9.0 WATER SYSTEM EVALUATION

The City's normal supply operations for the water distribution system includes water supply from primarily MWD imported water routing into Block 35 and Peck reservoirs. During the summer months when demands are higher, groundwater is also supplied to the system from City's active wells, Wells 11A and Well 15. The City's water distribution system was evaluated using winter operation conditions for the existing system evaluation. This was because hydrant testing data for model calibration was completed in January. The existing water distribution operations and controls were established from the model calibration and workshops conducted with the City engineering and operations staff.

The City's water system was evaluated for distribution performance under average day, maximum day, peak hour for existing, near-term, and ultimate planning horizons Maximum day and fire flow demand analysis was performed for existing system conditions. In addition to the water distribution system performance evaluation, the City's reservoirs and booster pump stations were analyzed for adequate capacity and performance to meet the City's facility sizing criteria and to determine storage required for operational, emergency, and fire flow conditions.

Since water distributions systems are among the most essential infrastructure systems, continued reliability is essential. To determine overall system reliability, feasible emergency or facility outage conditions were simulated and evaluated for capacity and performance to meet the City's planning criteria. Lastly, to determine potential water quality concerns in the system, water age analysis was performed using the updated hydraulic model. Water age refers to the time it takes for water to travel from a water source to consumers and is influenced by water distribution system velocities and pipe lengths. This is an important performance indicator to many utilities because excessive age can cause problems with sediment build up in the pipeline and disinfection by-products.

9.1 DISTRIBUTION SYSTEM PERFORMANCE

The existing distribution system is well looped throughout the service area, providing service redundancy as well as reliability to the City's customers. For comprehensive analysis of the distribution system, the model was established with various steady-state and extended period simulation (EPS) scenarios for ADD, MDD, and MDD plus fire flow demand conditions. EPS scenarios for the distribution system performance evaluations reflect a duration of 24-hour period. for the scenarios for the.

9.1.1 Existing Distribution System Evaluation

This evaluation reflects City's existing demands (ADD of 2,968 gpm, MDD of 4,451 gpm, and peak hour demand of 6,856 gpm). Operation conditions include MWD imported water supply only with Block 35 Ground Level Tank and Booster Pump Station, both directly serving the system. The Block 35 Elevated Tank, the groundwater wells and the Peck Facility are all offline, reflecting existing operation conditions. Peck Facility was under construction for a new reservoir and pump station. Larsson Booster Pumpstation is online and the Second Street Booster Pumpstation is offline. The Larsson Booster Pump Station supplies water to the Hill Zone, the higher-pressure zone in the system. The Second Street Booster Pump Station provides supplies as a backup to Larsson Booster Pump Station. Both pump stations receive water from the Main Zone, which receives supplies through the Block 35 Facility.

9.1.2 Near-Term Distribution System Evaluation

This evaluation reflects the projected 2025 demands (ADD of 3,002 gpm, MDD of 4,504 gpm, and peak hour of 6,936 gpm). Near-term planning horizon includes the six new development projects, as discussed in Section 5.3.1. Operation conditions for ADD only include imported water supply from MWD; however, MDD also includes groundwater from Well 15, routed to Peck Facility for treatment prior to distribution. By 2025, Peck Facility will be in operation. Larsson Booster Pumpstation is online, and the Second Street Booster Pumpstation is offline. The Second Street Booster Pump Station provides supplies as a backup to Larsson Booster Pump Station. Both pump stations receive water from the Main Zone, which receives supplies through the Block 35 Facility. Both booster pump stations will be upgraded. A fourth pump is to be installed at Larsson booster station and two additional pumps at Second Street booster station.

9.1.3 Ultimate Distribution System Evaluation

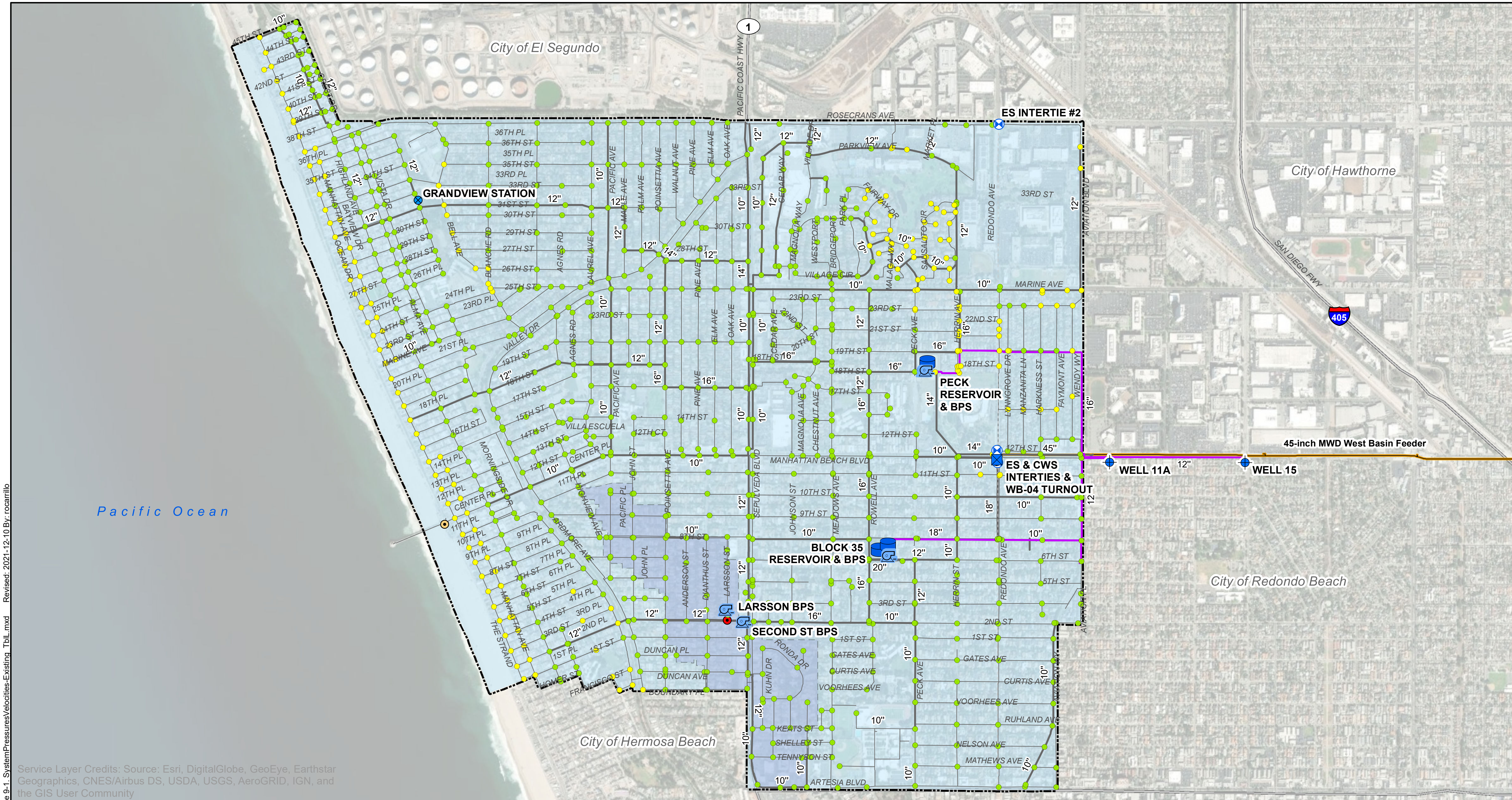
This evaluation reflects the projected 2030 demands (ADD of 3,177 gpm, MDD of 4,766 gpm, and peak hour of 7,339 gpm). Operation conditions for ADD only include imported water supply from MWD; however, MDD also includes groundwater from Well 15, routed to Peck Facility for treatment prior to distribution. By 2025, Peck Facility will be in operation. Larsson Booster Pumpstation is online, and the Second Street Booster Pumpstation is offline. The Larsson Booster Pump Station supplies water to the Hill Zone, the higher-pressure zone in the system. The Second Street Booster Pump Station provides supplies as a backup to Larsson Booster Pump Station. Both pump stations receive water from the Main Zone, which receives supplies through the Block 35 Facility.

9.1.4 Distribution System Evaluation Results

The water distribution system was evaluated to determine areas of low-pressure, high-pressure, and high velocity. The existing, near-term, and ultimate system conditions had similar low- and high-pressure nodes as well as similar high velocity results. As such, the system pressure and velocity analysis for all three system conditions are discussed as a single analysis.

The minimum 40 psi pressure criteria requirement applies to the service nodes in the distribution system during peak hour demands, to provide adequate water pressure to customers. Other nodes in the system near storage tanks and pump stations do not need to meet the minimum pressure criteria as they don't serve customers. Maximum distribution system pressure should not exceed 150 psi with a maximum recommendation of 125 psi, however parallel zone pipes traversing a higher-pressure zone's service area are not included to meet this criterion. If the maximum pressures exceed 125 psi, special consideration should be given to the design of new facilities in the high-pressure areas, such as increasing the pressure rating of pipeline, fittings, and other appurtenances.

The existing, near-term, and ultimate system evaluation results indicated that the system meets the City's required pressure criteria. Service nodes met the minimum pressures of 40 psi, and the system pressures did not exceed a maximum pressure of 150 psi. Per City's planning criteria, the velocity in the distribution is not to exceed 7 fps. There were no pipes identified as deficient for all system conditions. Figure 9-1, Figure 9-2, and Figure 9-3 show the existing, near-term, and ultimate system condition pressures. Note that the figures show the low-pressure nodes near the facilities, which is typical, as these are the nodes on the suction side of the pump stations and are not required to meet the minimum pressure requirements. The figures also show the areas where pressures in the system are greater than 125 psi. For pipe replacements or new facility construction in these areas will require special consideration.



- Reservoir
- Groundwater Well
- Import Water Turnout
- Interagency Connection (Intertie)
- Pressure Monitoring Station
- Flow Control Valve
- Booster Pump Station (BPS)
- Hill Zone
- Main Zone
- City of Manhattan Beach
- Outside Agency Pipeline

Existing Pipelines

- Less than 10" Diameter
- 10" Diameter and Greater
- Well Transmission Main
- MWD Distribution Main
- Pipe Max Velocity 5 to 7 fps
- Pipe Max Velocity > 7 fps
- Node Min Pressure < 40 psi
- Node Min Pressure > 40 psi
- Node Max Pressure 100 to 125 psi
- Node Max Pressure 125 to 150 psi
- Node Max Pressure > 150 psi

Note:
CWS = California Water Service
ES = City of El Segundo
MWD = Metropolitan Water District

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1,500 750 0 1,500 Feet

Date: 12/10/2021

TITLE:

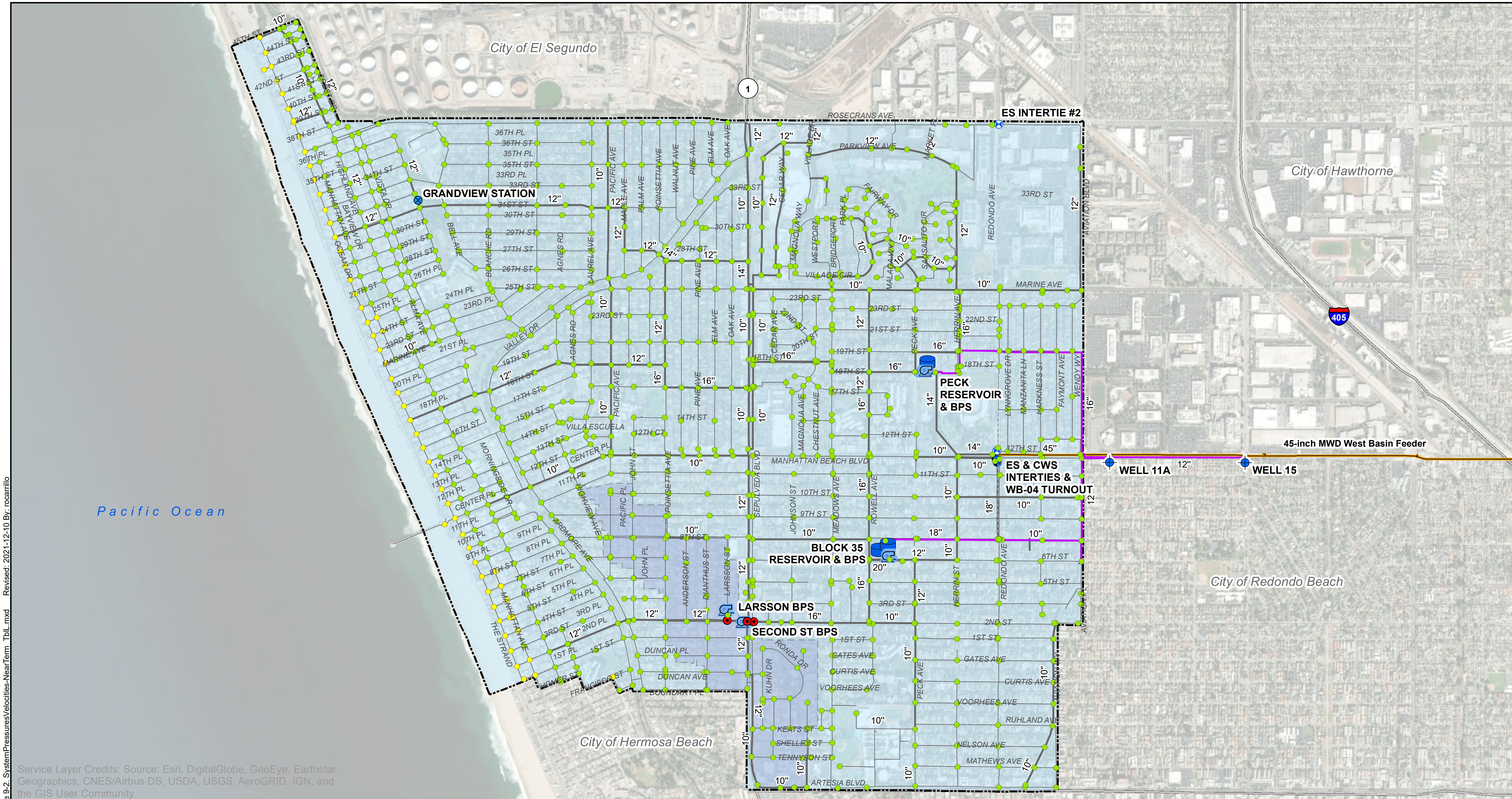
Figure 9-1 – Existing System Pressures and Velocities

