SRT consultants

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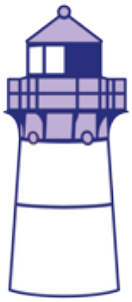

Acknowledgements

SRT Consultants gratefully acknowledges the support and contributions of the Montara Water and Sanitary District Board of Directors and staff in the development of this Water System Master Plan.

MWSD Board of Directors

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Joanne Marsh, Account Specialist

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2017
WATER SYSTEM MASTER PLAN

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µg/L	microgram per liter
ADD	Average Daily Demand
AL	Regulatory Action Level
AVWTP	Alta Vista Water Treatment Plant
AWWA	American Water Works Association
AWWTF	Airport Wells Water Treatment Facility
BACWA	Bay Area Clean Water Agencies
BAWSCA	Bay Area Water Supply and Conservation Agency
Cal-Am	California American Water Company
CCC	California Coastal Commission
CCR	California Code of Regulations
CCR	Consumer Confidence Report
CCWD	Coastside County Water District
CDFW	California Department of Fish and Wildlife
CDP	Coastal Development Permit
CDPH	California Department of Public Health
CDX	Coastal Development Exemption
CEQA	California Environmental Quality Act
CIP	Capital Improvements Plan
CPUC	California Public Utilities Commission
CT	Contact Time
DBP	Disinfection Byproduct
D/DBPR	Disinfectant and Disinfection Byproduct Rule
DDW	Division of Drinking Water
DLR	Reporting Detection Limit
DWR	Department of Water Resources
ES	Executive Summary
fps	feet per second
GAC	Granular Activated Carbon
GAPA	Gross Alpha Particle Activity
gp(c)d	gallons (per capita) per day
gpm	gallons per minute
GWR	Groundwater Rule
HAAs	Haloacetic Acids
HGL	Hydraulic Grade Line
I&C	Instrumentation & Controls
IDSE	Initial Distribution System Evaluation
IES	Ion Exchange System
IWMP	Integrated Watershed Management Plan
JPA	Joint Powers Authority
LCP	Local Coastal Program
LRAA	Locational Running Annual Average
(S)MCL(G)	(Secondary) Maximum Contaminant Level (Goal)
MBTE	methyl tertiary butyl ether

MDD	Maximum Daily Demand
MG(D)	million gallons (per day)
mg/L	milligrams per liter
MRDL(G)	Maximum Residual Disinfectant Level (Goal)
MWSD	Montara Water & Sanitary District
NAW	North Airport Well
ND	Not Detectable at Testing Limits
NOAA	National Oceanic and Atmospheric Administration
OEHHA	Office of Environmental Health Hazard Assessment
OMMP	Operation, Maintenance and Monitoring Plan
OSHA	Operational Safety and Health Administration
pCi/L	Picocuries per liter
PDWS	Primary Drinking Water Standards
PFD	Process Flow Diagram
PHD	Peak Hourly Demand
PHG	Public Health Goal
ppb	parts per billion
ppm	parts per million
PRV	Pressure Regulating Valve
PRWTP	Pillar Ridge Water Treatment Plant
psi	pounds per square inch
PSV	Pressure Sustaining Valve
PVC	Polyvinyl chloride
PWP	Public Works Plan
PWS	Public Water System
(L)RAA	(Locational) Running Annual Average
ROW	right-of-way
SAM	Sewer Authority Mid-Coastside
SAW	South Airport Well
SCADA	Supervisory Control and Data Acquisition
SDWA	Safe Drinking Water Act
SDWS	Secondary Drinking Water Standards
SFPUC	San Francisco Public Utilities Commission
SOCs	Synthetic Organic Chemicals
SWRCB	State Water Resources Control Board
TCP	1,2,3-Trichloropropane
TCR	Total Coliform Rule
TTHMs	Total Trihalomethanes
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VFD	Variable Frequency Drive
VOCs	Volatile Organic Compounds
WCC	Water Capacity Charge
WTP	Water Treatment Plant

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EXECUTIVE SUMMARY

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Executive Summary

The 2017 Water System Master Plan Update (2017 Master Plan) supports the long-term resource planning of water supply and water system facilities for the current and future demands of the Montara Water and Sanitary District (MWSD or District), and creates a basis for MWSD's Capital Improvements Program (CIP). MWSD provides water, sewer, and trash disposal services to the coastal communities of Montara, Moss Beach, and adjacent areas located north of El Granada and south of the Devil Slide Tunnel, in unincorporated San Mateo County, California. The 2017 Master Plan describes and assesses the existing water infrastructure, examines current and projected water demands, and outlines viable alternatives to allow the District to fulfill its mission:

> *To sensitively manage the natural resources entrusted to our care, to provide the people of Montara-Moss Beach with reliable, high quality water, wastewater, and trash disposal at an equitable price, and to ensure the fiscal and environmental vitality of the District for future generations. Be open to providing other services desired by our community.*

Several studies developed between 1996 and 2016 preceded this master planning effort and have evaluated alternative water supply options for the District's service area. The 2017 Master Plan updates and expands upon MWSD's *2011 Water System Master Plan Update*, prepared by SRT Consultants (SRT). The objectives of this 2017 Master Plan include addressing the following key issues for the MWSD water system:

- Assess current and future water supply reliability to ensure adequate daily service and fire protection for the District's customers;
- Assess the water system's historical water quality and treatment infrastructure reliability;
- Assess the hydraulic capacity of the District's existing distribution and storage facilities; and
- Develop a CIP to address existing deficiencies in the water system's infrastructure and future water demands, consistent with the current San Mateo County Local Coastal Program (LCP).

MWSD Water System

MWSD customers in eight (8) pressure zones are supplied through a distribution system that receives water from seven (7) treated water storage tanks, twelve (12) groundwater wells, and the surface and groundwater treatment facilities at the Alta Vista site, the Pillar Ridge site, and at wellheads. The MWSD water system includes raw (untreated) water and treated water storage facilities. Raw water diverted from Montara Creek is stored in an updated 77,000-gallon concrete raw water storage tank. The District's seven (7) treated water storage tanks have a combined capacity of about 1.4 million gallons (MG) for operational, emergency, and firefighting uses.

Water is conveyed to MWSD's customers through a network of pipes approximately 150,000 feet long ranging in diameter from two (2) to sixteen (16) inches, two (2) booster pump stations, and twenty-eight (28) Pressure Regulating Valve (PRV) stations. The water system provides potable water to over 6,000 residents, as well as commercial and industrial customers. Approximately 148 private fire protection (PFP) meters are also connected to the District's system; these meters only draw water in the event of a fire. In 2015, the MWSD's water system was consolidated with the Pillar Ridge water system, which counts 229 residences and serves over 850 people.

Supply and Consumption

MWSD is exclusively served by groundwater sources from the San Mateo Coastal Basin Aquifers and surface water from the Montara Creek. Each source has a rated capacity established at the time it was brought on line; however, all sources typically operate below their respective rated capacities. Rated capacities are used to determine the reliable capacity and the maximum serviceable demand of the water system. MWSD sources currently have a combined rated capacity of 677 gallons per minute (gpm), as follows:

Twelve (12) active groundwater wells	602 gpm
Montara Creek surface water	75 gpm
Total source capacity	**677 gpm**

The reliable capacity of the system is representative of the most probable true capacity, and is defined as the capacity of the system with the largest source out of service. The following calculation determines the reliable supply of the system, assuming the Alta Vista Well is out of service:

Total source capacity	677 gpm
Alta Vista Well capacity	(150 gpm)
Total reliable capacity	**527 gpm**

The drought supply capacity is representative of the District's capacity under the most severe drought conditions, and is considered an extremely conservative planning value. The industry-wide standard for calculating drought supply capacity is by reducing the total rated supply capacity by fifty (50) percent, as follows:

Total source capacity	677 gpm
Total drought capacity	**339 gpm**

According to 2016 monthly production records, the average production rate of the twelve (12) wells was 365 gpm while in operation, or about 61 percent of their rated capacity. Between November 2007 and December 2014, prior to the addition of three (3) Pillar Ridge wells, the average production rate of the nine (9) wells was 337 gpm while in operation, or about sixty-two (62) percent of their rated capacity. A summary of average production rates for each source for this time period is presented in Table ES-1. Detailed production data for 2004 - 2016 can be found in Appendices A and B.

Table ES-1 Average Monthly Production Rates, 2004 – 2016

MWSD Source	Rated Capacity, gpm	Annual Average Production Rate, gpm [a]
Alta Vista Well [b]	150	100
North Airport Well	100	72
South Airport Well	55	26
Airport Well No. 3	100	38
Drake Well	35	36
Portola Well No. 1	9	5
Portola Well No. 3	10	7
Portola Well No. 4	16	7
Wagner Well No. 3	70	58
Pillar Ridge Wells No. 1 – 3 [c]	57	40
Montara Creek Surface Diversion	75	62
TOTAL	**677**	**450**

[a] Production rates are the operating rates of each source when in use. The annual average is determined from the operating production rates of each source, averaged over the total operating time.
[b] The Alta Vista Well was added to the MWSD system in November 2007.
[c] The Pillar Ridge Wells were added to the MWSD system in January 2015.

MWSD customer billing records showing the volume of water delivered to metered customers between 2004 and 2016 were used to evaluate the annual consumption trends over the thirteen-(13)-year time period (2004 through 2016). The general decrease in consumption can be attributed to the District's implementation of the meter replacement program, leak detection program, and voluntary conservation by the District's customers. A summary of the consumption data analysis is presented in Table ES-2.

Table ES-2 Annual Consumption Rates, 2004 – 2016

Year	Total Consumption, MG	Average Daily Water Use, gpd
2004	117.41	321,671
2005	114.99	315,041
2006	111.17	304,575
2007	104.61	286,603
2008	106.72	292,384
2009	98.93	271,041
2010	92.83	254,329
2011	87.75	240,411
2012	93.11	255,107
2013	94.67	259,367
2014	86.48	236,921
2015	89.53	245,274
2016	90.08	246,754
Average	99.10	271,501

From this data, average and per capita water use values were calculated. The average annual consumption is approximately 99.1 million gallons (MG) and the average daily consumption is approximately 271,501 gallons per day (gpd).

MWSD’s source production is dependent upon customer consumption, as the sources only produce water in response to customer demands. The difference between the water system’s production and consumption rates represent system losses, known as unaccounted-for-water. Unaccounted-for-water represents water used for fire flow testing, water main flushing, repairs, filter backwash operations at the WTPs, and distribution system leaks. The system losses for the District have been estimated at 8 percent of total production, the average calculated from the 2004 through 2016 time

period assessed herein. This value is below the industry-wide standard of 10 percent unaccounted-for-water for a well-operated system.

Current and Future Demand

Water demand volume and trend projections provide the basis for sizing and prioritizing improvements to water facilities and identifying the need for additional water supply sources or facilities. Average daily, maximum daily, and peak hourly demands (ADD, MDD, PHD, respectively) were calculated from 2004 through 2016 monthly production records from all of the District's water supply sources. Population growth, future water demand volumes, and the allocation of available water sources among the various sectors in the community were estimated using the current demand calculations and data from the *2013 County of San Mateo Local Coastal Program Policies (LCP) Update.*

Since MWSD's water source production is directly dependent upon customer demand, recorded production values reflect the water system's demand and, therefore, the supply required to support the customer water use. Table ES-3 presents MWSD's average and peak water demands based on the production records between 2004 and 2016. On average, MWSD water sources produced 296,018 gpd over the past thirteen (13) years, with an annual average minimum and maximum production of 260,983 gpd in 2014 and 359,023 gpd in 2004, respectively. The data trend generally indicates the production decreasing across the thirteen (13) years.

Table ES-3 MWSD Water Use, 2004 – 2016

Year	MWSD Production (gallons)	Water Use (gallons)	Peaking Ratio
Average Daily Demand (ADD)	296,018	271,501 [b]	1.0
Maximum Daily Demand (MDD)	478,230 [a]	438,919 [b]	1.6 [c]
Maximum Hour (PHD)	32,069 [d]	29,433 [b, d]	2.6
Design Fire (2 hours)	240,000	240,000	N/A

[a] Based on daily production data for maximum production months, 2006 – 2016. 2004 and 2005 data was not available.
[b] Calculated from ADD and MDD production values, respectively, with an 8.2-percent reduction for unaccounted-for-water.
[c] Calculated empirically from the system's MDD and ADD values.
[d] Calculated utilizing a peaking ratio of 2.6, as used in previous MWSD Master Plans.

The per capita daily water demand was established as approximately 66 gallons per capita per day (gpcd) based on the MWSD water production and water connection records, the 2010 U.S. Census population data for Montara and Moss Beach

communities, number of residential water connections (1,620), and the population and the number of residences of the Pillar Ridge community (850 persons, 229 connections) at the time of the 2015 consolidation. This post-consolidation per capita daily water demand was determined by calculating the weighted average of the per capita demand of Montara and Moss Beach from 2004 to 2014 and the per capita demand of the consolidated system since 2015. Since the consolidation in 2015, the water supplied to Pillar Ridge through their one (1) meter is no longer absorbed in the Montara and Moss Beach per capita demand. The post-consolidation household size of 2.84 persons per household was similarly defined by calculating the weighted average of the household size of the Montara/Moss Beach area and of Pillar Ridge.

The projected demands on the system for future years were based on the following assumptions:

- The population already residing or owning property in the service area that is not connected to MWSD will be connecting to system at a rate similar to the historical rate of two (2) well conversions per year, and
- The District will serve new homes being built in the service area in accordance with the population growth rate of one (1) percent, or 20 units per year, as established in the *2013 County of San Mateo LCP Update* and the calculated per capita demand. Table ES-4, below, presents the projected ADD and MDD with the addition of up to 1000 connections.

Table ES-4 Projected Population and Demand Estimates

Connections Added	Number of Connections	Total Population Served [a]	Projected Average Daily Demand (gdp) [b]	Projected Maximum Daily Demand (gdp) [c]
200	1,820	5,824	333,506	533,609
400	2,020	6,392	370,994	593,590
600	2,220	6,960	370,994	653,571
800	2,420	7,528	445,970	713,552
1000	2,620	8,096	483,458	773,533

[a] Calculated using the household size of 2.84 of the post-consolidation system
[b] Calculated using the per capita demand of 66 gpcd
[c] Calculated using the empirical factor of 1.6 derived from the system's MDD and ADD values

System Reliability

To determine MWSD's water system reliability, the MDD was compared to the reliable supply capacity. Table ES-5 shows the current available capacity of the water system and compares this volume of water to the MDD of the current population within the MWSD service area. As shown, the water system is able to support the demands of the projected population with slight deficit appearing when 1000 new connections are added to the system.

Table ES-5 Water Supply Projections

Year	Reliable System Capacity, gpd [a]	MDD, gpd	Supply Available, gpd
2016 - current	758,880	478,230	280,650
200 new connections	758,880	533,609	225,271
400 new connections	758,880	593,590	165,290
600 new connections	758,880	653,571	105,309
800 new connections	758,880	713,552	45,328
1000 new connections	758,880	773,533	-14,653

[a] Calculated assuming all sources are operating at rated capacity for 24 hours per day

Water Quality

MWSD's water quality is monitored and reported in compliance with all applicable federal and state regulations. The United States Environmental Protection Agency (USEPA) that is responsible for setting standards and assuring compliance promulgates regulations at the federal level. The State Water Resources Control Board (SWRCB) Division of Drinking Water (DDW) maintains regulations at the State level. DDW requires that all public water systems (PWS) monitor each potable water source and distribution system for chemical, biological, and radiological contaminants, disinfection residuals, and disinfectant byproducts.

To ensure high water quality, MWSD owns and operates treatment facilities and associated processes, including a surface water treatment plant (WTP), a groundwater WTP, and wellhead treatment units at some of the District's twelve (12) production wells for nitrate treatment and disinfection. The Alta Vista Water Treatment Plant (AVWTP), the District's surface WTP, treats water diverted from Montara Creek by coagulation, contact clarification, filtration, and chlorination. The Pillar Ridge WTP treats groundwater

from the Corona Well, Culebra Well, and Retiro Well using aeration, settling, and iron and manganese filtration, and chlorination.

Water quality is reported to the District's consumers through the annual Consumer Confidence Report (CCR), as required by the Safe Drinking Water Act. MWSD is in compliance with all water quality regulations based on the 2016 MWSD CCR, included in Appendix C. The following constituents were detected below enforceable regulatory limits, but are mitigated by the District to ensure safe drinking water in case of future water quality concerns:

- Copper and lead were found at levels *below* the Regulatory Action Level (AL) of 1.3 and 15 ppm, respectively, in the 2015 residential tap sampling.
- Arsenic was detected at the Alta Vista Well at levels *below* the Maximum Contaminant Level (MCL) but above five (5) ppb.
- Fluoride was found at the Corona Well at levels *below* the MCL but above one (1) ppm.
- Manganese was found at levels that exceeded the SMCL of fifty (50) ppb and iron was found at levels that exceeded the SMCL of 300 ppb. Secondary MCLs are set to protect against aesthetic effects of water and exceeding SMCLs poses no health risks.

Distribution System and Storage Requirements

The capacities and deficiencies of the MWSD water system were evaluated based on a range of established demands and a hydraulic model analysis. Using the hydraulic model and current and future demand analyses, the District's distribution and storage facilities were evaluated against planning and design parameters adopted by the District's Board of Directors The results of the evaluation were used to inform the storage capacity requirements, distribution system deficiencies, and the CIP. For the purpose of this Master Plan, the required sizing of facilities to provide sufficient quantities of water at adequate pressure is based on the following demand scenarios: MDD, and Design Fire Flow.

The District's potable water distribution system was simulated using the WaterCAD Analyzer software to determine if system components are adequate, based on the District's planning and design parameters, under various water demand conditions. The WaterCAD Analyzer hydraulic model simulates water system operations and generates

information on pressure, flow, velocity, and headloss that can be used to analyze the performance of the system and identify its deficiencies. The scenarios modeled include maximum day and fire flow analyses for current and future demand conditions.

The total required volume of storage in a water system includes water for operational, emergency, and fire-fighting uses. Operational storage is directly related to the amount of water necessary to meet peak demands, and therefore is the only storage value related to the number of customers connected to the District's system. The intent of operational storage is to provide the difference in quantity between the customers' peak demands and the system's available supply.

Water storage for fighting fires is regulated in quantity by the National Fire Code, Insurance Service Office, and local Fire District. The fire fighting requirements established for the District's service area is 2,000 gpm for a period of 2 hours, or 240,000 gallons.

The volume of water allocated for emergency uses is a policy decision based on the historical record of emergencies experienced, the amount of time which is expected to lapse before the emergency can be corrected, and the ability of the utility to recover from these emergencies. There are three (3) types of emergency events that a utility typically prepares for: minor emergencies, major emergencies, and natural disasters. The susceptibility of MWSD's water system to these emergency situations have been evaluated based on the District's current equipment and approach to handling potential emergency situations.

Table ES-6 summarizes MWSD's established storage goals for current demands and for expected future growth. The total storage goal is a target value that the District has set for the operation of its system and is not a mandated requirement. To date, MWSD is in compliance with regulations related to water storage requirements and has sufficient storage to serve existing customers. Additional connections increase the operational and emergency storage goals, however, the system's current storage volume can handle the projected storage needs.

Table ES-6 MWSD Storage Goals

Storage Goal Category	Storage Volume, gallons					
Condition (Added Connections)	*Current (2016)*	*200*	*400*	*600*	*800*	*1000*
ADD	*296,018*	*333,506*	*370,994*	*408,482*	*445,970*	*483,458*
MDD	*478,230*	*533,609*	*593,590*	*653,571*	*713,552*	*773,533*
Operational Storage (25% of MDD)	119,558	133,402	148,398	163,393	178,388	193,383
Emergency Storage (2 Days at ADD)	592,036	667,012	741,988	816,964	891,940	966,916
Fire Fighting Storage (2 hours at 2,000 gpm)	240,000	240,000	240,000	240,000	240,000	240,000
Total Storage Goal	*951,593*	*1,040,414*	*1,130,385*	*1,220,357*	*1,310,328*	*1,400,299*
Existing Storage	*1,402,000*	*1,402,000*	*1,402,000*	*1,402,000*	*1,402,000*	*1,402,000*

Capital Improvement Program

The analysis presented in the 2017 Master Plan demonstrates that the water system requires improvements to address system deficiencies that exist under future demand scenarios and fire event simulations. The improvements are designed to provide sufficient response under maximum daily operational scenarios, fire flow, and other emergency conditions. These potential improvements make up the District's CIP and include the rehabilitation of the existing infrastructure, addition of new facilities, and implementation of a repair and replacement and preventive maintenance program. The proposed improvements are categorized *Priority Level 1* and *Priority Level 2,* based on the District's CIP prioritization criteria.

Priority Level 1 projects almost exclusively address the system deficiencies related to adding new customers to the system, as most of the identified system deficiencies are due to adding new connections to the system and therefore increasing demand. The projects and actions listed below would allow the District to address system deficiencies and continue to operate an efficient and reliable system. The near-term improvements will funded entirely through the Water Capacity Charge (WCC). *Priority Level 2* projects include the required improvements to address system renewal and replacement needs

and ensure sufficient response under daily operational scenarios, fire flow, and emergency conditions. These projects serve existing District's customers and are funded by the water rate revenues.

Table ES-7, below, summarizes *Priority Level 1* projects formulated to add new District customers and *Priority Level 2* projects meant to maintain efficient service to the existing customers.

Table ES-7 Priority 1 & 2 Level CIP

Program/Project	Total Program/Project Cost
New Customers CIP – Priority Level One	
1. Water Main Upgrades Program	$7,484,500
2. Existing Well Upgrade Program	$3,389,000
3. New and Upgraded PRV Stations' Program	$1,856,000
4. Emergency Generator Upgrades Program	$889,500
5. Schoolhouse Booster Pump Station Upgrade	$1,545,000
6. Portola Tank Telemetry Upgrade	$250,000
7. Develop Additional Supply Reliability	$1,984,000
8. Big Wave NPA Main Extension Project	$2,030,000
Existing Customers CIP – Priority Level Two	
1. Distribution System Renewal and Replacement Program	$980,000
2. Water Conservation Program	$45,128
3. Storage Tank Rehabilitation Program	$250,000
4. Emergency Generator Replacement Program	$235,000
5. Vehicle Replacement Fund	$81,000
6. Pillar Ridge Rehabilitation Program	$445,000

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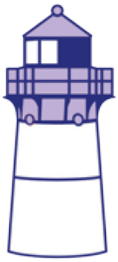


SECTION ONE
Introduction

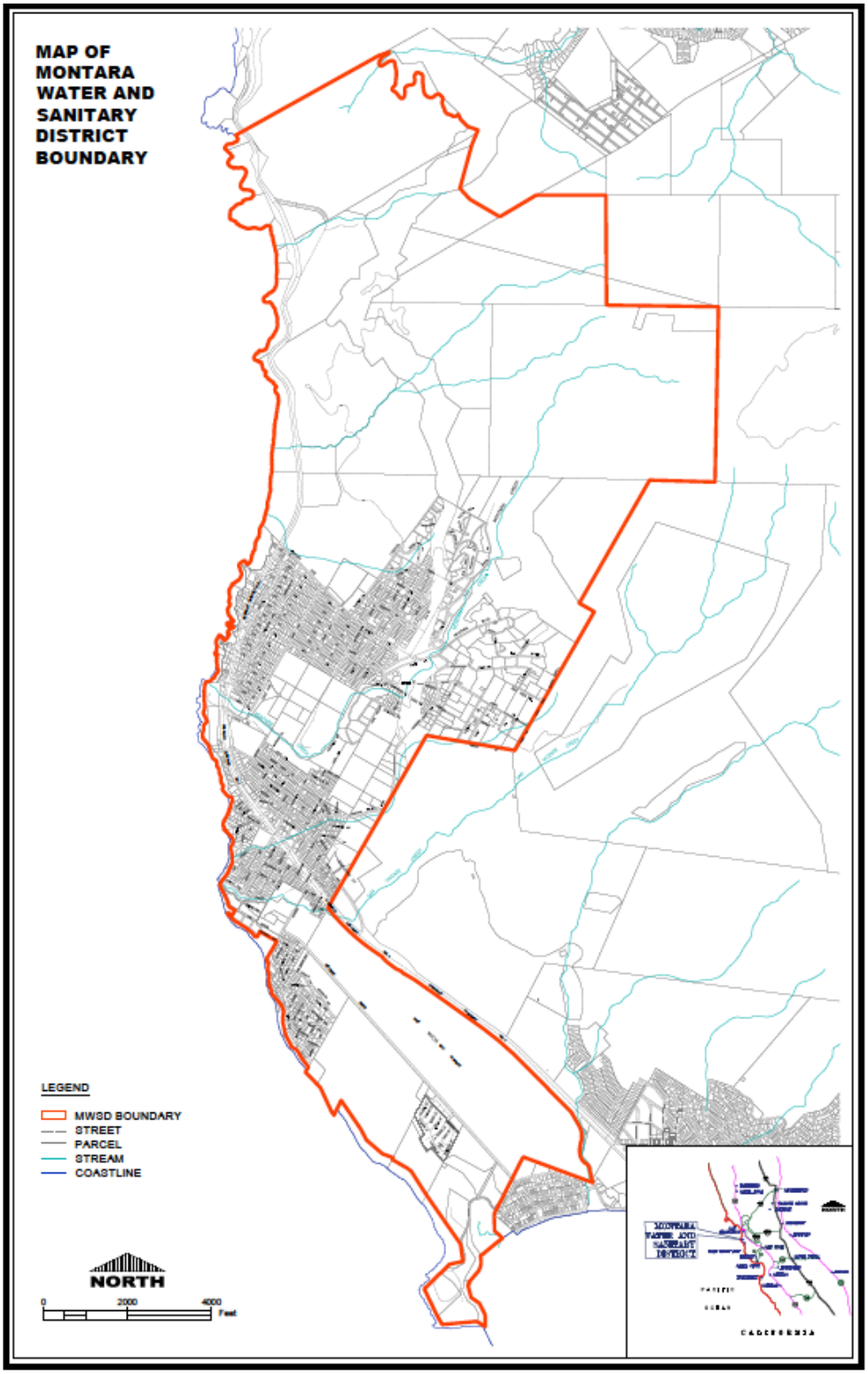
1. Introduction

The Montara Water and Sanitary District (MWSD, or District) provides water, sewer, and trash disposal services to the coastal communities of Montara, Moss Beach, and adjacent areas in unincorporated San Mateo County, California. In 2003, the Board of Directors adopted the following statement as the District's mission:

> *To sensitively manage the natural resources entrusted to our care, to provide the people of Montara-Moss Beach with reliable, high quality water, wastewater, and trash disposal at an equitable price, and to ensure the fiscal and environmental vitality of the District for future generations. Be open to providing other services desired by our community.*

The District owns and operates water storage, treatment, and distribution facilities ("water system" or "water infrastructure") that provide potable water to over 6,000 people. The water system serves 1,620 domestic accounts, 98-percent of which are residential connections, distributed among eight (8) pressure zones. The water served is diverted from a surface water source, Montara Creek, and extracted from twelve (12) groundwater wells that withdraw water from Montara Creek and Denniston Creek groundwater basins. The system also includes a surface water treatment plant (WTP), a groundwater WTP, seven (7) potable water storage tanks, and over 150,000 feet of distribution system pipelines.

Figure 1 MWSD Service Area



1.1. Objective

The objective of the 2017 Water System Master Plan Update (Master Plan) is to assess the District's current and future water supply needs, the adequacy of the system's infrastructure, and to create a foundation for the MWSD's Capital Improvement Plan (CIP). This Master Plan describes and assesses the existing water infrastructure, examines current and projected water demands, and outlines viable alternatives that will allow the District to fulfill its mission.

The objectives of this Master Plan include addressing the following key issues for the District's water system:

- Assess current and future water supply reliability to ensure adequate daily domestic water service and fire protection for the District's customers;
- Assess the water system's historical water quality and treatment infrastructure reliability;
- Assess the hydraulic capacity of the District's existing distribution and storage facilities;
- Develop a CIP to address existing deficiencies in the water system's infrastructure and future water demands; and
- Assess the ability of the system to handle the residential growth now allowed per the LCP and the implementation of planned large development projects (e.g., Big Wave and Sierra 1).

Figure 2 portrays the District's planning approach to assess its water system needs.

Figure 2 MWSD Master Plan Approach

MWSD Now	MWSD Needs	How MWSD Can Address Needs
Reliably Serving Customers with Water that meets all Drinking Water and Safety Standards ***Facilities*** Water Storage Tanks Wells and Pumps Surface Water Diversion Surface Water WTP Groundwater WTP Wellhead Treatment Distribution System ***Sources*** Montara Creek Airport Wells (3) Portola Estate Wells (3) Pillar Ridge Wells (3) Wagner Well Drake Well Alta Vista Well	• Ability to Reliably Serve Current and Future Water Demands • Continue to Serve Water Meeting All Drinking Water and Safety Standards • Function Reliably and Cost-effectively • Resource Sustainability	***Near-term:*** • Implement facility improvements • Explore options for additional water supply ***Long-term:*** • Develop additional water supply to meet future demands and secure supply reliability • Implement facility improvements ***Continuous*** • Water Conservation Program to maintain low per capita usage • Groundwater Monitoring

Facilities required to address the water system needs must be sized to provide sufficient quantities of water at adequate pressure while meeting the system demands. For the purpose of this Master Plan, the ability of the system to meet demands has been evaluated based on various flow scenarios, including:

- Maximum Day Demand
- Design Fire Flow

Water quality considerations have a major impact on the type and location of the facilities recommended for implementation in this Master Plan. Additionally, the monitoring and control of equipment controls, process units, backup equipment, and backup of power provisions ensures the water system's operational and seismic reliability. This monitoring process is essential in meeting the water supply and water quality requirements of the District.

1.2. Background

In May 2002, the Montara Sanitary District filed a condemnation action to acquire the local water system. The District's filing came after the voters of Montara and Moss Beach, with 81-percent of the votes in favor, authorized the issue of up to $19 million in general obligation bonds to purchase and rehabilitate the water system.

The Board of Directors of the Montara Sanitary District, in a special meeting held on May 29, 2003, approved a Settlement and Asset Purchase Agreement with the California-American Water Company (Cal-Am), which owned the water system serving Montara, Moss Beach, and adjacent areas. The Agreement was negotiated under the auspices of the County of San Mateo Superior Court.

The Agreement approved on May 29, 2003 authorized the Montara Sanitary District to take possession of Cal-Am's Montara Water System and all associated assets on August 1, 2003. In a document dated August 1, 2003, the California Department of Public Health [CDPH, now the State Water Resources Control Board (SWRCB) Division of Drinking Water, DDW] approved the application for a permit amendment requested by the then re-named Montara Water and Sanitary District. Domestic Water Supply Permit No. 02-04-98P-4110010, issued on February 23, 1998 by CDPH to the Citizens Utility Company of California and amended in 2002 for Cal-Am's acquisition of the water system, was again amended in 2003 to recognize MWSD's ownership and operation of the water system.

1.3. Previous Studies

Several studies preceded this master planning effort and have evaluated alternative water supply options for the District's service area:

- The *1996 Water System Master Plan Update* prepared by Montgomery Watson for the Citizens Utility Company of California evaluated potential new groundwater wells in the Montara and Denniston basins; rehabilitation of existing wells; water transfers from Federal, State, or local agencies in the form of water rights or entitlement transfers; water purchases from neighboring districts; increased diversion from Montara Creek; new local surface water diversions; and seawater desalination.
- The *1999 Montara Water Supply Study for Montara Sanitary District* prepared by the California Department of Water Resources (DWR) examined the development of new groundwater and surface water sources; new water

contract; water transfers; water from dewatering of Devil's Slide; seawater desalination; use of recycled water for irrigation and aquifer recharge; and increased water conservation.

- The *1999 Preliminary Feasibility Assessment of Groundwater in the Martini Creek, McNee Ranch and Upper Montara Area*, prepared by Balance Hydrologics for the Montara Sanitary District, indicated that additional local groundwater may be available, recommended conjunctive use of surface and groundwater resources, identified several potential well locations for further study, and recommended measuring flows on Martini Creek.
- The *2000 Water System Master Plan Update* prepared by Montgomery Watson for Citizens Utility Company of California elaborated on the alternatives put forth by the previous studies.
- The *2002 Montara Water Supply Source Study, Groundwater Alternatives* prepared by Bookman-Edmonston for Cal-Am discussed 42 potential sources of groundwater.
- The *2004 Water System Master Plan*, prepared by Olivia Chen Consultants
- The *2005 Water System Master Plan Addendum*, prepared by SRT Consultants
- The *Bay Area Clean Water Agencies (BACWA) Integrated Watershed Management Plan (IWMP)* compiled by BACWA, included the MWSD Groundwater Exploration Project, which consisted of drilling up to two (2) test wells for the purpose of characterizing the aquifers in terms of optimal potable water supply use.
- The *2007 Brackish Water/Seawater Desalination Feasibility Study*, prepared by RBF Consulting for MWSD, indicated that the construction of a seawater desalination facility on the District's property appears feasible.
- The *2011 Water System Master Plan Update*, prepared by SRT Consultants.

1.4. Previous Water Supply Augmentation Efforts

The aforementioned studies completed since 1996 were consistent in many of their findings; the discussion in this section summarizes the results, research, testing, and evaluation of alternatives as they relate to potential future water supply sources for MWSD.

1.4.1. Groundwater

Groundwater represents the least costly, most readily available source of water supply for MWSD. Completed studies have estimated capacities at various locations, but ultimately concluded that further investigations are required to define the extent and reliability of groundwater resources. The District investigated potential new groundwater sources in the Martini and Montara Creek basins in 2004 and 2005; these exploration efforts led to the addition of the Alta Vista production well with a rated capacity of 150 gallons per minute (gpm) as permitted by the California Coastal Commission (CCC).

