DIABLO WATER DISTRICT

2020 Facilities Plan

June 2020

Final

CDM Smith

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Abbreviations and Acronyms

°F	degrees Fahrenheit
ac	acre
AC	asbestos cement
AF	acre-feet
BMO	basin management objective
Canal	Contra Costa Canal
CBWTP	City of Brentwood Water Treatment Plant
CCI	Construction Cost Index
CCWD	Contra Costa Water District
CEQA	California Environmental Quality Act
City	City of Oakley
Corp Yard	Corporation Yard
County	Contra Costa County
CVP	Central Valley Project
Delta	Sacramento-San Joaquin Delta
District	Diablo Water District
du	dwelling unit
DWD	Diablo Water District
DWR	California Department of Water Resources
EC	electroconductivity
ECCFPD	East Contra Costa Fire Protection District
ENR	Engineering News Record
FRC	Facility Reserve Charge
ft/s	feet per second
GIS	geographic information system
gpd	gallons per day
gpm	gallons per minute
GSA	groundwater sustainability agency
GSP	groundwater sustainability plan
HGL	hydraulic grade-line
HP	horsepower
ISD	Ironhouse Sanitary District
ISO	Insurance Services Office
JPA	Joint Powers Authority
kVA	kilo-volt-ampere
kW	kilowatt
LF	linear feet
LSCE	Luhdorff & Scalmanini Consulting Engineers
MERA	Main Extension Reimbursement Assessment
MG	million gallons
mgd	million gallons per day
mg/L	milligrams per liter
MOU	memorandum of understanding

No.	number
PAC	Programmable Automation Controller
PRV	pressure reducing valve
psi	pounds per square inch
PVC	polyvinyl chloride
RBWTP	Randall-Bold Water Treatment Plant
Reclamation	United States Bureau of Reclamation
SCADA	supervisory control and data acquisition
SGMA	Sustainable Groundwater Management Act of 2014
SOI	Sphere of Influence
TDS	total dissolved solids
WTP	water treatment plant

Executive Summary

This 2020 Facilities Plan updates Diablo Water District's (DWD) 2006 Facilities Plan. It provides current water demand projections, identifies facilities to serve future growth, and provides phased capital improvement projects for implementation of improvements. This Executive Summary briefly summarizes the key findings.

ES.1 Study Area

DWD serves the City of Oakley and surrounding unincorporated lands located in the northeastern corner of Contra Costa County, east of the City of Antioch, and north of the City of Brentwood. The study area for this Facilities Plan includes the current DWD service area plus future planning areas within its sphere of influence (SOI) and Bethel Island.

The SOI includes the existing service area plus the remainder of the Hotchkiss Track, small unincorporated areas south of Oakley, and the remainder of Knightsen. DWD may potentially provide service to other parts of Bethel Island, which are outside the SOI, if requested by the island property owners.

ES.2 Land Use and Population Projections

For this Facilities Plan, ultimate buildout of the study area is assumed to occur by 2040. The buildout land uses are based on the City General Plan for the Oakley planning area west of Jersey Island Road, the East Cypress Corridor Specific Plan for the Oakley planning area east of Jersey Island Road, the East Cypress Corridor Lotting Plan for the Cypress Preserve Project, and the Contra Costa County General Plan for Knightsen and Bethel Island.

DWD currently serves about 42,000 residents. The buildout population is estimated at about 64,000 persons assuming that DWD serves the entire study area.

ES.3 Water Supply

Currently, DWD's primary raw water supply is surface water purchased from Contra Costa Water District that is supplied from the Contra Costa Canal and pipeline system and the Los Vaqueros Project. The surface water is treated at the Randall-Bold Water Treatment Plant (WTP).

DWD is operating a groundwater supply system that provides additional supply reliability. The system currently consists of groundwater from two wells in Oakley, conveyed in a dedicated well supply pipeline to the Blending Facility located near the Randall-Bold WTP. At the Blending Facility, the groundwater is treated and blended with treated surface water within DWD's distribution system, prior to distribution to any customers, so that there is negligible impact on water quality. DWD may install additional groundwater production wells in future phases, based on the rate of District growth and demand, future well siting studies, and the findings of the East Contra Costa Groundwater Sustainability Plan that is currently under development. When fully implemented, groundwater may comprise up to 20 percent of DWD's total future supply.

ES.4 Water Demand

The 2019 average day demand served by DWD was 4.9 million gallons per day (mgd) and is projected to reach 12.5 mgd by 2040. Table ES-1 summarizes the average day and maximum day demand under ultimate conditions at buildout.

Table ES-1. Ultimate Average Day and Maximum Day Demands by Area

Area	Ultimate Demands (mgd)	
	Average Day Demand	Maximum Day Demand
West of Jersey Island Road (including Knightsen)	8.16	16.32
East of Jersey Island Road	2.39	4.78
Subtotal Within DWD SOI	10.55	21.1
Bethel Island	2.0	4
Grand Total	**12.55**	**25.1**

ES.5 Treated Water Storage

DWD's criterion for distribution system storage is to provide total storage equal to two average demand days, which is equivalent to one maximum demand day for the DWD system. Table ES-2 summarizes the existing and ultimate storage requirements based on this criterion, compares the required total storage with the existing storage capacity, and identifies the required additional storage capacity. The storage requirements are presented for the three major planning areas within the DWD system: West of Jersey Island Road; East of Jersey Island Road (East Cypress Specific Plan Area); and Bethel Island. The storage for each major area is based on the demand within each area, in order to equitably distribute the storage throughout the system and provide localized reliability.

ES.6 Fire Protection

Since late 2002, the East Contra Costa Fire Protection District (ECCFPD) has served the DWD sphere of influence and Bethel Island. Based on information currently available from ECCFPD, the Oakley area is currently considered Class 3 for those portions located within 5 miles of a fire station and within 1,000 feet of a fire hydrant. It is considered Class 8 for those portions located within 5 miles of a fire station, but not within 1,000 feet of a fire hydrant. The Bethel Island area has an overall Class 5 rating.

Those areas served by the DWD system have fire hydrants spaced more frequently than the 1,000-foot requirement and can meet the fire protection objectives. As new development occurs and is served by DWD, it would be required to meet the fire protection objectives for water service. Fire station locations and related fire department considerations must be accomplished by ECCFPD.

Table ES-2. Treated Water Storage Requirements

Area	Average Day Demand		Total Required Storage at Two Times Average Day Demand [2]		Existing Tank Storage (MG)	Groundwater Supply for Emergency Storage [3,4]		Additional Tank Storage Needed by Buildout (MG)
	Existing (mgd)	Ultimate (mgd)	Existing Storage Requirement (Million Gallons [MG])	Ultimate Storage Requirement (MG)		Existing Well Storage (MG)	Ultimate Well Storage[5] (MG)	
West of Jersey Island Road [1]	4.3	8.2	8.7	16.3	12.5	4.0	7.0	0.0
East of Jersey Island Road (East Cypress Corridor Specific Plan Area)	0.3	2.4	0.5	4.8	0.0	0.0	0.0	4.8
Bethel Island (total)	0	2.0	0	4.0	0.0	0.0	0.0	4.0
Grand Total	**4.6**	**12.6**	**9.2**	**25.1**	**12.5**	**4.0**	**7.0**	**8.8**

[1] Existing tank storage is all in the West of Jersey Island Road area. It consists of Reservoir R-1 (2.5 MG), Reservoir R-2 (5 MG), and Reservoir R-3 (5 MG).
[2] Total storage includes 0.63 MG fire reserve in each major area based on a potential fire flow of 3,500 gpm for 3 hours. The remainder of the required storage is operational and emergency storage.
[3] Existing groundwater supply for emergency storage assumes 4 mgd well capacity with standby power times 2 days at 50% capacity, or 4 MG total storage.
[4] Wells are better located for emergency storage for the West of Jersey Island area. They cannot be counted as emergency storage for the East Cypress area or Bethel Island, since those areas are too far from the well system and may be isolated from the main system.
[5] Ultimate well storage includes a total of 7 mgd x 50% x 2 days = 7 MG (existing Stonecreek Well at 2.0 mgd and Glen Park Well at 2.0 mgd, and future Well #3 at 1.5 mgd and future Well #4 at 1.5 mgd, all at 50% capacity).

ES.7 Distribution System

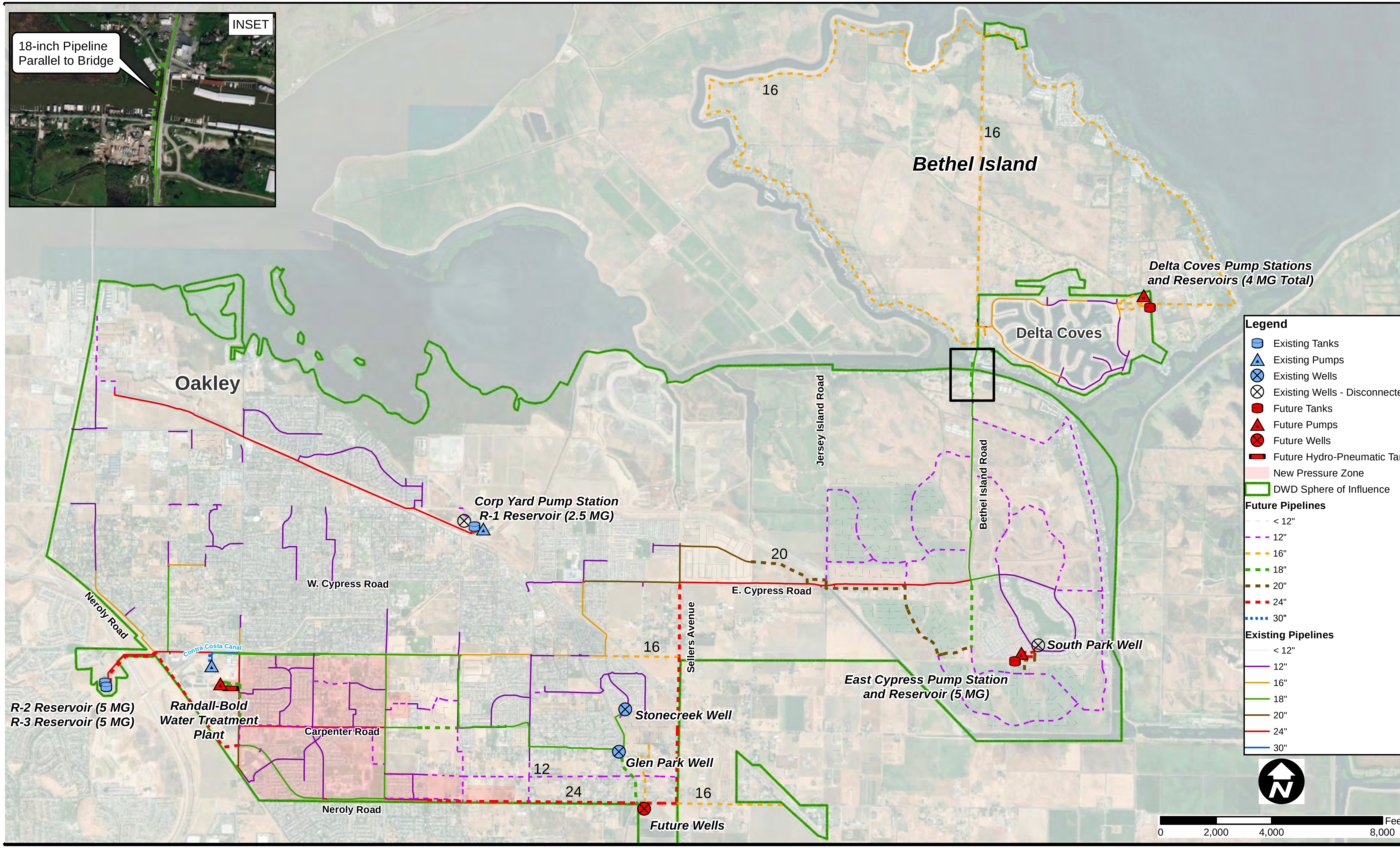
An ultimate network of major distribution system pipelines was identified for service to future development within DWD's SOI and Bethel Island. Pipeline sizing was based on hydraulic analyses under ultimate conditions to meet peak hour demands and to meet maximum day demands plus fire flows. The ultimate pipeline network represents a guide to water system improvements as future growth occurs.

ES.8 Facilities Planning

ES.8.1 Ultimate System Configuration and Operation

Figure ES-1 shows the major distribution system pipelines that will be required to serve future development within the study area, the location of the existing and future distribution storage and pumping facilities, and a proposed new pressure zone. The primary source of treated water to the DWD system will continue to be pumped flows from the DWD pumps at the Randall-Bold WTP. In addition, DWD's groundwater supply system will provide additional supply reliability for the entire system.

The ultimate DWD system is proposed to be split into two distinct pressure zones. The majority of the DWD system will remain in the existing pressure zone and will be served from the Randall-Bold WTP and the groundwater supply system. The existing pressure zone is divided into three



Date: 5/8/2020 File: C:\Users\tordellart\Desktop\DWD Figures\Figure 8-1 Ultimate System.mxd

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Figure ES-1
Diablo Water District
Ultimate Water Distribution System for
DWD Sphere of Influence and Bethel Island

major areas, each with its own storage and pumping facilities to meet peak hour and fire flow needs, as well as for emergency storage.

The existing pressure zone areas and corresponding distribution storage and pumping facilities include:

- West of Jersey Island Road Area – Reservoir R-1 and Corp Yard Pump Station (existing), Reservoir R-2 (existing), and Reservoir R-3 (existing). Storage from Reservoir R-1 must be pumped into the system. Reservoirs R-2 and R-3 provide gravity flow. Four groundwater supply wells (two existing, two future) also contribute to the supply of water for this area.
- East of Jersey Island Road Area – Future Cypress Reservoirs and Pump Station. Stored water must be pumped into the system (similar to Reservoir R-1 and the Corp Yard Pump Station).
- Bethel Island – Future Delta Coves Reservoirs and Pump Station. Stored water must be pumped into the system (similar to Reservoir R-1 and the Corp Yard Pump Station).

The distribution reservoirs will help to meet peaking needs in excess of the pumped deliveries from the DWD pumps at the Randall-Bold WTP. The sizing for the ultimate pipeline network is based on supplying water from the DWD pumps at the Randall-Bold WTP at the maximum day demand rate, and using storage to meet peak hourly flows and fire flows.

The proposed new pressure zone, indicated by the shaded area on Figure ES-1, would serve the southwest portion of the system near Carpenter Road, where ground elevation is higher and pressures are therefore lower. The new pressure zone would be supplied by a new set of pumps at Randall-Bold WTP.

ES.8.2 Recommended Capital Improvement Projects

Table ES-3 summarizes the recommended capital improvements and indicates the anticipated timeframe for implementation and estimated cost for each project. The actual schedule for improvements to serve new development will depend on the actual growth that occurs in the future.

Table ES-4 provides the capital improvement projects and costs for the proposed new pressure zone. These are separated from the rest of the District's capital projects because this new pressure zone will likely be developed through a separate benefit assessment of the users within the zone, separate from the Facility Reserve Charges.

Table ES-3. Summary of Recommended Capital Improvements for Ultimate DWD System

Type of Project and Area Served	Project	Anticipated Timing & Assumptions	Estimated Cost (May 2020 $) (1)				
			Base Construction Cost	Total Construction Cost (2)	Project Implementation Allowance (3)	Land Cost	Total Capital Cost (1)
Systemwide Projects (Including Delta Coves)							
Treated Water Supply (4)	Future expansion of Randall-Bold WTP for additional 5 mgd capacity. WTP expansion cost includes replacement of Randall-Bold high lift pumps, additional clearwell capacity, and treatment upgrades and associated documentation.	Specific timing for additional capacity depends on available amount of groundwater supply, rate of District growth, and customer conservation. Assumes unit cost of $4.50 per gallon per day for WTP capacity increase.	$22,500,000	$30,400,000	$10,600,000	$0	$41,000,000
Treated Water Supply (4)	Projects between 2021-2030 at Randall-Bold WTP associated with maintaining existing 15 mgd capacity available for near-term development. Costs obtained from CCWD's draft 2020 Water Treatment Plant Master Plan Report. Costs shown herein = Total Project Costs x Unused Existing Capacity (approx. 33%) x DWD Ownership (37.5%)	Projects reflect: Sodium Hypochlorite and Liquid Ammonia Sulfate Conversion, Filter Upgrades, Electrical Upgrades (switchgear), Chemical tank Improvements, Lagoon Pump Replacement, Intermediate Ozone and Post Ozone Improvements, Filter Media replacement, Line Wash Water and Solids Lagoons.	NA	$1,700,000	$430,000	$0	$2,130,000
Groundwater Supply (5)	Groundwater Well #3: New well at 1.5 mgd average capacity. Well and pump station costs based on Stonecreek Well and Pump Station. Includes treatment system at $700k and generator at $197k. Assumes Land cost for 0.25 acre per site at up to $250,000 per acre for developable land.	Estimated timing: 1 additional well required. Costs reflect Stonecreek pump station bid of $734,000 in 4/10 @ ENR of 9,730, inflated to $747,503 for 7/10 ENR of 9,909; and Stonecreek Well bid of $154,167 in 9/09 @ ENR of 9,724, inflated to $157,100 for 7/10 ENR of 9,909.	$2,100,000	$2,800,000	$700,000	$63,000	$3,563,000
	Pipeline to connect new High School well to Blending Facility pipeline. Pipeline anticipated to consist of installation of 18-inch pipe w/ 2,000 ft unpaved construction, and 3,500 ft paved construction. See Table 8-1 for pipeline unit costs.		$1,200,000	$1,600,000	$400,000	$0	$2,000,000
	Groundwater Well #4: New well at 1.5 mgd average capacity. Assumes 2,000 ft of pipe in paved alignment to connect to Well #3. Includes treatment system at $700k and generator at $197k. Assumes 50% increase from Base to Total Construction Cost due to additional planning required. Assumes land cost for 0.25 acre per site at up to $250,000 per acre for developable land.	--	$2,600,000	$3,900,000	$980,000	$63,000	$4,943,000
Transmission Capacity (6)	Transmission pipeline in Neroly/Delta Roads, Sellers Avenue to Cypress Road (21,700 linear feet [LF] of 24-inch pipe at $325 per LF assuming paved unit costs; plus 400 LF total for two cased crossings at Marsh Creek and Railroad at $772 per LF). Does not include 1,566 LF installed under MERA for Riata project.	Needed for ultimate system. Specific timing for implementation will depend on review of future development proposals.	$7,400,000	$10,000,000	$2,500,000	$0	$12,500,000
Transmission Capacity (6)	Transmission pipeline parallel to Cypress Road (3,100 LF of 20-inch pipe at $300 per LF assuming paved unit costs).	--	$930,000	$1,300,000	$330,000	$0	$1,630,000
Transmission Capacity (6)	Transmission pipeline in from Reservoirs R-2 and R-3 to Neroly Road (2,700 LF of 24-inch steel pipe at $343 per LF assuming paved unit costs). Transmission pipeline coming out of Randall-Bold WTP (500 LF of 30-inch steel pipe at $392 per LF assuming paved unit cost).	Needed for ultimate system. Specific timing for implementation will depend on review of future development proposals.	$1,100,000	$1,500,000	$380,000	$0	$1,880,000
Transmission Capacity (6)	Transmission pipeline in Bethel Island Road (500 LF of 18-inch pipe at $279 per LF assuming paved unit costs and 650 LF of 18-inch pipe assuming trenchless unit cost of $557 per LF). Assumes 50% implementation allowance.	Needed for ultimate system. Specific timing for implementation will depend on review of future development proposals.	$500,000	$700,000	$350,000	$0	$1,050,000
New Corporation Yard Building	Construction of new corporation yard, field office, training room and ancillary facilities. Total Capital cost of $4M provided by District based on current level of project planning.	--	NA	NA	NA	NA	$4,000,000
Permanent Generators at Existing Wells	New permanent generators placed at South Park Well Pump Station (250kW/312.5kVA); Glen Park Well Pump Station (200kW/250kVA); Stonecreek Well Pump Station: 200kW/250kVA	New permanent generators placed at South Park Well Pump Station @ $214,873; Glen Park Well Pump Station @ $197,125; Stonecreek Well Pump Station @ $197,125.	$610,000	$800,000	$200,000	$0	$1,000,000
Stonecreek Well Iron and Manganese Removal System	Package treatment system to be installed at Stonecreek Well Pump Station. Treatment system quote of $350k received; assume additional improvements required will result in 2x construction price.	--	$700,000	$900,000	$230,000	$0	$1,130,000
SCADA System Expansion (7)	Upgrade main SCADA control system (PLCs and HMI workstations) for future expansion to serve ultimate system facilities	Estimated timing: 2025-2030 timeframe. Inflated per ENR CCI estimate of $322,900 in May 2018.	NA	NA	NA	NA	$340,000
Facilities Plan Updates; Distribution System Map Updates	Periodic updates of DWD's facilities plan to reflect actual growth and adjust facilities requirements for future growth; and periodic updates of the distribution system maps and facilities database to add new facilities as growth occurs.	Estimated timing: Updates approximately every 10 years to buildout. Cost assumes a total of 2 updates at $250,000 per update for the Facilities Plan and $100,000 per update for the system maps and facilities database, and bi-annual FRC updates at $7,000 each on average).	NA	NA	NA	NA	$840,000

Table ES-3. Summary of Recommended Capital Improvements for Ultimate DWD System

Type of Project and Area Served	Project	Anticipated Timing & Assumptions	Estimated Cost (May 2020 $) (1)				
			Base Construction Cost	Total Construction Cost (2)	Project Implementation Allowance (3)	Land Cost	Total Capital Cost (1)
Growth Related Project Management	Pre-planning, planning and related staff labor for growth projects.	Assumed to be constant for five years. Budgeted based on FY 20-21 staff costs of $505,000. (5 x $505,000 = $2,525,000)	NA	NA	NA	NA	$2,525,000
Subtotal for Systemwide Projects (Including Delta Coves)							*$80,531,000*
East of Jersey Island Road - Expansion Facilities (Not Including Bethel Island & Delta Coves)							
Storage and Pumping Facilities (8) (9)	Cypress Reservoir & Pump Station: First phase including all site work, 2.5 MG tank, and pump station building with capacity for 5 x 60 HP pumps (4 duty + 1 standby pumps, each at 1,200 gpm and 150 total dynamic head design point). Also assumes chemical storage @ $215k, tank mixer @ $68k, and generator @ $250k. Land cost for 3.7 acres at $250k per acre.	Must be in place to serve more than 775 residential units in East Cypress Specific Plan area (Planning Areas 1 through 5). Prior to that time, initial units will temporarily use available storage in the west part of the system.	$4,200,000	$5,700,000	$1,400,000	$925,000	$8,025,000
	Cypress Reservoir & Pump Station: Second phase with second 2.5 MG tank, add additional pump at pump station as needed, up to 5 duty pumps at build out.	Needed when demands in East Cypress Specific Plan Area reach 1.25 mgd on an average day basis, which is a total of approximately 2,380 residential units in Planning Areas 1 through 5.	$2,500,000	$3,400,000	$850,000	$0	$4,250,000
Subtotal for East of Jersey Island Road - Expansion Facilities (Not Including Bethel Island & Delta Coves)							*$12,275,000*
Bethel Island and Delta Coves							
Specific requirements and financing arrangements for storage and pumping facilities for new development on Bethel Island are addressed on a case-by-case basis. For example, the Delta Coves development is financing and constructing the required storage and pumping facilities for its development. Future service to other parts of the island would be addressed in a similar manner.							
GRAND TOTAL FOR ALL RECOMMENDED PROJECTS							**$92,806,000**

(1) All costs in these columns as marked are in May 2020 dollars, ENR CCI for San Francisco of 12,819.17.
(2) Unless noted otherwise, Total Construction Cost equals the base construction cost plus a 35% construction contingency to cover required work not yet identified at the planning level, unforeseen conditions, bid climate, and change orders during construction.
(3) Project implementation allowance equals 25% of total construction cost for all projects except the Randall-Bold WTP expansion to cover engineering design, construction services, environmental, permitting, and legal. The implementation allowance for the Randall-Bold WTP expansion project is 35% of total construction cost to include an additional 10% for CCWD project administration.
(4) Due to existing and planned DWD groundwater wells, current financial plan anticipates DWD owned capacity of Randall-Bold WTP will be 20 mgd, requiring expansion of the Randall-Bold WTP by 5 mgd.
(5) Groundwater well costs include standby power capability for use as emergency storage. Costs are based on the Stonecreek Well and Pump Station construction.
(6) Pipeline unit construction costs include valves and appurtenances, pavement removal and replacement, traffic control, and an average allowance for correction of utility interferences.
(7) Costs of projects for supply and distribution storage and pumping include the costs of SCADA equipment for those facilities. Work associated with this item assumed to include: new Monitoring panel PLC at the Corp Yard; new PLC at the DWD/Randall-Bold WTP control panel; new PLC at the Blending Facility, new Ethernet switch at the Corp Yard, radio system upgrades/replacement, Local Operating Panel replacements at South Park PS, Glen Park Well PS, and Blending Facility. Capital cost reflects rough estimate for all work to be performed.
(8) Reservoir costs assume above-ground concrete tanks, and include site work, valve vault, telemetry, piping and appurtenances. Costs for reservoirs east of Jersey Island Road include a soil/foundation allowance due to the poor soils in those areas.
(9) Distribution pump station costs assume an above-ground building, and include standby pump, standby power, and telemetry.

Table ES-4. Proposed New Pressure Zone Infrastructure

Type of Project	Project	Assumptions	Estimated Cost (May 2020 $) (1)				
			Base Construction Cost	Total Construction Cost (2)	Project Implementation Allowance (3)	Land Cost	Total Capital Cost (1)
Pipes (4)	9,400 LF of 12-inch pipe at $166 per LF; 2,900 LF of 18-inch pipe (length includes piping from new pumps to existing zone, new pipeline to connect to southeast areas) at $264 per LF.	Assumes installation in existing roadways.	$2,300,000	$3,100,000	$780,000	$0	$3,880,000
Storage and Pumping Facilities (5)	At Randall-Bold WTP: Four new variable speed pumps (3 duty plus 1 standby, each at 900 gpm at 215' head). Two new hydropneumatic tanks, each 15,000 gallons, horizontally positioned, approx. 10' diameter and 26 ft long.		$1,600,000	$2,200,000	$550,000	$0	$2,750,000
Gate Valves and PRVs	2x new 8-inch gate valves. 4x new 12-inch gate valve. 1 new 18-inch gate valve. 2x new 8-inch PRVs for 12-inch pipe.		$300,000	$410,000	$100,000	$0	$510,000
Reconfigure existing pipe crossings in roadway	4 intersection pipe crossing re-designs. 18" x 8" cross to be split into two separate mains 18" x 12" cross to be split into two separate mains (two intersections) 20" x 18" Tee. New line to be connected and the cross is to be split into two lines. 20" N/S 24" into 18" E/W	18" x 8" cross to be split into two separate mains = $21,009.93 18" x 12" cross to be split into two separate mains (two intersections) = $21,649.72 each 20" x 18" Tee. New line to be connected and the cross is to be split into two lines. 20" N/S 24" into 18" E/W = $26,596.68	$91,000	$123,000	$31,000	$0	$154,000
Total for Proposed New Pressure Zone Infrastructure							**$7,294,000**

(1) All costs in these columns as marked are in May 2020 dollars, ENR CCI for San Francisco of 12,819.17.
(2) Total Construction Cost equals the base construction cost plus a 35% construction contingency to cover required work not yet identified at the planning level, unforeseen conditions, bid climate, and change orders during construction.
(3) Project implementation allowance equals 25% of total construction cost for all projects except the Randall-Bold WTP expansion to cover engineering design, construction services, environmental, permitting, and legal. The implementation allowance for the Randall-Bold WTP expansion project is 35% of total construction cost to include an additional 10% for CCWD project administration.
(4) Pipeline unit construction costs include valves and appurtenances, pavement removal and replacement, traffic control, and an average allowance for correction of utility interferences.
(5) Distribution pump station costs assume an above-ground building, and include standby pump, standby power, and telemetry.

Section 1
Introduction

This 2020 Facilities Plan updates Diablo Water District's (DWD or District) 2006 Facilities Plan. It updates water demand projections, identifies new facilities to serve future growth, and provides recommended capital improvements.

1.1 Background

In 1993, Oakley Water District became Diablo Water District. DWD's service area includes the City of Oakley, the downtown area of the Town of Knightsen (Knightsen), and portions of Bethel Island. DWD's ultimate service area, or Sphere of Influence (SOI), encompasses the existing service area and unincorporated county lands east and south of Oakley and slightly more of Knightsen. The SOI could also eventually include all of Bethel Island if residents wish to secure water service from DWD.

Since 2006, eastern Contra Costa County, including the area served by DWD, has experienced slower growth than in the previous decades. Accordingly, there have been limited changes in the area's land use planning since the 2006 Facilities Plan. This 2020 Facilities Plan reviews the current land use planning information in updating projected water demands and facility needs.

1.2 Report Organization

This report is organized in the following sections:

- Section 1 - Introduction
- Section 2 - Study Area Characteristics
- Section 3 - Study Area Development
- Section 4 - Existing Water System
- Section 5 - Water Demand
- Section 6 - Treated Water Storage
- Section 7 - Fire Protection
- Section 8 - Distribution System Network
- Section 9 - Facilities Planning

1.3 Acknowledgments

This report would not have been possible without the valuable assistance of DWD staff, especially Mr. Daniel Muelrath, General Manager; Mr. Nacho Mendoza, Manager of Water Operations; Mr. Wayne Weaver, Construction and Maintenance Manager; Ms. Christine Belleci, Administrative Analyst; Ms. Jennifer McCoy, Accounting Operations Manager; and Mr. Mike Yeraka, former General Manager (retired). Their assistance is gratefully acknowledged. In addition, Carlson, Barbee & Gibson, Inc., graciously provided the aerial photograph used for the report cover.

Section 2

Study Area Characteristics

Section 2 describes the location, climate, and topography of the service area. The study area includes DWD's sphere of influence as well as Bethel Island.

2.1 Location

DWD is located in the northeastern corner of Contra Costa County, east of the City of Antioch and north of the City of Brentwood. DWD's service area includes the City of Oakley, the downtown area of Knightsen, and portions of Bethel Island. Figure 2-1 presents the study area for this Facilities Plan, including the current DWD service area plus future planning areas within its SOI and Bethel Island.

