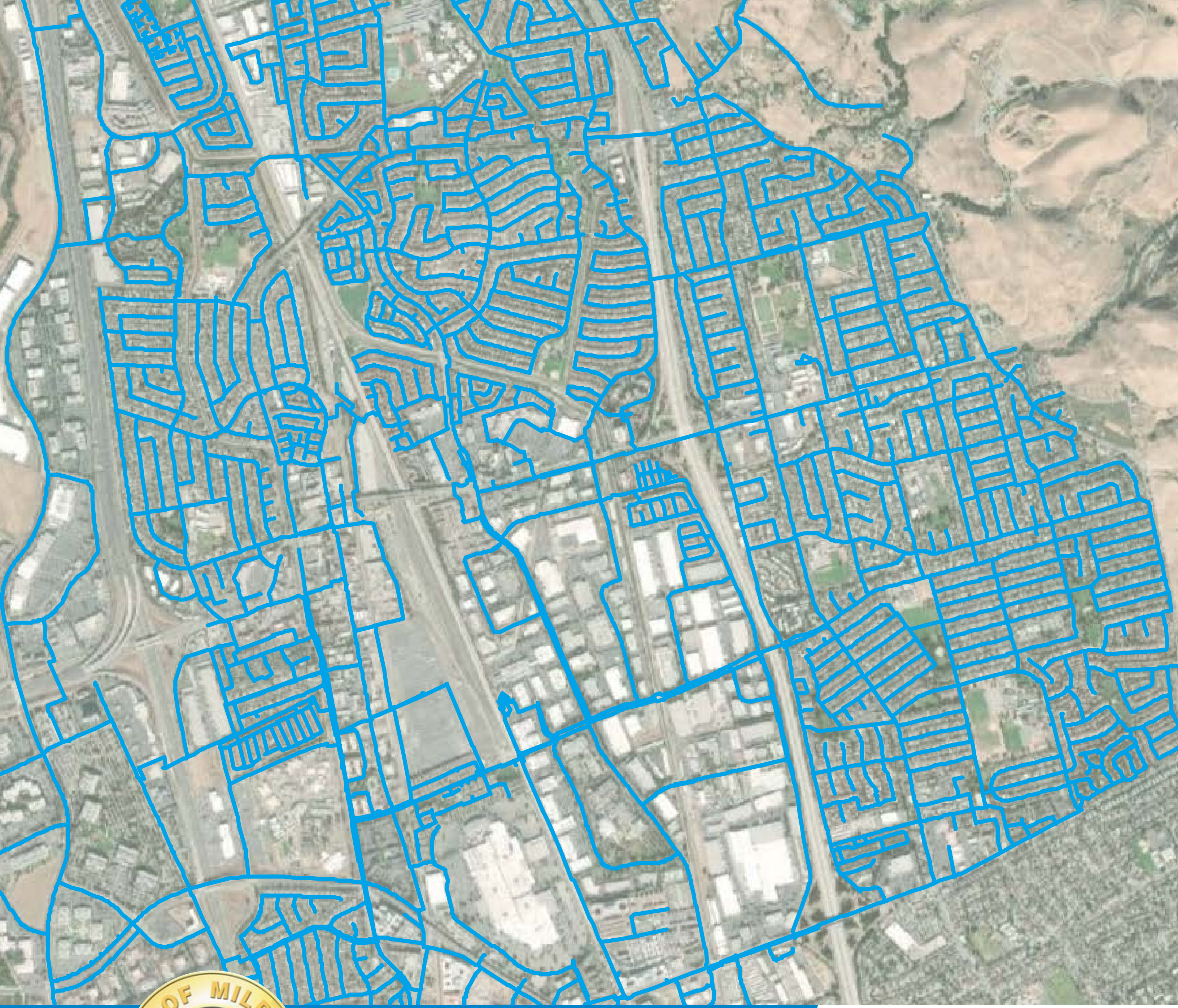

CITY OF MILPITAS

Water Master Plan

MARCH 2021

WEST YOST
Water. Engineered.

FINAL REPORT | MARCH 2021

Water Master Plan

PREPARED FOR

City of Milpitas

PREPARED BY

WEST YOST
Water. Engineered.

Water Master Plan

Prepared for

City of Milpitas

Project No. 270-60-19-16

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LIST OF ACRONYMS AND ABBREVIATIONS

2009 Update/ 2009 WMPU	2009 Water Master Plan Update
2020 WMP	2020 Water Master Plan
AB 1668	Assembly Bill 1668
AC	Asbestos Cement
ACWD	Alameda County Water District
ADD	Average Day Demand
af	Acre-Feet
af/yr	Acre-Feet Per Year
AMI	Advanced Metering Infrastructure
APN	Assessor's Parcel Number
AWIA	America's Water Infrastructure Act
AWWA	American Water Works Association
BART	Bay Area Rapid Transit
BAWSCA	Bay Area Water Supply And Conservation Agency
CIP	Capital Improvement Program
CIP ID	Capital Improvement Program ID
City	City of Milpitas
COF	Consequence Of Failure
County	Santa Clara County
CVP	Central Valley Project
CY	Calendar Year
DDW	Division of Drinking Water
Delta	Sacramento-San Joaquin Delta
DIP	Ductile Iron Pipe
DWR	Department of Water Resources
EIR	Environmental Impact Report
EPRV	Emergency Pressure Reducing Valve

ERP	Emergency Response Plan
Ft/kft	Feet Per 1,000 Feet
Ft/s	Feet Per Second
GIS	Geographical Information System
gpcd	Gallons Per Capita Per Day
gpd	Gallons Per Day
HGL	Hydraulic Grade Line
HPR	Hydrant Pressure Recorder
HydroScience	HydroScience Engineers, Inc.
I-680	Interstate 680
I-880	Interstate 880
ISG	Individual Supply Guarantee
Legislature	California State Legislature
LOF	Likelihood of Failure
LUA Report	Land Use Alternatives Report
LWU	Large Water Users
Maddaus	Maddaus Water Management, Inc.
MDD	Maximum Day Demand
MG	Million Gallons
mgd	Million Gallons Per Day
msl	Mean Sea Level
MSP	Midtown Specific Plan
MWELO	Model Water Efficient Landscape Ordinance
NRW	Non-Revenue Water
PG&E	Pacific Gas and Electric
PHD	Peak Hour Demand
PM	Preventative Maintenance
PRVs	Pressure Reducing Valves
PS	Pump Station
Psi	Pounds Per Square Inch
PVC	Polyvinyl Chloride
R&R	Rehabilitation and Replacement
RMC	Raines, Melton & Carella
RRA	Risk and Resilience Assessment
RWS	Regional Water System
SB X7-7	Water Conservation Act of 2009
SBWR	South Bay Water Recycling
SCADA	Supervisory Control and Data Acquisition
SCVWD	Santa Clara Valley Water District
SFPUC	San Francisco Public Utilities Commission
SJW	San Jose Water
SOI	Sphere of Influence

SWRCB	State Water Resources Control Board
TASP	Transit Area Specific Plan
TDH	Total Dynamic Head
UPC	Uniform Plumbing Code
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UWMP	Urban Water Management Plan
VTA	Valley Transit Authority
VW	Valley Water
WTP	Water Treatment Plant
WUF	Water Use Factors

Executive Summary

WATER MASTER PLAN PURPOSE

The purpose of this Water Master Plan for the City of Milpitas (City) is to evaluate the existing system infrastructure and incorporate impacts of short-term and long-term planned growth to develop a comprehensive road map for the City's Water System Capital Improvement Program (CIP). The City's last Water Master Plan was completed in 2002 and was then updated in 2009 to incorporate an analysis of the impacts of the City's Milpitas Metro Specific Plan (then known as the Transit Area Specific Plan). The City is continuing to experience significant growth, has recently completed an update to its General Plan and is in the process of updating two key specific plans, Milpitas Gateway-Main Street Specific Plan (formerly known as the Midtown Specific Plan) and Milpitas Metro Specific Plan.

Since the completion of the 2009 Water Master Plan Update (2009 WMPU), the State endured five years of drought starting in 2012, including the driest four consecutive years in California history (2012-2015). These unprecedented conditions led to statewide mandated water conservation, significant surface water supply reductions and curtailments, and legislation establishing new statewide water efficiency standards and contributing to new water use patterns and trends.

These factors make it critical to both reassess the City's water needs, priorities, and strategies and reevaluate water system infrastructure improvements, with a goal of ensuring a safe and reliable water supply for the City's residents and businesses.

