



# WATER SYSTEM

## 2. Existing Water System

The existing water system includes imported water connections, reservoirs, pump stations, system control valves, and pipelines. The distribution system consists of 14 pressure zones. This section describes the existing water system facilities. A water system map is provided as Exhibit 2-1 and a hydraulic schematic is provided as Exhibit 2-2 (exhibits are provided at the end of each section).

### 2.1 Water Supply System

The water system supply includes imported water, local groundwater, and local surface water. Imported water is provided by Metropolitan Water District of Southern California (MWD) through Municipal Water District of Orange County (MWDOC). Groundwater production wells include two wells that extract water from the Arroyo Trabuco aquifer, which is part of the San Juan Basin. Local surface water from Irvine Lake is purchased from Irvine Ranch Water District.

#### 2.1.1 Imported Water Connections

The District has an imported water supply from MWD through MWDOC. MWD's main water sources are the Colorado River via the Colorado River Aqueduct and the Lake Oroville watershed in Northern California through the State Water Project.

The majority of the District's imported water is untreated. Untreated imported water is conveyed from the Baker Pipeline to the District's Dimension Water Treatment Plant (DWTP). Water from the Baker Pipeline originates from either MWD or from Irvine Lake. Raw water stored in Irvine Lake is for emergency use only. The Baker Pipeline is owned and operated by the Santiago Aqueduct Commission (SAC), a joint powers agency formed to finance, construct, and maintain the Baker Pipeline. The Baker Pipeline was designed to bring imported untreated water from MWD to South Orange County.

The SAC includes Irvine Ranch Water District (IRWD), El Toro Water District (ETWD), Santa Margarita Water District (SMWD), Trabuco Canyon Water District, the Municipal Water District of Orange County (MDWOC), and Moulton Niguel Water District (MNWD).

The District's major source of treated imported water is MWD's Robert B. Diemer Filtration Plant. Typically, the Diemer Filtration Plant receives a blend of Colorado River water from Lake Mathews through the MWD Lower Feeder and State Water Project (SWP) water through the Yorba Linda Feeder. The treated water is conveyed from the plant through the Allen McCullough Pipeline (AMP) to the South County Pipeline and SMWD's Antonio Delivery System, respectively. The water enters the District's water system via the District's intertie with SMWD at the Plano Trabuco Pump Station. The water delivered by SMWD is the District's contractual capacity of 4 cfs in the AMP that is "wheeled" through SMWD's system.



The District can also receive additional treated water from the Baker Water Treatment Plant. The Baker Water Treatment Plant is a water treatment plant in Lake Forest that is operated by IRWD. The plant was a joint project by five South Orange County water districts with capacity ownership as follows:

- El Toro Water District has capacity rights of 5 cfs (3.2 MGD)
- Irvine Ranch Water District has capacity rights of 10.5 cfs (6.8 MGD)
- Moulton Niguel Water District has capacity rights of 13 cfs (8.4 MGD)
- Santa Margarita Water District has capacity rights of 13 cfs (8.4 MGD)
- Trabuco Canyon Water District has capacity rights of 2 cfs (1.3 MGD)

In 2017, TCWD entered into an agreement with the City of San Clemente to sell and deliver up to 1,200 AFY of treated water from the Baker Water Treatment Plant to the City of San Clemente. The District's water sources and capacities are summarized in Table 2-1.

**Table 2-1 : Imported Water Supply**

Supply Source	Supply To	Water Sources	Contractual Amount MGD, cfs
MWD/MWDOC untreated	DWTP	Colorado River, Lake Oroville Watershed	(3.84) 6.0
Lake Oroville Watershed	Plano Trabuco (SMWD Intertie)	Colorado River, State Water Project	(2.59) 4.0
Supply Type	Supply Facility	Water Sources	Contractual Amount MGD, cfs
Untreated	DWTP	Baker Pipeline	(3.84) 6.0
Treated	Plano Trabuco (SMWD Intertie)	Allen-McColloch Pipeline	(2.59) 4.0

Two residential communities, Portola Hills and Skyridge, are within the District's service area, but are not directly supplied water by the District. Portola Hills is served by IRWD's system. The District reads the meters and bills the customers for water service. In turn, IRWD bills the District for water supplied to these customers. Skyridge is set up in a similar manner but is supplied by the District's capacity in the South County Pipeline and wheeled through SMWD's system.

### 2.1.2 Emergency Interties

The District has emergency interties with Santa Magarita Water District (SMWD), Irvine Ranch Water District (IRWD), and El Toro Water District (ETWD). Through various arrangements, water can be conveyed to and from these districts for short durations such as emergencies or water transmission line breaks/repairs. These interties are described in Table 2-2. All of the District's interties are in the Harris Grade Zone.



**Table 2-2: Emergency Interties**

Name	Direction	Location	Capacity (cfs)	Operational Status	Notes
<b>SMWD</b>					
<b>Plano Trabuco</b>	to District	Plano Trabuco Rd	6	Active	Treated water from the Allen-McColloch Pipeline or Baker Treatment Plant.
<b>Valley Vista</b>	to SMWD	Valley Vista / El Toro Rd	3	Active	
<b>Zone 4</b>	to SMWD	Trabuco Canyon Rd / Plano Trabuco Rd	4	Active	
<b>Zone 5</b>	to SMWD	Trabuco Canyon Rd / Plano Trabuco Rd	1	Active	
<b>IRWD</b>					
<b>Ridgeline #1</b>	to District	Ridgeline Rd (at Ridgeline Pump Station)	4	Active	
<b>Ridgeline #2</b>	to IRWD	Ridgeline Rd / Santiago Canyon Rd	2	Offline	
<b>Santiago</b>	Both ways	Santiago Canyon Rd / Falcon St	0.75	Active	This was part of the former Santiago Canyon Water District system
<b>ETWD</b>					
<b>Larchmont</b>	Both ways	Larchmont Dr	1	Offline	

### 2.1.3 Groundwater Production Wells

The District owns two wells that pump from the Arroyo Trabuco Aquifer in the San Juan Groundwater Basin. However, because the aquifer is shallow, water supply for the District’s wells varies year to year. In wet years there is sufficient water to operate the wells all year. In dry years, the wells have not been operable. Due to the seasonal fluctuations of groundwater availability, the District pumps groundwater when available, but does not rely on it as a water supply source. Groundwater is under the influence of surface water; therefore, it is treated at the Trabuco Creek Wells Facility through a two-stage filtration process before it is sent into the distribution system. Table 2-3 shows the maximum pumping rate of each well when levels are high enough for operating the well.

**Table 2-3: Groundwater Production Wells**

Name	Location	Most Recent Max Pumping Rate*
<b>Rose Canyon Well</b>	Trabuco Canyon Road (Same site as Trabuco Creek Wells Facility)	600 gpm
<b>Lang Well</b>	Trabuco Canyon Road (Same site as Trabuco Creek Wells Facility)	300 gpm

\*Based on 2011 production data



## 2.2 Pressure Zones

A pressure zone is a geographical area of a water distribution system controlled by hydraulic boundary conditions, typically targeting a set hydraulic grade line (HGL) such that an acceptable range of pressures is delivered for customers and fire protection. Typical boundary conditions include gravity storage tank water levels, pump stations, and system control valves such as pressure reducing valves (PRVs), physical separations in piping, or closed valves. Pressure zone boundaries are often established based on geographic areas and elevations targeting static pressure ranges.

There are two general categories of pressure zones: “open” zones, and “closed” zones. An open zone’s HGL is controlled by a storage tank that “floats” or provides gravity service to the pressure zone that it serves. A closed zone is one that has no gravity storage and relies upon a direct pumped supply. The District’s water system consists of six (6) open zones and eight (8) closed zones. The open zones are Cooks, Harris Grade, Rose Canyon, Upper Dove Canyon, Trabuco, and Joplin. The District provides water to Joplin Zone but does not own any of the pipelines or tanks in the zone. The County of Orange owns, operates, and maintains the Joplin Zone pipelines and tanks.

The closed zones are Trabuco Oaks, Lower Dove Canyon, High Country, Lower Trabuco, Topanga Canyon, Canyon Creek, Falcon, and Saddle Crest. Trabuco Oaks, Lower Dove Canyon, High Country, and Lower Trabuco are served by pressure reducing stations. Topanga Canyon, Canyon Creek, Falcon, and Saddle Crest are served by pump stations with hydropneumatic tanks. Table 2-4 provides a summary of each pressure zone, and locations are shown on Exhibit 2-1.



**Table 2-4: Pressure Zones**

Pressure Zone	Type	HGL (ft) <sup>1</sup>	Service Elevation Range (ft) <sup>2</sup>	Average Day Demand (gpm) <sup>3</sup>	Notes
Cooks	Open	1250	1003 - 1013	2	
Harris Grade	Open	1508	931 - 1524	225	
Rose Canyon	Open	1357	1116 - 1332	10	
Upper Dove Canyon	Open	1418	1041 - 1307	705	
Trabuco	Open	1686	1362 - 1608	191	
Joplin	Open	1940	1318 - 1327	1	Zone supplied by District, but not owned by District
Trabuco Oaks	Closed	1208	1005 - 1112	28	
Lower Dove Canyon	Closed	1258	980 - 1108	118	
High Country	Closed	1496	1211 - 1370	86	
Lower Trabuco	Closed	1544	1252 - 1452	53	
Topanga Canyon	Closed	1533	1332 - 1451	18	Hydropneumatic Zone
Canyon Creek	Closed	1682	1391 - 1521	5	Hydropneumatic Zone
Falcon	Closed	1742	1399 - 1574	5	Hydropneumatic Zone
Saddle Crest	Closed	1604	1320 - 1460 <sup>4</sup>	83 <sup>4</sup>	Hydropneumatic Zone, Development in progress
<b>TOTAL (gpm)</b>				<b>1,452</b>	

<sup>1</sup> Based on reservoir high water levels.

<sup>2</sup> Based on approximate water meter ground elevation.

<sup>3</sup> Based on calendar year 2021 billing data.

<sup>4</sup> Per 2017 Saddle Crest Sub Area Master Plan.

## 2.3 Reservoirs

There are nine (9) active reservoirs (also called tanks) in the water system. Most of the reservoirs provide gravity storage to the open pressure zones and are above-ground steel tanks. The total capacity of the active reservoirs is approximately 11.4 million gallons (MG). A summary of reservoir type, capacity, and year of construction is provided in Table 2-5 with their location shown on Exhibit 2-1.



**Table 2-5: Existing Reservoirs**

Pressure Zone	Name	HWL Elevation (ft)	Capacity (MG)	Type	Year Constructed
<b>Cooks</b>	Cooks	1165	0.06	Steel	1963
<b>Harris Grade</b>	Harris Grade No. 1	1504	2.00	Steel	1980
	Harris Grade No. 2	1496	0.42	Steel	1965
	Saddle Crest <sup>2</sup>	1508	1.50	Steel	2020
<b>Rose Canyon</b>	Rose Canyon	1357	0.42	Steel	1979
<b>Joplin<sup>1</sup></b>	Joplin No. 1	1934	0.13	Steel	1934
	Joplin No. 2	1934	0.03	Steel	1934
<b>Upper Dove Canyon</b>	Upper Dove Canyon	1418	2.50	Steel	1988
<b>Trabuco</b>	Trabuco No. 1	1686	1.50	Steel	1984
	Trabuco No. 2	1686	3.00	Steel	1986
<b>Total Capacity (MG)<sup>3</sup></b>			<b>11.40</b>		

<sup>1</sup>The District provides water to Joplin Zone but does not own any of the pipelines or tanks in the zone.

<sup>2</sup> Already constructed but not in use.

<sup>3</sup> Joplin No.1 and No. 2 not included in calculations since they are not owned by District.

## 2.4 Pump Stations

Pump stations are used to pump water from lower pressure zones to higher pressure zones, or to supply the hydropneumatic zones. There are a total of ten (10) pump stations supplying the open pressure zones and the hydropneumatic zones. Since all supply enters the system in either Cooks or Harris Grade pressure zones, pump stations are used to transfer water to the upper zones and the reservoirs that serve those zones. Water supply enters the Cooks Zone supply sources on the westerly side of the District. It enters the Harris Grade Zone from the SMWD intertie and Plano Trabuco Pump Station.

A list of the system pump stations and key information for each station is included in Table 2-6. Total capacity represents the total design flow of all pumps at the facility. Firm capacity is defined as the pump station's capacity with the largest pump out of service. Capacities for each pump station were obtained from pumping system efficiency tests performed by Southern California Edison, as-builts, and pump nameplate data obtained during field visits.



**Table 2-6: Pump Stations**

Name	Pump	Design Flow (gpm)	Total Capacity (gpm)	Firm Capacity (gpm)	From (Zone)	To (Zone)
<b>DWTP</b>	Pump 1	450	2,700	1,350	DWTP	Cooks
	Pump 2	900				
	Pump 3	1350				
<b>Larchmont<sup>1</sup></b>	Pump 1	400	400	N/A	ETWD	Cooks
<b>Ridgeline</b>	Pump 1	892	3,568	2,676	Cooks	Harris Grade
	Pump 2	892				
	Pump 3	892				
	Pump 4	892				
<b>El Toro<sup>1</sup></b>	Pump 1	450	1,800	1,350	Cooks	Harris Grade
	Pump 2	450				
	Pump 3	450				
	Pump 4	450				
<b>Plano Trabuco</b>	Pump 1	900	2,700	900	SMWD	Harris Grade
	Pump 2	1800				
<b>Rose Canyon</b>	Pump 1	305	610	305	Harris Grade	Rose Canyon
	Pump 2	305				
<b>Robinson Ranch</b>	Pump 1	1000	1,900	900	Harris Grade	Trabuco
	Pump 2	450				
	Pump 3 (Diesel)	450				
<b>Falcon</b>	Pump 1	75	1,150	650	Harris Grade	Falcon
	Pump 2	75				
	Pump 3	500				
	Pump 4	500				
<b>Topanga Canyon</b>	Pump 1	120	1,860	240	Harris Grade	Topanga Canyon
	Pump 2	120				
	Pump 3	1620				
<b>Canyon Creek</b>	Pump 1	100	600	100	Harris Grade	Canyon Creek
	Pump 2	500				
<b>TOTAL (gpm)</b>			<b>17,288</b>	<b>8,871</b>		

<sup>1</sup>Emergency pump stations only. These are not used under normal operations.

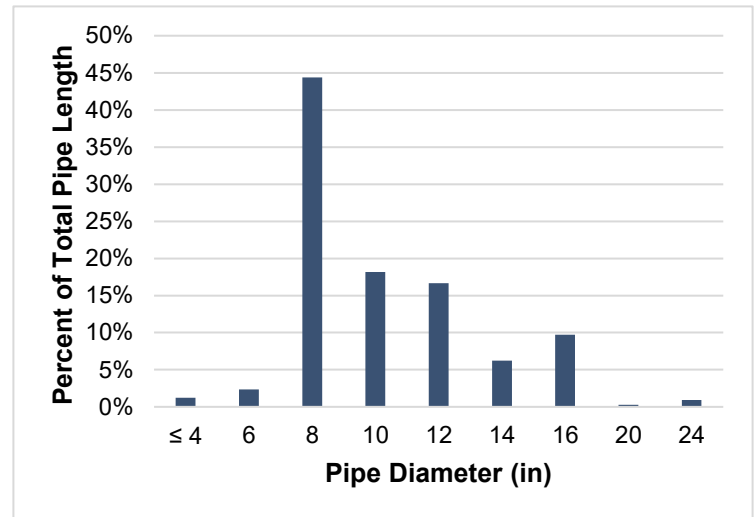


## 2.5 Pipelines

The water system is comprised of approximately 64 miles of distribution and transmission piping, which convey water from the supply sources to the water system facilities and meters. Pipe diameters range from less than 4” to 24” with the majority of the system made up of 8” diameter pipelines. The following tables and charts provide data on pipeline diameter, material, and installation year.