Ultimately, DWD will provide service within its SOI, as approved by the District's Board of Directors and the Local Agency Formation Commission. The current approved SOI includes the existing service area plus the remainder of the Hotchkiss Track, small unincorporated areas south of Oakley, and the remainder of Knightsen. The SOI could eventually include all of Bethel Island if residents wish to secure water service from DWD. DWD's SOI and Bethel Island encompass approximately 18,000 acres. Currently DWD serves almost three-quarters of this ultimate area. The remainder is undeveloped or is served by groundwater wells of individual property owners.

DWD's existing treated water distribution system is located in the western part of the study area, where the Oakley community began. Future development is occurring in the eastern part of the study area, and DWD's treated water system is expanding to serve the eastern area as necessary.

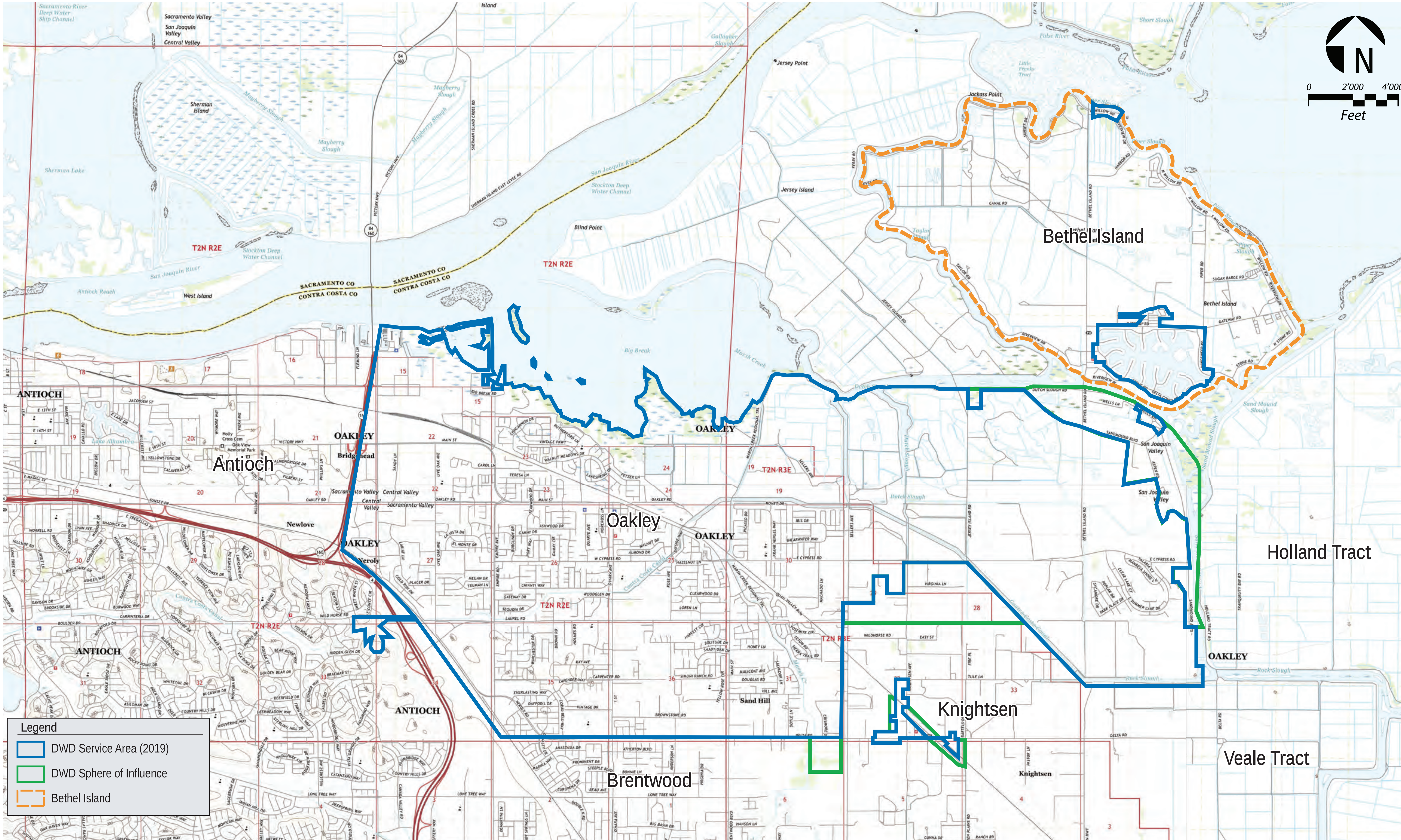
2.2 Climate

DWD's service area experiences a Mediterranean-type climate, with mild, rainy winters and hot, dry summers. DWD receives approximately 13 inches of precipitation annually, with 95 percent of this precipitation occurring in the months of October through April. Table 2-1 presents average monthly precipitation, temperature, and evapotranspiration data in DWD's area.

Table 2-1. Climate Summary

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Annual
Average Precipitation (inches)	2.66	2.35	2.08	0.78	0.43	0.09	0.00	0.02	0.18	0.62	1.60	2.41	13.22
Average Temperature (^{o}F)	46.3	51.2	55.4	59.8	66.3	72.0	75.4	74.3	71.6	64.6	54.5	46.6	61.5
Standard Monthly Average Evapotranspiration	1.16	2.02	3.77	5.46	7.10	7.96	8.25	7.41	5.61	3.79	1.90	1.16	55.59

Note: Sources of climate data include: the Antioch Pump Plant 3 weather station (#040232) data for 1981-2010, and average evapotranspiration data for 1985-2018 for the Brentwood, California station of the California Irrigation Management Information System.



Source: U.S. Department of the Interior | U.S. Geological Survey Topographic Maps - Copyright ©2018

\\wlcsvr1\Wordproc\REPORTS\DWD\Figures\Figure 23-1 DWD Study Area for Facilities Plan.ai 04/07/2020 JJT

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Figure 2-1
Diablo Water District Study Area for Facilities Plan

2.3 Topography

The terrain is gently rolling, with a gradual slope northerly toward the San Joaquin River. Ground elevation within the SOI varies from approximately 100 feet above mean sea level at the southwestern boundary of the SOI to about minus 5 feet at the eastern boundary.

The eastern part of the study area generally consists of reclaimed lands surrounded by levees. These areas are generally flat with many man-made drainage ditches and naturally occurring sloughs and wetlands. Bethel Island is also generally flat, reclaimed land surrounded by levees, with ground elevations ranging from 10 feet below to 5 feet above mean sea level.

2.4 Soils

Most of the soil in the DWD area is classified as Delhi Sand by the Natural Resources Conservation Service and has a Class III rating suitable for orchard and vineyard production. However, it does not naturally hold sufficient internal moisture for most crops and has a low nutrient level. A variety of Class I and Class II prime agricultural soils lie along Marsh Creek and portions of Hotchkiss Tract.

Section 3

Development of the Study Area

This section describes existing and future land uses and development within the study area.

3.1 Historical Perspective

Historically, land uses within the study area were predominately rural and agricultural. The study area has become increasingly suburban and the role of agriculture has diminished. Today, approximately 35 percent of the lands within DWD's SOI are in agricultural production or are undeveloped open space, primarily in the eastern part of the study area. However, those lands are slowly developing.

During the 1980s, significant residential growth occurred within the then unincorporated community of Oakley, and some small pockets of development occurred in the unincorporated eastern part of the study area. The rate of development slowed in the 1990s and then increased in the early 2000s.

Since the 2006 Facilities Plan, growth in the study area has generally slowed compared to past projections. The future land uses in the eastern portion of the study area have become better defined for certain developments. Recent development in the study area includes large subdivisions in eastern Oakley and growth along the edges of Bethel Island. In addition, the Delta Coves subdivision is currently under construction on Bethel Island and a large subdivision will be starting construction in eastern Oakley in 2020.

3.2 Land Use Planning Information

Information regarding future land uses within the study area was obtained from:

- City of Oakley (City) General Plan 2020 for the City of Oakley planning area west of Jersey Island Road (adopted in 2002, most recently amended in 2016);
- East Cypress Corridor Specific Plan for the City of Oakley planning area east of Jersey Island Road (adopted in 2006);
- East Cypress Corridor Lotting Plan for the Cypress Preserve Project, part of the East Cypress Corridor Expansion Area (prepared in 2019); and
- Contra Costa County General Plan 2005-2020 for Knightsen and Bethel Island (adopted in 2005).

The City of Oakley is currently updating its General Plan and expects to be complete in 2020, but has indicated no changes to land use designations are expected. The City is focusing its update on the areas of environmental justice, climate change, and transit/transportation. Contra Costa County is the process updating all aspects of its General Plan and expects to adopt *Envision Contra*

Costa 2040 at the end of 2020. Both the Oakley and County General Plans assume a timeframe for buildout in 2040.

The land use types defined by the local planning agencies were grouped into the following major categories appropriate for developing water demands:

- Single Family Residential
- Multiple Family Residential
- Commercial, Business Park, Industrial
- Institutional (schools, public and semi-public service)
- Parks
- Agricultural Limited (limited, very low density single family residential) – The treated water demand for the limited single family residential development is included under the Single Family Residential category.
- Open Space Type Uses (agricultural, Delta recreation, unirrigated parks, open space, any areas that will not use DWD treated water)

The existing and future land uses within the study area are described in the following sections, based on these major categories.

3.3 Existing Land Use

Figure 3-1 shows the existing land uses in the study area. The DWD treated water distribution system currently serves developed lands located generally west of the Burlington Northern & Santa Fe Railroad, with a few developments between the Contra Costa Canal and East Cypress Road, one in the eastern side of the East Cypress Specific Plan Area, and the Delta Coves development on Bethel Island.

The lands receiving service from the DWD treated water distribution system in 2019 included about 2,000 acres of residential development and about 300 acres of non-residential development. The remainder of the area consists of open space or other uses that do not receive DWD water service. Some parts of the area west of the railroad are still agricultural or are older rural residences served by private wells. When new development occurs in the study area, DWD provides treated water service.

Lands within the study area east of the railroad are primarily still in rural or agricultural use; however, this area is developing. The majority of existing dwelling units in this area are in the Cypress Grove, Emerson Ranch, and Cypress Lakes developments, and along the perimeter of the sloughs. A few small commercial areas are located directly south of the Bethel Island bridge and along Bethel Island Road.

Most of the development on Bethel Island is around the island perimeter with single family homes adjacent to the levee which surrounds the island. A small commercial area is located

Legend

DWD Sphere of Influence (SOI)

Bethel Island

Note: Study area for the Facilities Plan includes the DWD SOI and Bethel Island.

Aerial photograph courtesy of Google™earth

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Figure 3-1

Diablo Water District Existing Land Use

immediately north of the bridge. The interior of the island is sparsely developed with the exception of development along Gateway Road and the ongoing construction of the Delta Coves community.

3.4 Buildout Land Use

Figure 3-2 and Table 3-1 show the buildout land uses in the study area. The buildout land uses are based on the City General Plan for the Oakley planning area west of Jersey Island Road, the proposed Cypress Preserve development plans (from December 2019) in eastern Oakley, the East Cypress Corridor Specific Plan for the rest of the Oakley planning area east of Jersey Island Road, and the County General Plan for Knightsen, Bethel Island, and small areas between the DWD service area and SOI. There will be significant future development in the eastern portion of the study area, as well as infill development in the northwestern portion.

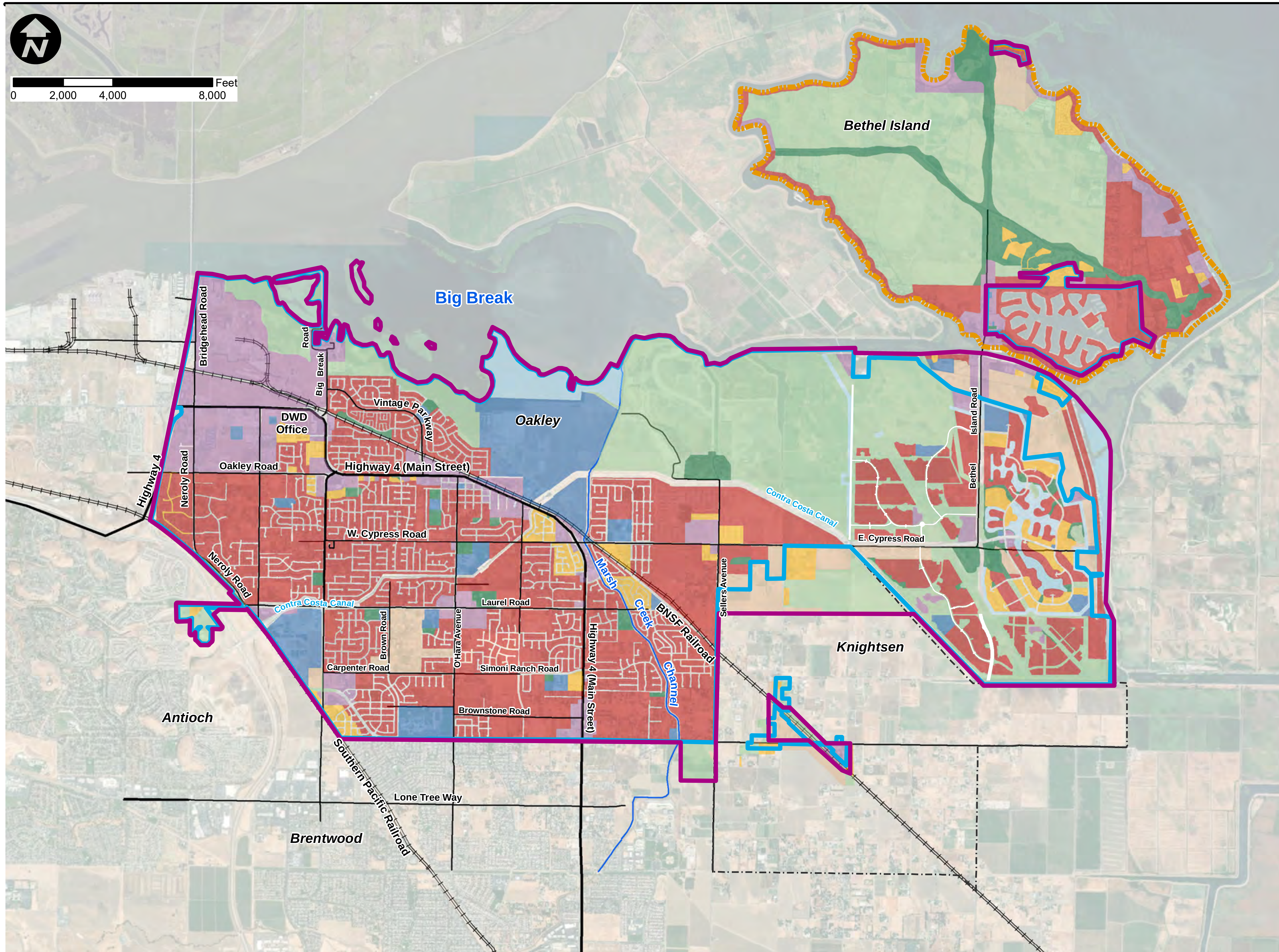
Table 3-1. Buildout Land Uses

Land Use	DWD Sphere of Influence			Bethel Island (acres)	Total [1] (acres)
	West of Jersey Island Road (acres)	East of Jersey Island Road (acres)	Subtotal (acres)		
Residential					
Single Family	3,335	866	4,201	792	4,993
Multiple Family	273	233	506	88	594
Total – Residential	3,608	1,098	4,707	880	5,587
Non-Residential					
Commercial, Business Park , Industrial (including former DuPont Facility)	1,064	141	1,205	252	1,456
Institutional (schools, public service lands)	702	71	773	2	775
Park and Recreation	128	84	211	361	572
Total – Non-Residential	1,894	296	2,189	614	2,804
Agricultural and Open Space Type Uses					
Agriculture Limited (limited very low density single family residential)	147	500	647	75	723
Agricultural, Delta Recreation, Open Space – No DWD Treated Water	1,603	1,523	3,127	1,843	4,970
Total – Open Space Type Uses	1,751	2,023	3,774	1,919	5,693
GRAND TOTAL	**7,252**	**3,418**	**10,670**	**3,414**	**14,084**

[1] Does not include roads and waterways.

The Delta Coves subdivision is under construction in the southeast part of Bethel Island, south of Gateway Road. This development will receive water service from DWD. Other development may occur around the island according to the County's allowable land uses and densities and approved projects. This Facilities Plan was prepared to accommodate future service to the entire island, in the event that existing and/or future property owners request it.

Of the 14,000 acres within the entire study area including Bethel Island (not including roadways and waterways), it is anticipated that ultimate buildout will comprise about 5,600 acres of residential development, 2,800 acres of non-residential development, and 5,700 acres of open



Note:
1. Study area for the Facilities Plan includes the DWD SOI and Bethel Island.
2. City of Oakley 2020 General Plan (East Cypress Corridor Specific Plan) December 16, 2002
3. Aerial Image Source: ESRI, DigitalGlobe, USGS, et. al. (2019)

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Figure 3-2
Planning Area – Buildout Land Use

space land uses. These open space land uses, which do not receive DWD water, include agriculture, Delta recreation, and public service and park land that are not irrigated with DWD water.

3.5 Dwelling Units

The number of residential dwelling units (du) at buildout was estimated by multiplying the acreage of residential land uses by the densities for each land use type in dwelling units per acre. The City and County General Plans define a range of allowable densities for new development for the various land use categories.

Table 3-2 summarizes the range of estimated residential units at buildout based on the buildout land uses and allowable density ranges from City and County planning documents, presented in Table 3-3. The low estimate uses the minimum value of the density range, and the high estimate uses the maximum value of the density range. The planning-level estimate was based on the average value of the allowable density range.

Based on the buildout land uses, the overall (composite) density of residential development within DWD's SOI, excluding Bethel Island, is anticipated to range from 2.7 to 4.3 units per acre (du/acre) for single family residential (average of 3.5 du/acre); and 6.1 to 10.6 du/acre for multiple family residential (average of 8.3 du/acre). On Bethel Island at buildout, the overall (composite) density of residential development is anticipated to range from 2.1 to 4.0 du/acre for single family residential (average 3.1 du/acre); and from 2.9 to 12.0 du/acre for multiple family residential (average 7.4 du/acre).

Table 3-2. Estimated Dwelling Units at Buildout

Land Use	Number of Dwelling Units [1] (du)		
	Low	Planning Level [2] (average)	High
DWD Sphere of Influence (excluding Bethel Island)			
Single Family Residential [3]	11,430	14,650	17,880
Multiple Family Residential	3,070	4,200	5,350
Total	14,500	18,860	23,230
Bethel Island			
Single Family Residential	1,640	2,420	3,200
Multiple Family Residential	260	660	1,050
Total	1,900	3,080	4,250
Entire Study Area			
Single Family Residential	13,060	17,070	21,080
Multiple Family Residential	3,330	4,860	6,400
GRAND TOTAL	**16,390**	**21,940**	**27,480**

[1] Range of estimated dwelling units is based on the allowable City and County General Plan densities for residential land uses in Table 3-3. Calculations for areas within the City's planning area were based on the City's densities, while those outside the City's planning area were based on the County's densities.
[2] The planning-level estimate used for the demand projections is based on the average value of the allowable density ranges.
[3] The Single Family Residential category includes about 360 units within Agriculture Limited lands that may potentially receive DWD treated water for domestic uses.

Table 3-3. Allowable Residential Density Ranges

Residential Land Use	City of Oakley Density Range (du/ac)	County Density Range (du/ac)
Single Family		
Very low	0.2-1.0	Not Applicable
Low	0.8-2.3	1.0-2.9
Medium	2.3-3.8	3.0-4.9
High	3.8-5.5	5.0-7.2
Multiple Family		
Low	5.5-9.6	7.3-11.9
Medium	7.6-13.2	Not Applicable
High	9.6-16.7	Not Applicable
Mobile Home	5.5-9.6	1.0-12.0

3.6 Population Growth

In 2019, DWD served approximately 42,000 residents, based on California Department of Finance population estimates. According to the City's existing General Plan, the city's total buildout population will be about 68,000, which includes about 49,000 people within the City limits and 19,000 in the city's expansion areas (the City has now annexed some of these expansion areas into its city limits). In addition, DWD will serve Knightsen and potentially all of Bethel Island in the future. As mentioned previously, the City's General Plan is currently being updated.

The population at buildout of DWD's ultimate service area was calculated based on buildout residential land uses, the average allowable residential densities, and average household sizes. The buildout population was estimated at 64,000 persons assuming that DWD serves the entire study area, using average residential densities.

Table 3-4 shows estimated population projections for the area served by DWD. Linear interpolation was used to estimate the population at five-year intervals. The actual growth in population over time will depend on economic and development cycles.

Table 3-4. Population Projection Estimates for Area Served by DWD

2019	2020	2025	2030	2035	2040
42,000	43,000	48,000	54,000	59,000	64,000

Section 4

Existing Water System

Section 4 describes the existing water system serving the study area. The description includes water supply, treatment facilities, and distribution system facilities.

4.1 Water Supply and Treatment

DWD's primary raw water supply for its distribution system is surface water from the United States Bureau of Reclamation (Reclamation) Central Valley Project (CVP) purchased from Contra Costa Water District (CCWD), DWD's wholesale supplier. This water is conveyed through the Contra Costa Canal and pipeline system and Los Vaqueros Reservoir. The water is treated at the Randall-Bold Water Treatment Plant (WTP) in Oakley.

In addition, DWD developed its own groundwater supply system to provide additional supply reliability. The first groundwater well came online in 2006 and the second in 2011. When fully implemented, groundwater could comprise up to 20 percent of DWD's total supply.

4.1.1 Surface Water Supply

DWD purchases CVP water from CCWD who has a contract with Reclamation for 195,000 acre-feet (AF) per year through February 2045. Figure 4-1 shows the major facilities supplying raw surface water to DWD. Raw surface water is supplied via the 48-mile long Contra Costa Canal and pipeline system (Canal) that can convey water either from Rock Slough in the Sacramento-San Joaquin Delta (Delta), Los Vaqueros Reservoir, or CCWD's other intakes on Old River and Victoria Canal (near Middle River).

The Canal and pipeline system are owned by Reclamation and operated by CCWD. Reclamation constructed the Canal and its four pump stations in 1937 as part of the CVP to serve agricultural demands in eastern and central Contra Costa County. Since that time, the predominant demand for canal water has been for residential, commercial, and industrial use; agricultural use is now negligible. CCWD assumed operation and maintenance of the Canal, pipelines, and pump stations in 1972. CCWD initiated Reclamation's administrative process to transfer title of the canal system to CCWD. Congressional authorization for the transfer was obtained in 2019 and there are a number of remaining tasks remaining in the process. The title transfer is anticipated to be complete by summer 2021.

Los Vaqueros Reservoir is a 160,000-AF storage facility located eight miles south of Brentwood. Water to fill the reservoir comes from either a pump station intake on Old River near Highway 4, or from Victoria Canal near Middle River. CCWD owns and operates Los Vaqueros Reservoir and its related intake, pumping, conveyance, and blending facilities. The reservoir provides water quality and emergency supply benefits. CCWD has proposed expanding the reservoir to a total of 275,000 AF to improve Bay Area supply reliability and water quality, while providing additional ecosystem benefits for the Delta. The project would include upgrades to existing conveyance facilities, new conveyance, and reoperation of existing facilities. CCWD is working through 2021

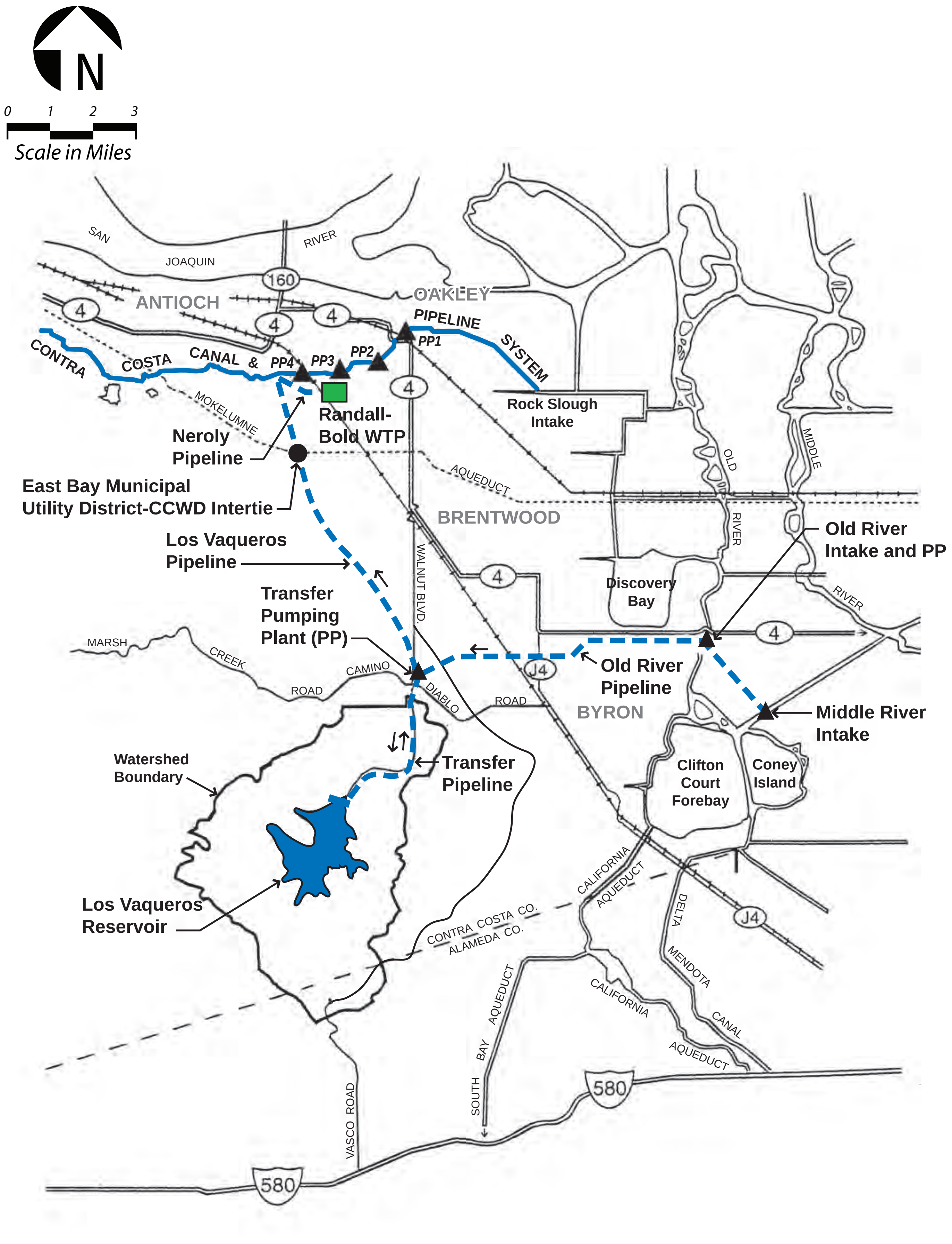

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Figure 4-1
Raw Surface Water Supply Facilities

to finalize project design, permitting, and local agreements. Design and construction are expected to occur from 2022 to 2029.

4.1.2 Randall-Bold WTP

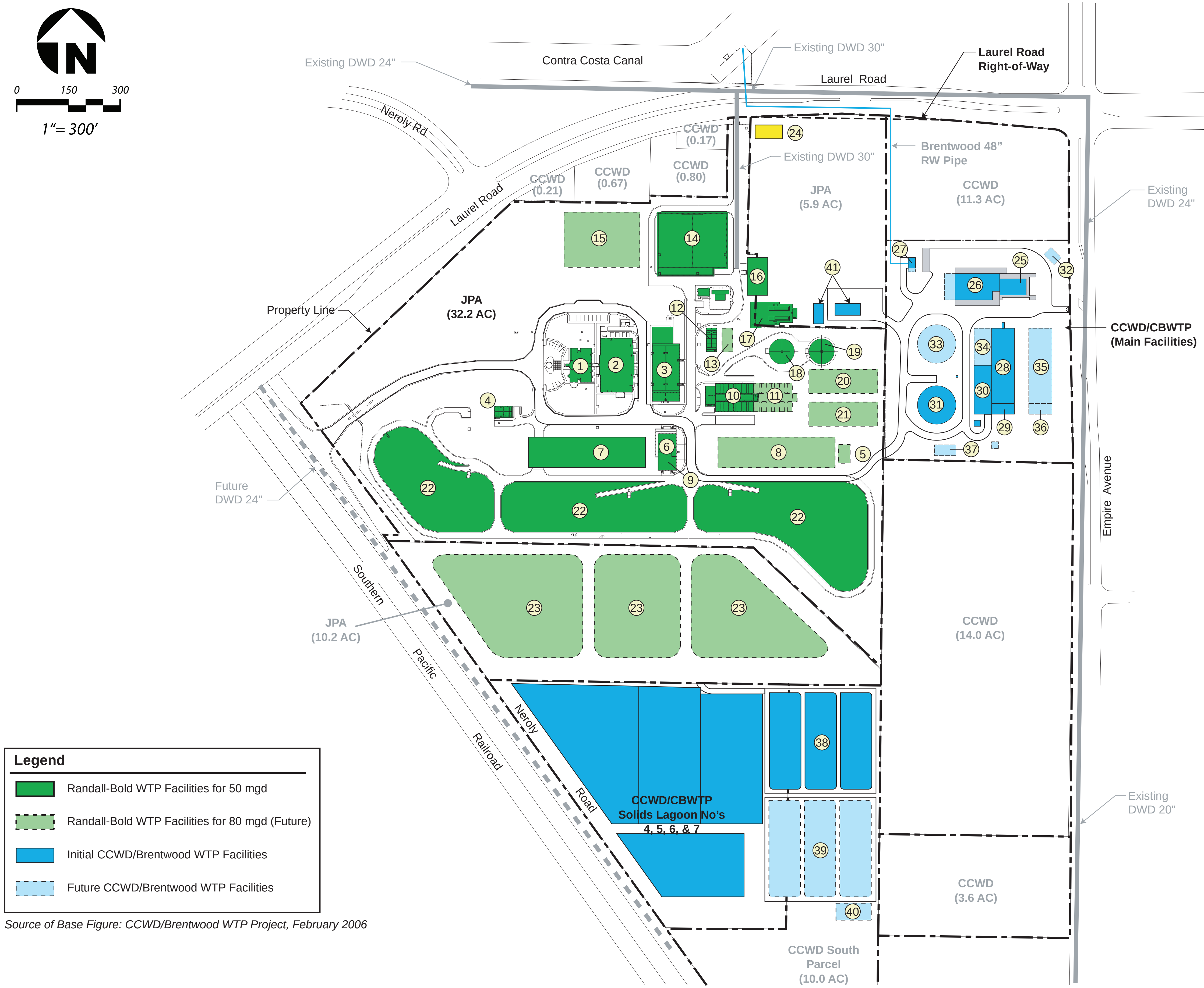
Raw surface water from the Canal and/or Los Vaqueros Reservoir is treated at the Randall-Bold WTP, which is jointly owned by DWD and CCWD and is operated and maintained by CCWD. The plant, constructed in 1992, is located in the southwestern portion of DWD's service area adjacent to the Canal near the intersection of Live Oak Avenue, Laurel Road, and Neroly Road. A Joint Powers Agreement between the two agencies specifies the terms of the contractual arrangement for ownership and operation.