PROJECT:
City of Manhattan Beach Water Master Plan

COORDINATE SYSTEM:
NAD 1983 StatePlane California V FIPS 0405 Feet

Stantec

V:\1840\active\184031379\gis_MXDs\Figure 9-1_SystemPressuresVelocities-Existing_Tbl.mxd Revised: 2021-12-10 By: rocarrillo



Reservoir
Groundwater Well
Import Water Turnout
Interagency Connection (Intertie)
Pressure Monitoring Station

Flow Control Valve
Booster Pump Station (BPS)
Hill Zone
Main Zone
City of Manhattan Beach
Outside Agency Pipeline

Existing Pipelines
Less than 10" Diameter
10" Diameter and Greater
Well Transmission Main
Pipe Max Velocity 5 to 7 fps
Pipe Max Velocity > 7 fps

Node Min Pressure < 40 psi
Node Min Pressure > 40 psi
Node Max Pressure 100 to 125 psi
Node Max Pressure 125 to 150 psi
Node Max Pressure > 150 psi

Note:
CWS = California Water Service
ES = City of El Segundo
MWD = Municipal Water District

N
1,600 800 0 1,600 Feet
Date: 12/10/2021

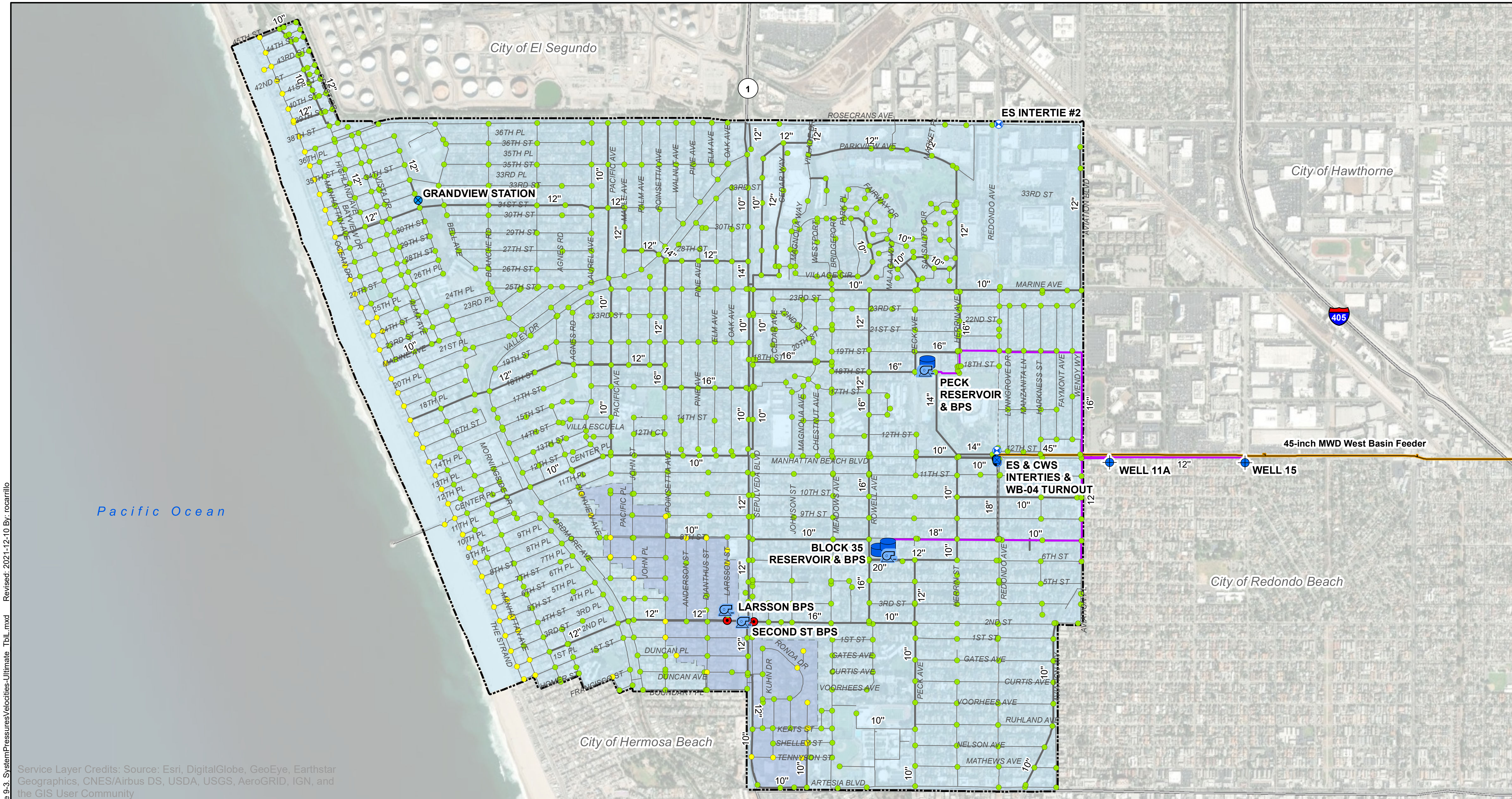
TITLE:
Figure 9-2 – Near-Term System Pressures and Velocities

PROJECT:
City of Manhattan Beach Water Master Plan

COORDINATE SYSTEM:
NAD 1983 StatePlane California V FIPS 0405 Feet

Stantec

V:\1840\active\184031379\gis_MXDs\Figure 9-2_SystemPressuresVelocities-NearTerm_TblL.mxd Revised: 2021-12-10 By: rocarrillo



- Reservoir
- Groundwater Well
- Import Water Turnout
- Interagency Connection (Intertie)
- Pressure Monitoring Station
- Flow Control Valve
- Booster Pump Station (BPS)
- Hill Zone
- Main Zone
- City of Manhattan Beach
- Outside Agency Pipeline

Existing Pipelines

- Less than 10" Diameter
- 10" Diameter and Greater
- Well Transmission Main
- MWD Distribution Main
- Pipe Max Velocity 5 to 7 fps
- Pipe Max Velocity > 7 fps
- Node Min Pressure < 40 psi
- Node Min Pressure > 40 psi
- Node Max Pressure 100 to 125 psi
- Node Max Pressure 125 to 150 psi
- Node Max Pressure > 150 psi

Note:
CWS = California Water Service
ES = City of El Segundo
MWD = Municipal Water District

N

1,600 800 0 1,600 Feet

Date: 12/10/2021

TITLE:
Figure 9-3 – Ultimate System Pressures and Velocities

PROJECT:
City of Manhattan Beach Water Master Plan

COORDINATE SYSTEM:
NAD 1983 StatePlane California V FIPS 0405 Feet

Stantec

9.2 FIRE FLOW ANALYSIS

The fire flow analysis is performed to evaluate if sufficient water will be available at the minimum required residual pressure within the distribution system during a fire emergency. When a fire event happens, significant amount of water is required at hydrants to fight fire. With higher water flow, system pressures drop at the same time within the distribution system. Adequate pressure is required to fight fire and to serve water demands for customers. Therefore, fire flow capacity is considered when evaluating a distribution system.

The fire flow analysis is preformed to evaluate if the system can provide minimum 20 psi residual pressure and flows not to exceed maximum 10 fps velocity during MDD and fire flow conditions to meet City's fire flow requirements. Steady-state simulations were performed on the City's existing water distribution system with MDD (4,451 gpm) and appropriate fire flow applied at each hydrant based on land use fire flow requirements. The analysis resulted with some hydrants having residual pressures less than 20 psi, as shown on Figure 9-4. The fire flow analysis was performed for the existing distribution system conditions as these conditions were calibrated for this study. It is recommended that the model be furthered calibrated during maximum day demand conditions and when Peck Reservoir and Pump Station are fully operational.

To determine improvement recommendations, for hydrants with low pressure and fire flow greater than 2,000 gpm, the flow was split between hydrant nodes and re-evaluated. This is typical practice since during a fire, if there is a close by hydrant, both hydrants can be used to fight fire. The system was re-evaluated, and pipeline improvement recommendations included upsizing in pipe diameters to meet the fire flow criteria. All pipeline improvements to mitigate fire flow deficiencies are shown on Figure 9-5. There are several individual pipeline improvement projects required to mitigate the fire flow deficiencies in area north of 30th Street to 45th Street, known as the El Porto area. As alternative to these individual improvement pipelines, an alternative analysis was conducted with a proposed 12-inch pipeline along Rosecrans Avenue from Laurel Avenue to Highland Avenue, referred to as the El Porto Area Fire Flow Improvement Analysis.

El Porto Area Fire Flow Improvement Analysis

The alternative analysis assumes that the proposed 12-inch pipeline along Rosecrans Avenue from Laurel Avenue to Highland Avenue is constructed in-lieu of the individual improvement pipelines in the El Porto area, shown in yellow on Figure 9-5. A fire flow analysis was performed with the proposed 12-inch pipeline (approximately 4,461 lf) along Rosecrans Avenue. The results of the analysis indicated that the addition of the 12-inch pipeline would eliminate the need for the individual pipeline projects as shown in yellow on Figure 9-5. The total length of individual pipeline projects (approximately 4,572 lf) is longer and includes varying pipe diameters between 8-inch to 12-inch. Each pipe location is expected to be constructed as separate individual projects which can take longer to complete. Overall costs for the individual project are $4.2 million and $4.5 million for the 12-inch pipeline in Rosecrans Avenue, but with the overall residential neighborhood impacts expected to be less for the 12-inch pipeline in Rosecrans Avenue alternative. The proposed 12-inch pipeline is considered in the water age analysis in Chapter 9 for potential water quality mitigation.

Reservoir	Flow Control Valve
Groundwater Well	Booster Pump Station (BPS)
Import Water Turnout	Hill Zone
Interagency Connection (Intertie)	Main Zone
Pressure Monitoring Station	City of Manhattan Beach
	Outside Agency Pipeline

Existing Pipelines

- Less than 10" Diameter
- 10" Diameter and Greater
- MWD Distribution Main
- Well Transmission Main
- Residual Pressure < 20 psi
- Pipe Diameter 4" or Less

Note:
CWS = California Water Service
ES = City of El Segundo
MWD = Metropolitan Water District

N
1,600 800 0 1,600 Feet
Date: 12/9/2021

TITLE: **Figure 9-4 – Existing Fire Flow Analysis**

PROJECT: City of Manhattan Beach Water Master Plan

COORDINATE SYSTEM: NAD 1983 StatePlane California V FIPS 0405 Feet

Stantec

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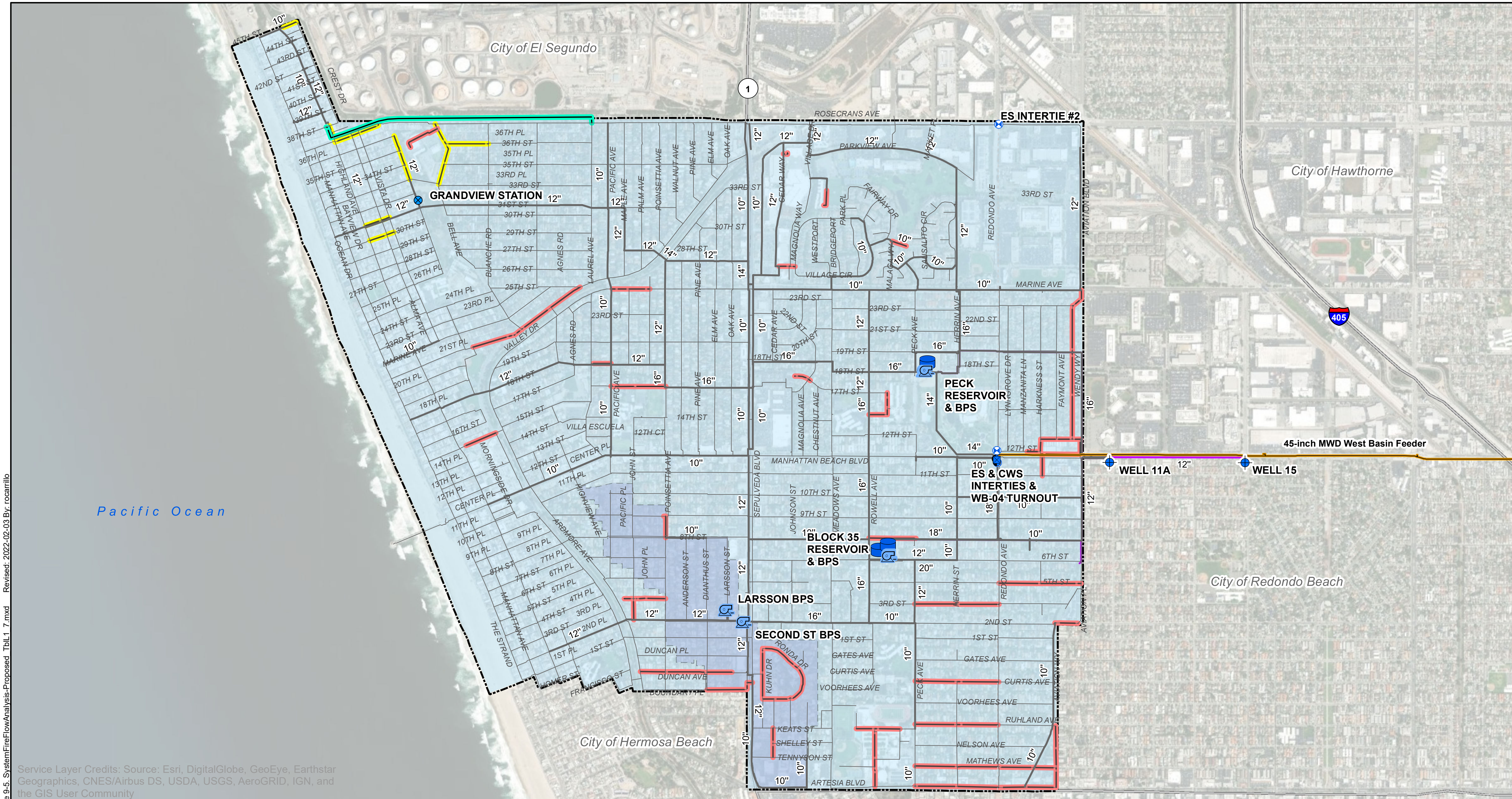


Reservoir	Flow Control Valve	**Existing Pipelines**
Groundwater Well	Booster Pump Station (BPS)	Less than 10" Diameter
Import Water Turnout	Hill Zone	10" Diameter and Greater
Interagency Connection (Intertie)	Main Zone	MWD Distribution Main
Pressure Monitoring Station	City of Manhattan Beach	Well Transmission Main
	Outside Agency Pipeline	

Fire Flow Results

- Deficient pipeline
- Proposed 12" El Porto Pipeline Project Phase I
- Deficiencies Addressed by Proposed El Porto Pipeline

Note:
CWS = California Water Service
ES = City of El Segundo
MWD = Metropolitan Water District

N

1,600 800 0 1,600 Feet

Date: 2/3/2022

TITLE:
Figure 9-5 – Recommended Fire Flow Pipeline Improvements

PROJECT:
City of Manhattan Beach Water Master Plan

COORDINATE SYSTEM:
NAD 1983 StatePlane California V FIPS 0405 Feet

Stantec

V:\1840\active\184031379\gis_MXDs\Figure 9-5_SystemFireFlowAnalysis-Proposed_TblL1_7.mxd Revised: 2022-02-03 By: rocarrillo

9.2.1 Fire Flow Analysis Recommendations

The fire flow analysis resulted in several pipeline locations that require upsizing to meet fire flow requirements. The total length of fire flow improvements recommended is approximately 35,783 lf ranging from 6-inch to 12-inch diameter pipelines. Pipeline improvements are summarized in Table 9-1 and illustrated on Figure 9-5.

