provide satisfactory supply for the entire system during the one hour in the maximum day with the highest demand.

6.3.1 Pressure

The total system demand for the peak hour simulation was calculated in the model as 16,254 gpm. Results from this simulation is approximately 16% less than the 2009 WMPU of 19,347 gpm. A peaking factor of 3.0 was used compared to the 2009 WMPU of 2.75. Due to a lack of hourly consumption data, a peaking factor of 3.0 was utilized. California Code of Regulations Section 64554 allows for a PHD peaking factor a minimum of 1.5

times the MDD peaking factor. The peaking factor of 3.0 allows the City to stay conservative for future analysis.

The system pressures and pipeline velocities are within requirements for most of the areas. Similar to the maximum day scenario, the high elevations (approximately 750 feet ASML) in the newly added 830 pressure zone fall below 40 psi and range between 14 psi to 39 psi along the transmission line traveling north of Shepherd Lane running east towards the Eastside Reservoir.

6.3.2 Velocity

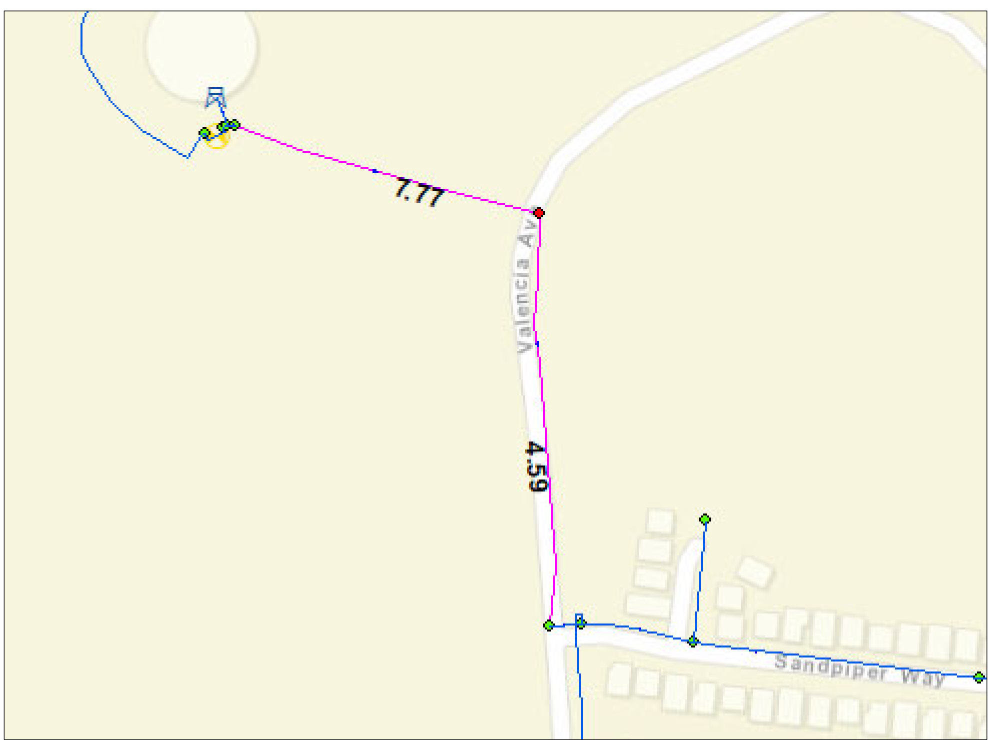
The velocity analysis evaluates the ability of the system to provide water while maintaining velocity under a specific maximum limit. Under the PHD scenario, velocities cannot be more than 7 fps.

Valencia Avenue Inlet/Outlet

The inlet/outlet line from Valencia Reservoir, along Valencia Avenue from the reservoir to Sandpiper Way, is a 12-inch pipeline. Velocities in this segment are approximately 8 fps. This exceeds the criteria of 7 fps under the PHD scenario. Upsizing this pipeline from 12-inch to 24-inch will reduce the velocity going through the pipelines to under 7 fps.

In addition, the same inlet/outlet pipeline has insufficient capacity to meet the velocity requirements during both fill cycles to the reservoir and during the MDD+FF scenario, when the Berry Street Reservoir pumps are off. The upsizing to 24-inch will reduce the velocity to acceptable levels and allow for more flow to and from the reservoir. Section 6.14.1 of the recommended projects adds more detail for this improvement. Figure 6-1 shows the existing velocities under PHD.

Figure 6-1: Existing Velocities Valencia Avenue Inlet/Outlet



6.4 Fire Flow Analysis

The fire flow analysis evaluates the ability of the water system to serve the minimum fire flow requirements throughout the service areas while also meeting MDD. The required flow rate for each pressure zone is established by using the City zoning and land usage information. The fire flow requirements per land usage are shown in Table 4-15. Since pressure zones are made up of multiple land usages, the highest fire flow within the pressure zone is used for the analysis for that respective zone.

6.4.1 Fire Flow Results

The fire flow requirements for the City are met in most areas. Notable deficiencies occur in the Olinda Village area and Brea Corsican Villas.

Olinda Village

The Olinda Village area is served from the 1000-ft and 1400-feet pressure zone in the Carbon Canyon area. The highest elevation on Copa de Oro Drive is unable to meet fire flow requirements. The City has placed special requirements for the landowners at higher elevation to mitigate pressure issues. Before construction is approved, the City requires the development to include a booster pump, storage tank, and sprinkler system for the proposed buildings. These facilities must be capable of supplying adequate pressure and flow to the sprinkler system.

The areas of Olinda Village not meeting the required available flow requirements of 1,500 gpm are shown on Figure 6-2. Upsizing the pipeline in Lilac Lane to 12-inch would allow all of the hydrants in the area to meet requirements except for the highest elevations along Copa de Oro Drive and Olinda Drive. Figure 6-3 shows the improved fire flows potentially achieved by upsizing the Lilac Lane pipeline to a 12-inch pipeline.

Figure 6-2: Existing Fire Flows - Olinda Village

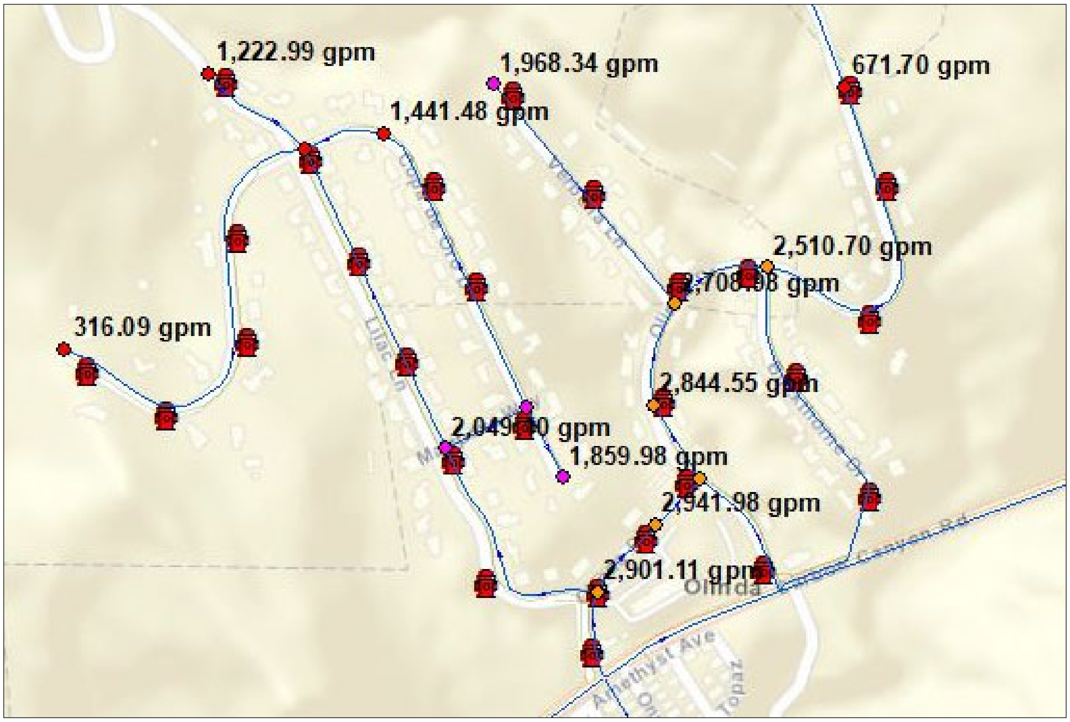
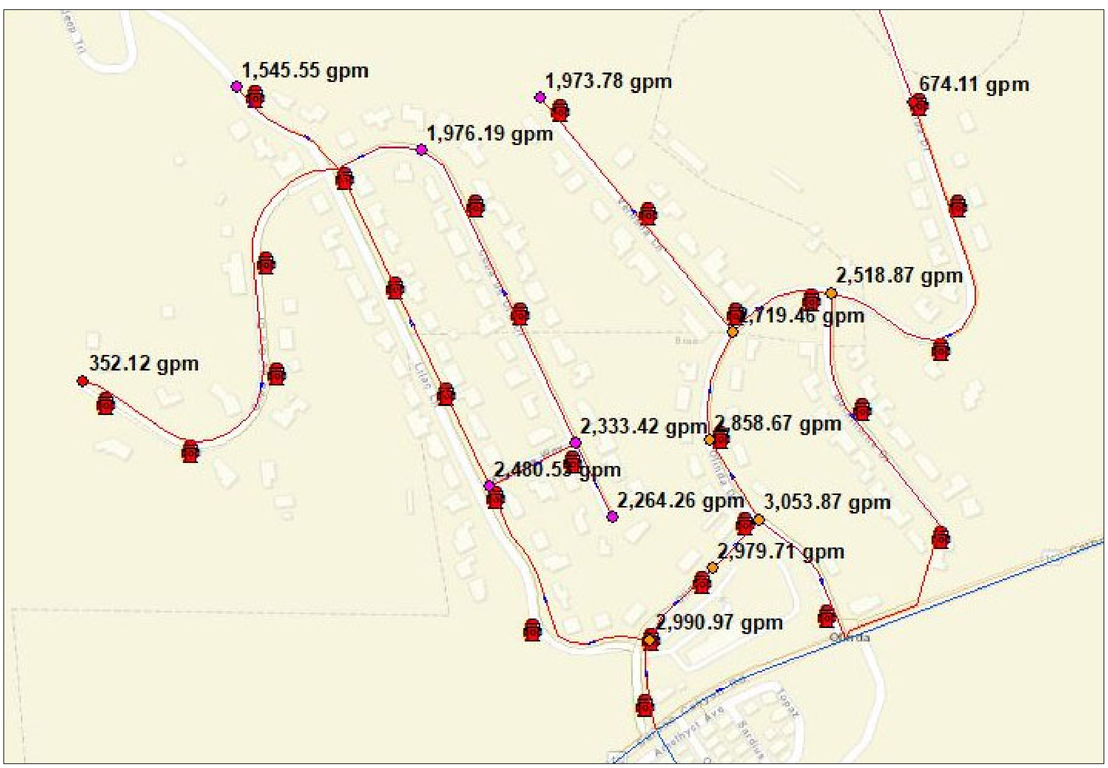


Figure 6-3: Fire Flows with Improvements - Olinda Village



Brea Corsican Villas

The Brea Corsican Villas, in the 515 pressure zone, are currently not meeting the available flow requirement of 4,000 gpm (High Density Residential land use). This fire flow requirement is an estimation based on the land use. The existing fire flows can be seen in Figure 6-4 below. Although the fire flow requirement is above the current available fire flow range of 3,271 gpm to 3,819 gpm when hydrants are flowed individually, they do meet the requirement when two or more hydrants flow simultaneously. To add redundancy to the system and for each individual hydrant to meet the fire flow requirement of 4,000 gpm, the backbone 8-inch loop could be upsized to12-inches.

Figure 6-4: Existing Fire Flows - Brea Corsican Villas

6.4.2 Velocity Analysis

Under the MDD+FF scenario, the velocities cannot exceed 15 fps, excluding dead-end locations. There are two areas where pipeline velocities are greater than 15 fps where fire flow requirements are 4,000 gpm.

Lotus Place, East of Vallejo Street

Using a fire flow requirement of 4,000 gpm, the pipeline on Lotus Place between Vallejo Street and Sonora Street has a velocity of 23 fps. Upsizing the 6-inch line to an 8-inch would decrease the velocity from 23 fps to 12 fps. Section 6.14.5 of the recommended projects includes more discussion for this improvement.

Roscoe Street

Similarly, the pipeline on Roscoe Street has a velocity reaching 26 fps. Upsizing the 8-inch line to a 12-inch will decrease the velocity from 26 fps to 11 fps. Section 6.14.7 of the recommended projects includes more discussion for this improvement.

6.5 Supply

Water supply analysis reviews the combined capacity of all the water supply sources when the largest single source of supply is out of service. The City water supply portfolio includes imported water from both the CDWC and MWD.

6.5.1 Primary Supply Criteria

The total water production capacity from non-emergency sources of water supply must be capable of collectively meeting the system MDD when the largest single source is out of service. This level of redundancy will allow the City to maintain normal deliveries regardless of a temporary loss of supply source due to an unforeseen emergency.

The total imported supply capacity for the City is 23,697 gpm from the four connections listed under Table 2-7 in Chapter 2. With the largest single source out of service, the capacity would decrease to 15,708 gpm. The system MDD is 8,615 gpm, which would leave a surplus of approximately 7,093 gpm. These results are shown in Table 6-1 below.