WATER MASTER PLAN OBJECTIVES

The primary objectives of this Water Master Plan are to:

- Evaluate historical and existing water demands to understand current water use patterns, trends, and unit water use factors and develop future water demand projections based on the future planned development included in the City's General Plan Update
- Review and refine performance and planning criteria used to evaluate the water system and formulate recommendations for future facilities
- Perform a condition assessment of the City's water assets, including evaluating criticality and likelihood of failure, consequence of failure, and business risk exposure for horizontal assets (e.g., pipes, valves) and vertical assets (e.g., reservoirs, pump stations)
- Prepare a water utility asset renewal and replacement study to provide priorities for asset renewal and replacement
- Develop and calibrate the City's water system hydraulic model using InfoWater modeling software to provide an accurate tool for evaluating various water system scenarios
- Evaluate the need for new backbone water facilities (including pipelines, storage facilities and pumping facilities) to serve buildout of the City's General Plan (estimated by the year 2040)
- Evaluate existing and projected source capacity (per Section 64558, Title 22, of the California Code of Regulations) to ensure that adequate storage is provided throughout the City's water system to meet existing and future needs and requirements
- Develop a capital improvement program for recommended potable water system facilities

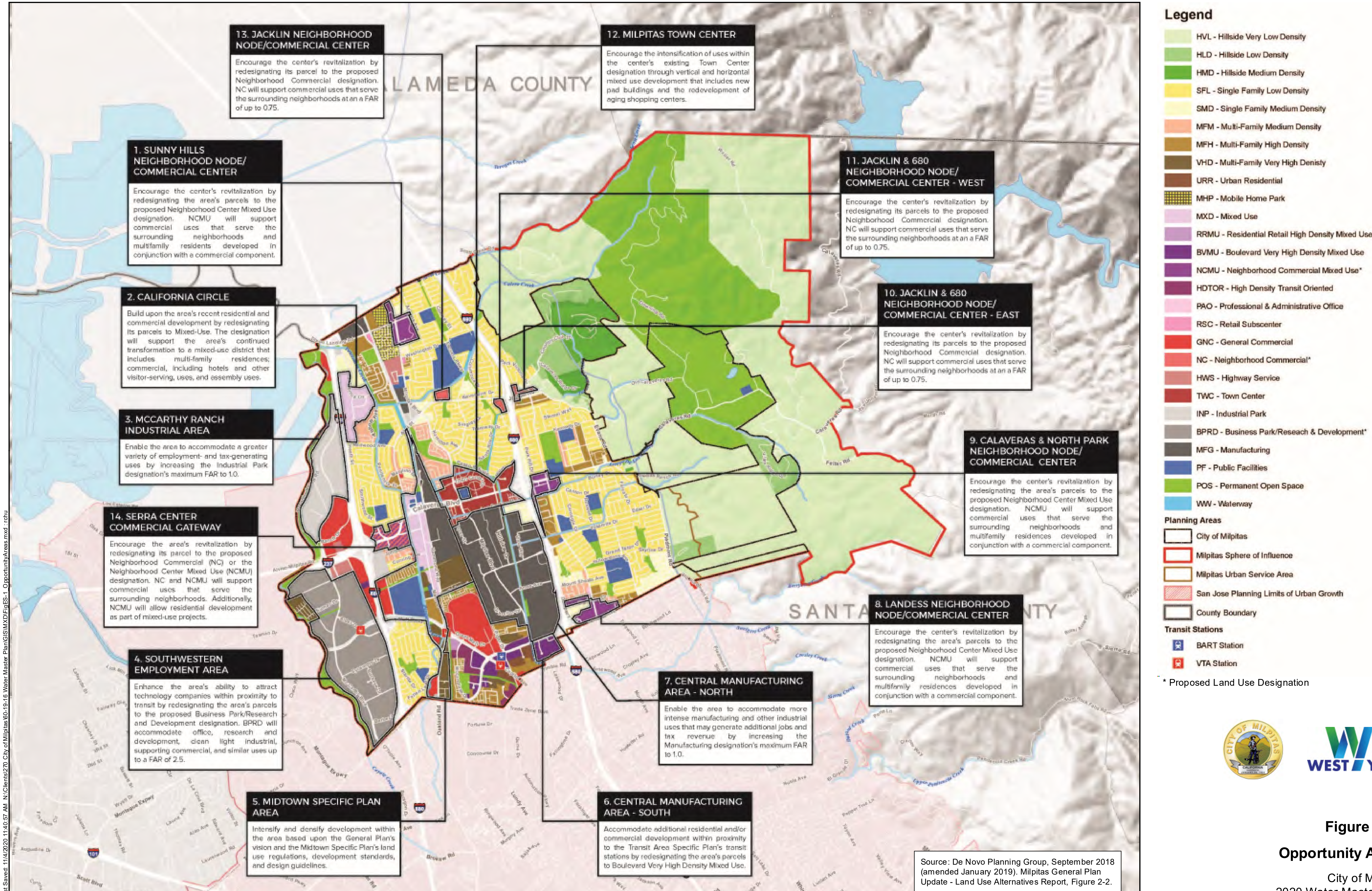
EXISTING AND PROJECTED FUTURE LAND USE

Most of the City's existing land use is single family residential, which is located primarily in the north and the east. Industrial and commercial land uses comprise much of the City's southern and western regions. The City anticipates future growth in the form of smaller development projects identified in several Opportunity Areas located throughout the City and significant new development in two large planning areas (Gateway-Main Street and Metro Plan areas). Opportunity Areas were previously defined by the City's Planning and Economic Development departments and represent locations throughout the City that can accommodate future growth and support economic development while protecting natural resources and open space.

Figure ES-1 shows the locations of each Opportunity Area and briefly describes the land use plan for that area. Growth strategies and goals are outlined in the City's General Plan and detailed in the Milpitas Gateway-Main Street and the Milpitas Metro specific plans.

Since updates to the General Plan, Milpitas Gateway-Main Street Specific Plan, and Milpitas Metro Specific Plan were in progress during the development of this Water Master Plan, West Yost coordinated with the City's Planning Department and HydroScience Engineers, Inc. (HydroScience), who is developing the City's Sewer Master Plan, to develop land use planning assumptions for use in the Water and Sewer Master Plans. These future land use assumptions are preliminary but represent conservative estimates of future development.

Table ES-1 summarizes buildout land use assumptions used in this report to model potential future growth. This Water Master Plan conservatively assumes the high end of the dwelling unit range will be constructed, and that areas shown in Table ES-1 are additional new development (not redevelopment). While this "new development" assumption may double-count some existing demands in growth areas where redevelopment occurs, it was necessary based on limited data. Parcel-specific development data was not available, so West Yost could not identify whether a future development was replacing an existing development (and replacing existing water use) or in addition to existing development (with additional water use).



Source: De Novo Planning Group, September 2018 (amended January 2019). Milpitas General Plan Update - Land Use Alternatives Report, Figure 2-2.

Figure ES-1

Opportunity Areas

City of Milpitas
2020 Water Master Plan

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Table ES-1. Potential New Growth at Buildout[a]

Development	Land Use Designation[b]	Total Acres	Range of Potential New Dwelling Units		New Non-Residential Building Square Footage
			Low	High	
Opportunity Areas - Residential					
Sunny Hills Neighborhood Node/Commercial Center	NCMU	19.92	275	350	569,573
California Circle	NCMU	54.10	248	360	551,816
California Circle	HDR	18.26	252	365	551,816
Landess Neighborhood Node/Commercial Center	NCMU	38.03	450	625	521,274
Calaveras & North Park Neighborhood Node/Commercial Center	NCMU	28.28	325	425	416,836
Milpitas Town Center	HDR[c]	38.07	400	525	434,872
	Subtotal	196.66	1,950	2,650	3,046,187
Opportunity Areas - Non-Residential					
McCarthy Ranch Industrial Area	INP	192.29	-	-	3,049,301
Southwestern Employment Area	BPRD	488.26	-	-	5,126,097
Central Manufacturing Area - North	MFG	492.14	-	-	2,602,882
Jacklin & 680 Neighborhood Node/Commercial Center - East	NC	7.95	-	-	152,321
Jacklin & 680 Neighborhood Node/Commercial Center - West	NC	6.42	-	-	75,502
Jacklin Neighborhood Node/Commercial Center	NC	9.79	-	-	99,629
	Subtotal	1,196.85	-	-	11,105,732
Milpitas Gateway-Main Street Specific Plan					
HDR Subset of Gateway-Main Street	HDR[c]	46.70	478	637	-
VHDR Subset of Gateway-Main Street	VHDR[e]	74.58	781	1,041	-
MDR Subset of Gateway-Main Street	MDR[f]	62.70	242	322	483,391
Non-Residential Subset of Gateway-Main Street	MFG[g]	300.30	-	-	954,012
	Subtotal	484.28	1,500	2,000	1,437,403
Milpitas Metro Specific Plan					
VHDR Subset of Metro Plan Area	VHDR	99.00	2,000	4,000	-
HDR Subset of Metro Plan Area	HDR	113.52	3,000	3,000	-
NC Subset of Metro Plan Area[h]	NC	85.35	-	-	2,087,075
	Subtotal	297.87	5,000	7,000	2,087,075
	Total	**2,176**	**8,450**	**11,650**	**17,676,397**

(a) Source: City of Milpitas - Buildout Land Use Condition Assumptions, HydroScience Engineers, August 3, 2020.