The District's pursuit to secure rights to conduct groundwater exploration work within the Caltrans Right-of-Way (ROW) east of Montara has continued. Caltrans secured this ROW over thirty years ago for the construction of a highway, however, the project was annulled. The ROW land ownership may be transferred to another governmental entity. Groundwater exploration performed by the District has confirmed this land's potential for containing groundwater sources to address the District's future supply needs, and/or to replace current sources of low quality. Progress on this effort is summarized in the following sections.

1.4.2. Surface Water

The studies produced between 1996 and 2000 advocated for the use of surface water sources to the maximum extent possible; however, lack of sufficient hydrologic information precluded the preparers of the reports from estimating the available volumes of surface water of adequate quality for development. In addition, concerns from resource agencies including the California Department of Fish and Wildlife (CDFW), and the National Oceanic and Atmospheric Administration (NOAA) regarding the diminishment of the fish population in Coastside creeks and endangered species protection, prohibit any new and/or increased creek diversions in the District's service area. No additional consideration to augmenting surface water supply has been considered by the District since the *2011 Water System Master Plan Update*.

1.4.3. Water Transfers

Early studies of the MWSD water supply deemed water transfers and water wheeling as feasible options for augmenting the MWSD water supply. However, as of the *2000 Master Plan Update,* it was determined that there were no reliable water supplies available for purchase from outside of the service area. 2003 and 2008 correspondence from the Bay Area Water Supply and Conservation Agency (BAWSCA) firmly stated that BAWSCA had no ability to secure water transfers from the San Francisco Public Utilities

Commission (SFPUC) for MWSD due to the terms of its existing contracts with SFPUC and the SFPUC's water allocation commitments to its existing wholesale customers.

Dewatering of the Devil's Slide area by the Department of Transportation was additionally evaluated in the *1996 Master Plan Update* and the *1999 DWR Study*. The project would have involved constructing a five (5)-mile-long pipeline to convey water to MWSD from the slide area. The feasibility, cost-effectiveness, and long-term reliability of this supply could not be assured, the water was both scarce and of poor quality. The District has considered no additional water transfer options since the *2011 Water System Master Plan Update*.

1.4.4. Recycled Water

The *2000 Master Plan Update* first included water reclamation as a potentially feasible solution to meet the short-term and long-term water supply needs of the District. Options for the transmission of treated wastewater from nearby wastewater treatment facilities or via the construction of decentralized wastewater treatment facilities within the District's service area continue to be evaluated.

1.4.5. Water Conservation

Contrary to prior studies, the *2011 Master Plan Update* considered water conservation as a reliable, additional supply source. This report documented an 18-percent reduction in water demand, equivalent to 40 gpm, from water conservation efforts implemented by the District, including water main leak reduction and operational changes, and from significant decreases in water use by District customers. This reduction was considered sustainable and, therefore, became an augmentation of the District's water supply. Despite MWSD's historically low per capita rate of water consumption, the *2011 Master Plan Update* recommended further water conservation measures to develop additional supply reliability.

1.4.6. Brackish and Seawater Desalination

The feasibility of seawater desalination by MWSD was evaluated in several of the listed studies. The *1996 Master Plan Update* proposed desalination as a source of additional water supply, but it was deemed economically infeasible for the District. The *2000 Master Plan Update* reevaluated seawater desalination and concluded that it may become more cost-effective in the future and should be further considered.

In 2007, the District began work on a *Brackish Water Desalination Study.* When no brackish water was discovered, the study instead focused on the feasibility of seawater

desalination on MWSD property, with full agreement from the Department of Water Resources (DWR), the study's funding agency. The existing outfall remaining from the decommissioned wastewater treatment plant on the District's property was considered as a potential intake for a desalination facility. The study found seawater desalination to be technically feasible.

Participation in a regional seawater desalination project with other Midcoast water purveyors has also been discussed as a long-term water supply option. Brackish water desalination at a location other than the District property also remains a feasible option for the District's water supply augmentation.

1.5. New Supply

The identification of supplemental water sources has been a central issue in the Montara/Moss Beach area since 1986, when the California Public Utilities Commission (CPUC) established a moratorium on new water connections based on the finding that water supplies were inadequate to meet demands on the system.

1.5.1. Caltrans ROW

Even prior to finalizing the water system acquisition process, MWSD proactively initiated a study and procured permits for groundwater exploration, and has continued to do so, in particular within the Caltrans ROW previously discussed.

With the appropriate water rights and land agreements, groundwater within the Caltrans ROW land could be used to address the District's future supply needs, and/or to replace current sources of low quality.

1.5.2. Pillar Ridge Sources

In January 2015, MWSD consolidated the Pillar Ridge Manufactured Home Community Water System (Pillar Ridge) and thus acquired supply sources, storage facilities, and treatment infrastructure. By consolidating with the Pillar Ridge water system, MWSD was no longer required to reserve 35 gpm of its supply and additionally procured the operation of three (3) groundwater wells with a total rated capacity of 57 gpm. These wells range in depth from 50 to 70 feet, and have the following rated capacities:

- Corona Well: 20 gpm
- Culebra Well: 25 gpm
- Retiro Well: 12 gpm

1.5.3. Existing Well Rehabilitation

In addition to having these groundwater supply additions, MWSD has assessed the potential for rehabilitating existing wells to restore them to their original pumping capacities. In 2014, the District rehabilitated Portola Wells No. 3 and 4 as prescribed in the *2011 Master Plan Update Near-Term CIP.* The Portola Wells Production Restoration Project called for re-drilling and rehabilitation of the wells and replacement of pumping equipment to restore the wells to their original rated capacities. Portola Well No. 3 was re-drilled to a depth of 600 feet and its instrumentation and pumping equipment were upgraded. These efforts improved the rated capacity of the well. This Portola Wells No. 3 production increase replaces the South Airport Well (SAW) production as SAW transitions to standby status, as directed by DDW. This well rehabilitation project therefore offsets the loss of the SAW fifty-five (55) gpm rated capacity. This well rehabilitation project ensures a smooth transition to conserve the District's total supply capacity. The District has also re-drilled Portola Well No. 4 to a depth of 800 feet and upgraded its instrumentation, pumping and casing. These efforts re-established the rated capacity of Portola Well No. 4. The North Airport Well's instrumentation and control (I&C) equipment was updated in January 2014, with no impact to the well's rated capacity.

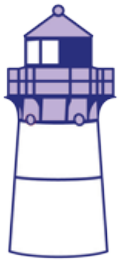
1.5.4. Recycled Water

Furthermore, MWSD has expended significant efforts in assessing the potential to collaborate with the Sewer Authority Mid-Coastside (SAM) Joint Powers Authority (JPA) that treats the sewerage of the MWSD's service area and that of nearby agencies, and the Coastside County Water District (CCWD) that purveys water to areas adjacent to MWSD, to produce tertiary treated recycled water for interested customers. Studies have assessed the feasibility of providing recycled water to interested customers, and have developed preliminary design for treatment and distribution facilities. At this time, MWSD, SAM, and CCWD are in the discussions and planning phases for the potential construction of a 0.8-million-gallon-per-day (MGD) recycled water treatment, storage, and distribution facility to provide water for irrigation to the Ocean Colony Golf Course in Half Moon Bay.

MWSD is currently evaluating the feasibility of implementing a small water reclamation operation within its service area. A decentralized water recycling plant would allow the augmentation of the system's supply capacity with direct non-potable water reuse for irrigation purposes.

1.5.5. Water Conservation

MWSD intensified water conservation strategies due to California's severe drought conditions. In 2014, California declared a state of emergency drought and issued various regulations and relief acts to reduce water consumption throughout the state. Despite already having a low per capita water consumption rate and prior water conservation programs, MWSD, with the support of its customers, further reduced water demand resulting in a 26-percent reduction since 2004. MWSD achieved this by adopting operational water conservation strategies, including but not limited to eliminating fire flow testing at hydrants. The District was rewarded for its water demand reduction efforts between 2004 and 2009 and received the 2009 Silicon Valley Water Conservation Award for the lowest per capita water consumption rate in California.



SECTION TWO
Water Supply and Consumption

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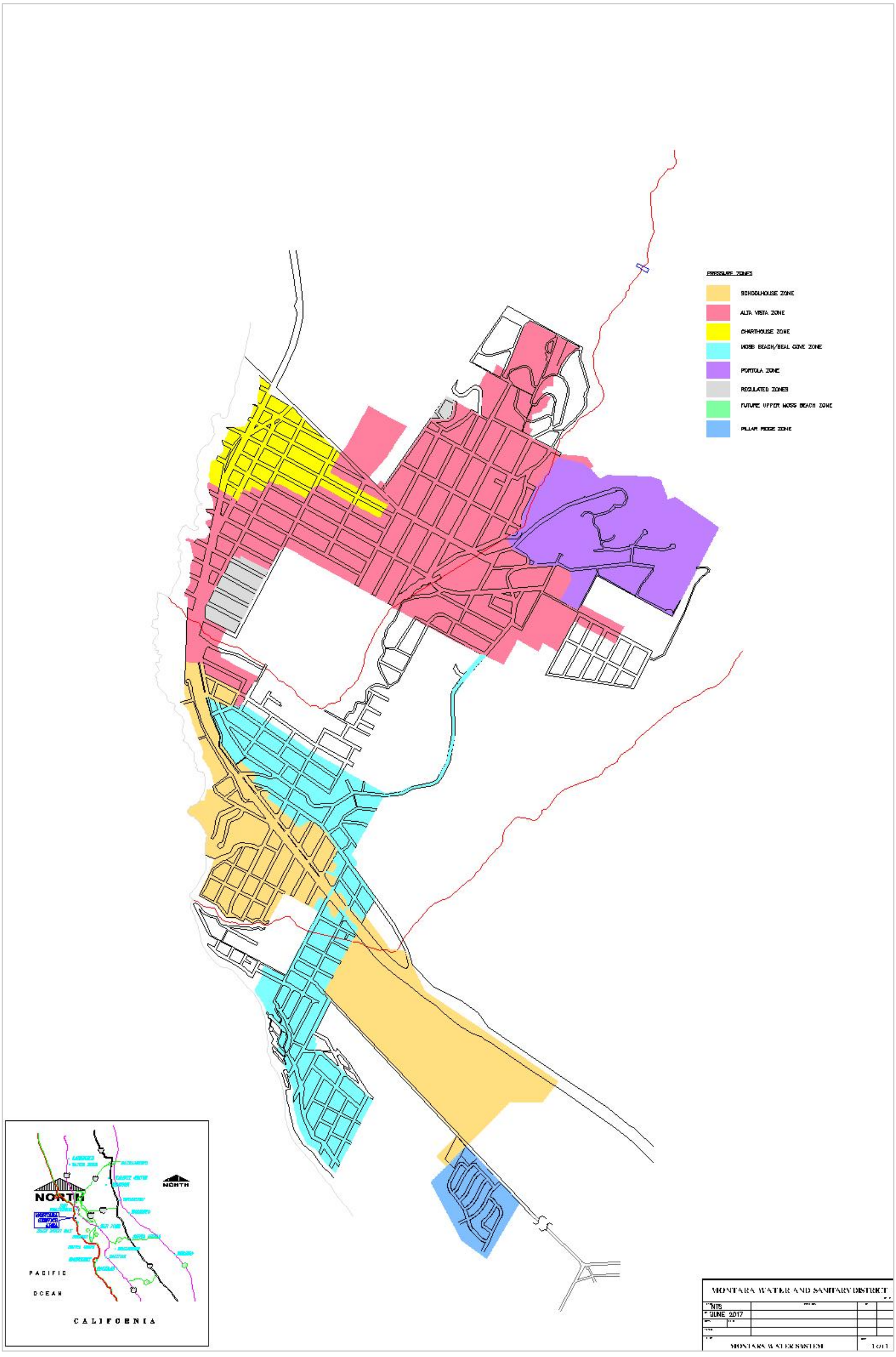
2. Water Supply and Consumption

MWSD is exclusively served by groundwater sources from the San Mateo Coastal Basin Aquifers and surface water from the Montara Creek. The District's water system includes water storage tanks, a surface WTP, a groundwater WTP, wellhead treatment facilities, two (2) booster pump stations, and distribution pipelines. Figure 3 presents an approximate layout of the District's facilities and pressure zones in the distribution system.

Figure 3 MWSD Water System Layout



2.1. Water Supply Capacity

MWSD currently withdraws water from one surface source and several groundwater wells:

- *Montara Creek* is the District's surface water source. Pre-1913 water rights allow MWSD to divert up to 200 gpm from Montara Creek, subject to regulatory and resource agency approvals, however, the availability of such a flow rate is uncertain. In addition, the CDFW occasionally limits diversion rates at certain seasons to protect endangered species. Presently, the AVWTP has a rated operating capacity of seventy-five (75) gpm. MWSD conveys water through a six (6)-inch diameter raw water pipeline from a diversion point north of Montara into a 77,000-gallon concrete raw water tank at the Alta Vista Water Treatment Plant (AVWTP). The District replaced this pipeline in 2003, immediately upon taking ownership of the water system. Suspended solids are allowed to settle in the raw water tank prior to treatment at the AVWTP. Treated water is stored in the 462,000-gallon AV Tank No. 1 or 500,000-gallon AV Tank No. 2 and then conveyed to the distribution system.
- *Groundwater* is currently extracted at twelve (12) locations: Alta Vista Well; Drake Well; Portola Wells Nos. 1, 3, and 4; Wagner Well No. 3; Airport Wells (North Airport Well, South Airport Well, and Airport Well No. 3); and the Pillar Ridge Wells (Corona Well, Culebra Well, and Retiro Well). From 2004 to present, the rated capacity of the groundwater sources has varied; more information on the groundwater source capacities and rates of production is presented in the following sections.

Each source has a rated capacity established at the time it was brought on line. Rated capacities are used to determine the reliable capacity and the maximum serviceable demand of the system. This section establishes the rated and actual capacity of the District's water system and determines its current reliable capacity.

2.1.1. Source Capacities and Rates of Production

To accurately evaluate the capacity of the MWSD water system, an analysis was conducted with the data collected since MWSD acquired the system. Although data was available for the period of 2000 – 2003, and was included in the *2004 MWSD Water System Master Plan,* the quality and consistency of data collection during this time period was unknown. Since actual production records were not available prior to

January 2004 to verify the accuracy of the data and subsequent analysis, the *2017 Master Plan Update* only includes data collected since the MWSD acquisition.

Three sets of analyses were completed that follow and expand upon the methodology presented in the *2011 Master Plan Update*; these analyses use data collected between January 2004 and October 2007, prior to the addition of the Alta Vista Well, between November 2007 and December 2014, following the addition of the Alta Vista Well and prior to the addition of the Pillar Ridge Wells, and between January 2015 and December 2016, after the addition of the Pillar Ridge Wells. The actual reported production rates were recorded while the source was in service and do not imply that the source can continuously operate at the reported rate. Most sources operate at the reported rates for fewer than twelve (12) hours per day due to diurnal customer demand fluctuations. In addition, some sources are taken out of service during certain times of the year, depending on source conditions and system demands. The data summarized in this section represent the actual production rates of the sources. Detailed annual production data for 2004 through 2016 is presented in Appendix A.

2.1.2. 2004 – October 2007 Source Capacities

Between January 2004 and October 2007, MWSD sources had a rated capacity of 470 gpm and an average combined production rate of 348 gpm while in service. A summary of the rated capacities and average production rates for each source during this time is presented in Table 1.

Table 1 Average Monthly Production Rates, 2004 – October 2007

MWSD Source	Rated Capacity, gpm	Annual Average Production Rate, gpm [a]
North Airport Well	100	56
South Airport Well	55	42
Airport Well No. 3	100	73
Drake Well	35	37
Portola Well No. 1	9	6
Portola Well No. 3	10	7
Portola Well No. 4	16	6
Wagner Well No. 3	70	58
Montara Creek Surface Diversion	75	63
TOTAL	**470**	**348**

[a] Production rates are the operating rates of each source and are only recorded when the source is being used. The annual average is determined from the operating production rates of each source, averaged over the total operating time, and not the total time.

2.1.3. November 2007 – 2014 Source Capacities

The Alta Vista Well, with a rated capacity of 150 gpm, was added to the system in November 2007. Between November 2007 and December 2014 (when Pillar Ridge was added to the MWSD system), MWSD sources had a total rated capacity of 620 gpm and an average combined production rate of 393 gpm. A summary of the average production rates for each source during this time is presented in Table 2.

Table 2 Average Monthly Production Rates, November 2007 – 2014

MWSD Source	Rated Capacity, gpm	Annual Average Production Rate, gpm [a]
Alta Vista Well	150	100
North Airport Well	100	77
South Airport Well	55	20
Airport Well No. 3	100	25
Drake Well	35	36
Portola Well No. 1	9	5
Portola Well No. 3	10	6
Portola Well No. 4	16	7
Wagner Well No. 3	70	59
Montara Creek Surface Diversion	75	56
TOTAL	**620**	**393**

[a] Production rates are the operating rates of each source and are only recorded when the source is being used. The annual average is determined from the operating production rates of each source, averaged over the total operating time, and not the total time.

2.1.4. Source Capacities 2015 - 2016

In January 2015, MWSD consolidated the Pillar Ridge Community and acquired three (3) wells with a total rated capacity of 57 gpm. Since 2015, MWSD sources had a total rated capacity of 677 gpm and an average combined production rate of 420 gpm. A summary of the average production rates for each source during this time is presented in Table 3.

Table 3 Average Monthly Production Rates, 2015 - 2016

MWSD Source	Rated Capacity (gpm)	Annual Average Production Rate (gpm) [a]
Alta Vista Well	150	122
North Airport Well	100	76
South Airport Well	55	0
Airport Well No. 3	100	0
Drake Well	35	28
Portola Well No. 1	9	2
Portola Well No. 3	10	36
Portola Well No. 4	16	15
Wagner Well No. 3	70	49
Pillar Ridge Wells No. 1 – 3	57	37
Montara Creek Surface Diversion	75	55
TOTAL	**677**	**365**

[a] Production rates are the operating rates of each source and are only recorded when the source is being used. The annual average is determined from the operating production rates of each source, averaged over the total operating time, and not the total time.

2.1.5. Summary of Source Capacities

AVWTP production records between 2004 and 2015 indicate that the treatment plant produces between 32 gpm and 74 gpm when in operation. When turbidity is too high, which typically occurs during the winter months, the AVWTP is shut down. In addition, AVWTP cannot operate when flow in the raw water pipeline falls below 30 gpm, which typically occurs in the summer months.

Currently, MWSD operates twelve (12) active groundwater wells with a combined rated capacity of 602 gpm. Production records between 2004 and 2016 show variable yields from the District's wells due to operational constraints and maintenance issues. The wells typically operate no more than twelve (12) hours in a given day, and they do not operate during all days of a year. The typical operating hours depend on water quality, well location, and system demands.

According to monthly production records in 2016, the average production rate of the twelve (12) wells was 365 gpm while in operation, or about 61-percent of their rated capacity. Between November 2007 and December 2014, prior to the addition of the Pillar Ridge Wells, the average production rate of the nine (9) wells was 337 gpm while in operation, or about 62-percent of their rated capacity. Prior to November 2007, when

the Alta Vista Well was added to the system, the eight (8) wells had a rated capacity of 395 gpm and the average production rate of the active wells was 285 gpm while in operation, or about 72-percent of their rated capacity.

2.2. System Reliability

The current rated capacities were utilized to evaluate the total MWSD source capacity. In summary, the District's water system currently relies on the following source capacities:

Twelve (12) active groundwater wells	602 gpm
Montara Creek surface water	75 gpm
Total source capacity	**677 gpm**

The reliable capacity of the system is representative of the most probable true capacity and is defined as the capacity of the system with the largest source out of service. The *2005 Water System Master Plan Addendum* defined the Airport Wells, collectively, as the largest source in the system for the supply reliability calculation, even though each well is technically an individual source. In 2005, considering the Airport Wells as one source was a valid argument based on water quality history, current treatment, and the lease agreement effective at that time.

The *2011 Water System Master Plan Update* re-evaluated these assumptions and determined that the largest source in the MWSD system was the Alta Vista Well with a rated capacity of 150 gpm. This decision was described in the *2011 Water System Master Plan Update* and was based on a nitrate contamination analysis of the Airport Wells, treatment modifications at the AVWTP, and lease agreement negotiations for the Airport Wells land that deemed the Airport Wells no longer collectively vulnerable to water quality or legal issues and, therefore, individual sources for the MWSD system.

The following calculation determines the reliable supply of the system, assuming the Alta Vista Well is out of service:

Total source capacity	677 gpm
Alta Vista Well capacity	(150 gpm)
Total reliable capacity	**527 gpm**

The drought supply capacity is representative of the District’s capacity under the most severe drought conditions, and is considered an extremely conservative planning value.

The industry-wide standard for calculating drought supply capacity is by reducing the total rated supply capacity by 50-percent, as follows:

Total source capacity	677 gpm
Total drought capacity	**339 gpm**

The current total, reliable, and drought supply capacities are summarized in Table 4. Figure 8 shows the annual ADD from 2004 to 2016 against MWSD's total, reliable and drought supply capacities.

Table 4 Total, Reliable, and Drought Supply Capacities, 2016

MWSD Source	Rated Capacity (gpm)	Rated Capacity (gpd)
Montara Creek Surface Diversion	75	108,000
Twelve (12) Groundwater Wells	602	866,880
Total Supply Capacity *Sum of all sources*	677	974,880
Reliable Supply Capacity *Total supply capacity excluding largest source*	527	758,880
Drought Supply Capacity *50% of total supply capacity*	339	487,440

The District determined that the North Airport Well (NAW) is a critical asset to the system, due to its strategic location and sustainable groundwater supply. NAW is the only large operating source located west of Highway 1, that can provide the necessary supply redundancy to parts of the Schoolhouse and Moss Beach pressure zones, should a main break occur preventing water to flow from the other sources across Highway 1.

2.3. Source Production

On average, MWSD water sources produced approximately 296,000 gallons per day (gpd) over the past thirteen (13) years, 2004 through 2016, with an annual average minimum production of 260,983 gpd in 2014 and an annual average maximum production of 359,023 gpd in 2004.

The data trend generally indicates the production decreasing across the first eleven (11) years; the observed production increase in 2015 is solely due to the acquisition of the Pillar Ridge Wells and the demand of the Pillar Ridge community. Over the thirteen (13)

years, production from all sources is relatively stable, with the exception of the Airport Wells and the Alta Vista Well. Most notably, when the Alta Vista Well came on line in 2008 for the first full year of production, MWSD was able to lessen its dependence on the Airport Wells, thus realizing an important improvement in the water system reliability. The average daily production rate of the MWSD system was calculated for this time period (2004 through 2016) and is presented in the Table below. The detailed monthly production data and analysis is included as Appendix B.

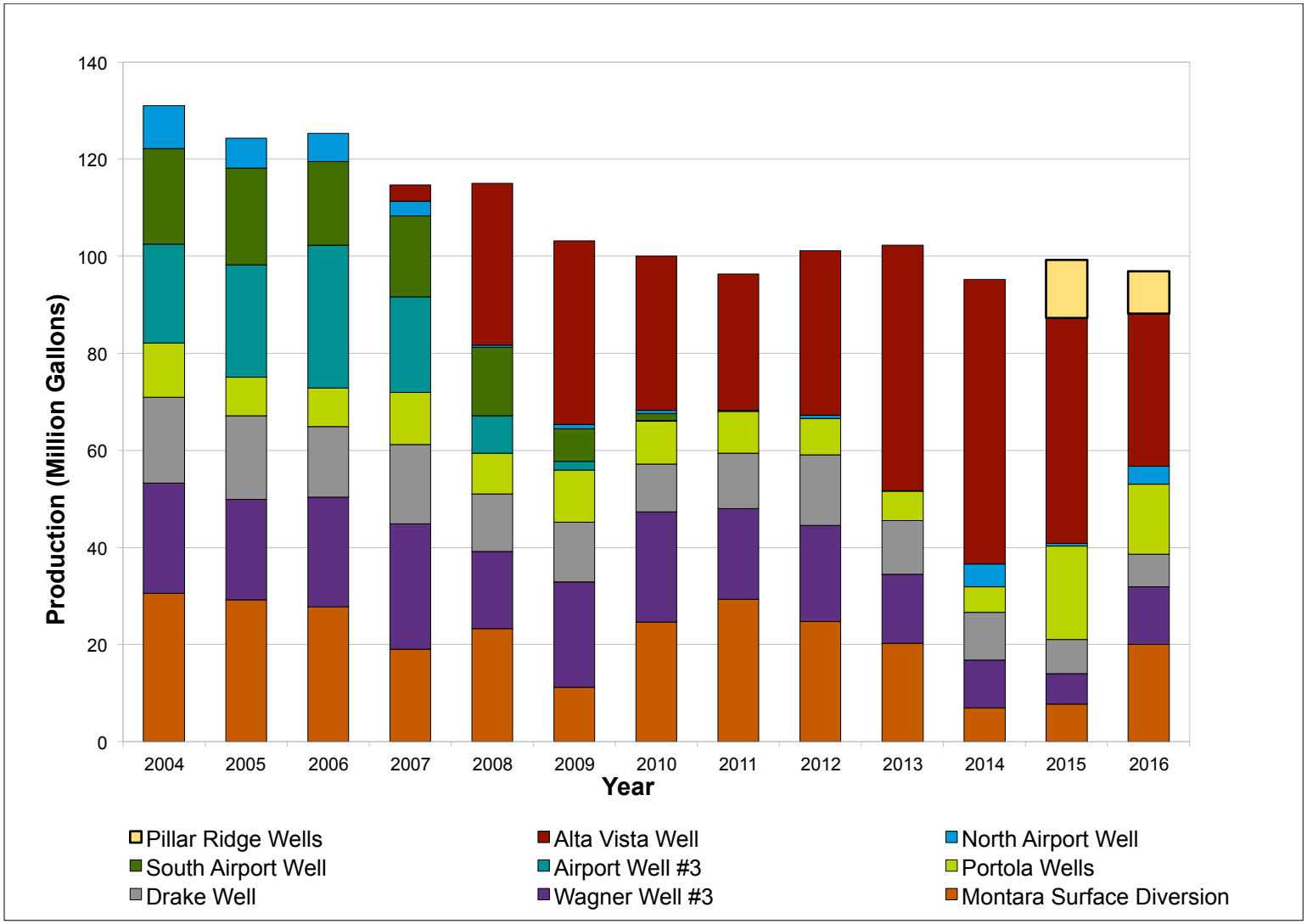
The maximum daily rate of production was determined by reviewing production records and by identifying the greatest production rate observed on any one (1) day during each of the previous nine (9) years, between 2008 and 2016. The maximum daily production rate was calculated as the maximum daily rate of production since 2008 due to significant changes in demands resulting from system improvements made between 2004 and 2008; results are summarized in Table 5. Figure 4 shows the total annual production for each source between 2004 and 2016 and Figure 8 shows the annual ADD from 2004 to 2016 against MWSD's total, reliable and drought supply capacities.

Table 5 Average and Maximum Daily Source Production

MWSD Source	Maximum Day Production (gpd) (Month) [a]	Average Daily Production (gpd) [b]
2004		359,023
2005	480,000 (August)	340,539
2006	534,360 (July)	343,315
2007	511,980 (August)	314,225
2008	437,440 (June)	315,050
2009	406,780 (July)	282,653
2010	478,230 (July)	274,118
2011	379,610 (July)	263,977
2012	381,080 (June)	277,178
2013	414,676 (June)	280,046
2014	386,610 (August)	260,983
2015	402,210 (August)	271,801
2016	400,876 (July)	265,324
	2008-2016 MDD	**2004-2016 ADD**
	478,230 (July, 2010)	296,018

[a] Maximum Day data prior to 2008 was not included in the calculation of the maximum daily rate due to major system improvements made to the system between 2004 and 2008, which significantly affected the demands.
[b] The average daily production was calculated for the 2004 – 2016 time period.

Figure 4 Total Annual Water Production by Source, 2004 – 2016



2.4. Current Consumption

2.4.1. Consumption Trends

Data on the volume of water delivered to metered customers between 2004 and 2016 was used to calculate annual and monthly consumption values.

The annual consumption data over the thirteen (13) year time period (2004 – 2016) shows that water consumption generally declines each year. The general decrease in consumption can be attributed to the District's implementation of the meter replacement program, leak detection program, and voluntary conservation by the District's customers. A summary of the consumption data analysis is presented in Table 6 and Figures 5 and 6.

Table 6 Annual Consumption Rates, 2004 – 2016

Year	Total Consumption, MG	Average Daily Water Use, gpd
2004	117.41	321,671
2005	114.99	315,041
2006	111.17	304,575
2007	104.61	286,603
2008	106.72	292,384
2009	98.93	271,041
2010	92.83	254,329
2011	87.75	240,411
2012	93.11	255,107
2013	94.67	259,367
2014	86.48	236,921
2015	89.53	245,274
2016	90.08	246,786
Average	99.10	271,501

Average and per capita water use values were calculated based on the above data. The average annual consumption is approximately 99.1 MG and the average daily consumption is approximately 271,500 gpd.

Average monthly consumption rates were also evaluated and are shown on Figure 5 on the following page. The driest months of the year, May through October, have the highest consumption volumes on average, most likely due to increases in water used for irrigation.

Figure 5 Average Monthly Consumption Volumes, 2004 – 2016

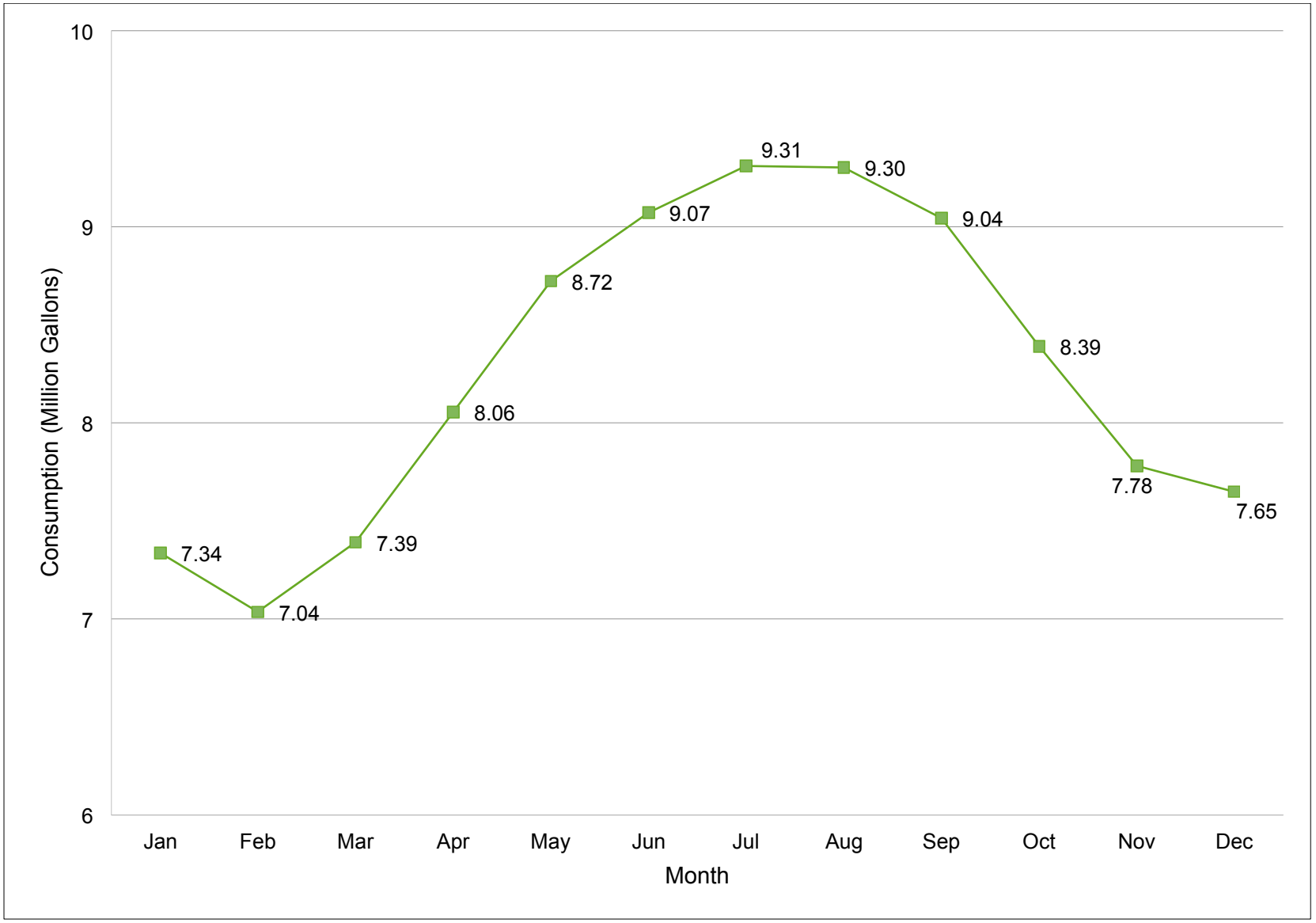
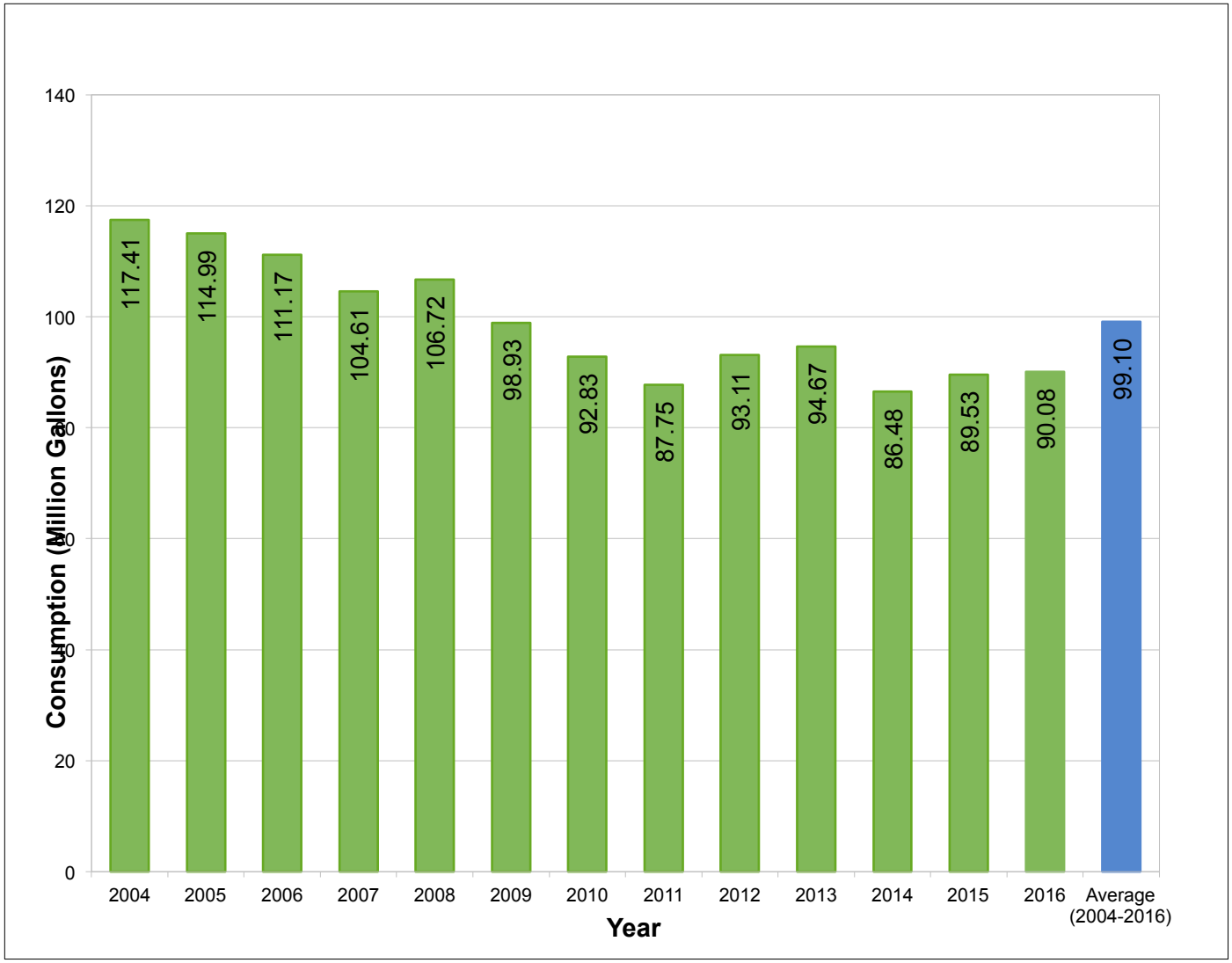


Figure 6 Annual Consumption Volumes, 2004 – 2016



2.4.2. Unaccounted-for-Water

MWSD's source production is dependent upon customer consumption, as the sources only produce water in response to customer demands. The difference between the water system's production and consumption rates represent system losses, known as unaccounted-for-water. Unaccounted-for-water represents water used for fire flow testing, water main flushing, repairs, filter backwash operations at the WTPs, and distribution system leaks. Table 7 and Figure 7 compare consumption and production volumes for the MWSD system and quantify unaccounted-for-water between 2004 through 2016.