Table 6-1: Supply Analysis – Largest Source Off

Capacity (gpm)	MDD (gpm)	Surplus Capacity (gpm)
15,708	8,615	7,093

Although there is four active imported connection available for supply, there are two inactive connections the City could use in the event of an emergency. The 2009 WMPU cited the two-2nd lift CDWC connections would add an additional capacity of approximately 3.34cfs (1,499 gpm). These connections are located at Puente Street and Midbury Street and the other is location near Puente Street and Northwood Street. For the primary supply criteria, only the four active connections listed under Table 2-7 in Chapter 2 were used to determine the total supply capacity.

6.5.2 Secondary Supply Criteria

A depletion of emergency and fire storage creates temporary vulnerability in subsequent emergency events. This vulnerability can be minimized by the system's ability to rapidly replenish storage within 48 hours.

The required emergency replenishment of 12.41 MG (4,309 gpm for 48-hours) and fire storage of 0.96 MG (requirement of 4,000 gpm for 4 hours) requires a minimum flow rate of 333 gpm over 48 hours.

Combined with an MDD of 8,615 gpm, the sources of supply must be capable of delivering 13,256 gpm for at least a 48-hour period. The system's capacity of 23,697 gpm leaves a surplus capacity of 10,441 gpm. Table 6-2 below shows the system's capability to replenish storage within 48 hours.

Table 6-2: Supply Analysis – 48 Hour Supply

Capacity (gpm)	Fire Storage (MG)	Emergency Storage (MG)	Refill Rate (gpm)	MDD (gpm)	Total Requirement (gpm)	Surplus Capacity (gpm)
23,697	0.96	12.41	4,641	8,615	13,256	10,441

6.6 Storage Capacity

Storage analysis compares the storage capacity to the storage requirements in each pressure zone that is served via gravity storage. Storage requirements are based on demand and fire flow requirements.

The principal functions of storage are:

1. To equalize fluctuations in instantaneous demand so that extreme and rapid variations in demand are not imposed on the sources of supply;
2. To provide water for firefighting; and
3. To meet demand during an emergency such as disruption of the major source of supply, a power outage, a pipe break, or another unforeseen emergency or maintenance issue.

6.6.1 Operational Storage

Operational storage describes the volume needed to equalize the cumulative difference between supply and demand over the course of a day. Maximum operational storage would typically occur under MDD conditions. The operational storage requirement is driven by system functionality. The volume of operational storage, as an industry standard, averages between 20% to 30% of MDD. For consistency with the 2009 WMPU, the operational storage for the City is considered 30% of the MDD.

6.6.2 Fire Storage

The water system must be capable of meeting MDD and firefighting requirements simultaneously. The fire storage requirement is driven by the OCFA and is based upon the highest fire flow requirement and duration in each pressure zone. The fire storage requirements are driven by emergency preparedness.

6.6.3 Emergency Storage

Emergency storage is required to meet demands during times of planned and unplanned equipment outages such as pump breakdown, power failure, pipeline rupture, etc. The reservoir should have sufficient capacity to supply 48 hours of ADD. The emergency storage requirement is driven by emergency preparedness.

6.6.4 Storage Design Criteria

Storage analysis compares the storage capacity to the storage requirements in each pressure zone that is served via gravity storage, as shown in Table 6-3.

Table 6-3: Storage Analysis

Pressure Zone Name	Volume (MG)	ADD (MGD)	MDD (MGD)	Fire Storage			Operational (30% of MDD) (MG)	Emergency (2 x ADD) (MG)	Total (MG)	Surplus Capacity (MG)
				(gpm)	(hrs)	(MG)				
1400	2.50	0.12	0.20	2,500	2	0.30	0.06	0.25	0.61	1.89
830	2.00	0.23	0.36	2,500	2	0.30	0.11	0.46	0.87	1.13
790	10.00	1.18	1.88	4,000	4	0.96	0.56	2.37	3.89	6.11
750	25.00	6.27	9.96	4,000	4	0.96	2.99	12.53	16.48	8.52
Total	39.50	7.80	12.41			2.52	3.72	15.60	21.84	17.66

As shown in Table 6-3, there is a surplus of storage in all levels of the system. The City requires 21.84 MG of overall water storage capacity but has 39.50 MG of capacity available, leaving a surplus capacity of 17.66 MG. There is storage directly serving pressure zones 1400, 830, 790, and 750. The remaining pressure zones do not have direct gravity storage but receive water from higher zones with storage via PRVs. Thus, the demands of the 515 to 750 pressure zones are included in the storage requirement of pressure zone 750, and pressure zones 925 and 1000 are included with pressure zone 1400. While the Berry Street Reservoir provides 30 MG of storage, it does not provide gravity storage to a zone and is not considered available storage under the cited criteria.

6.6.5 Secondary Storage Criteria

If the City continues to be dependent on an imported source of supply, an accommodation should be provided for the supplier to take the sources offline temporarily for purposes of routine maintenance, inspection, retrofit, etc. Wholesalers try to schedule such routine events during low demand periods to minimize impact. The regional wholesaler MWD and the 2009 WMPU recommend storage equivalent to the volume of water needed to supply seven days under average demand.

Table 6-4: Recommended Storage Capacity

Existing Total Storage (MG)	Existing Total ADD (MG)	ADD x7 (MG)	Surplus Capacity (MG)
69.50	7.80	54.61	14.89

Per Table 6-4, the recommended storage capacity of seven average days is met with a surplus of 14.89 MG. The existing total storage includes the combined capacity of all the reservoirs in the system, including Berry Street Reservoir. While the Berry Street Reservoir does not serve a pressure zone via gravity, it still provides storage for the system and is therefore considered in the total storage under these criteria.

6.7 Booster Pumps

6.7.1 Booster Pumping Efficiency

Maintaining high overall pumping plant efficiency is essential for minimizing energy costs. It is recommended for all pumps to be tested periodically for efficiency at least once a year. Any time a booster pump falls below 65% efficiency, maintenance or replacement should be considered to increase efficiency.

Table 6-5: Booster Pump Stations

Pump	Q (gpm)	SCE %
Carbon Canyon No. 2 Pump 1	443	59.2%
Carbon Canyon No. 2 Pump 2	539	64.6%
Carbon Canyon No. 3 Pump 1	414	52.0%
Carbon Canyon No. 3 Pump 2	422	52.2%
Berry Street Pump 1	1,325	53.3%
Berry Street Pump 2	1,331	57.0%
Berry Street Pump 3	685	61.4%
Tonner Pump 2	1,054	63.4%
Puente Pump 1	NA	NA
Puente Pump 2	NA	NA

The frequency of use and typical operation of a booster pump will also play a critical role in recommended improvements based on efficiency. Pumps that are used often or continuously have a higher priority than pumps that are rarely used or not needed for normal operations. The City has its pumps tested periodically by SCE to confirm wire-to-water efficiency.

Per Table 6-5, all pumps are below 65% efficiency and would typically be recommended for replacement. After discussions with City staff, both the Carbon Canyon Booster Pump Stations No.2 and No.3 are currently being replaced. The Berry Street Pump Station pumps will be replaced under Capital Improvement Plan (CIP) named “Berry Street High Pressure Pump” as discussed under Section 6.14.1. The Tonner Hills Pump 2 is performing just under the threshold requirement of 65% and being fairly new, it is not recommended to be replaced at the moment but should be monitored in the near term. The Puente Pumps have been out of service since 2012. Due to its inactive status, there are no efficiency tests for them.

6.7.2 Primary Booster Pump Design Criteria

The primary booster pumping stations specific to each zone must satisfy these design criteria:

- All zones must have sufficient capacity to meet their zones MDD plus the MDD of dependent zones with the largest unit out of service.

- Terminal zones (i.e. zones that do not provide flow to other zones) must have sufficient capacity to meet MDD with the largest unit out of service.

Booster pumping stations should be sized to supply dependent MDD, with the largest pump out of service. A dependent MDD is the total of the zone's MDD and the subzones that rely on the higher zone for water.

Table 6-6: Primary Booster Pump Analysis

Pressure Zone	Initial Capacity (gpm)	Existing Dependent MDD (gpm)	Surplus Capacity (gpm)
1400	598	1	597
1000	668	117	551
830	1,200	389	811
790	4,000	5,191	(1,191)
515*	2,000	3,424	(1,424)
* Terminal pressure zone			

Table 6-6 represents the capacities of each booster pumping station with its largest pump out of service. The booster pumping stations have sufficient capacity to satisfy the design criteria with the exception of the Berry Street Booster Pump Station that serves the 790 and 515 pressure zones.

The high-pressure pumps at the Berry Street Booster Pump Station do not meet the design criteria. In order to meet the dependent MDD in the 790 pressure zone, all pumps must be active. Booster pump stations should be designed to meet the dependent MDD with the largest pump out of service, to provide redundancy in the event of a pump failure. If pump failure occurs during high demand periods, the pump station would not be able to meet system demand. An additional pump should be added to this station with a minimum capacity of 1,191 gpm to address this deficiency.

The 515 pressure zone is a terminal zone in the water system. From Table 6-6, the low pressure pumps at the Berry Street Booster Pump Station are incapable of supplying its MDD with the largest unit out of service. In order to meet the dependent MDD in the 515 pressure zone with the low pressure pumps, all pumps must be active. An additional pump should be added to this station with a minimum capacity of 1,424 gpm to address this deficiency.

6.7.3 Secondary Booster Pump Design Criteria

The secondary booster pumping stations specific to each zone must have sufficient capacity to meet their own MDD, plus the MDD of all dependent zones, plus the refill rate of depleted fire and emergency storage within two days. Refill Rate is the required flowrate to provide the fire storage and emergency storage in 48 hours. Dependent MDD and refill rate are combined to provide the total requirement for the pressure zone.

Table 6-7: Secondary Booster Pump Analysis

Pressure Zone	Capacity (gpm)	Fire Storage (MG)	Emergency Storage (MG)	Refill Rate (gpm)	Dependent MDD (gpm)	Total Requirement (gpm)	Surplus Capacity (gpm)
1400	1,224	0.24	0.00	83	1	84	1,140
1000	1,340	0.30	0.20	174	117	291	1,049
830	2,100	0.30	0.46	264	389	653	1,447
790	7,000	0.96	2.36	1,153	5,191	6,344	656

Table 6-7 shows the capacities of each booster pumping station per pressure zone. All booster pump stations provide sufficient capacity to meet this design criteria.

6.8 Pressure Reducing Stations

For pressure zones supplied exclusively by pressure reducing stations, the combined capacity of all pressure reducing valves must provide dependent MDD plus fire flow at the net intermittent flow rating of the valves.

Table 6-8: MDD+FF Capacity of PRV

Pressure-Zone	# of PRV's Serving PZ	Intermittent Capacity (gpm)	MDD (gpm)	FF (gpm)	MDD+FF (gpm)	Surplus Capacity (gpm)
925	1	2,250	19	1,500	1,519	731
750B	1	3,900	42	2,500	2,542	1,358
750	7	27,300	656	2,500	3,156	24,144
725	1	2,250	19	1,500	1,519	731
700C	1	3,900	40	1,500	1,540	2,360
700B	2	7,800	30	2,500	2,530	5,270
700	4	15,600	67	4,000	4,067	11,533
650	2	7,800	137	1,500	1,637	6,163
635	6	14,280	204	1,500	1,704	12,576
625	4	6,870	106	1,500	1,606	5,264
605C	7	28,870	904	4,000	4,904	23,966
605B	4	12,690	323	4,000	4,323	8,367
605A	9	27,360	424	4,000	4,424	22,936
575	3	5,880	180	2,500	2,680	3,200
560	2	7,800	134	2,500	2,634	5,166
540	3	8,380	208	4,000	4,208	4,172
530	2	4,480	12	1,500	1,512	2,968

Per Table 6-8, the pressure reducing stations for the listed pressure zones are capable of supplying MDD+FF. This intermittent capacity was developed by using the manufacturer's maximum intermittent flow from their engineering data sheet for the City's valves.

While the 700 pressure zone does not contain a 700B and 700C subset, for the sake of the PRV analysis, it is separated due to distance between PRVs. The 700 pressure zone separation is located north of Lambert Road and west of Pointe Drive. The 700B separation is located north of Lambert Road, encompassing Skyline Drive to Sommerset

Drive, and the pipelines in between. The 700C separation is located along Canyon County Road to Stone Canyon Way, and pipeline in between.

The valves must also be capable of meeting MDD at the net continuous flow rating of the valves. Per Table 6-9, the pressure reducing stations for the listed pressure zones are capable of supplying MDD at continuous capacity.

Table 6-9: MDD Capacity of PRV

Pressure-Zone	# of PRV's Serving PZ	Combined Capacity (gpm)	MDD (gpm)	Surplus Capacity (gpm)
925	1	210	19	191
750B	1	800	42	758
750	7	5,600	656	4,944
725	1	460	19	440
700C	1	460	40	420
700B	2	920	30	890
700	4	3,200	67	3,133
650	2	920	137	782
635	6	2,760	204	2,556
625	4	1,840	106	1,734
605C	7	5,920	904	5,016
605B	4	1,930	323	1,607
605A	9	4,910	424	4,486
575	3	1,720	180	1,540
560	2	920	134	785
540	3	1,720	208	1,511
530	2	3,560	12	3,548

6.9 Operation Issues

6.9.1 Filling Valencia Reservoir

Both the 2002 WMP and 2009 WMPU noted that it is difficult to fill the Valencia Reservoir during the peak demand months. The 2002 Water Master Plan recommended adding additional pumps to fill the Valencia Reservoir in conjunction with pumps that would be necessary to fill a new reservoir at a 900-foot elevation base as part of the proposed Valencia 790/900 Booster Pump Station[2]:

"In order to meet projected water demands and to mitigate existing system deficiencies when filling Valencia Reservoir during summer demand periods, a small booster pumping station is proposed that will provide additional lift to Valencia Reservoir during those periods that it cannot be readily filled by gravity. These pumps will be located at the proposed Valencia 790/900 BPS."