Table 9-1 – Fire Flow Improvement Recommendations

CIP ID	Facility Description	Existing Size	Proposed Size	Quantity (lf)
FF-001	15th St bw Highland Ave and Valley Dr	6"	8"	511
FF-002	Duncan Ave bw Ardmore Ave and Dianthus St	4"	6"	1,016
FF-003	Duncan Ave bw Dianthus St and Sepulveda Blvd	4"	8"	393
FF-004	Boundary Pl bw Dianthus St & Sepulveda Blvd and bw Boundary & Duncan	6"	10"	825
FF-005	John St bw 3rd St and 2nd St	6"	8"	335
FF-006	3rd St bw Ardmore Ave and Poinsettia Ave	4"	8"	654
FF-007	Poinsettia Ave bw 9th St and 8th St	6"	8"	21
FF-008	17th St bw Pacific Ave and Poinsettia Ave	4"	6"	892
FF-009	Valley Dr bw Marine Ave & Blanche Rd, 21st St bw Blanche Rd & Mandor Dr	4"	6"	1,974
FF-010	18th St bw Laurel Ave and Pacific Ave	6"	8"	281
FF-011	Marine Ave bw Pacific Ave and Palm Ave	6"	8"	594
FF-012	Ritter Rd bw Grandview Ave and Bell Ave	6"	10"	595
FF-013	Lateral off Cedar Wy bw Carlotta Wy and 33rd St	6"	8"	106
FF-014	Near Magnolia Wy bw 33rd St and Santa Cruz Ct	6"	10"	271
FF-015	Village Center Dr bw Malaga Wy and Gateway Dr	8"	10"	230
FF-016	27th Wy bw Cedar Wy and Village Cir	8"	10"	256
FF-017	17th St bw (west of) Magnolia Ave and Chestnut Ave	6"	8"	262
FF-018	15th St near Roswell Ave and 17th St	6"	8"	634
FF-019	8th St bw Rowell Ave and Peck Ave	4"	6"	744
FF-020	Ronda Rd, Longfellow Dr, Kuhn Dr	6"	8"	2,507
FF-021	Chabela Dr bw Keats St and Tennyson St	6"	8"	464
FF-022	Mira Costa HS near Ruhland Ave bw Meadows Ave and Peck Ave	6"	10"	291
FF-023	Mira Costa HS near Ruhland Ave bw Meadows Ave and Peck Ave	8"	10"	398
FF-024	Mira Costa HS near Meadows Ave between Keats St and Artesia Blvd	4"	6"	914
FF-025	Artesia Blvd bw Peck Ave and Aviation Blvd	6"	10"	1,739
FF-026	Artesia Blvd bw Aviation Blvd and Aviation Wy	6"	8"	480
FF-027	Mathews Ave bw Peck Ave and Redondo Ave	6"	8"	1,328
FF-028	Mathews Ave bw Redondo Ave and Aviation Wy	4"	8"	914
FF-029	Aviation Wy bw Ruhland Ave and Artesia Blvd	4"	8"	992
FF-030	Ruhland Ave bw Peck Ave and Redondo Ave	6"	8"	1,315
FF-031	Curtis Ave bw Peck Ave and Redondo Ave	6"	8"	1,325
FF-032	3rd St bw Peck Ave and Redondo Ave	6"	8"	1,335
FF-033	2nd St bw Aviation Blvd and Aviation Pl	6"	8"	589
FF-034	5th St bw Redondo Ave and Aviation Blvd	4"	6"	1,302
FF-035	Harkness St bw Manhattan Beach Blvd and 11th St	2"	6"	286
FF-036	12th St bw Manzanita Ln and Harkness St	8"	8"	214
FF-037	12th St bw Harkness St and Aviation Blvd, Aviation Blvd bw 12th and Manhattan Beach Blvd	6"	8"	629
FF-038	12th St bw Harkness St and Aviation Blvd, Aviation Blvd bw 12th and Manhattan Beach Blvd	8"	8"	240
FF-039	Harkness St bw 12th St and Manhattan Beach Blvd, Manhattan Beach Blvd bw Harkness St and Aviation Blvd	6"	8"	629

CIP ID	Facility Description	Existing Size	Proposed Size	Quantity (lf)
FF-040	Harkness St bw 12th St and Manhattan Beach Blvd, Manhattan Beach Blvd bw Harkness St and Aviation Blvd	8"	8"	238
FF-041	Wendy Wy bw Marine Ave and 12th St	6"	8"	2,429
FF-042	Bell Ave bw Rosecrans Ave and 33rd St	6"	10"	170
FF-043	Phase 1 - New 12-inch Pipeline in Rosecrans Avenue from Laurel Ave to Highland/38th St	-	12"	4,461

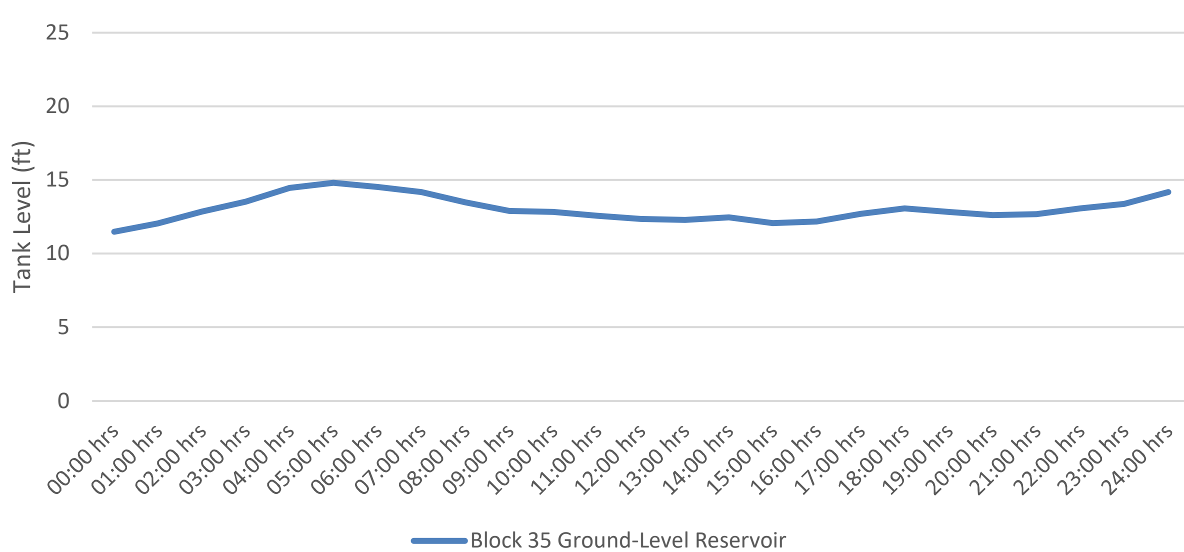
9.3 RESERVOIR AND BOOSTER STATION EVALUATION

The water distribution system was evaluated under MDD conditions for a duration of 24 hours to analyze the tanks for proper water level cycling operation and booster pump station capacities and operation to provide adequate pressures in the distribution system. The evaluation was performed for existing, near-term, and ultimate planning horizons.

9.3.1 Existing Reservoir and Booster Station Evaluation

The reservoirs and booster stations are evaluated with MDD (4,451 gpm) with existing water system operation conditions defined in Section 9.1.1. Under this scenario, approximately 4,451 gpm of imported water is supplied from MWD, with 2,936 gpm to the Block 35 Facility and 1,515 gpm directly serving the system. The Block 35 Booster Station is required to maintain minimum discharge pressure of approximately 56 psi to provide adequate system pressures downstream. During peak demand periods or when system pressures drop, the Block 35 pumps are turned on by a pressure set point (56 psi) and pump directly to the distribution system. Surplus supply during low demand periods comes through the Block 35 facility to be stored in the Block 35 Ground Level Tank. As shown in Figure 9-6 below, the Block 35 Ground Level Tank utilized approximately 1 foot of storage during the existing MDD conditions.

Figure 9-6 – Existing MDD EPS Modeled Reservoir Operation



The system evaluation resulted with no low-pressure service nodes or pipe velocity deficiencies caused by the operations under this scenario.

Table 9-2 provides a summary of the model results for the active booster stations under existing MDD conditions. Note that the Block 35 Pump Station discharge pressure is 62 psi on average, which is greater than the 56 psi set point. The higher pressure occurs because the system is served directly by MWD source water, and the pump station operation was controlled by the City operators to supplement additional flow during peak demands or during low pressures. Since MWD water was serving the distribution system directly, and it passes through the Block 35 discharge pipeline, higher discharge pressures and lower flow from the Block 35 Pump Station were observed. Similar discharge pressure was observed from the City's SCADA data on the day of the hydrant testing. MWD water flows of 3,285 to 4,845 gpm were delivered directly to the system under this analysis, with the Block 35 Pump Station supplementing unmet demands. The Larsson pump station provides discharge pressure of 61 psi on average with one pump operating. The system evaluation resulted with no low-pressure service nodes or pipe velocity deficiencies caused by the operations under this scenario.

Table 9-2 – Existing MDD EPS Modeled Booster Pump Station Operation

Pump Station/ Pump	Model ID	Pump Status	Rated Capacity (gpm)	Model Flow Range (gpm)	Suction Pressure (psi)	Discharge Pressure (psi)	Hours
Block 35 Booster Pump Station							
Pump 1	B35_P1	Duty	1,715	15 – 1,822	5	62	24
Pump 2	B35_P2	Duty	1,715	0			0
Pump 3	B35_P3	Duty	1,715	0			0
Pump 4	B35_P4	Standby	1,715	0			0
Larsson Booster Pump Station							
Pump 1	LSN_P1	Duty	580	196 – 376	33	61	24
Pump 2	LSN_P2	Duty	580	0			0
Pump 3	LSN_P3	Duty	580	0			0

9.3.2 Near-Term Reservoir and Booster Station Evaluation

The reservoirs and booster stations are evaluated with 2025 MDD (4,504 gpm) with near-term water system operation conditions defined in Section 9.1.2. Under this scenario, approximately 3,370 gpm of imported water is supplied from MWD, with 2,930 gpm delivered to the Block 35 Facility and 440 gpm to the Peck Facility. All groundwater (1,183 gpm) from Well 15 is delivered to the Peck Reservoir and treated prior to distribution. Well 15 provides adequate flow and has an average discharge pressure of 73 psi. The system evaluation resulted with no low-pressure service nodes or pipe velocity deficiencies caused by the operations under this scenario. As shown in Figure 9-7, the reservoirs utilize 1 to 3 feet of storage during near-term MDD conditions.

Figure 9-7 – Near-Term MDD EPS Modeled Reservoir Operation

Table 9-3 provides a summary of the model results for the active booster stations to meet near-term MDD conditions. Note that the pump sequencing shown in the tables reflects the model pumps and does not reflect the actual pump operation sequencing. On average, the discharge pressure downstream of Block 35 pump station is approximately 53 psi, the Peck pump station it is approximately 84 psi and the Larsson pump station is 61 psi. Although the Block 35 pump station discharge pressure is slightly lower than the set 56 psi, all pump stations provide adequate system pressures and have sufficient capacity.

Table 9-3 – Near-Term MDD EPS Modeled Booster Pump Station Operation

Pump Station/ Pump	Model ID	Pump Status	Rated Capacity (gpm)	Model Flow Range (gpm)	Suction Pressure (psi)	Discharge Pressure (psi)	Hours
Block 35 Booster Pump Station							
Pump 1	B35_P1	Duty	1,715	47 – 1,258	4	53	24
Pump 2	B35_P2	Duty	1,715	0 – 2,368			6
Pump 3	B35_P3	Duty	1,715	0			0
Pump 4	B35_P4	Duty	1,715	0			0
Peck Booster Pump Station							
Pump 1	PECK_P1	Duty	2,200	0 – 2,416	-6	84	16
Pump 2	PECK_P2	Duty	2,200	0			0
Pump 3	PECK_P3	Duty	2,200	0			0
Pump 4	PECK_P4	Duty	2,200	0			0
Larsson Booster Pump Station							
Pump 1	LSN_P1	Duty	580	203 – 390	30	61	24
Pump 2	LSN_P2	Duty	580	0			0
Pump 3	LSN_P3	Duty	580	0			0
Pump 4	LSN_P4	Standby	2,302	0			0

9.3.3 Ultimate Reservoir and Booster Station Evaluation

The reservoirs and booster stations are evaluated with 2030 MDD (4,766 gpm) with ultimate water system operation conditions defined in Section 9.1.3. Under this scenario, approximately 3,605 gpm of imported water is supplied from MWD, with 3,140 gpm of imported water delivered to the Block 35 Facility and 465 gpm to Peck Facility. All groundwater (1,183 gpm) from Well 15 is delivered to the Peck Reservoir and treated prior to distribution. Well 15 provides adequate flow and has an average discharge pressure of 73 psi. The system evaluation resulted with no low-pressure service nodes or pipe velocity deficiencies caused by the operations under this scenario. As shown on Figure 9-8, the reservoirs utilize 1 to 3 feet of storage during ultimate MDD conditions. The Peck Facility did oscillate/cycle during the 24-hour period and maintained the tank level from the start of the analysis, meaning sufficient water supply is available.