Table 7 Unaccounted-for-Water Volumes, 2004 – 2016

Year	Total Annual Water Production, MG	Total Annual Consumption, MG	Unaccounted-for-Water, MG	System Losses Percent of Total Production
2004	131.04	117.41	13.63	10.40%
2005	124.30	114.99	9.31	7.49%
2006	125.31	111.17	14.14	11.28%
2007	114.69	104.61	10.08	8.79%
2008	114.99	106.72	8.27	7.19%
2009	103.17	98.93	4.24	4.11%
2010	100.05	92.83	7.22	7.22%
2011	96.35	87.75	8.60	8.93%
2012	101.17	93.11	8.06	7.96%
2013	102.22	94.67	7.55	7.38%
2014	95.26	86.48	8.78	9.22%
2015	99.21	89.53	9.68	9.76%
2016	96.84	90.08	6.77	6.99%

Unaccounted-for-water is higher in 2004 and 2006, most likely due to an increased number of main and hydrant replacement projects and increased flushing activities to address water quality issues. Unaccounted-for-water volume decreased after 2006 following the implementation of the distribution system improvements program. In 2014 and 2015, the increases observed in unaccounted-for-water are likely due to distribution system leaks. A noticeable decrease of the volume of unaccounted-for water occurred in 2016, likely due to system improvements. For the purpose of estimating future demands, the system losses for the District have been assumed at 8.2-percent of total production, the average calculated from the 2004 – 2016 time period presented in the above Table 7. This value is below the industry-wide standard of 10% unaccounted-for-water for a well-operated system.

Figure 7 Annual Production, Consumption, Unaccounted-for-Water Volumes, 2004 - 2016

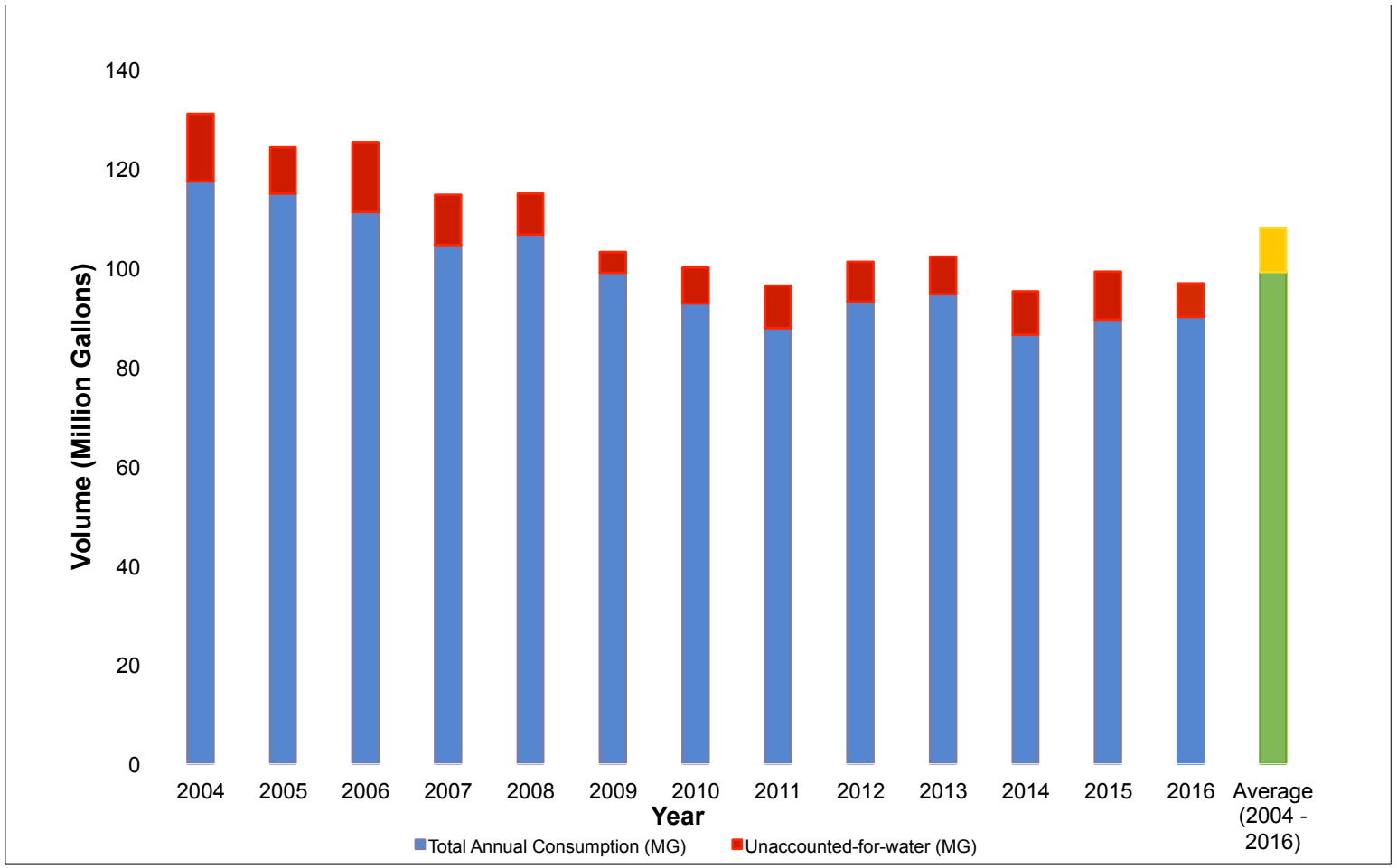
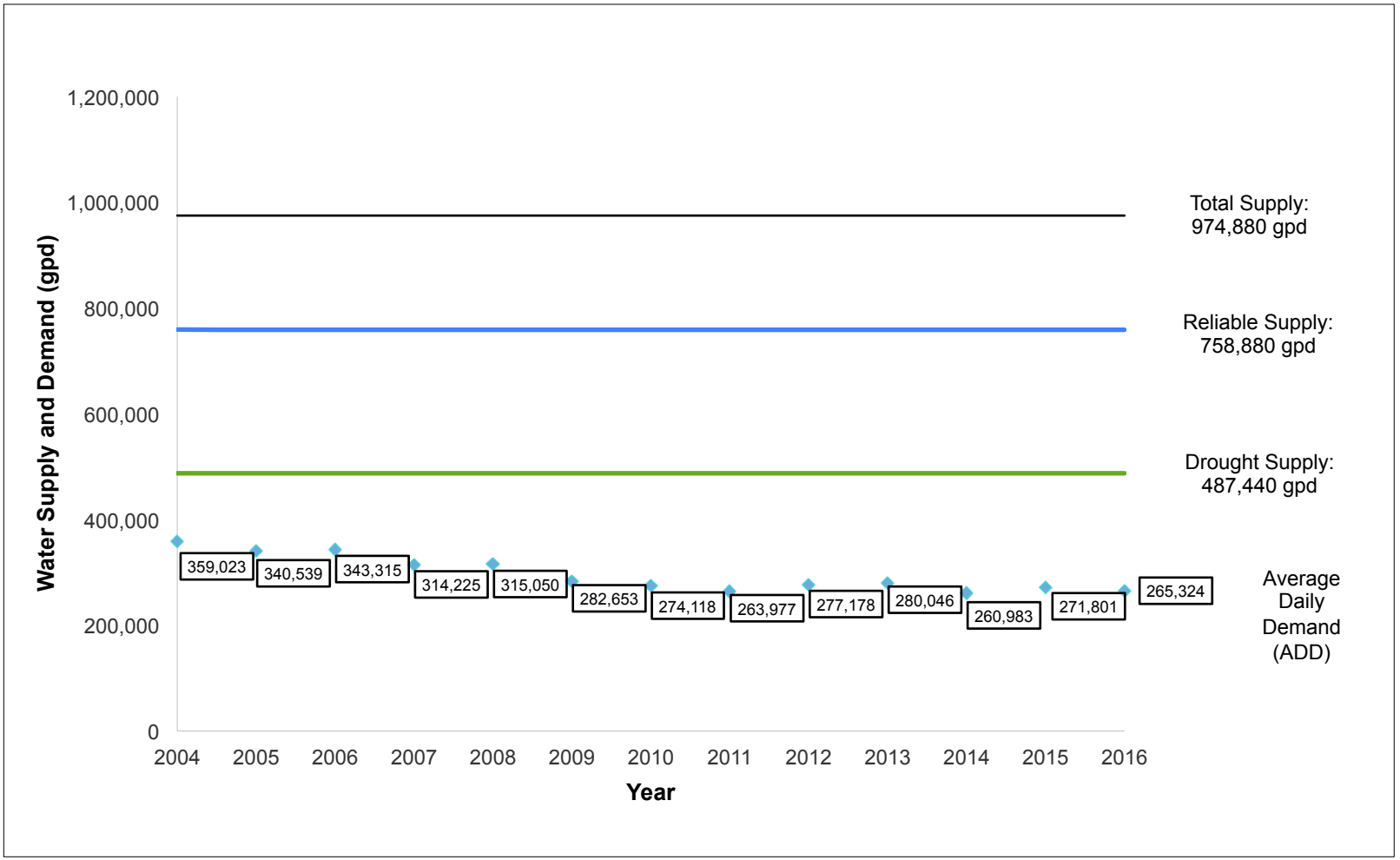


Figure 8 Annual Average Daily Demand vs. Supply Capacities, 2004 – 2016



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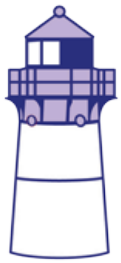

SECTION THREE
Current and Future Water Demand

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3. Current and Future Water Demands

Current and future water demands provide the basis for sizing and prioritizing improvements to water facilities and identifying the need for additional water supply sources or facilities. Average, maximum daily, and peak hourly demands (ADD, MDD, PHD, respectively) were calculated from 2004 through 2016 monthly production records from all of the District's water supply sources.

Population growth, future water demand volumes, and the allocation of available water sources among the various sectors in the community at future growth scenarios were estimated using the current demand calculations and data from the *2013 County of San Mateo Local Coastal Program Policies (LCP) Update.* The future growth scenarios were defined as potential number of connections added to the system, from the addition of 200 to up to 1,000 connections. It was assumed that any growth would not exceed the maximum growth rate of 20 units per year established in the *2013 San Mateo County LCP*.

The following sections detail information regarding the District's number of connections, existing customer demand, estimated water demands and supply availability based on projected growth, and the distribution of water use by LCP-designated priority uses and pressure zones.

3.1. Regulatory Framework

The regulatory framework that governs the current and future demand analysis contained within Chapter 3 of the Master Plan is multi-faceted, and includes regulations related to water quantity availability, storage volume, and allowable growth. The sections below detail the regulatory agencies and conditions that govern the demand analysis presented in Sections 3.2 through 3.4.

3.1.1. California Code of Regulations

Title 22 of the California Code of Regulations (CCR) requires that MWSD make available a sufficient quantity of water from the aforementioned water sources in order to have an adequate, dependable and safe water supply under MDD conditions for the entirety of the District's service area. Additionally, the CCR requires that system pressures remain at a minimum of 20 pounds per square inch (psi) under PHD or ADD conditions, whichever is

greatest, plus design fire flow. These sections also specify water quality criteria, as detailed in Section 4.

3.1.2. Fire Code

The National Fire Code, Insurance Service Office, and local Fire Department identify storage requirements for firefighting purposes based on a fire flow of 2,000 gpm for a two (2)-hour duration. 2,000 gpm corresponds to a land use of multiple one (1)- and two (2)-story residential and light commercial or light industrial developments.

3.1.3. California Coastal Commission and the Local Coastal Program

The geographic location of MWSD is also within the jurisdiction of the CCC. A Coastal Development Permit (CDP) is required under the California Coastal Act for any new development in the coastal zone, including most activities associated with changes to the MWSD water infrastructure. Such activities include, but are not limited to, a change in the intensity of water use or access to water, the placement of any solid material or structure, a change in land use density or intensity, and removal of major vegetation within the Coastal Zone. The San Mateo County's (County) LCP, initially created in the 1980s by the County Board of Supervisors to meet the requirements of the CCC, and since updated in 2013, serves to compile the policies and requirements of planning projects located within the Coastal Zone which ultimately fall under CDPs or Coastal Development Exemptions.

The San Mateo's LCP establishes the County's population growth limits by stipulating the land use density and development density limits, which ultimately define an area's buildout. Additionally, the LCP limits expansion of public works facilities to serve an area's specified buildout population. The *2013 County of San Mateo LCP Update* now in effect was certified by the CCC and approved by the Board of Supervisors of the County of San Mateo in August 2012.

According to the San Mateo County LCP, new public water connections in the District's service area are allowed only if they are consistent with the MWSD Public Works Plan (PWP) and amendments in effect, Chapter 2 of the LCP, and all other applicable policies of the LCP as amended. When the PWP was first certified in 2008, the moratorium on new connections that initially had been imposed by the California Public Utilities Commission (CPUC) in the 1980s on the then privately-owned water system was still in

effect. After acquiring the system in 2003, the District continued the moratorium due to substandard infrastructure and an unreliable water supply portfolio. Accordingly, the PWP acknowledged the existence of the moratorium by including reference to it and providing that the improvements authorized by the PWP were not intended to lift the moratorium. That provision was consistent with the District's early Master Plans and the condition of MWSD's infrastructure at that time.

However, MWSD has since improved the condition of its infrastructure and the reliability of its water supply through high levels of conservation and operational improvements. These improvements included the Water Main Replacement Program, which resulted in a six (6)-percent reduction in water losses, the Raw Water Pipeline Replacement, which improved water quality and flow, as well as groundwater pumping and treatment improvements, distribution system upgrades, and construction of additional storage facilities. These improvements increased the reliability of the District's water supply, thus allowing MWSD to repeal the moratorium in March 2011. The District has since continued water conservation programs and improvements to its infrastructure in order to provide an adequate supply of quality of water to its customers in an environmentally conscious and sustainable manner.

As of December 11, 2013, the District's PWP was approved by the CCC, acknowledging that the District had 128,000 gpd available to be utilized for new service connections and was permitted to serve new connections. Available water supply may be utilized to serve existing development that is within the LCP urban area that is currently served by private wells, or to provide new service connections to development that has been authorized pursuant to the County's LCP, including the LCP's growth limitation for the MWSD service area, which is currently one (1)-percent per year. Approval of any new private wells within the District's service area was limited to five (5) per year between August 8, 2012 and August 7, 2015.

The LCP Land Use Plan, including Policies 2.8 and 2.24 and Table 2.17, also requires that the District reserve available water supply for priority uses, and that the amount of water to be reserved would decrease as priority connections are made. As of December 11, 2013, approximately 47,000 gpd was available for non-priority uses, including

residential, commercial and industrial uses and for the conversion of private residential wells within the District's service area, based on MWSD's available water supply and LCP requirements.

3.2. Current Demand

Since MWSD's water source production is directly dependent upon customer demand, recorded production values reflect the water system's demand and therefore the supply required to support the customer water use. The following Table presents MWSD's average and peak water demands based on the production records between 2004 and 2016. Figure 8 shows the annual ADD from 2004 to 2016 against MWSD's total, reliable and drought supply capacities.

Table 8 MWSD Water Use, 2004 – 2016

Year	MWSD Production gallons	Water Use gallons	Peaking Ratio
Average Daily Demand (ADD)	296,018	271,501[b]	1.0
Maximum Daily Demand (MDD)	478,230[a]	439,015[c]	1.6[d]
Maximum Hour	32,069[e]	29,439[c]	2.6
Design Fire (2 hours)	240,000	240,000	N/A

[a] Based on daily production data for maximum production months, 2006 – 2016. 2004 and 2005 data was not used due to inaccessibility

[b] Based on water consumption data, from 2004 – 2016

[c] Calculated from average and maximum daily production values, respectively, with an 8.2-percent reduction for unaccounted-for-water

[d] Calculated empirically from the system's MDD and ADD values

[e] Calculated utilizing a peaking ratio of 2.6, as used in previous MWSD Master Plans

3.2.1. Per Capita Demand

The per capita demand is based on the MWSD water production and water connection records, the 2010 U.S. Census population data for Montara and Moss Beach, and the population of the Pillar Ridge community at the time of the 2015 consolidation. 2010 U.S. Census population data was used to estimate average household sizes for Montara and Moss Beach, while water connection records determined the population that MWSD serves.

Currently, the population served by MWSD includes the Montara, Moss Beach, and Pillar Ridge communities. The number of residential water connections serving the Montara and

Moss Beach communities was reported to be 1,620 by MWSD, and a household size of 2.72 persons was calculated for the Montara/Moss Beach area (weighted based on the reported household Census data and the percentage of the population in each Census designated area). The population of Montara/Moss Beach was determined to be 4,406. The population of the Pillar Ridge community was reported to be 850 people. Therefore, the District services a population of approximately 5,256 people (4,407-person Montara/Moss Beach population + 850-person Pillar Ridge population). Based on the population reported and the 2016 ADD (265,324), the per capita demand for 2016 was calculated to be 50 gpcd.

As detailed in Table 8 above, the average ADD for 2004 through 2016 was established as 296,018 gpd. This daily demand includes the 33 commercial water connections in the service area, so the population absorbs that demand in the per capita demand estimate.

To account for the addition of the Pillar Ridge system, as well as utilized all available historical data, the average per capita demand was established by utilizing per capita data for 2004 through 2016. Based on these calculations, the per capita daily water demand was established as approximately 66 gpcd. This per capita demand is significantly lower than the 72 gpcd estimated for the years 2004 through 2010, as reported in the 2011 Master Plan Update.

The per capita water use, which is based on the average annual daily consumption of 271,501 gpd and does not include unaccounted-for-water, is approximately 51 gpcd. As unaccounted-for-water volumes decrease, the per capita demand will also decrease and approach the per capita consumption value.

3.2.2. Demand by Pressure Zone

The distribution of water use by pressure zone as ADD is shown in Table 9 and is based on the estimated number of service connections and population in each zone, and the average ADD presented in Table 8. The boundaries of individual pressure zones are shown in Figure 3. With the incorporation of the Pillar Ridge water system, adjustments to the District's system to accommodate a new pressure zone were made.

Table 9 Estimated Current Water Demand by Pressure Zone

Pressure Zone	Hydraulic Grade Line, HGL (feet)	Percent of Connections [a]	Current Water Demand (gpd)
Alta Vista	512	43.6%	129,064
Charthouse	318	4.2%	12,433
Upper Moss Beach	388	2.5%	7,400
Moss Beach / Seal Cove	338	13.4%	39,666
Pillar Ridge [b]	179	16.2%	47,955
Portola	462	3.4%	10,065
Regulated	303 – 336	2.5%	7,400
Schoolhouse	193	14.2%	42,035
TOTAL		100%	296,018

[a] Based on number of actively billed residential domestic water meters.

[b] Percent of connections and water demand of Pillar Ridge Pressure Zone assumed based on estimated number of residences (229 residences) because this Pressure Zone is served by one (1) commercial meter instead of by residential meters.

3.3. Future Water Demand

Future demands on the MWSD water system were estimated for various numbers of additional connections. Future demand estimates are based on the following assumptions:

- The population that is already residing or owning property in the service area but not connected to MWSD will connect to water system, and
- The District will serve new homes being built in the service area in accordance with the *2013 County of San Mateo LCP Update*.

3.3.1. Existing Population Demand

Current populations within the service area have been estimated for 2004 through 2016 based on the average household size calculated from 2010 U.S. Census data, the population of the Pillar Ridge community at the time of the 2015 consolidation, and on records kept by MWSD regarding the number of residential water connections and sewer connections. Since every new house in the MWSD service area must be connected to the sewer system, the number of new sewer connections provides an accurate estimate of the

number of new houses, and therefore, the approximate population, including people relying on private wells for their water supply within the MWSD service area.

The information presented in the Table 10 was utilized to estimate population growth in the MWSD system since the Pillar Ridge consolidation and the end of the moratorium. The number of residences not connected to the MWSD water system was determined by calculating the difference between the number of residential sewer connections and the number of residential water connections each year. Prior to the Pillar Ridge consolidation, the population served by the system was determined by multiplying the number of water connections by the average Montara/Moss Beach household size of 2.72 persons. Calculating the difference between the number of sewer and water connections and multiplying by the household size of 2.72 resulted in estimated population relying on private wells.

Table 10 Current Population Estimates

Year	Number of Sewer Connections [a]	Number of Residential Water Connections [a]	Number of Houses Not Connected to MWSD Water System	Population Served by the District [b]	Estimated Population Not Connected to Water System [b]	Total Estimated Population in MWSD service area
2014	1,906	1,611	295	4,382	802	5,184
2015	1,907	1,611	296	5,232 [c]	805	6,037 [c]
2016	1,910	1,620	290	5,256 [c]	789	6,046 [c]

[a] Based on MWSD records
[b] Calculated using the historical household size od 2.72
[c] Includes 850-person population of Pillar Ridge community, as reported by Millennium Housing, as of the January 2015

Based on this analysis, there are an estimated 290 houses in the MWSD service area that are not connected to the system, housing an estimated population of approximately 790. The additional potential demand that could result from well conversions is taken into consideration in the analysis in this Master Plan Update.

3.3.2. Future Population Demand

The projected demand scenarios for future years were determined based on the potential number of connections added to the system. The demands were calculated using the household size of the post-consolidation system and the average per capita demand of 66 gpcd. Two large developments – the Big Wave Project and the Sierra 1 Development -

are also planned within the MWSD service area in the next three (3) years and are taken into account in the following analysis.

Table 11 Future Population and Demand Estimates

Connections Added	Number of Connections	Total Population Served by the System	Projected Average Daily Demand (gpd) [d]	Projected Maximum Daily Demand (gpd) [e]
Current 2016	1,620 [a]	5,256 [b]	296,018	478,230
200	1,820	5,824 [c]	333,506	533,609
400	2,020	6,392 [c]	370,994	593,590
600	2,220	6,960 [c]	370,994	653,571
800	2,420	7,528 [c]	445,970	713,552
1000	2,620	8,096 [c]	483,458	773,533

[a] From MWSD sewer and water connection records; see previous Table 10
[b] Estimated based on a 2.72 household size and a Pillar Ridge population of 850 people
[c] Calculated from the post-Pillar-Ridge consolidation household size (2.84)
[d] Assumes 66 gpcd demand
[e] Assumes 1.6 peaking ratio based on empirical analysis of MWSD system

3.3.3. Priority Uses

Priority uses must be considered in evaluating the supply available for additional connections to the MWSD system, as water must be reserved for these uses. The maximum volumes prescribed by the *2013 County of San Mateo LCP Update*, are presented in the following Table. The Sierra 1 Development, detailed in a Section 3.4.2 is an affordable housing complex located at one of the designated Priority Use sites in Moss Beach.

Table 12 Priority Uses

Priority Use	Requirements at Buildout (gpd)
Commercial Recreation	1,230
Public Recreation	4,080
Floriculture	10,000
Essential Public Services	5,000
Specific Developments of Designated Sites containing Affordable Housing	35,816 to 51,504
Other Affordable Housing	5,000
Total Water Capacity for Priority Land Uses	**61,126 to 76,814**

3.3.4. Supply and Demand Analysis

To determine the water system's reliability, the ADD and MDD are compared to the reliable supply capacity defined in Section 2. Table 13 shows the current available capacity of the water system, and compares this volume of water to the MDD of the current population within the MWSD service area. The MWSD system currently has enough supply to support the long-term demands that correspond to the addition of over 900 connections, as indicated by the supply excess/demand column in Table 13 and Figure 9.

This additional reliable supply can meet the demands the population currently residing within the service area but not connected to the system, as well as provide reliable supply for additional connections.

Table 13 Supply Projections – Reliable Supply

Connections Added	Reliable System Capacity (gpd) [a]	MDD (gpd)	Excess or Deficit Supply (gpd)
2016	758,880	478,230	280,650
200 connections	758,880	533,609	225,271
400 connections	758,880	593,590	165,290
600 connections	758,880	653,571	105,309
800 connections	758,880	713,552	45,328
1000 connections	758,880	773,533	-14,653

[a] Calculated assuming all sources are operating at rated capacity for 24 hours per day

In addition, the current MWSD projected supply and demand scenario was evaluated by comparing the current and future ADDs with a more conservative available supply estimate. In determining the available supply, this methodology utilizes the rated capacity of all sources as the basis for determining the available supply and assumes that the sources are capable of sustainably producing only 50-percent of their rated capacity. Table 14 presents this analysis.

Table 14 Supply Projections – Severe Drought Supply

Connections Added	Sources Operating at 50% Rated Capacity (gpd) [a]	ADD (gpd)	Excess or Deficit Supply (gpd)
2016	487,440	296,018	191,422
200 connections	487,440	333,506	153,934
400 connections	487,440	370,994	116,446
600 connections	487,440	409,482	77,958
800 connections	487,440	445,970	41,470
1000 connections	487,440	483,458	3,982

[a] Calculated assuming all sources are operating at rated capacity for 24 hours per day

3.4. Future Large Developments Demand

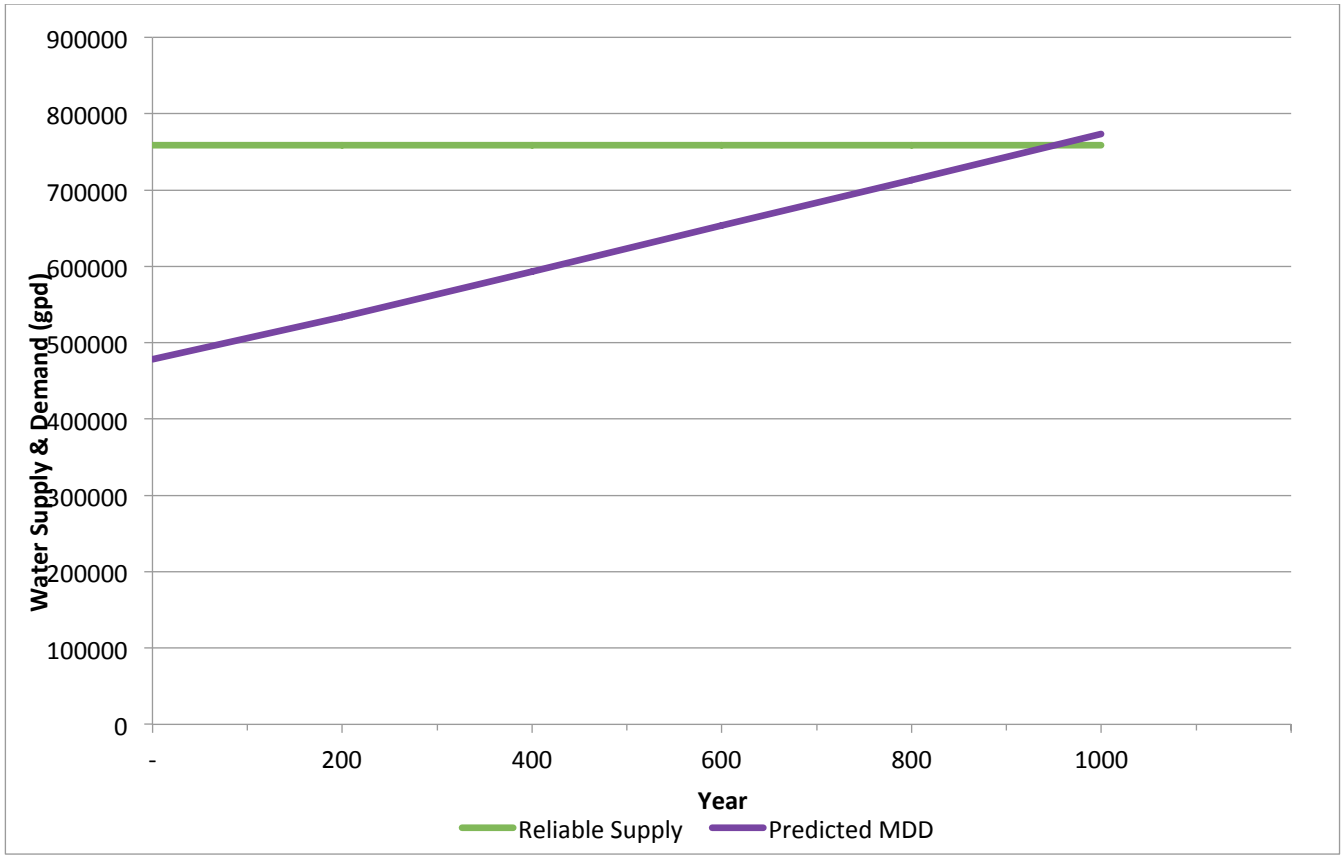
3.4.1. Big Wave Development

The Big Wave Project is a development that will be located on coastal land adjacent to the Half Moon Bay Airport and South of Pillar Ridge. The Project involves the construction of a Wellness Center that will include a total of 50 housing units for adults with special needs, and a Business Park, which will include 6 commercial buildings. The Big Wave project will be phased in and it is expected that Phase 1 - three (3) commercial buildings and 25 bedrooms of the Wellness Center - will be built by 2019. The type of businesses that the Business Center will host and the specifics about their water usage are currently unknown. The demand estimations will be confirmed once the water demands from the Big Wave development are finalized.

3.4.2. Sierra 1 Development

Sierra 1 is a development planned to come online by 2020 that will be located at the intersection of Carlos Street and Sierra Street in Moss Beach. The development will include 71-unit affordable housing complex and adjacent parking spaces. Assuming a per capita demand of 66 gpcd and an average household size of 2.84, the water demand of the Sierra 1 Project is estimated at 13,308 gpd or 9.24 gpm. The affordable housing units of the Sierra Project qualify as priority uses as described in the 2013 San Mateo County LCP, and therefore the water demand of Sierra 1 will be supplied by the priority use water reserves for affordable housing (35,816 to 51,504 gpd per the 2013 San Mateo County LCP).

Figure 9 Maximum Daily Demand vs. Reliably Supply



SECTION FOUR
Water Quality

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4. Water Quality

MWSD's water quality is monitored and reported in compliance with all federal and state regulations. Approximately 1,200 analyses are conducted on the drinking water per year, and findings are reported to consumers in annual Consumer Confidence Reports (CCR) as required by the USEPA's Safe Drinking Water Act.