The Randall-Bold WTP was designed for an initial capacity of 40 million gallons per day (mgd), with the capability to expand to 80 mgd. The initial treatment capacity allocated 15 mgd to DWD (37.5 percent) and 25 mgd to CCWD (62.5 percent). In 2010, Randall-Bold WTP capacity increased to 50 mgd, with treatment capacity allocated 15 mgd to DWD (30 percent) and 35 mgd to CCWD (70 percent).

DWD's current capacity of 15 mgd from Randall-Bold WTP provides an average day supply of 7.5 mgd (2,738 million gallons [MG]). DWD is entitled to increase its share of the capacity from 15 mgd to up to 30 mgd with advance notice to CCWD. In accordance with current agreements, DWD must purchase that additional supply in 5 mgd increments. DWD intends to purchase additional treatment capacity, when needed, as its primary supply for future development. It is currently anticipated that only an additional 5 mgd of capacity may be needed to meet future demands and water quality blending goals for the groundwater system. Increasing its total purchased capacity to 20 mgd will provide an average day supply of 10 mgd (3,650 MG). The specific timing for this additional capacity will depend on the available groundwater supply, rate of District growth, and customer conservation.

Figure 4-2 shows the plan layout of existing and future facilities at Randall-Bold WTP. It also shows the CCWD/Brentwood WTP that provides treated water to the City of Brentwood, located adjacent to Randall-Bold WTP. Figure 4-3 presents the current process flow diagram after the 2010 improvements. DWD allowed CCWD to modify the plant to a conventional sedimentation plant. These modifications included the addition of three-stage mechanical flocculation and horizontal flow sedimentation basins in place of a serpentine plug-flow flocculation basin, piping to convert the raw water ozone contactor to a settled water ozone contactor, and replacement of the filter media.

Table 4-1 summarizes the current (50 mgd) and ultimate (80 mgd) capacities of the treatment plant, clearwell, and pumping plant. DWD's share of the clearwell storage is proportional to its share of the treatment capacity. Water from the clearwell is pumped into DWD's distribution system from DWD's dedicated pumps at the Randall-Bold WTP pumping plant. The pumping plant is connected to DWD's distribution system via a 30-inch pipeline.



Source of Base Figure: CCWD/Brentwood WTP Project, February 2006

Randall-Bold Water Treatment Plant

1. RBWTP Control Building
2. RBWTP Operations Building
3. RBWTP Chemical Storage Area
4. RBWTP Raw (To be Settled) Water Ozone Contactor
5. RBWTP Future Settled Water Ozone Contactor
6. RBWTP Existing Flocculation Basins
7. RBWTP Flocculation and Sedimentation Basins
8. RBWTP Future Flocculation and Sedimentation Basins
9. RBWTP Future Chemical/Process Area
10. RBWTP Filters (6 Each)
11. RBWTP Future Filters (6 Each)
12. RBWTP Filtered Water Ozone Contactor
13. RBWTP Future Filtered Water Ozone Contactor
14. RBWTP Clearwell and Pump Stations
15. RBWTP Future Clearwell
16. RBWTP WAPA Electrical Substation
17. RBWTP MPP Standby Power Facility/Brentwood Standby Power
18. RBWTP Filter-to-Waste Basin
19. RBWTP Washwater Basin
20. RBWTP Future Washwater Clarification Facility
21. RBWTP Future UV/Membrane Facilities
22. RBWTP Backwash Water Lagoons
23. RBWTP Future Solids Lagoons
24. Diablo Water District Blending Facility

CCWD/City of Brentwood Water Treatment Plant (CBWTP)

25. CBWTP Operations Building
26. CBWTP Chemical Building
27. CBWTP Raw Water Pump Station
28. CBWTP Flocculation and Sedimentation Basins
29. CBWTP Ozone Contactor Basin
30. CBWTP Filters (4 Each)
31. CBWTP Clearwell
32. CBWTP Future Office Annex
33. CBWTP Future Clearwell
34. CBWTP Future Filters (3 Each)
35. CBWTP Future Flocculation and Sedimentation Basins
36. CBWTP Future Ozone Contactor Basins
37. CBWTP Future Maintenance Building
38. CBWTP Washwater Lagoons
39. CBWTP Future Washwater Lagoons
40. CBWTP Future Washwater Clarification
41. Brentwood Treated Water Pump Station

Figure 4-2
Randall-Bold WTP Plan Layout and Future WTP Facilities

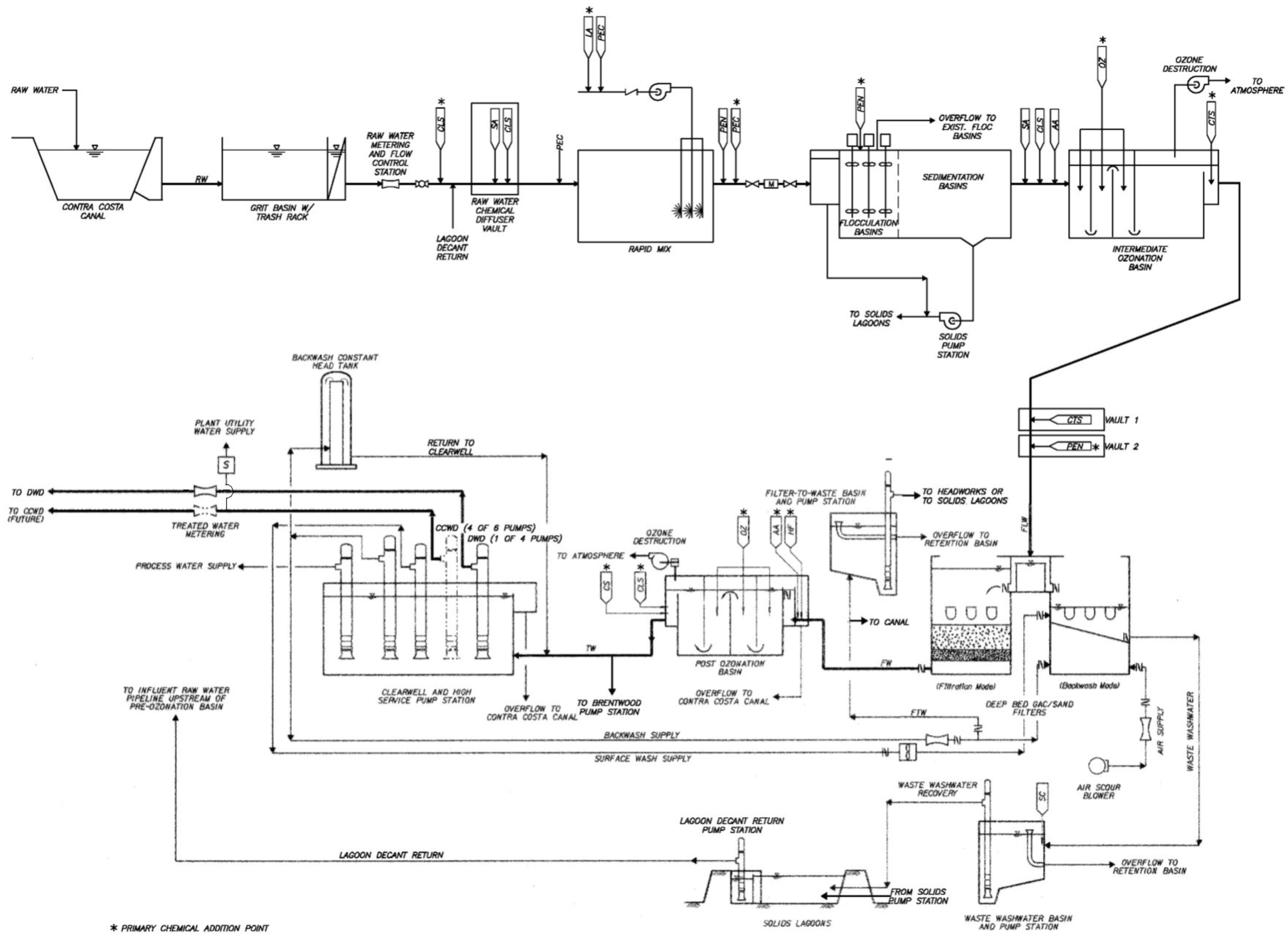


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Figure 4-3
Process Flow Diagram - Randall-Bold Water Treatment Plant

Table 4-1. Summary of DWD Allocations of Treatment, Clearwell, and Pumping Capacities at Randall-Bold WTP

	Units	DWD Allocation		Total	
		Current	Maximum	Current	Ultimate
Treatment Design Flow Rate	mgd	15	30	50	80
Clearwell Volume	MG	1.9	3.75	5	10
Treated Water Pumping to DWD Distribution System					
Number of Pumps	each	Same as total since DWD pumps are only for DWD. CCWD pumping capacity will be provided by separate pumps.		4	4
Total Capacity for DWD (all pumps including standby)	mgd			25.8	45
Firm Capacity for DWD (with one large pump as standby)	mgd			17.2	30.0
Pump Capacity (each) - Constant Speed 2 pumps @ 160 feet of head (Existing) 2 pumps @ 160 feet of head (Existing)	 mgd HP mgd HP			 4.3 150 8.6 300	 4.3 150 8.6 300

Notes: HP = horsepower

4.1.3 Groundwater Supply

DWD is operating a groundwater supply system that provides additional supply reliability. The system currently consists of groundwater from two wells in Oakley, conveyed in a dedicated well supply pipeline to the Blending Facility located near the Randall-Bold WTP. At the Blending Facility, the groundwater is treated and blended with treated surface water within DWD's distribution system, prior to distribution to any customers, so that there is negligible impact on water quality. The amount of groundwater used in proportion to surface water is automatically controlled to maintain good water quality with a target hardness of 140 milligrams per liter (mg/L), except in times of drought when DWD may temporarily increase the target hardness.

4.1.3.1 Groundwater Facilities

Figure 4-4 presents the facilities of DWD's Well Utilization Project. The first phase of the groundwater supply system included:

- a 310-foot deep well and pump station located in Glen Park in Oakley,
- the Blending Facility at the Randall-Bold WTP, and
- an 18-inch diameter, 18,250-foot-long dedicated well supply pipeline connecting the Glen Park Well and the Blending Facility.

The pipeline is sized for the anticipated ultimate groundwater use of 7 mgd to allow flexibility to meet future demands; however, installation of the pipeline does not commit DWD to implementing future phases of the well project. The Glen Park Well was put into service in 2006 and has a pumping capacity of approximately 2 mgd.

Disinfection is initiated at each well with injection of hypochlorite. At the Blending Facility, disinfection is boosted by injecting additional chemicals to chloraminate and fluoridate prior to

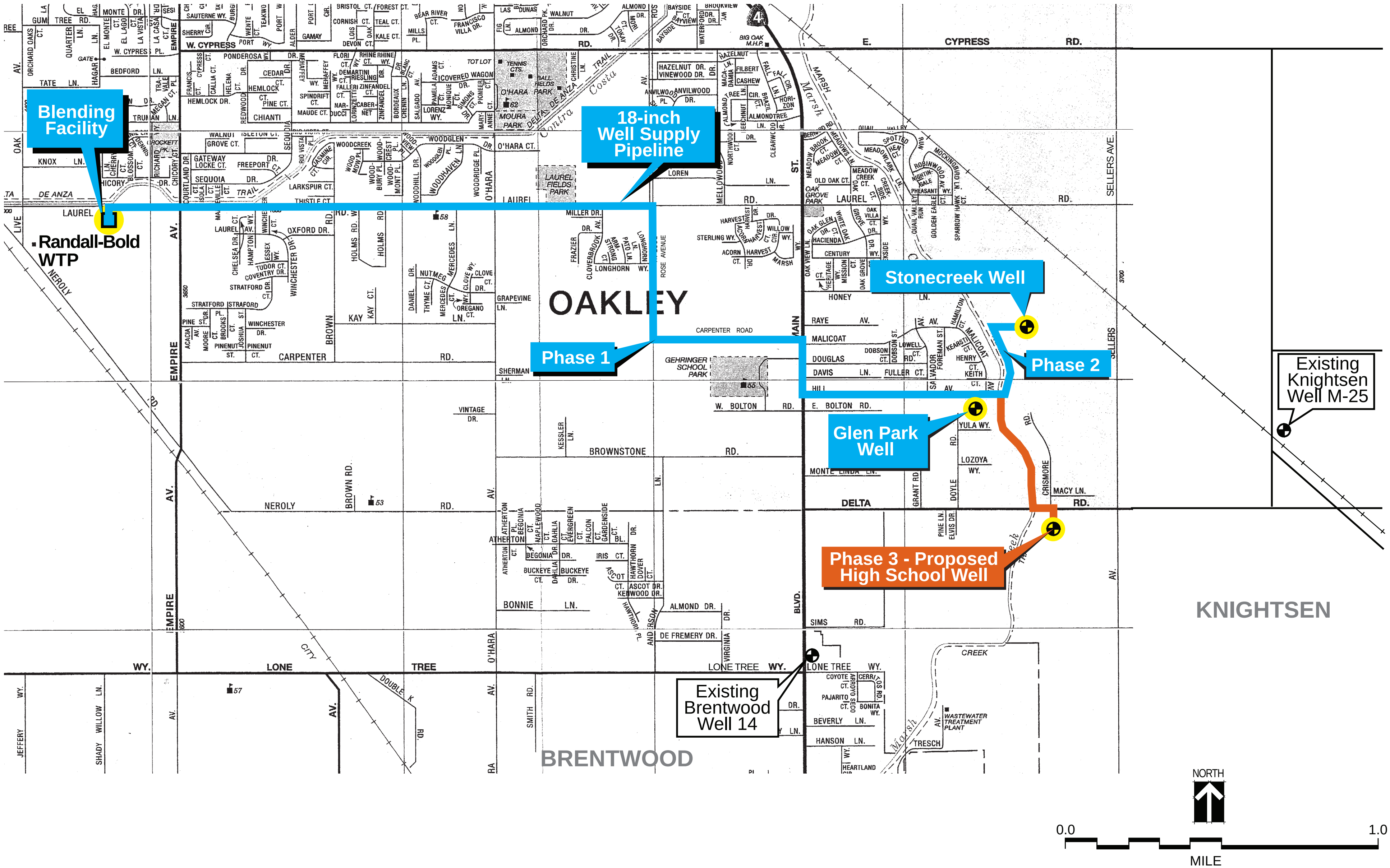


Figure 4-4
DWD Well Utilization Project Facilities

blending with surface water. Based on DWD's 2014 Blending Facility Operations Plan, the facility is operated to not exceed 280 mg/L total dissolved solids (TDS) in the delivered water, to support the 140 mg/L hardness goal. DWD continuously monitors effluent hardness, electroconductivity (EC), and well flow rates based upon the measured EC. The finished water TDS and EC can vary up to the secondary maximum contaminant level of 500 mg/L for TDS and 900 microSiemns per centimeter for EC, if the hardness limit is relaxed by DWD during water shortages; this may occur during periods of reduced deliveries from Randall-Bold WTP, requests from CCWD to conserve water, or State drought declarations. There is space at the Blending Facility site to expand the existing processes and to add potential future treatment processes, e.g., if it became necessary to treat for iron, manganese, or other constituents in the future.

In the second phase of the Well Utilization Project, the Stonecreek Well was put into service in June 2011. The Stonecreek Well is approximately one-half mile northeast of the existing Glen Park Well and constructed to similar standards. The Stonecreek Well has a pumping capacity of approximately 2.0 mgd and a yield similar to that of the Glen Park Well of 336 MG per year.

The pump motors at each well are operated using variable frequency drives which allows DWD to control the flow rate produced from each well. The wells operate year-round to reduce annual operating costs, since groundwater can be supplied at lower cost than surface water, and at higher flow rates to meet peaking needs during the summer months. DWD operates one or both wells, at a variety of flow rates, based upon time of use periods and seasonal groundwater basin water quality parameters and elevations.

DWD may install additional groundwater production wells in future phases, based on the rate of District growth and demand. These wells may also be located in the eastern part of DWD's SOI, with specific locations to be determined as part of future well siting studies. DWD will base the decision to expand the groundwater supply system on the performance of the Glen Park and Stonecreek Wells. It is currently anticipated that two additional 1.5 mgd wells will be developed. Future wells are assumed to have the same ratio of pumping capacity to annual yield as the Glen Park Well. DWD's decision to install additional wells will also consider the findings of the East Contra Costa Groundwater Sustainability Plan (GSP) that is currently being developed (see Section 4.1.3.4). The hydraulic model being prepared as part of the GSP could help determine the viability of these new wells.

Based on available information, it is possible that up to 5.5 mgd of ultimate pumping capacity can be achieved from the local groundwater basin, which would be about 20 percent of the District's total supply. However, the long-term ability of the groundwater basin to provide these quantities is uncertain. As the first and second wells continue to be operated, ongoing data collection and monitoring conducted by DWD will provide better information. If future investigations indicate that it will not be possible to provide the anticipated amount of groundwater supply to meet demands, then DWD will either procure additional surface water supply from CCWD and/or investigate other local supply sources.

4.1.3.2 Groundwater Management Plan

In 2007, DWD voluntarily adopted a groundwater management plan according to the procedures outlined in the Groundwater Management Planning Act (California Water Code Section 10750-10546). The Groundwater Management Plan can be viewed on the District's website. The purpose of the Groundwater Management Plan is to provide a management framework for maintaining a high quality, reliable, and sustainable supply of groundwater from the subbasin within DWD's SOI, previously designated as the Tracy Subbasin. In 2016, the subbasin was further divided and DWD now lies within the East Contra Costa Subbasin. The 2007 Groundwater Management Plan is still DWD's current guidance document.

DWD manages groundwater conjunctively with its surface water resources and support basin management objectives (BMOs) directed toward the sustainability of groundwater supplies on regional and local scales (e.g., groundwater basin and subbasin). Groundwater management involves coordinated actions related to groundwater withdrawal, replenishment, and protection to achieve long-term sustainability of the resource without detrimental effects on other resources and the environment. The Groundwater Management Plan sets forth the framework and related actions necessary to accomplish DWD's purposes while satisfying regional BMOs.

Regional BMOs addressed by the Groundwater Management Plan include the following:

- **Assessment of Groundwater Basin Conditions.** Monitoring programs and reporting on groundwater levels, groundwater quality, and pumping are necessary to ensure that undesirable effects such as long-term groundwater level declines, groundwater quality degradation, and significant inelastic land subsidence are avoided. Regional coordination of groundwater monitoring is important, and monitoring programs should be reevaluated periodically. Currently, comprehensive regional evaluation is not conducted on a regular basis. However, results from individual monitoring programs are made available to other agencies to aid in effective groundwater resource management and accomplishment of BMOs.

- **Avoidance of Overdraft.** It is important that groundwater pumping in the subbasin not exceed the sustainable yield of the subbasin in order to avoid chronic water level declines that could lead to overdraft conditions or cause significant inelastic land subsidence.

- **Preservation of Groundwater Quality.** This objective involves actions needed to sustain a supply of good quality groundwater for beneficial uses in the basin. It includes coordinated efforts that identify short- and longer-term water quality trends, wellhead and recharge area protection, and actions to avoid salt accumulation and/or mobility of naturally occurring constituents. It also includes active characterization and solution of any groundwater contamination problems through cooperation with responsible parties or through independent action.

- **Preservation of Interrelated Surface Water and Groundwater Resources.** Several entities in the subbasin, including DWD, use both surface water and groundwater. There are opportunities to expand these programs in the future and to increase the use of recycled water to meet existing and projected demands.

Local BMOs addressed by the Groundwater Management Plan include the following:

- **Understanding Local Groundwater Conditions.** Monitoring programs and reporting on groundwater levels, groundwater quality, and pumping have been implemented to assess groundwater conditions in the DWD service area. These programs are necessary to ensure that undesirable effects such as long-term groundwater level declines, groundwater quality degradation, and significant inelastic land subsidence are avoided.

- **Preservation of Groundwater Quality.** This objective involves actions needed to sustain a supply of good quality groundwater in the DWD service area. It includes coordinated efforts that identify short- and longer-term water quality trends, wellhead and recharge area protection, and actions to avoid salt accumulation and/or mobility of naturally occurring constituents.
- **Avoid Impacts to Shallow Groundwater.** This objective involves actions needed to avoid deleterious impacts to shallow wells that exist throughout DWD's sphere of influence. These wells may serve individual households or small community systems.
- **Local Groundwater Monitoring and Coordination with Regional Monitoring Program.** DWD has conducted intermittent monitoring of groundwater levels and quality within its service area. Coordination of the DWD groundwater monitoring program with other regional monitoring programs will eliminate duplication and ensure that adequate monitoring is being conducted and enhance its own understanding of conditions in its area.

To accomplish the BMOs discussed above, the Groundwater Management Plan incorporates a number of components that are divided into five categories: 1) monitoring program; 2) water resource sustainability; 3) groundwater resource protection; 4) agency coordination and public outreach; and 5) plan implementation and updates. The Groundwater Management Plan components reflect the focus on local groundwater management in the subbasin by DWD and continuing cooperation with the members of the East County Water Management Association and other stakeholders in the subbasin. The components, listed below, include actions to accomplish the regional and local BMOs.

- Category 1: Monitoring Program
  - 1A. Elements of Monitoring Program
  - 1B. Evaluation and Reporting of Monitoring Data
- Category 2: Water Resource Sustainability
  - 2A. Maintaining Stable Groundwater Levels
  - 2B. Water Conservation
  - 2C. Implementation of Conjunctive Water Management
  - 2D. Integration of Recycled Water
- Category 3: Groundwater Resource Protection
  - 3A. Well Construction and Destruction Policies
  - 3B. Management and Mitigation of Contaminated Groundwater
  - 3C. Long-Term Salinity Management
  - 3D. Identification and Management of Recharge Areas and Wellhead Protection Areas
- Category 4: Agency Coordination and Public Outreach
  - 4A. Continuation of Local, State, and Federal Agency Relationships
  - 4B. Public Outreach
  - 4C. Water Awareness Education

- Category 5: Plan Implementation and Updates
  - 5A. Plan Implementation and Reporting
  - 5B. Provisions to Update the Groundwater Management Plan

4.1.3.3 Groundwater Basin Characteristics

DWD's existing and future wells are located in a groundwater basin that has been studied since the late 1990s by Luhdorff & Scalmanini Consulting Engineers (LSCE). The last LSCE study of the groundwater basin was the "Investigation of Groundwater Resources in East Contra Costa County" (March 1999). The groundwater basin is not adjudicated and has not been studied by the California Department of Water Resources (DWR) beyond the information provided in Bulletin 118. The groundwater basin is not overdrafted.

The wells are located within the region identified as the Marginal Delta Dunes in the 1999 study. The 1999 study, and subsequent detailed investigations by LSCE, identified a favorable hydrogeologic area for well locations within DWD's service area. When groundwater is withdrawn from an aquifer, groundwater levels are lowered around the well, creating a cone of depression. Additional pumping could increase the amount of drawdown and decrease the productivity of existing wells in the area. Under certain conditions this could result in a lowered water table, which in turn could adversely affect certain shallow wells, trees, and creeks. However, the potential for such impacts from DWD's groundwater supply system has been investigated several times and found to be low, as described below.

In 1999, a regional groundwater investigation was completed for DWD. This investigation determined that there is a hydraulic connection with the alluvial plain to the south, where a significant amount of groundwater pumping already exists for municipal uses (City of Brentwood) and agricultural uses (East Contra Costa Irrigation District). As part of the regional groundwater investigation, test borings and wells were completed to obtain geological and water quality information. LSCE also conducted an investigation of potential impacts on nearby wells in 2002. Approximately 35 wells, including the Knightsen municipal well, private domestic wells, and irrigation wells, were identified within 2,500 feet of the Glen Park Well site. Thirty-four of these wells are shallower than 200 feet.

The deep annular seal of each of the Glen Park Well and Stonecreek Well extends to 200 feet below the ground surface and serves to isolate nearby wells from significant pumping impacts. The results of testing performed by DWD to date indicates that the operation of the Glen Park Well since 2006 has had no measurable or discernable impact on the water levels or water quality in nearby shallow wells. In March/April 2007, DWD drilled a test hole and monitoring well at the Stonecreek site to assess hydrogeologic conditions and suitability for siting of a production well. The results indicated the site to be similar with regards to consistency in samples and geophysical logs as compared to the Glen Park site; as a result, it is anticipated that the maximum pumping capacity from the Stonecreek Well site is approximately two mgd. Evaluation of groundwater levels from a 150-foot deep well approximately 2,000 feet from the Stonecreek Well has shown no discernable impact on water levels since the operation of DWD's well.

Besides demand and blending constraints, other considerations may dictate that pumping be limited to less than the maximum capacity stated above. These other considerations include mutual pumping interference, potential impacts to local wells, and groundwater management considerations as contained in DWD's Groundwater Management Plan. The plan embodies an impact-avoidance strategy based on phased development and ongoing testing and monitoring to ensure that pumping from DWD facilities do not induce adverse impacts on local and regional scales.

As part of the Groundwater Management Plan, DWD will continue to monitor groundwater levels and consult other well operators to monitor effects on other wells in the region. In the event local wells were to be adversely affected (e.g., lowering of groundwater below existing pumps or degradation of water quality), decisions about mitigation actions would be made on a case-by-case basis. Mitigation measures may include, but not be limited to, supplying the property with a different source of water, lowering or replacing pumps, or installing new wells.

4.1.3.4 Sustainable Groundwater Management Act Activities

In response to the Sustainable Groundwater Management Act of 2014 (SGMA), DWD serves as a groundwater sustainability agency (GSA) to assess the conditions in the local basin and adopt a locally-based sustainability management plan. A GSA is able to require registration of groundwater wells, measure and manage groundwater extraction, require reports from groundwater users, and assess fees to support the creation of a GSP.

The San Joaquin Valley-East Contra Costa Subbasin (5-022.19) has been designated by DWR as a medium-priority basin. As such, the GSA must adopt a GSP by January 31, 2022. The GSP must include a physical description of the basin, including groundwater levels, groundwater quality, subsidence, information on groundwater-surface water interaction, data on historical and projected water demands and supplies, monitoring and management provisions, and a description of how the plan will affect other plans, including city and county general plans. All medium priority basins must achieve sustainable management of the basin within 20 years of adopting a GSP.

Eight local agencies that overlay the subbasin entered into a Memorandum of Understanding (MOU) on May 9, 2017 to collaborate and develop a single GSP for the subbasin. With the exception of CCWD, each member agency has become a GSA to be the local agency to manage the subbasin within their respective service area. In addition to DWD, the member agencies of the East Contra Costa Subbasin MOU include the cities of Antioch and Brentwood, Byron Bethany Irrigation District, Contra Costa County, CCWD, Town of Discovery Bay, and East Contra Costa Irrigation District.

4.2 Corporation Yard

After the Randall-Bold WTP became fully operational, DWD's original surface water treatment plant (established in 1955) was retired from service. The former treatment plant site, located in the vicinity of Rose Avenue and Main Street near the Contra Costa Canal Pumping Plant No. 1, is now used as DWD's corporation yard (Corp Yard) for operations and maintenance activities. These activities include: an office for the Manager of Water Operations and Construction and Maintenance Manager; general storage area; Supervisory Control and Data Acquisition (SCADA) and backflow information room; storage room for repair clamps and other miscellaneous items; and kitchen and break room.

Corp Yard Well 01 is an inactive emergency standby well at the site. This well is no longer used for normal supply due to its poor water quality. The well is 12 inches in diameter and has a capacity of 1,000 gallons per minute (gpm).

The Corp Yard Pump Station and Reservoir R-1 (2.5 MG) are also located at the site, as described in Section 4.3.

4.3 DWD Distribution System

Figure 4-5 shows the current distribution system consisting of a pipeline network, distribution pumping facilities, and distribution storage facilities. Section 6 describes the treated water storage facilities.

The distribution system has only one pressure zone as the area is relatively flat. Treated water from the Randall-Bold WTP clearwell is pumped into DWD's distribution system from the high lift pumps as shown on Table 4-1.

Distribution storage is provided by Reservoirs R-1, R-2, and R-3. Reservoirs R-2 and R-3 (5 MG capacity each) are located in the hills west of Oakley and supply the distribution pipeline network by gravity. Reservoir R-1 supplies the distribution pipeline network via the Corp Yard Pump Station. Table 4-2 summarizes the key features of the Corp Yard Pump Station and Reservoir R-1. The station has a diesel standby generator for emergency power, three electric motor-driven pumps, and one gas/propane-powered pump.