The 2009 WMPU also addressed this issue, with the following summary[3]:

[2] *2002 Water Master Plan Update, City of Brea, page 8-11*
[3] *2009 Water Master Plan Update, City of Brea, page 7-10*

"The City's water system was clearly designed to operate most efficiently with water supplied from both MWD and CDWC. During times when the City finds it desirable or necessary to operate using only CDWC supplies, filling Valencia Reservoir will continue to be difficult and care must be taken not to over pressure the 790 Zone. Replacement of the existing 12-inch diameter reservoir pipeline with a 24-inch pipeline will greatly facilitate filling of Valencia Reservoir during all conditions. Future improvements, as described in the 2002 WMPU include a supplemental pump located near Valencia Reservoir to facilitate filling this facility."

As stated in the 2009 WMPU, the system was designed for Valencia Reservoir to be filled by the MWD connection, which is on the east side of the system near Valencia Reservoir. Since the City has transitioned to primarily receiving supply from CDWC, which is on the west side of the system, water now must be pumped from Berry Street Booster Pump Station across the system to the Valencia Reservoir. A pipeline improvement project on Valencia Avenue (as identified in Section 6.14.2) has been recommended to improve flow to the reservoir. Modeling shows that the pipeline improvements would increase the flow to the reservoir by approximately 450 gpm. Additional booster pump capacity was also recommended to address the issue. The 2002 and 2009 water master plans recommend a booster station on site at the Valencia Reservoir as the area is developed, which would assist in addressing the issue.

However, increasing the discharge pressure at Berry Street Booster Pump Station may be a better solution than adding a pump station at Valencia Reservoir if the areas downstream of the pump station can handle the increased pressure. Additional pumping capacity at the Berry Street Booster Pump Station has already been identified as a recommended project, so the costs would be lower than a new pump station. A pump station at Valencia Reservoir could also reduce pressure in the transmission main and potentially reduce the system's capacity to fill the Eastside Reservoir. It is recommended that an extended period simulation (EPS) study be conducted on the pump station to review the appropriate pumping capacity and Total Dynamic Head (TDH) of the high-pressure pumps. If the pump station is unable to maintain pressure to the Valencia Reservoir under current conditions, increasing the discharge pressure at the pump station would provide additional head to overcome the pressure loss to the Valencia Reservoir. The study should also ensure that the high-pressure pumps would have the flow capacity to address the pumping deficiency that was identified in Section 6.7.2, along with providing an increase in head of the pump station.

6.10 Pipeline Life Expectancy Analysis

Pipeline life expectancy varies depending on the material of the pipe. DIP have an approximate life expectancy of 100 years, CML have 70 years, and CI pipelines have 50-60 years on average. Once pipelines meet their life expectancy, they can begin to fail and have excessive leaks. Table 6-10 below shows a comparison of material by age within the City.

Table 6-10: Pipe Summary – Age and Material

Decade	AC (LF)	CI (LF)	CML (LF)	CU (LF)	DIP (LF)	PVC (LF)	STEEL (LF)	Unknown (LF)	Total (LF)
Unknown	-	45,864	15,074	-	3,414	-	-	16,840	81,192
1940-1949	-	928	-	-	1,972	-	-	-	2,900
1950-1959	-	14,441	-	-	3,570	-	-	13,594	31,605
1960-1969	-	101,362	5,434	-	22,101	-	50	18,075	147,022
1970-1979	373	115,923	26,174	-	105,730	-	7,948	2,465	258,613
1980-1989	-	51,253	6,906	-	143,693	135	-	10,903	212,890
1990-1999	-	36,364	1,017	-	118,492	11,965	-	3,390	171,228
2000-2009	-	2,878	219	-	73,088	398	7,172	-	83,755
2010-2020	-	3,470	-	47	104,038	29,401	337	-	137,293
Total	373	372,483	54,824	47	576,098	41,899	15,507	65,267	1,126,498

Reviewing the City's pipeline infrastructure, cast-iron pipelines that are older than 1970 have exceeded their life expectancy and should be considered for replacement. This includes approximately 162,000 LF of pipeline within the City.

6.11 Build-out Analysis

Proposed demands of pending developments as identified in Chapter 4 and the probable location of their zones have been evaluated. The proposed MDD for each development has been added into the pressure zones as incremental increases, as shown in Table 6-11.

Table 6-11: Incremental Increases to Pressure Zones in Build-out Phase

Pressure Zone	Incremental Increase in MDD (gpm)
1000	29
750	2
605	553
540	3
515	26
Total	613

Using the increased demand, the supply, storage, booster pump stations, and pressure reducing stations were analyzed to determine if additional capacity will be necessary.

The City has surplus capacity to meet the incremental increases in demand for supply (Table 6-2 and 6-3), storage (Table 6-3 and Table 6-4), and pressure reducing stations (Table 6-8 and Table 6-9).

The total imported supply capacity for the City is 23,697 gpm from the four connections listed under Table 2-7 in Chapter 2. With the largest single source out of service, the capacity would decrease to 15,708 gpm. The new system MDD is 9,228 gpm, which would leave a surplus of approximately 6,480 gpm. These results are shown in Table 6-12 below.

Table 6-12: New Supply Analysis – Largest Source Off

Capacity (gpm)	MDD (gpm)	Surplus Capacity (gpm)
15,708	9,228	6,480

The new required emergency storage of 13.29 MG (4,615 gpm for 48-hours) and fire storage of 0.96 MG (requirement of 4,000 gpm for 4 hours) requires a minimum flow rate of 333 gpm over 48 hours.

Combined with a new MDD of 9,228 gpm, the sources of supply must be capable of delivering 14,176 gpm for at least a 48-hour period. The system's capacity of 23,697 gpm leaves a surplus capacity of 9,521 gpm. Table 6-13 below shows the system's capability to replenish storage within 48 hours.

Table 6-13: New Supply Analysis – 48 Hour Supply

Capacity (gpm)	Fire Storage (MG)	Emergency Storage (MG)	Refill Rate (gpm)	MDD (gpm)	Total Requirement (gpm)	Surplus Capacity (gpm)
23,697	0.96	13.29	4,948	9,228	14,176	9,521

As shown in Table 6-14, there is a surplus of storage in all levels of the system. The City would require a new total of 23.21 MG of overall water storage capacity but has 39.50 MG of storage available, leaving a surplus storage of 16.29 MG.

Table 6-14: Proposed Build-out Demand Storage Analysis

Pressure Zone Name	Volume (MG)	ADD (MGD)	MDD (MGD)	Fire Storage			Operational (30% of MDD) (MG)	Emergency (2 x ADD) (MG)	Total (MG)	Surplus Capacity (MG)
				(gpm)	(hrs)	(MG)				
1400	2.50	0.15	0.24	2,500	2	0.30	0.07	0.30	0.67	1.83
830	2.00	0.23	0.36	2,500	2	0.30	0.11	0.46	0.87	1.13
790	10.00	1.18	1.88	4,000	4	0.96	0.56	2.37	3.89	6.11
750	25.00	6.79	10.80	4,000	4	0.96	3.24	13.59	17.79	7.21
Total	39.50	8.36	13.28			2.52	3.98	16.71	23.21	16.29

Per Table 6-15, the recommended storage of seven average days is met with a surplus of 11.01 MG. The existing total storage includes the combined capacity of all the reservoirs in the system, including Berry Street Reservoir.

Table 6-15: Proposed Build-out Demand Secondary Storage Capacity

Existing Total Storage (MG)	New Total ADD (MG)	ADD x7 (MG)	Surplus Capacity (MG)
69.50	8.36	58.49	11.01

Table 6-16 shows the capacities of each booster pumping station per pressure zone. All booster pump stations provide sufficient capacity to meet this design criteria under the new dependent MDD.

Table 6-16: Proposed Build-out Demand Secondary Booster Pump Analysis

Pressure Zone	Capacity (gpm)	Fire Storage (MG)	Emergency Storage (MG)	Refill Rate (gpm)	Dependent MDD (gpm)	Total Requirement (gpm)	Surplus Capacity (gpm)
1400	1,224	0.24	0.00	83	1	84	1,140
1000	1,340	0.30	0.26	194	145	339	1,001
830	2,100	0.30	0.46	264	417	681	1,419
790	7,000	0.96	2.36	1,153	5,778	6,931	69

The increased demand has exacerbated the deficit of the Berry Street pump station. The primary booster pump station analysis has been updated with the increased demand and is shown below in Table 6-17.

Table 6-17: New Primary Booster Pump Analysis

Pressure Zone	Capacity (gpm)	Existing Dependent MDD (gpm)	New Dependent MDD (gpm)	Surplus Capacity (gpm)
1400	598	1	1	597
1000	668	117	145	523
830	1,200	388	417	783
790	4,000	5,177	5,778	(1,778)
515	2,000	3,415	3,450	(1,450)

6.11.1 Build-out – Brea 265 (AERA Energy)

While most of the proposed developments are small in size and have a relatively small demand, the proposed Brea 265 (AERA Energy) development covers a large area of approximately 265 acres with 325 gpm in ADD. This project will likely be in the 605 pressure zone and needs to be supplied by the Valencia Reservoir through a new PRV. It will exacerbate the pumping deficiency in the 790 pressure zone, requiring an increase in capacity at the Berry Street Booster Pump Station (preferred) or a new pump station at the Valencia Reservoir (see Section 6.9.1 for further analysis). In addition, it is recommended that the new 24-inch pipeline in Valencia Avenue be constructed to increase the system's capacity to fill Valencia Reservoir, as described in Section 6.14.1.

There is currently a PRV that supplies the 605 zone on Birch Street, just east of Valencia Avenue. In order to serve the Brea 265 area with an acceptable water pressure, it is likely that this PRV will have to be moved to Valencia Avenue near Lambert Road to locate it as close as possible to the development. the existing 12-inch in Valencia Avenue is still in good condition, it could be repurposed as a 605 zone distribution pipeline for the development and could connect the new PRV with the existing 605 zone distribution pipeline in Birch Street.

6.12 2002 WMP Capital Improvement Program Review

The 2002 WMP concluded with a list of recommended projects. The projects were split into two groupings related to existing deficiencies and build-out conditions.

6.12.1 Recommended Improvements to Meet Existing Deficiencies

The existing deficiencies identifies projects to be implemented immediately. This improvement to the existing system was needed to meet reliability concerns at the Berry Street Booster Pump Station.

1) **Improvements at Berry Street Booster Pump Station** – The 2002 WMPU recommended that Berry Street BPS be expanded to take advantage of the capacity of the CDWC supply capacity. Since 2002, the City has expanded the CDWC connection and the Berry Street pumps beyond the recommendations of this plan in order to shift the majority of their supply through this connection.

6.12.2 Recommended Improvements to Meet Build-Out Demands

The 2002 WMP identified backbone infrastructure that would be necessary to provide water to undeveloped areas in the City at that time. A portion of the undeveloped areas identified in the 2002 WMP have been developed, so the City requested to review the list of projects identified under the section *Summary of Proposed Distribution System Improvements to Meet Build-out Demands, Table 9-2*[4] and identify which projects are no longer required due to developments constructed after 2002. The projects listed in Table 6-20 of this WMP are the remaining projects that have not been constructed and are still relevant to the City. These projects are categorized as “Recommended project for Potential Developments” in Appendix D.

The four projects listed below are projects that were part of the 2002 WMP build-out recommendations but have either been modified due to partial completion or no longer required.

1) **12-inch Pipe in Sunflower Street, Flower Hill Street to Lambert Road Pressure Reducing Station –** This project was a 470-foot pipe replacement to address fire flow deficiencies south of Lambert Road. This area has been improved and there are no fire flow issues anymore. This project is no longer necessary.

2) **Expand 790 Pressure Zone Transmission/Distribution Piping –** This project would expand the 790 pressure zone north, which would serve the undeveloped areas north of the City and provide a looped system on both sides of Highway 57. The lower portion of the 12-inch pipeline has been partially constructed in the area that is now the new 830 zone. The 16-inch and 24-inch pipelines that would serve the northern areas have yet to be constructed. These pipelines would still need to be constructed to serve undeveloped areas north of the City.

3) **Valencia 790/900 Booster Pumping Station** – This project is designated for housing two pressure zone booster pump stations, the 790 and 900. The 790

[4] *Page 9-4, Table 9-2, of the 2002 Water Master Plan dated December 2002 performed by Daniel Boyle Engineering.*

Booster Pump Station has been partially constructed as what is now called the Tonner Booster Pump Station. The 900 booster pump station has yet to be built. It would pump water to the new Eastside 900 Reservoir.

4) **Eastside 900 Pressure Zone – 6.0 MG Reservoir –** This project has been partially completed with the 2.0 MG Tonner Hills Reservoir serving the 830 pressure zone. The 6.0 MG reservoir was planned to serve approximately 1 square mile of a new 900 zone. The 2.0 MG Tonner Hills Reservoir serves approximately 0.25 square miles of the area's lower elevations. The new reservoir would still be necessary to serve the upper areas of the development, but it can be reduced by 25% due to the construction of the Tonner Hills Reservoir. The future Eastside 900 Pressure Zone Reservoir should now be approximately 4.5 MG. The development of the 2.0 MG Tonner Hills Reservoir decreased the storage required for the proposed Eastside 900 pressure zone resulting in the improvements categorized as projects 2A through 2F to still be part of the recommended improvements to meet build-out demands.