(b) Land Use Designations based on Preferred Land Use Map (PLUM), Figure 2-3.

(c) Originally Multifamily High Density (MFH), which has been renamed High Density Residential (HDR) in the PLUM.

(d) Originally Boulevard Very High Density Mixed Use (BVMU), which has been renamed Very High Density Mixed Use (VHDMU) in the PLUM.

(e) Originally Multi-Family Very High Density (VHD), which has been renamed Very High Density Residential (VHDR) in the PLUM.

(f) Originally Mixed Use (MXD), which has been retired in the PLUM. This subset has been recategorized as Medium Density Residential (MDR) based on housing density. MDR is the updated name for Multi-Family Medium Density (MFM).

(g) Originally multiple land uses, Manufacturing (MFG) selected because it is the most conservative (i.e., highest water use).

(h) Includes the "Central Manufacturing Area - South" Opportunity Area, which has been combined with MMSP.

EXISTING WATER SYSTEM FACILITIES

The City's existing potable water system includes the following major facilities: five turnouts, one emergency groundwater well, three emergency interties, five storage reservoirs, five pump stations, 17 pressure reducing valves (PRVs), and approximately 183 miles of pipelines.

There are six main pressure zones within the City's water service area, four served by the San Francisco Public Utilities Commission (SFPUC) (Zones SF1 through SF4), and two served by Valley Water (VW) (Zones VW1 and VW2), which was previously known as the Santa Clara Valley Water District. Under normal conditions, the City operates its potable water system such that the SFPUC and VW supplies remain separate. Isolation valves prevent mixing and create two distinct water service areas.

EXISTING AND PROJECTED FUTURE WATER SUPPLIES

The City's existing water supplies include imported water, groundwater, recycled water, and interties with neighboring agencies. Under normal conditions, imported water comprises the City's entire water supply. The City currently receives water supplies from the following sources:

- Treated surface water from the SFPUC
- Treated surface water from VW
- Tertiary treated recycled water from South Bay Water Recycling (SBWR)
- During emergencies, groundwater pumped from one well (Pinewood Well) within the City
- Emergency interties with San Jose Water (SJW) and the Alameda County Water District (ACWD)

In 2009, the SFPUC and Bay Area Water Supply and Conservation Agency (BAWSCA) members (including the City) entered into a Water Supply Agreement (WSA), a 25-year contract that allocates 184 million gallons per day (mgd) among BAWSCA members. The City's share of SFPUC supply is 9.23 mgd. Per the City's contract with VW, the City submits a request every three years detailing its desired annual supplies from VW. In each of the three years after submitting the request, the City is obligated to purchase at least 95 percent of the maximum annual amount listed on the schedule.

Groundwater can supplement reduced supplies from the SFPUC or Valley Water during prolonged droughts. As presented in the City's 2020 Urban Water Management Plan (UWMP), the City expects to rely on groundwater to augment supplies and meet demands during future dry years. The City hopes to increase future supply reliability by expanding its groundwater capabilities. Two new wells, the Curtis Well and the McCandless Well, are expected to come online during the City's buildout horizon (i.e., by 2040). The Pinewood, Curtis, and McCandless wells, in addition to other future wells described in the City's 2020 UWMP that are triggered by future development in the City's service area, are critical components of the City's future water supply portfolio.

To further improve supply reliability, this Water Master Plan also recommends that the City construct an additional VW turnout.

EXISTING AND PROJECTED FUTURE WATER DEMANDS

In 2019, the City served approximately 78,000 residents and used approximately 8.33 mgd of water. This translates to approximately 107 gallons per capita per day (gpcd), continuing a trend of lower per capita water use following the recent drought and subsequent mandatory water reduction measures. The City is on track to comply with its 2020 per capita water use target of 146 gpcd.

Buildout water demands equal the sum of existing demands and projected future demands as a result of new development. Demand projections are typically calculated based on land use, with expected land area multiplied by a water use factor (WUF). The WUFs are developed from recent historical consumption data and vary by land use type. In other words, the WUFs recognize that a 10-acre industrial processing plant would use more water than a similarly sized office park

West Yost developed preliminary WUFs for each General Plan land use designation based on existing demands (from billing data) and parcel acreages. These preliminary WUFs were refined by examining water use on a per capita basis and for representative developments (e.g., a typical office park or apartment complex), as identified by the City. Water demand projections were developed by applying finalized WUFs to future land use acreages summarized in Table ES-1.

Table ES-2 summarizes the buildout water demand projection. The City's projected water production required at buildout is approximately 13.9 mgd, or 15,600 acre feet per year (af/yr). This is an increase of approximately 5.6 mgd, or 67 percent, over existing (2019) production (8.3 mgd).

The land use-based water demand projection presented above is significantly lower than projections from the 2009 WMPU and the City's 2015 UWMP. At buildout (2040), the land use-based water demand projection is approximately 3.5 mgd and 7.0 mgd lower than projections from the 2009 WMPU and 2015 UWMP, respectively. In contrast, demand projections in this Water Master Plan are generally consistent with demand projections developed by Maddaus Water Management, Inc. (Maddaus) to help BAWSCA member agencies prepare for their 2020 UWMPs.

Table ES-2. Buildout Potable Water Demand Projection				
Development	Land Use Designation[a]	Total Acres[a]	WUF[b], gpd/ac	Demand, mgd
Opportunity Areas - Residential				
Sunny Hills Neighborhood Node/Commercial Center	NCMU	19.92	2,100	0.04
California Circle	NCMU	54.10	2,100	0.11
California Circle	HDR	18.26	4,500	0.08
Landess Neighborhood Node/Commercial Center	NCMU	38.03	2,100	0.08
Calaveras & North Park Neighborhood Node/Commercial Center	NCMU	28.28	2,100	0.06
Milpitas Town Center	HDR	38.07	4,500	0.17
			Subtotal	0.55
Opportunity Areas - Non-Residential				
McCarthy Ranch Industrial Area	INP	192.29	400	0.08
Southwestern Employment Area	BPRD	488.26	400	0.20
Central Manufacturing Area - North	MFG	492.14	2,000	0.98
Jacklin & 680 Neighborhood Node/Commercial Center - East	NC	7.95	1,400	0.01
Jacklin & 680 Neighborhood Node/Commercial Center - West	NC	6.42	1,400	0.01
Jacklin Neighborhood Node/Commercial Center	NC	9.79	1,400	0.01
			Subtotal	1.29
Milpitas Gateway-Main Street Specific Plan				
HDR Subset of Gateway-Main Street	HDR	46.70	4,500	0.21
VHDR Subset of Gateway-Main Street	VHDR	74.58	9,000	0.67
MDR Subset of Gateway-Main Street	MDR	62.70	2,300	0.14
Non-Residential Subset of Gateway-Main Street	MFG	300.30	2,000	0.60
			Subtotal	1.63
Milpitas Metro Specific Plan (MMSP)				
VHDR Subset of Metro Plan Area	VHDR	99.00	9,000	0.89
HDR Subset of Metro Plan Area	HDR	113.52	4,500	0.51
NC Subset of Metro Plan Area	NC	85.35	1,400	0.12
			Subtotal	1.52
			Total New Demand	4.99
			NRW (11%)	0.62
			New Water Production Required	5.60
			Existing (2019) Water Production	8.33
			Buildout Water Production Required	**13.9**