**Table 2-7: Existing Pipelines by Diameter**

Pipe Diameter (in)	Length (ft)	Length (mi)	Percentage (%)
≤ 4	4,105	0.8	1.2%
6	7,948	1.5	2.4%
8	149,084	28.2	44.4%
10	61,092	11.6	18.2%
12	56,056	10.6	16.7%
14	20,996	4.0	6.3%
16	32,168	6.1	9.6%
20	969	0.2	0.3%
24	3,125	0.6	0.9%
<b>TOTAL</b>	<b>335,541</b>	<b>63.5</b>	<b>100%</b>

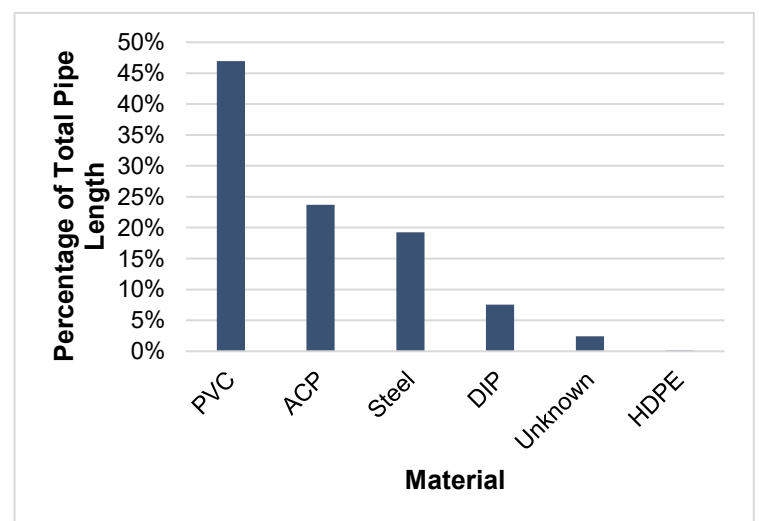


**Figure 2-1: Existing Pipelines by Diameter**

As shown in Table 2-8 and Figure 2-2, the predominant piping materials include polyvinyl chloride (PVC) and asbestos cement pipe (ACP), and to a lesser extent ductile iron pipe and HDPE (DIP).

**Table 2-8: Existing Pipelines by Material**

Material	Length (ft)	Length (mi)	Percentage (%)
PVC	157,828	29.9	47.0%
ACP	79,027	15.0	23.6%
Steel	64,723	12.3	19.3%
DIP	25,378	4.8	7.6%
Unknown	8,092	1.5	2.4%
HDPE	493	0.1	0.1%
<b>TOTAL</b>	<b>335,541</b>	<b>63.5</b>	<b>100%</b>



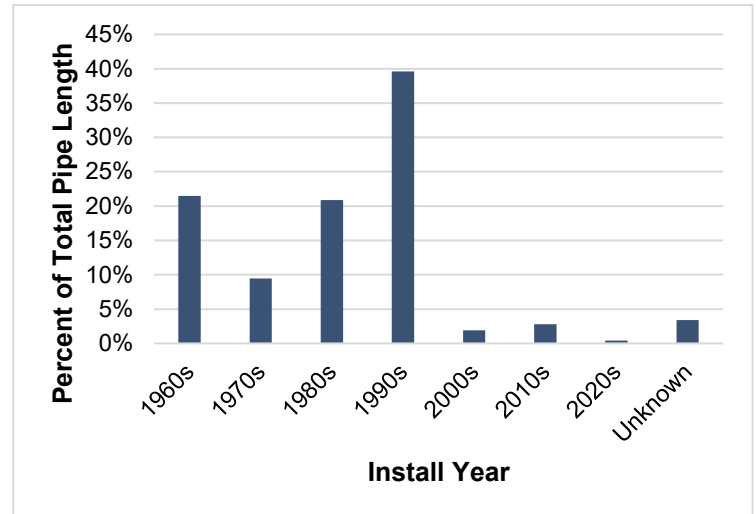
**Figure 2-2: Existing Pipelines by Material**



Pipe ages were based on year of installation, and as shown in Table 2-9 and Figure 2-3 the system contains pipe installations as early as the 1960s, with the majority of pipes in the 30-40 year age range. There are also about 2.2 miles, or about 3.4 percent of pipes with an unknown age.

**Table 2-9: Existing Pipelines by Install Year**

Install Year	Length (ft)	Length (mi)	Percentage (%)
1960s	72,112	13.7	21.5%
1970s	31,722	6.0	9.5%
1980s	69,961	13.3	20.9%
1990s	132,972	25.2	39.6%
2000s	6,445	1.2	1.9%
2010s	9,439	1.8	2.8%
2020s	1,427	0.3	0.4%
Unknown	11,463	2.2	3.4%
<b>TOTAL</b>	<b>335,541</b>	<b>63.5</b>	<b>100%</b>



**Figure 2-3: Existing Pipes by Install Year**

## 2.6 Meters

The District has approximately 4,097 active water meter accounts, based on 2021 billing data. The District tracks water consumption by “Account Type.” Table 2-10 summarizes the count per account type. A large percentage of the District’s meters are classified as residential.

**Table 2-10: Water Meter Summary**

Service Account Type	No. of Accounts	Percent of Accounts (%)
Agricultural	5	0.1%
Apartments	31	0.8%
Commercial	81	2.0%
Irrigation	84	2.1%
Residential <sup>1</sup>	3,896	95.1%
<b>TOTAL</b>	<b>4,097</b>	<b>100%</b>

<sup>1</sup>Includes Portola Hills and Skyridge communities



## 2.7 System Control Valves

System control valves are used throughout the water system to perform various functions. Pressure reducing valves are used to transfer water from a higher pressure zone into a lower pressure zone. The function of pressure reducing valves is to modulate and maintain a set downstream pressure regardless of upstream (upper pressure zone) conditions. Pressure reducing stations provide an important role in the distribution system by allowing storage in higher pressure zones to be utilized in lower pressure zones.

Other types of control valves include pressure relief valves, flow control valves, check valves, altitude valves, and pump control valves. Valves can also perform multiple functions. A brief description for each type of control valve is included below.

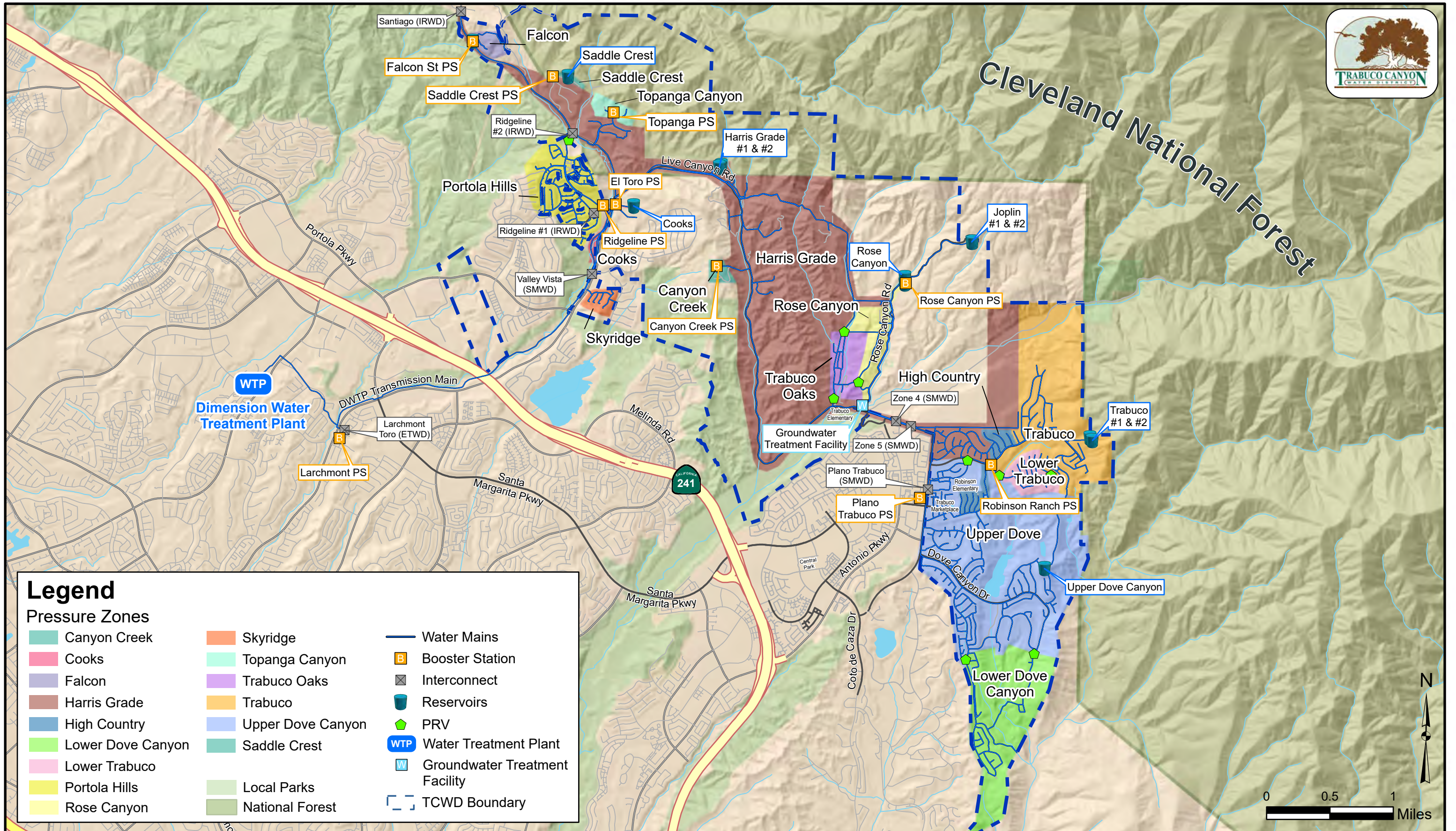
- Pressure reducing valve – Maintains a set downstream pressure. Allows a higher pressure zone to supply a lower pressure zone. These are used as supply points between zones.
- Pressure relief valve – Maintains a set upstream pressure. Provides a level of protection to the higher zone to allow higher pressures to discharge into the lower zone, or discharge to atmosphere.
- Pressure sustaining valve – Maintains a set upstream pressure. Provides a level of protection by preventing pressure fluctuations on either side of the valve. Similar function to pressure relief valve.
- Flow control valve – Maintains a set flow rate.
- Check valve – Allows flow in one-direction only.
- Altitude valve – Set to open and close based on level in a reservoir.
- Pump control valve – Set to open slowly based on the operation of a pump. These are sometimes used on pump station discharge lines.

A summary of the system control valves is shown in Table 2-11 with their locations shown on Exhibit 2-1 and Exhibit 2-2.



**Table 2-11: System Control Valves**

<b>Location</b>	<b>Valve Size (inches)</b>	<b>Zone Supplied</b>	<b>Function</b>
<b>Rose Canyon Rd (by Wells Facility)</b>	8	Rose Canyon Reservoir	Pressure Reducing
<b>North Ln</b>	3	Trabuco Oaks	Pressure Reducing
<b>North Ln</b>	6	Trabuco Oaks	Pressure Reducing
<b>Mountain View Rd</b>	6	Trabuco Oaks	Pressure Reducing
<b>Trabuco Oaks Dr</b>	3	Trabuco Oaks	Pressure Reducing
<b>Plano Trabuco Rd (Plano Trabuco PS)</b>	6	Upper Dove Canyon	Pressure Reducing
<b>Lindsay Dr</b>	4	Upper Dove Canyon	Pressure Reducing
<b>Lindsay Dr</b>	8	Upper Dove Canyon	Pressure Reducing
<b>Bell Canyon Dr</b>	2	Lower Dove Canyon	Pressure Reducing
<b>Bell Canyon Dr</b>	4	Lower Dove Canyon	Pressure Reducing
<b>Bell Canyon Dr</b>	8	Lower Dove Canyon	Pressure Reducing
<b>Sycamore Canyon Dr</b>	2	Lower Dove Canyon	Pressure Reducing
<b>Sycamore Canyon Dr</b>	4	Lower Dove Canyon	Pressure Reducing
<b>Sycamore Canyon Dr</b>	8	Lower Dove Canyon	Pressure Reducing
<b>High Country Dr (by Robinson Ranch PS)</b>	3	High Country	Pressure Reducing
<b>High Country Dr (by Robinson Ranch PS)</b>	6	High Country	Pressure Reducing
<b>Rosemont Dr</b>	2	Lower Trabuco	Pressure Reducing
<b>Rosemont Dr</b>	8	Lower Trabuco	Pressure Reducing
<b>Heritage Dr</b>	2	Lower Trabuco	Pressure Reducing
<b>Heritage Dr</b>	8	Lower Trabuco	Pressure Reducing



### Legend

#### Pressure Zones

- Canyon Creek
- Cooks
- Falcon
- Harris Grade
- High Country
- Lower Dove Canyon
- Lower Trabuco
- Portola Hills
- Rose Canyon
- Skyridge
- Topanga Canyon
- Trabuco Oaks
- Trabuco
- Upper Dove Canyon
- Saddle Crest
- Local Parks
- National Forest

- Water Mains
- Booster Station
- Interconnect
- Reservoirs
- PRV
- WTP
- Groundwater Treatment Facility
- TCWD Boundary





### **3. Demands**

The consumption of water is the driving force behind the hydraulic dynamics occurring in water distribution systems. When simulating these dynamics in the water distribution model, an accurate representation of system demands is just as critical as modeling the physical components. This section covers existing demands, demand projections, diurnal curves, peaking factors, and demand factors.

#### **3.1 Existing Demands**

##### **3.1.1 Production and Consumption**

Production and consumption data were obtained and analyzed for the system. Production records are reported by source type, such as the DWTP, groundwater wells or the imported water connections. Billing records are reported by account type and monthly usage by customers. Available production data included calendar years 2013 to 2020. Available billing records included data from July 2013 to December 2021. The analysis utilized the data with complete and overlapping records: calendar years 2014 to 2020. Refer to Figure 3-1 for a comparison of production and consumption (billing).

Consumption data shown in Figure 3-1 does not include both Portola Hills and Skyridge customers that are billed by TCWD but whose supply comes from IRWD and SMWD, respectively. The data shows that consumption figures from January 2014 to April 2018 were significantly greater than the production figures. However, production and consumption figures were observed to have a high degree of correlation from May 2018 through December 2020. Average yearly consumption is shown in Figure 3-2.