6.13 2009 WMPU Capital Improvement Program Review

The 2009 WMPU contained a list of CIP projects. A review of these projects allow for a better understanding of what recommendations should be done, which have been completed, and which are in the progress of completion.

1) **New 650 Zone Pressure Reducing Station in La Canada Drive** – This project included a 6-inch PRV in La Canada Drive to meet pressure and fire flow deficiencies in the northwest corner of the City. Several pipe replacement projects and PRV modifications have been done in this zone since 2009 that have resolved these issues. Current modeling does not show any pressure or fireflow issues in this area, therefore this project is no longer necessary.

2) **New Remote Valve in Lambert Road** – This project suggested adding a remote valve in Lambert Road between Sunflower Street and Valencia Avenue to allow the 12-inch pipeline in Lambert to flow water to Valencia reservoir when Berry Street BPS was on, then close and prevent backflow from Valencia Reservoir to Eastside Reservoir when the pumps were off.

3) **Valencia Reservoir Inlet/Outlet Trans. Main –** This project recommended replacing approximately 1,300 LF of existing 12-inch diameter pipeline from the terminus of the 24-inch diameter transmission main in Valencia Avenue, near the intersection of Sandpiper Way to Valencia Reservoir, with a new 24-inch diameter main. This project was also identified in this report and is listed in Section 6.14.2 as a recommended project.

4) **Berry Street Reservoir By-Pass –** This project recommended adding a bypass from the CDWC feed directly to the Berry Street BPS, thus bypassing the reservoir. The previous WMPU recommended additional study to determine the feasibility, size, and cost of this project. This is a recommended project to be implemented after potential study has been reviewed by the City.

5) **Carbon Canyon Reservoirs –** This project recommended adding an automated disinfection system, either dedicated on-site or portable, for the Carbon Canyon Reservoirs due to their distance from the water supply and water age. There are currently no water quality issues with the Carbon Canyon Reservoir, so this project does not appear to be necessary at this time. However, if water quality issues occur, this project should be considered for implementation.

6) **Puente Street Booster Pump Station** – This project recommended adding a VFD to allow the BPS to improve operation. Based on discussions with the City staff, it is recommended that the Puente Street Booster Pump Station be deactivated, and the budget be used to provide additional redundancy at the Berry Street Booster Pump Station.

7) **Carbon Canyon Booster Pump Station No. 2 –** This project recommended the construction of a masonry block building around the pumps. The #2 pump station is currently under design and is budgeted for construction.

8) **Carbon Canyon Booster Pump Station No. 3** – This project recommended the construction of a masonry block building and replacement of the two 75 hp

pumps. The #3 pump station is currently under design and is budgeted for construction.

9) **Carbon Canyon Road Waterline Upgrade** – This project recommended the addition of line valves along Carbon Canyon Road and replacement of 300 LF of 10-inch waterline crossing Carbon Canyon Creek. This project has been completed.

6.14 Project Descriptions for Capital Improvement Projects - Recommended Projects to Meet Existing Deficiencies

CIP projects have been identified to meet existing deficiencies in the City's water system. The cost estimates provided to construct each recommended project are rounded up to the nearest thousand. Cost estimates were estimated to include construction cost by incorporating proposed pipe diameter width, proposed trench width and approximate linear footage of pipeline improvements while incorporating industry-standard cost of approximate cost for trenching, pipe, fittings, labor/equipment cost, demolition cost and an additional 10% markup for contingency, 10% in administration and inspection, and 10% markup for design and engineering. These projects are categorized as "Recommended projects to Meet Existing Deficiencies" in Appendix D and their corresponding cost breakdown is summarized in Table 6-18.

6.14.1 Berry Street High Pressure Pump

Description
Add 1 new pump with a capacity of 2,000 gpm at Berry Street Pump Station.

Figure 6-5: Berry Street Pump Site

Justification
Pumps do not meet the Primary Booster design criteria. All pumps must be active to meet the dependent MDD, which does not allow for redundancy. Additionally, it is recommended to perform an EPS study to evaluate the capacity and TDH required of the high pressure pump station to overcome the pressure loss from the increased flow to the Valencia Reservoirs.

Estimate
The cost to construct this project is estimated to be $350,000.

6.14.2 Valencia Avenue Transmission Improvement

Description

Replace approximately 2,059 feet of existing 12-inch DIP with new 24-inch DIP along Valencia Avenue, between Lambert Road and Birch Street. Replace approximately 550 feet of existing 12-inch cast iron pipe with new 24-inch CML pipe connecting the Valencia Reservoir to Valencia Avenue, and replace approximately 716 feet of 12-inch DIP with new 24-inch CML pipe from that connection point to Sandpiper Way.

Figure 6-6: Proposed Valencia Avenue Improvements

Justification

The existing pipeline on Valencia Avenue between Lambert Road and Birch Street is of insufficient size to provide flow to the Valencia Reservoir. The pipelines on both sides of this section are 24-inch. It is recommended that this pipeline be upsized to provide a consistent 24-inch transmission line to the reservoir.

The existing pipeline between the Valencia Reservoir and Sandpiper Way is currently not meeting the PHD design criteria of being under 7 fps. Current velocities range between 8 fps and 13 fps. These pipeline improvements would decrease the velocities to 4 fps to 6 fps.

Estimate

The cost to construct this project is estimated to be $2,162,000.

6.14.3 Puente Street, Site Drive, and State College Boulevard Replacements

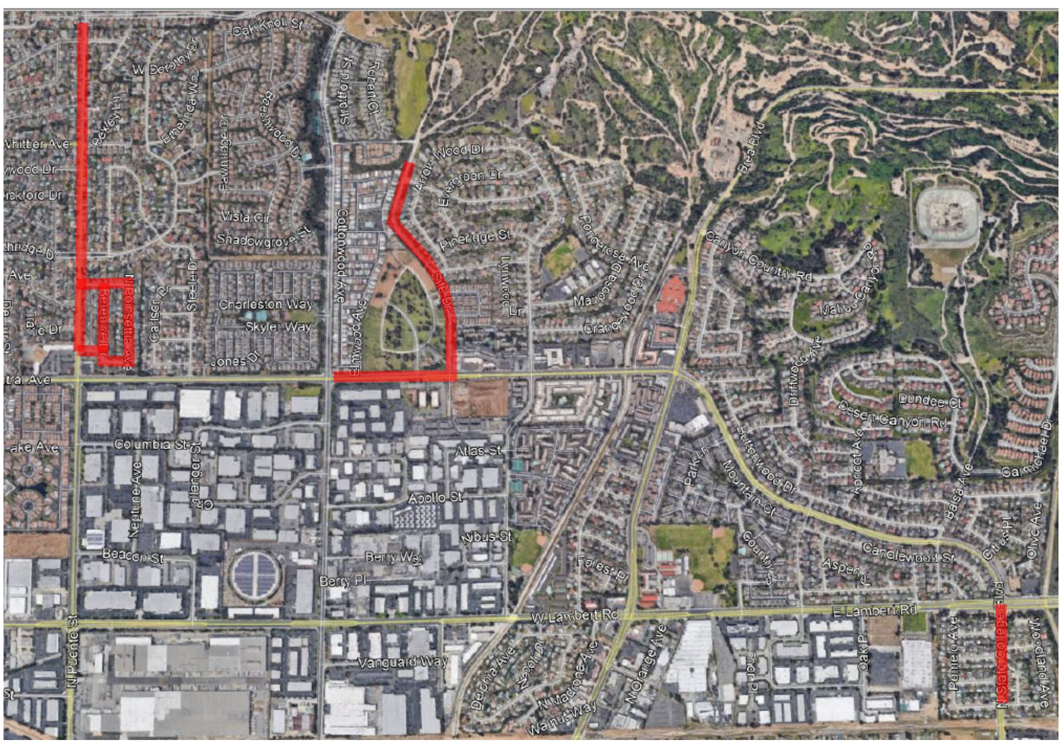
Description

Replace 12-inch pipeline on Puente Street from Northwood Street to Joyce Drive. In addition, replace 8-inch pipeline on Walling Ave and Joyce Drive from Puente Street to Poinsettia Avenue. Lastly, replace 8-inch pipeline from Poinsettia Avenue and Berenice Drive from Walling Avenue to Joyce Drive. These areas total approximately 2,860 feet of 8-inch pipeline and 3,815 feet of 12-inch pipeline and should be replaced with 12-inch DIP or C900 PVC and 8-inch DIP or C900 PVC respectability**.**

Replace 12-inch pipeline on Site Drive, from Central Avenue to approximately 100 feet north of Nutwood Street. In addition, replace 12-inch pipeline on Central Avenue from Berry Street to Site Drive. These areas total approximately 4,285 feet and should be replaced with 12-inch DIP or C900 PVC.

Replace 12-inch pipeline crossing north State College Boulevard from Avocado Street to East Lambert Road for approximately 1,253 feet and should be replaced with 12-inch DIP or C900 PVC.

Figure 6-7: Proposed Puente Street, Site Drive, and State College Boulevard Pipeline Replacement



Justification

CI have a service life of 50 to 65 years. Pipelines that are older than 1970 are reaching their service life and should be replaced.

Estimate

The cost to construct this project is estimated to be $4,738,000.

6.14.4 Valencia Pipeline Replacement

Description

Replace pipeline along Elm Street and Date Street, east of Valencia Avenue. Replace pipeline along South Oakhaven Avenue in between Date Street and Elm Street. Replace pipeline on Elm Street and Green Leaf Drive, north of Elm Street. Additionally, the pipeline along Tolbert Street should be replaced starting south of Vesuvius Drive. The pipeline east of Tolbert Street, along Mujica Place, and Vesuvius Drive from Tolbert Street to North Rose Drive should be replaced. Lastly, Spurr Circle, east of Vesuvius Drive, should have its pipeline replaced. These areas total approximately 9,560 feet and should be replaced with 8-inch DIP or C900 PVC.

Figure 6-8: Proposed Valencia Pipeline Replacement

Justification

CI have a service life of 50 to 65 years. Pipelines that are older than 1970 are reaching their service life and should be replaced with DIP or C900 PVC pipe.

Estimate

The cost to construct this project is estimated to be $4,111,000.

6.14.5 Decommission Puente Pump Station

Description
Decommission the Puente Pump Station.

Figure 6-9: Puente Pump Site

Justification
The pump has not been functional for several years and does not provide an essential function to the system.

Estimate
The cost to construct this project is estimated to be $200,000.

6.14.6 Lotus Place Pipe Improvements

Description

The following pipeline should be replaced with new 8-inch DIP or C900 PVC. Replace pipeline along Lotus Place, between Vallejo Street and Sonora Street. Replace the pipeline on Blossom Place from Vallejo Street to Sonora Street. The Skywood Street pipeline should be replaced from Vallejo Street to S. Palm Street. In addition, replace the pipeline on Sonora Street from Blossom Place to Skywood Street. Pipeline along S Palm Street from La Habra Boulevard to Skywood Street should also be replaced. Similarly, replace pipeline on Vallejo St from La Habra Boulevard to Skywood St. Lastly, the pipeline on La Habra Boulevard from Vallejo Street to Roscoe Street should be upsized with 12-inch DIP or C900 PVC These pipeline improvements total to approximately 6,970 feet.

Figure 6-10: Proposed Lotus Place Improvements Layout

Justification

Velocity in the Lotus Place segment is currently not meeting the MDD+FF design criteria of under 15 fps. Current velocities approximate around 23 fps. This pipeline improvement would decrease the velocities to 13 fps. Pipeline in the surrounding areas should be replaced due to old age.

Estimate

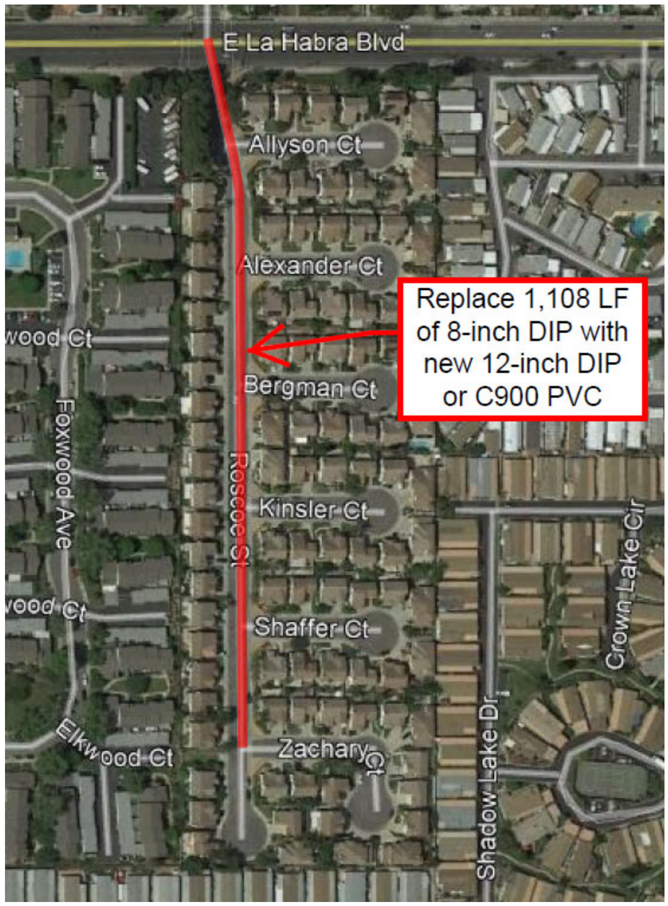
The cost to construct this project is estimated to be $2,947,000.