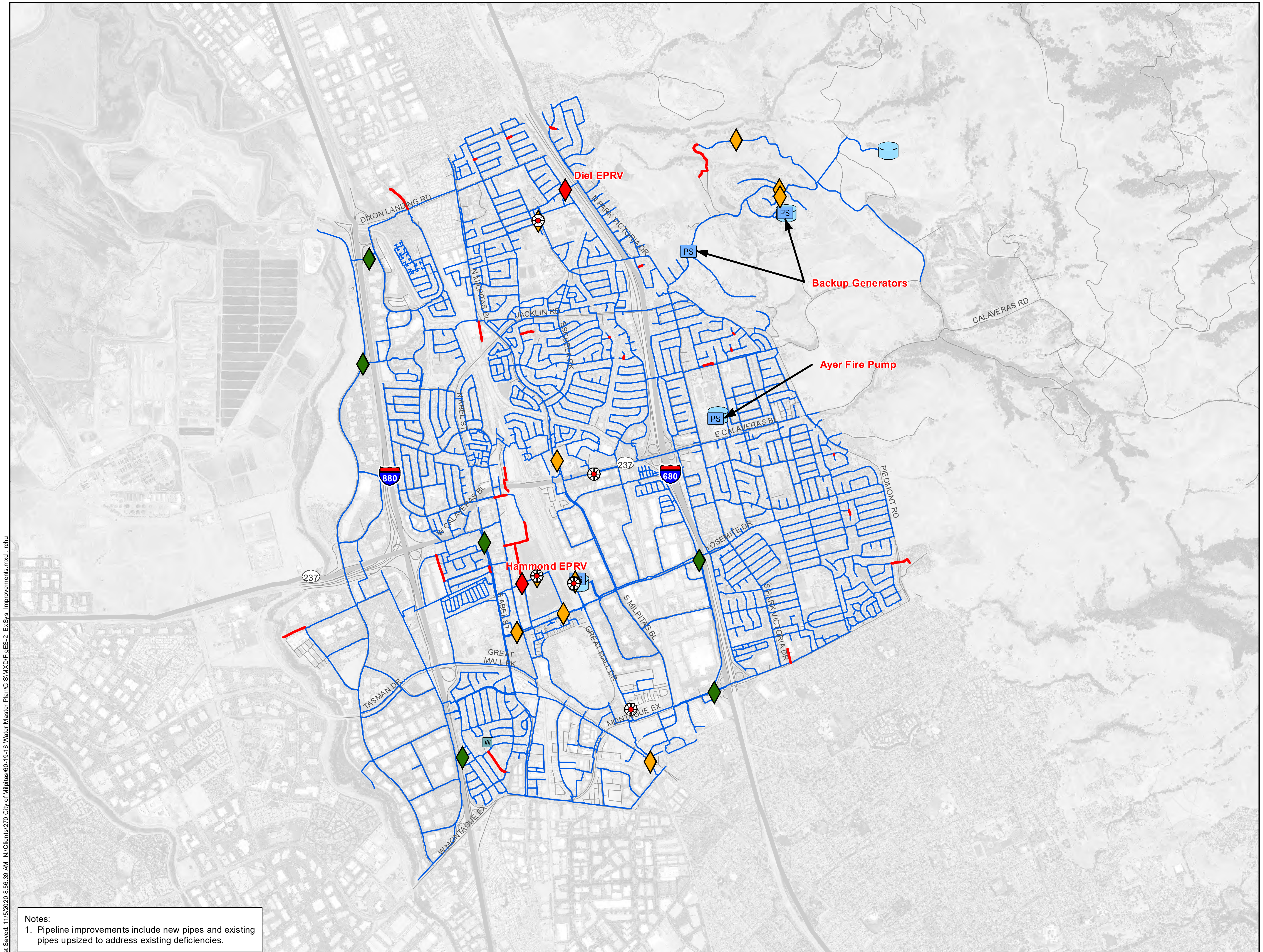
(a) Refer to Table ES-1.

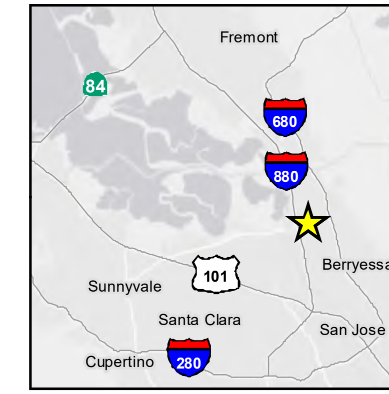
(b) Refer to Table 5-8.

EVALUATION OF EXISTING WATER SYSTEM

The City's existing water system was evaluated based on supply, storage, and pumping capacities, as well as its ability to meet recommended performance and operational criteria under various demand and emergency scenarios. Below is a summary of findings and recommendations from the existing system evaluation. Figure ES-2 shows the recommended improvements from the existing system analysis.

- Supply Capacity
  - Existing firm supplies (i.e., largest turnout offline in each service area) exceed maximum day demand. While the VW service area has a firm supply deficit, it can be met by the surplus in the SFPUC service area. While supplies from SFPUC and VW are normally segregated, the City can intermix supply sources if necessary. No additional supply facilities are recommended based on existing demands and normal operating conditions.
- Storage Capacity
  - There is sufficient storage in the SFPUC service area and a deficit of 0.45 million gallons (MG) in the VW service area. This deficit is not considered critical, as the Zone SF1 storage surplus can cover the shortfall in Zones VW1 and VW2. No additional storage is recommended based on existing demands and normal operating conditions.
- Pumping Capacity
  - Each pressure zone has a pumping capacity surplus. No additional pumping facilities are recommended based on existing demands and normal operating conditions.
- Distribution System
  - The existing distribution system meets all minimum pressure criteria under average day, peak hour, and maximum day demand conditions.
  - Based on fire flow analysis, West Yost identified potential projects to improve overall distribution system flows. These mainly consist of upsizing existing 6-inch and 8-inch diameter pipelines, though some PRV and isolation valve improvements are also recommended.
  - To comply with the City's design guidelines and improve fire flow capacity, the City should consider upsizing any 4-inch diameter pipelines that serve hydrants to 8-inch diameter pipelines.
  - Should SFPUC turnouts go offline, most of Zone SF2 has reduced fire flow capacity. As a result, West Yost recommends installing a pump at the Ayer Pump Station with a capacity of 4,000 gallons per minute (gpm).
  - The existing system is well equipped to handle a power outage or a VW supply outage. No additional significant impacts arise in either emergency scenario.
  - To evaluate system performance during a PRV outage, PRVs normally allowing flow from Zone 2 to Zone 1 were simulated to be disabled one at a time. The Sunnyhills and Parc Metro PRVs are the most critical, as outages at either of these PRVs results in new locations not meeting recommended fire flows. Recommended improvements include a new emergency PRV (EPRV), new pipelines, and pipeline upsizing.





Notes:
1. Pipeline improvements include new pipes and existing pipes upsized to address existing deficiencies.

Figure ES-2

Recommended Improvements for Existing Water System

City of Milpitas
2020 Water Master Plan

EVALUATION OF FUTURE WATER SYSTEM

The City's buildout water system was evaluated based on supply, storage, and pumping capacities, as well as its ability to meet recommended performance and operational criteria under various demand and emergency scenarios. At buildout, it is assumed that Curtis Well and McCandless Well would be available in emergencies. While the City does not currently anticipate any other major water system changes, buildout analyses assume that the infrastructure recommendations from the existing system evaluations have been implemented.

Below is a summary of findings and recommendations from the buildout system evaluation. Appendix G shows the locations of and provides details for each recommended improvement.

- Supply Capacity
  - Buildout firm supplies fall short of maximum day demands. The firm supply surplus in the SFPUC service area cannot make up for the deficit in the VW service area. Thus, West Yost recommends constructing a new VW turnout near the intersection of Piper Drive and Garden Street with the same capacity as the existing Gibraltar turnout.
- Storage Capacity
  - Buildout storage capacity is insufficient. The storage capacity surplus in the SFPUC service area cannot make up for the deficit in the VW service area. West Yost recommends constructing a new 2 MG storage reservoir in the VW service area.
  - To deliver water from this new storage reservoir, West Yost recommends constructing a new pump station with a firm capacity of 4,000 gpm.
- Pumping Capacity
  - Each pressure zone has a pumping capacity surplus. No additional pumping facilities are recommended to meet buildout demands.
- Distribution System
  - The buildout distribution system meets the minimum pressure criterion under a peak hour demand condition.
  - To address locations not meeting recommended fire flows, West Yost recommends installing a new EPRV near the intersection of Cedar Way and South Main Street. The Cedar EPRV would allow flows from Zone SF1 to Zone VW1 should pressures in Zone VW1 drop significantly.

ASSET RENEWAL AND REPLACEMENT

For assets in the City's water distribution system, West Yost performed a condition assessment that focused on risk, a combination of an asset's likelihood of failure and consequence of failure. Assets were then grouped according to three risk levels: A (Watch), B (Investigate), and C (Act). Level A is the initial action level, representing the point at which an asset or facility depicts aging or performance that requires increased attention, health checks, or predictive maintenance efforts. Assets in Level B should undergo detailed condition assessments, while assets in Level C are targets for renewal activities (e.g., inclusion in a mid-range capital improvement plan or more immediate design efforts).

Recommendations were identified based on asset classification and consist of both capital and non-capital projects. Capital projects include pipeline condition assessment, detailed facility condition assessment, and developing a water meter test program. Non-capital projects (i.e., operational improvement measures) include collecting asset performance data, developing a valve and hydrant exercising program, and reviewing the existing maintenance program to identify additional asset monitoring opportunities.

RECOMMENDED CAPITAL IMPROVEMENT PROGRAM

The recommended CIP for the City's existing and future water system includes recommendations from the existing system evaluation, the future system evaluation, the asset renewal and replacement study, and the AWIA risk and resilience assessment. Table ES-3 summarizes the proposed CIP phasing and cost. Improvements are grouped according to their "source" (e.g., Renewal and Replacement Study), and their costs are assigned to a five-year CIP period. The total CIP cost through 2051 is approximately $82.1 million (2020 dollars).