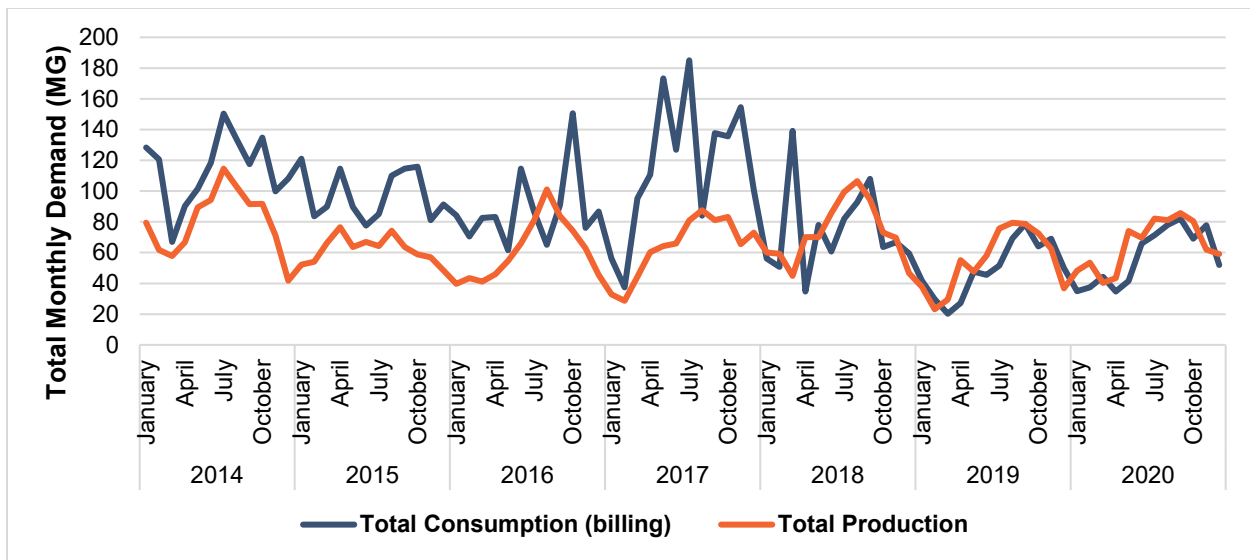


Figure 3-1: Production vs Consumption

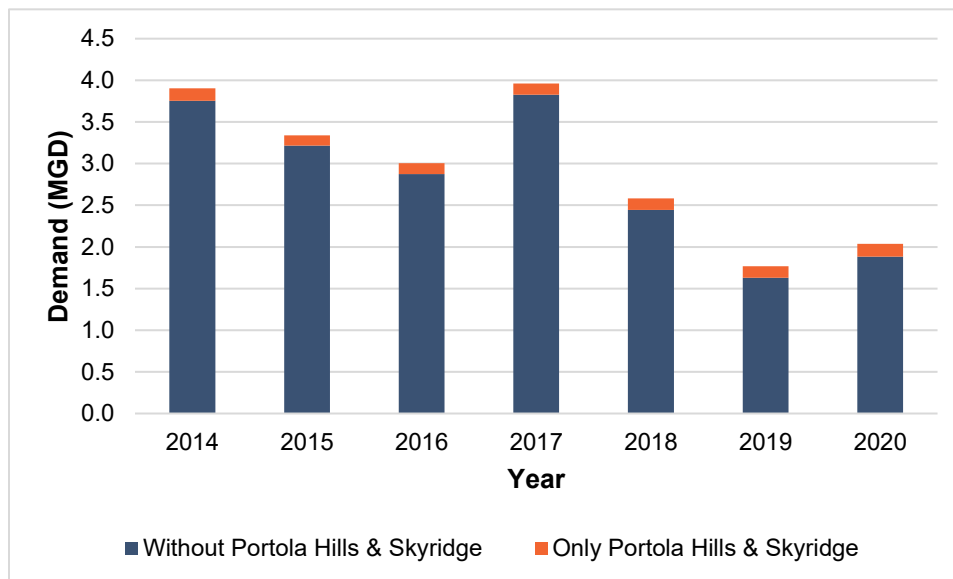


Figure 3-2: Average Yearly Demand



### 3.1.2 Non-Revenue Water

The difference between production and billing records, referred to as non-revenue water, may be attributed to a variety of factors. Non-revenue water can be a result of unbilled consumption such as fire-fighting, unauthorized consumption, metering inaccuracies, data handling errors, as well as leakage, overflows, flushing or pressure relief. Non-revenue water can be defined as unbilled authorized consumption plus water losses. Table 3-1 illustrates how AWWA accounts for various system demands

**Table 3-1: AWWA Water Balance**

Own Sources (Adjusted for known errors)	System Input	Water Exported	Billed Water Exported			Revenue Water
		Water Supplied	Authorized Consumption	Billed Authorized Consumption	Billed Metered Consumption (water exported is removed)	Billed Unmetered Consumption
Water Losses	Apparent Losses			Unbilled Authorized Consumption	Unbilled Metered Consumption	Non-Revenue Water (NRW)
		Real Losses	Unbilled Unmetered Consumption	Unauthorized Consumption		
Leakage on Transmission and/or Distribution Mains	Customer Metering Inaccuracies					
	Leakage and Overflows at Utility's Storage Tanks	Systematic Data Handling Errors				
Leakage on Service Connections		Leakage on Transmission and/or Distribution Mains				
		Leakage and Overflows at Utility's Storage Tanks				
	Leakage on Service Connections					

Senate Bill 555 requires that water suppliers periodically submit water audits to the California Department of Water Resources (DWR). Senate Bill 555 also required that the California State Water Resources Control Board (SWRCB) adopt rules requiring urban retail water suppliers to meet performance standards for the volume of water loss. The water loss standards were made public on December 1, 2020. Key points from the draft regulation are summarized below.

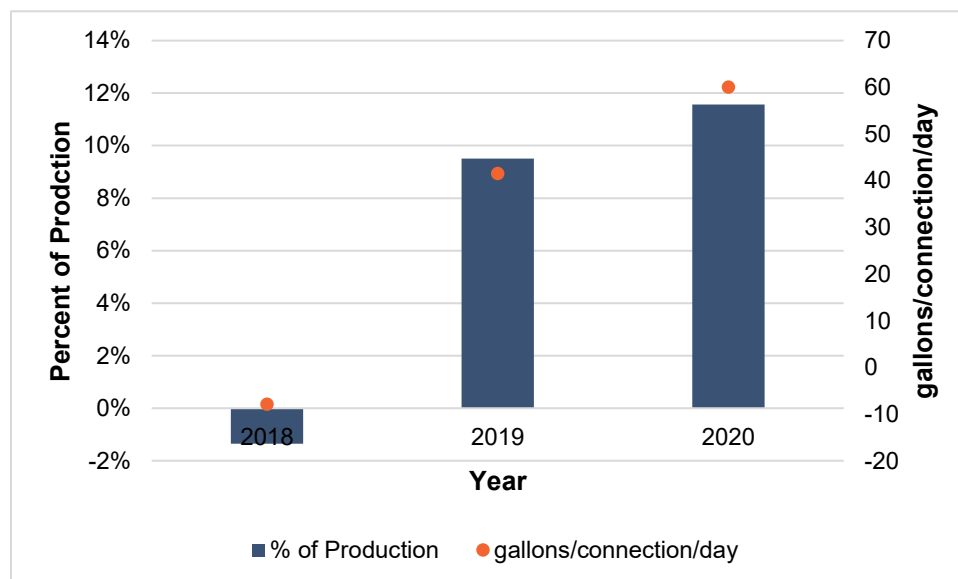
- An urban water supplier reporting in gallons per connection per day shall reduce its real water loss to no greater than 16 gallons per connection per day. An urban water supplier reporting in gallons per mile per day shall reduce its real water loss to no greater than 1,184 gallons per mile per day. Lastly, an urban water supplier reporting in a combination of gallons per mile per day and gallons per connection per day shall reduce its real water loss to no greater than 16 gallons per connection per day. Each urban water supplier shall reduce its real water loss to the aforementioned standards no later than January 1, 2028.



- Urban water suppliers will be required to submit annual water audits until January 1, 2028. After the 2028 deadline, compliance will be assessed every 3 years, with an allowed variation of 5 gallons per connection per day above the water loss standard.

The SWRCB used calendar years 2017 to 2019 District water audit data to calculate a water loss performance standard of 20.2 gallons per connection per day. This is slightly higher than the 16 gallons per connection per day threshold.

Based on industry standards, a non-revenue rate of about 10 percent is considered acceptable. As shown in Figure 3-3, from 2018 to 2020, the District’s non-revenue water has steadily increased, with a 2020 non-revenue water of approximately 12 percent, which is slightly above industry benchmarks. The figure also shows an average of 32 gallons per connection per day for the years 2018 to 2020.



**Figure 3-3: Non-Revenue Water\***

\*Does not include Portola Hills and Skyridge communities



### 3.2 Demand Projections

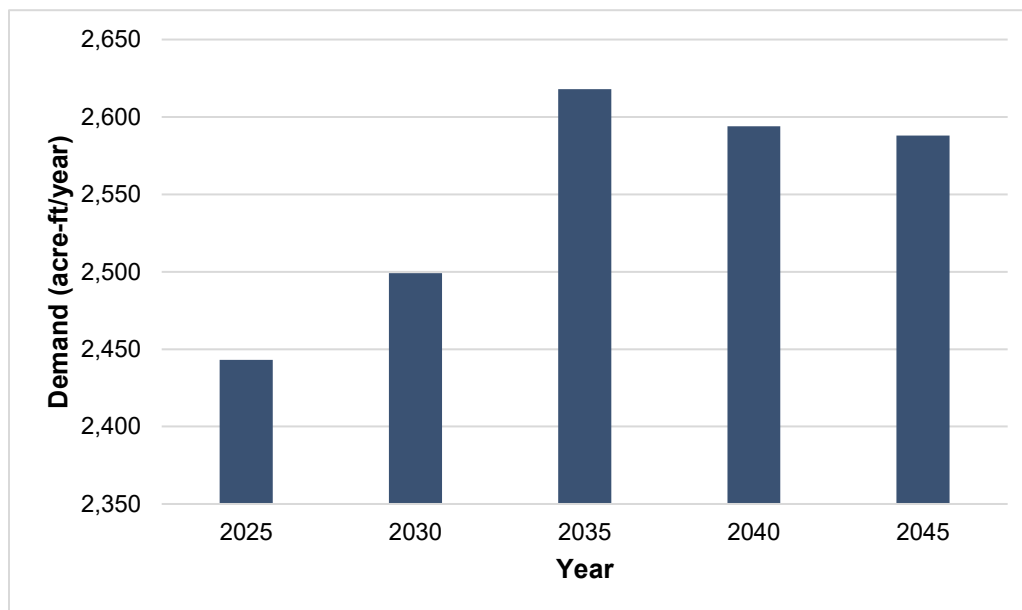
Demand projections were obtained from the District’s 2020 Urban Water Management Plan.

Table 3-2 is a projection of the District’s water demand from 2025 to 2045. Commercial, Industrial, and Institutional (CII) projections for 2025 through 2045 were broken down into commercial, industrial, and institutional/governmental using proportions reported for each billing sector in fiscal year 2019-20. While the volume of water used for single family residential applications is projected to increase between 2025 and 2045, usage slightly decreases as a percentage of total potable demand during that timeframe. Multi-family residential and CII usage is projected to increase. The volume of projected use for landscape applications stays constant at 503 AF between 2025 and 2045 (a slight decrease as a percentage of total potable demand). Projections for NRW remain steady during that timeframe (~8.3% of total potable demand).

**Table 3-2: Projected Water Use\***

Use Type	2025 (AF)	2030 (AF)	2035 (AF)	2040 (AF)	2045 (AF)
Single Family	1,595	1,594	1,688	1,663	1,656
Multi-Family	62	81	94	94	95
Commercial	81	114	117	120	120
Landscape	503	503	503	503	503
Non-Revenue Water	203	207	217	215	215
<b>TOTAL (AF)</b>	<b>2,443</b>	<b>2,499</b>	<b>2,618</b>	<b>2,594</b>	<b>2,588</b>

\*Data from District’s 2020 Urban Water Management Plan



**Figure 3-4: Projected Water Use\***

\*Data from District’s 2020 Urban Water Management Plan



The projections from the District’s 2020 Urban Water Management Plan were used to calculate future (2045) average day and maximum day demands. See Table 3-3.

**Table 3-3: Existing and Future Demands**

Scenario	Average Day	Max Day
Existing	2.09 MGD 3.2 cfs	3.88 MGD 6.0 cfs
Future (2045)	2.31 MGD 3.5 cfs	4.27 MGD 6.6 cfs

### 3.3 Diurnal Curve

Water demands vary throughout the day. Residential use is typically characterized by a dual-peak diurnal with a primary peak occurring in the early morning hours, and a secondary peak occurring in the evening. Commercial, institutional, and industrial use are typically consistent during work hours with low usage overnight (or during non-work hours).

Diurnal curves were developed as part of this Master Plan effort. Hourly system demands must be determined in order to establish a diurnal curve. To determine total system demands at each hour, the following data must be obtained at each hour:

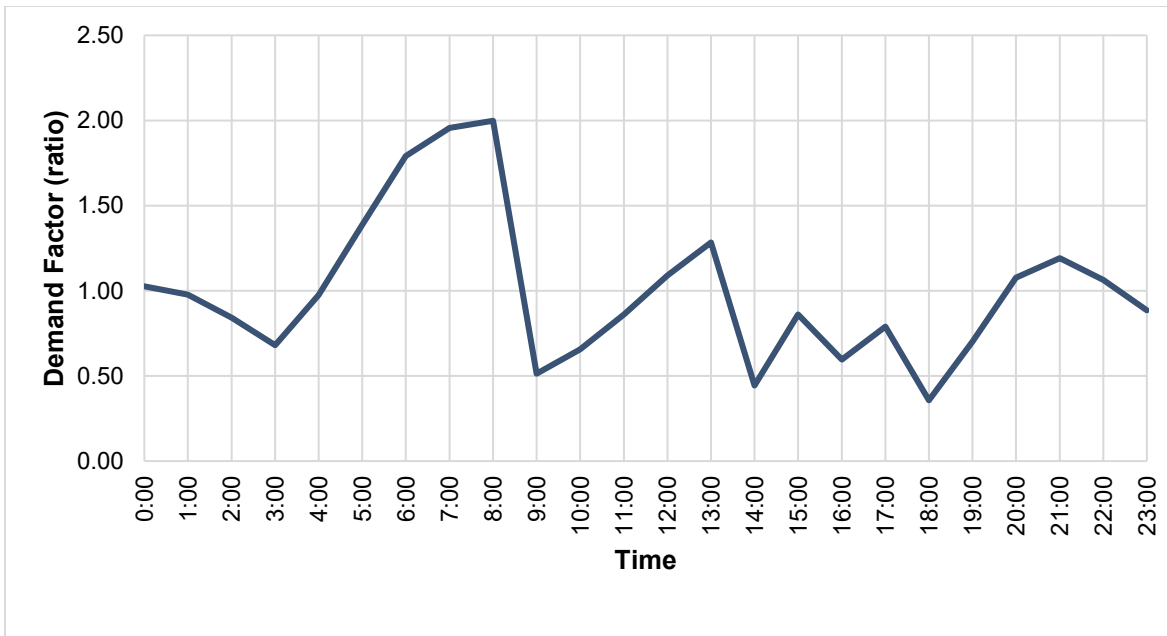
- Volume of flow into the system (i.e., treatment plant effluent, interties) (Volume IN)
- Volume of flow out of the system (Volume OUT)
- Change in water levels at the storage tanks/reservoirs ( $\Delta$  Reservoir Volume)

The volume of flow out of the system is zero since the District does not supply areas outside of its service area during normal operation. Essentially all the water received by the District is used by the District.