6.14.7 Roscoe Street Pipe Improvements

Description

Replace approximately 1,108 feet of existing 8-inch DIP with new 12-inch DIP or C900 PVC pipe in Roscoe Street, in between La Habra Boulevard and Zachary Court.

Figure 6-11: Proposed Roscoe Street Improvements Layout



Justification

Velocity in these segments are currently not meeting the MDD+FF design criteria of under 15 fps. Current velocities approximate around 26 fps. This pipeline improvement would decrease the velocities to 11 fps.

Estimate

The cost to construct this project is estimated to be $416,000.

6.14.8 Brea Corsican Villas Improvements

Description
Replace the existing 8-inch cast iron pipe with new 12-inch DIP or C900 PVC pipe along the following streets for a total of approximately 3,291 feet.

- Kerrwood Street, in between South Palm Street and Foxwood Avenue
- Foxwood Avenue, in between Kerrwood Street and Tanglewood Street
- Lakewood Court, in between La Habra Boulevard and Kerrwood Street
- Tanglewood Street, in between South Palm Street and Foxwood Avenue

Replace the existing 6-inch cast iron pipe with new 8-inch DIP along the following dead-end streets for a total of approximately 3,869 feet.

- Archwood Avenue, Merrywood Court, Leafwood Court, and Jaywood Court, all north of Kerrwood street
- Norwood Court, south of Kerrwood Street
- Ironwood Court, Foxwood Charwood Court, and Gatewood Court, along both sides (east and west) of Foxwood Avenue
- Elkwood Court, Dogwood Court, Breezewood Court, and Archwood Court, all south of Tanglewood Street
- Charwood Court, north of Tanglewood Street

Figure 6-12: Proposed Brea Corsican Villa Improvements Layout

Justification

Fire flows within the Brea Corsican Villas in the 515 pressure zone are currently not meeting the required available flow of 4,000 gpm. Current Available Fire Flow ranges between 3,271 gpm to 3,819 gpm, at 20 residual pressure. These pipeline improvements would increase the available fire flow capacities of the fire hydrants to meet OCFA requirements.

Estimate

The cost to construct this project is estimated to be $2,867,000.

6.14.9 Olinda Village Improvements

Description
Replace approximately 2,388 feet of existing 8-inch with new 12-inch DIP or C900 PVC pipe along Lilac Lane and Mariposa Way.

Figure 6-13: Proposed Olinda Village Improvements Layout

Justification
Fire flows within this Village are currently not meeting the required available flow of 1,500 gpm. Current Available Fire Flow ranges between 316 gpm to 2,941 gpm at 20 psi residual pressure. These pipeline improvements would increase the available fire flow capacities of most of the fire hydrants to meet OCFA requirements. The highest elevation hydrants on Copa de Oro Drive and Verbena Lane will be unable to meet the requirement unless a new reservoir is constructed to serve the area.

Estimate
The cost to construct this project is estimated to be $1,027,000.

6.15 Project Descriptions for Capital Improvement Projects - Recommended Projects for System Reliability

Based on all of the analysis from the chapter, the following CIP that do not address a deficiency, but will improve the system, reduce operations costs, or provide other system benefits. These projects are categorized as “Recommended projects to Improve System Reliability” in Appendix D and their corresponding cost breakdown is summarized in Table 6-19.

6.15.1 SR#1 - Carbon Canyon Reservoir Disinfection Description

Description
Add a disinfection system at the Carbon Canyon Reservoir or install a chloramination station at Berry Street.

Justification
The Carbon Canyon Reservoirs are remote reservoirs at the end of the system. To ensure there are no water quality issues at the reservoir, a disinfection system could be installed to monitor chlorine residuals an add inject chlorine as needed. Alternatively, the City could invest in transitioning the entire system to chloramine disinfection.

Estimate
The cost to construct this project is estimated to be $350,000.

6.15.2 SR#2 - Replace Generator at Berry Street Pump Station

Description
Install a new generator with the capacity to operate three high pressure pumps.

Justification
The existing generator should be upsized to provide the capacity to operate multiple pumps during a power outage.

Estimate
The cost to construct this project is estimated to be $300,000.

6.15.3 SR#3 - Berry Street Low Pressure Pump

Description
Add 1 new pump with a capacity of 1,500 gpm.

Justification
Pumps do not meet the Primary Booster design criteria. All pumps must be active to meet the dependent MDD, which does not allow for redundancy.

Estimate
The cost to construct this project is estimated to be $350,000.

6.15.4 SR#4 - 790 Zone Loop Completion

Description

Install new 12-inch CML pipeline that would run along N. Associated Road from Birch Street up to Lambert Road approximately 3,705 feet. This line would connect to the northern most water line in Lambert Road, as well as the 2nd most northern waterline in Birch Street to create complete the hydraulic loop for the high-pressure zone, 790 zone as shown in Figure 6-14.

Figure 6-14: 790 Zone Loop along N. Associated Road

Justification

The City's Water Division would want to create a hydraulic loop for the high-pressure water line (790 zone) between Birch Street and Lambert Road. By doing so, the pipeline will ensure water to the northern area of Lambert Road. Although there is an existing valve that is accessible from the 700 zone, that would provide water at an approximate 30 to 40 psi (or 70 to 92 hydraulic feet) lower than the 790 zone, creating this loop would ensure there would be no eruptions in the system. Additionally, opening the existing valve has proven to be a challenging task for the maintenance group due to the location of the valve at the intersection of Lambert & Associated Road and Wildcat Way.

Estimate

The cost to construct this project is estimated to be $1,668,000.

6.16 Recommended Projects

Based on all of the analysis performed in the chapter, a list of recommended projects have been identified. The recommended projects are broken down into three categories: *Existing Deficiencies*, *System Reliability,* and *Build-out Demand*.

Recommended Projects to Meet Existing Deficiencies are projects that address current issues in the system and are recommended to be completed when funding is available. This is shown in Table 6-18. The total estimate for *Recommended Projects to Meet Existing Deficiencies* is estimated at $18,818,000 in 2020 dollars.

Recommended Projects for System Reliability are optional projects that do not address a deficiency, but will improve the system, reduce operations costs, or provide other system benefits. This is shown in Table 6-19. The total estimate for *Recommended Projects to System Reliability* is estimated at $2,688,000 in 2020 dollars.

Recommended Projects for Potential Development are projects that will be necessary to provide water to undeveloped areas of the City. These projects should be implemented as the areas are developed. This is shown in Table 6-20. The total estimate for *Recommended Projects for Potential Development* is estimated at $103,833,000 in 2020 dollars.

Table 6-18: Recommended Projects to Meet Existing Deficiencies

Priority	Project #	Recommended Improvement	Quantity	Unit Cost	Cost
High	1	Berry Street High Pressure Pump	1 EA	$350,000/EA	$ 350,000
Medium	2	Valencia Ave Transmission Improvement	3,325 LF	$650/LF for 24-inch	$ 2,162,000
Medium	3	Puente Street, Site Drive, and State College Boulevard Replacements	12,212 LF	$430/LF for 8-inch and $375/LF for 12-inch	$ 4,738,000
Medium	4	Valencia Pipeline Replacement	9,560 LF	$430/LF for 8-inch	$ 4,111,000
Medium	5	Decommission Puente Pump Station	1 EA	$200,000/EA	$ 200,000
Low	6	Lotus Place Pipe Improvements	6,970 LF	$430/LF for 8-inch and $375/LF for 12-inch	$ 2,947,000
Low	7	Roscoe St Pipe Improvements	1,108 LF	$375/LF for 12-inch	$ 416,000
Low	8	Brea Corsica Villas Improvement	7,160 LF	$375/LF for 8-inch and $430/LF for 12-inch	$ 2,867,000
Low	9	Olinda Village Pipe Improvements	2,388 LF	$430/LF for 12-inch	$ 1,027,000
TOTAL COST FOR RECOMMENDED PROJECTS TO MEET EXISTING DEFICIENCIES					**$18,818,000**

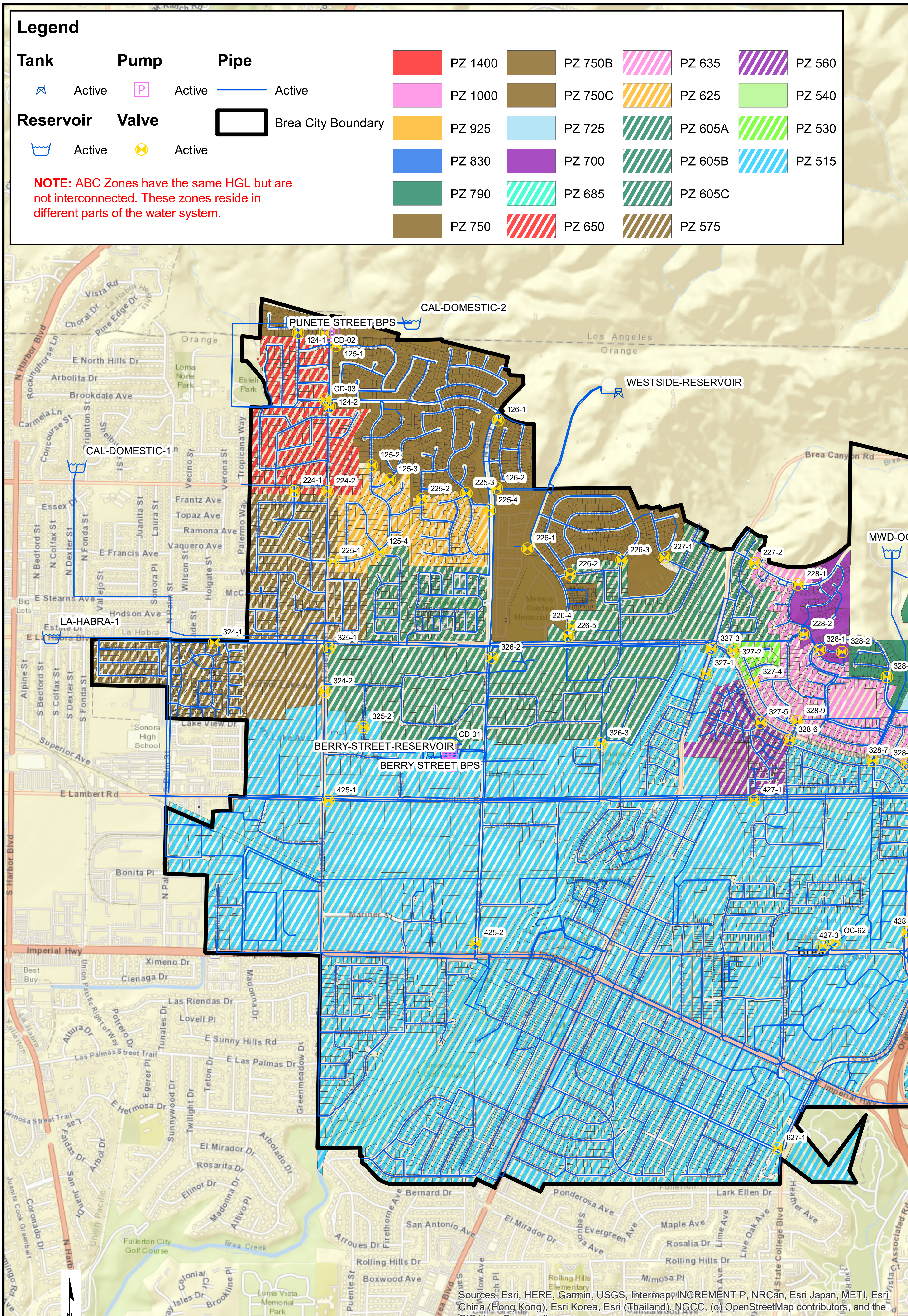
Table 6-19: Recommended Projects to Improve System Reliability

Project #	Recommended Improvement	Quantity	Unit Cost	Cost
SR #1	Carbon Canyon Reservoir Disinfection System	1 LF	$350,000/EA	$ 350,000
SR #2	Replace Generator at Berry Street Booster Pump Station	1 EA	$300,000/EA	$ 300,000
SR #3	Berry Street Low Pressure Pump	1 EA	$350,000/EA	$ 350,000
SR #4	790 Zone Loop Completion	3,750 LF	$450/LF for 12-inch	$ 1,688,000
TOTAL COST FOR RECOMMENDED PROJECTS TO IMPROVE SYSTEM RELIABILITY				**$ 2,688,000**