Table ES-3. Recommended Capital Improvement Program

Improvement	Capital Cost, $M[a,b]						
	2021-2025	2026-2030	2031-2035	2036-2040	2041-2045	2046-2051[c]	Total
Improvements from Renewal and Replacement Study (Chapter 10)							
Pipeline Condition Assessment	$0.5	-	-	-	-	-	$0.5
Detailed Facility Condition Assessment	$2.2	-	-	-	-	-	$2.2
Water Meter Test Program	$0.1	-	-	-	-	-	$0.1
Asset Renewal and Replacement	$17.1	$1.4	$1.6	$3.3	$17.0	$10.1	$50.5
Subtotal	$20.0	$1.4	$1.6	$3.3	$17.0	$10.1	$53.4
Improvements from Existing System Analysis (Chapter 8)							
Hammond EPRV and Corning Isolation Valve	$0.5	-	-	-	-	-	$0.5
Pipeline Improvements - Fire Flow	$5.6	-	-	-	-	-	$5.6
Fire Pump at Ayer Pump Station	-	$2.1	-	-	-	-	$2.1
Diel EPRV	-	$0.5	-	-	-	-	$0.5
Pipeline Improvements and New Pipelines - Fire Flow (Outage)	-	$0.2	-	-	-	-	$0.2
Backup Generators at Country Club and Tularcitos Pump Stations	-	$0.7	-	-	-	-	$0.7
Hydrant Service Pipeline Improvements	-	$0.4	-	-	-	-	$0.4
Subtotal	$6.1	$3.9	$0.0	$0.0	$0.0	$0.0	$9.9
Improvements from Future System Analysis (Chapter 9)							
Piper Turnout	-	-	-	$0.5	-	-	$0.5
VW Storage Reservoir	-	-	$5.5	-	-	-	$5.5
Pump Station for VW Storage Reservoir	-	-	$4.1	-	-	-	$4.1
Curtis Well	-	-	$6.0	-	-	-	$6.0
Cedar EPRV	-	-	$0.5	-	-	-	$0.5
Subtotal	$0.0	$0.0	$16.1	$0.5	$0.0	$0.0	$16.6
Improvements from Risk and Resilience Assessment[d]							
Perimeter Fencing	$0.030	-	-	-	-	-	$0.030
Site Security Protocols	$0.020	-	-	-	-	-	$0.020
Replace Isolation Valves	$2.0	-	-	-	-	-	$2.0
ShakeAlert Participation	$0.085	-	-	-	-	-	$0.085
Subtotal	$2.1	$0.0	$0.0	$0.0	$0.0	$0.0	$2.1
Total	**$28.2**	**$5.3**	**$17.7**	**$3.8**	**$17.0**	**$10.1**	**$82.1**

(a) Costs shown are in 2020 dollars and have been updated from those presented in the March 2021 Draft Water Master Plan to account for the recent bidding climate.

(b) Costs include mark-ups equal to 70 percent (Design and Construction Contingency: 35 percent; Engineering Design: 10 percent; Construction Management: 15 percent; and Permitting and Implementation: 10 percent).

(c) Includes forecasted renewal and replacement costs for the year 2051.

(d) Costs were only developed for four projects recommended in the Risk and Resilience Assessment.

CHAPTER 1
Introduction

1.1 WATER MASTER PLAN PURPOSE

The purpose of this Water Master Plan for the City of Milpitas (City) is to evaluate the existing system infrastructure and incorporate impacts of short-term and long-term planned growth to develop a comprehensive road map for the City's Water System Capital Improvement Program. The City's last Water Master Plan was completed in 2002 and was then updated in 2009 to incorporate an analysis of the impacts of the City's Milpitas Metro Specific Plan (then known as the Transit Area Specific Plan). The City is continuing to experience significant growth, recently completed an update to its General Plan and is currently in the process of updating two key specific plans, Milpitas Gateway-Main Street Specific Plan (formerly known as the Midtown Specific Plan) and Milpitas Metro Specific Plan.

Since the completion of the 2009 Water Master Plan Update, the State endured five years of drought starting in 2012, including the driest four consecutive years in California history (2012-2015). These unprecedented conditions led to statewide mandated water conservation, significant surface water supply reductions and curtailments, and legislation establishing new statewide water efficiency standards and contributing to new water use patterns and trends.

These factors make it critical to both reassess the City's water needs, priorities, and strategies and reevaluate water system infrastructure improvements, with a goal of ensuring a safe and reliable water supply for the City's residents and businesses.

1.2 WATER MASTER PLAN OBJECTIVES

The primary objectives of this Water Master Plan are to:

- Evaluate historical and existing water demands to understand current water use patterns, trends, and unit water use factors and develop future water demand projections based on the future planned development included in the City's General Plan Update
- Review and refine performance and planning criteria used to evaluate the water system and formulate recommendations for future facilities
- Perform a condition assessment of the City's water assets, including evaluating criticality and likelihood of failure, consequence of failure, and business risk exposure for horizontal assets (e.g., pipes, valves) and vertical assets (e.g., reservoirs, pump stations)
- Prepare a water utility asset renewal and replacement study to provide priorities for asset renewal and replacement
- Develop and calibrate the City's water system hydraulic model using InfoWater modeling software to provide an accurate tool for evaluating various water system scenarios
- Evaluate the need for new backbone water facilities (including pipelines, storage facilities and pumping facilities) to serve buildout of the City's General Plan (estimated by the year 2040)

- Evaluate existing and projected source capacity to ensure that adequate storage is provided throughout the City's water system to meet existing and future needs and requirements[1]
- Develop a capital improvement program for recommended potable water system facilities

1.3 PREVIOUS AND ON-GOING STUDIES

1.3.1 Previous Water Master Plans

The City's last Water Master Plan, the 2009 Water Master Plan Update (2009 Update, 2009 WMPU), was an update of the City's 2002 Water Master Plan (2002 Master Plan). The 2002 Master Plan defined the water system improvements necessary to meet the City's 2002 water demand and future demand associated with future development plans for 2008, 2018 and build-out year of 2021. The 2009 Update provided a re-evaluation of the City's water system capacity based on updated land use information from several near-term and long-term development projects, including the Transit Area Specific Plan, that were in the planning process at that time. The 2009 Update provided information required for the City's planning and financial efforts and defined the necessary water supply system improvements to accommodate the City's buildout land use.

The 2009 Update used baseline information, flow factors, and other information from the 2002 Master Plan and did not include any re-evaluation of flow factors or model calibration steps. Revised water demands were developed based on updated land use information and flow factors from the 2002 Master Plan. **In the 2009 Update, each water supply area (i.e., San Francisco Public Utilities Commission and Valley Water) was evaluated independently**. The demand conditions analyzed were peak hour demand and maximum day demand plus fire flow.

As noted above, this Water Master Plan provides a comprehensive review and evaluation of the City's existing and future water system needs through an independent evaluation in lieu of building on the 2002 Master Plan or the 2009 Update. The evaluation incorporates updates to unit water demand factors based on recent and projected water use trends and patterns to develop future demand projections, includes an update of the City's water system hydraulic model to evaluate system capacity, and reflects updates to future development plans to provide an updated and comprehensive review and evaluation of future water system needs. **Rather than evaluating each water supply area independently, this Water Master Plan better matches actual water system operations by evaluating them together as a single, citywide water system.**

1.3.2 Sewer and Storm Drain Master Plans

In parallel with this Water Master Plan, the City is also preparing a Sewer Master Plan (last updated in 2009) and a Storm Drain Master Plan (last updated in 2013). Unit water use factors, wastewater generation factors, and land use planning assumptions used in the new master plans have been coordinated for consistency as appropriate.

[1] Analyses from this Water Master Plan are referenced in the City's Source Capacity Planning Study (per Section 64558, Title 22, of the California Code of Regulations), which is being prepared as a separate deliverable.

1.3.3 City of Milpitas General Plan and Specific Plans

The City recently completed a General Plan Update which was adopted by City Council in March 2021. The City's previous General Plan was adopted in December 1994 and last amended in April 2015. The General Plan Update was a comprehensive effort to incorporate City growth and changes since 1994, as well as new laws passed, emerging social and environmental issues, and recently developed planning strategies and practices.

The City has two major development planning areas, the Milpitas Gateway-Main Street Specific Plan area (or Gateway-Main Street Area, formerly known as the Midtown Specific Plan area) and the Milpitas Metro Specific Plan area (or Metro Plan Area, formerly known as the Transit Area Specific Plan area). These areas have been in development over recent years, and development plans continue to be refined. Specific plans for both planning areas were last revised in 2010 (Gateway-Main Street Area, then known as Midtown) and 2011 (Metro Plan Area, then known as Transit Area) and are currently being updated to reflect current development opportunities and constraints.

Proposed future land use associated with the General Plan Update and updated Milpitas Gateway-Main Street and Milpitas Metro Specific Plans has been incorporated into this Water Master Plan and is discussed further in Chapter 2.