Therefore, the total hourly demand of the system is:

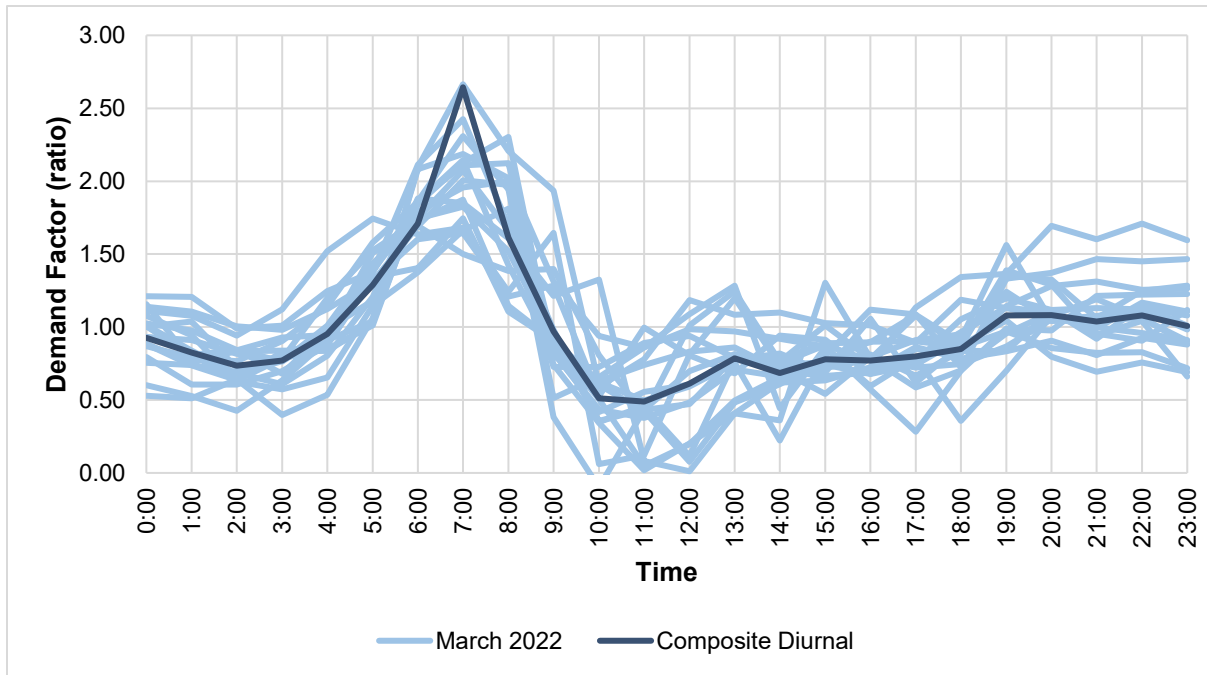
- Demand = Volume IN -  $\Delta$  Reservoir Volume

System-wide diurnal curves were created using SCADA data for March 2022. Diurnal curves were created for each day during this month. Two diurnal curves were developed as the focus of this analysis. The diurnal curve on March 29, 2022 was used for model calibration because fire flow tests were conducted on March 29, 2022 and March 30, 2022. Both dates had similar system-wide demands (1.83 MGD for March 29 and 1.6 MGD for March 30). The March 29, 2022 diurnal curve is shown in Figure 3-5.



**Figure 3-5: March 29,2022 Diurnal Curve**

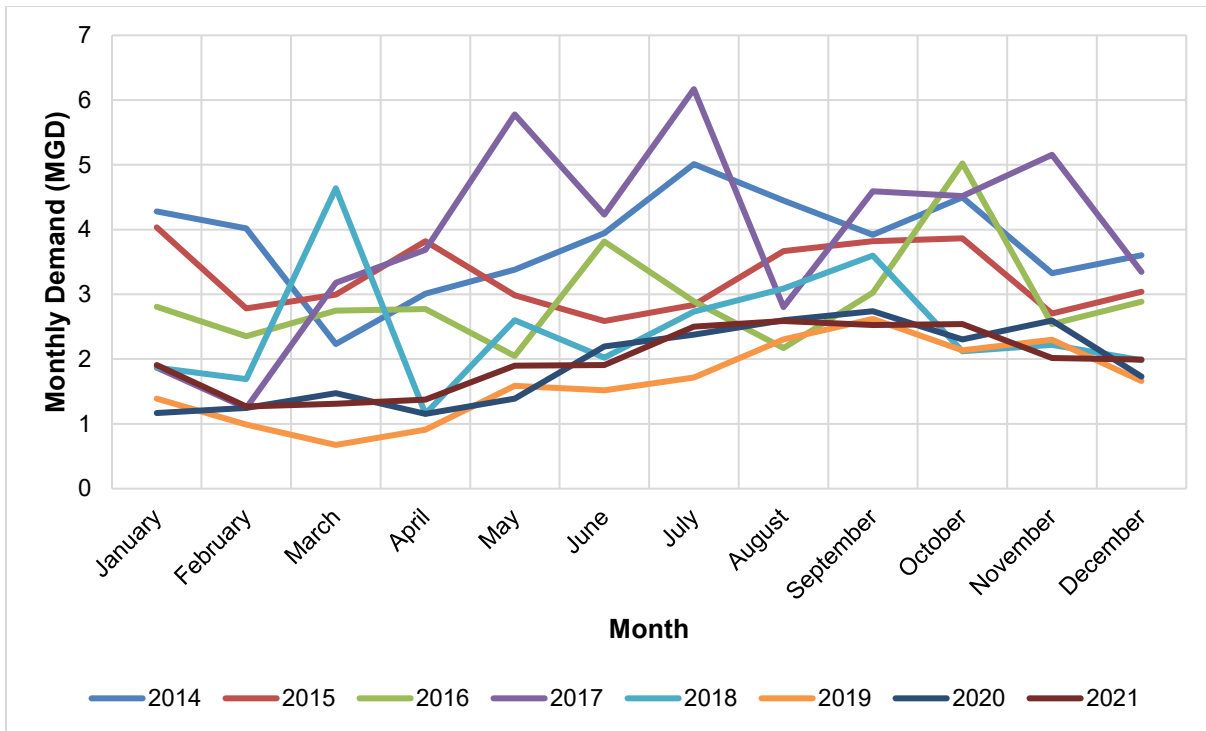
A composite diurnal curve was created to capture the typical demand fluctuations observed during the March 2022 timeframe. The diurnal curve was established using hourly demand data from 18 days in March as shown in Figure 3-6. Note, the composite diurnal is not meant to be an “average” across the time period. It is meant to capture both the peaks and average factors throughout the day. It is recommended that the composite curve be used for planning purposes as it represents varying demand fluctuations within the water system.



**Figure 3-6: Composite Diurnal Curve**

### 3.4 Peaking Factors

Water demands vary throughout the year due to seasonal changes. Peaking factors are used to capture the daily high and low demand conditions for analysis purposes. Maximum day demand represents the day with the highest total demand during the year, which typically occurs in the August or September timeframe. Minimum day demand represents the day with the lowest total demand during the year, which typically occurs in the winter months. The monthly demand for calendar years 2014 to 2021 are presented in Figure 3-7.



**Figure 3-7: Monthly Demand**

Peaking factors used for this analysis were established based on the most current system data. Average day demand was established based on monthly customer meter reading data for calendar year 2021.

**Table 3-4: Peaking Factors**

Demand Condition	Peaking Factor	Demand (MGD)	Demand (gpm)	Demand (AFY)
Minimum Day	0.56	1.16	806	1,298
Minimum Monthly	0.69	1.45	1,008	1,623
Average Day	1.00	2.09	1,452	2,338
Maximum Monthly	1.27	2.67	1,851	2,980
Maximum Day	1.85	3.88	2,693	4,336
Peak Hour	3.47	7.25	5,036	8,108

Note:

1. All peaking factors are applied to Average Day Demand.
2. Minimum Monthly Demand, Average Day Demand, and Maximum Monthly Demand were determined using meter demand data from 2021.
3. Maximum Day Demand was established using a typical system maximum demand of 3.88 MGD (6 cfs). This only occurs during consecutive days of extremely hot weather (temperatures above 90° F).
4. Peak Hour was established based on the highest peak hour observed in March 2022.



### 3.5 Demand Factors

The District’s *2016 Domestic Water Storage and Reservoir Siting Study* (2016 Study) by Psomas outlines the storage requirements and projected demands for future developments. The demand factors calculated in the Study were broken down by housing density. These same demand factors were used in the updated *2021 Domestic Water Storage and Reservoir Siting Study* (2021 Study). These demand factors are outlined in Table 3-5.

**Table 3-5: Demand Factors**

House Density	Average Daily Demand (Per Dwelling Unit Demand Factor)
Low	1,850 gpd
Medium	715 gpd
High	220 gpd

A list of future developments obtained from the 2021 Study is shown in Appendix L. Most of the future developments are low density housing dwelling units.

Residential demand factors were developed using 2021 billing data.

**Table 3-6: 2021 Residential Demand Factors**

Rate Code	Average Daily Demand (Per Dwelling Unit Demand Factor)
System-wide Residential	400 gpd
Residential Portola	246 gpd
Residential Skyridge	279 gpd



## 4. Design Criteria

Design criteria are used to evaluate the performance of the existing water system, and to set requirements for the design of new facilities. Design criteria are used when evaluating existing facilities in operation and determining if they sufficiently serve the needs of the system. Design criteria for new facilities are more conservative than evaluation criteria for existing facilities. Design criteria for new facilities must plan for future needs including an appropriate factor of safety to account for future unknowns.

Design criteria were established drawing upon several references including industry best practices, and utility regulatory requirements. Design criteria for the water system address service pressure, pipelines, pump stations, and storage. These are the criteria used to evaluate the performance of the existing system and serve as the basis for new project recommendations. The criteria also include planning level estimates for demand (usage) including average day, maximum day, and peak hour demands.

### 4.1 Pressure

Pressure criteria for a water system are based on the requirements set forth in General Order 103-A Public Utilities Commission of the State of California (Effective September 10, 2009). The identified pressure criteria for the water system incorporates the requirements of General Order 103-A, and industry best practices for operating a water system, shown in Table 4-1. Minimum service pressures are measured at the service connection to the distribution pipeline.

**Table 4-1: Pressure Criteria**

Demand Condition	Minimum Service Pressure (psi)	Notes
Static Pressure (No Demands)	60 psi	This is preferred, not required. Desired range is 60 to 80 psi.
Dynamic Pressure (Operating)	40 psi	This is a requirement for all demand conditions, except fire flow.
Maximum Day + Fire Flow	20 psi	This is a requirement

### 4.2 Pipelines

Distribution pipelines shall be sized for a maximum velocity of 10 ft/sec under maximum day demand plus fire flow conditions. There is no minimum velocity criterion.

**Table 4-2: Distribution Pipeline Velocity Criteria**

Demand Condition	Max Velocity
Maximum Day + Fire Flow	10 ft/sec



Transmission mains are defined as pipelines that generally do not have water service connections, often have no fire hydrant connections, and are 12-inch diameter and larger. Transmission mains shall be sized for a target velocity range of 5 to 7 ft/sec under peak hour demand, or worst-case flow conditions. Transmission mains may be sized beyond this velocity range if deemed appropriate for the application.

**Table 4-3: Transmission Main Velocity Criteria**

Demand Condition	Velocity Range
Peak Hour, or Worst-Case Flow Condition	5 to 7 ft/sec

### 4.3 Fire Flow

Water systems must be capable of providing sufficient fire flow for firefighting while maintaining a 20-psi residual pressure in the system. The purpose of fire flow criteria is to ensure adequate protection of buildings. The criteria listed in Table 4-4 are generalized planning-level criteria utilized for master planning purposes.

Actual fire flow requirements are subject to the requirements of California Fire Code, and are based upon building category, construction type, fire flow area, presence of hazardous materials, and high fire hazard areas. Reductions in required fire flow may be allowed where automatic sprinkler systems are provided. The Orange County Fire Authority (OCFA) now requires that all new residential construction have automatic fire sprinkler systems. As of January 2023, the new OCFA standard reduces most residential development fire flow requirements to approximately 500 gpm with a half-hour duration.

**Table 4-4: Fire Flow Criteria**

Land Use Designation	Fire Flow Required (gpm)	Duration (hrs)
Single Family Residential	1,500	2
Multi-family Residential	2,500	2
Commercial, Institutional	3,000	3

### 4.4 Pump Stations

Pump station criteria must consider the different types of pump stations and different operating conditions. For example, the criteria for pump stations serving open pressure zones will be different than the criteria for hypodermic pump stations serving a closed zone.

Firm capacity is defined as the pump station capacity with the largest pump out of service. Industry standards and best practices generally govern pump station design, with the criteria being firm capacity must meet a certain demand condition. Additionally, operating pump stations during non-peak hours of the day can be advantageous as it provides the opportunity for lower tiered pricing for electrical power.

The recommended pump station criteria are shown in Table 4-5. The criteria consider how multiple pump stations pump into the same pressure zone, and this allows for the criteria to be met by the total of the pump stations serving a particular zone. The benefit of this approach is that it provides flexibility when



implementing improvements. It also allows the District to add capacity at different pump stations where it may be more feasible than other locations. Additionally, a 16-hour window of pumping is used in the criteria to take advantage of time of lower tiered pricing for electrical power associated with pumping during non-peak hours of the day.

**Table 4-5: Pump Station Criteria**

Pump Station Type	Criteria
<b>Pumping to Open Zone</b>	Total combined firm capacity <sup>1</sup> for all pump stations serving the zone shall be maximum day demand volume in a 16-hour period.
<b>Pumping to Closed Zone</b>	Firm capacity shall be Peak Hour Demand plus dedicated fire flow pump.

<sup>1</sup> Total combined firm capacity is defined by the sum of the firm capacities at each individual pump station

## 4.5 Storage

AWWA M32 Manual – Computer Modeling of Water Distribution Systems provides guidelines on storage criteria to support normal and emergency system operation. The Manual identifies three primary storage components:

- Equalization storage: Amount of water required to meet demands in excess of normal production and delivery capabilities.
- Fire storage: Volume of water based on the maximum fire flow requirement in each pressure zone multiplied by the required flow duration.
- Emergency storage: Amount of additional storage as determined by each individual agency necessary to provide water during emergency events such as short-term supply disruptions.