Figure 9-8 – Ultimate MDD EPS Modeled Reservoir Operation

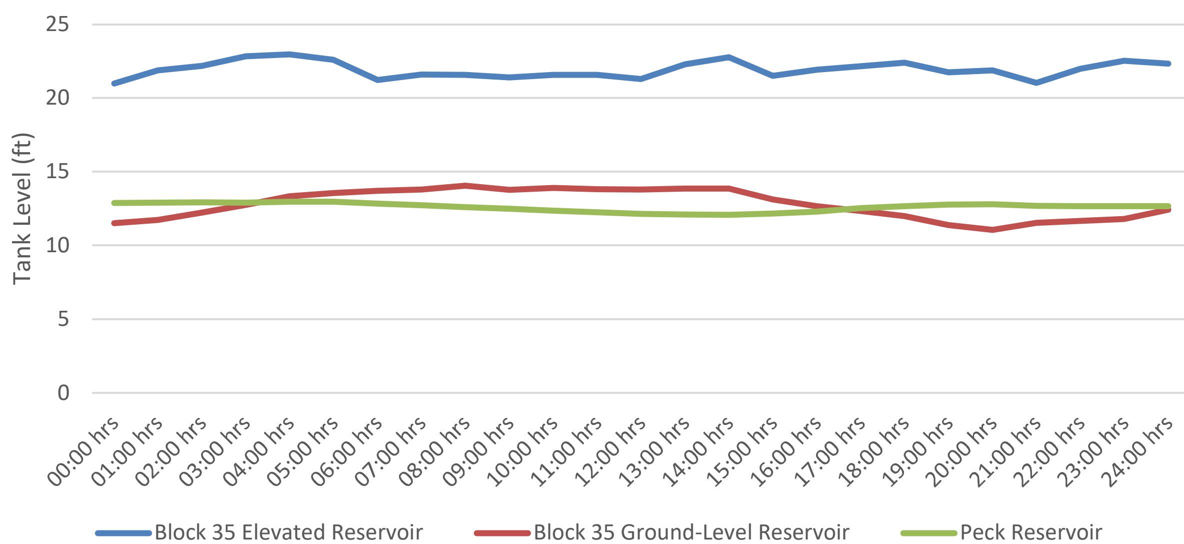


Table 9-4 provides a summary of the model results for the active booster stations to meet ultimate MDD conditions. Note that the pump sequencing shown in able 9-3 reflects the model pumps and does not reflect the actual pump operation sequencing. On average, the discharge pressure downstream of Block 35 pump station is approximately 53 psi, the Peck pump station it is approximately 84 psi, and the Larsson pump station is 76 psi. Although the Block 35 pump station discharge pressure is slightly lower than the set 56 psi, all pump stations provide adequate system pressures and have sufficient capacity.

Table 9-4 – Ultimate MDD EPS Modeled Booster Pump Station Operation

Pump Station/ Pump	Model ID	Pump Status	Rated Capacity (gpm)	Model Flow Range (gpm)	Suction Pressure (psi)	Discharge Pressure (psi)	Hours
Block 35 Booster Pump Station							
Pump 1	B35_P1	Duty	1,715	258 – 1,346	4	53	24
Pump 2	B35_P2	Duty	1,715	0 – 2,364			6
Pump 3	B35_P3	Duty	1,715	0			0
Pump 4	B35_P4	Duty	1,715	0			0
Peck Booster Pump Station							
Pump 1	PECK_P1	Duty	2,200	0 – 2,424	-6	84	18
Pump 2	PECK_P2	Duty	2,200	0			0
Pump 3	PECK_P3	Duty	2,200	0			0
Pump 4	PECK_P4	Duty	2,200	0			0
Larsson Booster Pump Station							
Pump 1	LSN_P1	Duty	580	215-412	34	76	24
Pump 2	LSN_P2	Duty	580	0			0
Pump 3	LSN_P3	Duty	580	0			0
Pump 4	LSN_P4	Standby	2,302	0			0

9.3.4 Reservoir and Booster Station Evaluation Recommendations

The water distribution system was evaluated under MDD conditions for a duration of 24 hours to analyze the tanks for proper water level cycling operation and booster pump station capacities and operation to provide adequate pressures in the distribution system. The evaluation was performed for existing, near-term, and ultimate planning horizons. The analysis results indicated that all active reservoirs and booster stations have sufficient capacity, and the booster stations provide adequate system pressures for the distribution system under existing, near-term, and ultimate planning conditions.

9.4 STORAGE ANALYSIS

A storage analysis was conducted to evaluate the existing storage required, based on the criteria as described in Chapter 7. Storage requirements consist of the sum of the storage volumes required for operational, emergency, and fire flow components

Operational storage provides daily or weekly equalization of supply and demands from storage reserves and is defined as 35 percent of ADDs for the City of Manhattan Beach. For the existing conditions, this component is 1.50 MG. Future demand conditions will require an operational storage volume of 1.61 MG.

Emergency storage is recommended in the event of an interruption in the primary supply source. The City's primary supply source is imported from MWD. The recommended emergency storage volume in the event of an MWD outage is seven days of ADDs. However, it is reasonable to assume groundwater supply sources will be available during a MWD outage for seven days. Therefore, the required emergency storage volumes can be reduced by the groundwater supply capacity. This Master Plan assumes a firm groundwater supply capacity, which is the capacity with the largest well out of service. For existing conditions, the firm groundwater capacity is 1,500 gpm from Well 15 only, or 15.12 MG for seven days.

Subtracting this capacity from the total emergency storage requirement of seven ADDs (29.89 MG) yields a net requirement of 14.77 MG, which results in overall storge deficit of 6.93 MG. In order for the City mitigate this deficit for storage, additional groundwater capacity is required. It is recommended for the City to use both wells during emergency conditions, when imported water is out. Future emergency conditions assumed groundwater capacity of 3,300 gpm (1,800 gpm from well 11A and 1,500 gpm from Well 15), or 33.26 MG. The future required volume based on seven ADDs is 32.06 MG, which is less than the groundwater supply. The entire future emergency storage requirement can be met from groundwater supplies.

9.4.1 Storage Analysis Recommendations

Emergency storage is recommended in the event of an interruption in the primary supply source. The City's primary supply source is imported from MWD. The recommended emergency storage in the event of an MWD outage is seven ADDs. However, it is reasonable to assume groundwater supply sources will be available during a MWD outage for seven days. Therefore, the required emergency storage volumes can be reduced by the groundwater supply capacity. The Block 35 and Peck Reservoir pump stations provide adequate system pressures and have sufficient capacity to meet future demands. For ultimate planning horizon, groundwater capacity assumes a firm operating capacity of 3,300 gpm (1,800 gpm from well 11A and 1,500 gpm from Well 15), or 33.26 MG for seven days. The required emergency volume for ultimate planning horizon based on seven ADDs is 32.06 MG, which is less than the ground water supply. The ultimate emergency storage requirement can be met with Well 15 and Well 11A supplying the distribution system. The future conditions will have a surplus storage of 7.74 MG.

Fire storage is assumed to be required for the largest fire flow requirement based on the various land uses as described in Chapter 7. For the City of Manhattan Beach, this would be based on the Commercial/Industrial requirement of 4,000 gpm for a four-hour duration. The fire storage volume is then 0.96 MG. This requirement remains the same for future conditions.

Total existing storage capacity is 10.3 MG, which is the total of Block 35 Ground Level Tank (2.0 MG), Block 35 Elevated Tank (0.3 MG), and the Peck Facility (8.0 MG).

Table 9-5 below shows the storage requirements analysis for existing and future demands conditions. With the current pumping capacity, the future conditions will have a surplus storage of 7.74 MG.

Table 9-5 – Existing and Future Storage Requirements

Demand Condition	Average Day Demand (mgd)	Fire Storage (MG)	Emerg. Storage (MG)	Oper. Storage (MG)	Total Storage Required (MG)	Existing Storage (MG)	Surplus/ (Deficit) (MG)
Existing	4.27	0.96	14.77	1.50	17.23	10.30	(6.93)
Ultimate	4.58	0.96	-	1.61	2.56	10.30	7.74

9.5 RELIABILITY ANALYSIS

As mentioned previously, normal supply operations for the City includes primarily MWD imported water supply routing into Block 35 and Peck reservoirs during winter. During the summer or higher demand months, groundwater is also supplied to the system from Wells 11A and 15. Historically, groundwater was pumped directly to Block 35 and Peck facilities and blended with imported water prior to serving the distribution system. Peck Facility upgrades add the capability for the City to treat groundwater at the Peck Facility, prior to serving the distribution system. The reliability analyses in this section assume groundwater treatment capability at the Peck Facility and Block 35 Facility follows historical operation of blending groundwater with imported water. However, it is recommended that Block 35 facility be equipped with treatment capabilities similar to the new Peck facility.

To determine overall system reliability, the following emergency or facility outage conditions were simulated for a duration of three days (72-hour) and evaluated for capacity and performance to meet the City's planning criteria:

- Imported water out of service
    - With Existing Groundwater Capacity
    - With Additional Groundwater Capacity
    - With Groundwater Routed to the Peck Facility
- Groundwater out of service
- Block 35 Facility out of service

9.5.1 Imported Water Out of Service

The following scenarios analyze the water distribution system with imported water out of service.

9.5.1.1 With Existing Groundwater Capacity

This scenario depicts a circumstance where imported water connection is out of service for 72 hours, and the distribution system is supplied with groundwater only. Operational and emergency storage in the reservoirs were assumed available and used for the analysis. Groundwater is supplied to Peck and Block 35 facilities. Groundwater is treated at Peck and blended with imported water at Block 35.

An analysis was performed for near-term ADD (3,002 gpm) to determine well capacity limits and operations. The City's total groundwater pumping capacity is 3,300 gpm (Well 11A and Well 15). Under this scenario, 1,800 gpm groundwater is routed to the Peck Facility and approximately 1,274 gpm groundwater is routed to the Block 35 Facility. The results indicated that the system met the City's requirements and can operate for 72 hours with existing groundwater capacities.

However, the City's existing groundwater pumping capacity is not sufficient to provide existing MDD (4,451 gpm), near-term MDD (4,504 gpm) or ultimate MDD (4,766 gpm), independent of the imported water supply. Without the imported water supply, the Peck Reservoir is emptying since the City' total MDD is greater that the well pumping capacity. It is recommended for the City to consider increasing the total well capacity or implement the construction of a new groundwater well to meet the City's system maximum demand in case imported water goes out of service.

9.5.1.2 With Additional Groundwater Capacity

This scenario depicts a circumstance where imported water connection is out of service for 72 hours and the City's total groundwater pumping capacity is increased to approximately 4,590 gpm and 4,790 gpm for near-term and ultimate MDD, respectively. To balance the flow and reservoir levels, 2,600 gpm of groundwater is routed to the Peck Facility and 1,989 gpm to the Block 35 Facility to meet near-term MDD demands. To meet ultimate water demands, the groundwater flows were increased to 2,800 gpm to Peck and 1,989 gpm to Block 35 Facilities. Note that these flows are not currently available with the City's current groundwater and well capacity. This was simulated to evaluate the system if additional groundwater was available. Once supply needs were met, the model analysis showed the Peck and Block 35 Facilities did oscillate/cycle as often as normal conditions and the tanks maintained similar tank levels as normal conditions. Tank levels are shown in Figure 9-9 and Figure 9-10 for near-term and ultimate demands.