1.3.4 Urban Water Management Plan

As an urban water supplier in California, the City is required to prepare and adopt an Urban Water Management Plan (UWMP) every five years. The City's 2015 UWMP was adopted in June 2016, and the City's 2020 UWMP was adopted in June 2021. The purpose of the UWMP is to evaluate the availability and reliability of the City's water supplies to meet projected future water demands over the next 20 years under various hydrologic conditions, while the purpose of the Water Master Plan is to evaluate and identify the needed water system infrastructure improvements to meet projected future water demands. At the time of preparation of this Water Master Plan, the 2020 UWMP was not yet prepared. However, assumptions used for this Water Master Plan and the 2020 UWMP were consistent with regard to future planned development within the City's service area.

1.3.5 Emergency Response Plan

Also, in conjunction with this Water Master Plan, the City's Emergency Response Plan, last updated in 2010, is being updated to reflect current conditions and comply with requirements of America's Water Infrastructure Act of 2018 (AWIA). AWIA requires the City's completion of a water system Risk and Resilience Assessment (RRA) by December 31, 2020 and an updated Emergency Response Plan (ERP) by June 30, 2021. The City's RRA and ERP are prepared as separate deliverables.

1.4 REPORT ORGANIZATION

This Water Master Plan is organized into the following chapters:

Chapter 1: Introduction	Describes the purpose and objectives for the Water Master Plan, its relationship to other on-going studies, report organization and acknowledgments
Chapter 2: Water Service Area and Land Use	Describes the City's existing water service area and land uses as well as projected future land uses based on information provided by the City Planning Department on planned future development
Chapter 3: Existing Water System Facilities	Provides background information on the City's existing water system (including pressure zones, supply turnouts, groundwater wells and emergency interties) and distribution system facilities (including storage reservoirs, pump stations, pipelines, pressure reducing valves and isolation valves)
Chapter 4: Water Supply Sources	Provides an overview of the City's available water supplies, including supplies from the San Francisco Public Utilities Commission, Valley Water, City groundwater wells, and recycled water provided by South Bay Water Recycling
Chapter 5: Water Demand	Presents historical, current and projected future water demands based on the planned future development described in Chapter 2
Chapter 6: Hydraulic Model Update and Calibration	Describes the update and calibration of the City's water distribution system hydraulic model used to analyze the City distribution system performance
Chapter 7: System Planning and Performance Criteria	Defines the recommended planning and performance criteria for the City water system, including supply, storage and pumping capacity, fire flow requirements, minimum and maximum system pressures, and maximum pipeline velocity and head loss
Chapter 8: Evaluation of Existing Water System	Describes the evaluation of the City's existing water system in comparison to the criteria developed in Chapter 7 and provides recommendations for existing system improvements
Chapter 9: Evaluation of Future Water System	Describes the evaluation of the City's water system and its ability to meet projected future water demands in comparison to the criteria developed in Chapter 7 and provides recommendations for future system improvements
Chapter 10: Asset Renewal and Replacement	Presents a summary of the findings of Water Utility Condition Assessment included in Appendix D and provides a discussion of risk management guidelines and asset profiling and recommends projects and activities to manage infrastructure risk

Chapter 11: Recommended Capital Improvement Program	Based on the evaluations described in Chapters 8, 9 and 10, provides a detailed summary of recommended capital improvements for the City's water system to meet existing and projected future demands, along with estimated construction costs
Chapter 12: References	Lists reference documents used in the preparation of this Water Master Plan

The following appendices to this Water Master Plan contain additional technical information, assumptions and calculations:

Appendix A: Water System Schematic Profile	Provides a schematic profile of the City's existing water system as referenced in Chapter 3
Appendix B: System Operations Narratives	Includes system narratives referenced in Chapter 3 describing normal and emergency operations protocols as prepared by Glen Campi, Public Works Maintenance Manager for Utilities
Appendix C: Hydrant Testing and HPR Placement Plan	Outlines the hydrant testing that was performed in March 2020 and the associated collection of water distribution system pressure data using hydrant pressure recorders needed to calibrate the City's water system hydraulic model as described in Chapter 6
Appendix D: Water Utility Condition Assessment	Provides the Water Utility Condition Assessment performed for the City's water system and referenced in Chapter 10; includes assessment methodologies, asset valuations, likelihood and consequence of failure factors and risk scores
Appendix E: Seismic Risk Assessment	Provides the Seismic Risk Assessment performed as part of the City's RRA and referenced in Chapter 10; includes an estimate of the consequences associated with an earthquake event affecting the City water system
Appendix F: Water Utility Financial Plan	Presents the water financial plan prepared by Raftelis which evaluates water utility revenues and expenditure forecasts for the study period from FY 2022 through FY 2040 as described in Chapter 11
Appendix G: Capital Improvement Program Mapbook and Project Summary Sheets	Provides figures showing the location of recommended water system improvements and, for some larger projects (e.g., EPRVs and new Ayer pump), single-page project summaries as referenced in Chapter 11

As noted above, the City's RRA and ERP are prepared as separate deliverables.

1.5 ACKNOWLEDGMENTS

The development of this Water Master Plan would not have been possible without the focused involvement and assistance of City staff. In particular, the following staff provided comprehensive information, significant input and important insights throughout development of this Water Master Plan:

Tony Ndah, Public Works Director

Harris Siddiqui, Principal Engineer (Project Manager for the Water Master Plan)

Glen Campi, Public Works Maintenance Manager for Utilities

Sophia Wendt, Assistant Engineer

Ned Thomas, Planning Director

Jessica Garner, Planning Manager

Kevin Riley, Milpitas Metro Specific Plan Manager

CHAPTER 2
Water Service Area and Land Use

This chapter describes the City's existing water service area and existing and future land uses. Future land use designations are based on discussions with the City Planning Department and City-provided data, reports, and maps.

2.1 WATER SERVICE AREA

2.1.1 Location and Description

Located in Santa Clara County, the City is bordered by the City of Fremont to the north and the City of San Jose to the south. Major transportation corridors connecting to the City include Highway 237, Interstate 880 (I-880), I-680, and Montague Expressway. The City is currently served by Valley Transit Authority (VTA) light rail and, as of June 2020, Bay Area Rapid Transit (BART).

As shown on Figure 2-1, the City's water service area is supplied by the San Francisco Public Utilities Commission (SFPUC) and Valley Water (VW, formerly known as the Santa Clara Valley Water District)[2]. The overall water service area is approximately 12 square miles and is generally coincident with City limits, except for some areas in the Calaveras Hills along the City's eastern edge. The City can be divided into two distinct topographical areas: the relatively flat "valley floor" on the western side and the steeper "hillside" area within the Calaveras Hills. Service elevations within the City range from near sea level in the west to almost 900 feet above mean sea level (msl) in the east.

Within its limits, the City has authority over land use and is responsible for providing public services. Figure 2-1 also shows the City's Urban Growth Boundary, the result of a voter-approved initiative that restricts development and the extension of public services and infrastructure in the eastern hill areas. In November 2016, the City voted to extend this development moratorium to December 31, 2038.

One exception to the moratorium is the Spring Valley Heights community, which is located outside the Urban Growth Boundary but served by City infrastructure. In 2005, after its groundwater supply became inadequate, the Spring Valley Heights community entered into an agreement with the City to receive potable water from its SFPUC service area. The Spring Valley Heights Association's private water system (CA Water System No. CA4300856) connects to the City's municipal supply through a master meter and is operated by the Spring Valley Heights Mutual Water Company.

2.1.2 Population Served and Service Connections

The City was incorporated in 1954, then spanning approximately 3 square miles with a population of 825. Manufacturing, assembly, and high-tech industries have since spurred steady expansion and population growth. The California Department of Finance estimates the City's January 1, 2020 population at 77,961, which this report will use as the "existing" population for 2019. Historical population is detailed in Chapter 5 of this report.

The City has nine customer billing codes, which West Yost has organized into three categories (residential, commercial, and public) and up to three connection types (water, fire, and irrigation). Table 2-1 presents a summary of historical potable water service connections by customer and connection type. Service connection counts are based on bimonthly billing data from 2013 through 2019 provided by the City in January 2020. In calendar year (CY) 2019, the City had 16,394 metered water service connections. Almost 89 percent of connections were residential, which includes multi-family connections. Note, one multi-family connection can serve as little as two or as many as hundreds of units.