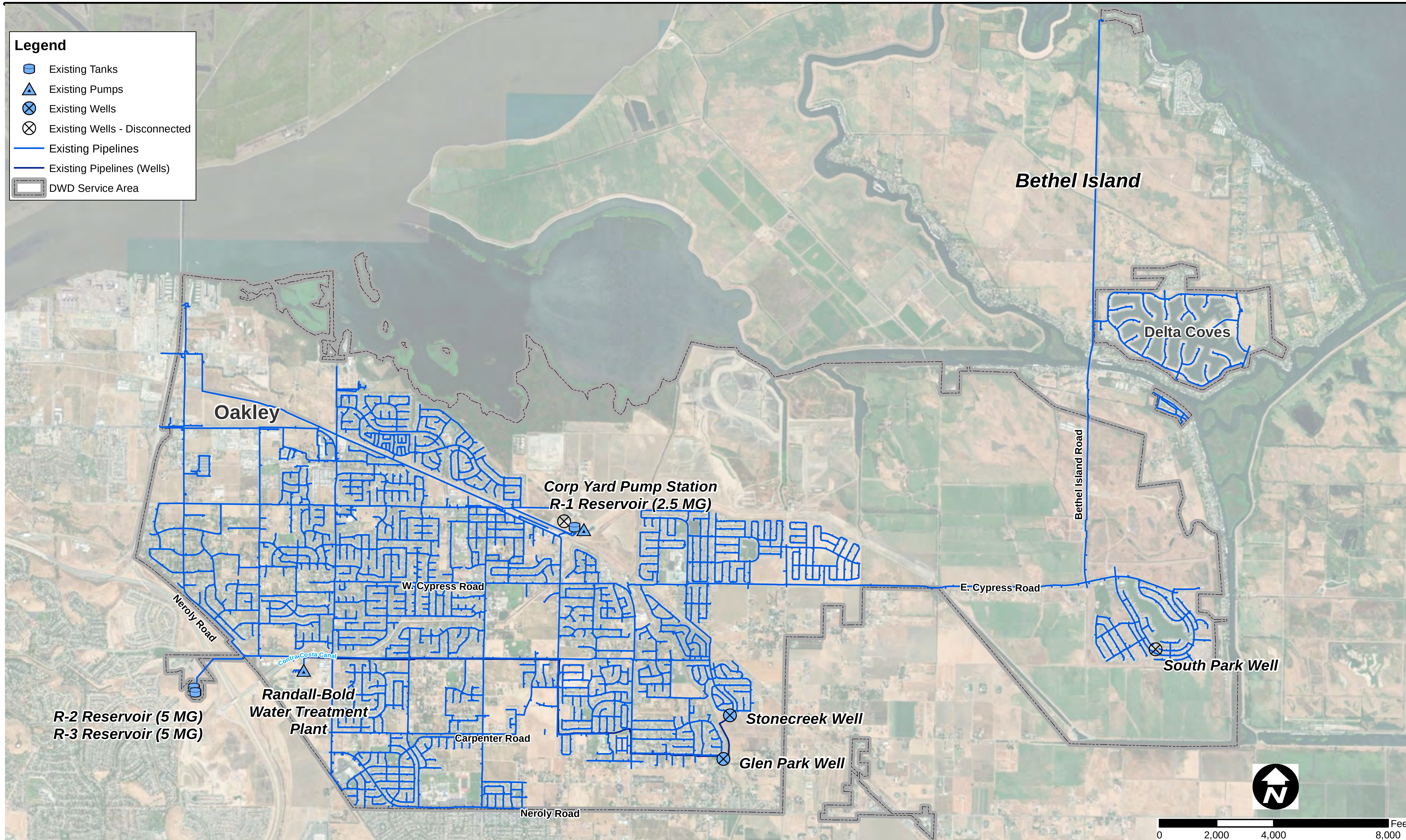
Table 4-2. Corp Yard Pump Station and Reservoir R-1

Component	Description	Capacity
Reservoir R-1 (Treated Water Reservoir) [1]	102-foot diameter steel tank	2.5 MG
Distribution Pump Station (Corp Yard Pump Station) Pump No. 1 Pump No. 2 Pump No. 3 Pump No. 4	Electric motor (variable frequency drive), vertical centrifugal, 200 HP, 200 feet total dynamic head (typically operated to maintain discharge pressure of 72 to 74 pounds per square inch) 75 HP	Pump 1, Pump 2, Pump 3 (2,780 gpm each) Pump 4 (1,600 gpm)
Meter	Annubar	14.4 mgd [2]
Standby Generator	Diesel	125 kilowatts

[1] Anodes were installed at Reservoir R-1 in 1998 to extend the life of the interior coating.
[2] Maximum meter capacity.

The distribution pipeline network consists of a primary grid of 10- to 24-inch mains in major streets, and a secondary feeder system of 6- and 8-inch mains in minor streets and subdivisions. The pipeline grid is fed by 24- and 30-inch mains from the Randall-Bold WTP, and a 24-inch main from Reservoirs R-2 and R-3.

Figure 4-6 presents distribution system pressures under current conditions (2018) for peak hour flows on the maximum demand day. These pressures would typically be the minimum pressures in the system under existing conditions.



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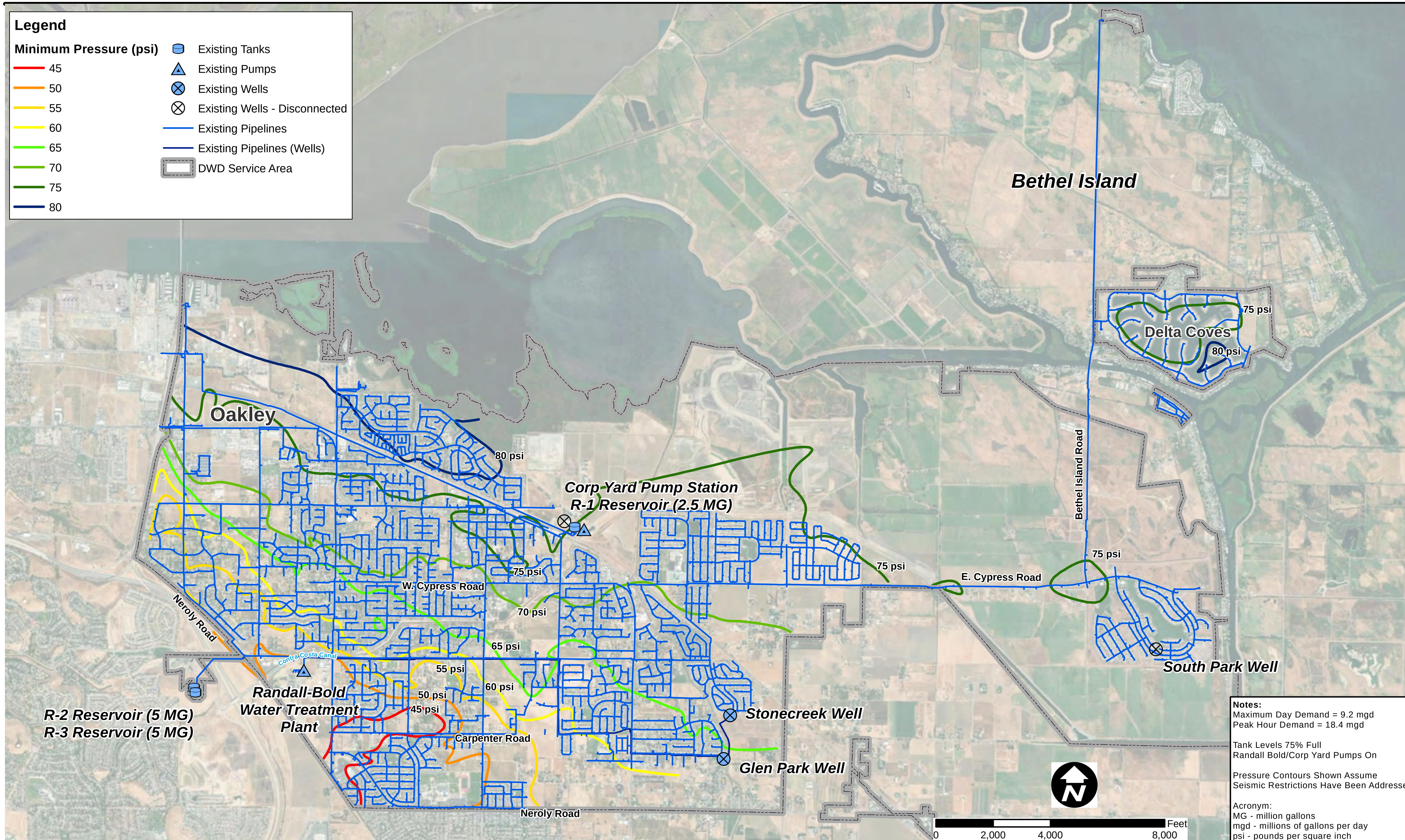
CDM Smith

Figure 4-5
Diablo Water District
Existing Water Distribution Facilities



Date: 5/8/2020 File: C:\Users\tordellart\Desktop\DWD Figures\Figure 4-6 Max Demand Min Pressure.mxd

Figure 4-6
Diablo Water District
Existing Water Distribution Facilities
Maximum Day Peak Hour Demand Conditions (Minimum Pressures)

CDM Smith

Figure 4-7 presents the anticipated maximum system pressures under current conditions (2018) for minimum hour flows during a winter day. Maximum system pressures generally occur during low demand periods when the Randall-Bold WTP pumps are operating. In general, areas with ground elevations lower than 20 feet require individual pressure reducing valves (PRVs) on services to prevent maximum pressures from exceeding 80 psi at the customer taps.

Most of the distribution system is a looped grid, which conveys water to any location from more than one direction. This is highly desirable for system reliability and economy. It allows a main to be shut down within the system for maintenance while adjacent mains convey flow to an otherwise “out-of-service” area. With a looped system, fire flows can reach a location through several routes instead of one, which allows for smaller mains in the system than if the system were not looped.

All 24- and 30-inch mains are steel, ductile iron, or concrete cylinder pipe; and all 16-, 18-, and 20-inch mains are ductile iron. The 12-inch mains are generally polyvinyl chloride (PVC) except for the main in Bridgehead Road north of Highway 4, which is ductile iron. Most 10-inch mains are cement-lined and tar-wrapped steel pipe and were installed in 1955-1956; some 10- inch mains are asbestos cement (AC). Six- and eight-inch mains are either AC (older mains) or PVC (all newer mains).

All water services, except those for firefighting, are metered. Backflow preventers are installed for homes with fire sprinklers to prevent contamination of DWD mains wherever a potential exists for cross-contamination.

Fire hydrant locations and spacing in all new developments are approved by the East Contra Costa Fire Protection District. Section 7, Fire Protection, discusses fire protection and hydrant requirements.

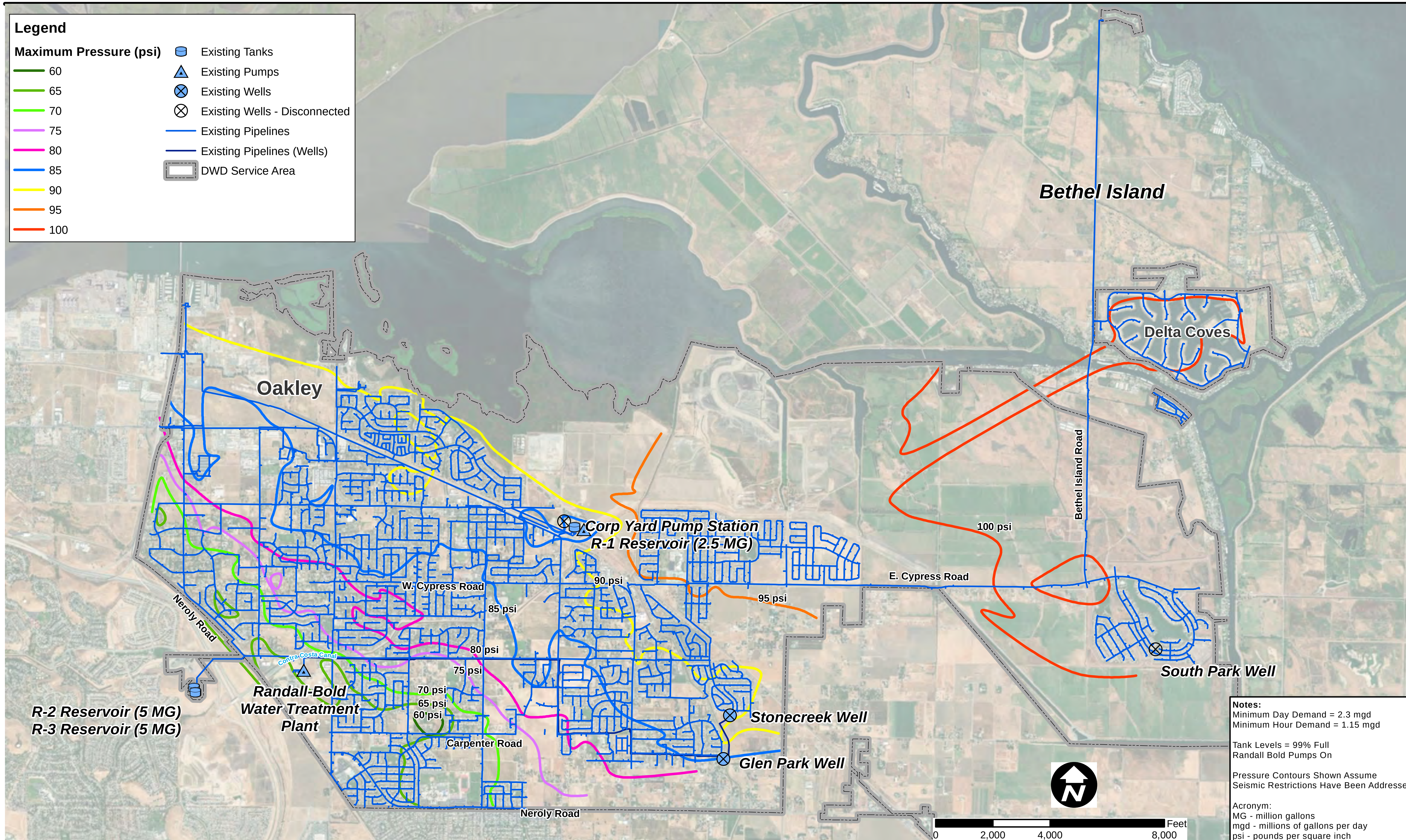
4.4 Interties

DWD has three interties with the City of Antioch at the western boundary of the DWD system. These interties provide a back-up emergency supply to DWD. The interties are located on DWD’s western boundary at Highway 160 and its intersections with Highway 4, Wilbur Avenue, and the Antioch Bridge, with capacities of 1,000 gpm, 3,000 gpm, and 1,000 gpm, respectively. DWD also has an agreement to provide Antioch with available water to help meet Antioch’s peaking needs in the east part of their system.

4.5 Other Water Systems within DWD’s Planning Area

There are over 30 small water systems serving small areas in the eastern part of DWD’s planning area. These water systems are permitted by Contra Costa County to provide water to the residents in Knightsen, Hotchkiss Tract (located in the East Cypress Specific Plan Area), and Bethel Island.

A majority of these small systems are all supplied by groundwater wells. Contra Costa County Environmental Health is responsible for compliance monitoring of these systems until the water supplier reaches 200 connections, at which point the responsibility shifts to the State.



Date: 5/8/2020 File: C:\Users\tordellart\Desktop\DWD Figures\Figure 4-7 Min Demand Max Pressure.mxd

CDM Smith

Figure 4-7

Diablo Water District

Existing Water Distribution Facilities

Minimum Day Minimum Hour Demand Conditions (Maximum Pressures)

Figure 4-8 shows the approximate locations of existing water wells in the Hotchkiss Tract and Bethel Island, which range in depth from 150 to 350 feet. Withdrawal rates are unknown because the systems are not equipped with meters. A past study (Bethel Island Specific Plan, July 1990) indicated that three major wells in the area operated by Contra Costa County Sanitary District 15 had discharge rates from 200 to 250 gpm each.

The equipment and distribution piping for the various small water systems typically consist of a pump, hydropneumatic tank, and small diameter piping. The systems use a mix of materials and are generally built without the benefit of uniform construction standards. Several systems have a small amount of storage. Many systems are not chlorinated because they do not have bacteriological contamination. Slough water is used for firefighting.

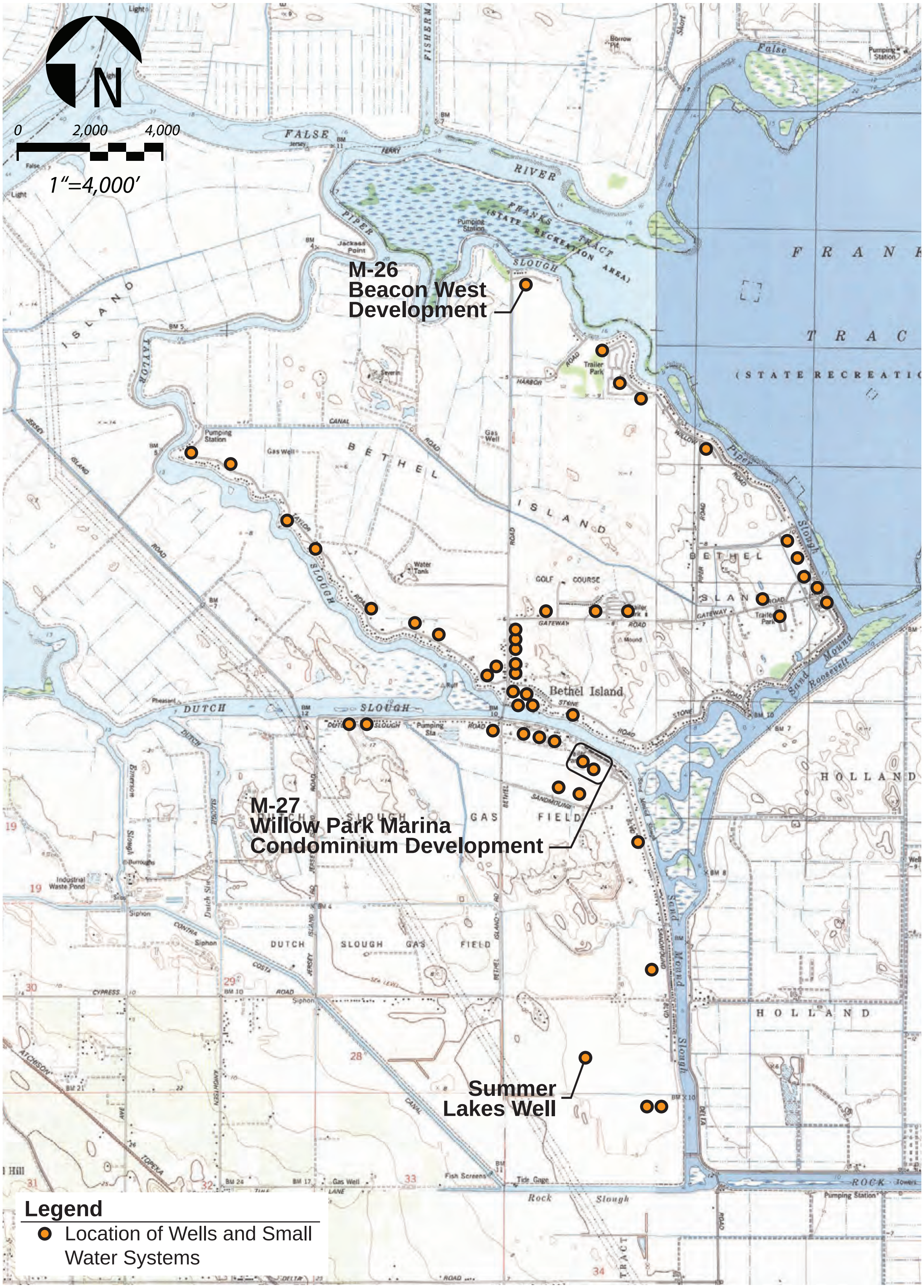
DWD operates and maintains several of the small water systems. DWD's services for operation and maintenance include laboratory testing to meet the requirements of the California Department of Public Health and the County Environmental Health Department. DWD has purchased the following small water systems, which it had been operating and maintaining for Contra Costa County since 1993:

- Knightsen (M-25) system consisting of a single well, with chlorination, that supplies about 21 homes or small businesses.
- Beacon West (M-26) system on Bethel Island consisting of a single well, chlorinated, that supplies about 20 residences. While this well is still owned by DWD, it is not currently being operated because DWD installed a six-inch pipeline from the southern end of Bethel Island to serve this area. The surge/storage tank at M-26 has been removed, but the pump remains.
- Willow Park Marina (M-27) system on Hotchkiss Tract consisting of 2 chlorinated wells operated alternately supplying about 80 condo units and a club house.

DWD also owns a well for emergency (standby) potable supply for the Summer Lakes development at the east end of Cypress Road. The well will primarily be used by the homeowners' association for irrigation and lake makeup water, and would only be used by the District under certain circumstances.

Some existing water systems in the area should be replaced by improved systems when feasible, due to development needs or other considerations. Though the water withdrawn from most wells meets primary drinking water standards, it exceeds secondary standards for TDS unless reverse osmosis treatment is provided. Groundwater quality in the area is generally considered marginal and can be high in iron, manganese, and other constituents in some locations.

If DWD treated water service becomes available to these areas, it is assumed that the existing small water systems would be abandoned and replaced by a system meeting DWD standards. Existing wells, and possibly new wells, might be used to supplement DWD's surface water supply from CCWD and/or provide emergency storage capacity.



Note: The labeled wells and small water systems are owned and/or operated by DWD.

Figure 4-8
Location of Existing Water Wells and Systems
Serving Bethel Island and Hotchikiss Tract

4.6 Future Opportunities

Ironhouse Sanitary District (ISD) owns and operates the wastewater treatment and collection systems in DWD's service area. ISD's service area encompasses all of DWD's service area, along with Bethel Island, Jersey Island, and part of Holland Tract. In 2015, ISD's average daily wastewater flow was 2.3 mgd and the maximum daily flow was 3.8 mgd.

In 2011, ISD completed construction of its Water Recycling Facility, producing tertiary-treated recycled water using membrane bioreactor basins and ultraviolet disinfection. This process treats the water to California Title 22 unrestricted reuse requirements. The facility has an average operating capacity of 4.3 mgd with future expansion capacity up to 6.8 mgd. The recycled water is land-applied on agricultural land owned by ISD on Jersey Island, distributed through residential fill stations, or conveyed to an outfall pipe in the San Joaquin River.

DWD and ISD are jointly conducting a Recycled Water Feasibility Study to explore and analyze potential recycled water projects in their service areas. The study will identify the potential recycled water market (e.g., potential users, quantities, and required quality and reliability needs) and develop water recycling alternatives, including a cost/benefit analysis, energy analysis, water quality and groundwater impacts, and development of a recommended project, operations plan, and recycled water fees. This study is partially funded by a grant from the State Water Resources Control Board, and it is expected to be complete in summer 2020.

Section 5

Water Demand

This section presents historical water use and customers within the DWD service area, identifies unit water demand and peaking factors, and provides water demand projections through ultimate buildout of the study area.

5.1 Historical and Projected Customer Connections

Table 5-1 presents the annual customer connections (meters) served by DWD since the 2006 Facilities Plan. In 2019, about 96 percent of DWD's customers were residential. The remaining were primarily commercial/institutional and landscape irrigation. There is a limited amount of heavy industrial development in the area. DWD does not provide any water for agricultural uses.

Table 5-1. Historical Customer Connections

Year	Residential		Commercial & Institutional	Industrial	Landscape Irrigation	Other/ Construction	Unmetered Commercial/ Industrial	Total
	Single Family	Multi-Family						
2005	8,349	41	108	1	87	0	2	8,588
2006	9,663	41	115	1	92	0	2	9,914
2007	9,646	41	116	1	103	0	2	9,909
2008	9,677	41	116	2	108	0	2	9,946
2009	10,169	15	128	2	125	0	2	10,441
2010	10,028	15	142	1	139	91	2	10,418
2011	10,183	16	137	1	136	0	1	10,474
2012	10,348	17	150	1	137	0	1	10,654
2013	10,579	20	134	1	137	72	0	10,943
2014	10,582	20	157	2	151	64	0	10,976
2015	10,740	20	152	2	149	86	0	11,149
2016	11,048	20	163	1	155	66	0	11,453
2017	11,466	20	167	1	157	103	0	11,914
2018	11,578	20	167	1	163	101	0	12,030
2019	11,702	21	156	1	174	114	0	12,168

Between 2005 and 2019, the total number of connections increased about 42 percent, which is an average annual growth rate of about 3 percent per year over the entire period. This 14-year period covers years of mostly low to moderate growth (9 years with less than 2 percent growth, 4 years of 2.5 to 5 percent growth) and 1 year of 15 percent growth.

As of August 2019, DWD had a total of 12,054 metered water services (not counting fire services). A breakdown of the meter sizes is shown in Table 5-2. The smaller diameter meters (1.5 inches and smaller) are primarily residential.

Table 5-2. 2019 Customer Meter Size

Meter Size (inches)	Number of Services as of August 2019 [1]
5/8	9,977
1	139
1 with backflow	1,796
2	57
3	67
4	13
6	4
8	-
10	1
12	-
Total	12,054

[1] Does not include fire service

Table 5-3 presents estimates for the future number of customer connections through 2040, which is the assumed buildout timeframe for the DWD service area. Buildout connections were estimated based on the calculated number of residential units and estimates of number of non-residential connections per acre from available information.

Linear interpolation was used to determine the usage at 5-year intervals between 2019 and buildout, which assumes an average growth rate over the entire planning period. The actual growth in connections over time will depend on economic and development cycles. The eastern Contra Costa County area has experienced alternating periods of slow growth and high growth since the 1980s.

Table 5-3. Projected Customer Connections

Year	Residential		Commercial, Business Park, Industrial, and Institutional	Parks and Landscape Irrigation	Other	Total
	Single Family	Multi-Family				
2019	11,702	21	156	174	114	12,168
2020	11,960	50	200	180	120	12,510
2025	13,240	190	430	210	130	14,200
2030	14,510	320	660	240	130	15,860
2035	15,790	460	890	270	140	17,550
2040	17,070	600	1,120	300	150	19,240

Notes regarding Buildout Connection Estimates:
Single family connections equal estimated buildout number of single family units.
Multi-family connections are based on the estimated number of multi-family unit, assuming 8 units per connection (average density for multi-family is 8 units per acre).
Non-residential connections assume 1 connection per approximately 2 acres, which is similar to the current density for areas served.
Growth in landscape irrigation connections is assumed to remain at the average for the past 5 years, about 3% per year.

5.2 Historical Water Use by DWD Customers

Information on existing demands is available only for customers historically served by DWD's existing system. Other residents in areas within DWD's sphere of influence are currently served by private or small mutual well systems. These areas include Knightsen and Hotchkiss Tract. Little or no information exists on the existing demands in those areas. For development of future demand projections for these areas, it is assumed that the peaking factors and demand patterns for these areas will be the same as for the area currently served by DWD's existing system.

Table 5-4 presents historical water demands consisting of water use by customers and non-revenue water. Non-revenue water refers to system losses between production and consumption. These losses might occur from metering, leaks, main breaks, fire flows, and other types of unmetered water use. Typically, non-revenue water for utilities ranges from approximately 5 to 10 percent. Between 2005 and 2019, non-revenue water in the DWD system averaged about 7 percent of total water use.

Table 5-4. Historical Water Demand

Year	Customer Use (MG)	Non-Revenue Water (MG)	Total Demand (MG)
2005	1,643	118	1,761
2006	1,633	122	1,755
2007	1,858	85	1,943
2008	1,914	79	1,993
2009	1,616	199	1,815
2010	1,756	60	1,816
2011	1,637	124	1,762
2012	1,812	130	1,942
2013	1,898	146	2,044
2014	1,812	22	1,834
2015	1,429	63	1,492
2016	1,447	79	1,526
2017	1,496	225	1,721
2018	1,646	211	1,856
2019	1,638	152	1,790

Residential use comprises the largest category of water use within the District. In 2019, about 85 percent of the total customer usage was residential. This has gone down from the peak of 99 percent seen in 2009.

Currently, there are no large industrial customers. In the 1990s and early 2000s, DWD had a large industrial customer, E. I. DuPont, whose Oakley facility started operating in 1961. In early 1997, DuPont made major cutbacks at this facility, and their industrial water usage essentially ended. While operating, the DuPont demand reached a high of 2.2 mgd in 1972-1973, and a low of 0.8 mgd in 1995-1996. The DuPont industrial demand was a relatively constant (baseload) demand, which did not vary significantly on a daily or a seasonal basis. There is a new industrial development proposed for this site, the Oakley Logistics Center. The estimated average day demand for this facility is 5,700 gallons per day (gpd) (4 gpm). Additional average day demand of 50 gpm was added to conservatively account for future expansion.

5.3 Unit Demand Factors

The unit demand factors shown in Table 5-5 were used to develop the demand projections. Customer billing data from 2017 was applied in the hydraulic model and coded by customer type. This was compared to known land use to calculate use factors by acre by land use type. A scaling factor was applied to account for system losses (losses in the system from the point of water production to water delivered to the customer's service). Single family residential water demands are based on water use per dwelling unit, and multiple family residential and non-residential demands are based on water use per acre. These unit demand factors represent average daily demands.

Table 5-5. Average Day Unit Demand Factors

Customer Category	Unit	Unit Demand Factor
Single Family Residential	gpd/du	360
Multiple Family Residential	gpd/ac	2,650
Commercial, Business Park, Industrial	gpd/ac	1,360
Institutional (Schools, Public Service)	gpd/ac	1,430
Irrigated Parks & Landscape	gpd/ac	1,430

These water use factors are lower than what was developed in the 1998 Facilities Plan and used again in the 2006 Facilities Plan. Since the last plan, California has been through several drought cycles and water use rates, and total water use, have dropped substantially. Due to water conservation regulations and mandates from the State Water Resources Control Board, water use rates are not anticipated to increase again to previous levels, so these use factors are considered reasonable.

Single family residential customers comprise the largest customer category. Table 5-6 shows the residential water demand per dwelling unit from 2005 through 2019, which includes unaccounted-for water. Residential demand per dwelling unit reached a maximum of 539 gpd/du in 2005 prior to the first drought in this period. Starting in 2009, unit residential demands has had an overall decrease through 2019. The minimum single family unit demand occurred in 2015 after the most conservative water use restrictions were enacted. For planning purposes, demand of 360 gpd/du was used for single family residences. This is approximately the average unit usage over last eight years from 2012 through 2019, covering the period of overall decline with some small rebounds in the unit demand since the last droughts.