4.1. Drinking Water Quality Monitoring and Reporting

The following sections detail the water quality standards that MWSD must meet based on the characteristics of the community size and water supply sources. The District must comply with regulations established at the federal and state levels. Regulations at the federal level are promulgated by the USEPA, which is responsible for setting standards and assuring compliance. Regulations at the state level are maintained by the SWRCB DDW, which carries out similar responsibilities.

The Federal Safe Drinking Water Act is the primary legislation that directs the USEPA's regulatory control. Through its original charter and subsequent amendments, Maximum Contaminant Level (MCL) standards for a significant number of constituents have been established. California establishes its own standards and MCLs in Title 22 of the California Code of Regulations (CCR). These standards are at least as stringent as the federal levels and are administered by the SWRCB DDW.

DDW requires that all public water systems (PWS) monitor their potable water sources for chemical, biological, and radiological contaminants. Testing for these categories of constituents, which include synthetic organic chemicals (SOCs), volatile organic compounds (VOCs), and radionuclides, is required at each water source in the system. Distribution systems must also be monitored for bacteriological constituents (total and fecal coliforms), disinfection residuals (chlorine), disinfection byproducts [total trihalomethanes (TTHMs) and haloacetic acids (HAAs)], lead, and copper.

4.1.1. Revised Total Coliform Rule (RTCR)

The USEPA Total Coliform Rule first came into effect in 1989 and the Revised Total Coliform Rule was published in 2013. The RTCR applies to all public water system and aims to decrease the risk of fecal contamination and subsequently the risk of waterborne

pathogens in drinking water. Total coliforms are used as an indicator for the presence of pathogens in drinking water and are frequently used to evaluate the treatment performance of a water system. The RTCR sets a MCL for E.coli and is in place to identify and reduce the potential points of entry of fecal contamination.

Sampling Requirements

Public Water Systems (PWSs) must perform routine sampling for total coliforms at specified intervals at locations that are representative of the water quality of the distribution system.

In the case where the routine sample is total coliform-positive, the sample must be tested for E.coli and repeat samples must be collected. At least three (3) repeat samples must be collected within 24 hours of obtaining total coliform-positive results. If the initial sample is tested positive for E.coli, the results must be reported to the State right away.

4.1.2. Primary Maximum Contaminant Levels

The USEPA has established Primary MCLs for constituents with known health effects, taking into account the technical and economic impacts of setting an MCL for that constituent. The USEPA provides a list of regulated constituents and current MCLs adopted by the State of California. All PWSs are required to monitor these constituents at each of their raw water sources at frequencies set forth by the DDW.

4.1.3. Secondary MCLs

Secondary MCLs (SMCLs) have been established for certain constituents without known health effects, but for which there are aesthetic concerns such as color, taste, or odor. The USEPA provides a list of the constituents with the current SMCLs adopted by the State of California. Currently, constituents with SMCLs must be tested for at least once every three (3) years at all groundwater sources.

Constituents with MCLs that typically impact PWSs with groundwater sources are iron and manganese; these constituents are common metallic elements found in the earth's crust that are chemically similar and cause similar problems. When exposed to air, iron and manganese sediments oxidize and change from colorless, dissolved forms to colored,

solid forms. Excessive amounts of these sediments are responsible for staining and may even clog water pipes. Iron and manganese can also affect the flavor and color of food and water. Finally, nonpathogenic bacteria, which feed on iron and manganese in water, can form slime in toilet tanks and clog water systems.

4.1.4. Disinfectant and Disinfection Byproducts Rule (D/DBPR)

The Disinfectant and Disinfection Byproducts Rule (D/DBPR) was created by the USEPA to protect public health from disinfectant chemicals and byproducts; the D/DBPR was developed in two stages, described below.

Stage 1 D/DBPR

Chemicals used to disinfect drinking water can react with naturally occurring materials in the water to form unintended organic and inorganic byproducts that may pose health risks. Amendments to the Safe Drinking Water Act (SDWA) in 1996 required that the USEPA develop rules to reduce disinfection byproducts (DBPs) in drinking water. The USEPA promulgated the Stage 1 D/DBPR on December 16, 1998. The Stage 1 D/DBPR applies to all PWSs that add chemical disinfectants to their drinking water supply. Stage 1 D/DBPR reduces exposure to three (3) disinfectants (chlorine, chloramines, and chlorine dioxide) by establishing maximum residual disinfectant level goals (MRDLGs) and maximum residual disinfectant levels (MRDLs) to the following DBPs: four (4) TTHMs, five (5) HAAs, chlorite, and bromate. The five (5) most common HAAs regulated under the Stage 1 D/DBPR are collectively referred to as HAA5 and are the following:

- Monochloroacetic acid (MCA), $ClCH_2COOH$
- Dichloroacetic acid (DCA), $Cl_2CHCOOH$
- Trichloroacetic acid (TCA), Cl_3CCOOH
- Monobromoacetic acid (MBA), $BrCH_2COOH$
- Dibromoacetic acid (DBA), $Br_2CHCOOH$

TTHM and HAA5 monitoring is required for any water system using chlorine as a disinfectant. Chlorite is monitored only in systems using chlorine dioxide as a disinfectant, whereas bromate must only be monitored in systems using ozone.

Under the Stage 1 D/DBPR, the MCL for TTHMs is 0.080 milligrams per liter (mg/L), for HAA5 is 0.060 mg/L, and for bromate is 0.01 mg/L. Compliance for TTHMs, HAA5 and bromate is measured by the running annual average (RAA) of all results taken from all sampling locations (system-wide average) over a one (1) year period. Chlorite compliance is measured as a monthly average and has an MCL of 1.0 mg/L.

Stage 2 D/DBPR

The USEPA's Stage 2 D/DBPR became effective on March 6, 2006 and applies to all PWSs that add chemical disinfectants to the drinking water supply. The Stage 2 D/DBPR strengthens public health protection for customers of systems that deliver disinfected water by requiring such systems to meet MCLs as an average at each compliance monitoring location, instead of as a system-wide average as in previous rules, for two (2) groups of DBPs: TTHMs and HAA5.

The Stage 2 D/DBPR builds incrementally on existing rules and targets systems with greater water quality risks. The rule additionally requires systems to investigate any "high" DBP levels via an Operational Evaluation, and to conduct an Initial Distribution System Evaluation (IDSE) to identify locations within their distribution systems representing maximum TTHM and HAA5 concentrations. Utilities can apply for an exemption to these two (2) requirements if all previous samples have been below 0.040 mg/L and 0.030 mg/L for TTHMs and HAA5s, respectively.

The major difference between the Stage 1 and the Stage 2 D/DBPR is the compliance calculation of TTHM and HAA5 concentrations. Stage 1 D/DBPR compliance is based on a system-wide RAA, while Stage 2 D/DBPR is based on RAAs at each location, called the locational running annual average (LRAA). Under the Stage 2 D/DBPR, the MCLs for TTHMs and HAA5 remain the same as under the Stage 1 D/DBPR.

4.1.5. Radionuclide Rule

The USEPA's final drinking water standard for radionuclides became effective on December 8, 2003. The final rule includes MCLs and monitoring requirements for gross alpha, radium-226, radium-228, uranium, and beta/photon emitters**.** The State of California

was required to adopt or issue a radionuclide rule no less stringent than the 2003 final federal rule.

Under the radionuclide rule, gross alpha, radium-226, radium-228, uranium must be analyzed, and results for the radium-226 and radium-228 analyses must be reported separately. The MCL for gross alpha is fifteen (15) picocuries per liter (pCi/l), for uranium is 20 pCi/l, and for the sum of radium-226 and radium-228 is five (5) pCi/l. Subsequent gross alpha, radium-226, radium-228, and uranium monitoring frequencies are based on the initial round of analysis results, the submittal of which was required in 2007. If the results were less than the detection limit for the purpose of reporting (DLR), the monitoring requirement is one (1) sample every nine (9) years. If the results were less than one-half of the MCL but greater than the DLR, the monitoring requirement is one (1) sample every six (6) years. If the results were greater than one-half of the MCL but less than the MCL, the monitoring requirement is one (1) sample every three (3) years. If the results were greater than the MCL, the sources have to be monitored quarterly until the RAA is less than the MCL. The PWS must provide radionuclide treatment at the State's discretion.

4.1.6. Arsenic Rule

On January 22, 2001, the USEPA published the final Arsenic Rule establishing the MCL at 0.010 mg/L [or ten (10) parts per billion (ppb)]. Drinking water systems were required to comply with the MCL by January 2006. Groundwater systems were required to take an initial sample between 2005 and 2007 to measure compliance with the new MCL. If that sample was less than the MCL, subsequent samples were required every three (3) years. If the initial sample was greater than the MCL, quarterly samples were required until the system consistently sampled below the MCL.

4.1.7. Lead and Copper Rule

On January 12, 2000, the USEPA revised the Lead and Copper Rule, previously adopted on December 11, 1995. The revised rules require that PWSs monitor lead and copper concentrations at a number of residential taps based on the population served. The required number of lead and copper samples may be reduced depending on past results. Compliance is based on the 90th percentile concentration for all samples collected. The Action Level (AL) for lead is 0.015 mg/L and for copper is 1.3 mg/L. Short-Term Revisions

were implemented in 2004 and in 2007, and included further requirements in public education, monitoring, treatment, customer awareness and lead service line replacement.

The USEPA is evaluating Long-Term Revisions to the Lead and Copper Rule to improve public health protection and to streamline the Rule's requirements; the Long-Term Revisions will intend to:

- Improve the effectiveness of corrosion control treatment in reducing exposure to lead and copper, and
- Trigger additional actions that equitably reduce exposure to lead and copper when corrosion control treatment alone is not effective.

4.1.8. Groundwater Rule

On October 12, 2006, the USEPA released the final Groundwater Rule (GWR) to reduce the risk of fecal contamination in PWSs; the GWR applies to all PWSs that use groundwater as a source of drinking water supply. The GWR addresses microbiological contamination risks in drinking water through a risk targeting approach. The four (4) major components of the GWR are described below.

Periodic Sanitary Survey

Under the GWR, states are required to conduct a sanitary survey for each PWS that uses groundwater. The survey requires evaluation of eight (8) critical elements and identification of significant deficiencies therein: 1) sources; 2) treatment; 3) distribution system; 4) finished water storage; 5) pumps, pump facilities, and controls; 6) monitoring, reporting, and data verification; 7) system management and operation; and 8) operator compliance with state requirements. Each PWS must have completed an initial survey by December 31, 2012 and must update the survey every three (3) years thereafter.

PWSs that meet certain performance criteria may have been granted an exemption to instead complete an initial survey by December 31, 2014 and to update the survey every five (5) years thereafter. The performance criteria are met if the PWS in question: 1) provides four (4)-log removal treatment of viruses before or at the first customer from all groundwater sources; 2) has outstanding performance record as defined by the state; and

3) has no history of total coliform MCL or monitoring violations under the Total Coliform Rule (TCR).

Source Water Monitoring

For water systems that do not achieve at least a four (4)-log of viruses inactivation or removal, triggered monitoring is required if any sample collected during the routine sampling under the TCR has a positive total coliform result. Subsequently, the PWS is required to take one (1) sample at each groundwater source and to test it for fecal indicators (*E. Coli, enterococci or coliphage*) within 24 hours of receiving the positive total coliform result. If any fecal indicator is detected, the PWS is required to take five (5) additional repeat samples and to test for a fecal indicator within 24 hours. If one (1) or more of the five (5) repeat samples test positive for any fecal indicator, corrective action is required. The compliance date for triggered monitoring and associated corrective action was December 1, 2009.

As a complement to triggered monitoring, the GWR allows states to require PWSs that do not provide at least a four (4)-log virus inactivation or removal to conduct source water assessment monitoring at any time to help identify high-risk systems. The USEPA recommends that the following risk factors be considered by states in targeting high-risk systems: 1) high population density combined with on-site wastewater treatment systems; 2) aquifers with restricted geographic extent, 3) aquifers with thin karst, fractured bedrock and gravel; 4) shallow unconfined aquifer; 5) aquifers with thin or absent soil cover; and 6) groundwater wells previously identified as having fecal contamination.

Corrective Actions

Corrective Actions are required for any PWS with a significant deficiency identified during the sanitary survey or with detectable fecal matter at any groundwater source. The PWS must implement one (1) or more of the following corrective actions within 120 days of identification of a significant deficiency or a positive fecal indicator detection: 1) correct all significant deficiencies, 2) eliminate the source of contamination, 3) provide an alternative source of water, and/or 4) provide treatment which reliably achieves four (4)-log virus inactivation or removal.

The most common and economically efficient method to provide a four (4)-log virus inactivation is chlorination. To achieve inactivation, a certain chlorine contact time (CT) - chlorine residual concentration in mg/L multiplied by contact time in minutes - value is required, which is based on water temperature and pH.

Compliance Monitoring

If a PWS already treats groundwater to achieve at least a four (4)-log virus inactivation or removal, the GWR requires regular compliance monitoring to ensure that the treatment technology installed is reliable. For PWSs that use chlorine as a disinfectant and serve more than 3,300 people, continuous residual chlorine monitoring is required. The PWS must maintain the state-determined residual chlorine level at all times. If the residual chlorine falls below the required level, the system must restore the residual chlorine to an appropriate level within four (4) hours. If the continuous residual chlorine monitor fails, the PWS is required to take a grab sample every four (4) hours, and the operator is allowed a maximum of fourteen (14) days to resume continuous monitoring.

These regulations took effect on December 1, 2009. MWSD has since continuously monitored residual chlorine to protect the water supply against California's Maximum Residual Disinfectant Level (MRDL) of four (4) mg/L as Cl_2 established in Title 22, Chapter 15, Section 64533 of the California CCR.

4.1.9. Surface Water Treatment Rule (SWTR)

The Surface Water Treatment Rules are a combination of rules that mandate the filtration and disinfection of surface water sources. The main objective of the Surface Water Treatment Rules is to decrease risk of illnesses by microbial pathogens including *Legionella*, *Giardia lamblia*, and *Cryptosporidium*.

Surface Water Treatment Rule (SWTR)

The Surface Water Treatment Rule came into effect in 1989 establishes maximum contaminant level goals for viruses, bacteria and Giardia lamblia for public water systems relying on surface water sources or groundwater sources under the direct influence of

surface water (GWUDI). The rule requires filtration and disinfection and includes treatment requirements.

Interim Enhanced Surface Water Treatment Rule (IESWTR)

The Interim Enhanced Surface Water Treatment Rule was instated in 1998 and applies to public water systems that serve 10,0000 people or more and that rely on surface water or GWUDI sources. The rule sets a list of additional requirements targeting Cryptosporidium and filtration requirements. It also includes the requirements for sanitary surveys and finished water reservoirs covers. The Rule also requires the evaluation of the balance of the risks between the inactivation process and the formation of disinfection by-products.

Filter Backwash Recycling Rule

The Filter Backwash Recycling Rule aims to ensure that all public water system that use conventional or direct filtration processes (employ) appropriate backwash water recycling practices. Additionally, the Rule stipulates that the recycled filter backwash water cannot bypass any of the treatment process of a conventional or direct filtration system.

Long-Term 1 Enhanced Surface Water Treatment Rule (LT1ESWTR)

The Rule applies to all public water systems using surface water or GWUDI sources that serve 10,000 people or less and is in continuation of the Interim Enhanced Surface Water Treatment Rule.

Long-Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR)

The Long-Term 2 Enhanced Surface Water Treatment Rule applies to all public water systems using surface water or GWUDI sources. The Rule includes provisions targeting Cryptosporidium, uncovered finished water storage facilities and the risk of disinfection by-product formation.

4.2. Consumer Confidence Report

In 1996, the U.S. Congress amended the Safe Drinking Water Act (SDWA) adding a requirement that water systems report water quality to their customers. The finalized rule, called the Consumer Confidence Report (CCR) Rule, was published in the Federal Register on August 19, 1998 and requires every community water system to prepare an annual CCR describing the quality of water delivered by the systems and to deliver the CCR to its customers by July 1st of each year.

Every CCR must contain the following:

1) Water system information, including the name and phone number of a contact person, information on public participation opportunities, a Spanish language section on important content, and information for other non-English speaking populations;

2) Water source identification and the results of the source water vulnerability assessment;

3) Summary of data on detected regulated and unregulated contaminants, including possible source(s) of each contaminant, and whether the water system received any violations; and

4) Educational information on nitrate, arsenic, lead, radon, and Cryptosporidium, if applicable. A copy of the most recent CCR (CCR 2016) is found in Appendix C.

4.2.1. MWSD Water Quality Concerns

Based on the 2016 MWSD CCR, MWSD is in compliance with all water quality regulations. The following constituents were detected below enforceable regulatory limits, but are mitigated by the District to ensure safe drinking water in case of future water quality concerns.

Copper and lead were found at levels *below* the AL of 1.3 and fifteen (15) ppm, respectively, in the 2015 residential tap sampling. No exceedances were found in the distribution system sampling.

Arsenic was detected at the Alta Vista Well at levels *below* the MCL but above five (5) ppb. While the drinking water meets the federal and state standards for arsenic, the California CCR guidelines require utilities to report observations of Arsenic concentrations greater than five (5) ppb and to monitor the contaminant more frequently. This precautionary protocol balances the current understanding of arsenic's possible health effects against the cost of removing arsenic from drinking water. The USEPA continues to research the health effects of low levels of arsenic, which is a mineral known to cause cancer in humans at high concentrations and is linked to other health effects such as skin damage and circulatory problems.

Fluoride was found at the Corona Well at levels *below* the MCL but above one (1) ppm. While the drinking water meets the federal and state standards for fluoride, it does contain low levels of fluoride. Some people who drink water that contains fluoride in excess of the federal MCL of four (4) ppm over many years are susceptible to bone disease. Children who drink water that contains fluoride in excess of the California MCL of two (2) ppm are susceptible to mottled teeth.

As previously stated, Secondary MCLs (SMCLs) were set to protect against unpleasant aesthetic effects of water such as color, taste, or odor. Exceeding SMCLs poses no health risks. Manganese was found at levels that exceeded the SMCL of 50 ppb, and iron was found at levels that exceeded the SMCL of 300 ppb. The high manganese and iron levels are most likely due to leaching of natural deposits in the soil where groundwater is in contact with naturally occurring sediments.

4.3. Water Treatment Facilities

MWSD owns and operates several DDW-approved treatment facilities and associated processes, including a surface water treatment plant (SWTP), a groundwater treatment plant acquired by MWSD after the 2015 consolidation for treatment of Pillar Ridge's three (3) wells (Corona Well, Culebra Well, and Retiro Well), and several wellhead treatment units. MWSD treatment facilities are designed to meet the regulations detailed in Section 4.1, above, and are described in detail below.

4.3.1. Surface Water Treatment – Alta Vista Water Treatment Plant (AVWTP)

The AVWTP treats surface water from the Montara Creek diversion structure, located approximately one-half mile and 50 feet higher than the AVWTP. Montara Creek water is fed by a six (6)-inch steel raw water pipeline into a 77,000-gallon concrete tank prior to treatment at the AVWTP. The direct-filtration AVWTP was constructed in 1978 with a design peak capacity of 75 gpm and was upgraded in 1995 to include pressure contact clarifiers and vertical pressure filter vessels.

The AVWTP treatment facilities consist of four (4) vertical pressure contact clarifiers, two (2) multi-media vertical pressure filters, chemical feeders and containers, one (1) compressor for the clarifier air scour, two (2) raw water booster pumps, one (1) surface wash pump, one (1) backwash pump, chemical feed metering pumps for cationic polyelectrolyte coagulant and hypochlorite solution, pneumatic control valves, storage, and controls. The AVWTP uses Nalco 8102 as the primary coagulant. Sodium hypochlorite disinfection maintains a residual chlorine concentration of 0.5 to 1.0 mg/L at the point the water enters the MWSD distribution system.

The District has implemented various improvements at the AVWTP in the last five (5) years, including the replacement of all sampling lines and all laboratory equipment, replacement of the filter turbidimeter, and replacement of both raw water booster pumps. One booster pump was replaced in September 2014 and the other booster pump was replaced in March 2015. The Operation, Maintenance and Monitoring Plan (OMMP) for the facility was last updated in 2013.

4.3.2. Groundwater Treatment

The PRWTP, which treats groundwater from the Corona Well, Culebra Well, and Retiro Well, was acquired by MWSD after the 2015 consolidation of the Pillar Ridge community into MWSD's service area. DDW has approved the PRWTP treatment processes for the removal of iron, manganese and VOCs. The existing treatment system consists of a Carbonair DAT-60 aeration tower, a Carbonair T-300 settling system, and a Filtronics Model FV-04 Electromedia 1 iron and manganese filtration system. The filtration system was designed and installed with the initial PRWTP in 1990, and the aeration system was

installed in 2003 during a treatment plant upgrade. The filter media for the Filtronics equipment was replaced in 2003.

In 2015, MWSD made various upgrades to the PRWTP including:

1) The installation of a new surge tank for backwash water;
2) A tie-in of the PRWTP waste lines into the sewer system;
3) The installation of new Filtronics filter media;
4) The repair of a broken lateral pipeline and an automatic control valve; and
5) The replacement of the air compressor for the hydropneumatic tank, the autodialer for callouts, and two (2) surge tanks for the storage wells.

Each of the Pillar Ridge Wells is outfitted with a submersible pump and a local pump control system consisting of a hydro-pneumatic tank and pressure switch. Raw water enters the PRWTP through the aeration tower and then resides in the settling system's tank, after which it is pumped through the iron and manganese filters and ultimately to the storage tanks. High service pumps transfer water from the storage tanks to the District's distribution system. The treated water storage tanks supply backwash water through the booster pumps; supernatant is pumped from the backwash water storage tank to an irrigation field.

4.3.3. Wellhead Treatment

The groundwater sources that feed the MWSD water system and are not treated at the PRWTP have wellhead treatment installed for disinfection and various constituents of concern. The three (3) Pillar Ridge Wells do no have wellhead treatment and the water they produce is treated at the PRWTP.

Disinfection

Wellhead liquid sodium hypochlorite disinfection systems are installed and in use at all District wells, with the exception of Portola Estate Well No. 4. Wagner Well No. 3 and Drake Well are chlorinated with the same liquid sodium hypochlorite disinfection system located downstream of the Drake Well. The systems use Pulsatron electric metering pumps that inject a 12.5-percent sodium hypochlorite solution into the water system to

maintain a free chlorine residual of 0.8 mg/L prior to the first customer in the distribution system.

Wells and raw water lines are on a regular maintenance and rehabilitation program to control the growth of iron bacteria, common in groundwater wells in the area. Wells are treated chemically every month and every three (3) to five (5) years for chemical and mechanical rehabilitation. During rehabilitation, pumps are pulled and cleaned and the wells are treated. During rehabilitation, the raw water lines are chemically treated to remove build up and disinfected as required by DDW.

Airport Wells

Water from the three (3) wells at the Half Moon Bay Airport, North Airport Well (NAW), South Airport Well (SAW), and Airport Well No. 3 (AW3), have localized water treatment facilities for disinfection (as described above) and the removal of nitrates. Additional water quality concerns at the Airport Wells include TCP and corrosivity.

Under an approved DDW drinking water permit amendment, an Ion Exchange System (IES) consisting of two (2) ion exchange vessels placed in series was installed in 2005 to reduce nitrate at the North Airport Well. The IES is only in operation when the North Airport Well is providing water for distribution. Water pumped from the North Airport Well is passed through a split-stream configuration, either undergoing treatment through the IES (50- to 65-percent of the North Airport Well raw water) or bypassing the IES and sent to blend with the IES treated effluent (45- to 50-percent of the North Airport Well raw water).

TCP has been reported in each of the Airport Wells in recent water quality monitoring results, with the SAW showing consistent presence of the chemical. TCP is expected to be regulated in the near future, and is considered by the State of California as an unregulated contaminant that should be monitored. The SWRCB established an interim non-enforceable Notification Level of 0.005 micrograms per liter (μg/L, or, ppb) in 2005. The Office of Environmental Health Hazard Assessment (OEHHA) within the California EPA established a Public Health Goal (PHG) of 0.0007 μg/L (or, ppb) in 2009. In July

2017, the SWRCB adopted1,2,3-TCP drinking water standards and set the MCL for TCP at 0.005 µg/L, consistently with the California Health and Safety Code.

Between 2011 and 2016, MWSD observed TCP at each of the three (3) Airport Wells at concentrations ranging from 0.0051 ppb to 0.026 ppb and did not observe TCP at other groundwater sources. TCP was reported every year between 2011 and 2016 at the SAW, and was only reported at NAW and AW3 in 2011, as shown in Table 15. The Airport Wells are not out of compliance for the reported TCP levels, however, the presence of the constituent could cause more substantial issues when the SWRCB establishes an MCL for TCP.

Table 15 2011-2016 Observed TCP Concentrations in Raw Water Supply

Raw Water Source	Concentration Observed by Year (µg/L, or, ppb)					
	2011	2013	2014	2015	2016	Maximum
North Airport Well	0.0051	-	-	-	-	0.0051
South Airport Well	0.013, 0.014, 0.019	0.012, 0.013	0.010, 0.011, 0.013	0.0095, 0.012, 0.026	0.013, 0.012, 0.012, 0.013	0.026
Airport Well No. 3	0.0053, 0.0064	-	-	-	-	0.0064

It was previously thought that the water produced by the Airport Wells was corrosive and possibly responsible for the system's LCR violation in the past. The operations of the Airport Wells have significantly changed since the initial issuance of the LCR violation status. Currently, NAW feeds the system whereas both SAW and the AW3 are locked out and tagged out of the system.

The District determined that NAW is a critical asset to the system, due to its strategic location and sustainable groundwater supply. NAW is the only large operating source located west of Highway 1, that can provide the necessary supply redundancy to parts of the Schoolhouse and Moss Beach pressure zones, should a main break occur preventing water to flow from the other sources across Highway 1. The District plans to keep NAW in operation provided that the remaining corrosivity concerns (if any) at the well are addressed. The LCR sampling scheduled for September 2017 will provide additional information on the North Airport Well corrosivity and its impact on the system.

SECTION FIVE
Distribution System and Storage Requirements

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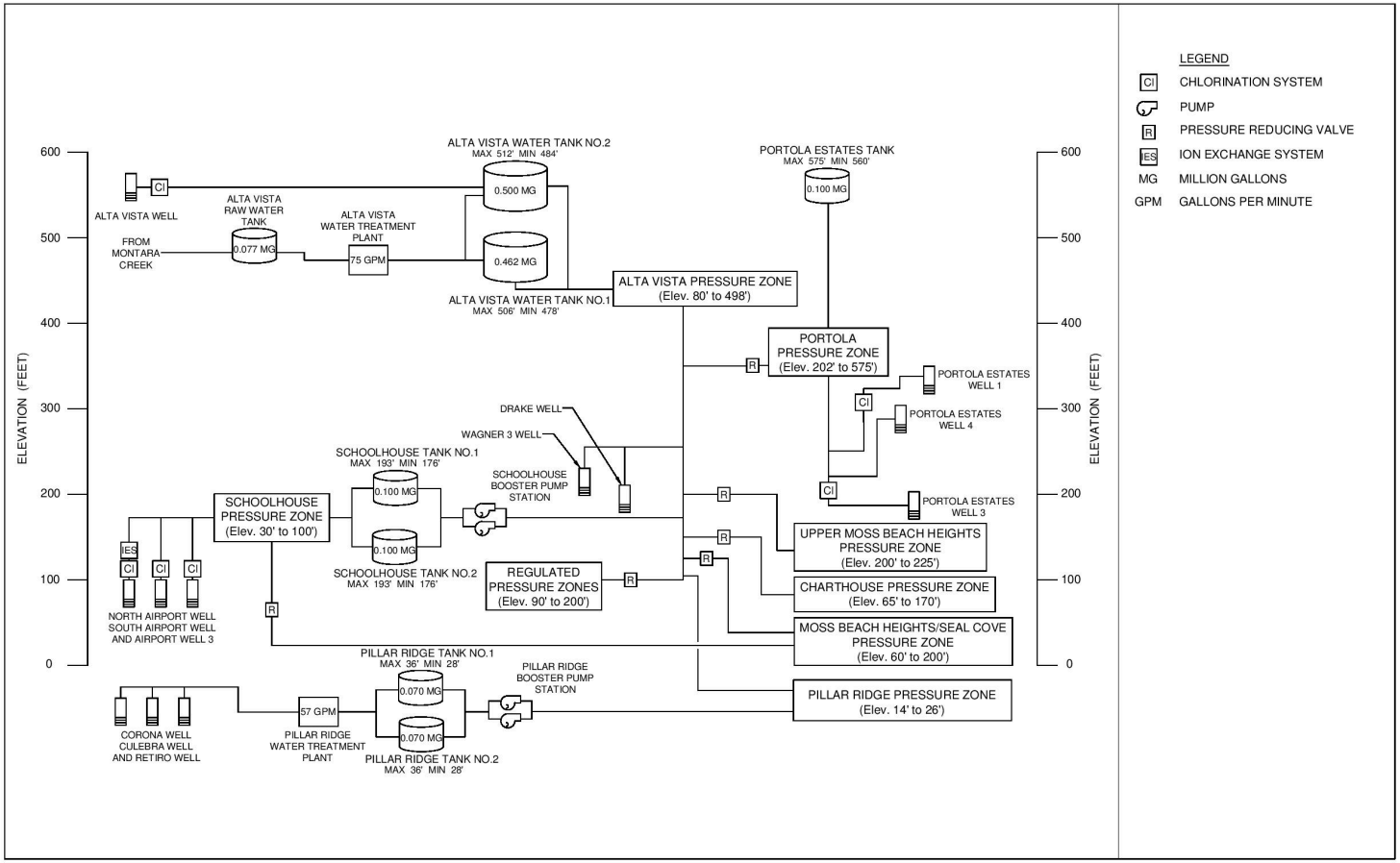
5. Distribution System and Storage Requirements

The capacities and deficiencies of the MWSD water system were evaluated based on current and projected demands and a hydraulic model analysis. The distribution and storage system facilities and associated design criteria were utilized to evaluate the efficiency of the system at handling a range of demands. This section outlines the current facilities and design parameters for current and projected demand scenarios, and evaluates the facilities against the parameters using the hydraulic model. The results of the evaluation indicate the deficiencies of the system and inform the CIP detailed in Section 6.

5.1. Existing Distribution System and Storage Facilities

MWSD customers in eight (8) different pressure zones are supplied through a distribution system that receives water from seven (7) storage tanks or directly from groundwater sources. The location of the District's distribution and storage facilities and the eight (8) pressure zones are shown in Figure 3, MWSD Water System Layout. A schematic of the water system is shown in Figure 13.

Figure 10 MWSD Water System Schematic



5.1.1. Distribution System

Water is conveyed to MWSD's customers through a network of pipes approximately 150,000 feet long, with pipes ranging in diameter from two (2) to sixteen (16) inches. Mains have been extended minimally and only as necessary for new PFP and domestic service connections. The District maintains an active main replacement program to address issues within the distribution system. In 2016 the replacement of a 1,266-foot long two (2)-inch diameter steel water main with a six (6)-inch PVC pipe was performed along 4th Street between East Avenue and Audubon Avenue.

As of December 2016, the water system had a total of 1,653 metered service connections, with 1,620 connections serving residential customers, and 33 connections serving commercial and industrial customers. In addition, MWSD has served a population of 850 in the Pillar Ridge community, as reported by Millennium Housing, the owner of the Pillar Ridge community, since the January 2015 consolidation. Water is delivered to the Pillar Ridge community through one (1) commercial meter. Additionally, 148 PFP meters are connected to the District's system; these meters do not draw water for domestic purposes and only draw water in the event of a fire.

Water from the higher pressure zones - those supplied by the Portola Estates and Alta Vista Tanks – is delivered to areas at lower elevations through multiple PRV stations. There are a total of 28 active PRVs in the District's water system, with the characteristics detailed in Table 17. All PRV station polyethylene tubing was upgraded with stainless steel tubing, and upgrades to PRV stations were made as needed.

Table 16 Pressure Regulating Valve Stations

Location	Manufacturer & Model	Size (inches)	Downstream Pressure Setting (psi)	Elevation (ft) [a]
Etheldore and Lancaster	Cla-Val 100	6	35	70
Etheldore and Lancaster	Bailey 30A	2	40	70
3rd and East	Unknown	6	70	115
3rd and East	Unknown	2	75	115
Farralone and 6th	Bailey 400	6	65	156
Farralone and 6th	Bailey 30A	3	70	156
6th and Farralone	Unknown	4	65	133
6th and Farralone	Baker	2	55	133
8th and Main	Baker	6	79	116
8th and Main	Unknown	3	83	116
11th and Farralone	Cla-Val	6	70	140
11th and Farralone	Bailey 30A	2	80	140
12th and Farralone	Bailey 400	6	80	140
12th and Farralone	Bailey 30A	2	85	140
13th and Farralone	Bailey 400	6	80	103
13th and Farralone	Bailey 30A	2	87	103
14th and Farralone	Bailey 400	6	90	95
14th and Farralone	Bailey 30A	2	85	95
Alamo and Cypress	Cla-Val	8	130	347
Alamo and Cypress [b]	Cla-Val	2	50	347
Sierra and Lincoln	Bailey 400	8	68	165
Sierra and Lincoln	Bailey 30A	3	75	165
Marine and Cabrillo	Unknown	8	40	69
Marine and Cabrillo	Unknown	2	45	69
Buena Vista and Lincoln	Unknown	6	75	192
Buena Vista and Lincoln	Unknown	2	85	192
Sunshine Valley Road	Unknown	6	30	246
Sunshine Valley Road	Unknown	2	35	246

[a] Elevations obtained from Google Earth
[b] Pressure Sustaining Valve (PSV)

5.1.2. Storage Facilities

The MWSD system includes raw water and treated water storage facilities. Raw water diverted from Montara Creek is stored in an updated 77,000-gallon concrete raw water storage tank that allows for initial sediment settling upstream of the AVWTP during approximately fifteen (15) hours of detention time.