Similar to the requirement for pump stations, the criteria for storage facilities apply to the total of all reservoirs that serve a particular pressure zone, not each individual reservoir.

### 4.5.1 Equalization Storage

Equalization storage, also known as operational storage, is the amount of water required to meet demands in excess of normal production and delivery capabilities. See parameters below for a summary of the equalization storage requirement:



**Table 4-6: Equalization Storage Requirement**

Parameter	Value	Notes
<b>Imported Water Capacity</b>	6.43 MGD <sup>1</sup>	Includes both treated and untreated water supply.
<b>Groundwater Production Capacity</b>	0 MGD	Due to the seasonal fluctuations of groundwater availability, the District pumps groundwater when available, but does not rely on it as a water supply source.
<b>Total Maximum Day Demand</b>	3.88 MGD <sup>2</sup>	
<b>Equalization Storage Requirement</b>	20% of Maximum Day Demand	Conservative assumption since imported water capacity is greater than maximum day demand.

<sup>1</sup>See Table 2-1 for reference.

<sup>2</sup>See Table 3-4 for reference.

#### 4.5.2 Fire Storage

Fire storage is the required volume of water needed to meet a building’s fire flow demand within a specified area for the required duration. Fire flow requirements for a building are based on the California Fire Code and building use and construction type.

For the District’s system, it is appropriate to require fire storage to be maintained in each of the reservoirs. The required fire storage depends on the worst-case fire flow volume within the pressure zone – typically industrial or commercial land use types.

The District’s water system has a commercial or government worst-case land use type. Commercial and government land use types have an assumed fire flow requirement of 3,000 gpm for a duration of 3 hours, or 0.54 MG (540,000 gallons).

#### 4.5.3 Emergency Storage

Emergency storage is the storage required to meet demands during a temporary interruption of the normal water supply. The duration of emergency storage is a policy-level decision based on an assessment of risk, the desired degree of emergency resiliency, and water quality considerations. The amount of emergency storage for a water system is calculated based on total storage, equalization storage, and fire storage:

- Emergency Storage = Total Storage - Equalization Storage - Fire Storage

Metropolitan Water District Administrative Code § 4503. Suspension of Deliveries states the following:

*(a) Whenever repairs or maintenance of the District's system, in the opinion of the General Manager of the District, shall require suspension of delivery of water at any point or points, such delivery may be suspended without liability on the part of the District; provided, that except in cases of emergency, as determined by the General Manager, notice of such suspension of service shall be given to the affected member public agency in advance of such suspension. Metropolitan will make a concerted effort to notify and work with member public agencies regarding all*



*scheduled interruptions. The District will schedule non-emergency interruptions for the low demand months of the year, typically October through April, in coordination with the member public agencies.*

***(b) Each member agency shall have sufficient resources such as local reservoir storage, groundwater production capacity, system interconnections or alternate supply source to sustain:***

***(1) A seven-day interruption in Metropolitan deliveries from raw and treated water distribution facilities based on average annual demands of the affected facility.***

It is recommended that the District’s emergency storage requirement be consistent with Metropolitan Water District’s requirements: 7-days of average day demand when considering local water supply sources. The District’s current average day demand is 2.09 MGD.

The storage criteria are summarized in Table 4-7.

**Table 4-7: Storage Criteria**

<b>Storage Component</b>	<b>Criteria</b>
<b>Equalization</b>	20% of Maximum Day Demand
<b>Fire</b>	Fire Flow x Duration
<b>Emergency</b>	7-days of Average Day Demand



## 5. Hydraulic Model Update

The hydraulic model is a computerized representation of the water distribution system. It consists of elements that represent the actual physical facilities of the distribution system including the network of supply points, pipelines, pump stations, and storage reservoirs. A hydraulic model is a tool used for analysis and planning to predict system performance, identify deficiencies, optimize operations, and size new facilities. The existing hydraulic model was developed by Psomas and last updated in 2020.

An updated hydraulic model was developed as part of this Master Plan using the latest GIS geodatabase of the system. The model development process described in the subsequent sections include:

- GIS Update
- Facilities Update
- Additional Model Building Tasks
- Demand Allocation
- Field Testing
- Model Calibration
- Scenarios

### 5.1 GIS Update

The District employs iWater Inc. to regularly update and maintain the water system GIS geodatabase using as-built records, operations staff input, field verification, and routine maintenance and data cleanup.

### 5.2 Facilities Update

System facilities include reservoirs, pump stations, wells, and control valves. The model development process included digitizing and assigning attributes to system facilities to accurately simulate their function in the model.

#### 5.2.1 Reservoirs

The District provided a GIS feature class titled wNetworkSite that contained a point for each facility within the water system. Any new reservoirs not already in the model were imported into the model as “tanks” which is how InfoWater models fixed volume reservoirs. The same naming convention was maintained (Dove Canyon, Harris Grade, etc.) in the model. Reservoir ground elevations and high-water level (HWL) information were obtained from as-builts.



## **5.2.2 Pump Stations**

The wNetworkSite GIS feature class contained a point for each pump at each of the pump stations. This layer was used to update any missing pump stations/pumps. As-builts and field visits were used to accurately digitize the pump station piping.

Manufacturer pump curves or efficiency tests conducted by Southern California Edison (SCE) were used to input pump curves in the model. Field visits were conducted to obtain pump nameplate data when pump curves or efficiency tests were not available. In some cases, nameplate data gathered from the field was used to obtain the missing pump curves from manufacturer representatives. Pump stations in the model are named using the same GIS naming convention.

## **5.2.3 Treatment Plant, Imported Water Connections, and Groundwater Wells**

System supply points such as imported water connections and groundwater wells are modeled as “fixed-head reservoirs” which simulate an endless supply at a specified pressure or head. Flow control valves or other controls are placed downstream of the supply to simulate the actual conditions of the supply.

The District’s two wells were input into the model with the appropriate system parameters but are not activated since they are currently inactive. Supply from the Dimension Water Treatment Plant was simulated as a fixed head reservoir with the respective pumps and a downstream PRV set at 290 psi. Interties were simulated as fixed head reservoirs with a flow control valve corresponding to a specified flow rate.

## **5.2.4 Control Valves and Isolation Valves**

The primary control valves used in the model include pressure reducing valves (PRV) and flow control valves. System PRVs were modeled where they exist in the system to allow upper pressure zones to supply lower pressure zones at a fixed downstream pressure. Flow control valves are used at system supply points and pump stations where a set flow condition needs to be simulated. Normally closed isolation valves are used to create a zone boundary and are simulated as such in the model.

## **5.3 Additional Model Building Steps**

### **5.3.1 Connectivity**

After the GIS data was imported and the facilities were updated, the configuration and connectivity of the system was checked. Zone boundaries were established using the appropriate boundary condition such as a normally closed valve, system facility, or physical separation. Pressure zones were assigned to all model pipelines for reference and used within model queries and query sets.

Connectivity checks were conducted using built-in InfoWater tools such as Orphan Nodes, Orphan Pipes, Trace Network tools, and any errors found were corrected.



### 5.3.2 Elevation Assignment

To develop elevation information for the model, the Digital Elevation Model (DEM) file was downloaded from Orange County Public Works webpage. The Elevation Extractor InfoWater tool was used to extract elevations from the DEM file and assign elevations to nodes within the model. A global subtraction of three feet was conducted on the model node elevations, to reflect typical water main pipe depths below the ground surface.

Pump station elevations were obtained from as-builts. Reservoir ground elevations and high-water levels (HWL) were also obtained from as-builts.

### 5.3.3 Hazen-Williams Coefficient Assignment

Hazen-Williams coefficients or C-factors are pipe roughness coefficients used in the Hazen-Williams head loss equation employed by the InfoWater model software. C-factors were initially assigned to pipes in the model based on pipe material and then modified during the calibration process. Pipes with unknown material were assigned a default value of 120. C-factors were assigned within industry-accepted ranges for pipe materials and based on typical field measurements and observations. A summary of the ranges of C-factors within the model is provided in Table 5-1.

**Table 5-1: Hazen-Williams Coefficients**

Material	C-factor
Asbestos Cement	120 - 130
Ductile Iron	130 - 140
HDPE	120
Steel	130 - 140
Polyvinyl Chloride	140 - 150
Unknown	120

### 5.3.4 Controls and Queries

Controls in the model are used to alter the status of various model elements based on specific system criteria. Controls are typically assigned to pumps and valves. Pump controls can be based on tank level, pressure and/or time of day. Valves can be controlled so that they appropriately open and close based on tank levels or other conditions.

Within InfoWater, users can select network components and related data by creating logical query statements using the DB Query feature. Queries are used to aid in model development and analysis. Unique queries can be developed using the model's database. The updated model includes a multitude of queries such as pipe material, pressure zone, and pipe diameter.



## **5.4 Demand Allocation**

This section describes how demands are assigned and simulated in the hydraulic model.

### **5.4.1 Demand Allocation**

Average day demands for the District's water system were derived from 12-months of billing data (calendar year 2021). The total existing average day demand assigned to the model was 1,452 gallons per minute (gpm) or 2.09 million gallons per day (MGD).

Average day demands were allocated within the model using the InfoWater Demand Allocator Extension. The Demand Allocator Extension compares meter locations and demand node coordinates in the model and uses an algorithm to assign proportionate demands from customer meter data to the demand nodes. Demand nodes are differentiated from other nodes in the model so demands are only assigned at service locations, and not to nodes at pump stations and reservoirs, hydrants, or other locations that do not have service connections.

### **5.4.2 Diurnal Patterns**

Diurnal demand patterns are defined in the model to generate hour-by-hour demand variations in the distribution system. The patterns are critical for accurately simulating parameters such as pipe velocities, travel times, and tank level changes in extended-period simulations (EPSs). Diurnal curves were established based on hourly system SCADA data for March 2022.

Two diurnal curves were used for hydraulic modeling purposes. The actual diurnal curve from March 29, 2022 was developed specifically for calibrating a scenario to that day, which was one of the days field hydrant tests were performed.

A second composite diurnal curve was developed based on trends from multiple days of March 2022 SCADA. The composite diurnal curve captures the varying demand fluctuations observed within the system during the month of March 2022. As a result, it approximates the system's typical average day demand pattern.

### **5.4.3 Demands for Calibration and Additional Scenarios**

To provide an accurate calibration scenario for the hydrant fire flow tests that occurred on March 29-30, 2022, a calibration demand set was created in the model. This demand set utilized the average day demand allocation and was adjusted based on a system-wide demand multiplier to match the specific system demand observed on that day, which was approximately 1.83 MGD (1,271 gpm). In this example the demand multiplier would be 0.88 (1,271 gpm/1,452 gpm).

Additional scenarios were created based on the calibration scenario. The primary difference in the additional scenarios were demands, which were globally adjusted to simulate current average day, maximum day, or future scenarios. Also, the composite diurnal curve was assigned to all demands.

## 5.5 Field Testing

Field data was collected on March 29-30, 2022 to facilitate calibrating the model. The District also provided SCADA data for March 2022 for their tanks and pump stations. Data provided included tank levels, pump flows, and pump station suction and discharge pressures.

A series of fire flow tests (hydrant tests) were conducted on March 29 and 30, 2022. A total of eighteen (18) fire flow tests were performed. All fire flow tests had one flowing hydrant and one nearby residual hydrant. The flowing hydrant was left to flow until the pressure gauge displayed a consistent reading. A photograph of one of the fire flow tests being conducted is shown in Figure 5-1.



**Figure 5-1: Fire Flow Test – Flow Hydrant**



## **5.6 Model Calibration**

The hydraulic model was calibrated to both the hydrant test data and tank level SCADA data. The objective of the calibration was to achieve a model data output within 10 percent of field values. Model calibration was considered complete when the model was within the specified goal, or when model adjustments did not yield further accuracy.

### **5.6.1 Hydrant Test Calibration Procedure**

The March 29, 2022 diurnal demand pattern was imported into the model for each demand junction to provide an accurate representation of the fluctuation of demands throughout the fire flow test period. The model allocated average day demand of 2.09 MGD was adjusted to 1.83 MGD, the March 29, 2022 system demand.

The following is an overview of steps performed to calibrate the model to field fire flow test results:

- A unique scenario was created in the model for each fire flow test. The only difference between the fire flow scenarios were the tank and control sets.
- Tank levels and operating pumps were adjusted based on SCADA data.
- PRV settings were adjusted.
- C-factors were adjusted but within industry standards for the pipe materials.

This iterative process was carried out until the model was within the calibration goal or where further adjustments did not improve results.



## 5.6.2 Hydrant Test Calibration Results

Table 5-2 presents a comparison of the model data output to the field data after calibration efforts were performed. The results show that the model was able to closely simulate static pressures and residual pressures for a majority of the test locations.

**Table 5-2: Calibration Results**

Test Hydrant Location	Zone	Static Pressure (psi)			Residual Pressure (psi)			Test Flow (gpm)
		Field	Model	% Difference	Field	Model	% Difference	
2	Harris Grade	98	96	2%	90	90	0%	1,547
4	Harris Grade	65	65	0%	45	52	-15%	949
5	Harris Grade	42	40	5%	35	37	-7%	581
6	Rose Canyon Reservoir	49	43	12%	38	38	0%	787
9	Rose Canyon Reservoir	112	109	2%	98	101	-3%	1,547
10	Trabuco Reservoir	120	115	4%	108	100	8%	1,565
11	Trabuco Reservoir	133	132	1%	125	118	6%	1,678
12	High Country	73	75	-3%	55	67	-22%	888
13	Harris Grade	112	113	-1%	94	93	1%	1,353
14	Trabuco Reservoir	87	87	0%	73	71	2%	1,210
15	Lower Trabuco	64	60	7%	53	55	-3%	1,061
16	Lower Trabuco	106	105	1%	92	99	-8%	1,453
17	Upper Dove Canyon	112	109	3%	95	99	-4%	1,565
18	High Country	78	78	0%	55	53	4%	1,186
19-1	Upper Dove Canyon	68	69	-1%	66	66	0%	1,244
19-2	Upper Dove Canyon	77	79	-2%	75	76	-1%	1,353
20	Lower Dove Canyon	70	71	-1%	60	58	4%	1,150
21	Lower Dove Canyon	73	74	-1%	52	57	-10%	1,126
		<b>AVERAGE</b>		<b>2%</b>	<b>AVERAGE</b>		<b>-3%</b>	



The objective of the hydrant test calibration was to achieve a model data output within 10 percent of field values. Table 5-3 summarizes the hydrant test model results significantly outside the calibration goal (10% within field values). Valve sweeps are recommended for these test hydrant locations.

An explanation is provided below for these test hydrant locations outside the calibration goal.