Figure 9-9 – Tank Levels When Imported Water is Out of Service Near-Term

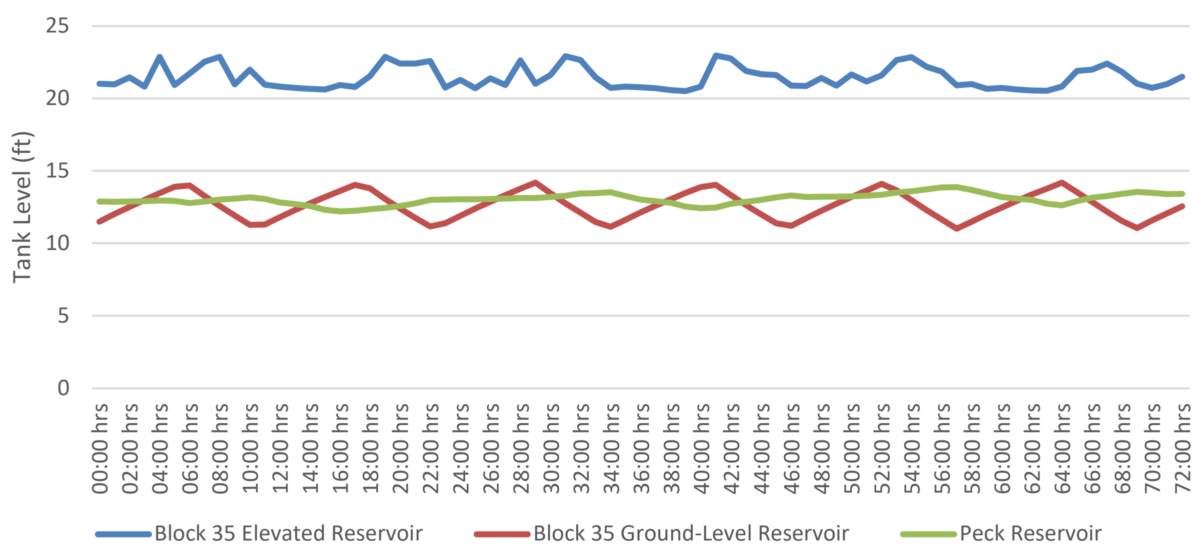
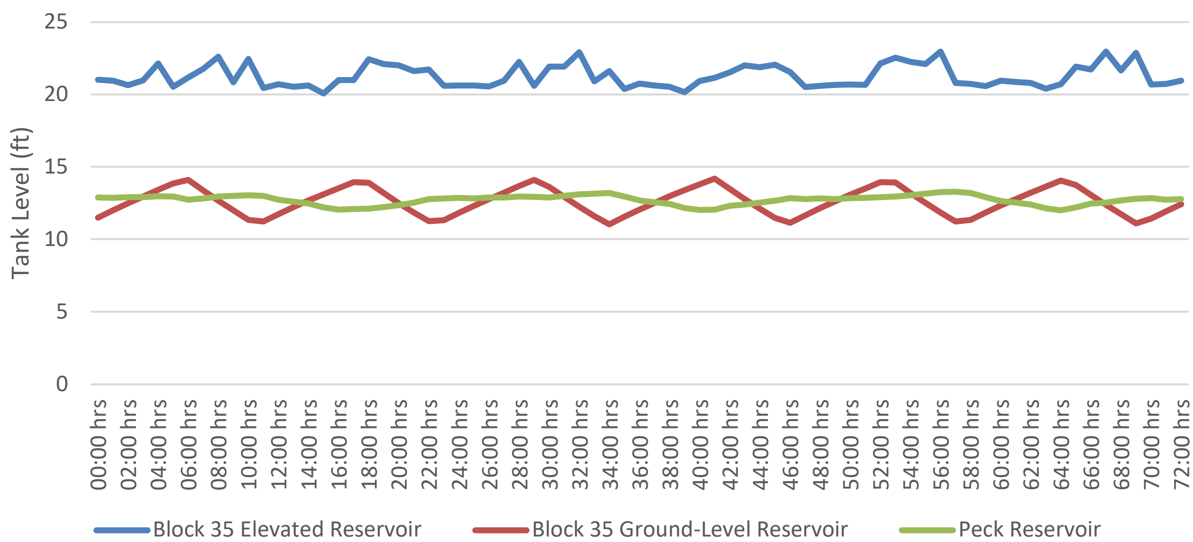


Figure 9-10 – Tank Levels When Imported Water is Out of Service Ultimate



The model results also indicate Peck and Block 35 pump stations needed to have two pumps pumping at each station for various hours to meet near-term and ultimate MDD, as shown in Table 9-6 and Table 9-7. One pump is on at the Larsson Booster Station to serve the higher-pressure zone. Note that the pump sequencing shown in the tables reflects the model pumps and does not reflect the actual pump operation sequencing. However, this does not change the discharge pressures required to provide adequate system pressures. On average, the discharge pressure downstream of Block 35 pump station is approximately 53 psi, the Peck pump station it is approximately 84 psi, and the Larsson pump station is 76 psi. Although the Block 35 pump station discharge pressure is slightly lower than the set 56 psi, all pump stations provide adequate system pressures and have sufficient capacity.

There were no service nodes with low-pressures and almost all pipes had flows with no velocity deficiencies caused by the operations under both scenarios, with the exception of the pipeline providing groundwater to the Block 35 Facility. The 10-inch pipe segment had a velocity of 8 fps, which is slightly higher than the minimum 7 fps. If the City is able to deliver approximately 2,000 gpm of groundwater to the Block 35 Facility, this pipeline will need to be upsized to 12-inch.

Table 9-6 – Imported Water Out of Service Modeled Booster Pump Station Operation Near-Term

Pump Station/ Pump	Model ID	Pump Status	Rated Capacity (gpm)	Model Flow Range (gpm)	Suction Pressure (psi)	Discharge Pressure (psi)	Hours
Block 35 Booster Pump Station							
Pump 1	B35_P1	Duty	1,715	783 – 1,188	4	53	72
Pump 2	B35_P2	Duty	1,715	0 – 2,359			28
Pump 3	B35_P3	Duty	1,715	0			0
Pump 4	B35_P4	Duty	1,715	0			0
Peck Booster Pump Station							
Pump 1	PECK_P1	Duty	2,200	0 – 2,432	-6	86	63
Pump 2	PECK_P2	Duty	2,200	0 – 2,327			16
Pump 3	PECK_P3	Duty	2,200	0			0
Pump 4	PECK_P4	Duty	2,200	0			0
Larsson Booster Pump Station							
Pump 1	LSN_P1	Duty	580	203 – 390	30	55	72
Pump 2	LSN_P2	Duty	580	0			0
Pump 3	LSN_P3	Duty	580	0			0
Pump 4	LSN_P4	Standby	2,302	0			0

Table 9-7 – Imported Water Out of Service Modeled Booster Pump Station Operation Ultimate

Pump Station/ Pump	Model ID	Pump Status	Rated Capacity (gpm)	Model Flow Range (gpm)	Suction Pressure (psi)	Discharge Pressure (psi)	Hours
Block 35 Booster Pump Station							
Pump 1	B35_P1	Duty	1,715	751 – 1,203	4	53	72
Pump 2	B35_P2	Duty	1,715	0 – 2,372			29
Pump 3	B35_P3	Duty	1,715	0			0
Pump 4	B35_P4	Duty	1,715	0			0
Peck Booster Pump Station							
Pump 1	PECK_P1	Duty	2,200	0 – 2,430	-6	85	62
Pump 2	PECK_P2	Duty	2,200	0 – 2,327			17
Pump 3	PECK_P3	Duty	2,200	0			0
Pump 4	PECK_P4	Duty	2,200	0			0
Larsson Booster Pump Station							
Pump 1	LSN_P1	Duty	580	215 – 412	30	55	72
Pump 2	LSN_P2	Duty	580	0			0
Pump 3	LSN_P3	Duty	580	0			0
Pump 4	LSN_P4	Standby	2,302	0			0

9.5.1.3 All Groundwater Supply Routed to the Peck Facility

This scenario depicts imported water out of service, similar to the previous scenario and assumes additional groundwater capacity is available. However, under this scenario, all groundwater was routed to the Peck Facility and system is evaluated under near-term MDD (4,504 gpm). Since Block 35 requires groundwater to be blended with imported water, this scenario assumes that all groundwater is pumped to the Peck Facility, where its treated, then pumped to the distribution system and to Block 35 Facility. In this scenario, water from the Block 35 Elevated Tank supplied the Block 35 Ground-Level Tank. Flow control was based on Block 35 Elevated Tank water levels. This scenario is intended to evaluate the capacity of the Peck Facility and to consider a 24-inch transmission line between Peck and Block 35 Facilities for potential overall operations improvements.

The system was evaluated with 4,540 gpm groundwater routed to the Peck Facility then pumped to the distribution system. Note that these flows are not currently available with the City's current groundwater and well capacity. This was simulated to evaluate the system if additional groundwater was available. Once supply needs were met, the model analysis shows the Peck and Block 35 Facilities oscillate/cycle more often than normal conditions. Tank levels are shown in Figure 9-11 for near-term MDD planning horizon.

Figure 9-11 – Imported Water Out of Service, no Treatment Improvements to Block 35

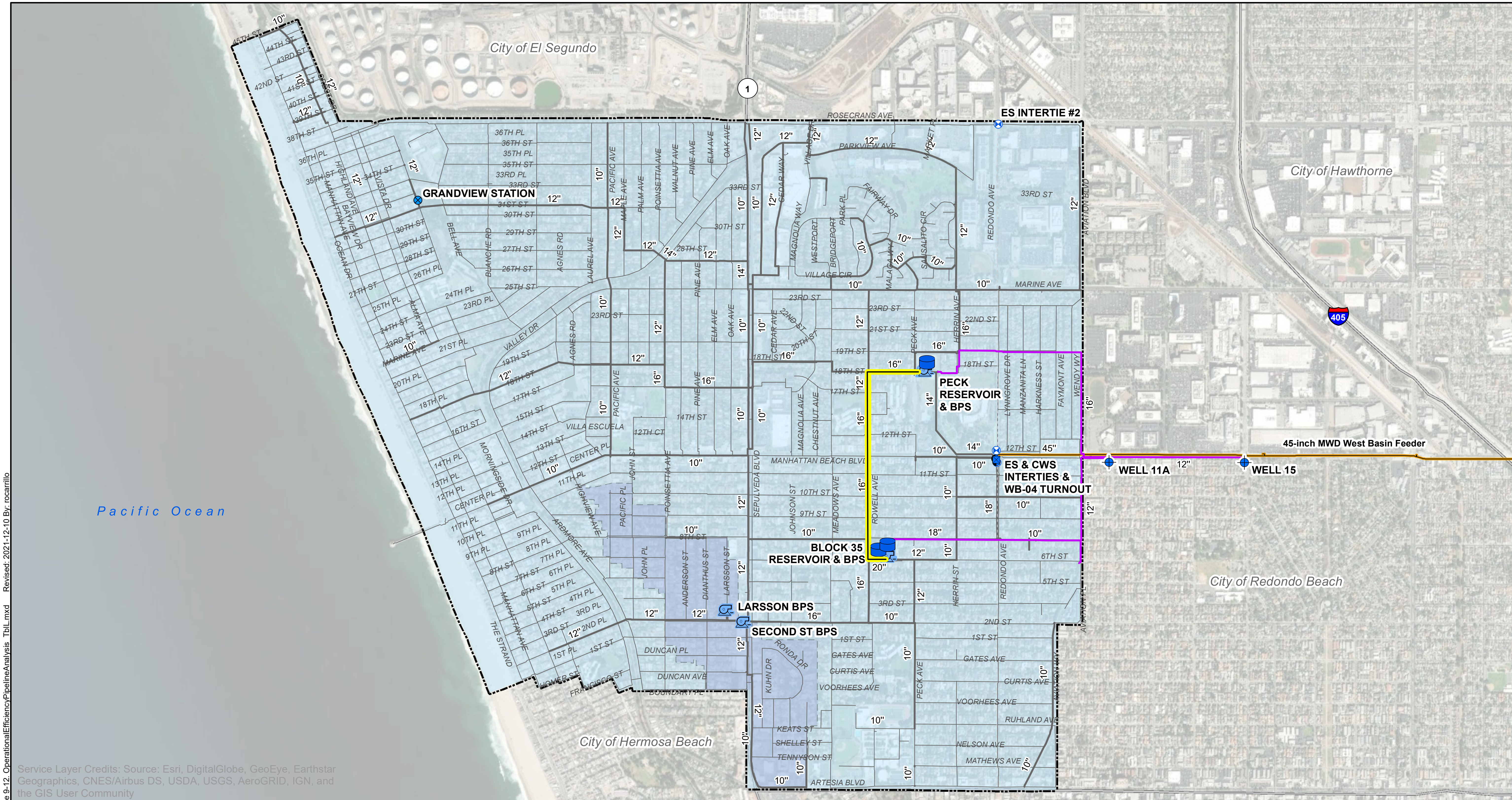
The model results indicated Peck pump stations needed to have three pumps pumping for various hours to meet near-term MDD, as shown in Table 9-8. Note that the pump sequencing shown in the tables reflects the model pumps and does not reflect the actual pump operation sequencing. However, this does not change the discharge pressures required to provide adequate system pressures. The discharge pressure required downstream of the Peck pump station is approximately 85 psi. Both pump stations have sufficient capacity.

Table 9-8 – Imported Water Out of Service, with All Groundwater Routed to Peck Facility

Pump Station/ Pump	Model ID	Pump Status	Rated Capacity (gpm)	Model Flow Range (gpm)	Suction Pressure (psi)	Discharge Pressure (psi)	Hours
Block 35 Booster Pump Station							
Pump 1	B35_P1	Duty	1,715	15 – 2,433	4	53	72
Pump 2	B35_P2	Duty	1,715	0 – 2,406			68
Pump 3	B35_P3	Duty	1,715	0			0
Pump 4	B35_P4	Duty	1,715	0			0
Peck Booster Pump Station							
Pump 1	PECK_P1	Duty	2,200	0 – 2,423	-6	90	70
Pump 2	PECK_P2	Duty	2,200	0 – 2,312			29
Pump 3	PECK_P3	Duty	2,200	0 – 2,300			32
Pump 4	PECK_P4	Duty	2,200	0 – 2,157			26
Larsson Booster Pump Station							
Pump 1	LSN_P1	Duty	580	203 – 389	31	56	72
Pump 2	LSN_P2	Duty	580	0			0
Pump 3	LSN_P3	Duty	580	0			0
Pump 4	LSN_P4	Standby	2,302	0			0

Consideration was given to a new 24-inch pipeline between Peck pump station and the Block 35 Facility. The system was analyzed with and without the addition of a new 24-inch pipeline between the two facilities. See Figure 9-12 for the location of the proposed 24-inch deficient pipeline. The model analysis showed that no significant differences in operations or benefits were provided in the system with a new pipeline and there were no low-pressure areas in the distribution system under both options. The existing system is well gridded with large diameter between the two facilities that provide sufficient flow distribution.

The only deficiency observed in the system was the velocity of 7.24 fps through the 16-inch transmission line routing the 4,500 gpm of groundwater from the City's wells to the Peck Facility. The pipe slightly exceeded the velocity criteria of 7 fps. Since this potential operating condition is temporary, and velocity criteria only exceeds slightly, improvements are not recommended for the 16-inch pipeline.