The District maintains seven (7) treated water storage tanks with a combined capacity of 1.402 million gallons for operational, emergency, and firefighting uses, listed in Table 18. Since the construction of four (4) new tanks between 2012 and 2016, the District has the capacity to take storage tanks out of service for maintenance or repairs due to system-wide redundancy.

Table 17 Treated Water Storage Tanks

MWSD Storage Tank	Capacity (gallons)	Year Built	Material	Diameter (feet)	Base Elevation (feet)	Overflow Elevation (feet)
Alta Vista Storage Tank No. 1	462,000	1976	Steel	52	478	506
Alta Vista Storage Tank No. 2	500,000	2015	Concrete	55	484	512
Portola Estates Storage Tank	100,000	1981	Wood	34	560	575
Schoolhouse West Storage Tank	100,000	2013	Steel	35	176	193
Schoolhouse East Storage Tank	100,000	2012	Steel	35	176	193
Pillar Ridge WTP Storage Tank No. 1	70,000	1989	Steel	40	28	36
Pillar Ridge WTP Storage Tank No. 2	70,000	1989	Steel	40	28	36
TOTAL	**1,402,000**					

The construction of the 35-foot diameter welded steel East and West Schoolhouse Storage Tanks was completed in 2012 and 2013, respectively, and the original 100,000-gallon concrete Schoolhouse Storage Tank was demolished. The tanks are 17 feet tall and are sited at the same elevation, buried to a depth of six (6) feet and supported by a retaining wall.

The 52-foot diameter steel Alta Vista Storage Tank No. 1 constructed in 1976 is located along an unpaved extension of Alta Vista Road, adjacent to a 77,000-gallon settling tank and the AVWTP. The construction of the 55-foot diameter Alta Vista Storage Tank No. 2 was completed in 2015; an eight (8)-inch pipeline connects Alta Vista Storage Tanks Nos. 1 and 2 along Alta Vista Road. Like the Schoolhouse Storage Tanks, the Alta Vista Storage Tank No. 2 was also buried twelve (12) feet below grade and is supported by retaining walls. These facilities store and treat water from Montara Creek before entering the District's storage and distribution system.

The following necessary improvements were implemented at the storage tanks built prior to 2012:

- Thorough inspections and cleanings of all storage tanks;
- Portola Estates Tank Improvements: Roof hatch, inlet and outlet, access road and drainage improvements at the Portola Estates Tank were completed to improve worker and public safety and to protect the environment; and
- Pillar Ridge Tank Improvements: Drainage and aeration improvements and major chemical treatment cleaning were completed after the January 2015 consolidation of the Pillar Ridge community system.

5.2. Distribution System and Storage Design Criteria

Planning and design criteria adopted by the District's Board of Directors at the December 18, 2003 meeting have been adopted by MWSD for system planning and are summarized in Table 18. These design criteria help define the system deficiencies and guide the necessary system improvements.

5.2.1. Distribution Pipeline System Criteria

The water distribution system must sustain a minimum working pressure of 40 psi during PHD conditions and 20 psi during fire flow conditions. In addition, velocity can be no higher than eight (8) feet per second (fps) during PHD conditions, and twelve (12) fps during fire flow conditions. The design criteria for all demand conditions are presented in Table 19.

Table 18 Distribution Pipeline System Criteria

Demand Condition	Minimum Pressure (psi)	Maximum Velocity (fps)	Maximum Headloss (ft /1,000 ft)
ADD	50	5	3
MDD	50	7	5
PHD	40	8	7
Fire Flow	20	12	10

5.2.2. Storage Criteria

The total required volume of storage in a water system includes water for operational, emergency, and fire-fighting uses. Operational storage is directly related to the amount of water necessary to meet peak demands, and therefore the only value related to the

number of customers connected to the District's system. The intent of operational storage is to provide the difference in quantity between the customers' peak demands and the system's available supply. The volume of water allocated for emergency uses is decided based on the historical record of emergencies experienced, and on the amount of time which is expected to lapse before the emergency can be corrected. The National Fire Code, Insurance Service Office, and local Fire Department regulate water storage required for fighting fires.

Operational Storage

Operational storage is the quantity of water that is required to moderate daily fluctuations in demand beyond the capabilities of the production facilities, based on MDD. Water must be stored to supply the peak flows that exceed the maximum day production rate. Operational storage is then replenished during off-peak hours when the demand is less than the production rate. Operational storage for a typical system is approximately equal to 25-percent of the MDD; for MWSD the operational storage requirement is 119,558 gallons.

Emergency Storage

Determination of the emergency storage volume is a policy decision based on the assessment of the risk of failures and the desired degree of system reliability. The amount of required emergency storage is a function of several factors including the diversity of the supply sources, redundancy and reliability of the production facilities, and the anticipated length of the emergency outage.

The vulnerability of the system is evaluated based on the susceptibility of the system to varying degrees of emergencies and the ability of the utility to recover from these emergencies. An emergency is defined as an unforeseen or unplanned event that may degrade the quality or quantity of potable water supplies available to serve customers. There are three (3) types of emergency events that a utility typically prepares for:

- *Minor emergency* - A fairly routine, normal, or localized event that affects few customers, such as a pipeline break, malfunctioning valve, hydrant break, or a brief power loss. Utilities plan for minor emergencies and typically have staff and material resources available to correct them.
- *Major emergency* - A disaster that affects an entire or large portion of a water system, lowers the quality and quantity of the water, or places the health and safety of a community at risk. Examples include water treatment plant failures,

raw water contamination, or major power grid outages. Water utilities infrequently experience major emergencies.

- *Natural disaster* - A disaster caused by natural forces or events that create water utility emergencies. Examples include earthquakes, forest or brush fires, hurricanes, tornadoes or high winds, floods, and other severe weather conditions. Water utilities rarely experience natural disasters.

The susceptibility of MWSD's water system to these emergency situations have been evaluated based on the District's geographic location, current equipment, and approach to handling potential emergency situations. The evaluation is presented in the following Table.

Table 19 MWSD Emergency Preparedness

MWSD Emergency Situation	Current Mitigation Approaches
Minor Emergencies	
Brief (2 hour) Power Loss	Emergency generators for potential power loss
Pipeline Break	Variable Frequency Drives (VFDs) at pumps
Valve Malfunction	Agreement with CCWD to deliver water to the District in the event of an emergency
Major Emergencies	
Major (8 hour) Power Loss	Emergency generators for potential power loss
Water Treatment Plant Failure	VFDs at pumps
Raw Water Contamination	Agreement with CCWD to deliver water to the District in the event of an emergency
Natural Disasters	
Earthquake, Forest Fire	Agreement with CCWD to deliver water to the District in the event of an emergency; the effectiveness of this is contingent upon the state of CCWD's water system, as an earthquake would be a regional disaster

Upon initial evaluation of the MWSD system resiliency and vulnerabilities, the volume of emergency storage should suffice to provide enough water to sustain the needs of the MWSD system in the most severe event of those listed in Table 19: an earthquake. Minor and major emergencies would require less emergency water storage and are therefore included within the more conservative evaluation focused on earthquake preparedness; the MWSD water system can recover from both minor and major emergencies in a maximum of eight (8) hours.

There are several ways in which emergency storage can be calculated depending on the types of systems and risks assumed; the *2011 Master Plan Update* presented a comparison of these methods and this analysis is updated in Table 21. The emergency storage values from the updated analysis range from 159,410 gallons to 592,036 gallons. The District has established its emergency storage goal at the most conservative value, 592,036 gallons, based on the American Water Works Association (AWWA) Guidelines for conservative emergency preparedness.

Table 20 Emergency Storage Methodology Comparison

Methodology	Formula	Current MWSD Emergency Storage Volume Required (gallons)
AWWA Recommended Target	MDD for 8 hours	159,410
50% of MDD	0.5 x MDD	239,115
DWD Guidelines	ADD	296,018
Per Capita Estimate	2 Days (time to restore normal water supply) x 50 gal/day x Population	525,600
AWWA Guidelines	2.0 x ADD	592,036

Fire Protection Storage

As previously stated, the National Fire Code, Insurance Service Office, and local Fire Department regulate the quantity of water storage suggested for firefighting purposes. The quantity of water that the District is required to provide can be drawn from operating sources or from storage facilities. Although areas of the District's system are strictly residential and only require 1,000 gpm for two (2) hours, the District has established its firefighting delivery and storage goal based on the ability of the District to provide 2,000 gpm for two (2) hours, strictly drawn from storage facilities. The District's established fire storage goal is considered conservative and totals 240,000 gallons.

Storage Summary

Table 22 summarizes MWSD's established storage goals for current demands and for the expected future and ultimate growth; the total storage goal is a target value that the District has set for the operation of its system and is not a mandated requirement. Values are conservative estimates assumed should a disaster occur. To date, MWSD is in compliance with regulations related to water storage requirements and has sufficient storage to serve additional customers, up to 1000 connections.

Table 21 MWSD Storage Goals

Storage Goal Category	**Storage Volume (gallons)**					
Condition	*Current (2016)*	*200*	*400*	*600*	*800*	*1000*
ADD	*296,018*	*333,506*	*370,994*	*408,482*	*445,970*	*483,458*
MDD	*478,230*	*533,609*	*593,590*	*653,571*	*713,552*	*773,533*
Operational Storage (25% of MDD)	119,558	133,402	148,398	163,393	178,388	193,383
Emergency Storage (2 Days at ADD)	592,036	667,012	741,988	816,964	891,940	966,916
Fire Fighting Storage (2 hours at 2,000 gpm)	240,000	240,000	240,000	240,000	240,000	240,000
Total Storage Goal	*951,593*	*1,040,414*	*1,130,385*	*1,220,357*	*1,310,328*	*1,400,299*
Existing Storage	*1,402,000*	*1,402,000*	*1,402,000*	*1,402,000*	*1,402,000*	*1,402,000*
Current Storage Deficit	**0**	**0**	**0**	**0**	**0**	**0**

Additional storage may be required to provide emergency storage capacity for the Big Wave development. The storage facility would be built at the cost of the developer and the location and volume of the tank would depend of the fire flow requirements of the development.

5.3. Hydraulic Model

The District's potable water distribution system was simulated using the WaterCAD software to determine if system components adequately operate under various water demand conditions based on the design and operational criteria listed in the previous sections. The simulation software also allows the District to estimate how the water system will operate if new connections, supply sources, system's improvements and/or storage facilities are added. The scenarios modeled include:

Maximum Flow Analysis

- MDD under current conditions (2016)

- MDD under future conditions (addition of 600 connections): The addition of 600 connections was selected as a conservative long-term growth scenario for MWSD's system.

Fire Flow Analysis

- System-wide fire flow analysis under current (2016) MDD conditions
- Simulation of fire events under current (2016) MDD conditions:
    - Fire event simulation in Moss Beach pressure zone
    - Fire event simulation in Upper Moss Beach pressure zone
    - Fire event simulation in Pillar Ridge pressure zone
    - Fire event simulation in Regulated pressure zone
    - Fire event simulation in Portola pressure zone

Based on the results of these analyses, deficiencies in the distribution system were identified and further analyzed to determine what improvements would be needed. Improvement scenarios modeled include:

Pipeline and Pressure Regulating Valve Setting Improvements Analysis

- MDD under current (2016) conditions with needed pipeline improvements
- System-wide fire flow analysis under current (2016) MDD conditions with needed pipeline and PRV setting improvements
- Fire event simulations in Moss Beach, Upper Moss Beach, Pillar Ridge, Regulated and Portola pressure zones under current MDD conditions with needed pipeline and PRV setting improvements

5.3.1. Development and Calibration

The WaterCAD Analyzer hydraulic model simulates water system operations and generates information on pressure, flow, velocity, and headloss that can be used to analyze the performance of the system and identify its deficiencies. The water distribution system is represented in the model as a schematic network of pipes, tanks, valves, pumps and reservoirs. The model is constructed by assigning nodes at each pipeline intersection or change in diameter, thus forming a network of pipelines that connect the various model elements.

CUCC developed a base H2ONET Analyzer hydraulic model of the now MWSD water system in 2003. Due to a lack of model documentation, the origin of the input data used in that version of the model was unknown, and model run results could not be verified with operational data. Errors were found in the configurations of certain areas of the distribution system as well as in the design and elevation data.

As a result, the pipeline network was reconfigured in WaterCAD using MWSD data and topographic data published by the United States Geological Survey (USGS). MWSD data includes physical data, such as pipe diameters, Supervisory Control and Data Acquisition (SCADA) data, such as continuously monitored flows and pressures, and assumed pressure losses in the system. The model can satisfactorily predict tank levels and source flow patterns, but it cannot predict most fire hydrant flows and actual water flow in most pipes.

The model is regularly updated, and most recently in 2017 for the purposes of this Master Plan Update. Calibration of the model was achieved in 2013 through fire hydrant test results and flow monitoring at critical locations.

5.3.2. Maximum Flow Analysis

To assess the current distribution system's ability to deliver water under MDD conditions, 24-hour simulations were run for current and future MDD. The scenarios in this analysis include:

- Current (2016) conditions: 332 gpm, MDD
- Long-term scenario - addition of 600 connections: 454 gpm, MDD

To analyze distribution system performance, headlosses in each pipeline were examined to determine which parts of the distribution system are "stressed" in meeting MDD while maintaining a minimum pressure of 50 psi. A pipeline was considered "stressed" if it experienced a headloss greater than five (5) feet per 1,000 feet (ft/1,000 ft) during the course of the simulation. Results of the maximum day flow analysis are presented in Table 22.

Table 22 Maximum Flow Analysis Results

Criteria	Demands	
	Current (2016)	Future Scenario 600 connections
Percentage of pipes with headloss greater than 5 ft per 1,000 ft	0.7%	1.6%

The existing distribution system demonstrated adequate performance and capacity to accommodate current (2016) MDD flow. Most pipelines sustained a headloss of less than five (5) ft/1,000 ft. Out of the 740 feet (0.5-percent) of pipeline which exceeded the 5 ft/1,000 ft headloss criteria, the highest headloss occurred in a two (2)-inch diameter pipe and a PRV located along Buena Vista Street. Under the future scenario demand conditions (addition of 600 connections), the percentage of pipelines exceeding the 5 ft/1,000 ft headloss criteria increased to almost two (2)-percent.

“Stressed” pipelines under current (2016) MDD conditions should be addressed in the near term and include the following sections of the distribution system:

- The 2-inch pressure regulating valve station and the adjacent 2-inch piping, along Buena Vista Street.
- Approximately 10 feet of 4-inch pipe downstream of the Alta Vista well.
- Approximately 100 feet of 4-inch pipe located downstream of the Drake and Wagner Well No.3 Wells.

5.3.3. Fire Flow Analysis

To evaluate the system’s ability to provide fire flow within the system, system-wide fire simulations and steady-state fire event simulations were performed. In order to balance the hydraulic model, the system-wide fire flow simulation conducted incorporated the Alta Vista, Charthouse, Schoolhouse, Moss Beach/Seal Cove and Upper Moss Beach pressure zones. Five fire event simulations were performed for the Moss Beach, Upper Moss Beach, Pillar Ridge, Regulated and Portola pressure zones.

The fire flow analysis considered that the Portola Tank is in service and feeding the system.

System-wide Response

To assess the current distribution system's ability to deliver adequate fire flow under the MDD condition of 332 gpm, a system fire flow analysis was performed. To analyze distribution system performance, pressures and available flows were examined for each node representing a possible fire hydrant in the system. Nodes were considered inadequate if the available flow at each node was less than 2,000 gpm. The results for a fire flow of 2,000-gpm and 1,500-gpm fire are presented in Table 23 and Figure 11.

Table 23 System Fire Flow Analysis Results

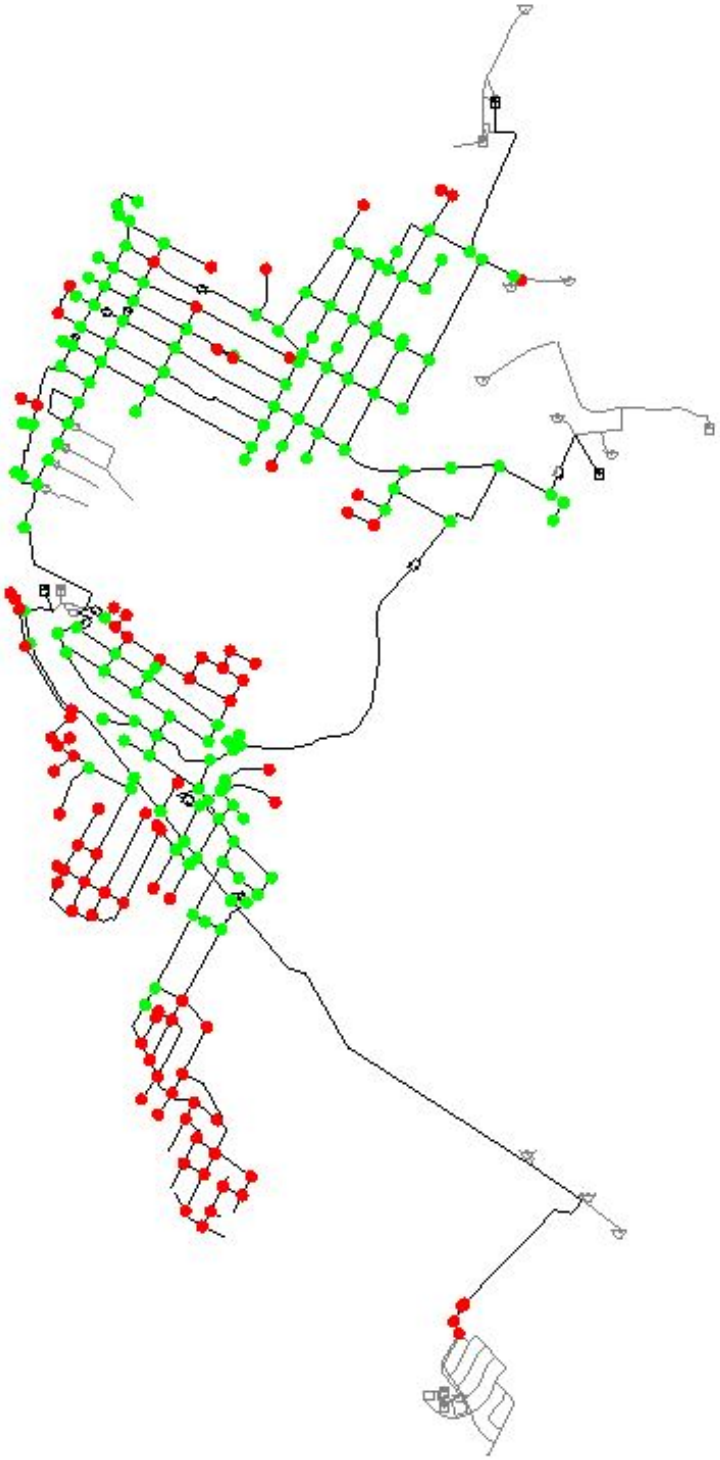
Percentage of nodes unable to deliver 2,000 gpm at 20 psi	39%
Percentage of nodes unable to deliver 1,500 gpm at 20 psi	19%

As shown in Table 23, a significant percentage of nodes in the zones of interest (Alta Vista, Schoolhouse, Charthouse, Moss Beach/Seal Cove and Upper Moss Beach) did not pass the fire flow requirements of 2,000 gpm at 20 psi. However, the analysis shows that the amount of failed nodes drops significantly when considering a fire flow of 1,500 gpm at 20 psi.

This system-wide fire flow simulation shows that 39-percent of the nodes in the distribution system were unable to provide adequate fire flow. Most of these nodes are located in the Schoolhouse, Moss Beach/Seal Cove and Upper Moss Beach pressure zones. It must be noted that a significant number of the failing nodes are located at the end of small diameter dead-end pipes, which is to be expected and does not necessarily reflect the overall ability of the system to supply fire flow to its connections. To mitigate this effect, the dead-end pipes can be connected to the closest water mains and convert the dead-end pipes into loops in the system, which will improve the delivery of fire flow to these nodes.

Based on these results, it appears that the replacement and upsizing of pipelines in the Alta Vista, the Upper Moss Beach and the Schoolhouse pressure zones are required to support the provision of fire flow throughout the system. Additionally, the adjustment of PRV stations is required to ensure pressures higher than 20 psi during a fire event. Since the Schoolhouse and Moss Beach/Seal Cove pressure zones are primarily affected, the adjustment of the settings at the PRVs located on Sunshine Valley Road and the PRVs at the Etheldore and Lancaster intersection is expected to significantly improve the system-wide fire flow results.

Figure 11 System Fire Flow Analysis Results – 2,000 gpm at 20 psi



Fire Event Simulations

To assess the existing distribution system's ability to handle fire flows, five (5) fire event simulations were run in the following pressure zones:

- Moss Beach
- Upper Moss Beach
- Pillar Ridge
- Regulated
- Portola

A two (2)-hour, 2,000-gpm fire event under MDD conditions was simulated at a single node in each pressure zone. The nodes in each pressure zone were selected to show a fire event at the most remote location of each pressure zone. A pipeline was considered "stressed" if it suffered a headloss greater than ten (10) ft/1,000 ft and was considered "critically stressed" if it suffered a headloss greater than 20 ft/1,000 ft. Table 24 illustrates the percentage of existing pipelines that are "stressed" and "critically stressed" during the fire event simulations. The following figures highlight the "critically stressed" pipelines that have headlosses higher than 20 ft/1,000 ft.

Table 24 Fire Event Simulation Results

Pressure Zone Simulation	Percentage of pipelines with headloss greater than the established criteria	
	10 ft / 1,000 ft	20 ft / 1,000 ft
Fire Simulation 1: Moss Beach	24.6%	11.3%
Fire Simulation 2: Upper Moss Beach	18.1%	9.6%
Fire Simulation 3: Pillar Ridge	7.6%	1.7%
Fire Simulation 4: Regulated	15.1%	9.4%
Fire Simulation 5: Portola	7.2%	4.6%

Based on this analysis, some pipelines require replacement, particularly two (2)- and four (4)-inch diameter pipelines in the Alta Vista pressure zone, as shown in the following Figures. The results also show that the 8-inch transmission pipe downstream of the Alta Vista Tanks needs to be upsized.

The Pillar Ridge and Portola pressure zones can partially cater to their respective fire flow, however, their respective tanks do not hold enough storage to supply all of the required fire flow. These fire event simulations therefore result in localized temporarily stressed pipelines and cause stressed pipelines in other pressure zones as well. In the case of a fire at Pillar Ridge, the 180-foot 4-inch pipeline connecting the Schoolhouse zone to the Pillar Ridge zone needs to be replaced with an 8-inch pipeline in order for

the MWSD system to supply its fire flow contribution and maintain 20 psi in the system. In the case of a fire in the Portola pressure zone, the fire flow is supplied by the Portola tank and the Alta Vista tank, which causes limited and relatively localized strain to the system.

Figure 12 Results of Fire Simulation 1: Moss Beach

Figure 13 Results of Fire Simulation 2: Upper Moss Beach

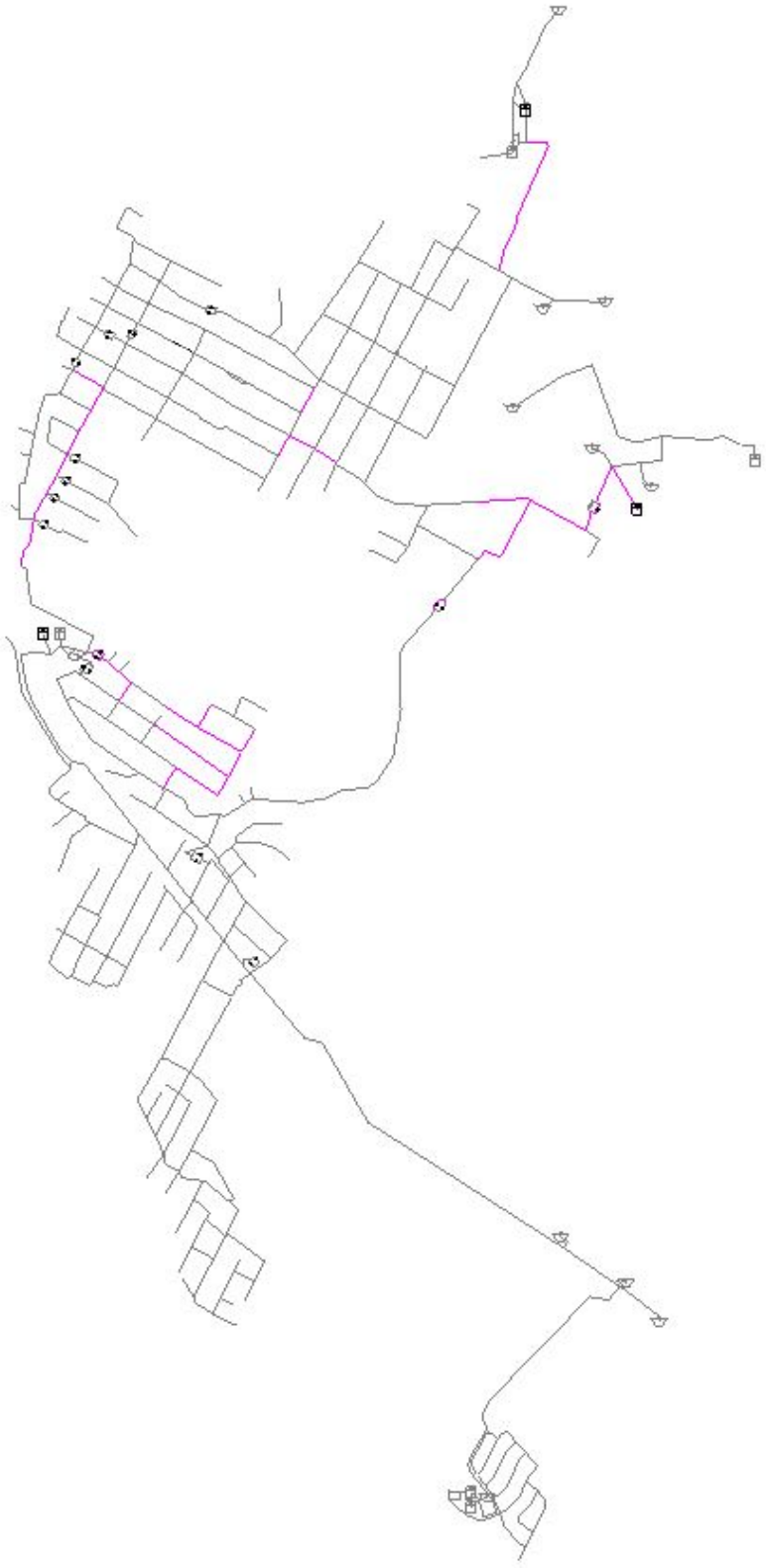


Figure 14 Results of Fire Simulation 3: Pillar Ridge

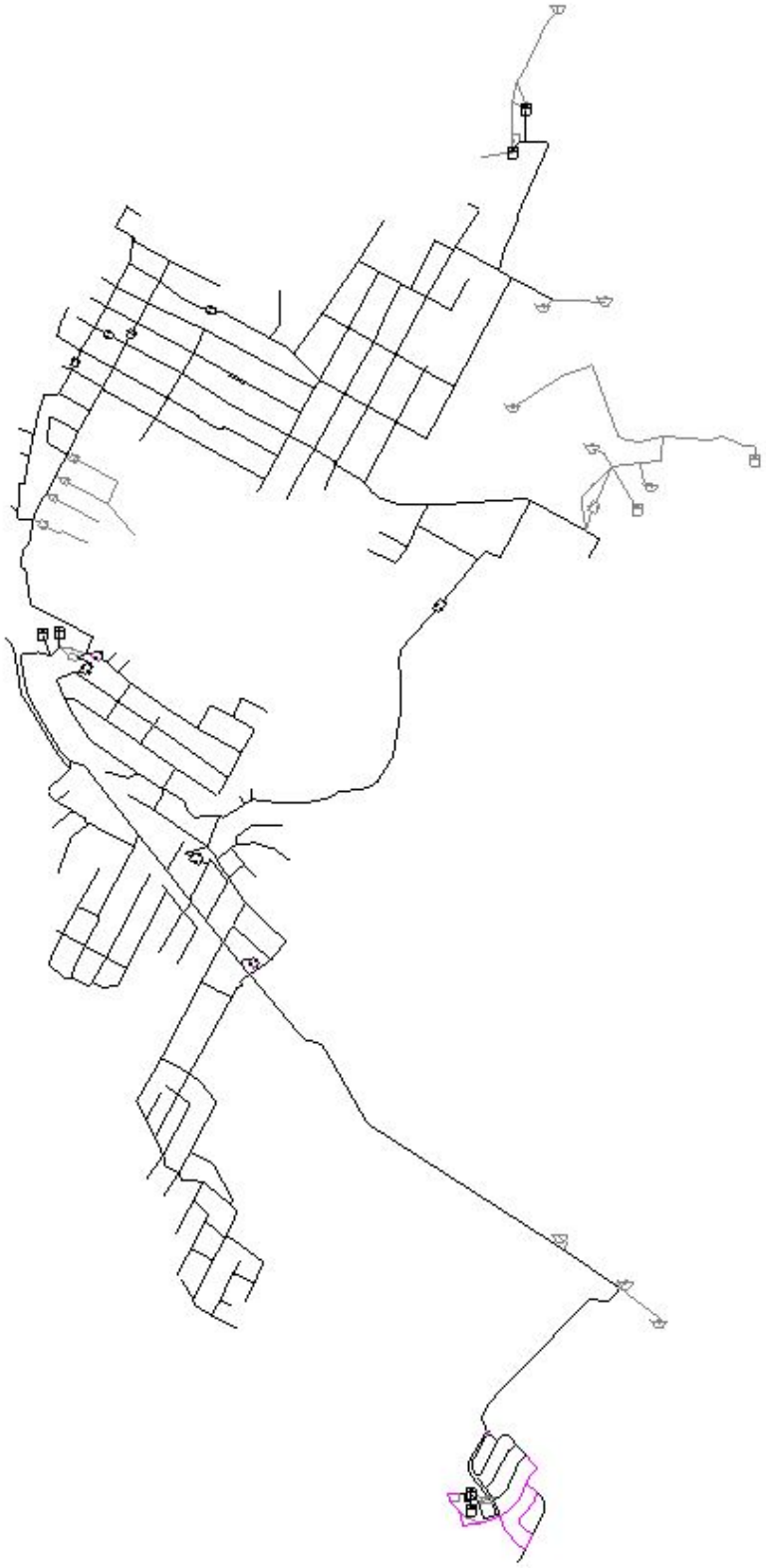


Figure 15 Results of Fire Simulation 4: Regulated

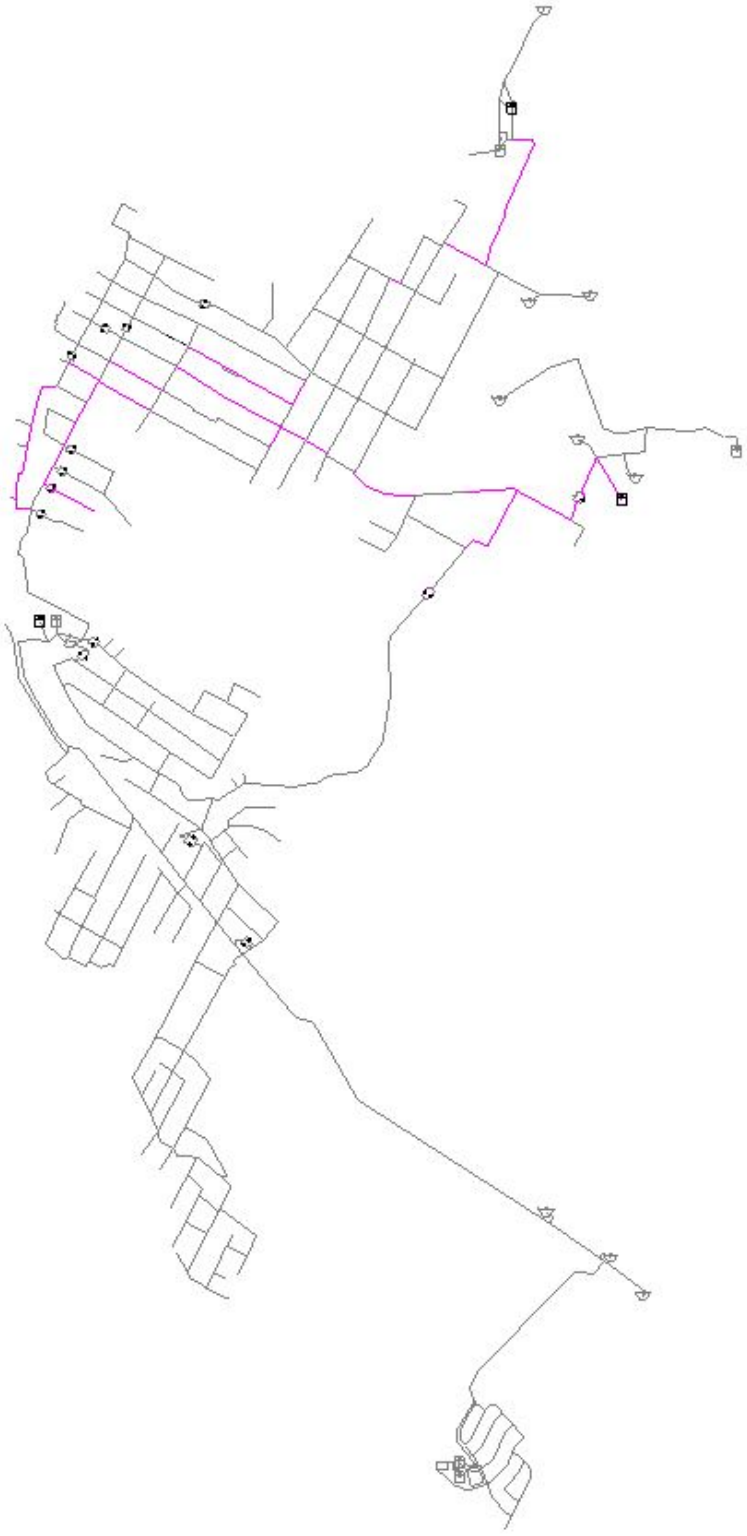
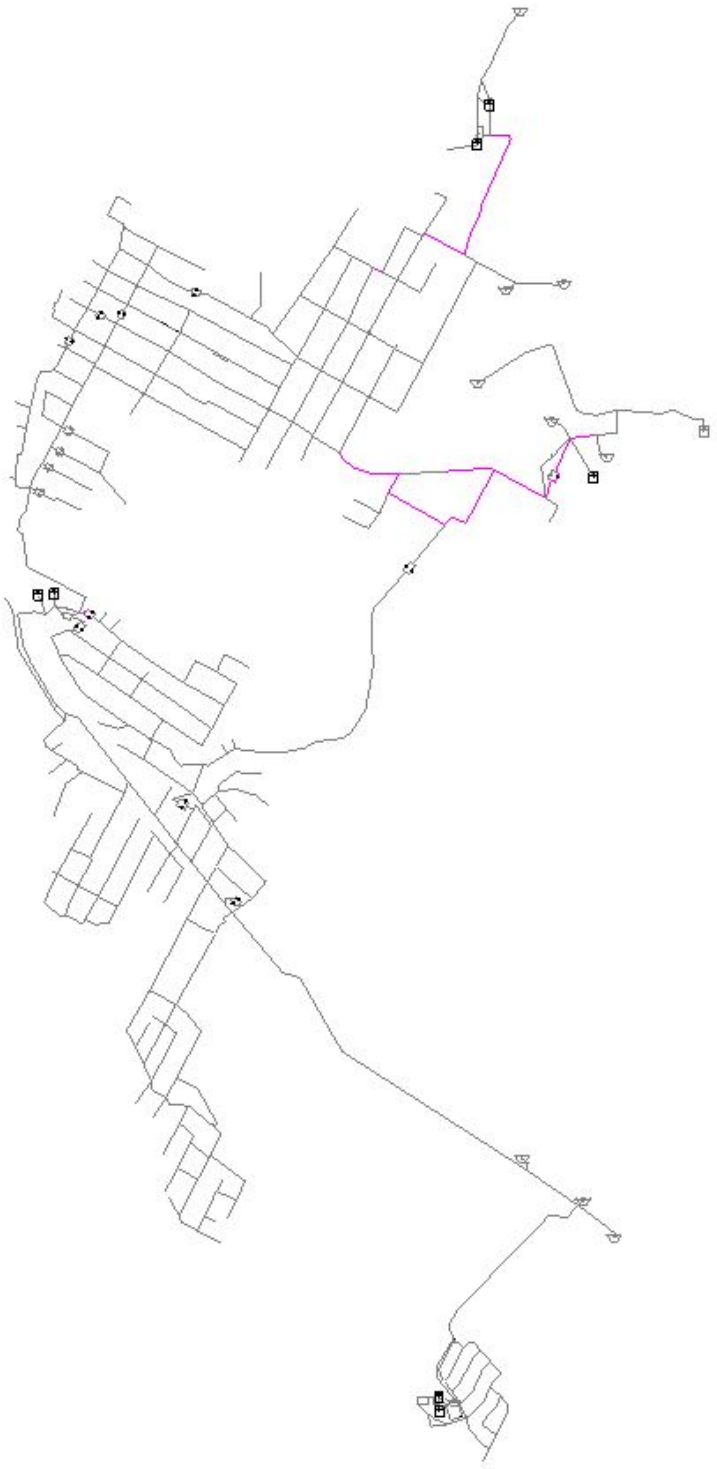


Figure 16 Results of Fire Simulation 5: Portola



5.3.4. System Improvements Analysis

The maximum flow and fire flow analyses identified deficiencies in MWSD's water system, including:

- "Stressed" pipelines,
- "Stressed" pressure regulating stations, and
- Necessary changes to current PRV settings.