Table 6-20: Recommended Projects For Potential Developments

Project #	Recommended Improvement	Quantity	Unit Cost	Cost
1A	Expand 790 Zone Transmission/ Distribution Piping	26,285 LF of 16-inch and 1,010 LF of 24-inch	$550/LF for 16-inch and $600/LF for 24-inch	$ 15,114,000
1B		1 Imported Water Connection Valve	$200,000/Emergency Conn.	$ 200,000
1C		1 Pump Station (2 pumps)	$850,000/pump	$ 1,700,000
2A	Eastside 900 Zone Transmission Pipelines	13,982 LF of 12-inch and 24,655 LF of 16-inch	$375/LF for 12-inch and $550/LF for 16-inch	$ 18,804,000
2B		2 Pumps	$650,000/pump	$ 1,300,000
2C		1 Pump Station (2 pumps)	$650,000/pump	$ 1,300,000
2D		4.0 MG	$1.5M/MG	$ 6,000,000
2E		4.5 MG	$1.5M/MG	$ 6,750,000
2F		1 PRS and 1 Emergency Connection	$200,000/Emergency Conn and $200,000/PRS	$ 400,000
3A	1050 Zone Improvements	3,687 LF	$375/LF for 12-inch	$ 1,383,000
3B		1 Pump Station (3 pumps)	$1.7M/pump	$ 5,100,000
4A	Expansion of CC 1000 Zone System	557 LF of 8-inch and 18,858 LF of 12-inch	$430/LF for 8-inch and $375/LF for 12-inch	$ 7,312,000
4B		1 Pump Station (3 pumps)	$850,000/pump	$ 2,550,000
4C		7.5 MG	$150,000/MG	$ 11,250,000
5A	CC 1200 Zone Improvements	2,200 LF	$375/LF for 12-inch	$ 825,000
5B		1 Pump Station (2 pumps)	$750,000/pump	$ 1,500,000
6A	CC 1400 Zone Improvements	23,720 LF	$375/LF for 12-inch	$ 8,895,000
6B		1 Pump Station (3 pumps)	$150,000/pump	$ 450,000
6C		2 Pumps	$750,000/pump	$ 1,500,000
6D		9.3 MG	$150,000/MG	$ 10,700,000
6E		4 PRS	$200,000/PRS	$ 800,000
TOTAL COST FOR RECOMMENDED PROJECTS TO MEET BUILD-OUT DEMAND				**$103,833,000**

Appendix A - Existing System Exhibit



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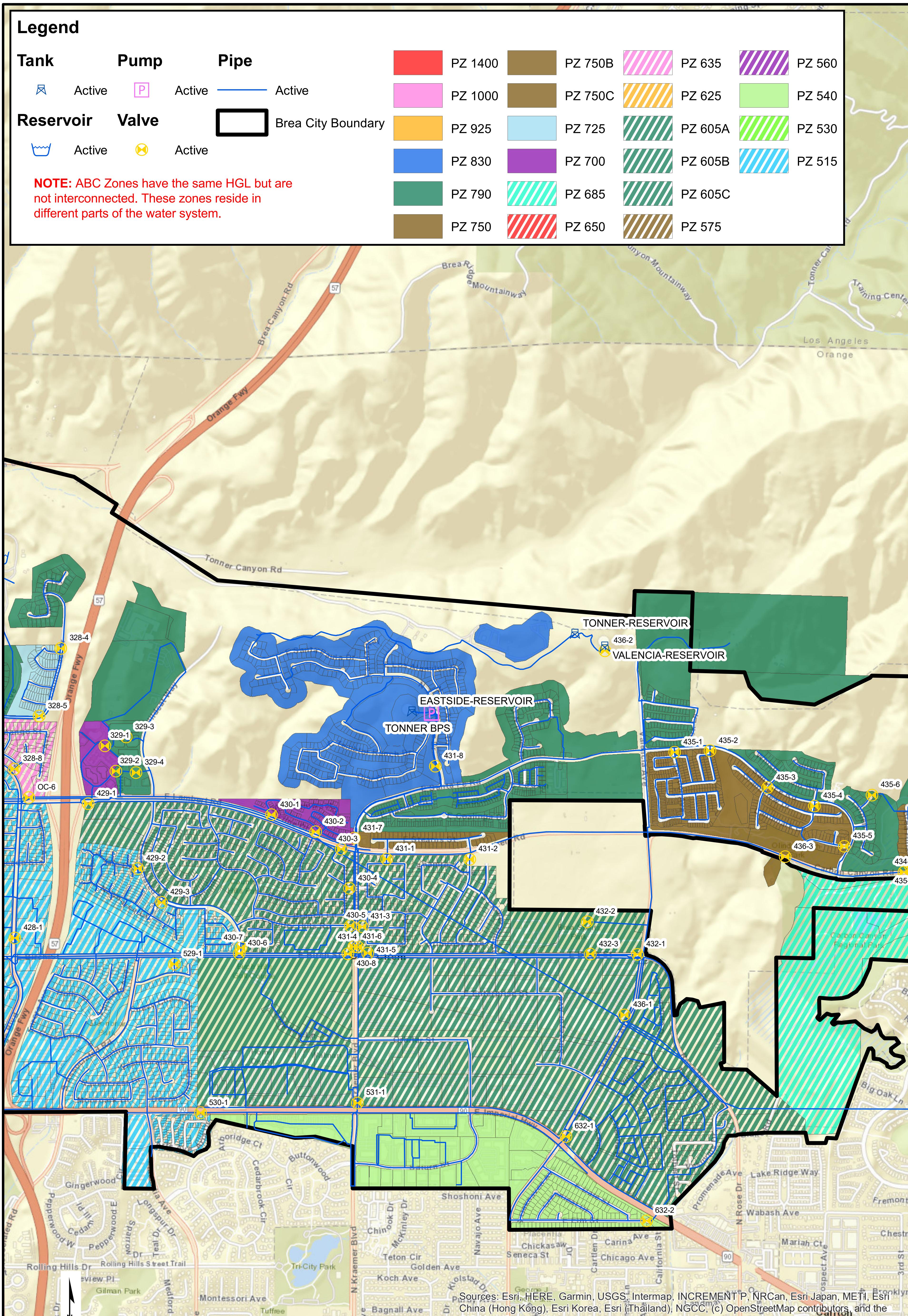

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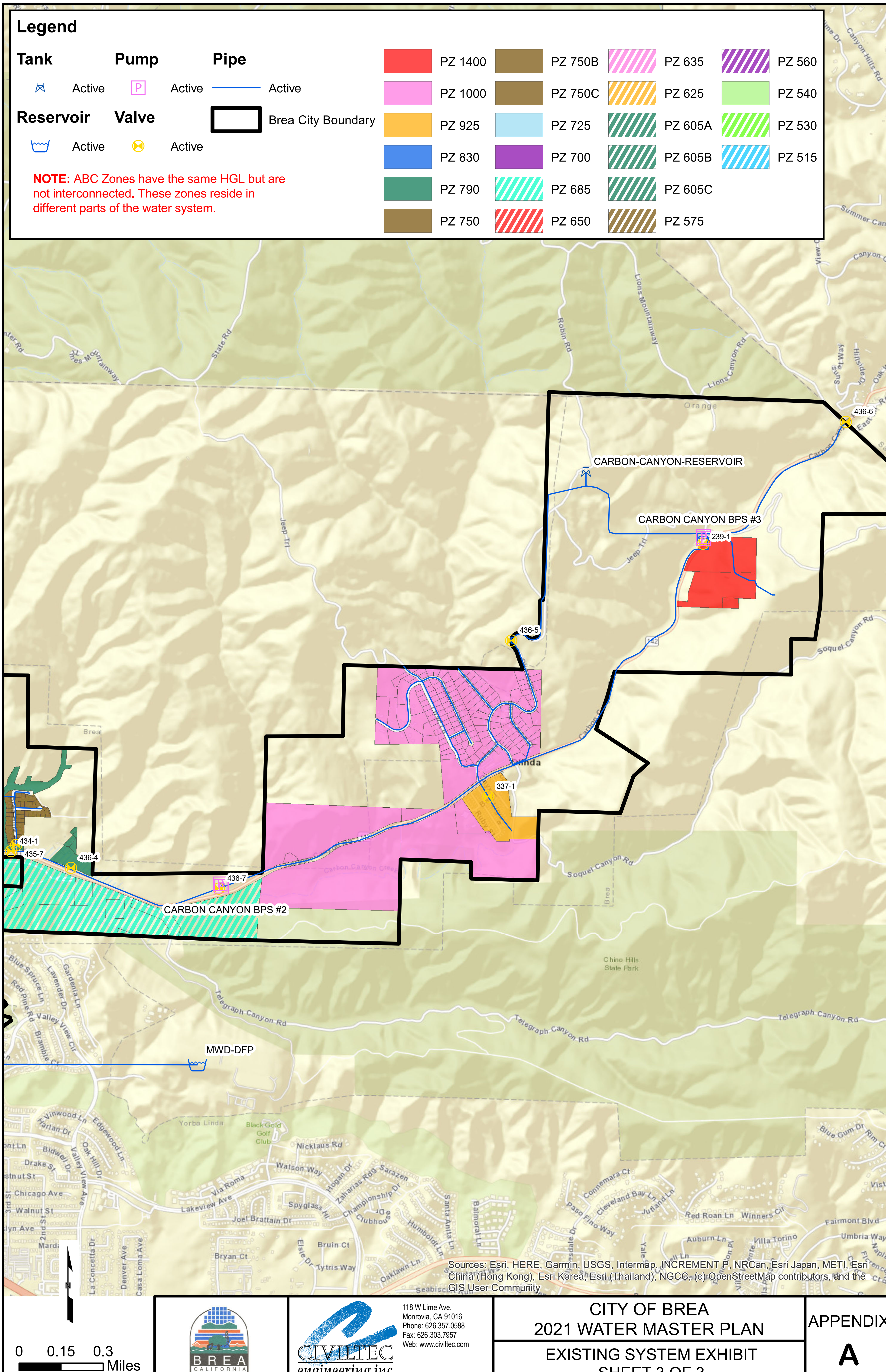

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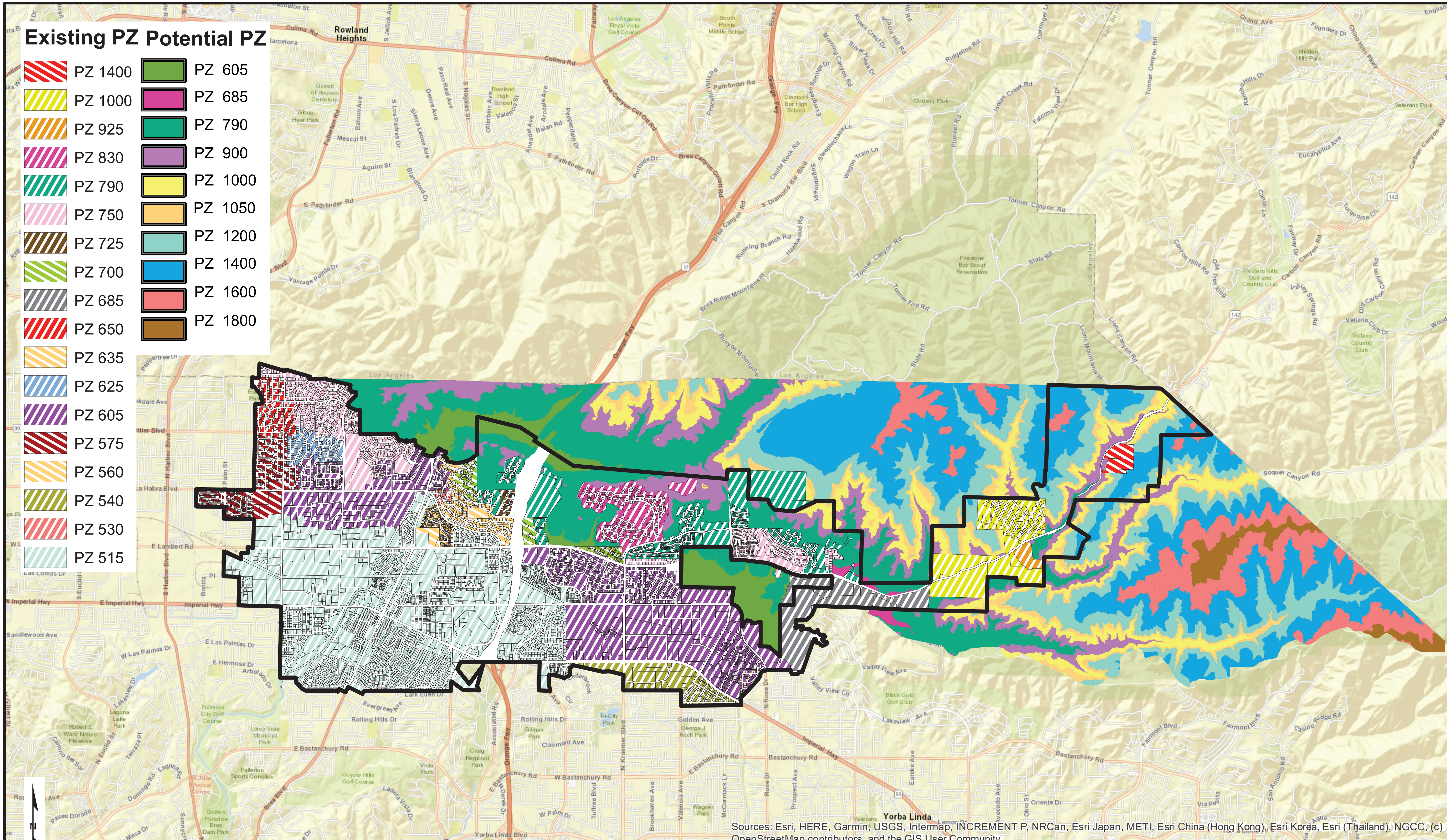
Appendix B - Proposed System Pressure Zones