Table 5-6. Historical Single Family Residential Unit Water Demand

Year	Average Day Unit Demand (gpd/du)
2005	539
2006	472
2007	535
2008	537
2009	483
2010	410
2011	397
2012	436
2013	442
2014	370
2015	295
2016	306
2017	339
2018	360
2019	342
Average last 5 years (2015-2019)	328
Average last 10 years (2010-2019)	370
Maximum over last 10 years	442
Average 2005-2019 (entire period)	417
Maximum over entire period (2005)	539

5.4 Peaking Factors and Diurnal Curve

Water system facilities are generally sized for peak demand periods. The peaking conditions of most concern for water facility sizing are maximum day demand and peak hour demand. Average day demand refers to the average daily usage of water over a year. Maximum day demand is the maximum water usage for a 24-hour period during a year, which generally occurs during the maximum month of usage in the summer. Peak hour demand is the peak flow during an hourly period on the day of maximum demand.

Table 5-7 presents the historical average day and maximum day demands from 2005 through 2019. These demands include non-revenue water. In the DWD system, the maximum day typically occurs during the summer months from June to September.

Table 5-7 and Figure 5-1 show the maximum day peaking factor for DWD's water system as a whole over the period from 2005 to 2019. This maximum day peaking factor relates maximum day demand to the average day demand supplied by DWD. For planning purposes, a maximum day demand factor of 2.0 times the average day demand was selected for this plan, which is the average value over the last 10 years and reflects a variety of weather conditions that affect seasonal and annual water use.

Table 5-7. Historical Demands Supplied by DWD [1]

Year	Average Day Demand (mgd)	Maximum Day Demand (mgd)	Maximum Day Peaking Factor
2005	4.8	10.5	2.2
2006	4.9	9.3	1.9
2007	5.7	10.9	1.9
2008	5.7	9.0	1.6
2009	5.1	10.7	2.1
2010	5.1	9.1	1.8
2011	5.1	9.0	1.8
2012	5.3	10.5	2.0
2013	5.5	9.4	1.7
2014	4.8	9.0	1.9
2015	4.0	9.2	2.3
2016	4.0	8.4	2.1
2017	4.6	9.8	2.1
2018	5.0	9.4	1.9
2019	4.9	10.0	2.0
Average over last 5 years (2015-2019)			2.1
Average over last 10 years (2010-2019)			2.0
Average over last 15 years (2005-2019)			1.9

[1] These demands are for DWD customers only, and do not include any water wheeled through the DWD system to other agencies (e.g., Brentwood).

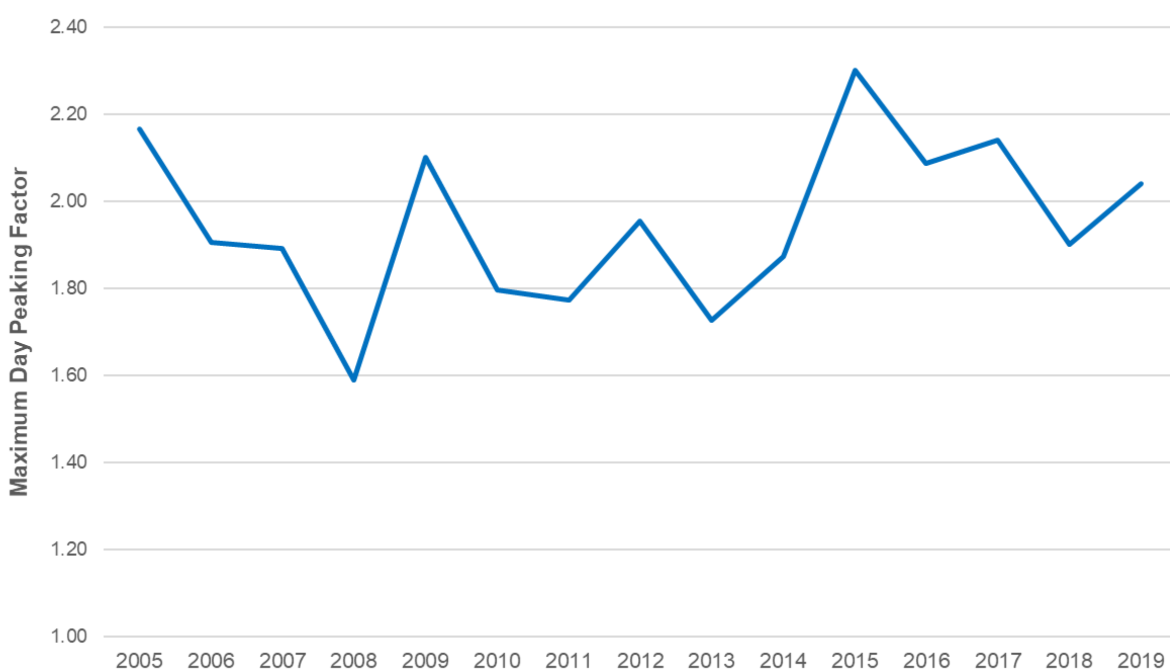


Figure 5-1
Maximum Day Peaking Factor

Figure 5-2 presents the diurnal curve developed for DWD's water system based on historical hourly data from the SCADA system. The diurnal curve shows the variation in demand over a 24-hour maximum demand period in 2017 (July 7, 2017). The highest demand hour on the diurnal curve for maximum day is the peak hour factor for planning purposes.

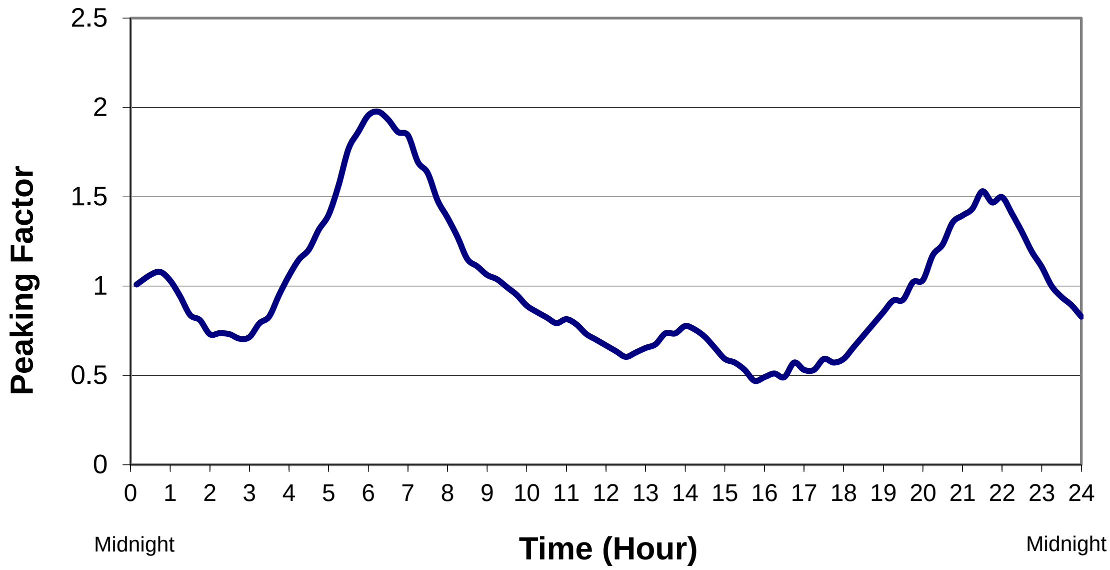


Figure 5-2
Maximum Day Diurnal Curve

The peak hour factor on the maximum day, as indicated on Figure 5-2 is 2.0, which means that the peak hour demand is 2.0 times the maximum day demand. The maximum day demand is 2.0 times the average day demand. Therefore, the peak hour (highest) system demand on the maximum day is estimated at 4.0 times the average day demand for planning purposes.

Monthly factors are also of interest in water system planning, since the level of water use may vary significantly over the course of a year. Figure 5-3 presents the monthly factors for the system as a whole. These monthly factors relate the monthly average flow to the annual average daily flow, and on based on 10 years of historical data from 2010 through 2019. The monthly factor ranges from 0.6 times the average day demand in the winter to 1.45 times the average day demand in the summer.

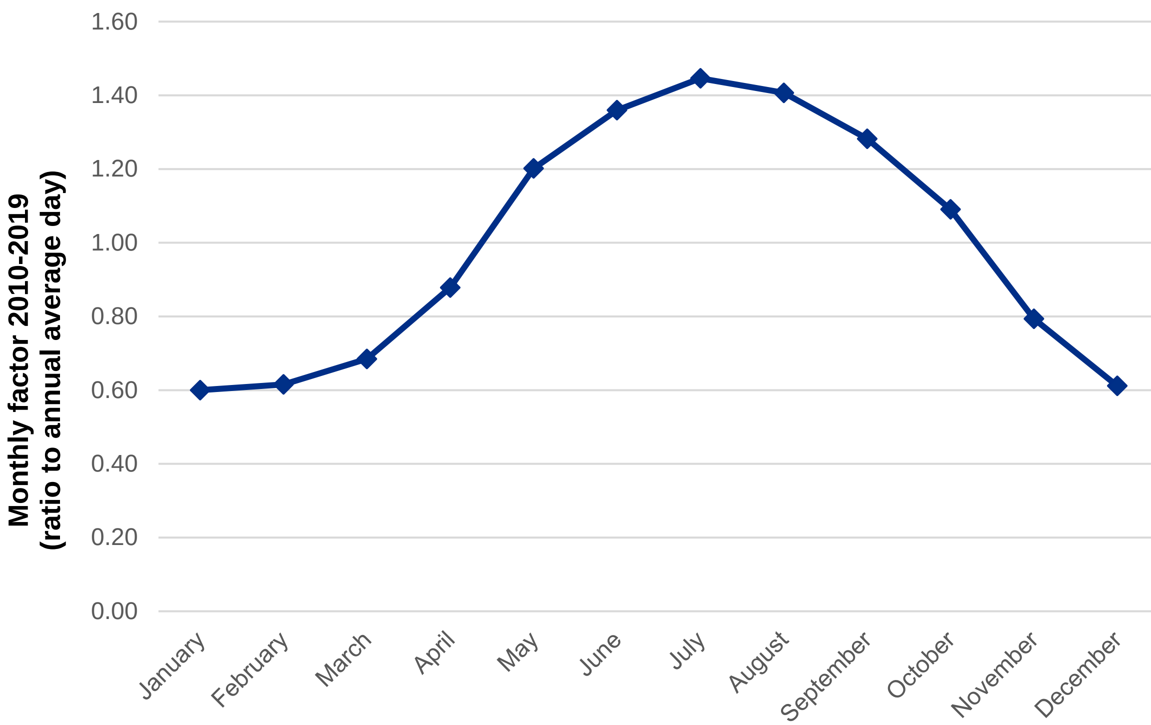


Figure 5-3
Monthly Factors

5.5 Water Demand Projections

Table 5-8 presents annual water demand projections in 5-year increments from 2019 through buildout at 2040. Buildout water demand was estimated and then linear interpolation used to determine the usage at 5-year intervals. The breakdown of 2019 usage by customer sector was estimated from available information. At buildout, residential usage will comprise about 75 percent of the total use; and non-residential uses about 25 percent.

Table 5-8. Projected Water Demand

Year	Customer Sector (MG per year)					Total Demand (MG)	Average Day Demand (mgd)
	Residential		*Commercial, Business Park, & Light Industrial*	*Institutional (Public & Schools)*	*Parks and Landscape Irrigation*		
	Single Family	Multi-Family					
2019	1,460	55	67	45	162	1,790	4.9
2020	1,525	80	95	55	165	1,920	5.3
2025	1,855	510	235	110	170	2,580	7.1
2030	2,190	340	380	170	180	3,260	9.0
2035	2,520	470	520	225	185	3,920	10.7
2040	2,850	600	660	280	190	4,580	12.6

Buildout water usage for each customer sector was calculated using buildout land uses from the City of Oakley General Plan, the East Cypress Corridor Specific Plan, and the Contra Costa County General Plan (for Knightsen and Bethel Island), and the unit demand factors for each customer type from Table 5-5.

Agriculture, open space and Delta recreation areas are not irrigated with DWD water. In addition, DWD's policy is to require that large new turf landscape areas use private groundwater wells or non-potable water for irrigation. Landscape irrigation is assumed to increase over existing levels to accommodate small or isolated areas where it is not feasible to provide another source of irrigation water. It is assumed that parks and landscape areas in new development areas, such as the East Cypress Corridor, will irrigate large landscape areas with groundwater, not with DWD water.

Table 5-9 summarizes the ultimate average day and maximum day demands by major area within the DWD ultimate planning area. In the table, all values are average day demands, except for the bottom line that shows the maximum day demand.

Table 5-9. Ultimate Average Day and Maximum Day Demands by Area

		Ultimate Average Day Demands (mgd)				
Item	Average Day Unit Demand	West of Jersey Island Road (including Knightsen)	East of Jersey Island Road	Subtotal Within DWD SOI	Bethel Island	Grand Total
Single Family Residential Land Uses	360 gpd/du	5.29	1.52	6.81	1.0	7.81
Multiple Family Residential Land Uses	2,650 gpd/ac	0.9	0.51	1.41	0.23	1.64
Commercial, Business Park Industrial Land uses	1,360 gpd/ac	1.45	0.11	1.56	0.25	1.81
Institutional (Public Service, Schools, Community Facilities) [1]	1,430 gpd/ac	0.52	0.25	0.77	0.52	1.29
Total Average Day Demand		**8.16**	**2.39**	**10.55**	**2.0**	**12.55**
		Ultimate Maximum Day Demands (mgd)				
Total Ultimate Maximum Day Demand (at 2 times average day)		16.32	4.78	21.1	4	25.1

[1] Future demands assume that large turf/landscape areas at parks, schools, and other public facilities will be irrigated with groundwater or recycled water. If DWD water is used to irrigate such areas in the future, DWD could specify that large irrigators using DWD water must irrigate in the early morning (e.g., between midnight and 4 a.m.) to avoid increasing summer peak demands.

Section 6

Treated Water Storage

Section 6 describes DWD's existing storage facilities, the criteria established for determining the required storage volume, the existing and ultimate storage requirements based on the established criteria, and the anticipated sequencing of required additional storage capacity.

6.1 Existing Storage Facilities

Table 6-1 summarizes DWD's existing storage facilities, which are shown on Figure 6-1.

Table 6-1. Existing Storage Facilities [1]

Facility	Description	Location	Volume (MG)
Reservoir R-1	Steel tank; must pump into system from Corp Yard Pump Station (with standby power)	Rose Avenue & Oakley Road (Corp Yard)	2.5
Reservoir R-2	Steel tank; located on hill for gravity flow	Laurel & Neroly Roads	5.0
Reservoir R-3	Steel tank; located on hill for gravity flow	Laurel & Neroly Roads	5.0
Glen Park Well (emergency storage)	2.0 mgd with portable standby power capability	Glen Park, Hill Avenue	2.0 [2] (over 2 days)
Stonecreek Well (emergency storage)	2.0 mgd with portable standby power capability	Future Park, Teton Road	2.0 [2] (over 2 days)
Total Existing Storage Capacity			16.5

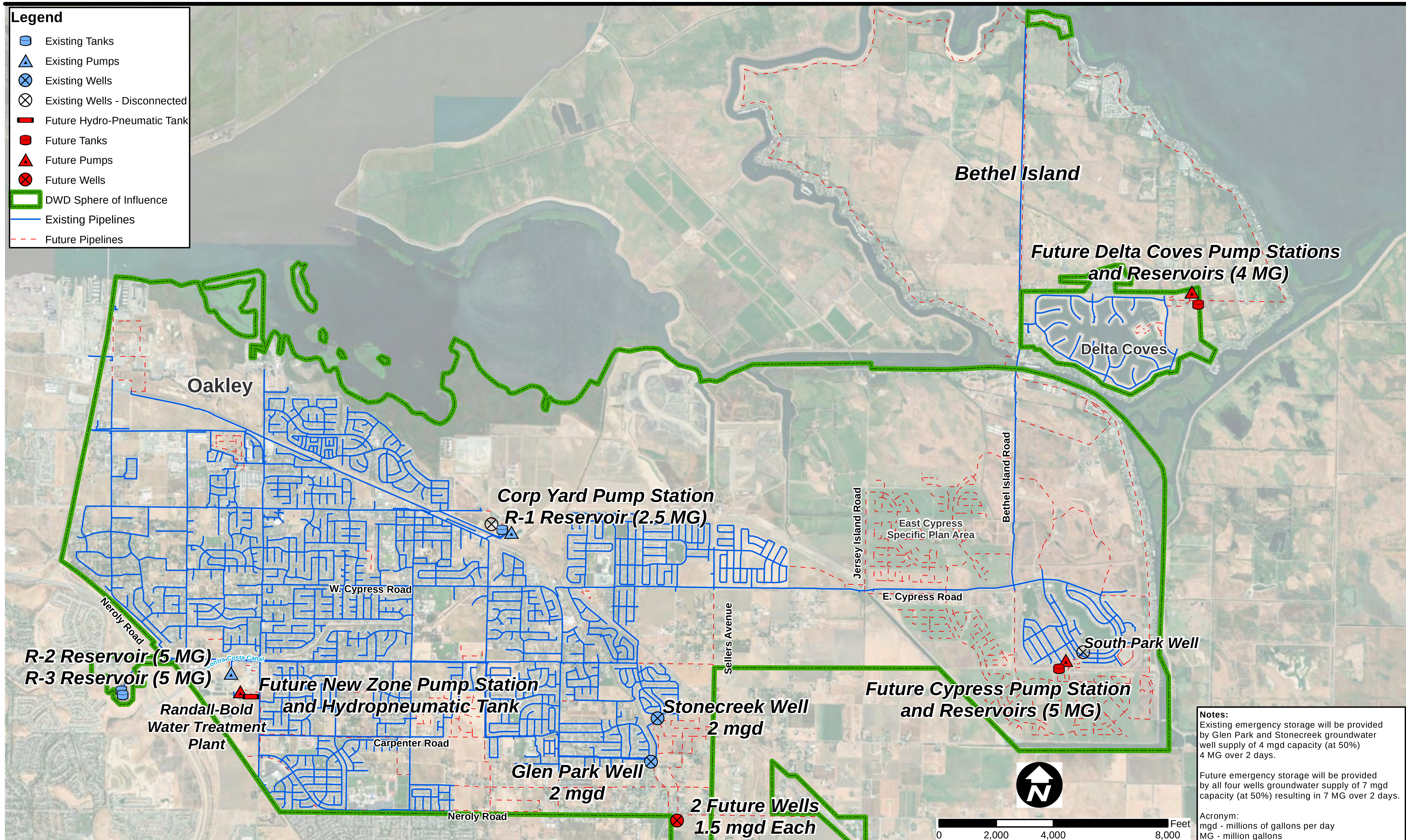
[1] The Randall-Bold WTP clearwell is required for WTP operations and is not part of DWD's distribution storage. The small clearwells (2 @ 0.12 MG each) at the Corp Yard serve as a wet well for the Corp Yard emergency standby well (now inactive) and are not part of DWD's distribution storage.
[2] Well provides emergency storage. Total storage is calculated from flow over a two-day period using 50% capacity.

6.2 Criteria for Storage Volume

DWD's criterion for distribution system storage is to provide total storage equal to two average demand days, which is equivalent to one maximum demand day for the DWD system. This criterion is consistent with the accepted standards of other local agencies and is reasonable for planning purposes.

Distribution storage includes the following components:

- Operational storage (also called equalizing or balancing storage)
- Fire reserve storage
- Emergency storage



Date: 5/11/2020 File: C:\Users\tordellart\Desktop\DWD Figures\Figure 6-1 Exist_Future Storage.mxd

CDM Smith

Figure 6-1
Diablo Water District
Existing and Future Storage Facilities

Operational (equalization) storage is the volume of water required to moderate daily fluctuations in demand and meet peak hour demands. Providing operational storage allows treatment plants and pumps to operate at a relatively constant rate throughout the day. With operational storage to meet peak hour needs, treatment plants and pump stations are generally designed for the average flow on the maximum demand day.

The required volume of operational storage is determined by the variation in the hourly demands during the maximum demand day. Some water must be stored to supply peak flows which exceed the average flow on the maximum demand day. This operational storage is then replenished during off-peak hours when the demand is less than production/pumping rates. Typically, the operational storage requirement ranges from 25 to 50 percent of the maximum day demand.

Fire reserve storage volumes are normally based on guidelines developed by the National Insurance Underwriters Association (i.e., Insurance Services Office [ISO]) for insurance rating purposes. Fire flow requirements are discussed in Section 7. A residential fire flow of 2,000 gpm for 2 hours requires 240,000 gallons of fire storage. A non-residential fire flow of 3,500 gpm for 3 hours requires 630,000 gallons of fire storage. The fire reserve storage should always be available for fire protection to every part of the distribution system. Typically, it is assumed that only one fire will occur at a time within a pressure zone. The fire reserve amount is based on the most critical land use with the highest fire requirement within each zone.

Emergency storage is the volume of water required to supply the service area during planned or unplanned equipment outages, power outages, or short-term loss of raw water supply or treatment plant production. This storage needs to be adequate to provide a reasonable level of uninterrupted service under these circumstances. Emergency storage can be thought of as all available storage less the fire reserve storage. In a non-fire emergency, all the remaining storage (operational and emergency) effectively becomes emergency storage. Emergency use of stored water might occur due to temporary water quality issues with regular supply, electrical power outages affecting regular supply, or equipment or pipeline failures.

6.3 Treated Water Storage Requirements

Table 6-2 summarizes the existing and ultimate storage requirements of the District based on the planning-level water demands developed in Section 5. Table 6-2 also compares the required total storage with the existing storage capacity and identifies the required additional storage capacity.

The storage requirements are presented for the three major planning areas within the DWD system: west of Jersey Island Road; east of Jersey Island Road (East Cypress Specific Plan Area); and Bethel Island. The storage for each major area is based on the demand within each area, in order to equitably distribute the storage throughout the system and provide localized reliability.

Table 6-2. Treated Water Storage Requirements

Area	Average Day Demand		Total Required Storage at Two Times Average Day Demand [2]		Existing Tank Storage (MG)	Groundwater Supply for Emergency Storage [3,4]		Additional Tank Storage Needed by Buildout (MG)
	Existing (mgd)	Ultimate (mgd)	Existing Storage Requirement (MG)	Ultimate Storage Requirement (MG)		Existing Well Storage (MG)	Ultimate Well Storage[5] (MG)	
West of Jersey Island Road [1]	4.3	8.2	8.7	16.3	12.5	4.0	7.0	0.0
East of Jersey Island Road (East Cypress Corridor Specific Plan Area)	0.3	2.4	0.5	4.8	0.0	0.0	0.0	4.8
Bethel Island (total)	0	2.0	0	4.0	0.0	0.0	0.0	4.0
GRAND TOTAL	4.6	12.6	9.2	25.1	12.5	4.0	7.0	8.8

[1] Existing tank storage is all in the West of Jersey Island Road area. It consists of Reservoir R-1 (2.5 MG), Reservoir R-2 (5 MG), and Reservoir R-3 (5 MG).
[2] Total storage includes 0.63 MG fire reserve in each major area based on a potential fire flow of 3,500 gpm for 3 hours. The remainder of the required storage is operational and emergency storage.
[3] Existing groundwater supply for emergency storage assumes 4 mgd well capacity with standby power times 2 days at 50% capacity, or 4 MG total storage.
[4] Wells are better located for emergency storage for the West of Jersey Island area. They cannot be counted as emergency storage for the East Cypress area or Bethel Island, since those areas are too far from the well system and may be isolated from the main system.
[5] Ultimate well storage includes a total of 7 mgd x 50% x 2 days = 7 MG (existing Stonecreek Well at 2.0 mgd and Glen Park Well at 2.0 mgd, and future Well #3 at 1.5 mgd and future Well #4 at 1.5 mgd, all at 50% capacity).

6.4 Ultimate Storage Facilities

DWD's existing storage capacity is 16.5 MG, as shown on Table 6-1. The total ultimate storage capacity for both DWD's SOI and Bethel Island is about 28.5 MG (24.5 MG within the SOI; 4 MG for Bethel Island). Table 6-3 summarizes the anticipated ultimate storage facilities and their ultimate capacities. Figure 6-1 shows the locations of the existing and future facilities.

Table 6-3 also provides an approximate timeframe for implementation of the future storage facilities tied to the level of average day demands. The actual timing for the facilities would be based on the actual rate of development and growth of demands over time.

The design for reservoirs on the east side of the system will have to consider the geotechnical conditions in that area. Major issues include a high liquefaction potential and potential settlement under structures. It is anticipated that a suitable foundation for the new reservoirs can be provided by removal and replacement methods (over-excavating the liquefiable soils and replacing with compacted native material that meets the specifications). It is anticipated that this may have to be done to a depth of 15 to 30 feet below surface depending on the underlying soils at the site. A detailed geotechnical investigation will be required for each reservoir design.

Table 6-3. Ultimate Storage Facilities

Facility	Status	Approximate Timing	Description	Location	Volume (MG)
West of Jersey Island Road (including Knightsen)					
Reservoir R-1	Existing	Existing	Ground-level steel tank; pumps into system via Corp Yard Pump Station	Rose Avenue & Oakley Road	2.5
Reservoir R-2	Existing	Existing	Steel tank located on hill for gravity flow	Off Laurel & Neroly Roads west of Oakley	5.0
Reservoir R-3	Existing	Existing	Steel tank located on hill for gravity flow	Off Laurel & Neroly Roads west of Oakley	5.0
Groundwater Wells for Emergency Storage	Existing	Existing	4 mgd existing capacity, with standby power	Glen Park Well (Hill Avenue) Stonecreek Well (Teton Road & Sierra Trail Road)	4.0 (over 2 days)
	Future	To be determined based on rate of District growth/demand and in consideration of the findings of the GSP.	Total of 3 mgd new well capacity; with standby power. Future well capacities to be determined based on specific sites; anticipated to require 2 wells.	Future well sites to be determined based on future studies.	3.0 (over 2 days)
Subtotal for West of Jersey Island Road (including Knightsen)					*19.5*
East of Jersey Island Road (East Cypress Specific Plan Area)					
Cypress Reservoir 1 and Pump Station:	Future Cypress 1	Must be in place to serve residential units in the East Cypress Specific Plan. Prior to that time, initial units will temporarily use available storage in the west part of the system, as approved by District.	New 2.5 MG tank; pump into system. Initial phase would include all site work, pump station building configured to add future pumps (with construction of 2nd tank), and initial pumps.	Site identified in East Cypress Specific Plan south of the Summer Lake interim levee (at southeast corner of interim levee and future Byron Highway extension). The tanks would be constructed adjacent to each other.	2.5
Cypress Reservoir 2	Future Cypress 2	Needed when average day demand in the area reaches 1.25 mgd.	New 2.5 MG tank; pump into system (add pumps).		2.5
Subtotal for East of Jersey Island Road (East Cypress Specific Plan Area)					*5.0*
Total for DWD SOI					***24.5***
Bethel Island					
Delta Coves Reservoir and Pump Station	Future	Needed for service to Delta Coves development.	Two new 0.5 MG tanks; pump into system. Dual tanks required for reliability due to isolated location relative to DWD supply sources.	Site within Delta Coves development in vicinity of southeast corner of Gateway Road and Piper Road (extension)	*1.0*
Bethel Island Reservoir and Pump Station	Future	Needed for future service to rest of island. Timing and phasing will depend on future development needs and requests for service.	New 3 MG tank (may be phased); pump into system.	Site to be determined in future studies. For this Facilities Plan, assumed to be in the vicinity of the Delta Coves Reservoir.	*3.0*
Subtotal for Bethel Island					*4.0*
Grand Total Ultimate Storage Capacity including Bethel Island					***28.5***

Section 7

Fire Protection

Section 7 identifies the fire protection agency for the DWD service area, the ISO rating for the area, and fire protection standards for the water system.

7.1 Fire Protection Agency

Since 2002, the East Contra Costa Fire Protection District (ECCFPD) has served the DWD SOI and Bethel Island. ECCFPD serves Brentwood, Oakley, and the unincorporated communities of Knightsen, Bethel Island, Byron, Discovery Bay, and Marsh Creek-Morgan Territory.

Prior to 1994/1995, the area was served by the Oakley Fire District and Riverview Fire Protection District, which subsequently merged with the Contra Costa County Fire Protection District. From 1994 to 1999, the Contra Costa County Fire Protection District provided fire service to the area. In 1999, the Oakley Fire District was re-formed as a County-dependent district. In November 2002, fire protection for the entire area was consolidated as the ECCFPD.

7.2 ISO Rating

The ISO evaluates and rates areas for fire insurance purposes. The ISO evaluation considers both water system and fire department considerations, and assigns a Public Protection Classification or Class based on a point system. Class 1 represents the best possible protection and Class 10 indicates the area does not meet ISO's minimum fire suppression criteria. The ISO class can affect the fire insurance costs of residents; those communities with better ratings typically have lower insurance premiums.

In 1977, Oakley received a Class 5 rating. ISO's 1977 grading report made several specific recommendations for improvements to the water system. These recommendations addressed fire flows, fire reserve storage, fire hydrant type and spacing, and fire hydrant maintenance and inspection. In 1992, the ISO upgraded Oakley from a Class 5 to a Class 3 rating due in large part to water system improvements implemented by DWD.

ISO's 1992 grading report contained recommendations for upgrading hydrants in older areas of Oakley. Subsequent to 1992, the former Oakley Fire District completed the hydrant upgrades by adding new hydrants to reduce spacing where needed and replacing hydrants as needed to conform to outlet requirements. Much of this work was done in conjunction with DWD's waterline replacement program, which replaced older undersized pipes in the older downtown area.

In early 1996, ISO re-graded the entire area served by the Contra Costa County Fire Protection District. This re-grading occurred after the County District's merger with the former Oakley Fire District and Riverview Fire Protection Districts. The entire County fire protection service area, including Oakley, received an overall Class 3 rating. The Class 3 rating was due to fire department considerations, not to the water system. The water system portion of the entire fire protection service area received a Class 1 rating.

Based on information currently available from the ECCFPD, the Oakley area is currently considered Class 3 for those portions located within 5 miles of a fire station and within 1,000 feet of a fire hydrant. It is considered Class 8 for those portions located within 5 miles of a fire station, but not within 1,000 feet of a fire hydrant. The Bethel Island area has an overall Class 5 rating.