System improvements were simulated to assess the adjusting the PRV settings at 2 PRV stations and upsizing the pipelines and PRVs identified in the aforementioned analyses.

To address the deficiencies identified in the maximum flow analysis, all 1.5-, 2-, 3- and 4-inch pipelines were assumed to be replaced with 6-inch pipelines, as follows:

- 310 feet of 1.5-inch diameter pipeline upsized to 6-inch diameter pipeline,
- 1,725 feet of 2-inch diameter pipeline upsized to 6-inch diameter pipeline,
- 1,215 feet of 2.5-inch of diameter pipeline upsized to 6-inch diameter pipeline,
- 475 feet of 3-inch diameter pipeline upsized to 6-inch diameter pipeline, and
- 4,670 feet of 4-inch diameter pipeline upsized to 6-inch diameter pipeline.

Improved Maximum Flow Analysis – Current Population

Under the current MDD conditions, the following pipeline improvements to the pipes that showed headlosses over the criteria will ensure compliance of the entire water system at current MDD:

- Upsize the 100-feet long 4-inch pipe downstream of Drake and Wagner wells to a 6-inch pipeline,
- Upsize the 10-foot long 4-inch pipe downstream of the Alta Vista well to an 8-inch pipeline, and
- Upsize the 2-inch PRV and adjacent 2-inch piping on Buena Vista Street.

Since the headlosses are not significant, these are not high priority replacement projects.

Improved System-wide Fire Flow Analysis

For the improved system-wide fire flow analysis, the following improvements to the system were made to alleviate deficiencies identified in the fire flow analysis:

- To alleviate the deficiencies in the Schoolhouse pressure zone, 2,240 feet of pipeline located along Highway 1 and along California Avenue were upsized to 10-inch diameter pipeline.
- To alleviate the deficiencies in the Upper Moss Beach pressure zone, 750 feet of pipeline located along California and Pearl Street were upsized to 6-inch diameter pipeline.
- To ensure that the required fire flow was supplied, 6,250 feet of pipeline in the Alta Vista pressure zone were upsized, from 4-inch to 6-inch and from 6-inch to 8-inch.
- To alleviate the deficiencies in the Moss Beach pressure zone, the settings at the Sunshine Valley Road PRV station were changed from 35 psi to 60 psi on the 2-inch side and from 30 psi to 55 psi on the 6-inch side.
- The settings at the PRV station located at the intersection of Etheldore and Lancaster were adjusted from 40 psi to 55 psi on the 2-inch side and from 35 psi to 50 psi on the 6-inch side in order to allow the supply of the fire flow at a minimum of 20 psi to a larger number of nodes in the Schoolhouse pressure zone.

The impact of these improvements on the system is presented in Table 25. The remaining failing nodes are mostly nodes located at the end of small diameter dead-end pipes. The provision of fire flow to these nodes can be highly improved by connecting the end of these pipes to the closest water mains.

Table 25 System Fire Flow Analysis with Improvements Results

Percentage of nodes unable to deliver 2,000 gpm at 20 psi	21%
Percentage of nodes unable to deliver 1,500 gpm at 20 psi	13%

Improved Fire Events Analysis

With the pipeline and PRV settings improvements in place, the percentage of “stressed” pipelines further decreased during the fire event simulations in the Moss Beach, Upper Moss Beach, and Regulated pressure zones, as shown in the Table 26 and the following Figures. The Portola and Pillar Ridge simulations cause localized strain to the

system, but also required improvements in the other pressure zones, since both these pressure zones are located further from part of their necessary fire flow storage.

Table 26 Fire Event Simulation Results with Pipeline and PRV Improvements

Pressure Zone Simulation	Percentage of pipelines with headloss greater than the established criteria	
	10 ft / 1,000 ft	20 ft / 1,000 ft
Fire Simulation 1: Moss Beach	13.5%	5.6%
Fire Simulation 2: Upper Moss Beach	8.6%	4.4%
Fire Simulation 3: Pillar Ridge	7.6%	1.7%
Fire Simulation 4: Regulated	10.4%	5.3%
Fire Simulation 5: Portola	5.2%	2.1%

The following improvements were determined through the five (5) fire event simulations and include the pipelines that were repeatedly "critically stressed" during the fire event simulations:

- Replace 1,300 feet of 6-inch pipeline with an 8-inch pipeline along 6th Street in the Alta Vista pressure zone,
- Replace 1,305 feet of 6-inch pipeline with an 8-inch pipeline along 5th Street in the Alta Vista pressure zone,
- Replace 380 feet of 4-inch diameter pipeline with 6-inch diameter pipeline along 8th Street in the Alta Vista pressure zone,
- Replace 470 feet of 4-inch diameter pipeline with 6-inch diameter pipeline along Pearl Street in the Upper Moss Beach pressure zone,
- Replace 180 feet of 4-inch diameter pipeline with 8-inch diameter pipeline right upstream of the Pillar Ridge pressure zone.

Figure 17 Results of System Wide Fire Simulation with System Improvements

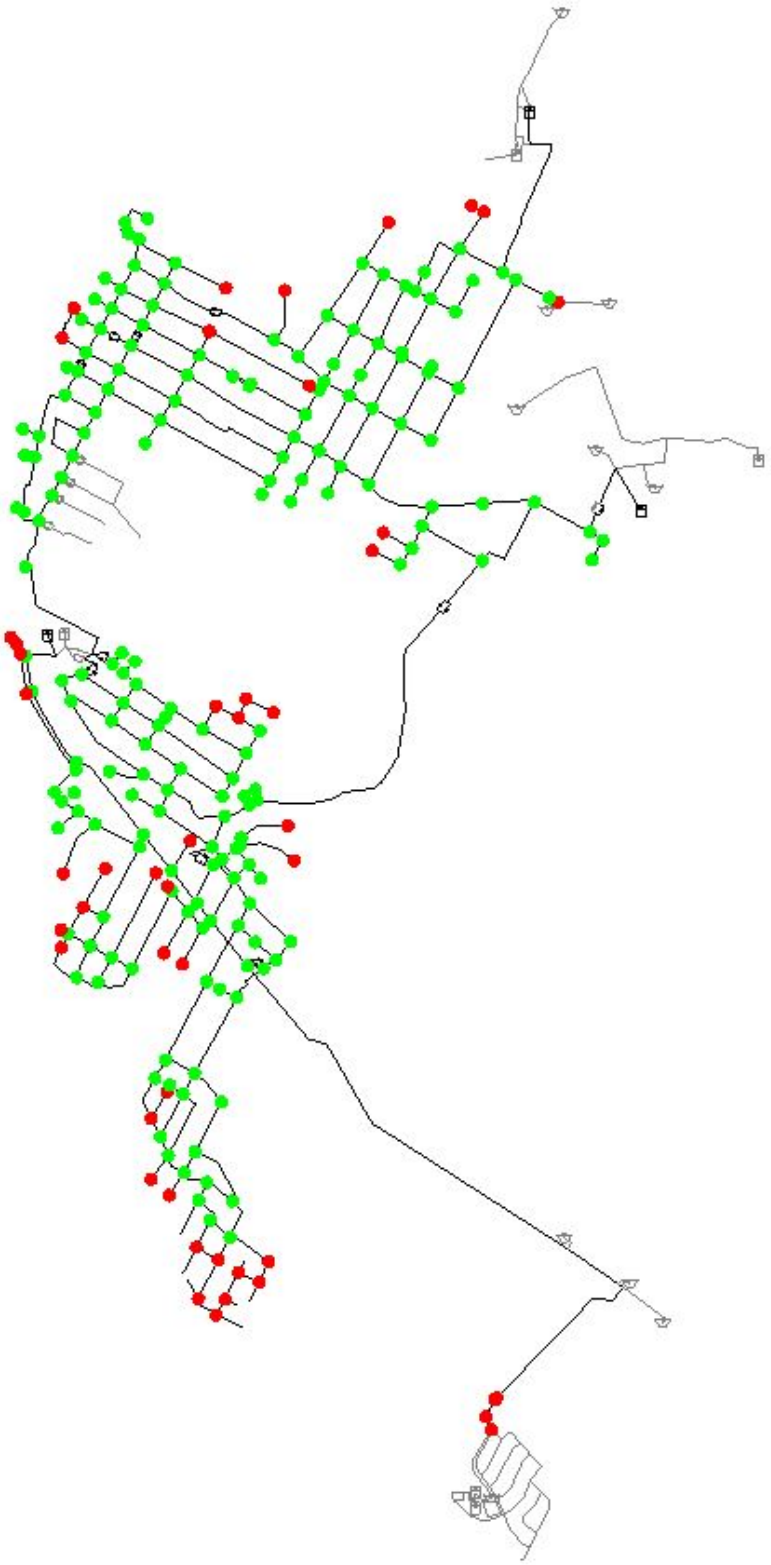


Figure 18 Results of Fire Simulation 1 with System Improvements: Moss Beach

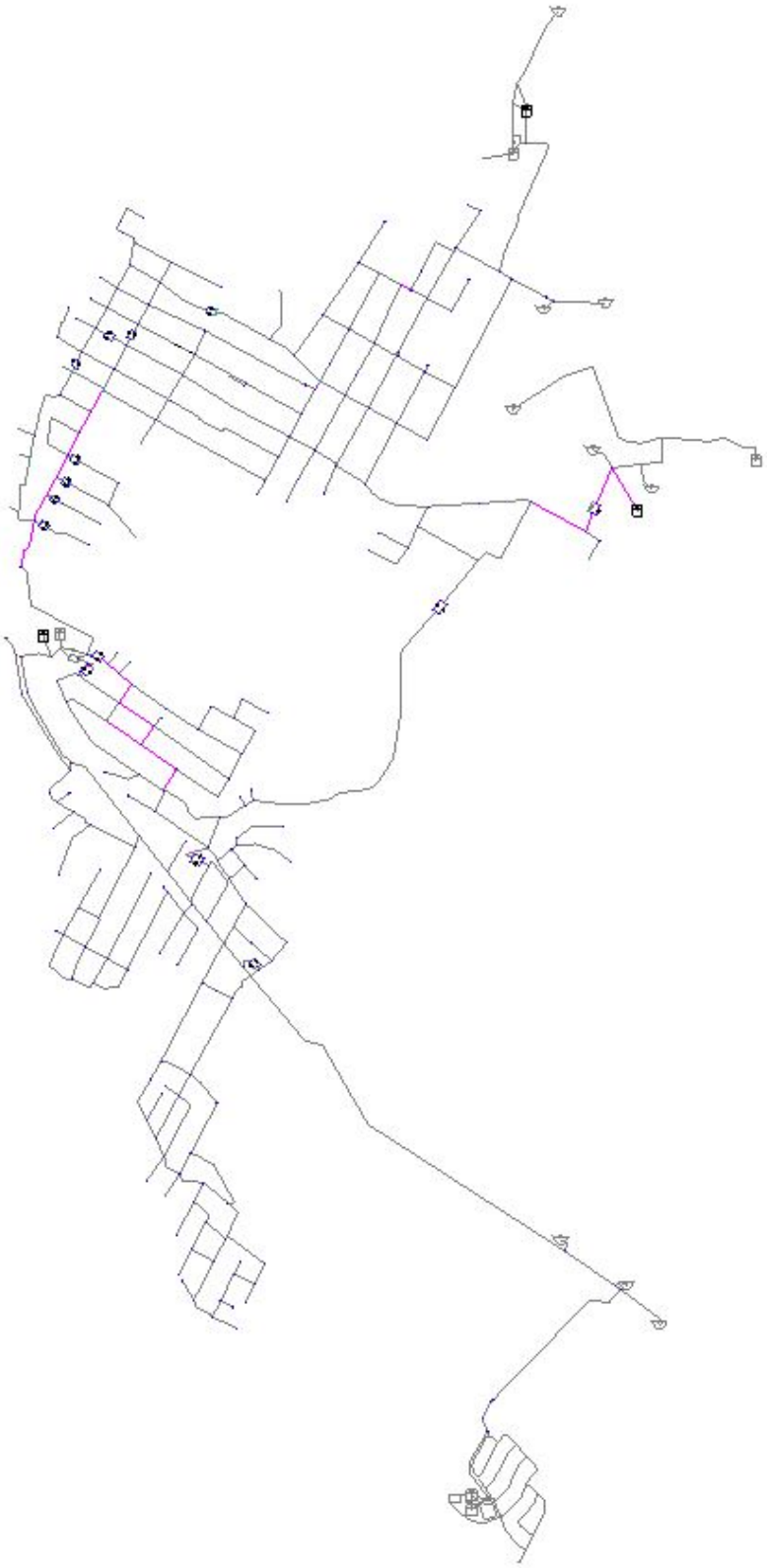


Figure 19 Results of Fire Simulation 2 with System Improvements: Upper Moss Beach

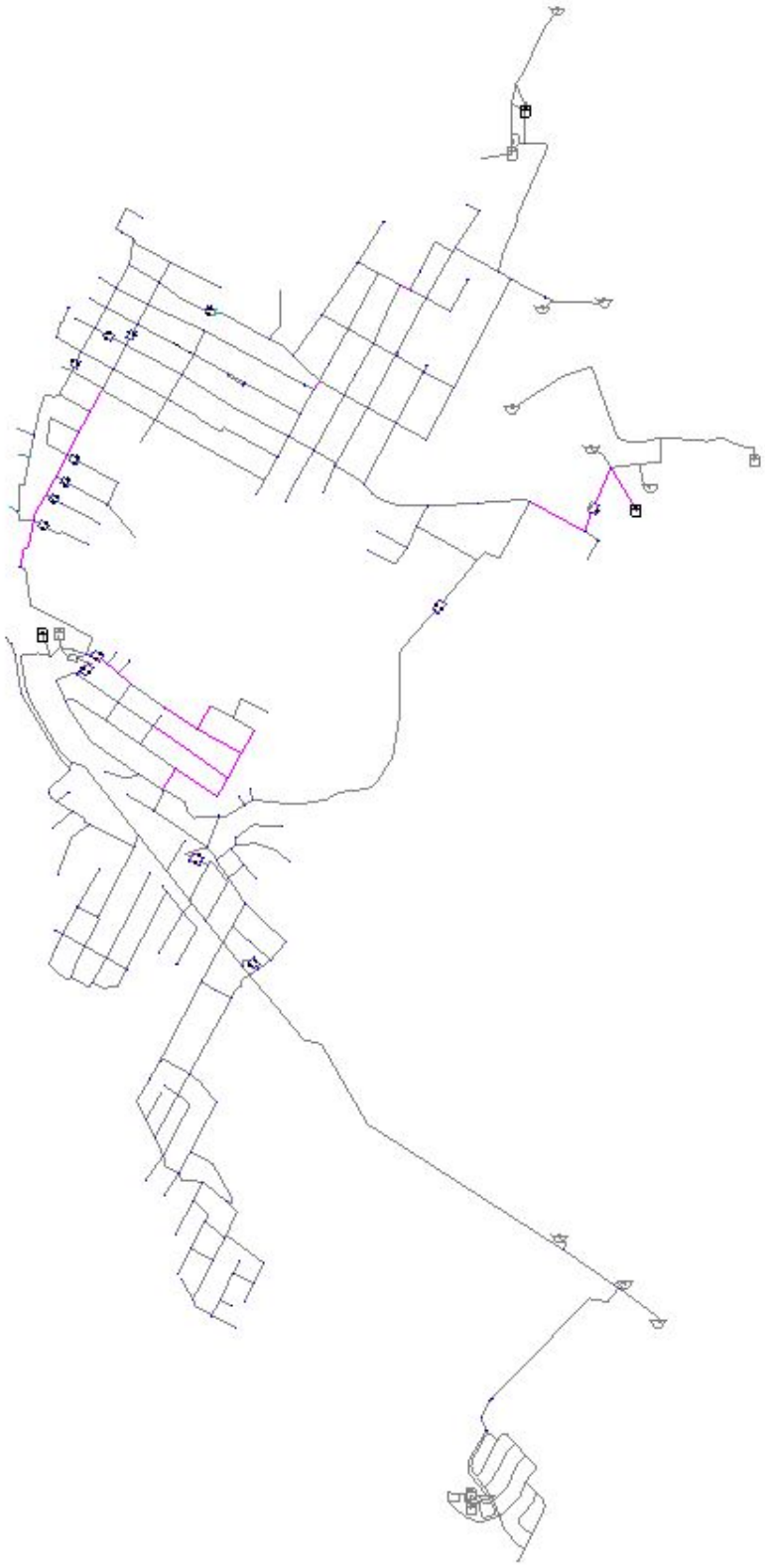


Figure 20 Results of Fire Simulation 4 with System Improvements: Regulated

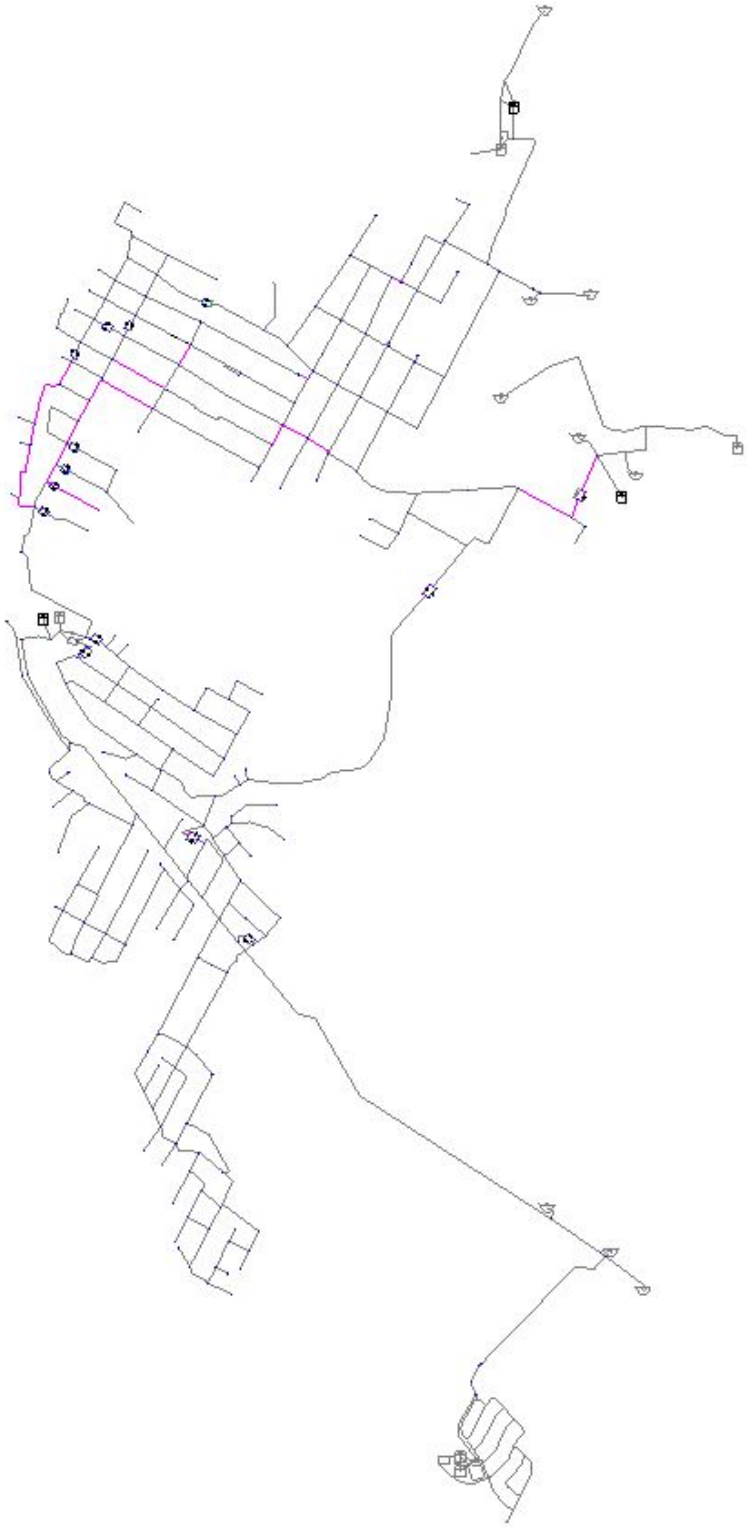
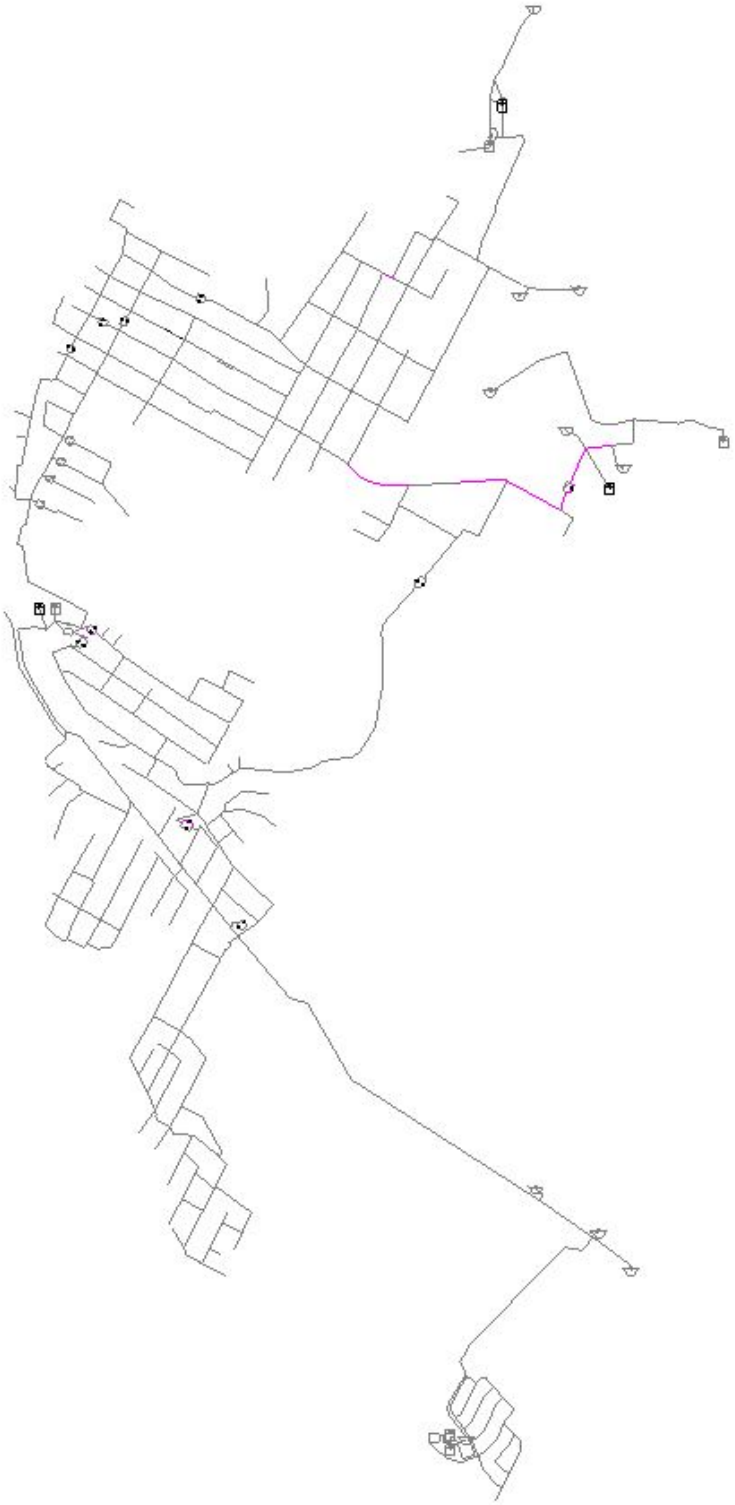


Figure 21 Results of Fire Simulation 5 with System Improvements: Portola



As indicated in these Figures, some pipelines remained "stressed" during a fire event. However, 2,000 gpm of fire flow and system residual pressure above 20 psi can be maintained. Replacement of "critically stressed" pipelines will further improve system performance and the priority of these improvements needs to be addressed in the main replacement program.

Improved Maximum Flow Analysis – Future Population

The following improvements, in addition to the improvements required to satisfy the current MDD summarized above, would allow the District's water system to meet the requirements of the future MDD scenario (addition of 600 connections) shown in Figure 22:

- Replace 320 feet of 8-inch diameter pipeline with 10-inch diameter pipeline along Drake Street, between Cedar Street and Elm Street.
- Replace 570 feet of 4-inch diameter pipeline with 6-inch diameter pipeline along Audubon Avenue in the Alta Vista pressure zone.
- Replace 1,480 feet of 8-inch diameter pipeline with 10-inch diameter pipeline downstream of the Alta Vista Tank, along Alta Vista Road.
- Upsize the 3-inch PRV and adjacent 3-inch piping located on Farallone Street.
- Upsize the 100-feet long 4-inch pipeline downstream of the Wagner well.

Summary of Fire Flow Improvements (System-Wide and Fire Events Analyses)

The improvements listed below correspond to the "critically stressed" pipelines highlighted in Figure 23. The following improvements were determined based on the results of the system-wide fire analysis and the five (5) fire events simulations performed, and would allow the District to satisfy the fire flow criteria throughout tis service area:

- Replace 8,395 feet of 1.5-, 2-, 2.5-, 3- and 4-inch diameter pipelines with 6-inch diameter pipeline.
- Adjust the setting of the PRV located on Sunshine Valley Road to allow an increased downstream pressure; from 35 psi to 60 psi on the 2-inch side and from 30 psi to 55 psi on the 6-inch side.

- Adjust the setting of the PRV located at the intersection of Etheldore and Lancaster Street to allow an increased downstream pressure; from 40 psi to 55 psi on the 2-inch side and from 35 psi to 50 psi on the 6-inch side.
- Replace 1,300 feet of 6-inch pipeline with an 8-inch pipeline along 6th Street in the Alta Vista pressure zone.
- Replace 1,305 feet of 6-inch pipeline with an 8-inch pipeline along 5th Street in the Alta Vista pressure zone.
- Replace 1,400 feet of 8-inch pipeline with 10-inch diameter pipeline in the Schoolhouse pressure zone, along Highway 1 downstream of the Schoolhouse tanks.
- Replace 840 feet of pipeline with 10-inch diameter pipeline in the Schoolhouse pressure zone.
- Replace 380 feet of 4-inch diameter pipeline with 6-inch diameter pipeline along 8th Street in the Alta Vista pressure zone.
- Replace 470 feet of 4-inch diameter pipeline with 6-inch diameter pipeline along Pearl Street in the Upper Moss Beach pressure zone.
- Replace 180 feet of 4-inch diameter pipeline with 8-inch diameter pipeline right upstream of the Pillar Ridge pressure zone.