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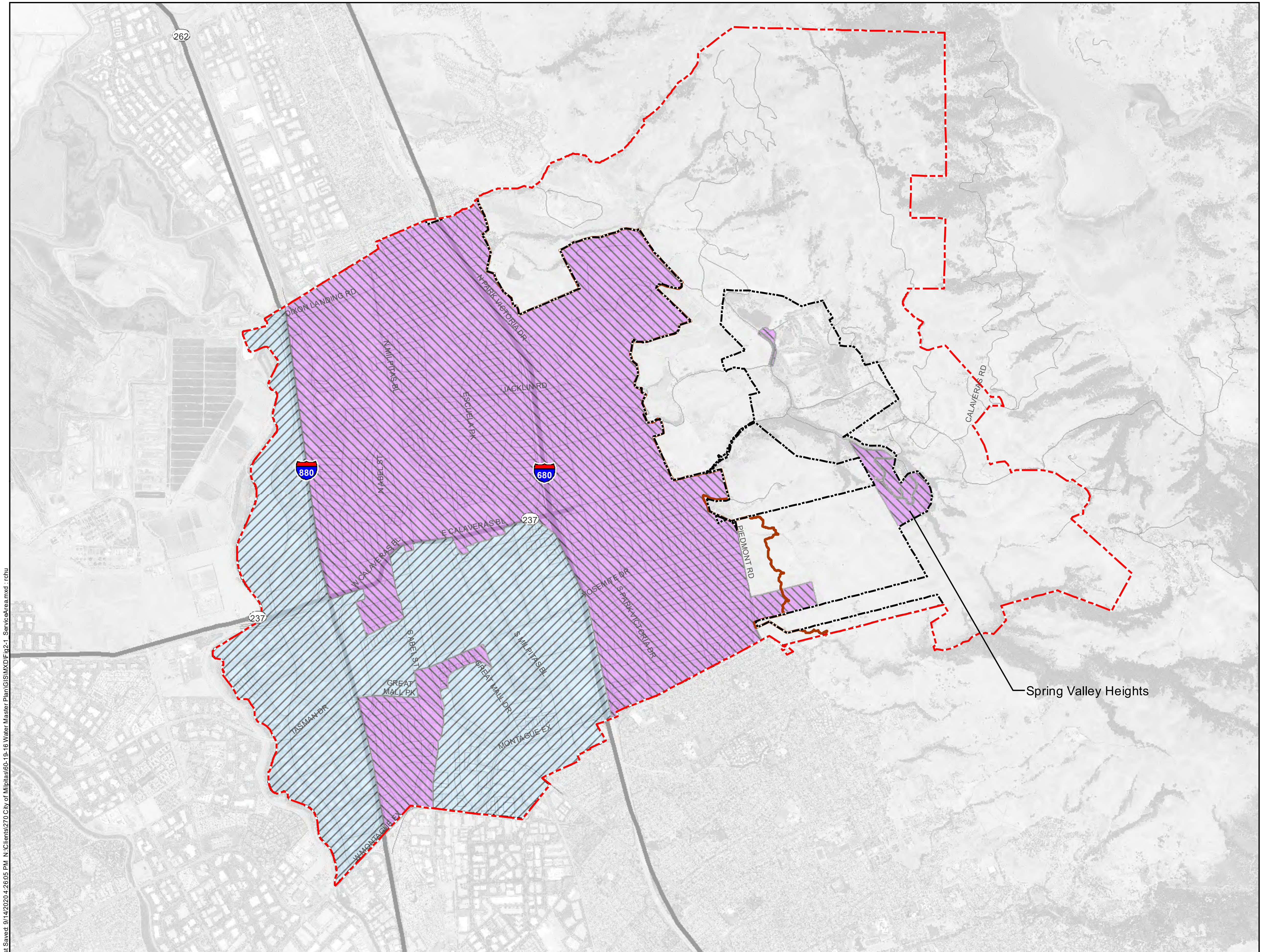
[2] In 2019, the Santa Clara Valley Water District (SCVWD) changed its name to Valley Water (VW).



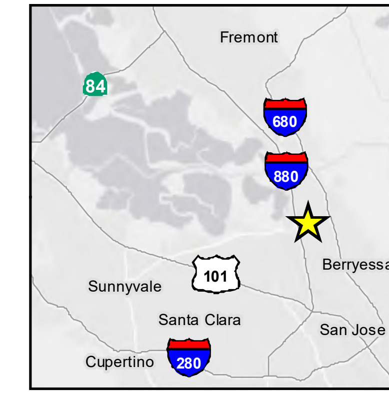


Figure 2-1

Existing Water Service Area

City of Milpitas
2020 Water Master Plan

Table 2-1. Historical Water Service Connections[a, b]

Customer Type	Billing Code	CY 2013 Number of Connections	CY 2013 Percent of Total	CY 2014 Number of Connections	CY 2014 Percent of Total	CY 2015 Number of Connections	CY 2015 Percent of Total	CY 2016 Number of Connections	CY 2016 Percent of Total	CY 2017 Number of Connections	CY 2017 Percent of Total	CY 2018 Number of Connections	CY 2018 Percent of Total	CY 2019 Number of Connections	CY 2019 Percent of Total
Residential															
Water	WRES	14,197	86.6%	14,244	86.8%	14,257	86.9%	14,259	87.0%	14,264	87.1%	14,280	87.2%	14,287	87.1%
Fire	FRES	108	0.7%	109	0.7%	109	0.7%	110	0.7%	110	0.7%	110	0.7%	110	0.7%
Irrigation	IRP	119	0.7%	120	0.7%	120	0.7%	120	0.7%	119	0.7%	121	0.7%	124	0.8%
Subtotal Residential		14,424	88.0%	14,473	88.2%	14,486	88.3%	14,489	88.4%	14,493	88.5%	14,511	88.6%	14,521	88.6%
Commercial															
Water	WCOMM	974	5.9%	963	5.9%	958	5.8%	954	5.8%	940	5.7%	938	5.7%	943	5.8%
Fire	FAO	462	2.8%	455	2.8%	446	2.7%	444	2.7%	438	2.7%	436	2.7%	449	2.7%
Irrigation	IP	351	2.1%	346	2.1%	341	2.1%	331	2.0%	326	2.0%	320	2.0%	312	1.9%
Subtotal Commercial		1,787	10.9%	1,764	10.7%	1,745	10.6%	1,729	10.5%	1,704	10.4%	1,694	10.3%	1,704	10.4%
Public															
Water - City	WCITY	44	0.3%	44	0.3%	44	0.3%	44	0.3%	45	0.3%	45	0.3%	46	0.3%
Water - County	WSCC	1	0.0%	1	0.0%	1	0.0%	1	0.0%	1	0.0%	1	0.0%	1	0.0%
Irrigation - City	ICP	130	0.8%	128	0.8%	129	0.8%	129	0.8%	129	0.8%	123	0.8%	122	0.7%
Subtotal Public		175	1.1%	173	1.1%	174	1.1%	174	1.1%	175	1.1%	169	1.0%	169	1.0%
Total		**16,386**	**100.0%**	**16,410**	**100.0%**	**16,405**	**100.0%**	**16,392**	**100.0%**	**16,372**	**100.0%**	**16,374**	**100.0%**	**16,394**	100.0%

(a) Source: Billing data provided by City in January 2020.
(b) Includes potable water service connections only. Recycled water connections are excluded.

2.2 EXISTING LAND USE

Most of the City's existing land use is single family residential, which is located primarily in the north and east. Industrial and commercial land uses comprise much of the City's southern and western regions. Figure 2-2 shows the City's existing land use, while Table 2-2 summarizes key land use statistics.