Assuming compliance with DWD Standard Specifications and Standard Drawings, areas served by the DWD system have fire hydrants spaced more frequently than the 1,000-foot requirement and can meet the fire protection standards described below. As new development occurs and is served by DWD, it would be required to meet the fire protection standards for water service. Fire station locations and related fire department considerations must be accomplished by ECCFPD.

ECCFPD has developed a five-year Strategic Plan to meet the district's five overarching goals:

- Ensure financial stability and sustainability
- Reduce response times for emergency services throughout the district
- Maintain a high-performing work force
- Modernize stations, apparatus, and equipment
- Develop a community risk reduction program

The associated implementation plan identifies projects and funding needs necessary to implement the strategic plan. Without new resources and funding, significant reductions in emergency response times will not be possible. Accountability for the strategic plan will be provided through regular reports to the Board of Directors, with progress updates and strategy adjustments conducted annually.

7.3 Fire Protection Objectives

ECCFPD provides planning and development services including detailed plan review to ensure that properties and buildings are properly constructed in accordance with local and state fire requirements, inspection and code enforcement, and public education.

In 2019, ECCFPD Ordinances adopted the 2019 California Fire Code as the Fire Code of the ECCFPD. Table B105.1(1) in the California Fire Code, shown below, specifies minimum fire flow for one- and two-family dwellings of 1,000 gpm for one hour. With an approved sprinkler system, the required flow is 500 gpm for one half hour.

TABLE B105.1(1)
REQUIRED FIRE FLOW FOR ONE- AND TWO-FAMILY DWELLINGS, GROUP R-3 AND R-4 BUILDINGS AND TOWNHOUSES

FIRE-FLOW CALCULATION AREA (square feet)	AUTOMATIC SPRINKLER SYSTEM (Design Standard)	MINIMUM FIRE FLOW (gallons per minute)	FLOW DURATION (hours)
0–3,600	No automatic sprinkler system	1,000	1
3,601 and greater	No automatic sprinkler system	Value in Table B105.1(2)	Duration in Table B105.1(2) at the required fire-flow rate
0–3,600	Section 903.3.1.3 of the *California Fire Code* or Section 313.3 of the *California Residential Code*	500	$^1/_2$
3,601 and greater	Section 903.3.1.3 of the *California Fire Code* or Section 313.3 of the *California Residential Code*	$^1/_2$ value in Table B105.1(2)	1

For SI: 1 square foot = 0.0929 m^2, 1 gallon per minute = 3.785 L/m.

For other types of buildings, Table B105.1(2) specifies minimum fire flows based on building size and type as defined by the California Building Code. Depending on the building materials, fire rating, and construction type, minimum required flow ranges from 1,500 gpm to over 4,000 gpm, and minimum fire flow duration ranges between 2 hours and 4 hours.

A 20 psi minimum residual pressure at the hydrant is required during fire flows taken from fire hydrants. For functioning of automatic sprinklers, a minimum pressure of 50 psi from the sprinkler is desirable.

ECCFPD, in conjunction with DWD, is responsible for review and approval of fire hydrants. The fire protection district requires that hydrants be installed at the same time that new waterlines are constructed to serve new development. The DWD Standard Specifications and Standard Drawings contain the relevant hydrant spacing and equipment requirements. Typical hydrant spacing requirements are at approximately 500-foot intervals for residential areas, and 300-foot intervals or closer in commercial/industrial areas. Fire hydrants must include one 4.5-inch outlet and two 2.5-inch outlets, with at least a 6-inch diameter pipe from the water main to the hydrant. Though DWD provides input, they defer to ECCFPD on the final placement of any fire hydrants or fire protection improvements.

ECCFPD is responsible for inspecting and maintaining hydrants. In addition, they are also responsible for updating and installing new hydrants where needed in already developed areas.

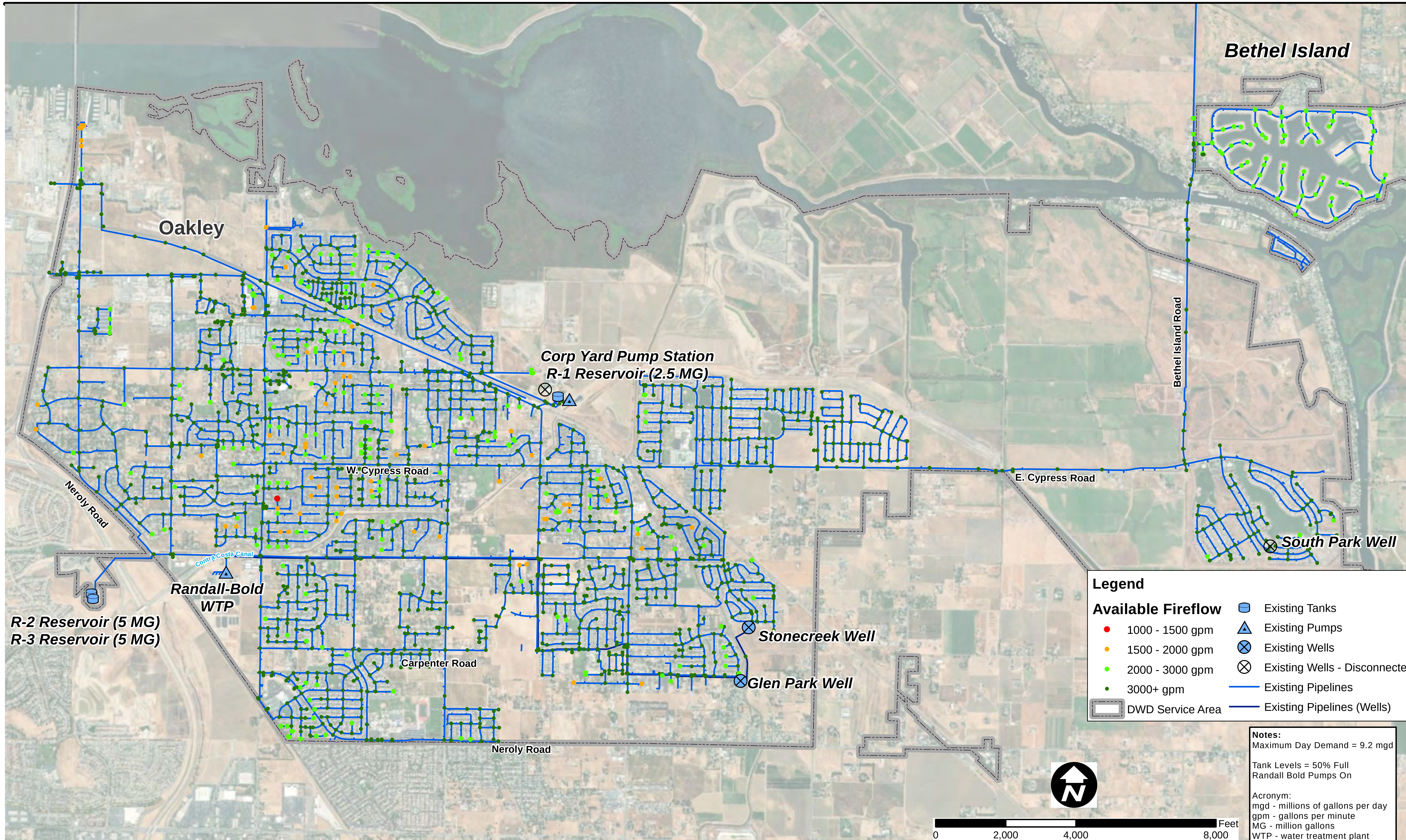
Generally, the hydrant upgrading occurs at the same time that water districts are doing maintenance, repair or replacement of waterlines.

7.4 Available Fire Flow – Existing and Future

CDM Smith performed a hydraulic analysis of the available fire flow at each node in the District's system for both the existing and future buildout scenarios. These scenarios assume the fire occurs on a maximum demand day, with the storage tanks (Reservoirs R-2 and R-3) at half full and applies a system wide low-pressure limit of 20 psi. The values shown assume one fire flow at a time and give the maximum flow at each node such that the pressure at all other nodes does not fall below 20 psi. See Figures 7-1 and 7-2 for existing and future available fire flow information.

As shown in Figure 7-1, the hydraulic model predicts that the available fire flow throughout the existing system exceeds 1,500 gpm at a residual pressure of 20 psi. Lowest available fire flows, which are between 1,500 and 2,000 gpm (orange nodes), tend to be at dead ends, and at residential developments. This exceeds the one- and two-family dwelling requirement of 1,000 gpm.

As shown in Figure 7-2 for future conditions, the hydraulic model predicts that the available fire flow exceeds 1,000 gpm at a residual pressure of 20 psi for most of the system. One model node within the proposed new pressure zone (see Section 8.3.1) has available fire flow below 1,000 gpm. That node is at a dead-end of a 6-inch, 22-foot long pipeline. The node just upstream of the 22-foot pipe has over 1,000 gpm of available fire flow. Thus, there are no fire flow related capacity deficiencies in the buildout system, which will include both the existing pressure zone and the recommended new pressure zone (see discussion in Section 8.3.1).



Date: 5/8/2020 File: C:\Users\tordellart\Desktop\DWD Figures\Figure 7-1 Fireflow Existing.mxd

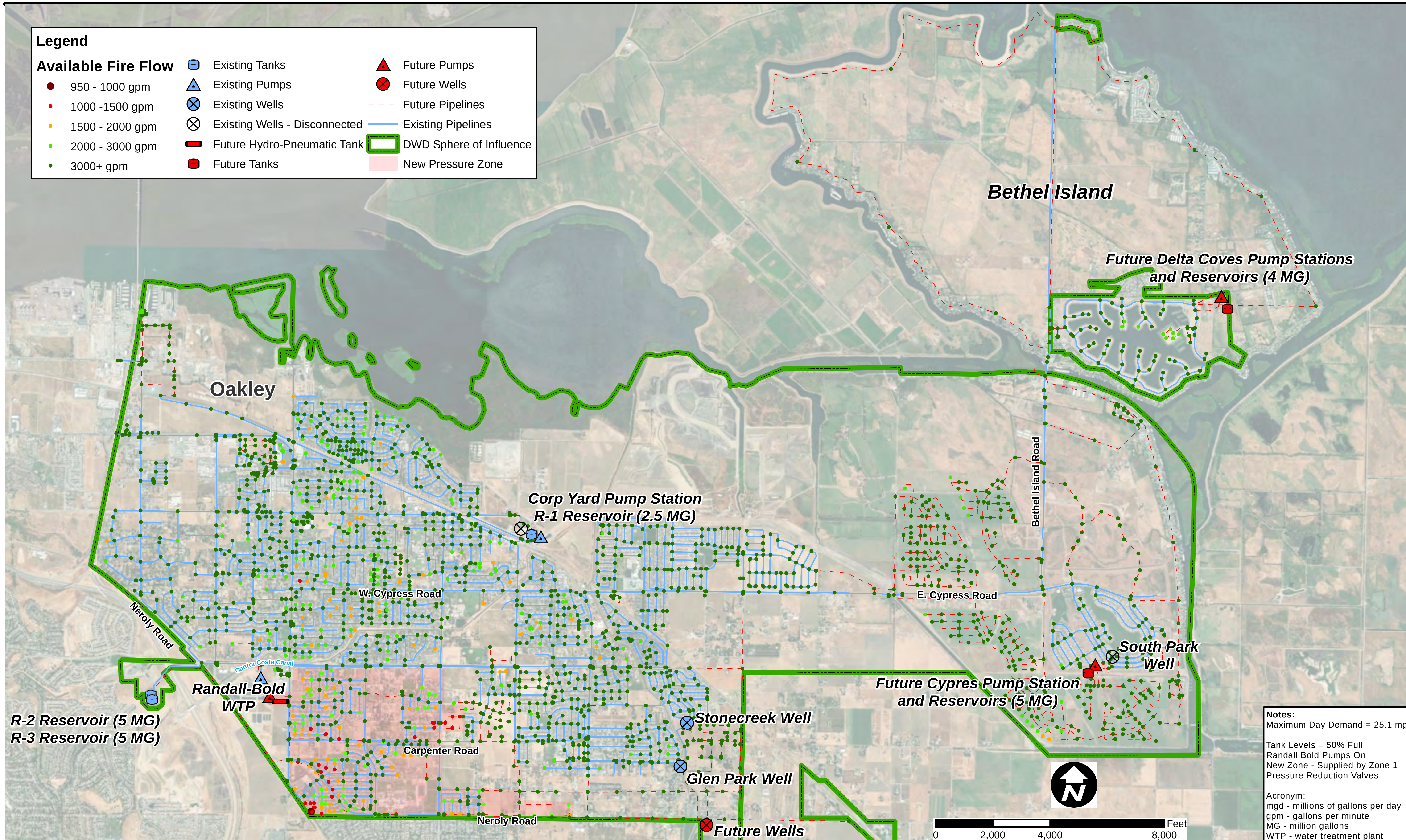
CDM Smith

Figure 7-1

Diablo Water District

Existing Water Distribution Facilities

Maximum Day Demand - Available Fireflow



Date: 5/8/2020 File: C:\Users\tordellart\Desktop\DWD Figures\Figure 7-2 Fireflow Future.mxd

CDM Smith

Figure 7-2
Diablo Water District
Future Water Distribution Facilities
Maximum Day Demand - Available Fireflow

Section 8

Distribution System Network

Section 8 discusses the hydraulic evaluation of the distribution system network. The section provides an overview of the hydraulic model, a discussion of analysis criteria and assumptions, and presents results of the modeling evaluation including the ultimate pipeline network.

8.1 Hydraulic Model Description

8.1.1 Model History

The District's hydraulic model was originally developed in the mid-1980s. The model, developed using the University of Kentucky's KYPIPE hydraulic network software, included most of the then existing distribution system piping, except for smaller diameter pipelines that do not provide looping. The original model was calibrated using the results of more than 15 hydrant tests.

In 1995, CDM Smith converted the model to EPANET, a hydraulic and water quality modeling program developed by the U.S. Environmental Protection Agency. Between 1995 and 1998, CDM Smith revised the model to evaluate several residential developments constructed within the District's service area. For the 1998 Facilities Plan analysis, CDM Smith added all new pipes larger than 8-inch diameter, as well as 8-inch diameter loops, based on the District's distribution system maps. After 1998, the model was further revised to represent and analyze proposed new development projects. As part of those analyses, CDM Smith converted the model from EPANET to H2ONET to take advantage of better model features.

For the 2006 Facilities Plan, CDM Smith reviewed and checked the model to verify that all existing and proposed pipes larger than 8-inch diameter were included in the model. This checking was based on the District's Water Distribution System Maps (March 2003) and December 2005 improvement plans (as-builts, approved plans, and the most recent set of preliminary plans).

8.1.2 Model Updates for Facilities Plan

For this 2020 Facilities Plan, CDM Smith reviewed and checked the model to verify that all existing and proposed pipes larger than 8-inch diameter were included in the model. This review was based on the District's Water Distribution System geographic information system (GIS) and Maps updated in July 2019.

Two model scenarios were developed: Existing and Ultimate. The Existing scenario represents the DWD system as it existed in 2018 with an average day demand of 4.6 mgd. The Ultimate (or Buildout) scenario represents future, buildout of the entire study area including Bethel Island, and has a total average day demand of 12.55 mgd.

8.1.3 Updated Demand Allocations

As discussed in Section 5, water demands were calculated based on land uses and the associated unit water use rates. Demands were allocated for the existing and ultimate model scenarios.

ArcGIS software was used to allocate demands to the model nodes. The service area was divided into demand areas or "polygons" around each node based on the Thiessen polygon method, such that each polygon contained one node and the entire service area was part of a polygon. These polygons were then intersected with the land use maps to determine the amounts of each land use type within each polygon.

Demands were calculated by multiplying the land use within the polygon by the appropriate unit water demand factor. For polygons encompassing multiple land uses, demands were the sum of the various land uses times the appropriate unit demand factors. For residential land uses, acreages were converted to number of dwelling units based on the average allowable densities for each residential category.

8.1.4 Model Calibration and Verification

As part of the model update, the existing scenario model was calibrated based on 11 fire hydrant tests conducted throughout the existing system on August 23, 2018. The model was also verified using system SCADA data from a maximum weekday in July 2017.

The model uses the Hazen-Williams formula for head loss calculations. The purpose of model calibration was to adjust the Hazen-Williams pipe roughness values so that the model results would more closely match the head losses and pressures actually observed during hydrant tests. Based on the calibration analysis, C values in the model were adjusted to improve the agreement between the observed field data and predicted model results. The C-values in the model range from 110 to 140 and are generally dependent on the size, material, and age of the pipelines.

For the model verification, results from the calibrated model were compared with the actual (observed) system SCADA data on the selected maximum demand day in July 2017. If the model is reasonably accurate, modeled pump station flows and suction and discharge pressures should match actual (observed) flows and pressures, and modeled reservoir levels should track actual (observed) levels.

For the verification, the pump flows were set to match the actual data. Good to excellent results are typically considered to be those where hourly reservoir levels match within one foot. The modeled results from the verification for existing reservoir levels were within one foot of actual levels throughout the day. Therefore, the verification indicates that the calibrated model provides a reasonable representation of the system performance.

8.2 Analysis Criteria

For the hydraulic analysis of the ultimate system, CDM Smith used the following criteria:

8.2.1 Pressures

- Minimum delivery pressure at the main of 50 psi on average during the maximum day in order to provide adequate pressures for fire sprinklers, where installed
- Minimum delivery pressure of 20 psi at fire hydrants under maximum day plus fire flow conditions.

- Maximum delivery pressure of 100 psi in existing areas. Future development will be required to install pressure reducing valves in areas where pressures would exceed 80 psi at delivery to customers.

8.2.2 Pipeline Flow Velocities and Head Losses

- New pipelines sized to meet the following criteria under maximum demand day peak hour conditions:
  - Desirable velocity: 5 feet per second (ft/s)
  - Maximum velocity: 7 ft/s
  - Desirable head loss: 5 ft/1000 ft
  - Maximum head loss: 10 ft/1000 ft

8.2.3 Fire Flows

- 1,000 gpm residential
- 1,500 gpm and greater for commercial and industrial, depending on building construction type and square footage

8.2.4 Demand Multipliers

- Maximum day demand is 2.0 times average daily demand.
- Peak hour demand is 4.0 times average daily demand, or 2.0 times maximum day demand.

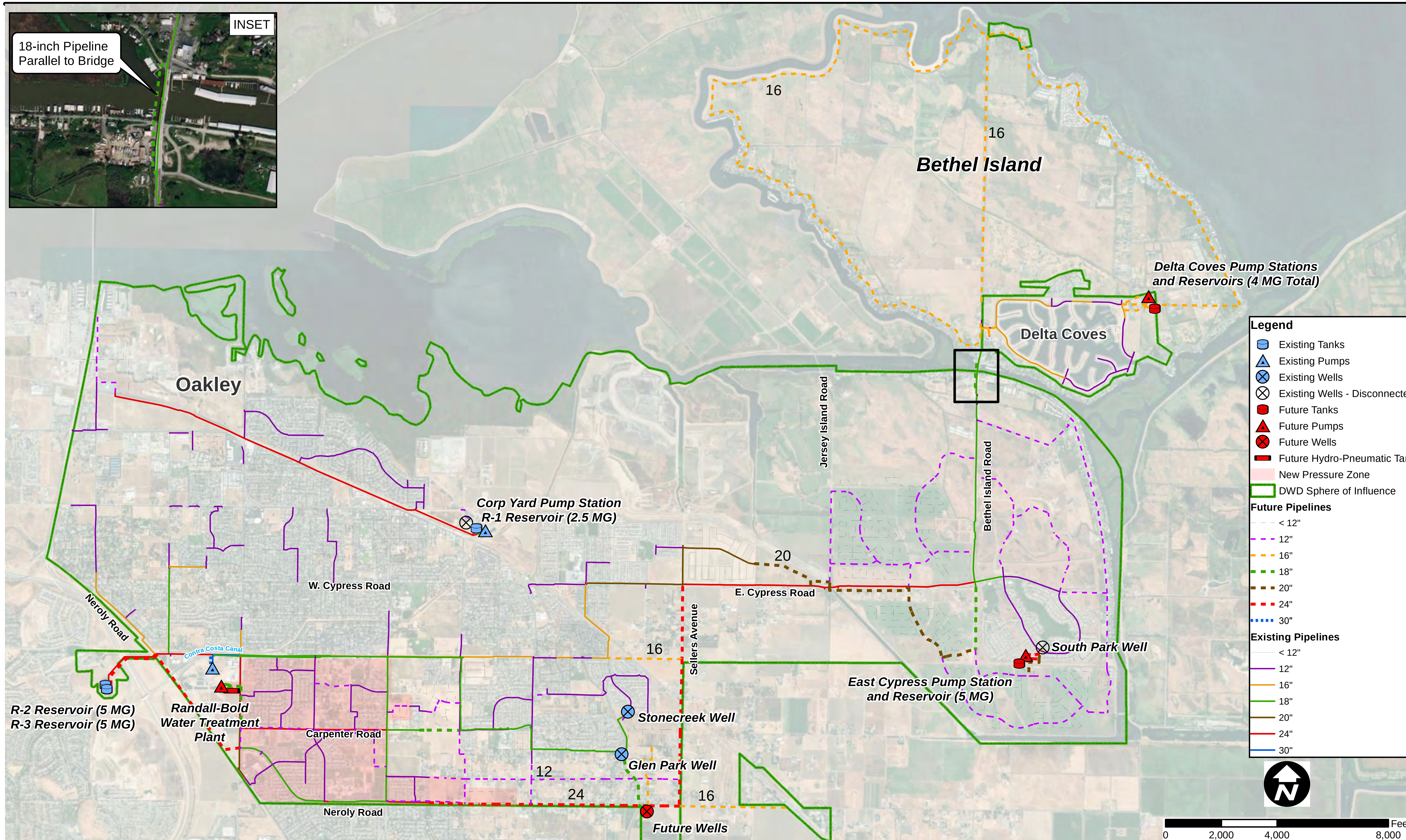
8.3 Ultimate Pipeline Network

CDM Smith performed a hydraulic analysis under ultimate demand conditions to determine the required pipe sizes to serve future development within the DWD study area. This analysis included model runs for the peak hour on the maximum day, maximum day plus fire flow, minimum (winter) day, and an extended period simulation over 48 hours under maximum day conditions to check reservoir cycling.

Figure 8-1 presents the major distribution system pipelines required to serve future development within the study area, and the location of the storage and pumping facilities serving each area. Pipelines were initially sized to meet peak hour demands. The pipeline sizes were then checked for adequacy, and revised where necessary, to meet maximum day demands plus fire flows. The figure shows all 12-inch and larger diameter pipelines that are needed for future service.

8.3.1 New Pressure Zone

As shown in Figure 4-6, the area surrounding Carpenter Road in the southwest portion of the system has water pressures consistently below the 50 psi standard under current conditions. The low pressures in this area are mainly due to the high elevation, with the hydraulic grade-line (HGL) set by the levels of Reservoirs R-2 and R-3. Reducing head loss through additional piping or



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CDM Smith

Figure 8-1
Diablo Water District
Ultimate Water Distribution System for
DWD Sphere of Influence and Bethel Island

upsizing existing piping will not alleviate the issue. To remedy this low pressure area, CDM Smith evaluated the following alternatives with the District:

- Alternative 1 – Add a new pressure zone for the Carpenter Road area including a new pump station and hydro-pneumatic tank;
- Alternative 2 – Add a new pressure zone for the Carpenter Road area including a new pump station and gravity tank (similar to Reservoirs R-2 and R-3 at a nearby high point); and
- Alternative 3 – Install altitude valves at Reservoirs R-2 and R-3, upsize the pumps at Randall-Bold WTP to meet peak hour demands, and increase the hydraulic grade line higher than the level of Reservoirs R-2 and R-3 for the entire system.

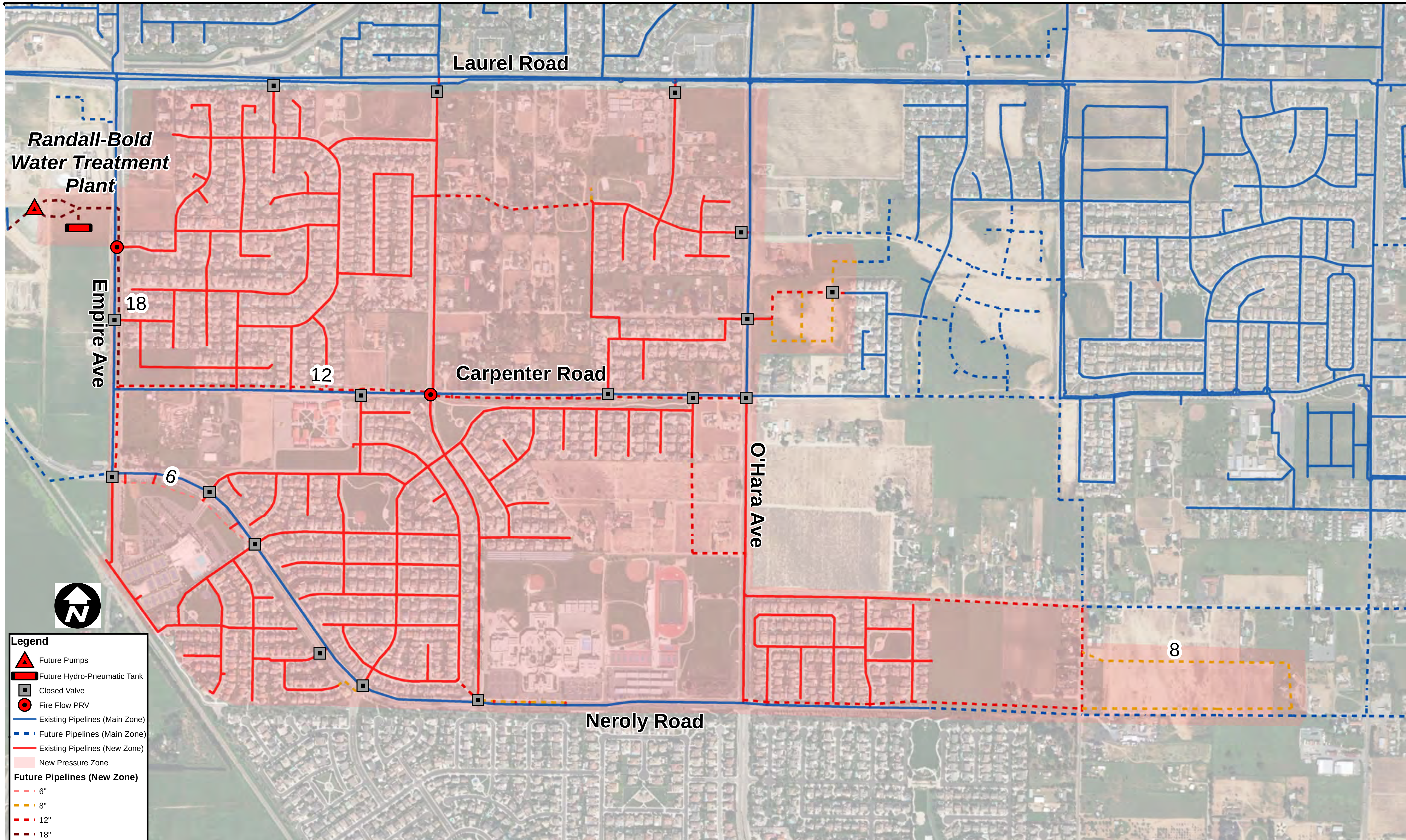
After discussions with the District, CDM Smith recommends Alternative 1 to remedy the low pressures in the Carpenter Road area and the new facilities are presented in Figure 8-2. The District preferred this alternative because it eliminates the land acquisition and new pipeline that would be required to construct the new gravity tank in Alternative 2. Additionally, Alternative 1 eliminates the need to upgrade the pumps at Randall-Bold WTP as well as avoids many of the water quality and maintenance issues experienced by the District with altitude valves (included in Alternative 3) in the past.

This new pressure zone will likely be developed through a separate benefit assessment of the users within the zone, separate from the Facility Reserve Charges (FRCs).

8.3.2 Build Out Water System

The proposed DWD system at buildout will consist of two pressure zones. Each pressure zone will be served from Randall-Bold WTP. Figure 8-2 presents the location and limits of the new proposed second pressure zone. Each zone and major area will have its own storage and pumping facilities, as described in Section 6, to meet peak hour and fire flow needs, as well as for emergency storage. The distribution storage and pumping facilities include:

- Existing Pressure Zone - West of Jersey Island Road Area: Reservoir R-1 and Corp Yard Pump Station (existing), Reservoirs R-2 and R3 (existing), and emergency storage from the Glen Park Well, Stonecreek Well, and potential future wells;
- Existing Pressure Zone - East of Jersey Island Road Area: Future Cypress Reservoirs and Pump Station;
- Existing Pressure Zone - Bethel Island: Future Delta Coves Reservoirs and Pump Station; and
- New Pressure Zone – Carpenter Road Area: Future pumps and hydro-pneumatic tank at Randall-Bold WTP.



Date: 4/23/2020 File: C:\Users\tordellart\Desktop\DWD Figures\Figure 8-2 New Pressure Zone.mxd

CDM Smith

Figure 8-2
Diablo Water District
New Pressure Zone

Table 8-1 provides an estimate of future major transmission pipelines (12-inch and larger) that will be needed to serve new development within DWD's SOI, excluding Bethel Island. Some of the transmission improvements on Table 8-1 are identified as future capital projects to be implemented through DWD's FRC Fund. The estimated costs for these capital projects are provided in Section 9. The remainder will be installed by developers and reimbursed, through DWD's Main Extension Reimbursement (MERA) Fund. The estimated costs for the MERA pipelines are shown on Table 8-1.

Major waterlines for Bethel Island are shown on Figure 8-1. Developers are responsible for installing all waterlines to serve new development on Bethel Island. Specific requirements will be determined on a case-by-case basis in response to requests for service, similar to the agreement created to provide service to the Delta Coves Subdivision.