Reservoir
Groundwater Well
Import Water Turnout
Interagency Connection (Intertie)
Pressure Monitoring Station

Flow Control Valve
Booster Pump Station (BPS)
Hill Zone
Main Zone
City of Manhattan Beach
Outside Agency Pipeline

Existing Pipelines
Less than 10" Diameter
10" Diameter and Greater
MWD Distribution Main
Well Transmission Main

24"Pipeline Evaluated between Peck and Block 35 Facilities

Note:
CWS = California Water Service
ES = City of El Segundo
MWD = Metropolitan Water District

N
1,600 800 0 1,600 Feet
Date: 12/10/2021

TITLE: **Figure 9-12 – Block 35 Facility out of Service**

PROJECT: City of Manhattan Beach Water Master Plan

COORDINATE SYSTEM: NAD 1983 StatePlane California V FIPS 0405 Feet

Stantec

V:\1840\active\184031379\gis_MXDs\Figure 9-12_OperationalEfficiencyPipelineAnalysis_TblL.mxd Revised: 2021-12-10 By: rocarrillo

9.5.2 Groundwater Out of Service

In this reliability analysis, all groundwater wells are out of service and the imported water connection is assumed as the only supply to verify the system's capacity. Operational and emergency storage in the reservoirs was assumed available and used for the analysis.

The system was evaluated to provide near-term and ultimate MDD of 4,504 and 4,766 gpm, respectively. The imported water is directed to both Block 35 and Peck Facilities via two flow control valves. To meet the MDD demands, flow of approximately 1,640 gpm was routed to the Peck Facility and 2,920 gpm to the Block 35 Facility under the near-term analysis. For the ultimate analysis, the imported MWD water from WB-04 was 1,804 gpm to the Peck Facility and 2,936 gpm to the Block 35 Facility, with a total of 4,736 gpm, which is within the capacity of the allocation of WB-04 (15 cfs). The model analysis showed the Peck and Block 35 Facilities operated similar to normal conditions for both near-term and ultimate demand analysis, as shown in Figure 9-13 and Figure 9-14.

Figure 9-13 – Tank Levels when Groundwater is Out of Service Near-Term

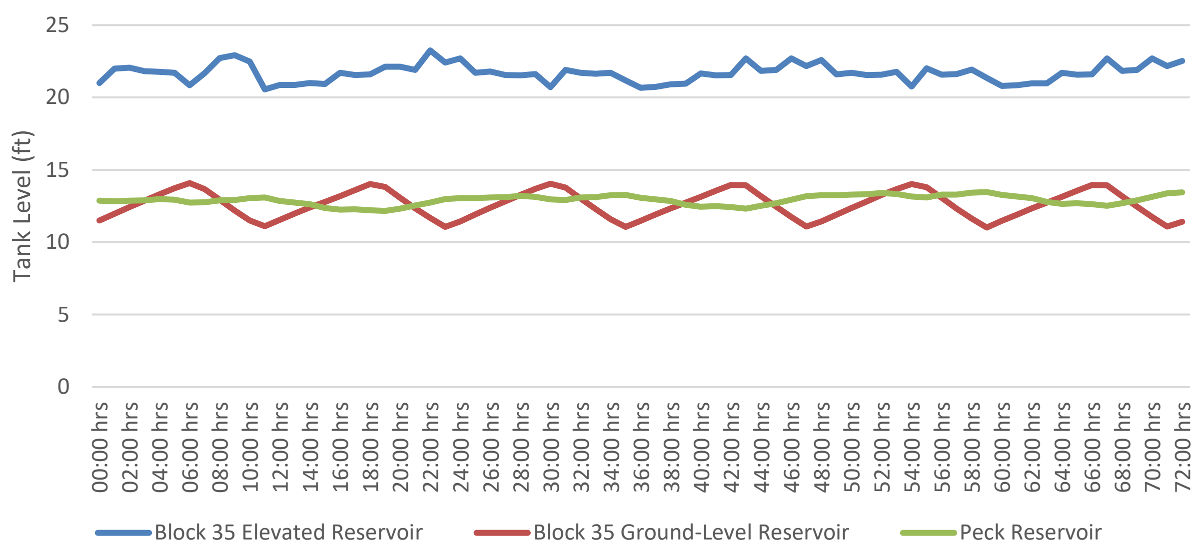
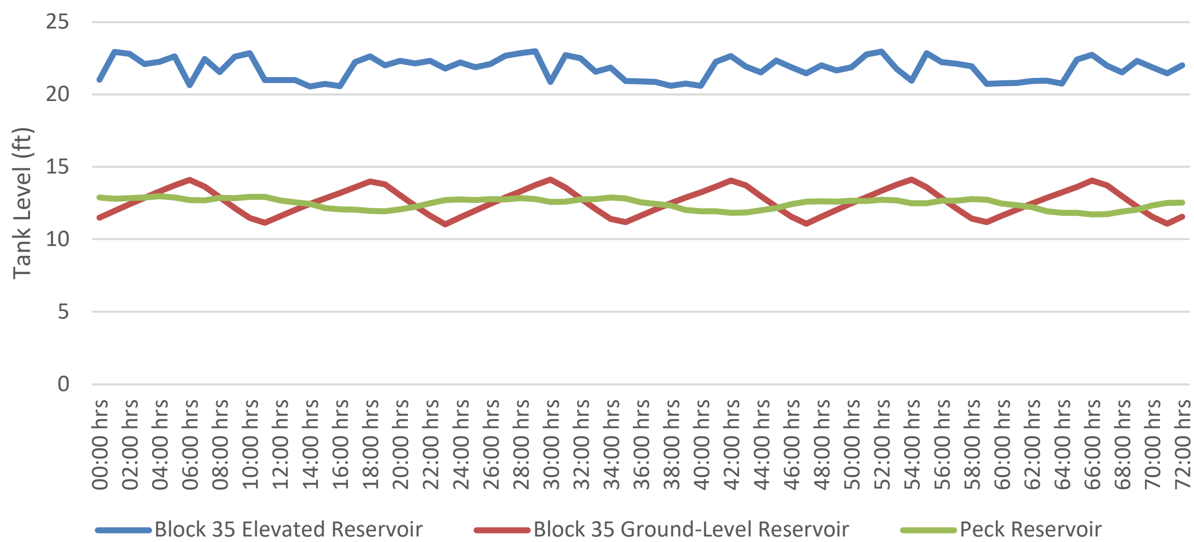


Figure 9-14 – Tank Levels when Groundwater is Out of Service Ultimate



The model results also indicated Peck and Block 35 pump stations needed to have two pumps pumping at each station for various hours to meet near-term and ultimate MDD, as shown in Table 9-9 and Table 9-10. One pump at the Larsson pump station operated to provide flow to the Hill Zone. Note that the pump sequencing shown in the tables reflects the model pumps and does not reflect the actual pump operation sequencing. However, this does not change the discharge pressures required to provide adequate system pressures. The discharge pressure required downstream of Block 35 pump station is approximately 55 psi and for the Peck pump station it is approximately 85 psi. All pump stations have sufficient capacity. There were no low-pressure areas or pipe velocity deficiencies caused by the operations under this scenario for near-term and ultimate planning conditions.

Table 9-9 – Groundwater Out of Service Modeled Booster Pump Station Operation Near-Term

Pump Station/ Pump	Model ID	Pump Status	Rated Capacity (gpm)	Model Flow Range (gpm)	Suction Pressure (psi)	Discharge Pressure (psi)	Hours
Block 35 Booster Pump Station							
Pump 1	B35_P1	Duty	1,715	778 – 1,188	4	53	72
Pump 2	B35_P2	Duty	1,715	0 – 2,346			27
Pump 3	B35_P3	Duty	1,715	0			0
Pump 4	B35_P4	Duty	1,715	0			0
Peck Booster Pump Station							
Pump 1	PECK_P1	Duty	2,200	0 – 2,427	-6	84	48
Pump 2	PECK_P2	Duty	2,200	0 – 2,301			2
Pump 3	PECK_P3	Duty	2,200	0			0
Pump 4	PECK_P4	Duty	2,200	0			0
Larsson Booster Pump Station							
Pump 1	LSN_P1	Duty	580	203 – 389	30	55	72
Pump 2	LSN_P2	Duty	580	0			0
Pump 3	LSN_P3	Duty	580	0			0
Pump 4	LSN_P4	Standby	2,302	0			0

Table 9-10 – Groundwater Out of Service Modeled Booster Pump Station Operation Ultimate

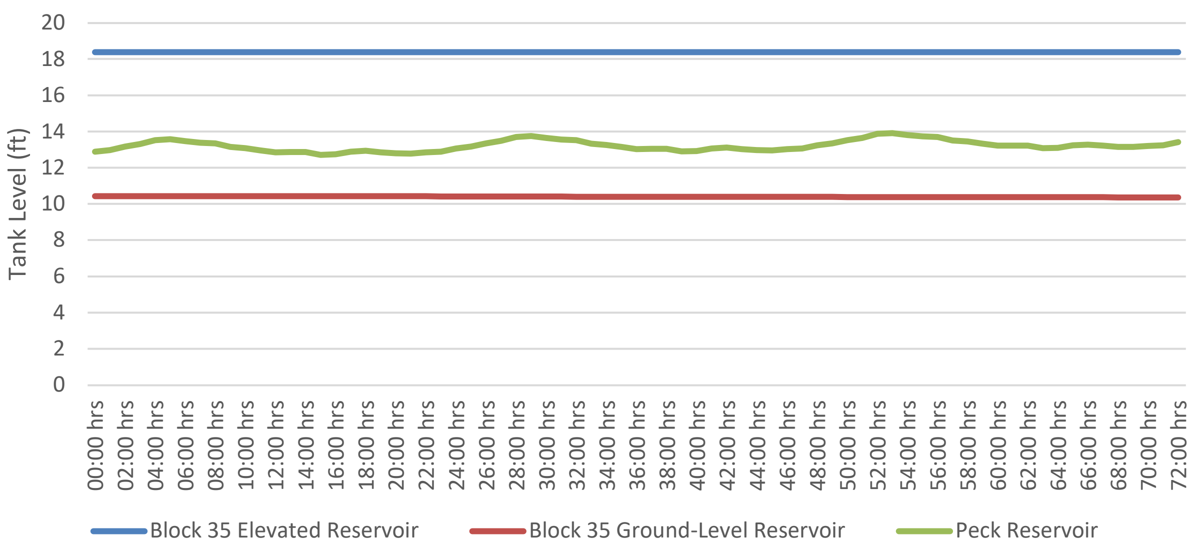
Pump Station/ Pump	Model ID	Pump Status	Rated Capacity (gpm)	Model Flow Range (gpm)	Suction Pressure (psi)	Discharge Pressure (psi)	Hours
Block 35 Booster Pump Station							
Pump 1	B35_P1	Duty	1,715	794 – 1,196	4	53	72
Pump 2	B35_P2	Duty	1,715	0 – 2,345			24
Pump 3	B35_P3	Duty	1,715	0			0
Pump 4	B35_P4	Duty	1,715	0			0
Peck Booster Pump Station							
Pump 1	PECK_P1	Duty	2,200	0 – 2,429	-6	85	52
Pump 2	PECK_P2	Duty	2,200	0 – 2,319			7
Pump 3	PECK_P3	Duty	2,200	0			0
Pump 4	PECK_P4	Duty	2,200	0			0
Larsson Booster Pump Station							
Pump 1	LSN_P1	Duty	580	215 – 412	30	55	72
Pump 2	LSN_P2	Duty	580	0			0
Pump 3	LSN_P3	Duty	580	0			0
Pump 4	LSN_P4	Standby	2,302	0			0

9.5.3 Block 35 Facility & Pump Station Out of Service

In this scenario, the Block 35 Facility was out of service and the Peck Facility is operating. This circumstance can potentially occur if the City needs to make upgrades to the Block 35 Facility. The system is evaluated for near term planning horizon with MDD of 4,504 gpm.

Under this scenario, all water supply is routed to the Peck Facility, then delivered to the distribution system. Water supply includes an average imported water of 3,365 gpm via existing 14-inch diameter pipeline to the Peck Facility and 1,185 gpm groundwater via the existing 16-nch diameter from Well 15. The model analysis concluded that both existing pipelines supplying water to the Peck Facility met the maximum velocity criteria of 7 fps and Well 15 provided adequate flow and discharge pressure, on average 72 psi. As shown in Figure 9-15, the Peck Facility did oscillate/cycle as often as normal conditions and the tank maintained similar levels as normal conditions. However, the 16-inch pipeline immediately downstream of the Peck Pump Station, along 18th Street from the Peck Pump station to North Peck Avenue, has a velocity of approximately 8 fps, slightly surpassing the maximum velocity of 7 fps.

Figure 9-15 – Tank Levels When Block 35 Facility Out of Service



The Peck pump stations needed to have three pumps pumping for various hours to meet near-term MDD, as shown in Table 9-11. The discharge pressure required downstream of the Peck pump station is approximately 86 psi. The Larsson pump station provided flow to the Hill Zone with one pump on and a discharge pressure of 54 psi. Both pump stations have sufficient capacity. Note that the pump sequencing shown in the tables reflects the model pumps and does not reflect the actual pump operation sequencing. There were no low-pressure areas caused by the operations under this scenario for near-term planning conditions.

Table 9-11 – Block 35 Facility Out of Service Modeled Booster Pump Station Operation

Pump Station/ Pump	Model ID	Pump Status	Rated Capacity (gpm)	Model Flow Range (gpm)	Suction Pressure (psi)	Discharge Pressure (psi)	Hours
Peck Booster Pump Station							
Pump 1	PECK_P1	Duty	2,200	558 – 1,947	-6	86	72
Pump 2	PECK_P2	Duty	2,200	106 – 1,880			72
Pump 3	PECK_P3	Duty	2,200	0 – 2,389			69
Pump 4	PECK_P4	Duty	2,200	0			0
Larsson Booster Pump Station							
Pump 1	LSN_P1	Duty	580	203 – 389	28	54	72
Pump 2	LSN_P2	Duty	580	0			0
Pump 3	LSN_P3	Duty	580	0			0
Pump 4	LSN_P4	Standby	2,302	0			0

9.5.4 Reliability Analysis Recommendations

The results of the reliability evaluations of the City's distribution system are summarized as follows:

Imported Water Out of Service: Three scenarios were simulated in the hydraulic model to depict circumstances where imported water connection is out of service for 72 hours, and the distribution system is supplied with groundwater only. The scenarios included system evaluations with existing groundwater capacity only and additional groundwater capacity available to determine if the system can be fully supplied with groundwater. In addition, a third scenario was evaluated where all groundwater was routed to the Peck Facility, treated and then distributed to the system. The City was interested in evaluating a proposed 24-inch pipeline between Peck Facility and the Block 35 Facility.