Figure 22 Pipeline Improvements for Future MDD

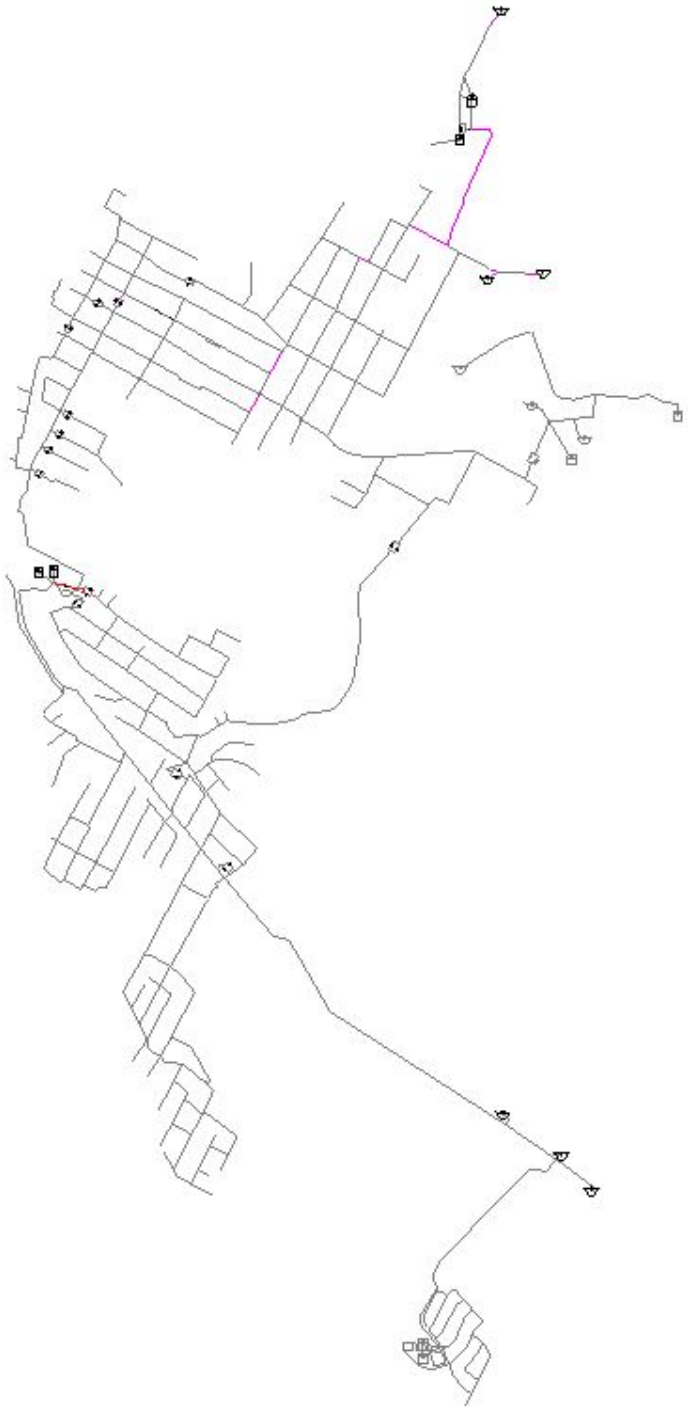
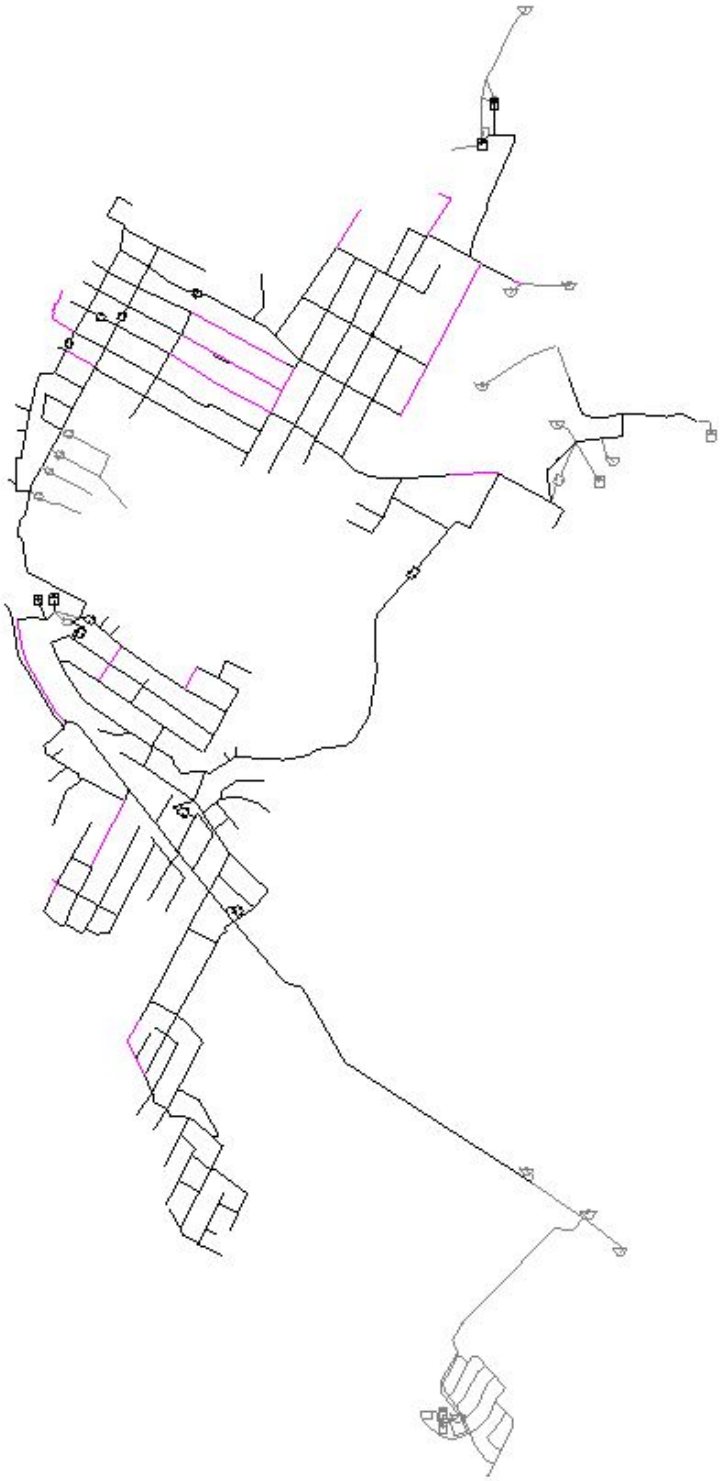


Figure 23 Summary of Pipeline Improvements for All Fire Events Scenarios



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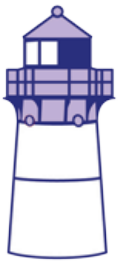

SECTION SIX
Capital Improvements Program

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6. Capital Improvements Program

The results of the analysis presented in the previous sections demonstrate that MWSD's water system requires improvements to address system weaknesses, continue to improve water supply reliability, and ensure sufficient response under daily operational scenarios, fire flow, and emergency conditions. These potential improvements make up the District's Capital Improvements Program (CIP) and include the rehabilitation of the existing infrastructure, addition of new facilities, development of new sources of supply, and implementation of repair, replacement, and preventive maintenance programs. The proposed improvements are categorized as Priority Level 1 and Priority Level 2, based on the District's CIP prioritization criteria.

In 2003, MWSD established CIP prioritization criteria that serve as the foundation for the District's capital improvements decision-making process to ensure a relevant implementation schedule and adequate funding for the improvements. The criteria provide a method to rate the relative importance of a particular project based upon factors such as protection of public health, employee safety, legal and regulatory requirements, and funding constraints. These criteria established which projects should be implemented in any given year and over the CIP planning horizon. The prioritization criteria used by MWSD are presented in Table 27 and are categorized into three (3) project levels in order of most to least critical for implementation.

Table 27 Prioritization Criteria

Prioritization Level	Description	Examples
Level 1: Mandatory Projects	"Must do", highest priority. District has little or no control to defer.	(1) Projects required by law/legislation, regulations; (2) Projects protecting health and safety of employees and the public; and (3) Project funded by others.
Level 2: Necessary Projects	Must be done. District has moderate level of control over the timing of implementation.	(1) Projects required for providing adequate emergency storage and meeting fire flow requirements; (2) Projects reducing water system losses and reducing pipeline leaks.
Level 3: Discretionary Projects	Should be done. District has significant level of control over the timing of implementation.	Projects that are required but can be deferred to a later date. Level 3 projects can be completed as needed, if Level 1 or Level 2 projects are postponed.

In addition, following the introduction of new domestic connections to the water system in 2011, the District has started developing a two-part CIP that includes projects designed exclusively for or shared by the new customers connecting to the water system. This category is funded through the Water Capacity Charge (WCC). The second category of projects is needed for the existing customers and designed to provide appropriate levels of renewal and replacement for the current water system. The water rate revenues fund these projects.

The planning-level cost estimates included in this CIP are total project costs with the +50%/-30% estimating accuracy and include the following elements:

1. Engineer's opinion of probable construction cost
2. Planning, permitting, legal, and administrative costs - 40 percent of construction cost
3. Planning-level contingency -25 percent of construction cost

The CIP projects and programs presented in Table 28 include Priority Level 1 and Priority Level 2 projects for the water system. Project descriptions that follow include the cost of the entire project or program. The actual timing of project implementation would depend on various factors, including but not limited to the number of customers requesting water connections and regulatory climate.

Table 28 Summary of New & Existing Customer CIP Projects and Costs

Program/Project	Total Program/Project Cost
New Customers CIP – Priority Level One	
1. Water Main Upgrades Program	$7,484,500
2. Existing Well Upgrade Program	$3,389,000
3. New and Upgraded PRV Stations' Program	$1,856,000
4. Emergency Generator Upgrades Program	$889,500
5. Schoolhouse Booster Pump Station Upgrade	$1,545,000
6. Portola Tank Telemetry Upgrade	$250,000
7. Develop Additional Supply Reliability	$1,984,000
8. Big Wave NPA Main Extension Project	$2,030,000
Existing Customers CIP – Priority Level Two	
1. Distribution System Renewal and Replacement Program	$980,000

2. Water Conservation Program	$45,128
3. Storage Tank Rehabilitation Program	$250,000
4. Emergency Generator Replacement Program	$235,000
5. Vehicle Replacement Fund	$81,000
6. Pillar Ridge Rehabilitation Program	$445,000

6.1. Priority Level 1 Improvements

Near-term improvements are *Priority Level 1* projects that almost exclusively address the system deficiencies related to adding new customers to the system. Most of the anticipated system deficiencies are due to adding new connections to the system and increasing demand. These are the highest priority, "must do" capital projects. The District has little or no control to defer these projects. Examples of such projects include: (1) projects required by law/legislation, regulations; (2) projects protecting health and safety of employees and the public; and (3) project funded by others.

The projects and actions described below would allow the District to address system deficiencies and continue to operate an efficient and reliable system. The proposed *Priority Level 1* near-term improvements continues the District's progress toward sustainability through investments that: (1) diversify sources of water supply, (2) improve water quality, (3) encourage conservation of water and energy, and (4) meet current and future infrastructure needs. The near-term improvements will be almost entirely funded through the Water Capacity Charge (WCC).

Table 28 contains all *Priority Level 1* projects that have been formulated to provide benefit to, and be paid for by, new District customers. A detailed discussion of each of the projects follows.

6.1.1. Water Main Upgrade Program

Upsizing of existing water mains and isolation and control valves will be required to accommodate new water customers. Under the water main upgrade program, the District will undertake the effort of designing and constructing new distribution system mains that need to be upsized to accommodate increasing demands due to the addition of new water customers. This program includes an estimated 12,800 linear feet of 8-inch- and 10-inch-diameter mains installed in the water system replacing existing 2-inch, 4-inch, and 6-inch-diameter mains.

The Water Main Upgrade Program will involve the strategic upgrade of existing water mains to incorporate “arterial distribution loops” throughout the system. These arterial loops will provide added redundancy and reinforcement to handle the addition of new customers or potential leaks and pipe failures. The loops will be designed utilizing the existing distribution system and the installation of short spans of new pipelines. Isolation and control valves will also be installed in critical locations as part of the loop design. As a whole, the arterial loops will provide the District’s Operations Staff the ability to isolate and repair critical sections of the distribution system while still conveying water throughout the system. Additionally, this program includes upsizing of the existing mains that would become deficient due to added new customer demands.

The estimated cost of this program is $7,484,500 and will be paid by new customers through the WCC.

This project is ranked as Priority Level 1 because it ensures redundancy and reinforcement of the distribution system to handle the addition of new customers or potential leaks and pipe failures.

6.1.2. Existing Well Upgrade Program

The existing District's wells operate within their design parameters in the existing water system. Hydraulic analysis demonstrates, however, that with increased demands due to new water customers, existing wells’ pumps and motors would need to be upsized to pump into the system. The pump and motor replacement and piping modifications are required to accommodate new customers due to increased pressures at each wellhead they would have to overcome. This program would involve replacement of all existing motor control centers (MCCs) and associated power supply improvements.

The estimated cost of this project is $3,389,000 and will be funded by new customers through the WCC.

This project is ranked as Priority Level 1 because it is required to accommodate new customers.

6.1.3. New and Upgraded Pressure-Regulating Stations Program

Due to the District's water system configuration and the terrain of the service area, the District operates over 20 existing pressure-regulating stations (PRV station). With the addition of new customers throughout the service area, this project will install up to 5 new PRV stations and increase the capacity of 13 existing PRV stations.

The estimated cost of this project is $1,856,000 and will be funded by new customers through the WCC.

This project is ranked as Priority Level 1 because it ensures efficient water distribution under new demand conditions.

6.1.4. Emergency Generator Upgrade Program

Existing generators at the District's pumping and treatment facilities will become undersized following upgrades of the existing pumps and motors and would require replacement. This program would secure safe and reliable emergency power to the District's critical water treatment and delivery facilities and provide safe operation by staff under the increased demand conditions due to new customers. The associated appurtenances, including automatic transfer switches (ATS) would also have to be replaced due to the increased generator and system capacities.

The estimated cost of this project is $889,500 and will be funded by new customers through the WCC.

This project is ranked as Priority Level 1 because it ensures efficiency of operations under new demand conditions.

6.1.5. Schoolhouse Booster Pump Station Upgrade

The District owns and operates the existing Schoolhouse Booster Pump Station. The addition of new water customers throughout the service area necessitates installation of a new set of booster pumps to accommodate the distribution system expansion for new customers and a new set of parameters under which the system would operate when demand increases. This project will include an addition of a new set of pumps and replacement of the existing pumps with larger pumps and motors.

The estimated cost of this project is $1,545,000 and will be funded by new customers through the WCC.

This project is ranked as Priority Level 1 because it ensures water deliveries to new customers with increased flows in the distribution system.

6.1.6. Portola Tank Telemetry Upgrade

The existing Portola Tank currently operates with no telemetry link to the District's SCADA system. While this arrangement works to serve existing water customers, addition of new customers throughout the District's service area will require adding the

tank to SCADA to ensure operational optimization of the tank under new demand conditions.

The estimated cost of this project is $250,000 and will be funded by new customers through the WCC.

This project is ranked as Priority Level 1 because it ensures operational optimization of the Portola Tank under new demand conditions.

6.1.7. Develop Additional Supply Reliability

This project provides for planning, permitting, and implementation of water supply augmentation to ensure that the water system's reliability remains intact with the addition of the new water customers to the system. Currently, the District has over 20 percent reliability and redundancy in its water supply portfolio, which was achieved by adding new sources, implementing water system improvements, securing the existing Airport Wells for its water supply portfolio, and conservation. This portion of the water supply portfolio will initially be utilized to add new customers to the system; however, the supply reliability needs to be replenished and paid for by the new customers to ensure consistent continued reliability of the water system. The project includes new groundwater source planning, permitting, and development.

The estimated cost of this project is $1,984,000 and will be funded by new customers through the WCC.

This project is ranked as Priority Level 1 because it ensures consistent continued reliability of the District’s water system.

6.1.8. Big Wave NPA Water Main Extension

This project provides for the installation of a new 12-inch-diameter, 4,400-foot-long water main extension required to serve the Big Wave NPA development with 2,000 gpm of fire flow for 2 hours at a residual pressure of 20 psi at the hydrant on the Big Wave NPA property.

The estimated cost of this project is $2,030,000. This project will be funded entirely by the developer and is not included in the water connection fee calculations.

This project is ranked as Priority Level 1 because it is paid by others.

6.2. Priority Level 2 Improvements

The District's water system requires improvements to address system renewal and replacement needs and ensure sufficient response under daily operational scenarios, fire flow, and emergency conditions. These necessary improvements make up the District's Priority Level 2 and include the rehabilitation of the existing infrastructure, repair and replacement, and preventative maintenance programs.

These projects provide measurable progress in achieving the District's goals, but over which the District has a moderate level of control over the timing of implementation. Examples of such projects include projects reducing water system losses and reducing pipeline leaks. These projects serve existing District's customers and are funded by the water rate revenues.

Priority Level 2 Projects include (1) Projects required for providing adequate emergency storage and meeting fire flow requirements and (2) Projects reducing water system losses and reducing pipeline leaks.

Table 28 contains all *Priority Level 2* projects that have been formulated to provide benefit to, and be paid for by, new District customers. A detailed discussion of each of the projects follows.

6.2.1. Distribution System Renewal and Replacement Program

This program is an on-going annual rehabilitation program that includes projects such as mechanical systems replacement, water meter replacement, water lateral replacement, water main replacement and fire hydrant replacement.

The estimated cost of this project is $980,000 and will be funded by existing customers through rate revenues.

This program is ranked as Priority Level 2 because it addresses system renewal and ensures sufficient response under daily operational scenarios, fire flow, and emergency conditions.

6.2.2. Water Conservation Program

The District continues its multi-year rebate program to encourage customers to replace their fixtures and appliances with water-efficient units.

The estimated cost of this project is $45,128 and it will be funded by existing customers through rate revenues. This program is ranked as Priority Level 2 because it continues to promote water conservation.

6.2.3. Storage Tank Rehabilitation Program

The existing Alta Vista Tank 1 (AVT 1) was inspected in 2016 and found needing to be taken off line for rehabilitation. It was determined that the tank floor and areas on the wall of the AVT 1 shows signs of significant corrosion. AVT 1 will be rehabilitated, including: cleaning, recoating and corrosion spot repair. Some areas, such as the tank floor, may require more extension corrosion repair.

The estimated cost of this project is $250,000 and the program will be funded by existing customers through rate revenues. This is a Priority Level 2 program because it ensures continued operation of the existing water supply sources.

6.2.4. Emergency Generator Replacement

This project will replace existing emergency generators that reached the end of their useful life.

The total cost is estimated at $235,000 and the project will be funded by existing through water rate revenues. This project is ranked as Priority Level 2 because it ensures efficiency of water operations.

6.2.5. Vehicle Replacement Fund

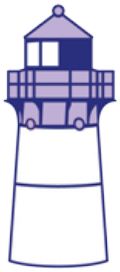
This funding is targeted to the renewal of the District fleet of trucks and started in FY 15/16 with a purchase of a heavy truck followed by replacing one light truck annually in the following three years of the CIP.

The total estimated cost of this fund is $81,000. This project will be funded by the water rate revenues and is ranked as Priority Level 2 because it ensures efficiency of water operations.

6.2.6. Pillar Ridge Rehabilitation Program

Consolidation of the Pillar Ridge Water System into the MWSD water system benefits all District's customers. The addition of new facilities, however, necessitates planning for the renewal and replacement of the Pillar Ridge treatment, supply, and storage facilities. Existing customer water rate revenues will fund this project.

The total cost of this program is $445,000 and it will be funded through water rate revenues. This program is Priority Level 2 because it ensures existing facility functionality and reliability.



APPENDICES

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7. Appendices Table of Contents

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APPENDIX A
Rates of Production

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7.1. Appendix A: Rates of Production

Average Annual Rates of Production, All Sources, 2004 – October 2007

Source	Rated Capacity (gpm)	*Rates of Production (gpm)*				
		2004	2005	2006	Jan. – Oct. 2007	Average Rate of Production
North Airport Well	100	77	51	46	49	56
South Airport Well	55	44	43	40	41	42
Airport Well No. 3	100	62	65	90	77	73
Drake Well	35	37	40	34	37	37
Portola Well No. 1	9	7	6	5	5	6
Portola Well No. 3	10	7	7	6	7	7
Portola Well No. 4	16	8	3	5	9	6
Wagner Well No. 3	70	52	46	63	69	58
Montara Creek Surface Diversion	75	66	67	69	51	63
Total Monthly Rate of Production	**470**	**359**	**329**	**359**	**345**	**348**
Total Groundwater Rate of Production	**395**	**293**	**262**	**290**	**294**	**285**

Average Annual Rates of Production, All Sources, November 2007 – 2014

Source	Rated Capacity (gpm)	Rates of Production (gpm)								
		Nov. – Dec. 2007	2008	2009	2010	2011	2012	2013	2014	Average Rate of Production
Alta Vista Well	150	41	75	81	93	140	109	131	133	100
North Airport Well	100	53	55	64	186	91	81	25	62	77
South Airport Well	55	48	37	32	21	23	0	0	0	20
Airport Well No. 3	100	67	54	60	17	0	0	0	0	25
Drake Well	35	37	38	36	37	46	34	29	29	36
Portola Well No. 1	9	8	5	6	5	5	4	5	5	5
Portola Well No. 3	10	7	7	6	6	8	5	2	11	6
Portola Well No. 4	16	10	6	8	7	9	8	5	3	7
Wagner Well No. 3	70	73	73	64	64	65	56	45	36	59
Montara Creek Surface Diversion	75	22	51	55	65	85	73	47	53	56
Total Monthly Rate of Production	**620**	**365**	**400**	**412**	**503**	**472**	**370**	**290**	**332**	**393**
Total Groundwater Rate of Production	**545**	**344**	**350**	**357**	**438**	**388**	**297**	**243**	**278**	**337**

Average Annual Rates of Production, All Sources, 2015 - 2016

Source	Rated Capacity (gpm)	Rates of Production (gpm)		
		2015	2016	Average Rate of Production
Alta Vista Well	150	122	122	122
North Airport Well	100	74	79	76
South Airport Well	55	0	0	0
Airport Well No. 3	100	0	0	0
Drake Well	35	30	27	28
Portola Well No. 1	9	0	3	2
Portola Well No. 3	10	40	32	36
Portola Well No. 4	16	16	14	15
Wagner Well No. 3	70	42	55	49
Pillar Ridge Wells No. 1 – 3	57	40	33	37
Montara Creek Surface Diversion	75	54	56	55
Total Monthly Rate of Production	**677**	**422**	**419**	**420**
Total Groundwater Rate of Production	**602**	**365**	**365**	**365**

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APPENDIX B
Production Data and Analysis

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2006 Monthly Production Data (Gallons)

Source	January	February	March	April	May	June	July	August	September	October	November	December	Total Production
North Airport Well	346,600	183,430	443,990	229,040	575,860	1,464,560	1,252,640	296,090	245,790	190,270	421,940	224,410	**5,874,620**
South Airport well	1,597,240	1,591,350	1,462,920	1,305,640	1,585,310	1,617,650	1,571,620	1,439,120	1,313,210	1,316,440	1,276,600	1,132,960	**17,210,060**
Airport Well No. 3	2,455,890	2,341,560	2,455,550	2,231,840	2,680,040	3,510,980	3,151,620	2,283,820	1,912,550	1,722,420	2,773,560	1,852,210	**29,372,040**
Drake Well	1,464,940	1,238,060	1,504,090	1,448,320	1,501,750	1,613,440	1,579,610	1,313,590	1,248,940	1,240,060	2,540	352,430	**14,507,770**
Portola Well No. 1	222,470	185,600	255,540	216,200	266,740	251,110	253,300	243,810	222,820	236,220	222,900	62,330	**2,639,040**
Portola Well No. 3	299,740	274,690	305,820	222,520	0	0	117,480	357,660	332,620	352,070	328,910	333,220	**2,924,730**
Portola Well No. 4	11,860	0	0	0	105,070	103,930	179,640	437,750	407,400	415,930	392,180	379,400	**2,433,160**
Wagner Well No. 3	2,200,610	1,865,420	2,191,810	2,142,380	1,609,710	0	838,190	2,515,570	2,279,220	2,069,980	2,576,510	2,313,460	**22,602,860**
Montara Surface Diversion	1,243,500	2,037,800	1,070,400	1,096,400	2,500,800	2,936,300	3,062,600	3,065,000	2,967,100	2,948,100	2,627,300	2,190,500	**27,745,800**
Total Monthly Production	**9,842,850**	**9,717,910**	**9,690,120**	**8,892,340**	**10,825,280**	**11,497,970**	**12,006,700**	**11,952,410**	**10,929,650**	**10,491,490**	**10,622,440**	**8,840,920**	**125,310,080**

2007 Monthly Production Data (Gallons)

Source	January	February	March	April	May	June	July	August	September	October	November	December	Total Production
Alta Vista Well	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3,970	1,572,300	1,798,500	**3,374,770**
North Airport Well	32,120	175,270	62,490	70,960	223,640	551,580	290,400	456,910	407,850	321,440	226,100	173,520	**2,992,280**
South Airport well	1,074,110	984,150	1,064,260	1,109,110	1,131,380	1,353,850	1,804,120	1,921,580	1,704,950	1,594,710	1,449,300	1,506,640	**16,698,160**
Airport Well No. 3	1,048,660	1,489,160	1,509,090	1,562,100	2,015,520	2,508,740	2,055,280	2,213,300	1,740,030	1,384,030	1,160,190	989,090	**19,675,190**
Drake Well	1,251,860	1,267,260	1,285,010	1,306,040	1,333,680	1,412,840	1,484,800	1,501,588	1,370,535	1,462,547	1,355,136	1,310,911	**16,342,207**
Portola Well No. 1	0	0	0	0	79,510	249,560	260,450	333,250	338,440	383,110	366,860	350,350	**2,361,530**
Portola Well No. 3	337,770	302,420	330,600	305,110	331,660	292,400	302,390	279,840	304,960	284,540	299,120	301,410	**3,672,220**
Portola Well No. 4	395,310	360,410	394,160	343,530	312,540	372,560	412,940	308,700	453,380	461,510	437,960	438,640	**4,691,640**
Wagner Well No. 3	1,805,090	1,805,090	2,123,710	2,259,830	2,292,980	2,264,760	2,334,470	2,407,530	2,162,290	2,268,860	2,130,670	1,936,720	**25,792,000**
Montara Surface Diversion	2,866,800	1,391,200	2,228,200	1,672,600	2,131,100	1,802,400	1,731,900	1,645,700	1,868,400	1,480,700	273,300	0	**19,092,300**
Total Monthly Production	**8,811,720**	**7,774,960**	**8,997,520**	**8,629,280**	**9,852,010**	**10,808,690**	**10,676,750**	**11,068,398**	**10,350,835**	**9,645,417**	**9,270,936**	**8,805,781**	**114,692,297**

2008 Monthly Production Data (Gallons)

Source	January	February	March	April	May	June	July	August	September	October	November	December	Total Production
Alta Vista Well	1,863,000	2,957,400	2,519,000	2,707,300	2,867,200	2,935,500	2,853,100	2,994,200	2,891,000	2,737,100	2,987,000	2,965,900	**33,277,700**
North Airport Well	101,070	21,700	8,960	5,460	72,890	142,060	16,240	14,110	7,120	0	10,610	32,970	**433,190**
South Airport well	1,444,940	986,250	1,083,380	1,106,560	1,278,680	1,287,120	1,288,230	1,259,440	1,209,100	1,128,160	1,050,740	1,019,308	**14,141,908**
Airport Well No. 3	901,770	260,090	240,980	627,410	1,087,910	1,336,680	749,700	719,380	773,490	320,090	410,410	326,690	**7,754,600**
Drake Well	1,231,373	717,954	594,040	887,606	1,068,330	1,037,700	1,136,410	1,038,070	1,045,000	1,106,390	989,920	908,600	**11,761,393**
Portola Well No. 1	337,540	290,540	318,320	150,710	0	0	0	0	211,050	343,080	310,990	301,460	**2,263,690**
Portola Well No. 3	300,080	252,970	310,120	260,780	307,480	292,670	291,080	287,320	268,410	275,100	72,050	247,680	**3,165,740**
Portola Well No. 4	429,880	354,280	424,210	189,050	0	0	0	0	251,450	449,430	442,420	429,140	**2,969,860**
Wagner Well No. 3	2,001,170	875,730	507,500	1,042,300	1,479,970	1,466,100	1,668,970	1,548,080	1,417,980	1,594,360	1,279,410	996,108	**15,877,678**
Montara Surface Diversion	0	915,400	2,555,700	2,694,900	3,049,700	2,725,800	2,630,200	2,453,100	2,092,400	1,714,700	1,347,400	1,168,300	**23,347,600**
Total Monthly Production	**8,610,823**	**7,632,314**	**8,562,210**	**9,672,076**	**11,212,160**	**11,223,630**	**10,633,930**	**10,313,700**	**10,167,000**	**9,668,410**	**8,900,950**	**8,396,156**	**114,993,359**

2009 Monthly Production Data (Gallons)

Source	January	February	March	April	May	June	July	August	September	October	November	December	Total Production
Alta Vista Well	2,842,100	2,648,100	2,970,300	2,737,500	3,036,900	2,985,600	3,728,700	3,430,400	3,273,000	3,411,900	3,418,400	3,335,300	**37,818,200**
North Airport Well	27,400	25,550	19,330	66,080	99,280	62,830	17,800	12,700	122,280	130,250	167,840	89,620	**840,960**
South Airport well	859,222	345,520	321,420	692,490	860,910	850,380	450,040	697,430	226,780	575,325	630,418	298,480	**6,808,415**
Airport Well No. 3	87,530	25,750	10,190	45,000	390,990	498,370	347,340	276,310	12,750	0	12,890	18,590	**1,725,710**
Drake Well	975,810	891,290	997,030	181,840	1,231,340	1,229,370	1,340,430	1,339,780	1,320,590	900,030	538,140	1,352,150	**12,297,800**
Portola Well No. 1	305,730	266,120	279,640	269,000	263,730	271,630	262,160	262,460	251,960	228,280	229,480	219,970	**3,110,160**
Portola Well No. 3	284,170	261,050	285,200	277,680	281,870	268,790	270,040	267,250	255,270	257,920	245,150	248,130	**3,202,520**
Portola Well No. 4	414,130	360,360	384,280	374,450	371,050	352,880	351,220	371,480	377,290	377,450	365,580	351,170	**4,451,340**
Wagner Well No. 3	1,189,262	1,229,290	1,332,140	1,543,580	1,251,770	1,303,040	1,626,730	2,564,660	2,616,810	2,329,980	2,571,270	2,088,880	**21,647,412**
Montara Surface Diversion	1,306,100	840,700	1,153,700	1,205,500	1,135,200	1,013,500	913,100	870,600	758,400	775,100	726,300	567,500	**11,265,700**
Total Monthly Production	**8,291,454**	**6,893,730**	**7,753,230**	**7,393,120**	**8,923,040**	**8,836,390**	**9,307,560**	**10,093,070**	**9,215,130**	**8,986,235**	**8,905,468**	**8,569,790**	**103,168,217**

2010 Monthly Production Data (Gallons)

Source	January	February	March	April	May	June	July	August	September	October	November	December	Total Production
Alta Vista Well	3,032,400	2,737,600	2,177,700	2,184,700	1,491,500	2,016,400	2,510,800	2,479,400	2,908,300	3,189,400	3,323,500	3,724,000	**31,775,700**
North Airport Well	90,140	11,650	119,720	33,950	83,180	65,930	231,700	39,350	4,580	7,140	26,170	8,300	**721,810**
South Airport well	321,195	134,225	147,920	168,150	166,578	100,650	309,600	31,200	1,950	21,000	11,700	22,050	**1,436,218**
Airport Well No. 3	13,300	0	14,390	17,470	6,690	1,390	0	0	0	0	0	0	**53,240**
Drake Well	1,003,680	728,570	979,200	849,270	887,440	905,490	1,156,630	817,420	598,080	667,310	644,370	632,580	**9,870,040**
Portola Well No. 1	221,540	194,380	233,270	230,270	242,340	225,480	213,250	191,980	164,860	189,860	125,240	210,400	**2,442,870**
Portola Well No. 3	213,980	236,300	268,770	260,430	265,130	251,960	254,750	226,500	203,290	232,160	156,100	250,490	**2,819,860**
Portola Well No. 4	376,520	316,440	347,950	345,000	322,360	300,580	319,770	276,240	246,800	269,400	178,960	300,340	**3,600,360**
Wagner Well No. 3	2,201,070	1,806,940	2,017,440	1,881,970	1,948,590	1,975,200	2,256,990	2,001,180	1,822,410	1,584,150	1,552,710	1,595,070	**22,643,720**
Montara Surface Diversion	381,200	659,500	1,526,200	1,725,800	3,118,500	3,135,300	3,172,700	3,275,800	2,907,800	2,250,000	1,739,800	796,800	**24,689,400**
Total Monthly Production	**7,855,025**	**6,825,605**	**7,832,560**	**7,697,010**	**8,532,308**	**8,978,380**	**10,426,190**	**9,339,070**	**8,858,070**	**8,410,420**	**7,758,550**	**7,540,030**	**100,053,218**

2011 Monthly Production Data (Gallons)

Source	January	February	March	April	May	June	July	August	September	October	November	December	Total Production
Alta Vista Well	2,826,900	2,958,700	3,514,400	2,884,700	2,675,900	1,786,500	1,928,100	1,917,200	1,659,000	2,380,400	2,119,300	1,421,500	**28,072,600**
North Airport Well	8,670	12,100	2,310	4,680	10,430	16,290	14,090	5,520	1,770	4,810	21,660	26,720	**129,050**
South Airport well	2,550	8,700	1,200	4,350	3,950	18,070	6,300	4,650	1,050	3,725	13,500	900	**68,945**
Airport Well No. 3	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Drake Well	307,050	498,170	657,390	471,750	695,990	1,241,030	1,295,410	1,351,100	1,192,610	1,375,920	1,189,010	1,150,050	**11,425,480**
Portola Well No. 1	204,510	190,060	198,400	192,130	200,370	161,290	149,180	180,000	186,300	184,500	179,140	179,420	**2,205,300**
Portola Well No. 3	265,730	241,410	265,560	256,870	210,030	210,080	220,080	248,690	253,240	252,740	211,530	251,670	**2,887,630**
Portola Well No. 4	290,470	296,840	318,050	304,750	248,430	272,870	257,860	296,740	313,080	314,250	310,070	309,890	**3,533,300**
Wagner Well No. 3	993,830	1,342,770	1,616,320	1,365,820	1,588,860	1,912,540	1,970,310	1,909,360	1,685,940	1,098,270	1,309,870	1,892,430	**18,686,320**
Montara Surface Diversion	2,591,200	1,459,100	1,004,500	2,193,000	3,179,800	2,858,200	2,923,900	2,693,500	3,170,000	2,396,900	2,303,200	2,569,700	**29,343,000**
Total Monthly Production	**7,490,910**	**7,007,850**	**7,578,130**	**7,678,050**	**8,813,760**	**8,476,870**	**8,765,230**	**8,606,760**	**8,462,990**	**8,011,515**	**7,657,280**	**7,802,280**	**96,351,625**

2012 Monthly Production Data (Gallons)

Source	January	February	March	April	May	June	July	August	September	October	November	December	Total Production
Alta Vista Well	2,012,000	1,818,800	2,654,100	2,738,100	2,194,000	2,256,200	2,620,600	2,584,800	2,737,000	3,328,100	4,138,800	4,777,900	**33,860,400**
North Airport Well	3,780	62,420	5,310	12,790	9,420	332,530	52,950	45,060	15,230	35,440	32,100	87,840	**694,870**
South Airport well	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Airport Well No. 3	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Drake Well	1,153,140	1,032,520	1,309,770	1,271,570	1,161,700	1,175,630	1,189,060	1,118,792	1,158,928	1,282,950	2,000,264	689,103	**14,543,427**
Portola Well No. 1	178,390	147,530	168,530	163,390	166,520	161,230	156,070	155,420	143,570	162,590	55,690	141,530	**1,800,460**
Portola Well No. 3	246,160	210,420	247,100	241,290	242,990	232,890	234,600	230,140	218,150	185,360	17,330	128,020	**2,434,450**
Portola Well No. 4	312,630	262,170	301,990	293,580	296,180	291,630	300,832	351,480	328,820	279,040	36,070	213,220	**3,267,642**
Wagner Well No. 3	2,134,800	1,898,470	1,865,290	1,717,290	1,666,000	1,734,140	2,144,770	1,416,670	1,260,160	1,497,040	1,506,090	1,015,710	**19,856,430**
Montara Surface Diversion	2,157,800	1,889,580	1,055,600	1,099,300	2,840,100	3,050,400	2,915,800	3,261,900	2,902,700	2,004,300	874,800	660,000	**24,712,280**
Total Monthly Production	**8,198,700**	**7,321,910**	**7,607,690**	**7,537,310**	**8,576,910**	**9,234,650**	**9,614,682**	**9,164,262**	**8,764,558**	**8,774,820**	**8,661,144**	**7,713,323**	**101,169,959**