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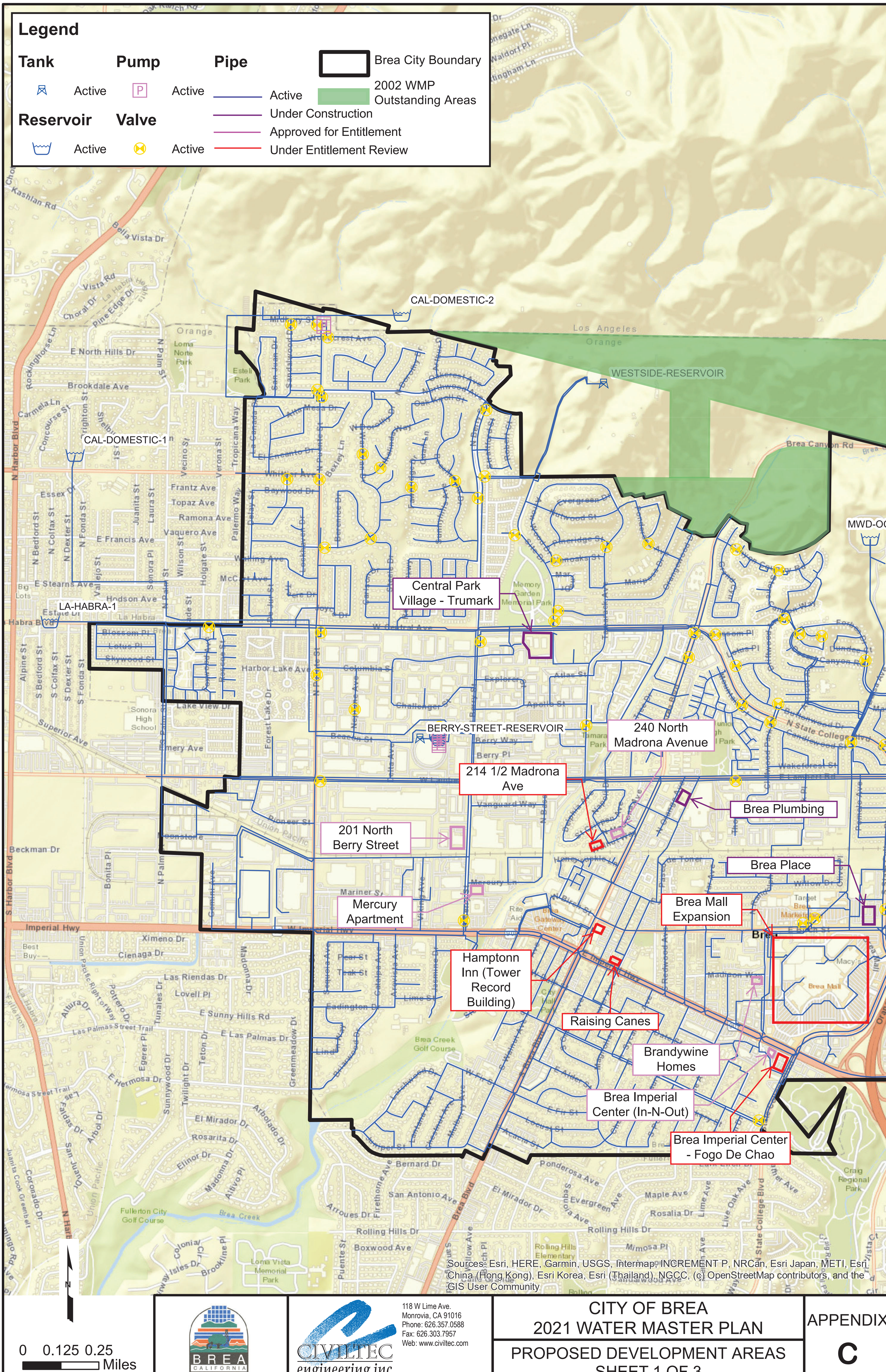
Proposed System Pressure Zones
For City of Brea

APPENDIX
B

Appendix C – Proposed Development Areas



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PROPOSED DEVELOPMENT AREAS
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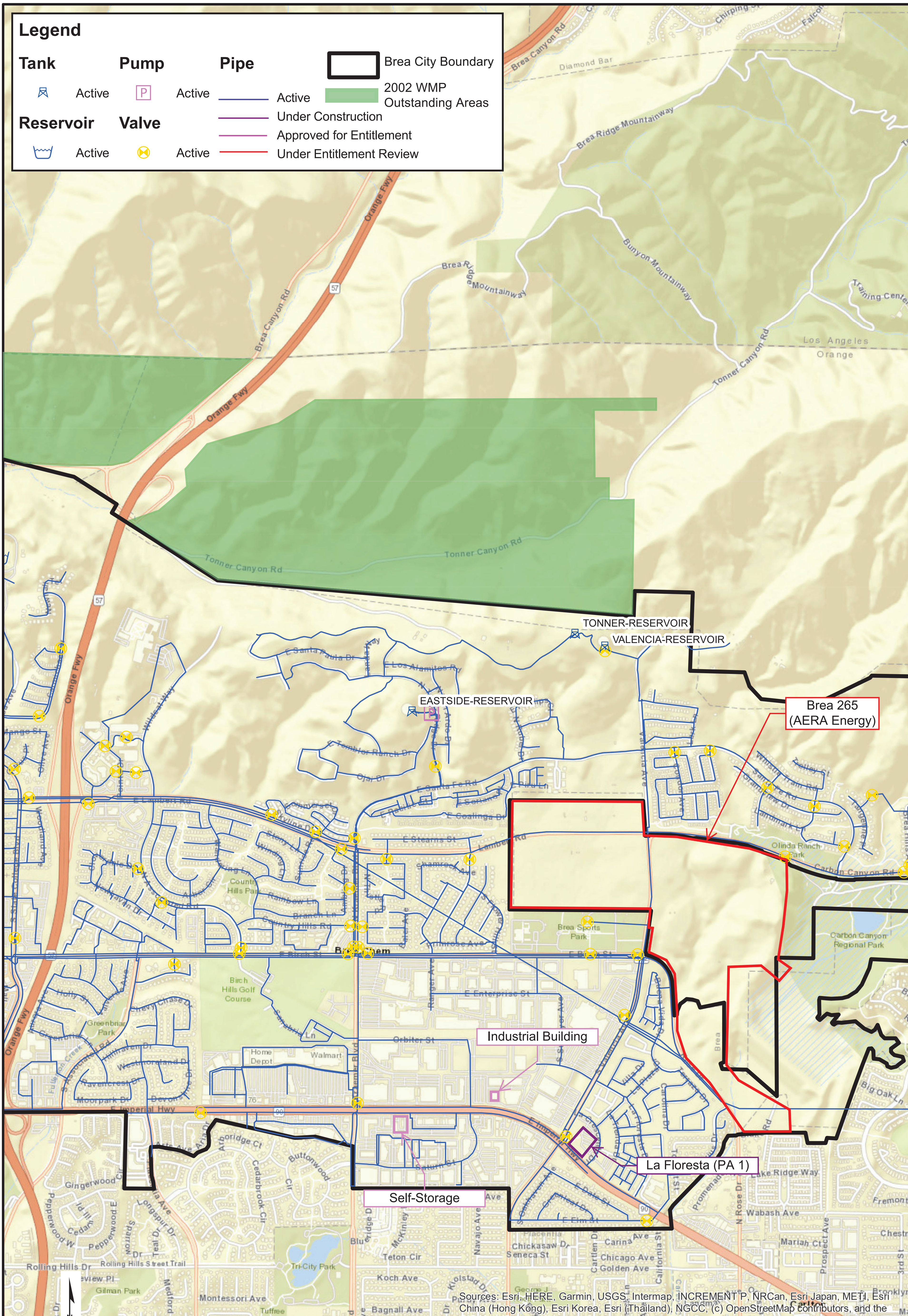

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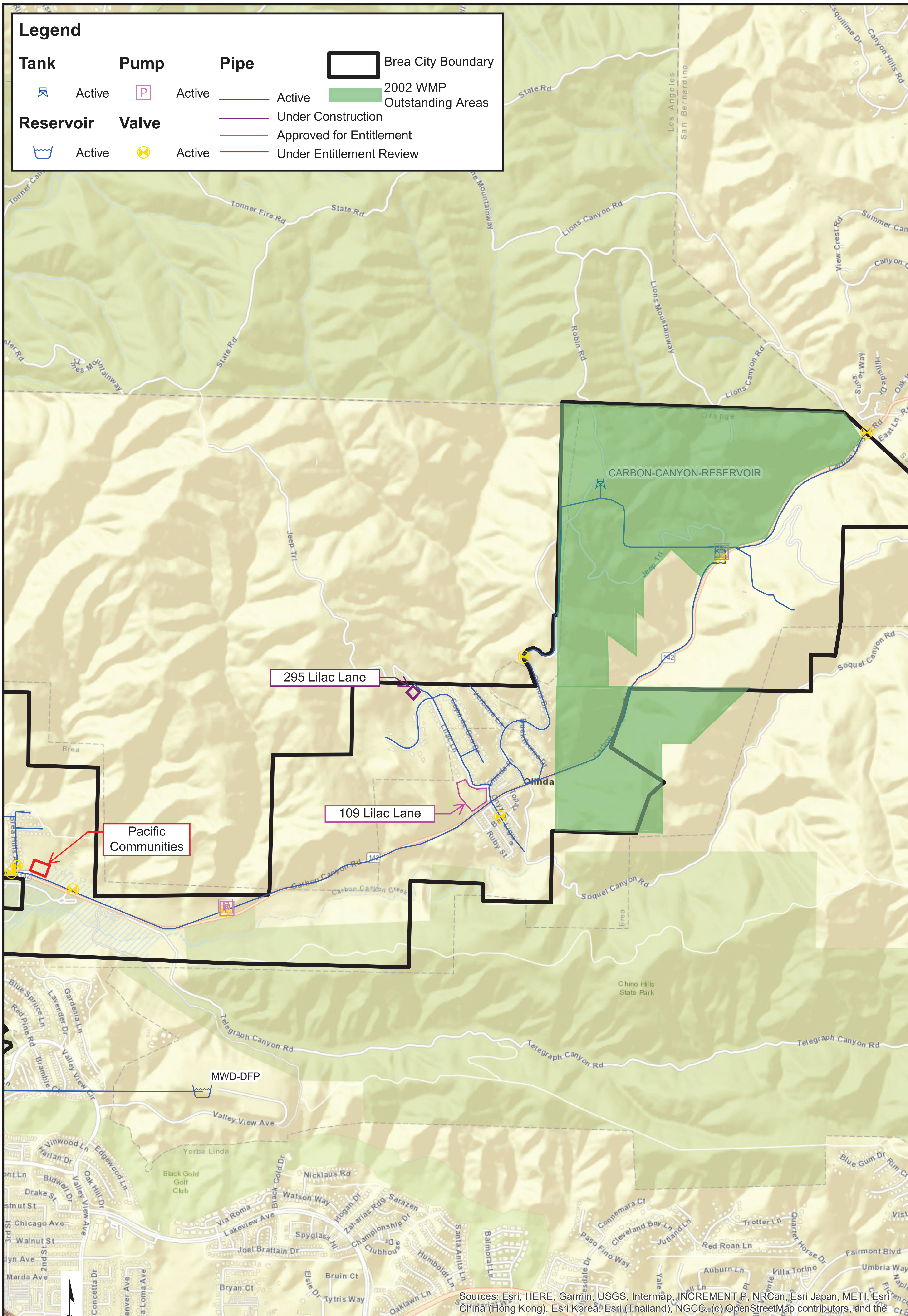

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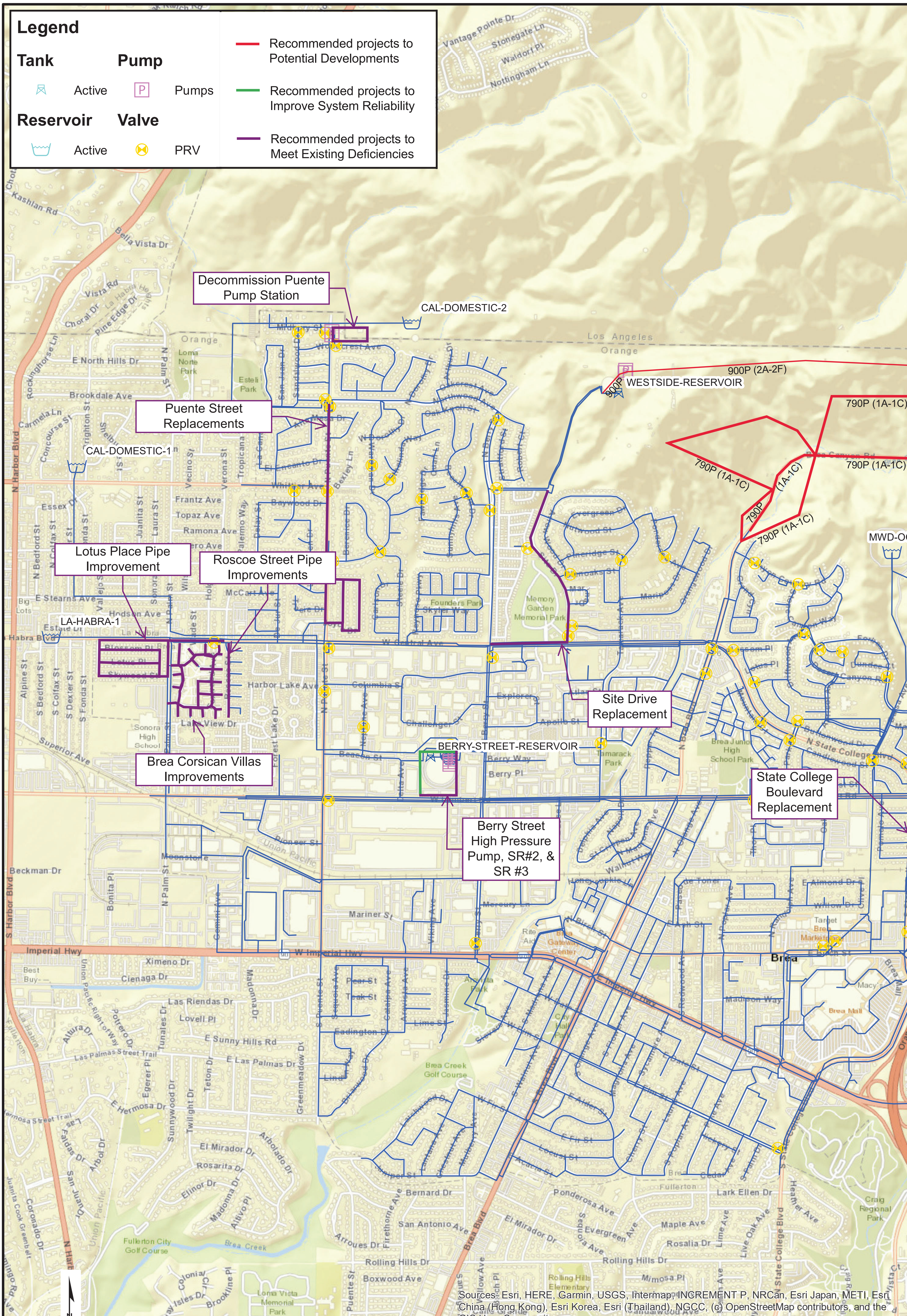
Appendix D – Proposed Recommended Improvements