The results indicated that with groundwater pumping capacity of 3,300 gpm (Well 11A and Well 15), the City can rely on groundwater supply only for 72 hours in case of an emergency occurring during ADD for all planning horizons. However, the groundwater pumping capacity is no sufficient for MDD. It is recommended for the City to consider increasing the total well capacity or implement the construction of a new groundwater well to meet the City's system MDD in case imported water goes out of service. The system was evaluated with and without the addition of a new 24-inch pipeline between the two facilities. The model analysis showed that no significant differences in operations or benefits were provided in the system with the proposed 24-inch pipeline.

Groundwater Out of Service: In this scenario all groundwater wells are out of service and the imported water connection is assumed as the only supply to verify the system's capacity. Operational and emergency storage in the reservoirs was assumed available and used for the analysis. The system was evaluated for near-term and ultimate planning horizons. The results indicated that the imported MWD water allocation from WB-04 is required to be increased, with 1,800 gpm to the Peck Facility and 2,936 gpm to the Block 35 Facility. No improvement recommendations are required.

Block 35 and Pump Station Out of Service: Under this scenario, the Block 35 Facility is out of service and the Peck Facility is operating. This circumstance can potentially occur if the City needs to make upgrades to the Block 35 Facility. The system is evaluated for near term planning horizon under MDD conditions with all water supply routed to the Peck Facility then distributed to the system. To deliver MDD demands, an average imported water of 3,365 gpm is supplied from the MWD connection, and 1,185 gpm groundwater is supplied from Well 15. The results indicate that the Peck Reservoir and Pump Station with three pumps on, provide sufficient capacity and pressure to meet City's system requirements. However, the 16-inch pipeline immediately downstream of the Peck Pump Station, along 18th Street from the Peck Pump station to North Peck Avenue, has a velocity of approximately 8 fps, slightly surpassing the maximum velocity of 7 fps. Since this potential operating condition is temporary, and velocity criteria only exceeds slightly, improvements are not recommended for the 16-inch pipeline.

9.6 WATER AGE EVALUATION

This section of the report covers the water quality analysis of the Manhattan Beach using the InfoWater Water Age Simulation. The evaluation includes only the water age at every junction in the system and no other water quality analysis was conducted such as chlorine decay.

9.6.1 Water Age Analysis

Water age analysis is performed to determine the water age of the water distribution system. The analysis begins with all water in the system at an age of zero, and then calculates the time spent by a molecule of water as it flows through the network. After a certain period of time, the increasing water age in the system plateaus, indicating the typical water age in that part of the system.

Water age analysis for Manhattan Beach was performed for the near-term planning horizon with ADD of approximately 3,002 gpm and a duration of 28-day period (672 hours), to allow the storage tanks/reservoirs (collectively referred to as reservoirs) to stabilize. After 21 days, the reservoirs, and hence the system, stabilize and therefore, the average water age over the final seven days was used to observe the water age of the system.

The average water age for the three reservoirs in the system ranges from less than a day (20 hours) for the Block 35 Ground Level Reservoir to just under three days (60 hours) for the Peck Reservoir and over five days (130 hours) for the Block 35 Elevated Tank as illustrated in Figure 9-16. One thing of note is the very small operating range (change in tank level) of all the tanks for the system as illustrated in Figure 9-17. This could be a major contributing factor to the water age, especially if water leaving the elevated tank is over five days old. Water age in reservoirs is greatly impacted by the volumetric change between each timestep. Therefore, reservoirs that have a frequent turnover will have lower water age than those with a longer turnover relative to total volume.

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Figure 9-16 – Year 2025 ADD Water Age (28-day)

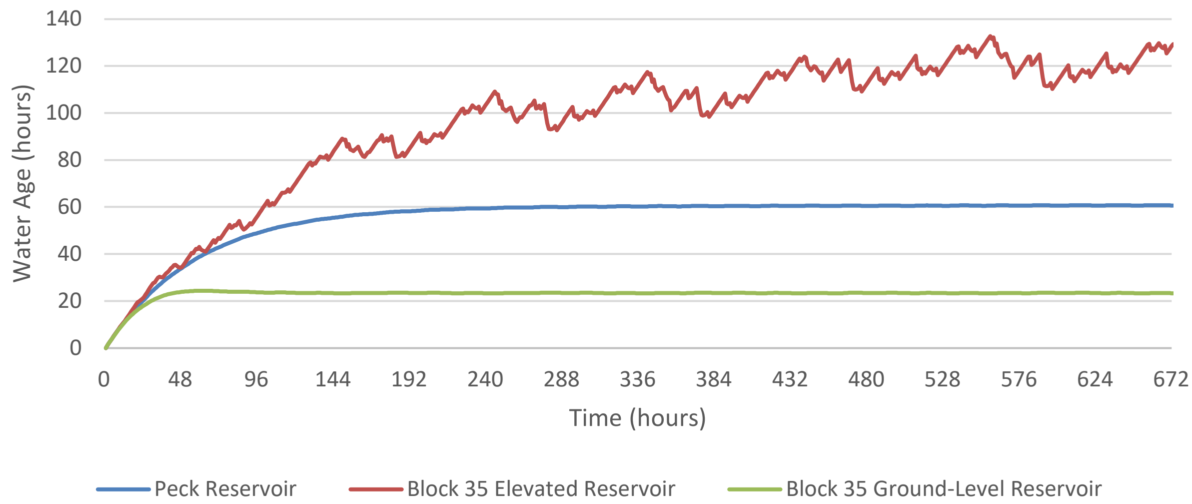
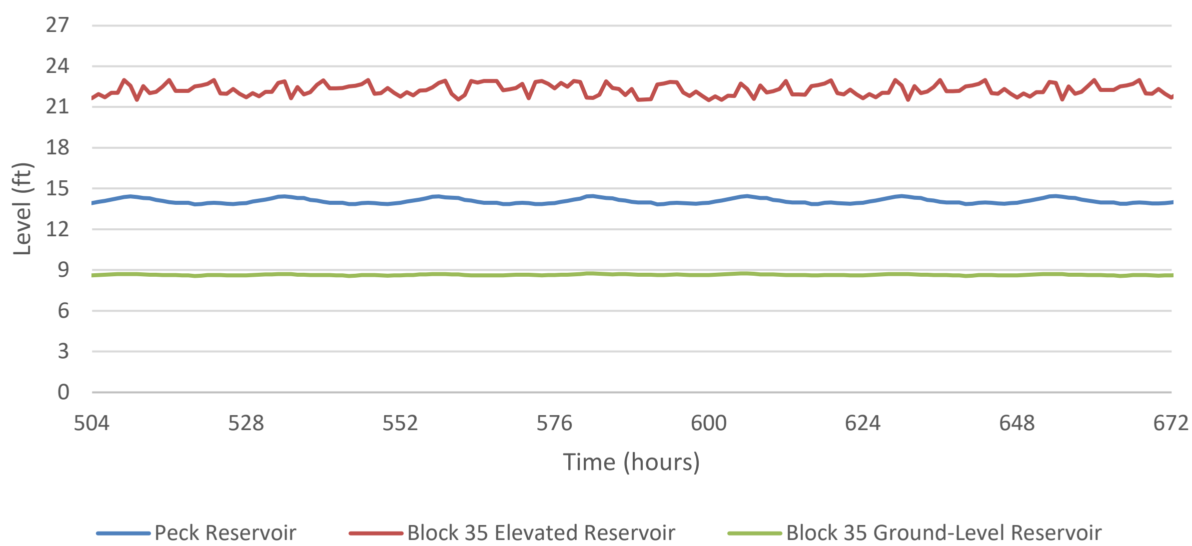


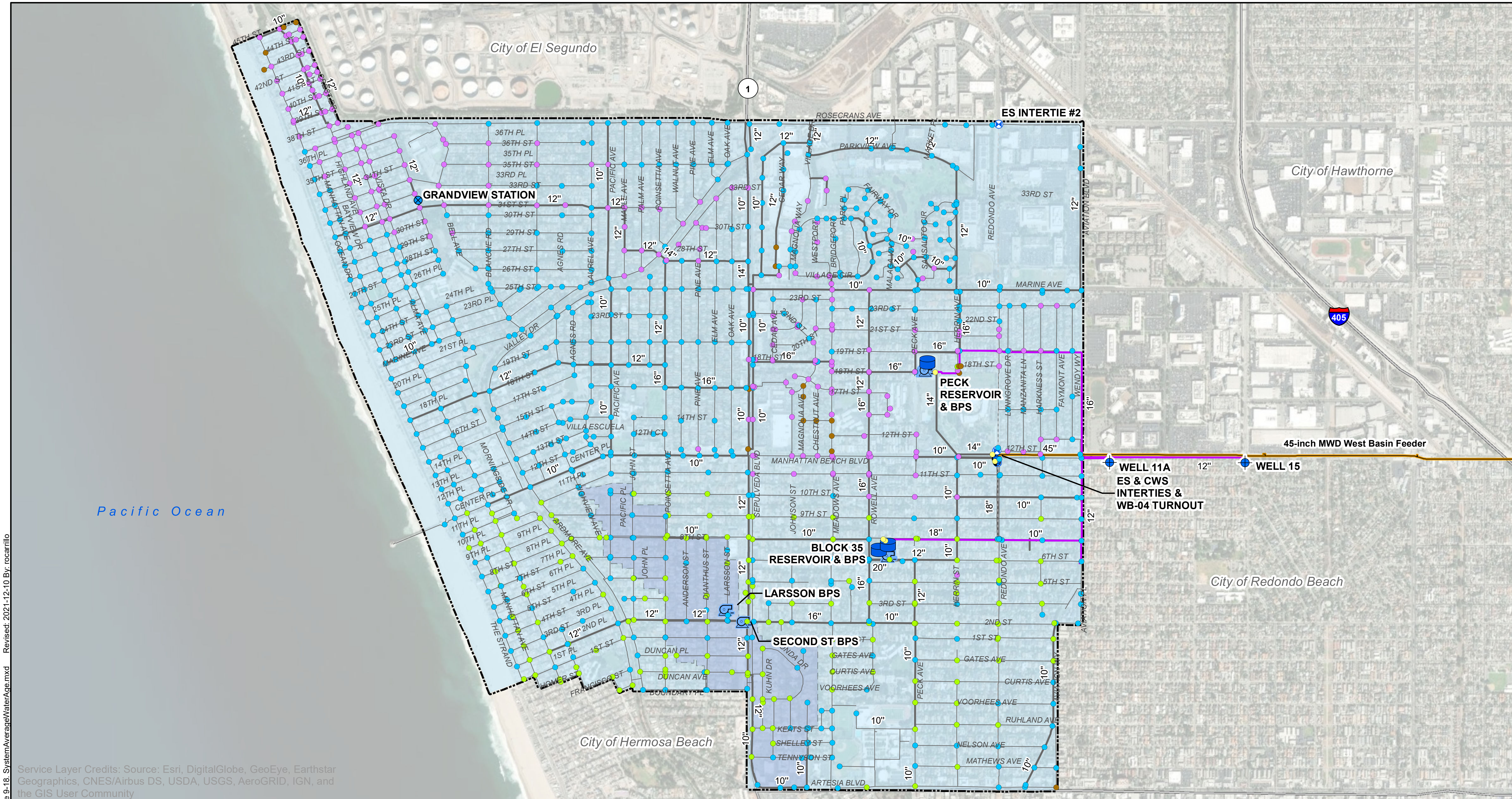
Figure 9-17 – Year 2025 ADD Water Age – Change in level



Water age analysis for the distributions system were only performed on service nodes (nodes with demands), to avoid overwhelming results with high water age calculated at dead end lines (such as fire hydrant leads with zero demand) where there is no movement of water in the pipe.

The average water age for the distribution system, as illustrated in Figure 9-18, ranges from around two days in the southern section of the system to more than six days in the northwest section of the system, near 44th Street referred to as the El Porto area. Typically, water age is used as proxy for chlorine residual. Water age that is greater than six days indicates low chlorine residual. One potential cause for higher water age can be explained by the distance from the water supply sources. Other locations that are closer to the reservoir can have high water age due to the age of the water in the reservoirs.

As part of this Master Plan, to address the high water age near the El Porto area, a pipeline alternative analysis was performed, and details are discussed in the next section. Other options for the City to consider in mitigating concern for high water age are as follows. One solution is to cycle the reservoirs more often to reduce age of water in the reservoirs. The second solution is to confirm that chlorine levels are within acceptable ranges by performing chlorine sampling over a seven-day period at water age locations of more than six days. The third option is to install Auto flushes to increase water turn over, therefore reducing water age and increasing chlorine residual.



Reservoir	Flow Control Valve
Groundwater Well	Booster Pump Station (BPS)
Import Water Turnout	Main Zone
Interagency Connection (Intertie)	City of Manhattan Beach
Pressure Monitoring Station	Outside Agency Pipeline

Average Water Age

- Less than 24 hours
- 24 to 48 hours
- 48 to 96 hours
- 96 to 120 hours
- 120 to 336 hours

Existing Pipelines

- Less than 10" Diameter
- 10" Diameter and Greater
- Well Transmission Main
- MWD Distribution Main

CWS = California Water Service
ES = City of El Segundo
MWD = Metropolitan Water District of Southern California

N

1,500 750 0 1,500 Feet

Date: 12/10/2021

TITLE:
Figure 9-18 – Distribution System 28-Day Average Water Age (Year 2025 ADD)

PROJECT:
City of Manhattan Beach Water Master Plan

COORDINATE SYSTEM:
NAD 1983 StatePlane California V FIPS 0405 Feet

Stantec

V:\1840\active\184031379\gis_MXDs\Figure 9-18_SystemAverageWaterAge.mxd Revised: 2021-12-10 By: rocarrillo

9.6.2 Water Age Improvement Alternative Analysis

The water age in the El Porto area, or northwest end of the system, is shown to have very high water age (to in excess of six days) in the vicinity of 38th to 45th Street. In this area, water quality issues were observed during the fire flow field testing and confirmed by the City. To address the water age issues near the northwest portion of the system, a pipeline project is proposed along Rosecrans Avenue, west of Sepulveda Boulevard. This project is referred to the El Porto Pipeline Project in this report and is intended to provide a looped system bringing less aged water to the El Porto area.