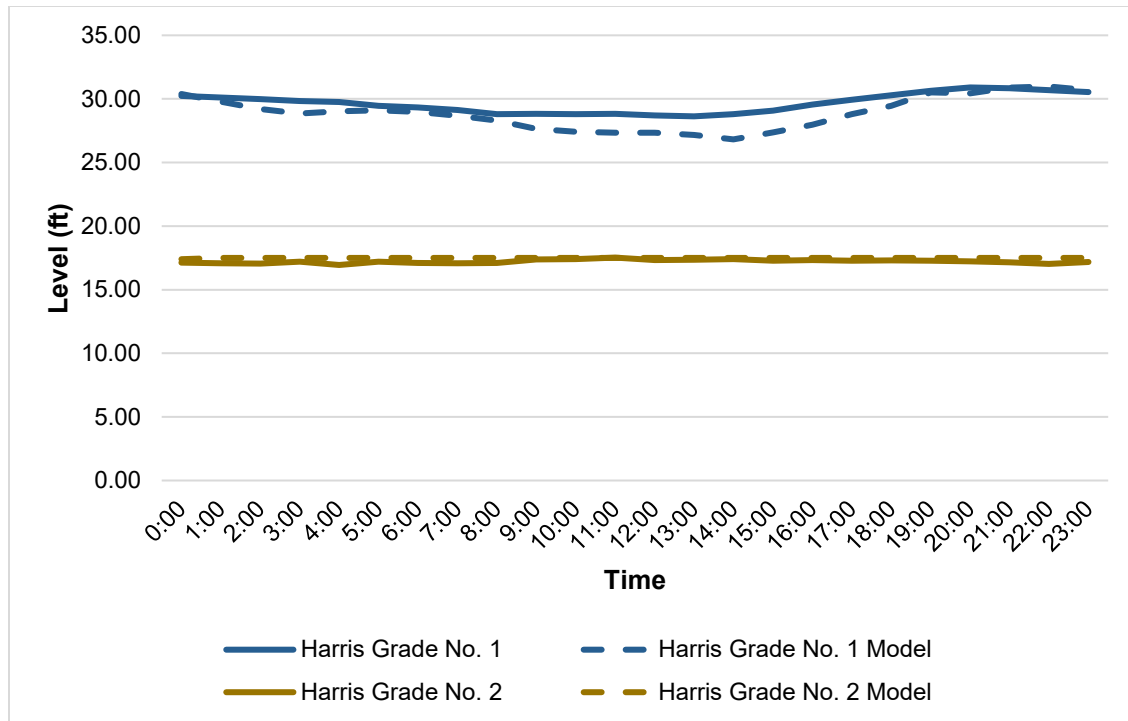
**Table 5-3: Hydrant Test Model Results Outside Calibration Goal**

Test Hydrant Location	Zone	Static Pressure (psi)			Residual Pressure (psi)			Test Flow (gpm)
		Field	Model	% Difference	Field	Model	% Difference	
4	Harris Grade	65	65	0%	45	52	-15%	949
12	High Country	73	75	-3%	55	67	-22%	888

- **Test Hydrant Location 4** – Model static pressure value is within calibration goal. Model was unable to match the field residual pressure due to partially closed valve believed to be on 10-inch water main in Canyon Creek Zone, off Live Oak Canyon Drive. The District is looking into cost effective ways to locate the valve.
- **Test Hydrant Location 12** – Model static pressure value is within calibration goal. Model unable to match the field residual pressure suggesting there is a closed valve(s) we are not aware of.

### 5.6.3 Reservoir Level Calibration Results

The model was also calibrated by running a 24-hour extended period simulation (EPS) for March 29, 2022 demand and comparing model predicted tank levels to field (actual) tank levels shown in SCADA. An example of one of the reservoir level comparison graphs is shown in Figure 5-2. Comparison between model predicted tank levels and SCADA tank levels for all reservoirs are shown in Appendix A.



**Figure 5-2: Harris Grade Zone Reservoir Level Calibration Results**

## 5.7 Scenarios

Once the calibrated March 29, 2022 scenario was completed, additional scenarios were created for different demand conditions. The hydraulic model can perform steady state and extended period simulation (EPS) scenarios. A steady state simulation is a single snapshot in time and does not include any changes in the model over time. Extended period simulations are performed over a finite period of time and incorporate system controls and changes in the system over time, such as hourly demand variation, tanks emptying, and pumps activating based on level control. The scenarios developed in the hydraulic model and used in analyses are the following:

- March 29, 2022
  - Representative of current average day demand – 1.83 MGD (1,270 gpm)
- 2022
  - Maximum Day Demand (EPS)
    - Maximum Day Demand – 2.09 MGD (1,452 gpm)
    - Maximum Day Demand plus Fire Flow Simulations – 3.55 MGD (2,693 gpm)
  - Minimum Day Demand (EPS) – 1.45 MGD (1,008 gpm)



- 2045
  - Average Day Demand (Steady-State) – 2.09 MGD (1,452 gpm)
  - Maximum Day Demand (EPS) – 3.55 MGD (2,693 gpm)

Note, a separate peak-hour scenario is not required when a maximum day EPS scenario is developed. The peak-hour can be evaluated by looking at specific time-steps within the maximum day scenario. Although average day demand scenarios were created, analyses and system planning are typically based on maximum day demand or peak-hour scenarios.



## 6. System Evaluation

A combination of methods was used to evaluate the water system, including hydraulic model analyses, tabular calculations, and review of operational data. Using the hydraulic model, scenarios were used for simulating different demand conditions to evaluate the existing system, and future scenarios were used when sizing and making recommendations.

The water system analysis included an evaluation of pumping, pressure zone interconnections, pipelines, and overall operations. Each analysis includes an introduction to what was being analyzed, a description of the design criteria, and recommended projects or actions.

### 6.1 Water Supply Facilities

A tabular analysis was performed to determine if adequate supply is available to meet current and future demands.

#### 6.1.1 Criteria

The District's water supply sources must meet the existing and projected demands outlined in Table 6-1.

**Table 6-1: Water Demands (Existing and 2045)**

Scenario	Average Day	Max Day
Existing	2.09 MGD	3.88 MGD
	3.2 cfs	6.0 cfs
Future (2045)	2.31 MGD	4.27 MGD
	3.5 cfs	6.6 cfs

#### 6.1.2 Supply Source Capacity Analysis

The District relies mainly on imported water due to the seasonal variability of their groundwater supply. As a result, water from the wells is not included in this analysis. Results from this analysis are shown in Table 6-2.



**Table 6-2: Supply Source Capacity Analysis**

<b>Parameter</b>	<b>Existing</b>	<b>Future (2045)</b>
<b>Average Day Demand</b>	2.09 MGD 3.2 cfs	2.31 MGD 3.5 cfs
<b>Max Day Demand</b>	3.88 MGD 6.0 cfs	4.47 MGD 6.6 cfs
<b>SUPPLY</b>		
<b>MWD/MWDOC untreated Supply</b>	3.84 MGD 5.9 cfs	3.84 MGD 5.9 cfs
<b>MWD/MWDOC treated Supply</b>	2.59 MGD 4.0 cfs	2.59 MGD 4.0 cfs
<b>District Wells</b>	0	0
<b>Total Supply</b>	6.43 MGD 9.9 cfs	6.43 MGD 9.9 cfs
<b>MEETS CRITERIA?</b>		
<b>Supply &gt; Average Day Demand?</b>	Yes	Yes
<b>Supply &gt; Max Day Demand?</b>	Yes	Yes

### 6.1.3 Recommendations

No new regular supply facilities are needed at this time based on projected demands, and existing contracted supply from MWD/MWDOC. The District’s wells are currently offline due to operational issues. Appendix B contains a technical memorandum summarizing the improvements required to make these wells fully operational again. However, if these wells are brought back online the District would only be able to rely on them as a water source during wet years due to the seasonal variability of the groundwater supply.

It is good practice for a water system to also have emergency interconnections that can be utilized in the event of an outage from one of their regular supply sources. The District also has several emergency interties with neighboring agencies as outline in Section 2.1. It is recommended that these emergency interties are regularly exercised to ensure that they are operable.



## 6.2 Storage Facilities

### 6.2.1 Criteria

The storage criteria used for this analysis is shown in Table 6-3. The criteria was applied to the emergency storage available system-wide and within each of the four major pressure zones. Emergency storage is a function of total storage, equalization storage, and fire flow storage. The criteria identifies emergency storage to be 7-days of average day demand when considering local supply sources such as groundwater.

**Table 6-3: Storage Criteria**

Storage Component	Criteria
Equalization	20% of Maximum Day Demand
Fire Flow	Worst-Case Fire Flow Volume
Emergency	7 days of Average Day Demand <sup>1</sup>

<sup>1</sup>7-days of Average Day Demand is recommended by Metropolitan Water District.

### 6.2.2 Analysis

The District does not have a reliable groundwater source, as result the local supply parameter for this storage analysis was set to zero. A storage analysis was conducted for the entire system to determine if the emergency storage criteria is met. See Section 4.5 for discussion on emergency storage volume.

Emergency storage days were calculated as:

- Emergency Storage Days = Emergency Storage / (Average Day Demand – Local Supply)

#### 6.2.2.1 Storage Analysis - All Water Supplies Offline

The District’s main water supply comes from DWTP and the Plano Trabuco Intertie. If DWTP is offline for maintenance, the District receives water through its IRWD intertie at Ridgeline Pump Station. This analysis evaluates the District’s storage with all supply sources offline. Table 6-4 shows that the District has approximately 4 days of emergency storage under existing and future scenarios.

**Table 6-4: System-wide Storage Analysis – All Water Supplies Offline**

Scenario	Local Supply (MGD)	Average Day Demand (MGD)	Total Effective Storage <sup>1</sup> (MG)	Equalization Storage (MG)	Fire Flow Storage (MG)	Emergency Storage (MG)	Emergency Storage (Days)	Notes
Existing	0.00	2.09	9.14	0.78	0.54	7.82	3.7	Saddle Crest Reservoir not in operation
Future (2045)	0.00	2.31	10.73	0.85	0.54	9.34	4.0	Saddle Crest Reservoir in operation

<sup>1</sup>Calculated using reservoir diameter and operating level.



### 6.2.2.2 Storage Analysis - Plano Trabuco Intertie Online

A more conservative storage analysis was conducted with the Plano Trabuco Intertie online and the rest of the water supply sources offline. Table 6-5 shows that the District has over 7 days of emergency storage under existing and future scenarios with only the Plano Trabuco Intertie as a water supply source.

**Table 6-5: System-wide Storage Analysis – Plano Trabuco Intertie Online**

Scenario	Local Supply (MGD)	Average Day Demand (MGD)	Total Effective Storage <sup>1</sup> (MG)	Equalization Storage (MG)	Fire Flow Storage (MG)	Emergency Storage (MG)	Emergency Storage (Days)	Notes
Existing	3.88	2.09	9.14	0.78	0.54	7.82	>7 <sup>2</sup>	Saddle Crest Reservoir not in operation
Future (2045)	3.88	2.31	10.73	0.85	0.54	9.34	>7 <sup>2</sup>	Saddle Crest Reservoir in operation

<sup>1</sup>Calculated using reservoir diameter and operating level.

<sup>2</sup>Supply exceeds demand, therefore unlimited supply is available to meet demand.

### 6.2.2.3 Storage Analysis – Ridgeline #1 Intertie Online

An additional storage analysis was conducted with only Ridgeline #1 Intertie online. Table 6-6 shows that the District has over 7 days of emergency storage under existing and future scenarios with only Ridgeline #1 Intertie as a water supply source.

**Table 6-6: System-wide Storage Analysis – Ridgeline #1 Intertie Online**

Scenario	Local Supply (MGD)	Average Day Demand (MGD)	Total Effective Storage (MG) <sup>1</sup>	Equalization Storage (MG)	Fire Flow Storage (MG)	Emergency Storage (MG)	Emergency Storage (Days)	Notes
Existing	2.59	2.09	9.14	0.78	0.54	7.82	>7 <sup>2</sup>	Saddle Crest Reservoir not in operation
Future (2045)	2.59	2.31	10.73	0.85	0.54	9.34	>7 <sup>2</sup>	Saddle Crest Reservoir in operation

<sup>1</sup>Supply exceeds demand, therefore unlimited supply is available to meet demand.

<sup>2</sup>Calculated using reservoir diameter and operating level.

### 6.2.2.4 Storage Analysis – Reduced Demand with all Supplies Offline

The above analyses could be considered conservative because they do not include any level of demand reduction as a result of public outreach. For example, MWD assumes a demand reduction of 25 percent could be achieved by placing short-term restrictions on irrigation and non-essential water usage. Table 6-7 shows storage analysis results with a 25 percent reduction in average day demand and with all water supply sources offline. The District has approximately 5 days of emergency storage under existing and future conditions when average day demands are reduced by 25 percent.



**Table 6-7: System-wide Storage Analysis – Reduced demand with all Supplies Offline**

Scenario	Local Supply (MGD)	Average Day Demand <sup>3</sup> (MGD)	Total Effective Storage <sup>1</sup> (MG)	Equalization Storage (MG)	Fire Flow Storage (MG)	Emergency Storage (MG)	Emergency Storage (Days)	Notes
Existing	0.00	1.57	9.14	0.78	0.54	7.82	5.0	Saddle Crest Reservoir not in operation
Future (2045)	0.00	1.73	10.73	0.85	0.54	9.34	5.4	Saddle Crest Reservoir in operation

<sup>1</sup>Calculated using reservoir diameter and operating level.

<sup>2</sup>Supply exceeds demand, therefore unlimited supply is available to meet demand.

<sup>3</sup>Average day demand reduced by 25 percent.

### 6.2.3 Recommendations

The system-wide storage analyses illustrate that the District does not have capacity for 7 days of emergency storage when all water supply sources are offline. Additional storage is needed to meet this criteria. It is recommended the District aim to achieve 7-days of emergency storage when average demand is reduced by 25 percent. A new reservoir with an effective volume of at least 1.5 MG installed in the Harris Grade pressure zone would facilitate in achieving this goal.

## 6.3 Pump Stations

Pump stations are typically sized to meet maximum day demands or peak hour demands depending on the pressure zone the pump station is supplying. Industry standards and best practices generally govern pump station design. Firm capacity is defined as the pump station’s capacity with the largest pump out of service. Firm capacity is typically used to determine the adequacy of a pump station to serve a certain area. The following analysis includes an identification of the criteria, a summary of the analysis, and recommendations.

### 6.3.1 Criteria

The pump station criteria are shown in Table 6-8. A 16-hour window of pumping is used in the criteria to take advantage of time of lower tiered pricing for electrical power associated with pumping during non-peak hours of the day.

**Table 6-8: Pump Station Criteria**

Pump Station Type	Criteria
Pumping to Open Zone	Total combined firm capacity <sup>1</sup> for all pump stations serving the zone shall be maximum day demand volume supplied in a 16-hour window.
Pumping to Closed Zone	Firm capacity shall be Peak Hour Demand plus dedicated fire flow pump.

<sup>1</sup> Total combined firm capacity is defined by the sum of the firm capacities at each individual pump station. Firm capacity for each individual pump station is documented in Table 2-6 with largest pump remaining in standby.



### 6.3.2 Analysis

The pumping analysis is divided into two sections based on the pump station criteria to be applied. The first section analyzes pressure zones and pump stations that supply a reservoir. The second section analyzes pressure zones and pump stations that directly supply the pressure zone without a reservoir. Demands for pressure zones solely served by PRVs were absorbed into the nearest zone with a pump station(s). For example, since Robinson Ranch PS serves the Trabuco Zone which in turns supplies water to the Lower Trabuco Zone via a PRV, the pump station analysis for Robison Ranch PS included demands for the Trabuco and Lower Trabuco zones.