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PROPOSED RECOMMENDED IMPROVEMENTS
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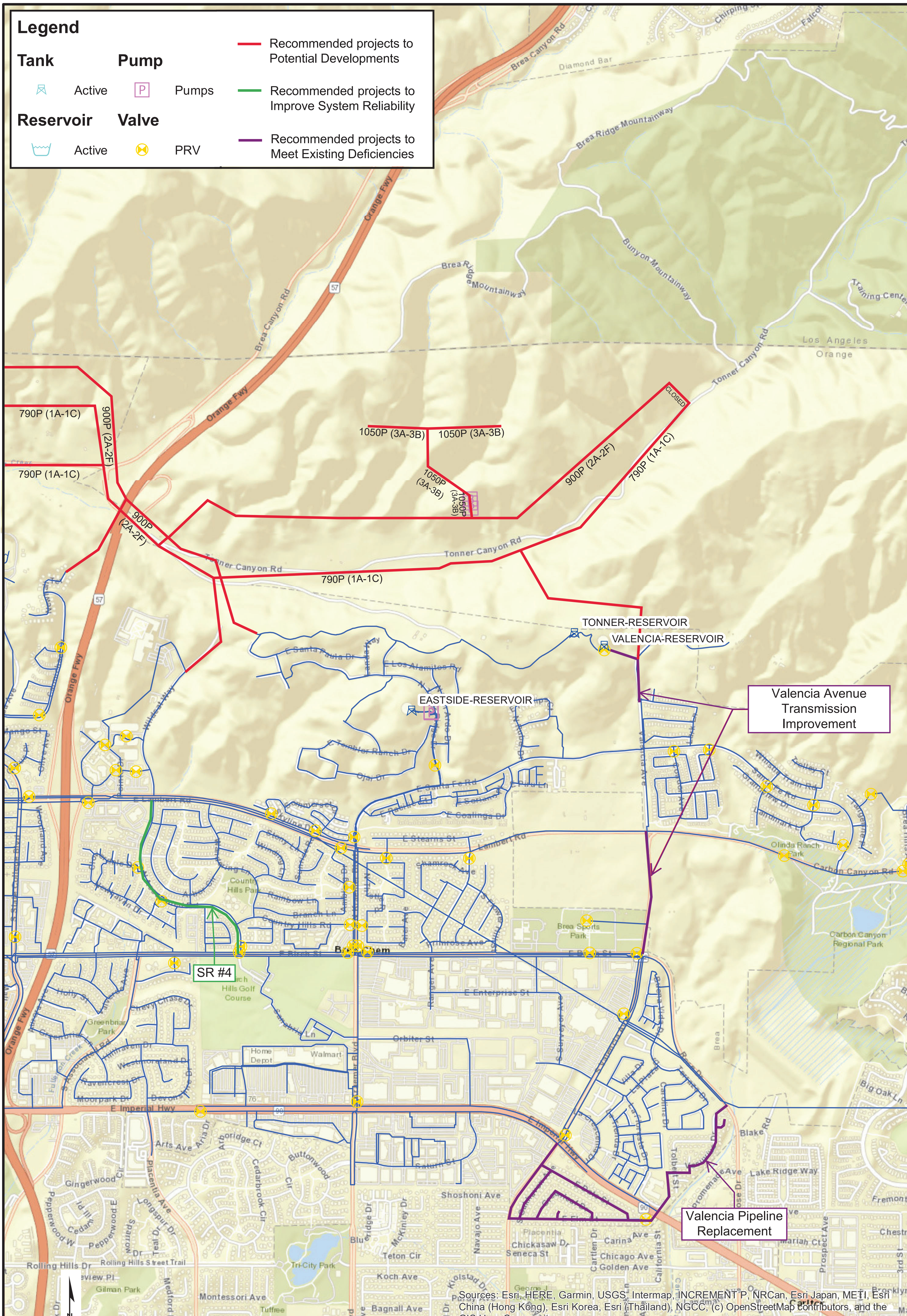

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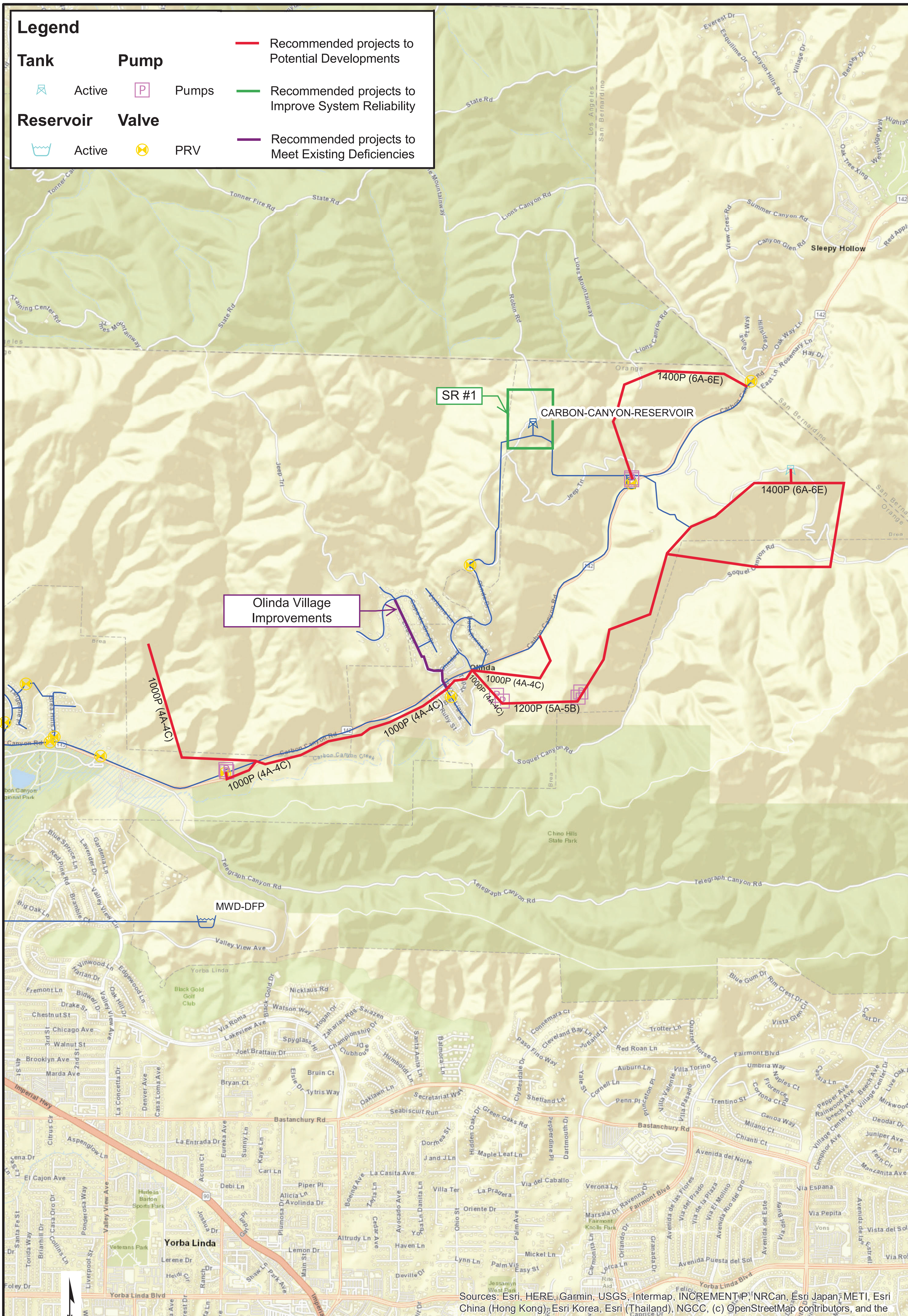

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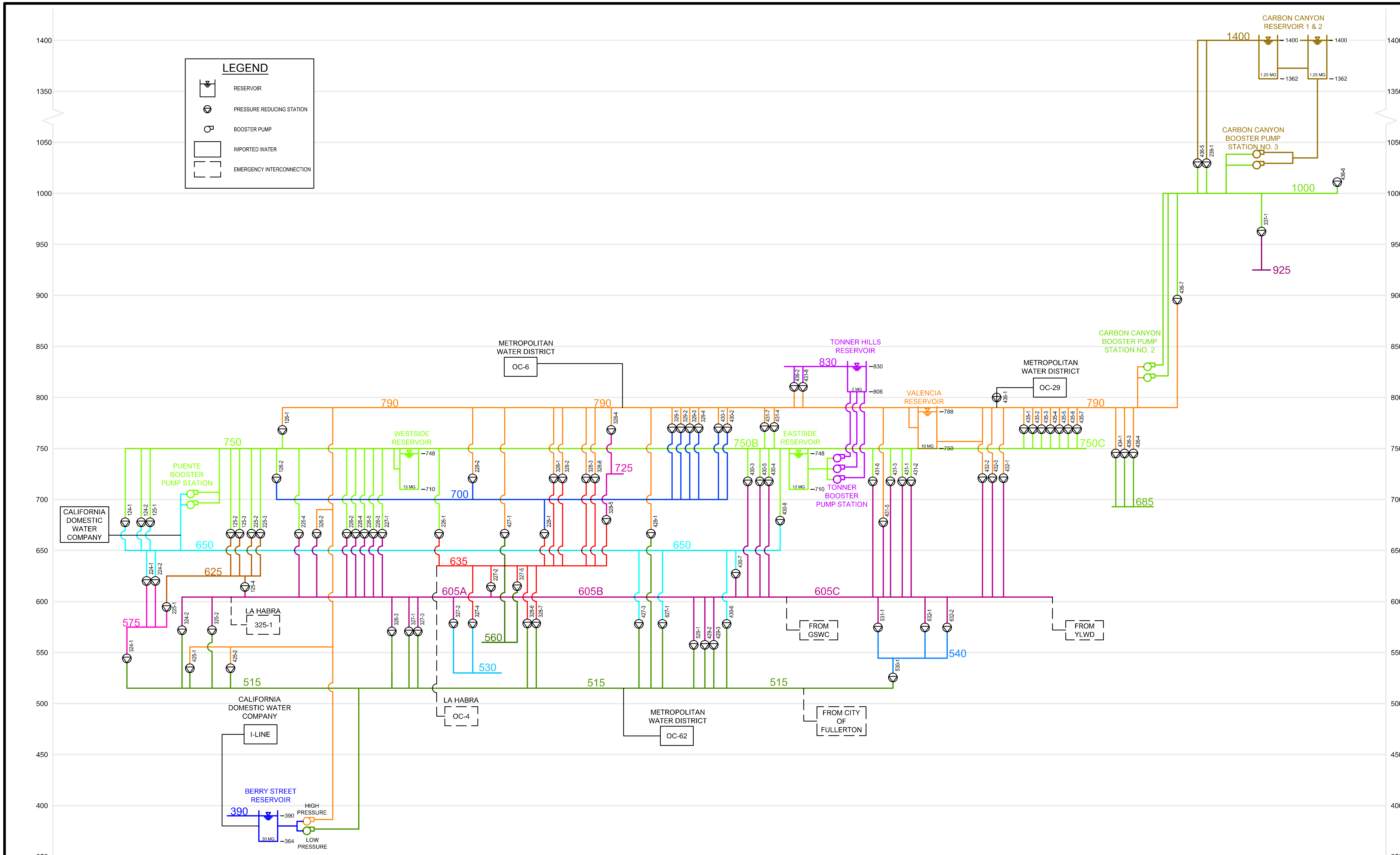
Appendix E – Existing Hydraulic Profile



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EXISTING HYDRAULIC PROFILE
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