The El Porto Pipeline Project includes a new 12-inch pipeline parallel to the existing 8-inch pipeline along Rosecrans Avenue from Sepulveda Boulevard to Highland Avenue and along Highland Avenue to 38th Street. The 12-inch pipeline will connect to the existing distribution system via 12-inch at the intersection of Rosecrans and Laurel Ave. From the connection point at Highland and 38th Street, the following three alternative pipeline alignments were evaluated: The proposed 12-inch pipeline will parallel the existing 8-inch pipe along Rosecrans Avenue from Sepulveda Boulevard to Highland Avenue and along Highland Avenue to 38th Street. A connection is proposed to the existing pipeline at Laurel Avenue. However, from this location three alternatives were evaluated to determine the best benefit for water aging in the El Porto area. These alternatives are analyzed as described below:

- Alternative 1
    - Upsize existing 8-inch to 12-inch main along 38th and Crest Drive from Highland Avenue to 45th Street
- Alternative 2
    - Construct a dedicated 12-inch main along 38th and Crest Drive from Highland Avenue to 45th Street with no interconnections.
- Alternative 3
    - Construct a dedicated 12-inch main along Highland Avenue from 38th Street to 45th Street with no interconnections.

These improvements aim to help circulate the water in the system more frequently and help minimize water quality issues. The following sections of the report evaluate each of these alternatives to determine which of them reduces the water age in the El Porto area, in particularly in the vicinity of 38th to 45th Street the best.

To identify the preferred alternative, water age analysis was performed for ADD near-term conditions with each alternative pipeline alignment. Nine service nodes were selected (one for each of the streets) between Rosecrans Avenue and 45th Street, and water age results were compared between each alternative scenario and water age results from the near-term ADD analysis, as shown on Table 9-12. This was done to monitor the progression or regression of the water age resulting from each proposed pipeline improvement alternative.

Table 9-12 – Water Age Comparison: Near-term vs Alternatives

Model Node	Location	Alternative 1			Alternative 2			Alternative 3		
		Near-term	Near-term with Alt 1	Change	Near-term	Near-term with Alt 2	Change	Near-term	Near-term with Alt 3	Change
		Water Age (hours)			Water Age (hours)			Water Age (hours)		
36730	45th St	138	97	**-30%**	138	86	**-38%**	138	85	**-38%**
36640	44th St	100	88	**-12%**	100	88	**-12%**	100	90	**-10%**
36440	43rd St	106	98	**-8%**	106	103	**-3%**	106	105	**-1%**
36450	42nd St	90	85	**-6%**	90	95	**6%**	90	91	**1%**
36320	41st St	88	83	**-6%**	88	85	**-3%**	88	85	**-3%**
36250	40th St	87	81	**-7%**	87	82	**-6%**	87	83	**-5%**
36090	39th St	83	86	**4%**	83	84	**1%**	83	85	**2%**
35500	38th St	84	78	**-7%**	84	79	**-6%**	84	79	**-6%**
34890	Rosecrans Ave	82	81	**-1%**	82	81	**-1%**	82	81	**-1%**
Average		**95**	**86**	**-8%**	**95**	**87**	**-7%**	**95**	**87**	**-7%**

In addition, the results of all alternative water age analysis are mapped in Figure 9-19, to show the water age of the system regionally. The results of Alternative 1 water age analysis indicate that there is a general decrease in water age with the greatest reduction occurring around 44th and 45th Street and then the reduction decreasing the further south. Alternative 2 water age analysis shows similar trends, however, unlike Alternative 1, there is an increase of water age at 39th and 42th Street, meaning that Alternative 1 is preferred over Alternative 2. Finally, Alternative 3 water age analysis shows the same water age trends as Alternative 2, concluding that Alternative 1 is the preferred alignment.

Alternative Analysis Recommendation

The water age evaluation of the three alternative analyses resulted in the recommendation of the Alternative 1, which recommends upsizing the existing 8-inch pipeline to 12-inch, along 38th and Crest Drive from Highland Avenue to 45th Street.

City of Manhattan Beach
Proposed Pipeline
Proposed Parallel Pipe on Rosecrans

Existing Pipelines

Less than 10" Diameter
10" Diameter and Greater

Average Water Age

Less than 24 hours
24 to 48 hours
48 to 96 hours
96 to 120 hours
120 to 336 hours
Greater than 336 hours

CWS = California Water Service
ES = City of El Segundo
MWD = Metropolitan Water District of Southern California

320 160 0 320 Feet

N

Date: 12/8/2021

TITLE: **Figure 9-19 – Alternative 1, 2, & 3 28-Day Average Water Age (Year 2025 ADD)**

PROJECT: City of Manhattan Beach Water Master Plan

COORDINATE SYSTEM: NAD 1983 StatePlane California V FIPS 0405 Feet

Stantec

9.6.3 Water Age Improvement Recommendation

With the recommendation of the Alternative 1 pipeline from the previous analysis, the proposed El Porto Pipeline Project includes a new 12-inch pipeline parallel to the existing 8-inch pipeline along Rosecrans Avenue from Sepulveda Boulevard to Highland Avenue and along Highland Avenue to 38th Street and an upsizing of the existing 8-inch to 12-inch main along 38th and Crest Drive from Highland Avenue to 45th Street. The 12-inch pipeline will connect to the existing distribution system via 12-inch at the intersection of Rosecrans and Laurel Ave.

Due to the total length and cost of the proposed El Porto Pipeline Project, further water age analysis was performed to determine a phasing construction of the pipeline. Water age analysis was performed for each construction phase and results of the same service nodes were compared to show the water age progression at each phase of the pipeline project. All water age analysis included ADD and near-term planning horizon.

Phase 1

Proposed Phase 1 includes the construction of a new 12-inch pipeline parallel to the existing 8-inch pipeline along Rosecrans Avenue from Sepulveda Boulevard to Highland Avenue and along Highland Avenue to 38th Street. The 12-inch pipeline will connect to the existing distribution via 12-inch at the intersection of Rosecrans and Laurel Ave. This 12-inch proposed pipeline segment is the same improvement recommended in the fire flow analysis section of this Master Plan, to improve fire flow in the El Porto area. Since this pipeline segment improves fire flow in the distributions system, this was selected as Phase 1 for this construction.

As shown in Table 9-13**, t**he results however show a general increase in water age but by only a couple of hours at most locations between Rosecrans Avenue and 45th Street as illustrated in Figure 9-20. This is not unusual with the addition of a large diameter main next to an existing small main, the total flow in the existing main decreases reducing velocity and increasing water age. Therefore, it is suggested that the City install temporary Autoflushers at the interconnection on Grandview Avenue and Laurel Avenue to reduce the water age until the full project is completed.

Phase 2

Proposed Phase 2 includes upsizing of the existing 8-inch to 12-inch main along 38th and Crest Drive from Highland Avenue to 45th Street. As shown in Table 9-13**, t**he results show that there is a general decrease in water age around 45th Street and 44th Street while there is a general increase in water age by a small number of hours at most locations between Rosecrans Avenue and 42th Street as illustrated in Figure 9-20. Water age gets better with the construction of Phase 2 of the El Porto Pipeline Project.

Phase 3

The final phase of the project includes the construction of a 12-inch pipeline parallel to the existing 8-inch pipe along Rosecrans Avenue from Sepulveda Boulevard to Laurel Avenue. The results of the Phase 3 analysis are the same as results shown in Table 9-12, Alternative 1. With the complete Alternative 1 project, overall, the water age improves by approximately nine hours or 8 percent for the entire area west of Sepulveda Boulevard. The most significant improvement is at 45th Street area with an improvement of nearly two days in water age to be approximately four days. Phase 3 is shown on Figure 9-20.

Table 9-13 – Water Age Comparison: Near-Term vs Alternative 1 Phases

Model Node	Location	Phase 1			Phase 2		
		Near-term Water Age (hours)	Water Age (hours)	Percentage Difference	Near-term Water Age (hours)	Water Age (hours)	Percentage Difference
36730	45th St	138	140	**1%**	138	103	**-25%**
36640	44th St	100	99	**-1%**	100	93	**-7%**
36440	43rd St	106	108	**2%**	106	104	**-2%**
36450	42nd St	90	91	**1%**	90	92	**2%**
36320	41st St	88	90	**2%**	88	90	**2%**
36250	40th St	87	89	**2%**	87	89	**2%**
36090	39th St	83	89	**7%**	83	89	**7%**
35500	38th St	84	84	**0%**	84	85	**1%**
34890	Rosecrans Ave	82	90	**10%**	82	87	**6%**
Average		**95**	**98**	**3%**	**95**	**92**	**-1%**

9.6.3.1 El Porto Pipeline Project Recommendation

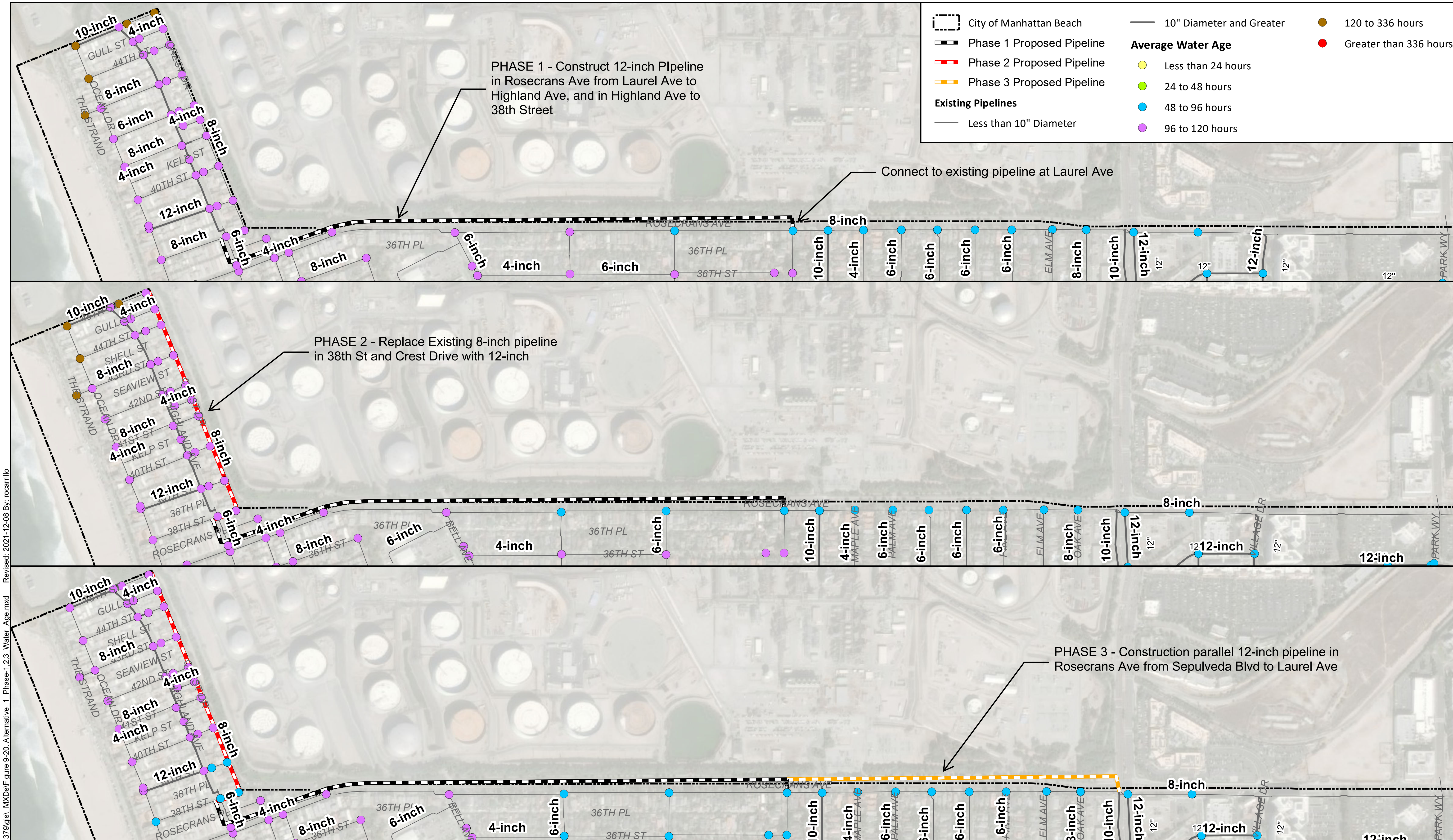
To mitigate water quality issues in the northwestern end of the system, the El Porto area, the water age analysis results recommend the following phasing of the proposed El Porto Pipeline Project:

- Phase 1: New 12-inch pipeline parallel to the existing 8-inch pipeline along Rosecrans Avenue from Sepulveda Boulevard to Highland Avenue and along Highland Avenue to 38th Street. The 12-inch pipeline will connect to the existing distribution via 12-inch at the intersection of Rosecrans and Laurel Ave. (This pipeline is shown as recommendation for fire flow projection as improvement project FF-043)

- Phase 2: Upsize existing 8-inch to 12-inch main along 38th and Crest Drive from Highland Avenue to 45th Street.

- Phase 3: Construct a 12-inch pipeline parallel to the existing 8-inch pipe along Rosecrans Avenue from Sepulveda Boulevard to Laurel Avenue.

These improvements will help circulate the water in the system more frequently and help minimize water quality issues. However, it should be noted that until the entire alternative has been constructed, the City will not notice a decrease in water age between Rosecrans Avenue and 45th Street. If during the initial phase of the project water aging is creating an issue in the system, it is suggested that the City install temporary Autoflushers at the interconnection on Grandview Avenue and Laurel Avenue, to reduce the water age until the full project is completed.



N

740 370 0 740 Feet

Date: 12/8/2021

Figure 9-20 – Alternative 1, Phase 1,2,3
28-Day Average Water Age (Year 2025 ADD)

NAD 1983 StatePlane California V FIPS 0405 Feet

City of Manhattan Beach Water Master Plan

Stantec

V:\1840\active\184031379\gis_MXDs\Figure 9-20 Alternative 1 Phase-1,2,3 Water Age.mxd Revised: 2021-12-08 By: rocarrillo