#### 6.3.2.1 Existing Water System

Table 6-9 shows that all the District’s pump stations are adequately sized to meet existing system demands. El Toro PS is not included in the analysis since it is usually not in operation. El Toro PS is brought online in order to convey water from Ridgeline #1 Intertie, when DWTP is offline.

**Table 6-9: Existing Water System - Pumping Analysis Summary**

Open Pressure Zones (Gravity Reservoir Supplied)						
Zone	Max Day Demand (16-hr gpm)	Pump Station(s)	Firm Capacity (gpm)	Total Zone Firm Capacity (gpm)	Meets Criteria?	Surplus/ (Deficiency) (gpm)
Harris Grade	3,258	Ridgeline	2,676	3,576	Yes	318
		Plano Trabuco	900			
Trabuco Reservoir	681	Robinson Ranch	900	900	Yes	219
Joplin	1	Rose Canyon	305	305	Yes	304
Rose Canyon Reservoir	Supplied by PRV					
Upper Dove Canyon	Supplied by PRV					
Cooks Reservoir	Supplied directly by DWTP					
Closed Zones (Pumped Supply Only)						
Zone	Peak Hour Demand (gpm)	Pump Station(s)	Firm Capacity (gpm)	Dedicated Fire Flow Pump?	Meets Criteria?	Surplus/ (Deficiency) (gpm)
Topanga Canyon Rd	64	Topanga Canyon Rd	240	Yes	Yes	176
Canyon Creek	19	Canyon Creek	100	Yes	Yes	81
Falcon St	20	Falcon St	650	Yes	Yes	630
Trabuco Oaks	Supplied by PRV					
Lower Dove Canyon	Supplied by PRV					
High Country	Supplied by PRV					
Lower Trabuco	Supplied by PRV					



### 6.3.2.2 Future (2045) Water System

Table 6-10 shows that pump stations pumping out of the Harris Grade Zone are not quite adequately sized to meet future system demands.

**Table 6-10: Future (2045) Water System - Pumping Analysis Summary**

Open Pressure Zones (Gravity Reservoir Supplied)						
Zone	Max Day Demand (16-hr gpm)	Pump Station(s)	Firm Capacity (gpm)	Total Zone Firm Capacity (gpm)	Meets Criteria?	Surplus/ (Deficiency) (gpm)
Harris Grade	3,611	Ridgeline	2,676	3,576	No	(35)
		Plano Trabuco	900			
Trabuco Reservoir	681	Robinson Ranch	900	900	Yes	145
Joplin	1	Rose Canyon	305	305	Yes	303
Rose Canyon Reservoir	Supplied by PRV					
Upper Dove Canyon	Supplied by PRV					
Cooks Reservoir	Supplied directly by DWTP					
Closed Zones (Pumped Supply Only)						
Zone	Peak Hour Demand (gpm)	Pump Station(s)	Firm Capacity (gpm)	Dedicated Fire Flow Pump?	Meets Criteria?	Surplus/ (Deficiency) (gpm)
Topanga Canyon Rd	71	Topanga Canyon Rd	240	Yes	Yes	169
Canyon Creek	21	Canyon Creek	100	Yes	Yes	79
Falcon St	22	Falcon St	650	Yes	Yes	628
Trabuco Oaks	Supplied by PRV					
Lower Dove Canyon	Supplied by PRV					
High Country	Supplied by PRV					
Lower Trabuco	Supplied by PRV					

### 6.3.3 Recommendations

#### 6.3.3.1 Existing Water System

There is surplus pumping capacity in all the District’s pressure zones. At this time, no pump station improvements related to increasing capacity are needed at the pump stations serving these zones. When these pumps stations require upgrades due to condition or age, pump station capacity should be reassessed.



### 6.3.3.2 Future (2045) Water System

The 2045 water system pumping analysis indicates a need for increased pumping capacity into the Harris Grade by at least 35 gpm. Since Ridgeline PS pump capacity is limited by DWTP, pumping capacity improvements will need to be implemented at Plano Trabuco PS or a new pump station within the zone. The District should continue to monitor demand every few years and reassess if a new pump station should be constructed or capacity upgrades should be conducted at Plano Trabuco PS by 2045.

## 6.4 Pressure Zone Supply

Providing multiple supply points to a pressure zone increases service reliability and fire flow protection capability to the water service area. Supply points to a pressure zone can be a reservoir, pump station, pressure reducing station, imported water connection, or treatment plant supply. An analysis was conducted to verify supply points to each pressure zone, with the criteria that each pressure zone maintains a minimum of two (2) supply points for reliability/redundancy.

For pressure zones where multiple supply points are not feasible such as smaller or isolated sections of the service area, we recommend ensuring the single supply point is made as reliable and redundant as feasible. For example, if a pump station is the single supply point, the pump station should have backup pumps for redundancy, and backup power provisions.

### 6.4.1 Criteria

**Table 6-11: Pressure Zone Supply Criteria**

Criteria Type	Criteria
Pressure Zone Supply	Pressure zone should have a minimum of two (2) supply points

### 6.4.2 Analysis

Table 6-12 lists each pressure zone and up to two supply points for the zone. The criteria is met if the zone has two supply points. If a pressure zone has more than two supply points, only two are listed for the purpose of this analysis. For pressure zones that currently do not meet the criteria, discussion has been provided under Section 6.4.3.



**Table 6-12: Pressure Zone and Supply Points Summary**

Pressure Zone	Supply Point #1	Supply Point #2	Meets Criteria?
<b>Cooks</b>	Dimension Water Treatment Plant	Larchmont PS (ETWD)	<b>No</b>
<b>Harris Grade</b>	Ridgeline #1 PS (IRWD)	Plano Trabuco PS (SMWD)	Yes
<b>Rose Canyon</b>	PRV (Rose Canyon Rd, by Trabuco Wells Facility)	None	<b>No</b>
<b>Upper Dove Canyon</b>	PRV (Plano Trabuco Rd, by Plano Trabuco Pump Station)	PRV (Lindsay Dr)	Yes
<b>Trabuco</b>	Robinson Ranch Pump Station	PRV (near Upper Dove Canyon Reservoir)	Yes
<b>Joplin<sup>1</sup></b>	Rose Canyon Pump Station	None	<b>No</b>
<b>Trabuco Oaks</b>	PRV (North Ln)	PRV (Mountain View Rd)	Yes
<b>Lower Dove Canyon</b>	PRV (Bell Canyon Dr)	PRV (Sycamore Canyon Dr)	Yes
<b>High Country</b>	PRV (High Country Dr, by Robinson Ranch PS)	None	<b>No</b>
<b>Lower Trabuco</b>	PRV (Heritage Dr)	PRV (Rosemont Dr)	Yes
<b>Topanga Canyon<sup>2</sup></b>	Topanga Canyon Rd PS	None	<b>No</b>
<b>Canyon Creek<sup>2</sup></b>	Canyon Creek PS	None	<b>No</b>
<b>Falcon<sup>2</sup></b>	Falcon Street PS	None	<b>No</b>
<b>Saddle Crest<sup>2,3</sup></b>	Saddle Crest PS	None	<b>No</b>

<sup>1</sup>Zone supplied by District, but not owned by District

<sup>2</sup>Hydropneumatic Zone

<sup>3</sup>Development in progress

### 6.4.3 Recommendations

The pressure zones that do not meet the pressure zone supply criteria are Trabuco Reservoir, Rose Canyon Reservoir, High Country, Joplin, and the four hydropneumatic zones. A brief discussion of each zone that does not meet the dual supply minimum is provided below.



- **Cooks** – Although Cooks has two supply points (DWTP and Larchmont), it does not meet the criteria because Larchmont PS is currently not operable. However, the pressure zone is small enough that a second supply point is not warranted.
- **Trabuco** – This is the third largest zone and is only served by Robinson Ranch PS. A second supply source is recommended for redundancy. Although the zone is only served by a single supply point, the District has one portable generator that can provide Robinson Ranch PS backup power in the event of a loss of power. It is recommended that the District purchase more portable generators as a mitigation measure in the event of District-wide power failure. Having one portable generator means that some pressure zones would be out of water if such an event were to occur (i.e. due to SCE shutdown because of high winds).
- **Rose Canyon** – This is a small zone with an average day demand of 10 gpm served by a pressure reducing station (PRS) with one PRV. Since this is a small zone, it is understandable that providing a second supply point to the zone may not be feasible. However, it is recommended that the District regularly maintain the PRS serving this zone.
- **Joplin** – This is the smallest zone supplied by the District through Rose Canyon PS. Pipelines and reservoirs in this zone are owned by the County of Orange Probation Department. Although the zone is only served by a single supply point, the District has one portable generator that can provide Rose Canyon PS backup power in the event of a loss of power. It is recommended that the District purchase more portable generators as a mitigation measure in the event of District-wide power failure.
- **High Country** – This is a relatively small zone with an average day demand of 87 gpm served by a PRS with two PRVs. Since this is a small zone, it is understandable that providing a second supply point to the zone may not be feasible. However, it is recommended that the District regularly maintain the PRS serving this zone.
- **Topanga Canyon** – This is a hydropneumatic zone located adjacent to the Harris Grade Zone, at the end of Topanga Canyon Road. The zone has an average day demand of 19 gpm. Although the zone is only served by a single supply point, there are provisions in place that provide additional backup for this zone. The Topanga Canyon Road PS includes an emergency generator (diesel engine), capable of meeting maximum day demands plus fire flow demands in the event of a loss of power. It is considered sufficient that this zone has only one primary supply point.
- **Canyon Creek** – This is a hydropneumatic zone located adjacent to the Harris Grade Zone, west of Live Oak Canyon Road. The zone has an average day demand of 5 gpm. Although the zone is only served by a single supply point, the District has one portable generator that can provide Canyon Creek PS backup power in the event of a loss of power. It is recommended that the District purchase more portable generators as a mitigation measure in the event of District-wide power failure.
- **Falcon** – This is a hydropneumatic zone located adjacent to the Harris Grade Zone, along Falcon Street. The zone has an average day demand of 6 gpm. Although the zone is only served by a single supply point, the District has one portable generator that can provide Canyon Creek PS



backup power in the event of a loss of power. It is recommended that the District purchase more portable generators as a mitigation measure in the event of District-wide power failure.

- **Saddle Crest** – This is a hydropneumatic zone in development. This zone is adjacent to Harris Grade, along A Street. Although the zone is only served by a single supply point, there are provisions in place that provide additional backup for this zone. The Saddle Crest PS includes an emergency generator (diesel engine). It is considered sufficient that this zone has only one primary supply.

## 6.5 Distribution System Pressure

The pressure analysis evaluated the model’s predictions of pressures at service nodes per the criteria in Table 6-13. Service nodes are defined as those nodes where customer service occurs and excludes areas such as inside system facilities and transmission mains to storage reservoirs. Areas of low and high pressure were evaluated.

### 6.5.1 Criteria

**Table 6-13: Pressure Criteria for Distribution System**

Demand Condition	Minimum Service Pressure (psi)	Notes
Static Pressure (No Demands)	60 psi	This is preferred, not required. Desired range is 60 to 80 psi.
Dynamic Pressure (Operating)	40 psi	This is a requirement for all demand conditions, except fire flow.
Maximum Day + Fire Flow	20 psi	This is a requirement

### 6.5.2 Analysis

Low pressure areas (areas with pressure less than 40 psi) were generally identified in model in the Harris Grade and Trabuco pressure zones. Refer to Exhibit 6-1 for locations. The low pressures are due to the relatively high elevations in Harris Grade Zone along Hamilton Trail.

Pressures in excess of 125 psi were considered high pressure areas. High pressure areas were generally observed in the model in the Harris Grade, Upper Dove Canyon, and Trabuco pressure zones. Refer to Exhibit 6-2 for high pressure areas.

### 6.5.3 Recommendations

Low- and high-pressure areas in the system are primarily attributed to elevation, and not facility controls or operation. It is also typically not preferred in operations to change pressures for certain areas because the pipelines are accustomed to certain pressures and raising those pressures could result in leaks or breaks.



Large-scale projects due to system pressures are not recommended due to practicality. The installation of a parallel line and a new pump station, essentially creating a new sub zone, would be required to mitigate low pressures along Hamilton Trail. This solution, although feasible, is not practical. High pressures were observed throughout the system and would require construction of several pressure reducing stations to mitigate this.

## 6.6 Fire Flow Availability

A fire flow analysis was performed in the model under maximum day condition on all hydrants using the criteria summarized in the table below.

### 6.6.1 Criteria

**Table 6-14: Fire Flow Criteria**

Land Use Designation	Fire Flow Required (gpm)	Duration (hrs)
Single Family Residential	1,500	2
Multi-family Residential	2,500	2
Commercial, Institutional	3,000	3

### 6.6.2 Analysis

The available fire flow was calculated at 20 psi residual pressure. Hydrants with static pressure less than 30 psi were excluded from the analysis. A map and list of these hydrants can be found in Appendix K. Of the 497 residential hydrants imported into the model, 5 hydrants (approximately 1 percent of the total) were identified as deficient or unable to meet the required residential fire flow. The model results show most of the deficient hydrants in the Trabuco Oaks Zone. All the 14 hydrants that serve commercial land uses met the required commercial fire flow of 3,000 gpm.

See Exhibit 6-3 for available fire flow analysis results on the existing system.

### 6.6.3 Recommendations

The model results show deficient hydrants in the Trabuco Oaks and Trabuco pressure zones. Although the fire flow required criteria for residential areas is 1,500 gpm, project recommendations were made for hydrants with available fire flow of less than 1,000 gpm. These hydrants are all in the Trabuco Oaks Zone along Adkinson Lane and Trabuco Oaks Drive.

The following improvements are recommended to provide adequate fire flow to the affected areas in the Trabuco Oaks Zone.

- 500 LF of 6-inch pipe along Adkinson Lane to be replaced with 8-inch PVC pipe (Available fire flow increased from 925 gpm to 1,196 gpm)



- 3,200 LF of 4-inch pipe along Trabuco Oaks to be replaced with 8-inch PVC pipe (Available fire flow increased from 636 gpm to 3,397 gpm)

## 6.7 Transmission Main Analysis

A critical component of the water supply system is the transmission main from DWTP to Ridgeline PS. The sole means of conveying water from DWTP to the rest of the system is through this transmission main.

The transmission main alignment is shown in Exhibit 2-1. The transmission main alignment is in Dimension Drive, Lake Forest Drive, Regency Lane, and within an easement/bike trail that parallels El Toro Road until it terminates at the intersection of El Toro Road and Ridgeline Road. The alignment includes above-grade creek crossings at two locations along the bike trail portion of the alignment.