The following assumptions regarding system operations were used for the ultimate system analysis:

- Randall-Bold WTP pumps operate continuously at a rate equal to the average maximum daily demand, with no time-of-use pumping. No pump upgrades are required for ultimate conditions.
- Other pump stations (Corp Yard, Delta Coves, East Cypress) operate during high demand periods as needed to meet peak hour flows.
- Reservoirs R-2 and R-3 cycle normally between 75 and 100 percent full based on level control settings, except during ultimate maximum demand conditions.
- Future pumps in the East Cypress Specific Plan area operate at pressures ranging from 70 psi to 74 psi under normal conditions. The pumps will have variable frequency drives to allow for operational flexibility under a variety of head conditions.
- Corp Yard Pump Station delivers flow from Reservoir R-1 into the distribution system at pressures ranging from 64 psi to 70 psi.
- Future pumps on Bethel Island operate at pressures ranging from 60 psi to 65 psi under normal conditions. The pumps will have variable frequency drives to allow for operational flexibility under a variety of head conditions.
- New Pressure Zone (Carpenter Road) isolated from existing pressure zone as shown in Figure 8-2.
- New Pressure Zone (Carpenter Road) served by new pumps and new hydro-pneumatic tank at Randall-Bold WTP, estimated to operate at pressures ranging from 75 to 85 psi.

Table 8-1. Future Pipelines to Serve New Development for Ultimate Demand Scenario

Location	Pipe Diameter (inches)	Quantity (feet)	Unit Cost [1] (per linear ft)	Construction Cost [1] (2020 $)
Transmission Pipelines (included as DWD Projects)				
New pipeline from Randall-Bold WTP	30	500	$392	Costs for transmission projects are provided in Section 9
Reservoirs R-2 and R-3 to Neroly Rd. (paved unit cost)	24	2,700	$343	
Neroly Rd. between Laurel Rd. and Empire Ave. (paved unit cost)	24	4,800	$325	
Neroly/Delta Rd. between O'Hara Rd. and Sellers Ave. (paved unit cost)	24	9,000	$325	
Marsh Creek Crossing at Neroly/Delta Rd. (casing)	24	200	$772	
Sellers Ave. between Delta Rd. and East Cypress Rd. (paved unit cost)	24	7,900	$325	
BSNF Railroad Crossing at Sellers Ave. (casing)	24	200	$772	
Parallel to East Cypress Rd. between Knightsen Ave. and Jersey Island Road (paved unit cost)	20	3,100	$300	
Bethel Island Rd. (paved unit cost)	18	500	$279	
Bethel Island Rd. (trenchless unit cost)	18	650	$557	
Total Transmission Projects				
MERA Pipelines (to be installed by developers)				
Within DWD Sphere of Influence (west of Jersey Island Road)				
West of Jersey Island Road Area				
12" pipelines	12	24,000	$95	$2,850,000
16" pipelines	16	9,150	$145	$1,660,000
18" pipelines	18	3,850	$157	$760,000
Subtotal West of Jersey Island Road				*$5,270,000*
East of Jersey Island Road Area (excluding Bethel Island)				
12" pipelines	12	56,200	$102	$7,170,000
18" pipelines	18	2,250	$170	$480,000
20" pipelines	20	8,800	$186	$2,050,000
24" pipelines	24	1,400	$219	$380,000
Contra Costa Canal Crossing north of East Cypress Rd. (casing)	20	200	$802	$200,000
Subtotal East of Jersey Island Road (excluding Bethel Island)				*$10,280,000*
Total MERA Pipelines within DWD Sphere of Influence (excluding Bethel Island)				***$15,550,000***
New Pressure Zone				
12" pipelines (paved unit cost)	12	9,400	$166	$1,950,000
18" pipeline (paved unit cost	18	2,900	$264	$960,000
Subtotal New Pressure Zone				*$2,910,000*
New Pressure Zone: To be developed through a separate benefit assessment of the users within the zone, not coming from FRCs.				
Bethel Island				
16" pipelines	16	64,500	$213	$17,170,000
Bethel Island Pipelines: Developers are responsible for the costs of installing all new waterlines to serve new development on Bethel Island. Specific requirements for waterlines will be determined on a case-by-case basis in response to requests for service.				

[1] All costs in this table are in May 2020 dollars (Engineering News Record Construction Cost Index [ENR CCI] 12,819.17). Unit costs for pipes include pipes, fittings, valves, and corrosion protection. The unit costs are average values including both simple and difficult projects. Unit costs do not include any construction contingency. Paved unit costs are used for the major transmission projects. Unpaved unit costs are used for all other improvements. The estimated construction cost includes a 25% contingency.

8.4 Water System Reliability

The DWD system has multiple levels of redundancy for supply and distribution. As long as the Randall-Bold WTP system is operational and providing water to DWD's distribution system, DWD can meet all of its supply needs. The distribution system is looped to facilitate water transmission even if a main break were to occur. Distribution storage is provided at various locations throughout the system that is available for emergency supply in the event of a temporary outage of the WTP.

DWD raw surface water supply is very reliable given CCWD's contracts with Reclamation and with East Contra Costa Irrigation District for supplemental supply. The reliability of the raw water supply is discussed in detail in DWD's Urban Water Management Plan. CCWD has 14 to 28 months of emergency supply storage, at normal usage rates, with Los Vaqueros Reservoir.

In addition, CCWD conducted a seismic reliability of their water supply system and is implementing recommended improvements. These improvements include the Multi-Purpose Pipeline, which was recently completed, to improve flexibility and reliability of supply; as well as a pipeline interties, landslide mitigations, and modifications of petroleum pipelines at canal crossings.

Canal operations have infrequently stopped from 1 to 8 hours duration due to electrical or mechanical failures over the past years. However, the treatment plant intake is positioned so that water can be fed by gravity from the Los Vaqueros Reservoir south of Brentwood or from the Contra Loma Reservoir located in Antioch. Consequently, no water supply interruptions have occurred due to electrical or mechanical failures.

A catastrophic interruption of water supplies including, but not limited to, a regional power outage, an earthquake, or other disaster are expected to be short term. DWD has never had a catastrophic event that has prevented it from being able to supply water to its customers. Catastrophic events that have occurred in the past include the Loma Prieta earthquake of 1989, the freeze of 1990, and occasional power outages that have lasted up to nine hours.

The District was unaffected by the Loma Prieta earthquake. Although water was observed to be sloshing back and forth in the District's reservoirs, no structural failures or loss of water occurred. During the freeze of 1990, the District was inundated with customer calls about not having water service due to frozen pipes. District staff responded to the needs of the customers and continued repairs until all services were restored.

When power outages occur, the District relies on its elevated storage to provide service to its customers. The District also has backup gas and propane-driven pumps which can be brought into service in the event of a power failure. With current standby generators, the Randall-Bold WTP does have the capability to produce water during a power failure and is able to pump water from its 5 MG clearwell at a rate of 4.2 mgd with one pump running on a standby generator.

8.5 Ultimate System Emergency Operation

As discussed in Section 6, additional storage is recommended for the ultimate system to provide total storage equal to two average day demands. The total recommended future storage can supply two average demand days with the Randall-Bold WTP out of service. This assumes that pump stations at the Corp Yard, East Cypress, and Bethel Island have standby power.

Additional emergency supply may be available from the existing and future wells, and the Antioch treated water system, assuming the wells have standby power, and flow from Antioch is available. The Glen Park Well and Stonecreek Well can each potentially provide 2 mgd, and the two future wells could provide a total of 3 mgd. Three existing interties with the Antioch treated water system could provide a total of 5,000 gpm, or a total of 7.2 mgd. Blending requirements may not be met during emergency operation.

The worst case scenario for the DWD system is loss of supply from Randall-Bold WTP. In the event that an extended outage or reduction in supply from the WTP were to occur, DWD would implement its emergency water shortage contingency plan to reduce customer demands as outlined in its Urban Water Management Plan, as needed in conjunction with its emergency supply sources discussed below.

During emergency operation with Randall-Bold WTP out of service, it is assumed that the existing pumps at Randall-Bold WTP as well as the potential future pumps supplying the new pressure zone are out of service. To maintain supply and pressure into the new pressure zone, the isolation valves separating this zone from the main zone would need to be re-opened providing a direct hydraulic connection to Reservoirs R-2 and R-3 which will maintain the HGL of the entire DWD system. There will be pressure reducing valves that allow high fire flow rates from the main zone into the new zone at a pressure lower than normal operations. Therefore, opening the isolation valves is recommended.

Pumps at Corp Yard, Bethel Island, and East Cypress could temporarily supply flow to the system utilizing the respective ground level storage tanks, but not appreciably increase the HGL. If Reservoirs R-2 and R-3 drain to near empty, the system HGL will be near the bottom elevation of the tank, or at 179 feet. At this HGL, the lowest pressure in the District's system will be approximately 34 psi near Carpenter Road. Groundwater wells with standby power will be able to continue providing flow into the system. If production from the wells exceeds system current demand, the tanks will be able to fill and provide higher pressure. Flow from interties, if available at pressures exceeding the DWD pressure, will also contribute to meeting demands during this emergency operation.

Section 9

Facilities Planning

Section 9 describes the recommended capital improvements for ultimate service within the study area. A description of the ultimate system is presented first, then a discussion of future improvement requirements. These improvements include a new pressure zone, surface water supply facilities, groundwater supply facilities, distribution pumping facilities, distribution storage facilities, and pipelines. The recommended improvements are summarized at the end of the section, with a brief discussion of environmental factors.

9.1 Ultimate System Configuration and Operation

A schematic profile of the ultimate system configuration is shown on Figure 9-1. Figure 8-1 presents the major distribution system pipelines that will be required to serve future development within the study area and the location of the existing and future distribution storage and pumping facilities.

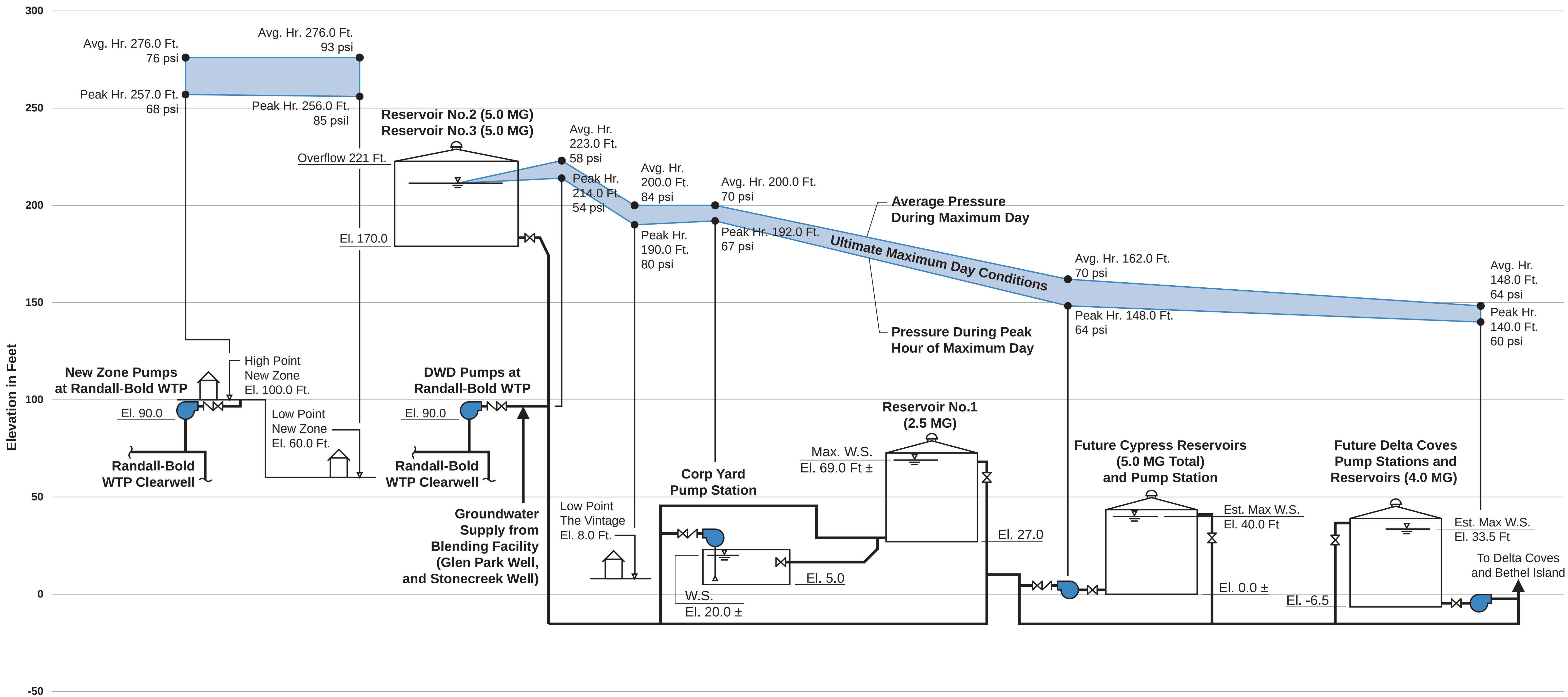
The primary source of treated water to DWD's distribution system will continue to be pumped flow from DWD's pumps at the Randall-Bold WTP. In addition, DWD's groundwater supply system will provide additional supply reliability.

The ultimate DWD system is proposed to be split into two distinct pressure zones. The majority of the DWD system will remain in the existing (main) pressure zone and operate the same way the current system operates, with Reservoirs R-2 and R-3 determining the HGL. A new pressure zone that represents about seven percent of DWD's demand, is proposed for the southwest portion of the DWD system near Carpenter Road where the ground elevation is higher. The new pressure zone would be supplied by a new set of pumps at Randall-Bold WTP that would provide a higher pressure than the existing WTP pumps. The new pumps will be sized for a lower flow because they will supply only the new pressure zone. The main pressure zone will be served from the Randall-Bold WTP and the groundwater supply system, while the new pressure zone will be supplied by only the Randall-Bold WTP clearwell.

9.1.1 Existing (Main) Pressure Zone

The existing (main) pressure zone, which covers the majority of the DWD system and will represent about 93 percent (11.5 mgd) of the total ultimate average day demand, is divided into three major areas; each area has its own storage and pumping facilities to meet peak hour and fire flow needs, as well as emergency storage. The existing high-service pumps at Randall-Bold WTP will be adequate to meet the ultimate demands of the main pressure zone (this assumes the new pressure zone pumps are installed). The main pressure zone areas and corresponding distribution storage and pumping facilities include:

- West of Jersey Island Road Area – Reservoir R-1 and Corp Yard Pump Station (existing), Reservoir R-2 (existing), and Reservoir R-3 (existing). Storage from Reservoir R-1 must be



Notes:
1. HGLs and pressures taken from model results for maximum day under ultimate conditions.

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Figure 9-1
Diablo Water District - Ultimate Treated Water System Schematic

pumped into the system. Reservoirs R-2 and R-3 provide gravity flow. Four groundwater supply wells (two existing, two future) also contribute to the supply of water for this area.

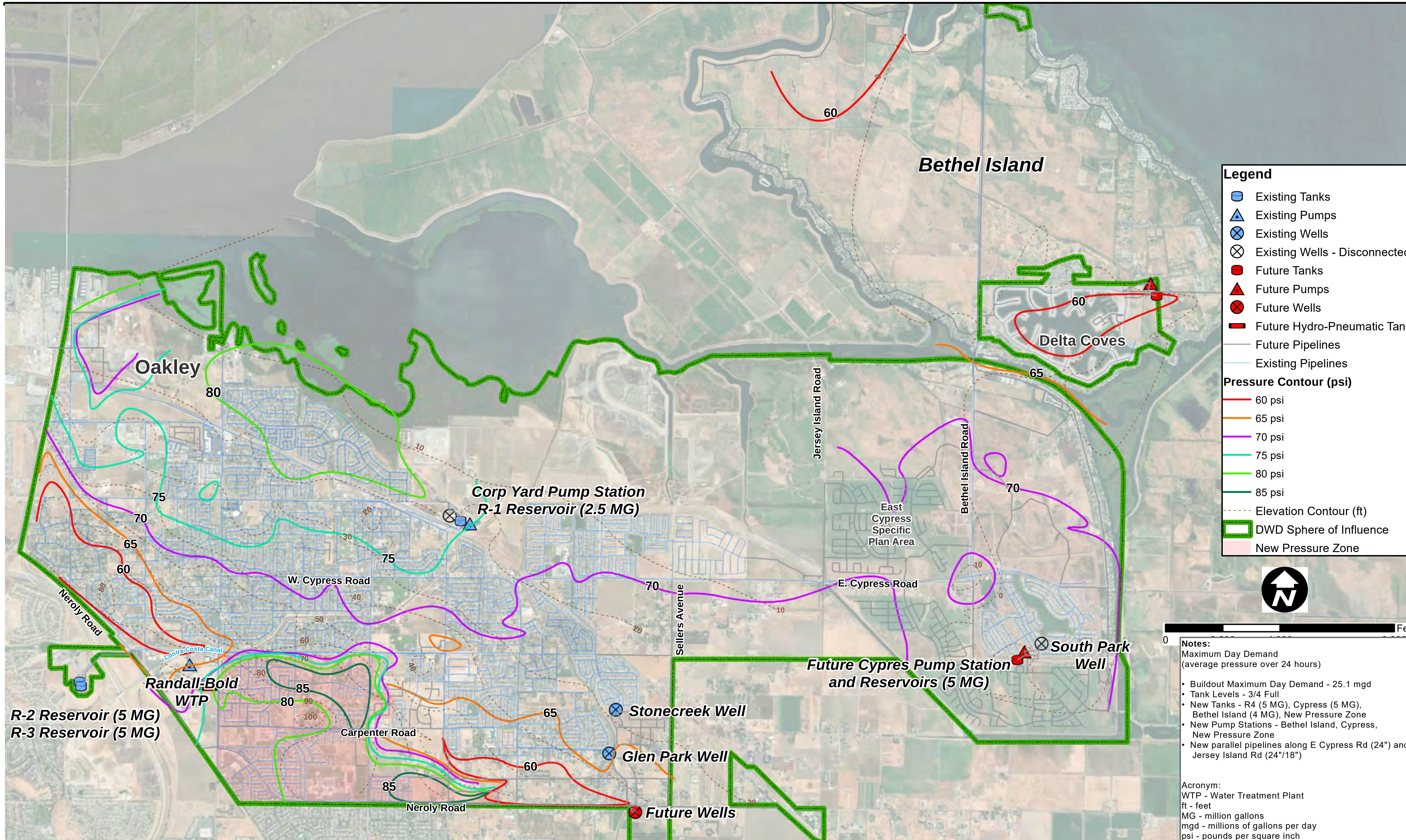
- East of Jersey Island Road Area – Future Cypress Reservoirs and Pump Station. Stored water must be pumped into the system (similar to Reservoir R-1 and the Corp Yard Pump Station).
- Bethel Island – Future Delta Coves Reservoirs and Pump Station. Stored water must be pumped into the system (similar to Reservoir R-1 and the Corp Yard Pump Station).

The distribution reservoirs will help to meet peaking demands in excess of the pumped supply from the DWD pumps at the Randall-Bold WTP. The sizing for the ultimate pipeline network is based on supplying water from the DWD pumps at the Randall-Bold WTP at the maximum day demand rate and using storage to meet peak hourly flows and fire flows. It is assumed that DWD's pumps at the Randall-Bold WTP will not be operated on a time of use basis under peak demand conditions in the future.

Under ultimate maximum day demands, the discharge pressure at the Corp Yard Pump Station is anticipated to range from 69 psi to 72 psi. Discharge pressure at the Delta Coves and Bethel Island Pump Station is anticipated to range from 61 psi to 67 psi, while discharge pressure at the Cypress Pump Station is anticipated to range from 64 psi to 74 psi. Each of these pump stations will be operated with a sustaining valve that will allow the storage reservoirs to fill when the system pressure is above the valve setting (during off peak hour operation). During peak hour conditions, when local pressures drop below the desired minimum, pumps will turn on to maintain system pressure, pumping from their respective storage reservoirs.

Figure 9-2 shows the results of a 24-hour extended period simulation model run under maximum day demand conditions. Pressures shown in the figure represent the average pressure over the 24-hour simulation period. The system experiences its lowest system pressures during maximum demand conditions. Figure 9-3 shows the anticipated system pressures under minimum demand conditions, which occur during the minimum demand hour on a winter day, and represent the maximum pressures in the system. Lower elevation lands within the study area require individual pressure reducing valves at customer connections to prevent excessive pressures under minimum demand conditions. The Uniform Plumbing Code requires PRVs on all new services where peak pressures exceed 80 psi.

Under lower demand conditions, it would be possible to operate the DWD pumps on a time of use basis. When the DWD pumps at Randall-Bold WTP are not operating, the distribution reservoirs will serve the entire system. Reservoirs R-2 and R-3 operate by gravity flow. The pump stations at Reservoir R-1 and the Cypress Reservoir will boost flows from those at-grade reservoirs; standby power is provided in case of power outage. It may also be possible to take the Cypress Reservoir out of service under lower demand conditions and serve the east side zone solely from DWD's pumps at the Randall-Bold WTP and Reservoirs R-1, R-2, and R-3. If the Cypress Reservoir were taken out of service for part of the year, a detailed hydraulic analysis should be done to determine the appropriate time period, based on level of demand, during which demands plus fire flow could be met. Once on-line, both of the Delta Coves Reservoirs should not be taken out of service



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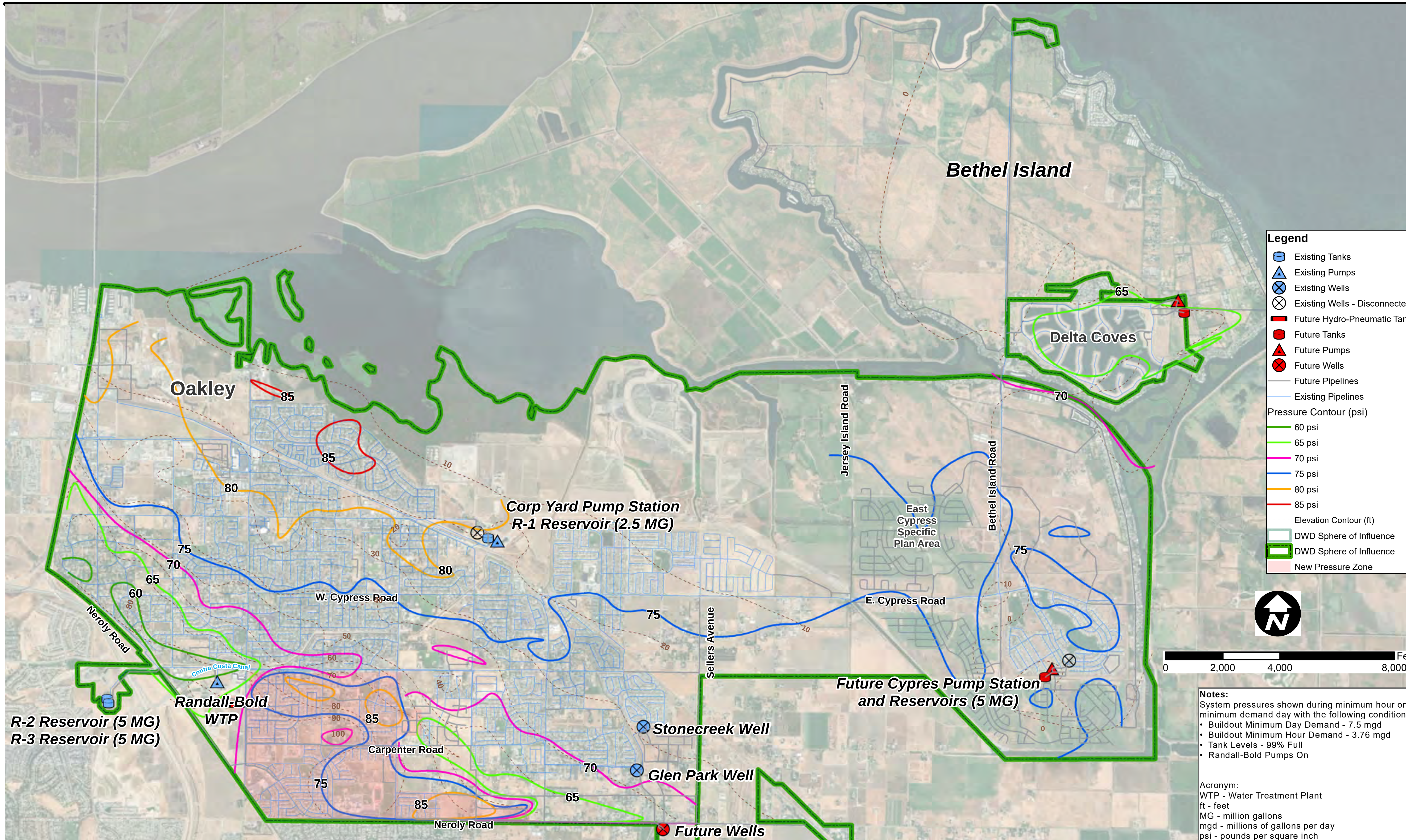
CDM Smith

Figure 9-2

Diablo Water District

Buildout Water Distribution System for

Max Day Demand - Average Hour Pressure



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CDM Smith

Figure 9-3
Diablo Water District
Buildout Water Distribution System for
Maximum Pressure Conditions (Minimum Hour Demand)

completely due to its isolated location and need to have emergency storage on Bethel Island in the event of a waterline break affecting deliveries to the island.

During the high demand summer months, it will not be possible to operate the DWD pumps at Randall-Bold WTP on a time of use basis under ultimate conditions. For a few weeks in the summer, during periods with maximum and near-maximum days, the DWD pumps at Randall-Bold WTP will be operating at or close to 24 hours per day. DWD will have to monitor turnover in the reservoirs and adjust pumping from the Randall-Bold WTP to maintain adequate water quality.

9.1.1.1 Bethel Island

Future water infrastructure development on Bethel Island will be funded by developers, rather than DWD, to meet the demands on the island; this was the same approach implemented for the Delta Coves development. The chemical feed facility that serves Delta Coves is sized to meet the buildout demands of Delta Coves only (a maximum capacity of 500 gpm) and was not designed for any planned expansion. An additional chemical feed facility will likely be needed for development of the rest of Bethel Island. If the existing pipeline that is part of the Delta Coves loop will be used to convey supply to the rest of Bethel Island, additional evaluation will be required to determine whether it provides adequate capacity. This will depend on the locations and concentrations of future Bethel Island developments around the perimeter of the island. Also, there is room for additional storage at the current location of the future Delta Coves reservoir which is anticipated to be needed for future Bethel Island development.

9.1.2 New (High) Pressure Zone

The area near Carpenter Road is higher in elevation than the rest of the DWD system. If this area continues to operate in the same pressure zone as the rest of the DWD system, pressures in this area are predicted to average 40 psi to 50 psi during ultimate maximum day demands, which is below DWD’s minimum required pressure of 50 psi. As discussed in Section 8, it is recommended that this area be separated into a new pressure zone with a higher operating HGL to provide pressures above 50 psi. This area would be isolated via gate valves and flow control valves and served by new pumps and a new hydro-pneumatic tank located at Randall-Bold WTP (see Section 9.6). The new pumps would draw from the Randall-Bold WTP clearwell and have a higher design head to provide sufficient pressure into the new zone. The hydro-pneumatic tank would maintain pressure in the zone and be sized appropriately to allow the pumps to cycle on and off at an acceptable frequency.

9.2 Supply Requirements

To meet future demands, DWD will need to provide additional supply capacity. The primary supply will be treated surface water supplemented with groundwater. Table 9-1 summarizes the anticipated supply capacity requirements to meet future maximum day demands. The table shows the impact on timing of additional surface water supply depending on when additional groundwater supply capacity is implemented. The actual year that additional capacity is required will depend on the extent and timing of future development.

Table 9-1. Supply Capacity Requirements

Year	Water Demands			
	Average Day Demand (mgd)	Maximum Day Demand (Equals Total Supply Needed) (mgd)	Groundwater Well Supply (mgd)	RBWTP Capacity Needed to Meet Demand (mgd)
2018	4.6	9.2	4.0	5.2
2020	5.3	10.6	4.0	6.6
2025	7.1	14.2	4.0	10.2
2030	9.0	18.0	5.5	12.5
2035	10.7	21.5	7.0	14.5
2040	12.6	25.2	7.0	18.1

9.3 Surface Water Supply Facilities

DWD's surface water supply facilities include the Randall-Bold WTP, the clearwell at the WTP, and the high lift pumps that pump from the clearwell into DWD's distribution system. The existing facilities are described in Section 4.

9.3.1 Randall-Bold WTP and Clearwell

DWD and CCWD jointly own the Randall-Bold WTP through a Joint Powers Authority (JPA). CCWD operates the plant for the JPA. The WTP was designed and constructed as a 40 mgd plant that could be expanded in the future to an ultimate capacity of 80 mgd. According to the JPA agreement, treated water is to be delivered to DWD at such rates of flow and under such pressures as DWD requests. The Randall-Bold WTP capacity was expanded from 40 mgd to 50 mgd, with CCWD taking ownership of the additional 10 mgd of capacity.

At ultimate buildout, DWD may require up to 18.1 mgd of treated water from the Randall-Bold WTP. DWD's 15 mgd current capacity for maximum day demand will not meet the projected buildout maximum day demand of 18.1 mgd. It is recommended that DWD increases its share of the Randall-Bold WTP capacity to 20 mgd once the systemwide demands exceed the current capacity.

When the WTP is expanded, the Randall-Bold WTP clearwell will be expanded to accommodate the additional production capacity. The cost of the WTP expansion includes the cost of the clearwell expansion. The Randall-Bold WTP clearwell is not part of DWD's distribution storage; it is for WTP operations only.

Due to the age of the Randall-Bold WTP and its existing systems, CCWD is planning several projects in the 2021-2030 timeframe that will allow the plant to maintain its existing treatment capacity. A summary of the major activities currently planned is presented below. Starred items (*) indicate work associated with maintaining existing yet unused capacity available for future District customers.