2013 Monthly Production Data (Gallons)

Source	January	February	March	April	May	June	July	August	September	October	November	December	Total Production
Alta Vista Well	3,763,100	2,792,800	2,957,800	3,219,900	4,100,100	4,498,000	5,036,000	4,670,800	4,841,600	4,801,000	4,537,100	5,266,600	**50,484,800**
North Airport Well	0	9,590	0	0	79,660	0	0	0	27,880	0	0	19,820	**136,950**
South Airport well	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Airport Well No. 3	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Drake Well	814,940	727,092	858,846	862,458	989,748	1,032,058	1,061,251	993,096	941,106	906,727	1,048,125	825,370	**11,060,817**
Portola Well No. 1	246,050	210,830	215,640	219,810	235,550	224,180	227,470	225,770	214,560	211,360	203,040	203,840	**2,638,100**
Portola Well No. 3	251,240	221,480	227,370	214,050	0	0	0	0	0	0	0	0	**914,140**
Portola Well No. 4	431,550	303,270	135,690	129,920	160,560	158,030	170,670	184,210	193,760	213,420	209,480	199,370	**2,489,930**
Wagner Well No. 3	597,570	721,300	860,190	921,790	1,514,058	1,512,800	1,597,850	1,364,270	1,331,770	1,326,760	1,370,530	1,071,410	**14,190,298**
Montara Surface Diversion	1,454,000	2,003,600	2,178,000	2,405,400	2,329,200	1,792,400	1,909,500	1,753,100	1,384,000	1,414,600	815,500	862,500	**20,301,800**
Total Monthly Production	**7,558,450**	**6,989,962**	**7,433,536**	**7,973,328**	**9,408,876**	**9,217,468**	**10,002,741**	**9,191,246**	**8,934,676**	**8,873,867**	**8,183,775**	**8,448,910**	**102,216,835**

2014 Monthly Production Data (Gallons)

Source	January	February	March	April	May	June	July	August	September	October	November	December	Total Production
Alta Vista Well	5,420,600	4,358,600	4,566,800	4,981,200	5,515,100	5,625,300	5,699,300	5,185,000	4,700,300	4,904,600	4,274,500	3,366,200	**58,597,500**
North Airport Well	23,410	0	18,870	0	187,850	31,370	453,160	1,290,510	1,045,350	1,013,440	489,490	221,440	**4,774,890**
South Airport well	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Airport Well No. 3	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Drake Well	903,546	769,810	885,266	791,729	945,007	965,663	993,688	778,750	782,431	620,949	559,754	826,726	**9,823,319**
Portola Well No. 1	165,740	163,060	183,620	174,460	180,190	169,170	171,090	116,780	168,210	166,860	82,040	7,280	**1,748,500**
Portola Well No. 3	0	0	0	0	0	0	0	0	0	44,626	834,844	1,598,550	**2,478,020**
Portola Well No. 4	94,360	0	0	14,650	134,450	159,430	143,780	119,940	149,110	157,440	65,870	8,690	**1,047,720**
Wagner Well No. 3	1,111,090	948,570	1,361,970	951,500	912,500	946,180	939,990	614,100	751,180	372,520	372,200	558,530	**9,840,330**
Montara Surface Diversion	824,700	510,700	699,400	452,800	701,000	688,700	679,200	700,500	553,400	547,800	327,300	262,900	**6,948,400**
Total Monthly Production	**8,543,446**	**6,750,740**	**7,715,926**	**7,366,339**	**8,576,097**	**8,585,813**	**9,080,208**	**8,805,580**	**8,149,981**	**7,828,235**	**7,005,998**	**6,850,316**	**95,258,679**

2015 Monthly Production Data (Gallons)

Source	January	February	March	April	May	June	July	August	September	October	November	December	Total Production
Alta Vista Well	3,895,700	3,656,300	4,151,800	3,525,000	3,357,300	3,320,800	4,021,300	4,135,400	4,470,100	4,140,800	3,955,400	3,727,400	**46,357,300**
North Airport Well	34,270	0	700	0	6,060	0	19,470	148,160	303,280	4,250	480	50,390	**567,060**
South Airport well	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Airport Well No. 3	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Drake Well	635,996	496,522	667,050	438,974	556,544	687,896	741,370	682,536	492,552	581,700	501,538	621,100	**7,103,778**
Portola Well No. 1	0	0	0	0	0	0	0	0	0	0	26,780	0	**26,780**
Portola Well No. 3	1,783,480	1,491,650	1,650,620	1,963,530	2,004,500	1,782,250	1,797,360	1,898,270	1,225,450	1,312,220	1,055,240	1,223,540	**19,188,110**
Portola Well No. 4	390	0	0	0	0	0	0	0	0	0	0	0	**390**
Wagner Well No. 3	510,610	412,350	482,000	276,700	477,238	716,670	714,180	670,350	483,385	511,876	499,040	488,670	**6,243,069**
Pillar Ridge Wells Nos. 1 – 3	1,008,045	898,874	1,057,237	998,567	1,030,083	999,727	1,084,084	977,255	971,757	1,002,786	972,991	977,203	**11,978,609**
Montara Surface Diversion	622,700	529,400	589,400	612,900	792,600	666,995	770,900	769,700	746,600	725,500	638,500	276,900	**7,742,095**
Total Monthly Production	**8,491,191**	**7,485,096**	**8,598,807**	**7,815,671**	**8,224,325**	**8,174,338**	**9,148,664**	**9,281,671**	**8,693,124**	**8,279,132**	**7,649,969**	**7,365,203**	**99,207,191**

2016 Monthly Production Data (Gallons)

Source	January	February	March	April	May	June	July	August	September	October	November	December	Total Production
Alta Vista Well	4,018,100	3,667,400	3,194,800	2,656,900	3,172,400	3,234,100	1,661,200	1,667,200	1,646,100	2,032,100	1,778,600	2,621,500	**31,350,400**
North Airport Well	0	175,650	1,288,420	1,465,760	734,880	7,710	0	62,150	14,100	0	14,930	10,220	**3,773,820**
South Airport Well	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Airport Well #3	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Drake Well	563,040	426,856	383,882	591,944	689,988	646,272	631,082	587,818	588,066	568,028	563,426	490,748	**6,731,150**
Portola Well #1	0	0	0	0	0	87,146	0	0	0	0	0	0	**0**
Portola Well #3	973,760	712,070	961,950	597,000	945,310	310,300	1,634,460	1,674,720	1,628,620	1,618,830	1,495,870	1,374,790	**87,146**
Portola Wel #4	0	0	0	411,154	0	0	0	0	0	0	0	0	**411,14**
Wagner Well #3	508,610	415,060	510,390	1,003,810	1,274,810	1,319,350	1,232,360	1,076,290	1,145,280	1,098,910	1,164,300	1,081,090	**11,830,260**
Pillar Ridge Wells Nos. 1-3	972,235	0	0	0	615,477	933,048	1,046,527	1,049,414	1,026,705	1,055,899	1,001,430	1,001,452	**88,702,187**
Montara Surface Diversion	273,300	887,500	1,029,500	1,046,200	1,174,800	2,416,100	3,041,300	2,945,200	2,689,600	1,870,000	1,511,900	1,143,600	**20,029,000**
Total Production (Gallons)	**7,309,045**	**6,284,536**	**7,368,942**	**7,772,768**	**8,607,665**	**8,954,026**	**9,246,929**	**9,062,792**	**8,738,471**	**8,243,767**	**7,530,456**	**7,723,400**	**96,842,797**

Average Monthly Production Data (Gallons), 2004 – 2016

Source	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Total Production
Alta Vista Well	3,709,238	3,449,463	3,588,338	3,454,413	3,551,300	3,582,300	3,757,388	3,633,050	3,640,800	3,865,675	3,816,575	3,900,788	**43,949,325**
North Airport Well	141,612	109,753	233,275	275,414	304,732	360,653	283,126	318,562	402,796	266,968	158,656	143,322	**2,998,868**
South Airport well	655,080	559,907	552,773	632,428	739,642	761,300	775,654	755,868	656,889	662,703	629,178	610,127	**7,991,549**
Airport Well #3	594,265	519,358	592,107	672,094	853,958	992,677	884,923	854,937	720,353	625,965	670,212	530,961	**8,511,808**
Drake Well	1,105,887	947,160	1,077,426	990,256	1,169,753	1,246,882	1,312,968	1,210,754	1,134,357	1,132,581	1,020,292	1,016,235	**13,364,551**
Portola Well #1	206,934	182,626	201,606	178,833	182,572	192,892	185,389	187,099	202,212	218,483	192,313	182,705	**2,313,664**
Portola Well #3	440,986	375,272	461,018	440,776	441,430	359,214	483,626	511,798	444,223	455,096	444,561	548,886	**5,406,885**
Portola Well #4	286,025	238,671	239,553	247,639	209,489	211,860	217,818	223,742	254,488	267,136	222,677	235,698	**2,854,793**
Wagner Well #3	1,536,107	1,355,660	1,502,359	1,471,612	1,528,132	1,447,035	1,647,983	1,737,869	1,622,146	1,517,751	1,550,729	1,483,701	**18,401,083**
Pillar Ridge Wells	1,980,280	898,874	1,057,237	998,567	1,645,560	1,932,775	2,130,611	2,026,669	1,998,462	2,058,685	1,974,421	1,978,655	**20,680,796**
Montara Surface Diversion	1,483,683	1,424,098	1,630,992	1,709,275	2,404,600	2,419,458	2,505,425	2,464,967	2,320,158	1,934,208	1,474,083	1,146,183	**22,917,131**
Average Monthly Production	**8,428,441**	**7,496,899**	**8,320,586**	**8,389,045**	**9,641,729**	**9,831,906**	**10,229,616**	**10,104,192**	**9,643,200**	**9,158,281**	**8,584,310**	**8,218,334**	**108,046,540**

Source Production (Gallons), 2004 – 2016

Source	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Alta Vista Well				3,374,770	33,277,700	37,818,200	31,775,700	28,072,600	33,860,400	50,484,800	58,597,500	46,357,300	31,350,400
North Airport Well	8,852,400	6,194,520	5,874,620	2,992,280	433,190	840,960	721,810	129,050	694,870	136,950	4,774,890	567,060	3,773,820
South Airport well	19,682,010	19,852,870	17,210,060	16,698,160	14,141,908	6,808,415	1,436,218	68,945	0	0	0	0	0
Airport Well #3	20,424,050	23,136,870	29,372,040	19,675,190	7,754,600	1,725,710	53,240	0	0	0	0	0	0
Drake Well	17,736,270	17,171,160	14,507,770	16,342,207	11,761,393	12,297,800	9,870,040	11,425,480	14,543,427	11,060,817	9,823,319	7,103,778	6,731,150
Portola Well #1	3,465,260	2,975,130	2,639,040	2,361,530	2,263,690	3,110,160	2,442,870	2,205,300	1,800,460	2,638,100	1,748,500	26,780	87,146
Portola Well #3	3,528,930	3,738,590	2,924,730	3,672,220	3,165,740	3,202,520	2,819,860	2,887,630	2,434,450	914,140	2,478,020	19,188,110	13,927,680
Portola Well #4	4,103,210	1,257,810	2,433,160	4,691,640	2,969,860	4,451,340	3,600,360	3,533,300	3,267,642	2,489,930	1,047,720	390	411,154
Wagner Well #3	22,704,470	20,728,410	22,602,860	25,792,000	15,877,678	21,647,412	22,643,720	18,686,320	19,856,430	14,190,298	9,840,330	6,243,069	11,830,860
Pillar Ridge Wells Nos. 1-3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	11,978,609	8,702,187
Montara Surface Diversion	30,546,700	29,241,500	27,745,800	19,092,300	23,347,600	11,265,700	24,689,400	29,343,000	24,712,280	20,301,800	6,948,400	7,742,095	20,029,000
Total Gallons Produced	***131,043,300***	***124,296,860***	***125,310,080***	***114,692,297***	***114,993,359***	***103,168,217***	***100,053,218***	***96,351,625***	***101,169,959***	***102,216,835***	***95,258,679***	***99,207,191***	***96,843,397***

Production, Consumption, and Unaccounted-for-Water, 2004 – 2016

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Average
Total Annual Production (MG)	131.04	124.30	125.31	114.69	114.99	103.17	100.05	96.35	101.17	102.22	95.26	99.21	96.84	108.05
Total Annual Production (gpd)	359,023	340,539	343,315	314,225	315,050	282,653	274,118	263,977	277,178	280,046	260,983	271,801	265,324	296,018
Total Annual Consumption (MG)	117.41	114.99	111.17	104.61	106.72	98.93	92.83	87.75	93.11	94.67	86.48	89.53	90.07	99.10
Average Daily Consumption (gpd)	321,671	315,041	304,575	286,603	292,384	271,041	254,329	240,411	255,107	259,367	236,921	245,274	246,786	271,501
Unaccounted-for-water (MG)	13.63	9.31	14.14	10.08	8.27	4.24	7.22	8.60	8.06	7.55	8.78	9.68	6.78	8.95
Unaccounted For Water (gpd)	37,352	25,498	38,740	27,623	22,667	11,612	19,790	23,566	22,071	20,679	24,062	26,527	18,538	24,517
Percentage Unaccounted-for-water	10.40%	7.49%	11.28%	8.79%	7.19%	4.11%	7.22%	8.93%	7.96%	7.38%	9.22%	9.76%	7.00%	8.22%

Maximum Daily Demand (MDD), 2006 – 2016

Year	MDD (gpd)	Month of MDD
2006	534,360	July
2007	511,980	August
2008	437,440	June
2009	406,780	July
2010	478,230	July
2011	379,610	July
2012	381,080	June
2013	414,676	June
2014	386,610	August
2015	402,210	August
2016	400,876	July
Assumed MDD (2008 – 2015)	**478,230**	

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APPENDIX C
2016 Consumer Confidence Report

Montara Water and Sanitary District

2016 CCR

Consumer Confidence Report

July 2017

Excellent Quality and Consistent Water System Upgrades

A message from the Board President

Dear Customer,
Your Water Meets all Quality Standards.
We are pleased to report continued compliance of your local water with all federal and state drinking water regulations, as demonstrated by this Consumer Confidence Report for 2016. This Report summarizes the results of approximately 2,200 analyses conducted on your drinking water in the past year.

Infrastructure Upgrades. The District has continued its infrastructure improvement efforts by replacing the water main along 4th Street and bringing the new Alta Vista Tank online. This new tank increased our system's storage capacity, improving the reliability of the water system and our fire-fighting capabilities. The District will continue to implement projects that maximize system reliability while minimizing costs and environmental impacts.

Please Keep Up Your Excellent Conservation Practices. With drought conditions persisting into 2016, with your support, MWSD has reduced water consumption by 26% since 2004. Despite the recent rainfall, we encourage you to continue conserving – there is never enough water to waste. For more information on how to save water and reduce your water bills, please visit *saveourh20.org*.

Please Contact Us. We Are Here to Serve! For more information on the MWSD system and the quality of your drinking water, you can visit the District's office, the website at mwsd.montara.org, or attend one of our Board meetings. District Staff and Board Members are always available to discuss issues with customers and constituents.

Sincerely,
Dwight Wilson, Board President

Our High-Quality Water Supply

The Montara Water and Sanitary District (MWSD) is served by groundwater from San Mateo Coastal Basin Aquifers and surface water from the Montara Creek.

We test the drinking water quality for many constituents as required by State and Federal regulations. This report shows the results of our monitoring for the period of January 1 through December 31, 2016 and may include earlier monitoring data.

To ensure that tap water is safe to drink, the U.S. Environmental Protection Agency (USEPA) and SWRCB prescribe regulations that limit the amount of certain contaminants in water provided by public water systems. SWRCB regulations also establish limits for contaminants in bottled water that must provide the same protection for public health.

The sources of drinking water (both tap water and bottled water) include rivers, lakes, streams, ponds, reservoirs, springs, and wells. As water travels over the surface of the land or through the ground, it dissolves naturally-occurring minerals and, in some cases, radioactive material, and can pick up substances resulting from the presence of animals or from human activity.

Contaminants that may be present in source water include:
Microbial contaminants, such as viruses and bacteria that may come from sewage treatment plants, septic systems, agricultural livestock operations, and wildlife.

Inorganic contaminants, such as salts and metals, that can be naturally-occurring or result from urban stormwater runoff, industrial or domestic wastewater discharges, oil and gas production, mining, or farming.

Pesticides and herbicides that may come from a variety of sources such as agriculture, urban stormwater runoff, and residential uses.

Organic chemical contaminants, including synthetic and volatile organic chemicals that are byproducts of industrial processes and petroleum production, and can also come from gas stations, urban stormwater runoff, agricultural application, and septic systems.

Radioactive contaminants that can be naturally-occurring or be the result of oil and gas and mining activities.

A Drinking Water Source Assessment for all sources was completed in January 2003 and is on file with the California State Water Resources Control Board (SWRCB) Division of Drinking Water.

Este informe contiene información muy importante sobre su agua potable.
Tradúzcalo o hable con alguien que lo entienda bien.

A Message from the USEPA and the SWRCB Division of Drinking Water

Drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of contaminants does not necessarily indicate that the water poses a health risk. More information about contaminants and potential health effects can be obtained by calling the USEPA's Safe Drinking Water Hotline (1-800-426-4791).

Some people may be more vulnerable to contaminants in drinking water than the general population. Immuno-compromised persons such as persons with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV/AIDS or other immune system disorders, some elderly, and infants can be particularly at risk from infections. These people should seek advice about drinking water from their health care providers. USEPA/Centers for Disease Control (CDC) guidelines on appropriate means to lessen the risk of infection by Cryptosporidium and other microbial contaminants are available from the Safe Drinking Water Hotline (1-800-426-4791).

If present, elevated levels of lead can cause serious health problems, especially for pregnant women and young children. Lead in drinking water is primarily from materials and components associated with service lines and home plumbing. MWSD is responsible for providing high quality drinking water, but cannot control the variety of materials used in plumbing components. When your water has been sitting for several hours, you can minimize the potential for lead exposure by flushing your tap for 30 seconds to 2 minutes before using water for drinking or cooking. If you do so, you may wish to collect the flushed water and reuse it for other beneficial purposes, such as watering plants. If you are concerned about lead in your water, you may wish to have your water tested. Information on lead in drinking water, testing methods, and steps you can take to minimize exposure is available from the Safe Drinking Water Hotline or at *http://www.epa.gov/lead.*

Important Information about Your Drinking Water

Copper and **Lead** were found at levels ***below*** the Regulatory Action Level (AL) of 1.3 ppm and 15 ppb, respectively, in the 2015 residential tap sampling. No exceedance was found in the distribution system. Although residential tap sampling was not required in 2016, results from 2015 are still representative of current conditions. The typical sources for copper and lead contamination are corrosion of household plumbing systems and erosion of natural deposits. Copper is an essential nutrient, but some people who drink water containing copper in excess of the AL over a relatively short time may experience gastrointestinal distress and liver or kidney damage. People with Wilson's disease should consult their doctor.

Arsenic was detected at two District wells at levels ***below*** the MCL. While your drinking water meets the federal and state standard for arsenic, it does contain low levels of arsenic. The arsenic standard balances the current understanding of arsenic's possible health effects against the cost of removing arsenic from drinking water. The USEPA continues to research the health effects of low levels of arsenic, which is a mineral known to cause cancer in humans at high concentrations and is linked to other health effects such as skin damage and circulatory problems.

Fluoride was found at five District wells at levels ***below*** the MCL. While your drinking water meets the federal and state standard for fluoride, it does contain low levels of fluoride. Some people who drink water containing fluoride in excess of the federal MCL of 4 mg/L over many years may get bone disease, including pain and tenderness of the bones. Children who drink water containing fluoride in excess of the state MCL of 2 mg/L may get mottled teeth.

Secondary MCLs were set to protect you against unpleasant aesthetic effects such as color, taste, odor, and the staining of plumbing fixtures (e.g., tubs and sinks), and clothing while washing. Exceeding the secondary MCLs poses no health risks. **Manganese** was found at levels that **exceeded** the secondary MCL of 50 ppb that is set to protect consumers from neurological effects. The high manganese levels are most likely due to leaching of natural deposits in the soil where groundwater is in contact with naturally occurring sediments. **Iron** was found at levels that **exceeded** the secondary MCL of 300 ppb. The high iron levels are due to leaching of natural deposits.

Terms Used in this Report

Maximum Contaminant Level (MCL): The highest level of a contaminant that is allowed in drinking water. Primary MCLs are set as close to the PHGs (or MCLGs) as is economically and technologically feasible. Secondary MCLs are set to protect the odor, taste, and appearance of drinking water.

Maximum Contaminant Level Goal (MCLG): The level of a contaminant in drinking water, below which there is no known or expected risk to health. MCLGs are set by the USEPA.

Public Health Goal (PHG): The level of a contaminant in drinking water, below which there is no known or expected risk to health. The California Environmental Protection Agency (CEPA) sets pHGs.

Maximum Residual Disinfectant Level (MRDL): The highest level of a disinfectant allowed in drinking water. There is convincing evidence that addition of a disinfectant is necessary for control of microbial contaminants.

Maximum Residual Disinfectant Level Goal (MRDLG): The level of a drinking water disinfectant, below which there is no known or expected risk to health. MRDLGs do not reflect the benefits of the use of disinfectants to control microbial contaminants.

Primary Drinking Water Standards (PDWS): MCLs and MRDLs for contaminants that affect health along with their monitoring and reporting requirements, and water treatment requirements.

Secondary Drinking Water Standards (SDWS): MCLs for contaminants that affect taste, odor, or appearance of the drinking water. Contaminants with SDWSs do not affect the health at the MCL levels.

Secondary Maximum Contaminant Level (SMCL): Secondary MCLs are set to protect the odor, taste, and appearance of drinking water. Exceeding the SMCLs poses no health risks.

Treatment Technique (TT): A required process intended to reduce the level of a contaminant in drinking water.

Regulatory Action Level (AL): The concentration of a contaminant that, if exceeded, triggers treatment or other requirements that a water system must follow.

Variances and Exemptions: SWRCB Division of Drinking Water permission to exceed an MCL or not comply with a treatment technique under certain conditions.

ND: not detectable at testing limit

NTU: nephelometric turbidity unit

ppm: parts per million or milligrams per liter (mg/L)

ppb: parts per billion or micrograms per liter (µg/L)

ppq: parts per quadrillion or picograms per liter (ng/L)

pCi/L: picocuries per liter (a measure of radiation)

T.O.N.: threshold odor unit

Tables 1, 2, 3, 4, 5, 7, and 8 list all of the drinking water contaminants that were detected during the most recent sampling events for the constituent. The presence of these contaminants in the water does not necessarily indicate that the water poses a health risk. The State Board allows us to monitor for certain contaminants less than once per year because the concentrations of these contaminants do not change frequently. Some of the data, though representative of the water quality, are more than one year old.

TABLE 1 – SAMPLING RESULTS SHOWING THE DETECTION OF COLIFORM BACTERIA

Microbiological Contaminants	Highest No. of detections	No. of months in violation	MCL	MCLG	Typical Source of Bacteria
Total Coliform Bacteria	0	0	More than 1 sample in a month with a detection	0	Naturally present in the environment
Fecal Coliform or E. coli	0	0	A routine sample and a repeat sample detect total coliform and either sample also detects fecal coliform or E. coli	0	Human and animal fecal waste

TABLE 2 – SAMPLING RESULTS SHOWING THE DETECTION OF LEAD AND COPPER

Lead and Copper	No./Date of samples collected	90th percentile level detected	No. Sites exceeding AL	AL	PHG	Typical Source of Contaminant
Lead (ppb)	11 2015 Tap Sampling	8.4	0	15	0.2	Internal corrosion of household water plumbing systems; discharges from industrial manufacturers; erosion of natural deposits
Copper (ppm)	11 2015 Tap Sampling	0.11	0	15	0.3	Internal corrosion of household plumbing systems; erosion of natural deposits; leaching from wood preservatives

TABLE 3 – SAMPLING RESULTS FOR SODIUM AND HARDNESS

Chemical or Constituent (and reporting units)	Sample Date	Level Detected	Range of Detections			MCL	PHG (MCLG)	Typical Source of Contaminant
Sodium (ppm)	Annually	39	28	–	50	None	None	Salt present in water and generally found naturally occurring in ground & surface water
Hardness (ppm)	Annually	133	96	–	170	None	None	Sum of polyvalent cations present in water, generally magnesium and calcium, and are usually naturally occurring in ground & surface water

TABLE 4 – DETECTION OF UNREGULATED CONTAMINANTS

Chemical or Constituent (and reporting units)	Sample Date	Level Detected	Range of Detections			Notification Level	Health Effects Language
Boron (ppm)	Annually (varies by location)	0.2	0.13	–	0.23	1	The babies of some pregnant women who drink water containing boron in excess of the notification level may have an increased risk of developmental effects, based on studies in laboratory animals.

TABLE 5 – DETECTION OF CONTAMINANTS WITH A PRIMARY DRINKING WATER STANDARD								
Chemical or Constituent (and reporting units)	**Sample Date**	**Level Detected**	**Range of Detections**			**MCL**	**PHG (MCLG) [MRDLG]**	**Typical Source of Contaminant**
Turbidity (NTU)	Annually	0.4	N/A	–	N/A	TT	None	Soil runoff
Arsenic (ppb)	Quarterly	404	2.1	–	7.7	10	0.004	Erosion of natural deposits; runoff from orchards; glass and electronics production waste
Fluoride (ppm)	Quarterly	1.0	0.2	–	2	2	1	Erosion of natural deposits; water additive which promotes strong teeth; discharge from fertilizer and aluminum factories
Nitrate (ppm)	Annually (date)	1.5	ND	–	10	10	10	Runoff and leaching from fertilizer use; leaching from septic tanks and sewage; erosion of natural deposits
Toluene (ppb)	Quarterly	2	ND	–	10	150	150	Discharge from petroleum and chemical factories; underground gas tank leaks
Total Trihalomethanes [TTHMs] (ppb)	As needed	15	ND	–	67	80	none	Byproduct of drinking water disinfection
Haloacetic Acids [HAA5] (ppb)	As needed	6.6	4	–	10	60	none	Byproduct of drinking water disinfection
Control of DBP precursors [TOC] (ppm)	Quarterly	0.4	ND	–	0.5	TT	none	Various natural and man-made sources
Dioxin (2,3,7,8-TCDD) (ppq)	2 quarters per 3 years	1.5	1.1	–	2.0	30	0.05	Emissions from waste incineration and other combustion; discharge from chemical factories
cis-1,2-Dichlorothene (ppb)	Quarterly	1.0	ND	–	4.3	6	100	Discharge from industrial chemical factories; major biodegradation byproduct of TCE and PCE groundwater contamination
trans-1,2-Dichloroethene (ppb)	Quarterly	0.2	ND	–	1.2	10	60	Discharge from industrial chemical factories; minor biodegradation byproduct of TCE and PCE groundwater contamination
Trichloroethene (TCE) (ppb)	Quarterly	0.2	ND	–	1.5	5	1.7	Discharge from metal degreasing sites and other factories

TABLE 6 – SAMPLING RESULTS SHOWING FECAL INDICATOR-POSITIVE GROUND WATER SOURCE SAMPLES					
Microbiological Contaminants	**Total No. of Detections**	**Sample Dates**	**MCL [MRDL]**	**PHG (MCLG) [MRDLG]**	**Typical Source of Contaminant**
E. coli	0	N/A	0	(0)	Human and animal fecal waste
Enterococci	0	N/A	TT	N/A	Human and animal fecal waste
Coliphage	0	N/A	TT	N/A	Human and animal fecal waste

**Any violation of an MCL, TT or AL is asterisked. Additional information is provided in this report.*

TABLE 7 – DETECTION OF CONTAMINANTS WITH A SECONDARY DRINKING WATER STANDARD								
Chemical or Constituent (and reporting units)	**Sample Date**	**Level Detected**	**Range of Detections**			**SMCL**	**PHG (MCLG)**	**Typical Source of Contaminant**
Color (Color Units)	Varies	0	ND	–	ND	15	None	Naturally-occurring organic materials
**Iron (ppb)	Quarterly	1781	ND	–	8,300	300	None	Leaching from natural deposits; industrial wastes
**Manganese (ppb)	Varies	59.8	ND	–	300	50	None	Leaching from natural deposits
Total Dissolved Solids [TDS] (ppm)	Annually	245	170	–	320	1,000	None	Runoff/leaching from natural deposits
Specific Conductance (µS/cm)	Annually	435	300	–	570	1,600	None	Substances that form ions when in water; seawater influence
Chloride (ppm)	Annually	67	42	–	92	500	None	Runoff/leaching from natural deposits; seawater influence
Sulfate (ppm)	Annually	26	9.6	–	42	500	None	Runoff/leaching from natural deposits; industrial wastes

TABLE 8 – SAMPLING RESULTS SHOWING TREATMENT OF SURFACE WATER SOURCES	
Treatment Technique [(a)] (Type of approval filtration technology used)	Dual-media pressure filters, coagulation and contact clarifiers
Turbidity Performance Standards [(b)] (that must be met through the water treatment process)	Turbidity of the filtered water must: 1 – Be less than or equal to 0.3 NTU in 95% of measurements in a month. 2 – Not exceed 0.3 NTU for more than eight consecutive hours. 3 – Not exceed 1 NTU at any time.
Lowest monthly percentage of samples that met Turbidity Performance Standard No. 1	100%
Highest single turbidity measurement during the year	0.20
Number of violations of any surface water treatment requirements	0

[(a)] *A required process intended to reduce the level of a contaminant in drinking water.*

[(b)] *Turbidity (measured in NITU) is a measurement of the cloudiness of water and is a good indicator of water quality and filtration performance. Turbidity results that meet performance standards are considered to be in compliance with filtration requirements.*

Montara Water and Sanitary District

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Continuing Our Commitment

The District Board Meetings for public participation are held on the first and third Thursday of each month at 7:30 p.m. at the District Office at 8888 Cabrillo Highway, Montara, CA 94037. For more information about this report and with any questions related to your public water system, please contact the District at (650) 728-3545. You may also fax to us at (650) 728-8556, or email to mwsd@coastside.net, or visit us online at *mwsd.montara.org*

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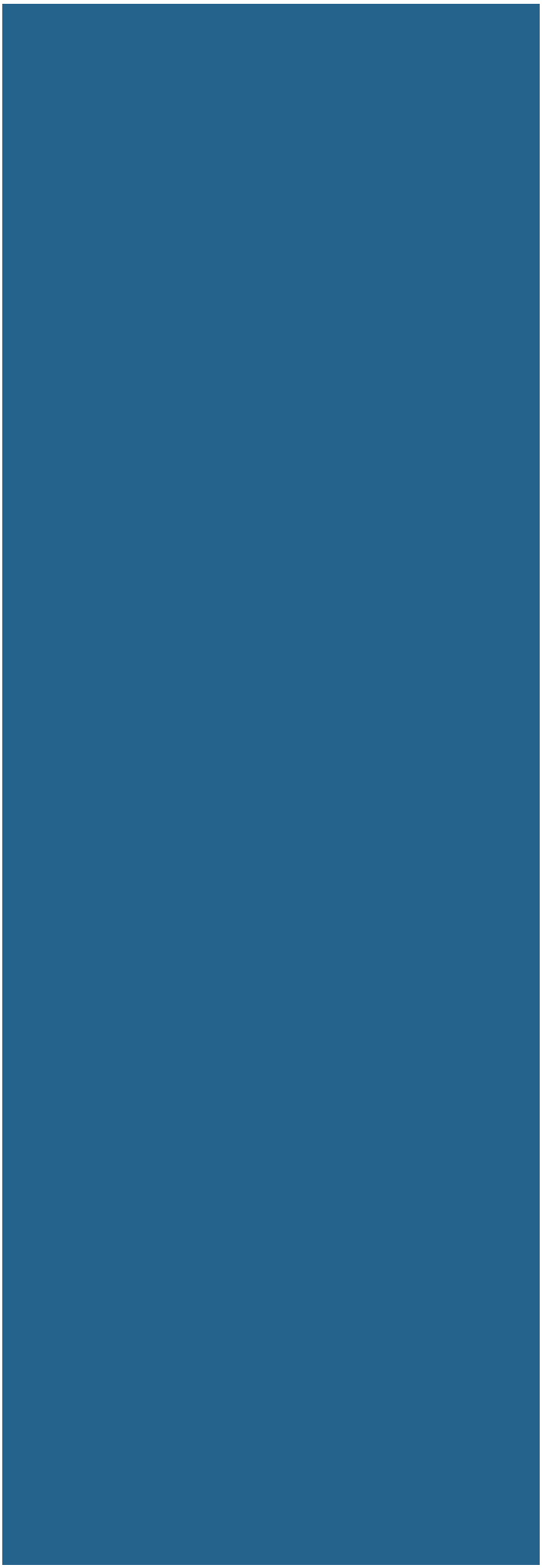

SRT consultants