Characteristics of the transmission main include the following:

- Constructed in 1964
- 16” diameter, CML&C welded steel pipe, CL 250 – 12,500 LF
- 14” diameter, CML&C welded steel pipe, CL 200 – 3,300 LF
- 10” diameter, CML&C welded steel pipe, CL 150 – 6,200 LF
- Total transmission main length of 22,000 LF
- Typical flow range: 1 cfs to 6 cfs (based on treated water effluent from DWTP)

### 6.7.1 Operational Issues and Break History

The transmission main has had a history of breaks. Breaks have typically occurred along the bike path portion of the alignment. Pipe samples reveal that the breaks have occurred due to loss of cement lining and loss of cement coating (typically at joints), which has allowed the steel cylinder to corrode and ultimately fail. Pipe breaks require the entire transmission main and DWTP to be shut down, and require the District’s supply to rely on Plano Trabuco Intertie, imported supply from IRWD at Ridgeline PS, or other emergency intertie locations.

There is also a lack of isolation valves along the pipeline alignment. Isolation valves are used to close off sections of pipe that need repair. Without isolation valves, large sections of pipe need to be drained before repair work can be done. It is good practice for valves to be located on a transmission main every 1,000 to 3,000 ft.

The pipeline alignment within easements and the bike trail can be problematic for construction equipment and District vehicles to easily access the pipeline. It is preferred to have pipelines located within the street for easier access to the pipeline for maintenance.



Based on pressure readings at DWTP and Ridgeline PS, the transmission main is typically operating near or above the pressure rating of the pipe. Head losses in the transmission main are approximately 8 ft/1000 ft of pipe across the entire length of the pipeline. It is not known for sure if this loss is concentrated in a certain section of pipe, or evenly distributed across the full length. Although this is not excessive, it is higher than preferred for a transmission main, causing the DWTP pumps to operate at a higher discharge pressure to deliver the water at Ridgeline PS.

### **6.7.2 Recommendation**

The operational issues and break history described in the previous section are primarily the result of the pipeline being 60-years old, which essentially means the transmission main has reached the end of its useful life. A welded steel pipe transmission main would be expected to have a typical service life of 50-70 years.

Due to the operational issues and break history indicating the transmission main is reaching the end of its useful life, and the criticality of this transmission main to the water system, it is recommended to proceed with full replacement of the transmission main. The new pipeline alignment should be located within City streets where possible. A pipeline alignment study should be conducted prior to the final design of the pipeline.

## **6.8 System Performance and Operations**

The water system was also evaluated for water age and pipe break history. Both water age and pipe break history were found to be within acceptable industry performance benchmarks.

### **6.8.1 Water Age**

Water age refers to the time it takes for water to travel from sources to consumers. Water age is dependent on flow velocities, pipe diameters, pipe lengths, and system configuration in the distribution system.

Water age is a general indicator of water quality. Excessive water age can reduce the residual disinfectant concentration as chlorine or monochloramine reacts with organic material in the water and on the pipe walls. If the water travels a long time from the water source to the consumers, the reduced disinfectant concentration may not be able to control microorganisms that cause adverse health effects.

For systems that use chlorine or chloramine as a disinfectant, water age is also an accepted surrogate for disinfection by-products (DBPs). DBPs are created when disinfectants like chlorine or chloramine, used to control microbial pathogens, react with naturally occurring materials in the drinking water. DBPs are also of concern as they are known to cause adverse health effects.

The hydraulic model was used to perform a water age simulation under existing average day demand conditions to identify areas of the District's distribution system that tend to have higher ages. The water age analysis indicates high levels of water age as the water travels farther away from the water supply sources (water treatment plant and interconnections), particularly in the Upper Dove Canyon and Lower



Dove Canyon pressure zones. High water age was also observed in the dead-end zones such as the those served by hydropneumatic pump stations. It is recommended that the District regularly flush these areas.

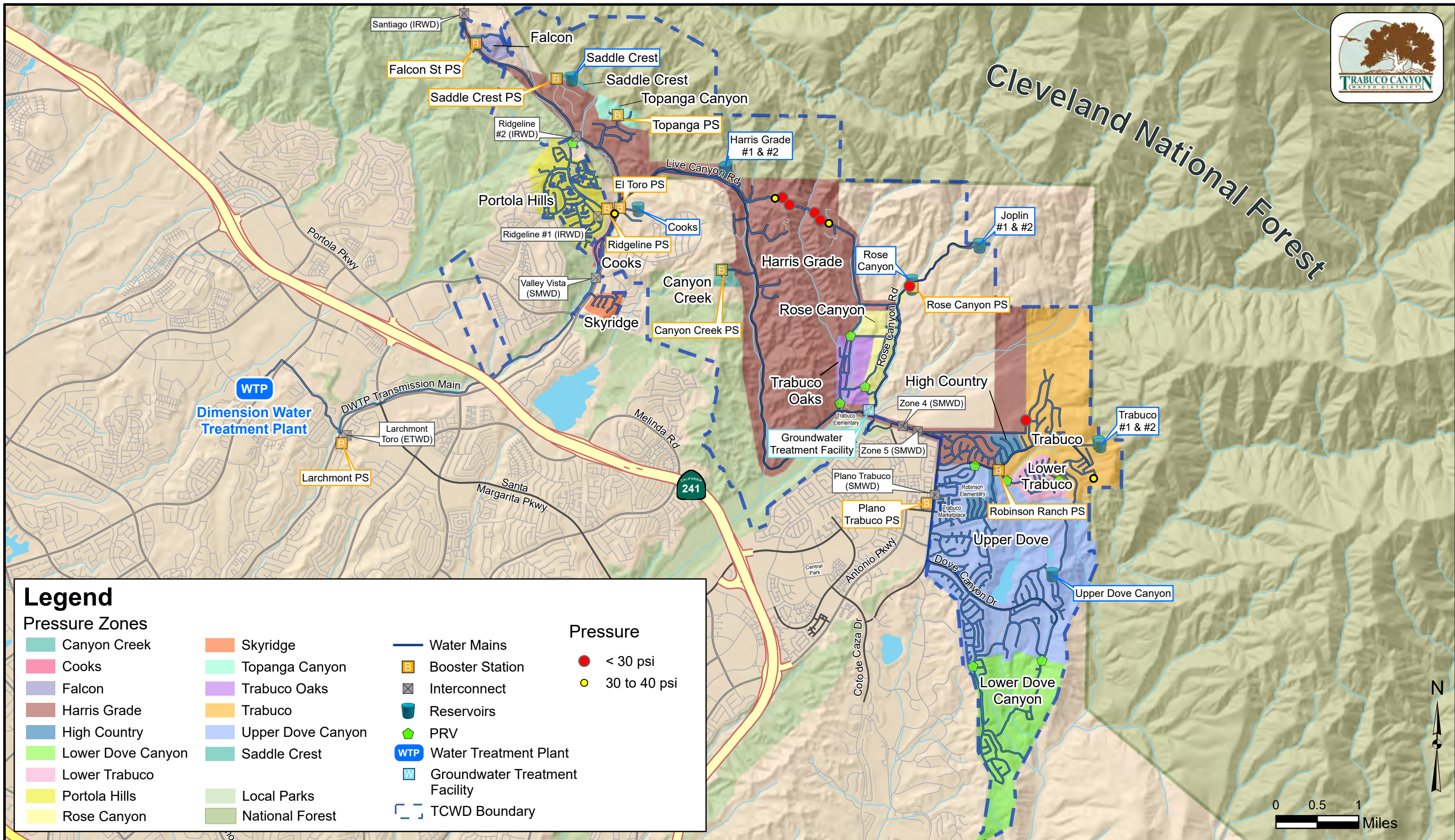
See Exhibit 6-4 for water age analysis results.

### **6.8.2 Pipeline Replacement Program**

Pipeline replacement projects are a good practice for a water system to annually replace pipelines that are aging, undersized, have a higher break frequency, or are not standard pipe materials. The recommended pipeline replacement program prioritizes replacing pipes with the oldest pipes in the system. The majority of these pipes were installed in the 1960s and 1970s. Data provided by District showed that historically, these pipelines tend to have a higher break frequency when compared to the newer pipelines.

### **6.8.3 Trabuco Creek Crossing**

The west side of the water system is connected to the east side by three water lines that cross Trabuco Creek. The pipelines are 10-inch ACP, 12-inch steel, and 16-inch steel and they convey water from DWTP to the remainder of the system. An analysis was conducted using the model to determine if all three water lines are adequately sized. Model results show that these pipelines have enough capacity to convey the required flows. The District mentioned that these pipes are shallow enough within the creek that they are exposed during large storms. The County of Orange (County) is currently planning to replace the Trabuco Creek Bridge. Pipeline relocation should be done during the bridge replacement. It is recommended that these pipelines be relocated within the new bridge structure as a part of the County's bridge replacement project.



### Legend

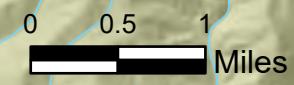
#### Pressure Zones

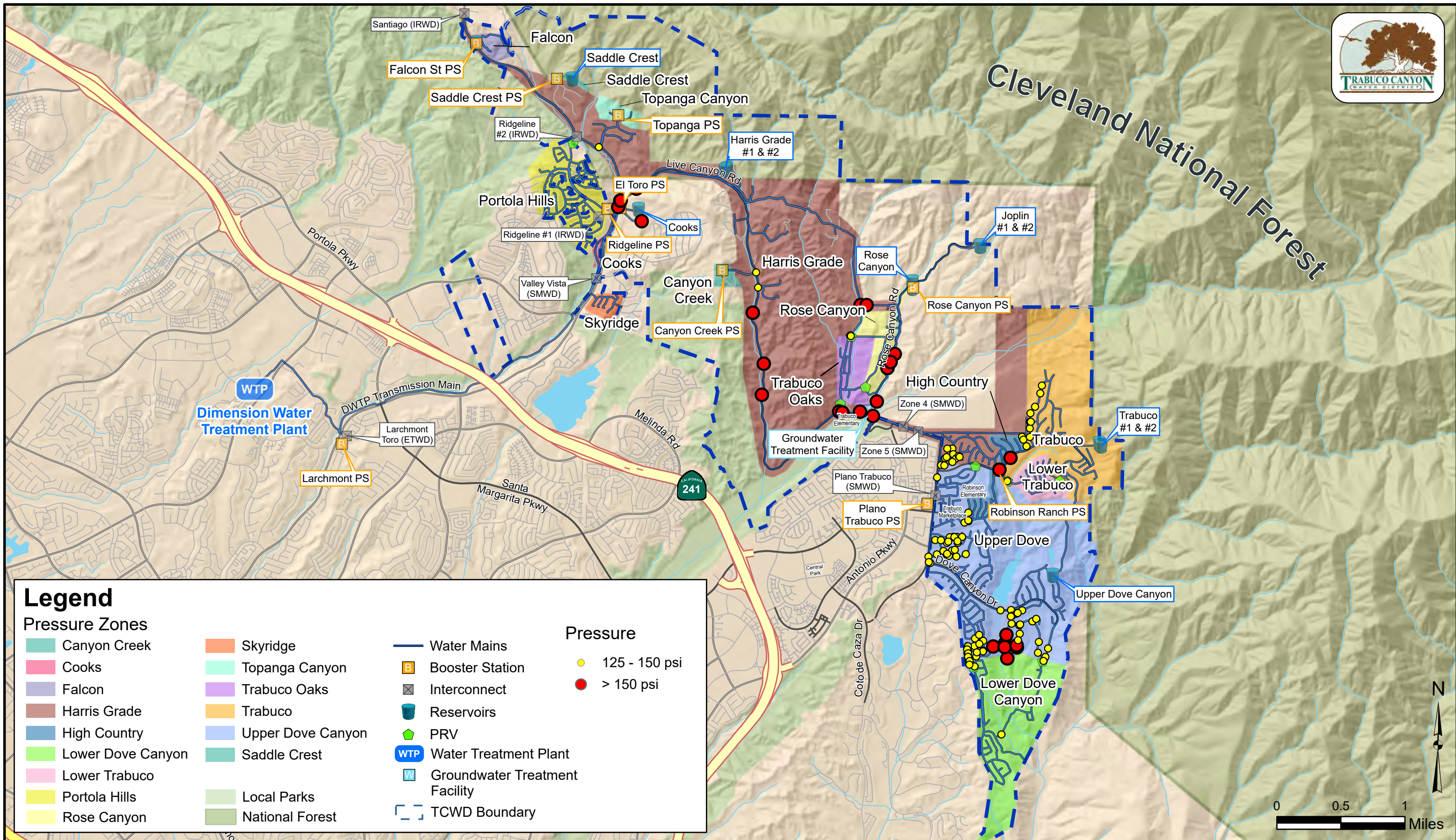
- |  |  |
|--|--|
| <span style="display:inline-block; width:15px; height:15px; background-color:#4DB6AC;"></span> Canyon Creek      | <span style="display:inline-block; width:15px; height:15px; background-color:#FF9800;"></span> Skyridge          |
| <span style="display:inline-block; width:15px; height:15px; background-color:#E91E63;"></span> Cooks             | <span style="display:inline-block; width:15px; height:15px; background-color:#4DD0E1;"></span> Topanga Canyon    |
| <span style="display:inline-block; width:15px; height:15px; background-color:#9575CD;"></span> Falcon            | <span style="display:inline-block; width:15px; height:15px; background-color:#9C27B0;"></span> Trabuco Oaks      |
| <span style="display:inline-block; width:15px; height:15px; background-color:#A1887F;"></span> Harris Grade      | <span style="display:inline-block; width:15px; height:15px; background-color:#FFB74D;"></span> Trabuco           |
| <span style="display:inline-block; width:15px; height:15px; background-color:#4285F4;"></span> High Country      | <span style="display:inline-block; width:15px; height:15px; background-color:#BBDEFB;"></span> Upper Dove Canyon |
| <span style="display:inline-block; width:15px; height:15px; background-color:#81C784;"></span> Lower Dove Canyon | <span style="display:inline-block; width:15px; height:15px; background-color:#4DB6AC;"></span> Saddle Crest      |
| <span style="display:inline-block; width:15px; height:15px; background-color:#F48FB1;"></span> Lower Trabuco     | <span style="display:inline-block; width:15px; height:15px; background-color:#C8E6C9;"></span> Local Parks       |
| <span style="display:inline-block; width:15px; height:15px; background-color:#FFF176;"></span> Portola Hills     | <span style="display:inline-block; width:15px; height:15px; background-color:#C8E6C9;"></span> National Forest   |
| <span style="display:inline-block; width:15px; height:15px; background-color:#FFF176;"></span> Rose Canyon       |  |

#### Pressure

- < 30 psi
- 30 to 40 psi

- Water Mains
- B Booster Station
- X Interconnect
- Reservoirs
- ♦ PRV
- WTP Water Treatment Plant
- W Groundwater Treatment Facility
- TCWD Boundary





### Legend

#### Pressure Zones

- Canyon Creek
- Cooks
- Falcon
- Harris Grade
- High Country
- Lower Dove Canyon
- Lower Trabuco
- Portola Hills
- Rose Canyon
- Skyridge
- Topanga Canyon
- Trabuco Oaks
- Trabuco
- Upper Dove Canyon
- Saddle Crest
- Local Parks
- National Forest

#### Pressure

- 125 - 150 psi
- > 150 psi

- Water Mains
- Booster Station
- Interconnect
- Reservoirs
- PRV
- WTP Water Treatment Plant
- Groundwater Treatment Facility
- TCWD Boundary