- Chemical Feed System Investigations and Upgrades
- Server Room Improvements

- Sodium Hypochlorite and Liquid Ammonia Sulfate Conversion*
- Filter Upgrades*
- Electrical Upgrades (switchgear)*
- Chemical tank Improvements*
- Lagoon Pump Replacement*
- Intermediate Ozone and Post Ozone Improvements*
- Filter Media replacement*
- Line Wash Water and Solids Lagoons*
- Energy Efficiency Studies
- Ozone Generation Dielectric Replacement

9.3.2 DWD Pumps at Randall-Bold

The DWD pumps at Randall-Bold WTP pump treated water from the clearwell directly into DWD's distribution system to meet system demands and to refill the reservoirs. This pump station should be sized consistent with the treatment capacity purchased by DWD. The ultimate pumping capacity must equal the ultimate DWD treatment capacity.

Table 9-2 summarizes the existing pumping capacity for DWD at the Randall-Bold WTP. The firm pumping capacity assumes that one of the largest pumps is a standby pump and is not in service. Additionally, Table 9-2 notes the additional pumps recommended for installation at Randall-Bold WTP to serve the new pressure zone.

Table 9-2. DWD Existing and Recommended Additional Pumping Capacity at Randall-Bold WTP

	Existing Capacity	Recommended Additional Capacity for New Pressure Zone
Units and Individual Capacities	1 @ 4.3 mgd (150 HP)	1 @ 1.3 mgd (60 HP)
	1 @ 4.3 mgd (150 HP)	1 @ 1.3 mgd (60 HP)
	1 @ 8.6 mgd (300 HP)	1 @ 1.3 mgd (60 HP)
	1 @ 8.6 mgd (300 HP)	1 @ 1.3 mgd (60 HP)
Future Firm Capacity (excluding one large pump as standby)	17.2 mgd	3.9 mgd
	21.1 mgd	
Future Total Capacity (including standby)	25.8 mgd	5.2 mgd
	31.0 mgd	

DWD's pumping capacity at the Randal-Bold WTP will be expanded by adding new pumps sized to meet the higher head required for the new pressure zone near Carpenter Road. The existing high lift WTP pumps will remain as-is and do not need to be upsized as long as the additional pumps for the pressure zone are installed.

9.4 Groundwater Supply Facilities

Section 4 describes the existing groundwater facilities. Groundwater is conveyed in a dedicated pipeline to the Blending Facility located near the Randall-Bold WTP and is treated and blended with treated surface water within DWD's distribution system. The groundwater facilities for conveyance and blending were designed to add more wells in the future.

At buildout, it is projected that 7 mgd of groundwater well capacity will be available to supplement the 18.1 mgd surface water supply to meet ultimate maximum day demands. Specific locations of such wells would be determined as part of future siting feasibility studies and in coordination with findings and hydraulic model from the GSP.

Table 9-1 presents the anticipated timing for additional groundwater supply capacity to meet future needs. Additional groundwater supply can defer the timing of additional Randall-Bold WTP capacity if suitable well locations can be identified and implemented.

For a total groundwater supply capacity of 7 mgd, it is assumed that 2 new wells will be required at an average capacity of 1.5 mgd per well, in addition to the existing Glen Park and Stonecreek Wells at 2 mgd per well.

In addition to the new wells, DWD is planning to install an iron and manganese removal system at the Stonecreek Well. Since its initial operation, the water supplied from this well has contained elevated levels of iron and manganese; as a result, to meet its water quality goal for customers, the District only uses this well on a limited basis. The additional of a local treatment system at the wellhead would allow the well to be used to its full capacity. The District conservatively estimates that a similar iron and manganese removal system will also be required at the two future wells, whose locations have not yet been finalized.

DWD is also planning to install permanent generators at each of its existing wells, which are currently configured with temporary generator hookups. The generator size anticipated at each well is as follows.

- South Park Well Pump Station: 250 kilowatt (kW)/312.5 kilo-volt-ampere (kVA)
- Glen Park Well Pump Station: 200 kW/250 kVA
- Stonecreek Well Pump Station: 200 kW/250 kVA

Additional work anticipated at each well site to accommodate the new generators assumes the following.

- Existing circuit breaker connection to the main switchboard can be used to power the electrical loads
- New conduit and wire required
- Diesel generators will be supplied with belly fuel tank
- Integration of control/monitoring of new generators into controls/SCADA
- Bay Area Air Quality Management District permitting

The District also plans to install permanent generators at each of the two future well sites.

9.5 Distribution Storage Facilities

Section 6 describes the existing and ultimate storage requirements. Table 6-3 summarizes the anticipated ultimate storage facilities and the anticipated timing for additional storage.

9.6 Distribution Pumping Facilities

The distribution pump stations at Cypress Lakes and Delta Coves will be used primarily to pump water from storage to meet peak hour needs in excess of the maximum demand rate supplied from the Randall-Bold WTP, and for fire flows. The existing Corp Yard Pump Station boosts water from Reservoir R-1 into the distribution system. The Corp Yard Pump Station has adequate capacity to meet ultimate needs.

In addition, the following future distribution pump stations will be needed for service to the entire study area:

- New Pressure Zone Pump Station will be needed to supply water to the new pressure zone located along Carpenter Road. The pumps will be sized to meet all demands for the zone with the exception of fire flow. Future demands in this zone are estimated to be 600 gpm on average day demand, 1,200 gpm on maximum day demand, and 2,400 gpm during peak hour demand. The new pressure zone pump station will need a total capacity to meet peak hour demands which can be delivered with four new variable speed pumps (3 duty pumps plus one standby, each at 900 gpm at 215 feet of head, 60 HP). Multiple pumps allow the wide range of demands throughout the year to be met without short-cycling the pumps. The new zone pump station will also require two new hydro-pneumatic tanks, 15,000 gallons each, which will maintain the hydraulic grade line.

  Fire flow in the new zone will be supplemented from the main zone through two PRVs shown in Figure 8-2. During normal operation, these PRVs will remain closed, keeping the two zones isolated from each other. As a fire flow in the new zone reduces pressure in the zone, the two PRVs will open to provide the required additional flow and maintain the required system pressure.

- Future Cypress Pump Station will be needed to boost water from the future Cypress Reservoirs to the service area east of Jersey Island Road (excluding Bethel Island, the pumps and storage on Bethel Island would be sized to meet its demands and storage needs in the event the area was isolated from the main system). The model predicts a need to pump a peak hour flow of 6.5 mgd under ultimate maximum day demand conditions. It is anticipated that the new pump station would have five pumps total, consisting of four duty pumps and one standby pump. Each pump will have a design flow of 1,200 gpm at 150 feet of head and 60 horsepower, assuming 80 percent pump efficiency. Standby power will be required.

- Future Delta Coves Pump Station will be needed to boost water from the future Delta Coves Reservoirs serving the Delta Coves Development and future development on Bethel Island. The model predicts a need to pump a peak hour flow of 5 mgd under ultimate maximum day demand conditions (serving all of Bethel Island). It is anticipated that (at buildout) the pump station would have four pumps total consisting of three duty pumps and one standby pump. Each pump will have a design flow of 1,200 gpm at 160 feet of head and 60 horsepower, assuming 80 percent pump efficiency. Standby power will be required.

Water stored in the Cypress and Delta Coves reservoirs must be pumped for delivery to the distribution system at the proper pressure, similar to the operation of Reservoir R-1 and the Corp Yard Pump Station. They are not able to supply the system via gravity. Under average day and lower demand conditions, water could be supplied directly to the eastern area from DWD's main system via the transmission pipelines in the Cypress Road corridor. Under higher demand conditions, the pump stations would operate to maintain acceptable pressures. The pumps may also operate under lower demand conditions in order to turn over the water in the reservoirs to maintain water quality. In the event of an emergency loss of supply from DWD's main system at the Randall-Bold WTP, supply would be pumped from the reservoirs or wells.

9.7 Pipelines

Section 8 describes the ultimate pipeline network. Table 8-1 lists the future pipelines that will be required to serve new development. The majority of these pipelines will be constructed as part of new development projects.

Six major transmission pipeline projects are included in the capital projects due to their importance for system-wide transmission capacity and the size of the projects. These projects provide additional transmission capacity from the Randall-Bold WTP and Blending Facility to the rest of the distribution system. These pipeline projects are:

- 30-inch pipeline from Randall-Bold WTP to distribution mains along Laurel Road;
- 24-inch pipeline from Reservoirs R-2 and R-3 to distribution mains along Laurel/Neroly Roads ;
- 24-inch pipeline in Neroly Road between Laurel Road and Empire Avenue;
- 24-inch pipeline in Neroly/Delta Road between O'Hara and Sellers Avenues, and in Sellers Avenue between Delta Road and Cypress Road;
- 20-inch pipeline parallel to East Cypress Road between Knightsen Avenue and Jersey Island Road; and
- 18-inch pipeline underneath canal to Bethel Island redundant to existing 18" pipeline on Bethel Island Bridge.

For pipelines constructed as part of development projects that are oversized to provide service to other development areas, DWD reimburses developers for the costs of installing larger pipelines than required for their specific development based on the District's MERA policy.

9.8 Pipeline Replacement Program

The District should consider establishing a fund for replacement of pipelines that are old or in poor condition. A simple approach would be to assume replacement of a certain percentage of pipelines each year, based on an anticipated service life (e.g., 1 to 2 percent per year based on a 50 to 100 year service life). A more detailed approach would involve development of a database of information on existing pipelines to use in estimating their remaining service life and calculating the anticipated pipeline replacement costs over time. Typically, the database would consist of an inventory of existing pipelines by diameter, material, and age. Other factors that may be included, depending on the specific conditions that may affect pipeline service life, are cathodic protection, soil conditions, and installation conditions.

A 50-year service life is a typical time frame for planning for future replacement costs. However, pipes can have a longer service life, up to 100 years, depending on the specific system and location conditions. The District has a relatively new system. Although the oldest pipes in the original town of Oakley are approximately 65 years old and in good condition, other portions of the District's system are prone to repeated problems/failures, particularly in areas with corrosive soils. The District is finding that service lines often need to be replaced at least once during the life of the water main. The District is planning to budget $1.5 million to replace failing mains and perform preventative maintenance/replacement of service lines in Fiscal Year 2024/2025, in addition to developing a Condition Assessment and Replacement Program for its entire distribution system.

Development of a replacement program would provide budgeting information to the District for planning purposes. It would identify the anticipated lengths of pipelines by diameter that are anticipated to exceed their anticipated service life over five-year time periods during the planning period. The District could then budget for the estimated costs to replace this amount of pipe. Specific replacement projects would be determined individually by the District based on the actual pipe age, maintenance and repair records, and compatibility with other projects such as street repair or installation of other utilities. As part of the replacement projects, the existing pipe size would be evaluated for appropriateness to determine if upsizing may be warranted in selected areas.

A similar approach could also be taken to establish a replacement program for other types of water system facilities, such as existing valves, reservoirs, pumps, and wells.

9.9 SCADA System Expansion

DWD's existing SCADA system is designed for expansion using Programmable Automation Controllers (an upgrade to the traditional programmable logic controller) and radio communications. DWD has standardized on Modicon Programmable Automation Controllers (PACs) and EtherNet-based communication protocol. Future sites will also use a Modicon system with appropriate Input/Output compatible with the existing systems in use at other DWD facilities.

The following existing facilities are monitored by the SCADA system:

- Randall-Bold WTP Pump Station
- Corp Yard Pump Station and Reservoir R-1
- Reservoirs R-2 and R-3
- Blending Facility for Groundwater Supply
- M-27: Willow Park Marina Condominium Development
- Delta Coves Chemical Feed Facility
- Glen Park Well
- Stonecreek Well
- South Park Well

Each of the facilities listed above have either just recently been upgraded, or will be upgraded in 2020/2021, to the Modicon M340 PAC and EtherNet protocol. As a result, these locations are not expected to require another significant hardware upgrade within the next 10 years, or until the equipment becomes obsolete.

Table 9-3 lists anticipated major future facilities that will be included in the SCADA system and the typical input and output parameters that would be monitored. The major future facilities include reservoirs, pump stations, and wells. The capital project cost estimates for these facilities include the SCADA equipment that will be required at the sites.

Table 9-3. Typical SCADA Input/Output Requirements for Major Future Facilities

Facility	Typical Input/Output Requirements	
	Input	Output
Future Wells for Groundwater Supply at Blending Facility (2 sites)	Local/Remote Pump Running Pump Speed Feedback Pump Fault Intrusion Power Fail Pressure Flow Well Level Well Low Level	Pump Start/Stop Pump Speed
Cypress Reservoir & Pump Station Delta Coves Reservoir & Pump Station Bethel Island Reservoir & Pump Station	Local/Remote (each pump) Pump Running (each pump) Pump Fault (each pump) Lead/Lag/Standby Intrusion Power Fail Pressure Flow Pump Speed Fdbk (each pump) Reservoir High Level Reservoir Level	Pump Start/Stop (each pump) Pump Speed (each pump)

DWD has already connected most of its remote well and other sites to the SCADA system. Current facilities yet to be connected include:

- Knightsen Well (Knightsen, and potential candidate for connection to DWD groundwater supply system); and
- Antioch Intertie (managed by the City of Antioch, the previous telephone-based connection is no longer operational).

The cost of connecting these facilities to DWD's SCADA system is borne by the individual developments and/or facility owners.

If there is a need for future chloramination booster stations, such as in the east part of the system, these facilities will also be monitored by the SCADA system. DWD may also monitor flow and/or pressure in the future at critical locations in the distribution system. Such locations may include a high elevation location in the southwest part of the system to monitor minimum pressures under high demand conditions, and a low elevation location in the Vintage area to monitor maximum pressures.

During the system design for each future site, a radio survey must be performed to establish necessary antenna heights and communication paths. The use of radio for communications is dependent on the ability to obtain a radio path between the sites. If a radio path is not obtainable then a dedicated telephone line will be needed.

9.10 Water System Operations and Maintenance Activities

As discussed in Section 4.2, after the Randall-Bold WTP became fully operational, the District converted the former treatment plant site at Rose Avenue into a Corporation Yard. The District is currently planning to construct a new corporation yard building with field office, training room, and ancillary facilities, either on or adjacent to the existing corporation yard property. The new facilities support the increased need for office and training space not currently available in existing facilities.

Following completion of the new corporation yard facilities, the District will consider whether to demolish the older facilities. Several possible actions may be taken, which range from filling the clarifiers with sand, to demolishing, filling, and paving the clarifier and filter areas. During improvements performed at the Corp Yard Pump Station and its associated clearwells in 2017-2018, the District isolated the clearwells that underlie the filters from the clearwells beneath the pump station, allowing for the future demolition of the clearwells beneath the filters. Because of the various alternatives and potential structural issues involved, an abbreviated feasibility study, including environmental site assessment, should be conducted before the District performs any demolition.

9.11 Recommended Capital Improvements

Table 9-4 summarizes the recommended capital improvements and indicates the anticipated timeframe for implementation and estimated cost for each project. The actual schedule for improvements to serve new development will depend on the actual growth that occurs in the future.

Table 9-4 provides the estimated costs for the recommended capital projects. These are conceptual planning-level cost estimates. All costs are in current dollars and are indexed to the Engineering News Record Construction Cost Index for San Francisco (ENR CCI) of 12,819.17 (as of May 2020). The estimated capital costs include:

- Base Construction Cost: Primarily calculated using unit construction costs based on cost data from CDM Smith's Timberline cost estimating database. Parametric costs were used for some larger cost items (e.g., Randall-Bold WTP expansion).
- Total Construction Cost: Base construction cost plus a markup at 35 percent of the base construction cost, which is intended to account for additional work that may be identified during final design, uncertainties in the bidding climate, and change orders during construction.
- Project Implementation Allowance: Allowance of 25 percent of the total construction cost to cover engineering, construction services, and environmental, permitting, legal and administration. For the Randall-Bold WTP-related projects, the project implementation allowance is 35 percent of the total construction cost, which includes 10 percent for CCWD review and administration.
- Land Costs (if applicable): Land acquisition costs are included for improvements that are not in public rights-of-way or on property already owned by the District. It is assumed that future pipelines will be constructed within public rights-of-way. Land acquisition costs are included for the new wells and reservoir and pump station on the east side of the sphere of influence.

Table 9-5 provides the capital improvement projects and costs for the proposed new pressure zone. These are separated from the rest of the capital projects because this new pressure zone will likely be developed through a separate benefit assessment of the users within the zone, separate from the FRCs.

Table 9-4. Summary of Recommended Capital Improvements for Ultimate DWD System

Type of Project and Area Served	Project	Anticipated Timing & Assumptions	Estimated Cost (May 2020 $) (1)				
			Base Construction Cost	Total Construction Cost (2)	Project Implementation Allowance (3)	Land Cost	Total Capital Cost (1)
Systemwide Projects (Including Delta Coves)							
Treated Water Supply (4)	Future expansion of Randall-Bold WTP for additional 5 mgd capacity. WTP expansion cost includes replacement of Randall-Bold high lift pumps, additional clearwell capacity, and treatment upgrades and associated documentation.	Specific timing for additional capacity depends on available amount of groundwater supply, rate of District growth, and customer conservation. Assumes unit cost of $4.50 per gallon per day for WTP capacity increase.	$22,500,000	$30,400,000	$10,600,000	$0	$41,000,000
Treated Water Supply (4)	Projects between 2021-2030 at Randall-Bold WTP associated with maintaining existing 15 mgd capacity available for near-term development. Costs obtained from CCWD's draft 2020 Water Treatment Plant Master Plan Report. Costs shown herein = Total Project Costs x Unused Existing Capacity (approx. 33%) x DWD Ownership (37.5%)	Projects reflect: Sodium Hypochlorite and Liquid Ammonia Sulfate Conversion, Filter Upgrades, Electrical Upgrades (switchgear), Chemical tank Improvements, Lagoon Pump Replacement, Intermediate Ozone and Post Ozone Improvements, Filter Media replacement, Line Wash Water and Solids Lagoons.	NA	$1,700,000	$430,000	$0	$2,130,000
Groundwater Supply (5)	Groundwater Well #3: New well at 1.5 mgd average capacity. Well and pump station costs based on Stonecreek Well and Pump Station. Includes treatment system at $700k and generator at $197k. Assumes Land cost for 0.25 acre per site at up to $250,000 per acre for developable land.	Estimated timing: 1 additional well required. Costs reflect Stonecreek pump station bid of $734,000 in 4/10 @ ENR of 9,730, inflated to $747,503 for 7/10 ENR of 9,909; and Stonecreek Well bid of $154,167 in 9/09 @ ENR of 9,724, inflated to $157,100 for 7/10 ENR of 9,909.	$2,100,000	$2,800,000	$700,000	$63,000	$3,563,000
	Pipeline to connect new High School well to Blending Facility pipeline. Pipeline anticipated to consist of installation of 18-inch pipe w/ 2,000 ft unpaved construction, and 3,500 ft paved construction. See Table 8-1 for pipeline unit costs.		$1,200,000	$1,600,000	$400,000	$0	$2,000,000
	Groundwater Well #4: New well at 1.5 mgd average capacity. Assumes 2,000 ft of pipe in paved alignment to connect to Well #3. Includes treatment system at $700k and generator at $197k. Assumes 50% increase from Base to Total Construction Cost due to additional planning required. Assumes land cost for 0.25 acre per site at up to $250,000 per acre for developable land.	--	$2,600,000	$3,900,000	$980,000	$63,000	$4,943,000
Transmission Capacity (6)	Transmission pipeline in Neroly/Delta Roads, Sellers Avenue to Cypress Road (21,700 linear feet [LF] of 24-inch pipe at $325 per LF assuming paved unit costs; plus 400 LF total for two cased crossings at Marsh Creek and Railroad at $772 per LF). Does not include 1,566 LF installed under MERA for Riata project.	Needed for ultimate system. Specific timing for implementation will depend on review of future development proposals.	$7,400,000	$10,000,000	$2,500,000	$0	$12,500,000
Transmission Capacity (6)	Transmission pipeline parallel to Cypress Road (3,100 LF of 20-inch pipe at $300 per LF assuming paved unit costs).	--	$930,000	$1,300,000	$330,000	$0	$1,630,000
Transmission Capacity (6)	Transmission pipeline in from Reservoirs R-2 and R-3 to Neroly Road (2,700 LF of 24-inch steel pipe at $343 per LF assuming paved unit costs). Transmission pipeline coming out of Randall-Bold WTP (500 LF of 30-inch steel pipe at $392 per LF assuming paved unit cost).	Needed for ultimate system. Specific timing for implementation will depend on review of future development proposals.	$1,100,000	$1,500,000	$380,000	$0	$1,880,000
Transmission Capacity (6)	Transmission pipeline in Bethel Island Road (500 LF of 18-inch pipe at $279 per LF assuming paved unit costs and 650 LF of 18-inch pipe assuming trenchless unit cost of $557 per LF). Assumes 50% implementation allowance.	Needed for ultimate system. Specific timing for implementation will depend on review of future development proposals.	$500,000	$700,000	$350,000	$0	$1,050,000
New Corporation Yard Building	Construction of new corporation yard, field office, training room and ancillary facilities. Total Capital cost of $4M provided by District based on current level of project planning.	--	NA	NA	NA	NA	$4,000,000
Permanent Generators at Existing Wells	New permanent generators placed at South Park Well Pump Station (250kW/312.5kVA); Glen Park Well Pump Station (200kW/250kVA); Stonecreek Well Pump Station: 200kW/250kVA	New permanent generators placed at South Park Well Pump Station @ $214,873; Glen Park Well Pump Station @ $197,125; Stonecreek Well Pump Station @ $197,125.	$610,000	$800,000	$200,000	$0	$1,000,000
Stonecreek Well Iron and Manganese Removal System	Package treatment system to be installed at Stonecreek Well Pump Station. Treatment system quote of $350k received; assume additional improvements required will result in 2x construction price.	--	$700,000	$900,000	$230,000	$0	$1,130,000
SCADA System Expansion (7)	Upgrade main SCADA control system (PLCs and HMI workstations) for future expansion to serve ultimate system facilities	Estimated timing: 2025-2030 timeframe. Inflated per ENR CCI estimate of $322,900 in May 2018.	NA	NA	NA	NA	$340,000
Facilities Plan Updates; Distribution System Map Updates	Periodic updates of DWD's facilities plan to reflect actual growth and adjust facilities requirements for future growth; and periodic updates of the distribution system maps and facilities database to add new facilities as growth occurs.	Estimated timing: Updates approximately every 10 years to buildout. Cost assumes a total of 2 updates at $250,000 per update for the Facilities Plan and $100,000 per update for the system maps and facilities database, and bi-annual FRC updates at $7,000 each on average).	NA	NA	NA	NA	$840,000

Table 9-4. Summary of Recommended Capital Improvements for Ultimate DWD System

Type of Project and Area Served	Project	Anticipated Timing & Assumptions	Estimated Cost (May 2020 $) (1)				
			Base Construction Cost	Total Construction Cost (2)	Project Implementation Allowance (3)	Land Cost	Total Capital Cost (1)
Growth Related Project Management	Pre-planning, planning and related staff labor for growth projects.	Assumed to be constant for five years. Budgeted based on FY 20-21 staff costs of $505,000. (5 x $505,000 = $2,525,000)	NA	NA	NA	NA	$2,525,000
Subtotal for Systemwide Projects (Including Delta Coves)							*$80,531,000*
East of Jersey Island Road - Expansion Facilities (Not Including Bethel Island & Delta Coves)							
Storage and Pumping Facilities (8) (9)	Cypress Reservoir & Pump Station: First phase including all site work, 2.5 MG tank, and pump station building with capacity for 5 x 60 HP pumps (4 duty + 1 standby pumps, each at 1,200 gpm and 150 total dynamic head design point). Also assumes chemical storage @ $215k, tank mixer @ $68k, and generator @ $250k. Land cost for 3.7 acres at $250k per acre.	Must be in place to serve more than 775 residential units in East Cypress Specific Plan area (Planning Areas 1 through 5). Prior to that time, initial units will temporarily use available storage in the west part of the system.	$4,200,000	$5,700,000	$1,400,000	$925,000	$8,025,000
	Cypress Reservoir & Pump Station: Second phase with second 2.5 MG tank, add additional pump at pump station as needed, up to 5 duty pumps at build out.	Needed when demands in East Cypress Specific Plan Area reach 1.25 mgd on an average day basis, which is a total of approximately 2,380 residential units in Planning Areas 1 through 5.	$2,500,000	$3,400,000	$850,000	$0	$4,250,000
Subtotal for East of Jersey Island Road - Expansion Facilities (Not Including Bethel Island & Delta Coves)							*$12,275,000*
Bethel Island and Delta Coves							
Specific requirements and financing arrangements for storage and pumping facilities for new development on Bethel Island are addressed on a case-by-case basis. For example, the Delta Coves development is financing and constructing the required storage and pumping facilities for its development. Future service to other parts of the island would be addressed in a similar manner.							
GRAND TOTAL FOR ALL RECOMMENDED PROJECTS							***$92,806,000***

(1) All costs in these columns as marked are in May 2020 dollars, ENR CCI for San Francisco of 12,819.17.
(2) Unless noted otherwise, Total Construction Cost equals the base construction cost plus a 35% construction contingency to cover required work not yet identified at the planning level, unforeseen conditions, bid climate, and change orders during construction.
(3) Project implementation allowance equals 25% of total construction cost for all projects except the Randall-Bold WTP expansion to cover engineering design, construction services, environmental, permitting, and legal. The implementation allowance for the Randall-Bold WTP expansion project is 35% of total construction cost to include an additional 10% for CCWD project administration.
(4) Due to existing and planned DWD groundwater wells, current financial plan anticipates DWD owned capacity of Randall-Bold WTP will be 20 mgd, requiring expansion of the Randall-Bold WTP by 5 mgd.
(5) Groundwater well costs include standby power capability for use as emergency storage. Costs are based on the Stonecreek Well and Pump Station construction.
(6) Pipeline unit construction costs include valves and appurtenances, pavement removal and replacement, traffic control, and an average allowance for correction of utility interferences.
(7) Costs of projects for supply and distribution storage and pumping include the costs of SCADA equipment for those facilities. Work associated with this item assumed to include: new Monitoring panel PLC at the Corp Yard; new PLC at the DWD/Randall-Bold WTP control panel; new PLC at the Blending Facility, new Ethernet switch at the Corp Yard, radio system upgrades/replacement, Local Operating Panel replacements at South Park PS, Glen Park Well PS, and Blending Facility. Capital cost reflects rough estimate for all work to be performed.
(8) Reservoir costs assume above-ground concrete tanks, and include site work, valve vault, telemetry, piping and appurtenances. Costs for reservoirs east of Jersey Island Road include a soil/foundation allowance due to the poor soils in those areas.
(9) Distribution pump station costs assume an above-ground building, and include standby pump, standby power, and telemetry.

Table 9-5. Proposed New Pressure Zone Infrastructure

Type of Project	Project	Assumptions	Estimated Cost (May 2020 $) (1)				
			Base Construction Cost	Total Construction Cost (2)	Project Implementation Allowance (3)	Land Cost	Total Capital Cost (1)
Pipes (4)	9,400 LF of 12-inch pipe at $166 per LF; 2,900 LF of 18-inch pipe (length includes piping from new pumps to existing zone, new pipeline to connect to southeast areas) at $264 per LF.	Assumes installation in existing roadways.	$2,300,000	$3,100,000	$780,000	$0	$3,880,000
Storage and Pumping Facilities (5)	At Randall-Bold WTP: Four new variable speed pumps (3 duty plus 1 standby, each at 900 gpm at 215' head). Two new hydro-pneumatic tanks, each 15,000 gallons, horizontally positioned, approx. 10' diameter and 26 ft long.		$1,600,000	$2,200,000	$550,000	$0	$2,750,000
Gate Valves and PRVs	2x new 8-inch gate valves. 4x new 12-inch gate valve. 1 new 18-inch gate valve. 2x new 8-inch PRVs for 12-inch pipe.		$300,000	$410,000	$100,000	$0	$510,000
Reconfigure existing pipe crossings in roadway	4 intersection pipe crossing re-designs. 18" x 8" cross to be split into two separate mains 18" x 12" cross to be split into two separate mains (two intersections) 20" x 18" Tee. New line to be connected and the cross is to be split into two lines. 20" N/S 24" into 18" E/W	18" x 8" cross to be split into two separate mains = $21,009.93 18" x 12" cross to be split into two separate mains (two intersections) = $21,649.72 each 20" x 18" Tee. New line to be connected and the cross is to be split into two lines. 20" N/S 24" into 18" E/W = $26,596.68	$91,000	$123,000	$31,000	$0	$154,000
Total for Proposed New Pressure Zone Infrastructure							***$7,294,000***

(1) All costs in these columns as marked are in May 2020 dollars, ENR CCI for San Francisco of 12,819.17.
(2) Total Construction Cost equals the base construction cost plus a 35% construction contingency to cover required work not yet identified at the planning level, unforeseen conditions, bid climate, and change orders during construction.
(3) Project implementation allowance equals 25% of total construction cost for all projects except the Randall-Bold WTP expansion to cover engineering design, construction services, environmental, permitting, and legal. The implementation allowance for the Randall-Bold WTP expansion project is 35% of total construction cost to include an additional 10% for CCWD project administration.
(4) Pipeline unit construction costs include valves and appurtenances, pavement removal and replacement, traffic control, and an average allowance for correction of utility interferences.
(5) Distribution pump station costs assume an above-ground building, and include standby pump, standby power, and telemetry.

9.12 Environmental Factors

The California Environmental Quality Act (CEQA) does not require a formal environmental investigation and report for a study that involves only planning and determination of the feasibility, necessity, advisability, and timing of facilities that may or may not be constructed in the future. A Negative Declaration or Environmental Impact Report must be prepared in the future when the District considers approval and authorization of construction of a specific project. This environmental documentation will address impacts and mitigations for the specific projects as required by CEQA.

The future water system improvements identified in this Facilities Plan are pipelines, storage reservoirs, pump stations, and wells. These improvements will be similar to the District's existing water system facilities. Environmental factors were considered for construction of the existing water system facilities and will be considered for construction of any future improvements.

Generally, future pipelines would be constructed within public street rights-of-way and would have minimal environmental impacts. Some future facilities would be expansions of existing facilities, e.g., adding another tank or well at an existing site, and would also have minimal environmental impacts. New reservoirs and pump stations may be constructed in the eastern portion of the study area to serve new development. The need for such facilities would be addressed in the environmental documentation for the proposed development areas. Prior to construction of these facilities, a specific site would be selected and the applicable environmental documentation prepared addressing that specific site.

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