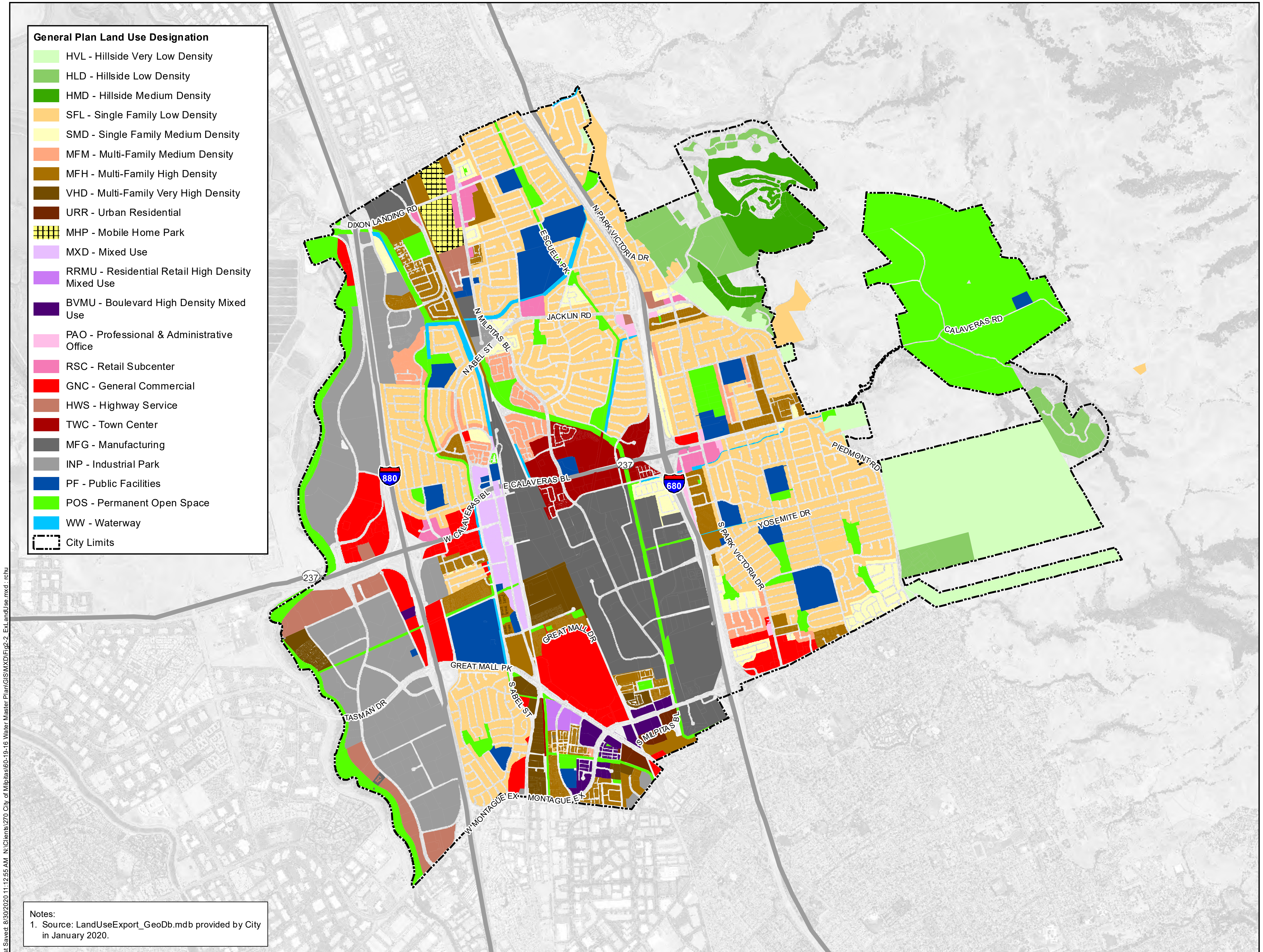
Table 2-2. Existing Land Use[(a)]

Population[(b)]	Dwelling Units	Non-Residential Square Footage	Jobs[(c)]	Jobs per Housing Unit[(d)]
77,961	22,215	28,007,888	53,000	2.39

(a) Unless otherwise noted, data is from the Draft Environmental Impact Report - Milpitas General Plan, Table 2.0-3, received January 2020.
(b) Source: CA Department of Finance, E-1 Population Estimates (May 1, 2020).
(c) Source: Estimate provided by the City in February 2021.
(d) Calculated based on dwelling units and jobs estimate.

The City classifies customers (excluding hotels and schools) using at least 30,000 gallons per day (gpd) as Large Water Users. To update the list of Large Water Users, West Yost reviewed City-provided billing data[3] from 2013 through 2019. Users were identified according to the "LOCATION_NO" field provided in billing records. In general, each "LOCATION_NO" corresponds to a single water meter. In CY 2019, there were 19 Large Water Users; they are ranked in Table 2-3.

[3] Billing data was bimonthly. Usage was grouped into calendar years based on the ending date of the billing period. As a result, annual consumption may not match other sources.



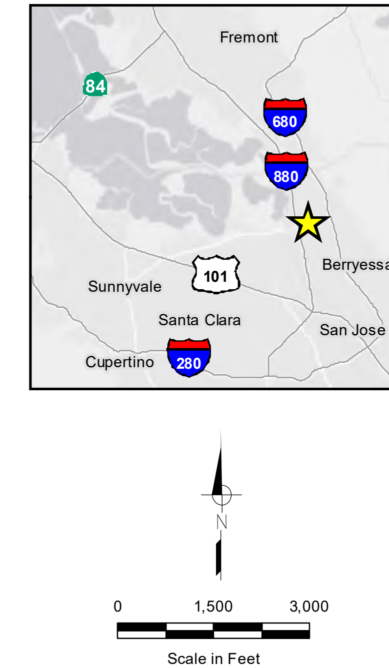


Figure 2-2

Existing Land Use

City of Milpitas
2020 Water Master Plan

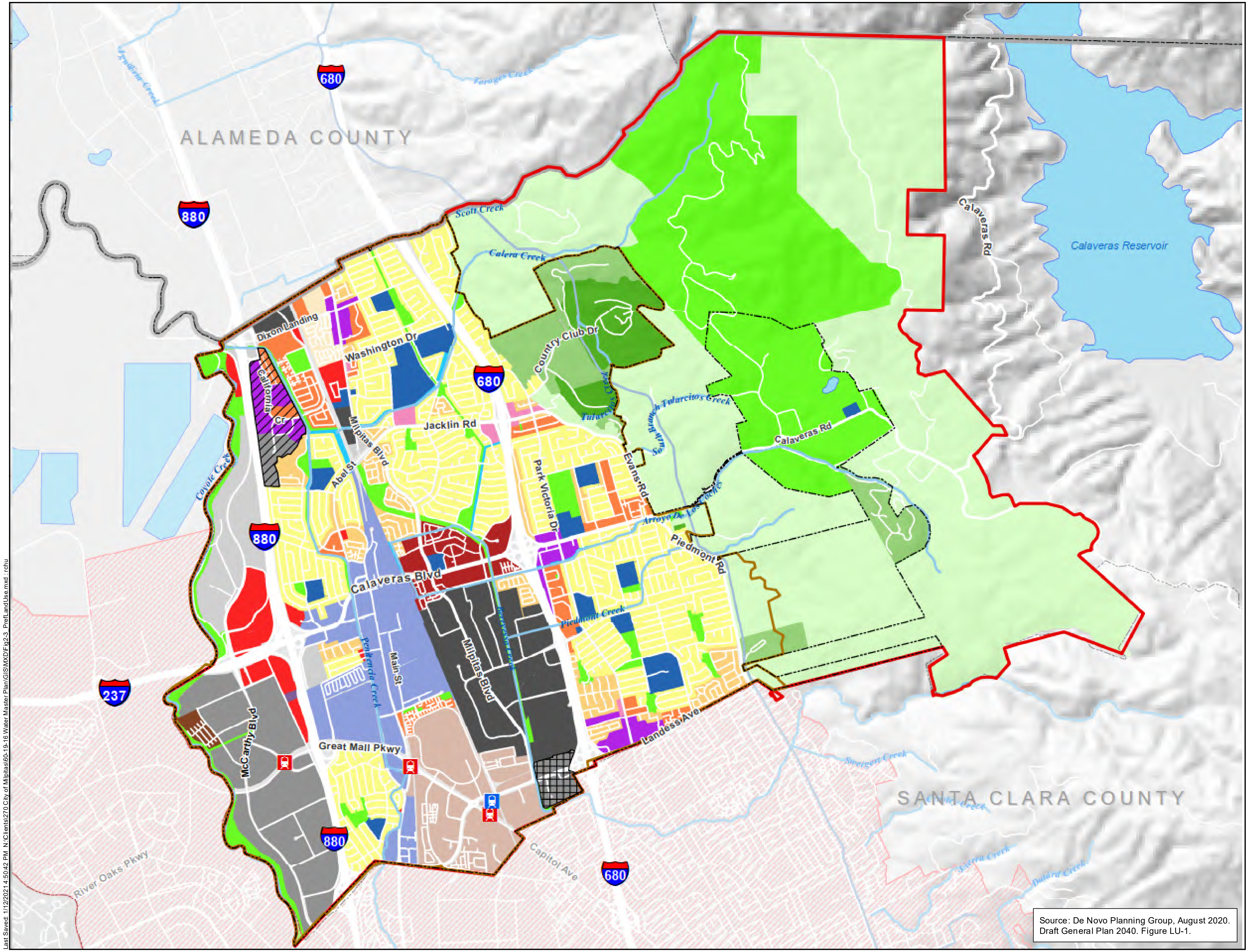
Rank	Location ID[b]	Customer	CY 2019 Consumption, gpd
1	3015659	Linear Technology	179,606
2	3015510	Evoqua Water Technologies LLC	177,956
3	3014575	SCC GSA Fiscal Bldg3	110,257
4	3015655	Headway Technologies Inc	92,605
5	3016862	Essex Management Corporation	92,074
6	3014546	Milpitas Mills LP	77,853
7	3015553	T Marzetti Company-West	73,949
8	3014577	SCC GSA Fiscal Bldg3	49,960
9	3014598	Milpitas Housing Assoc	47,336
10	3013322	City of Milpitas	39,712
11	3015908	Jefferson Smurfit Corp #200585	39,378
12	3015754	Fairfield Murphy Road LLC	38,397
13	3016857	Cisco Systems	35,091
14	3001280	Evoqua Water Technologies LLC	34,175
15	3015508	555 Apartments LLC	33,945
16	3010133	Spinnaker Pointe LLC	32,972
17	3003005	Spring Valley Apartments	31,851
18	3017196	Corwil Technology	31,291
19	3001229	KLA-Tencor	29,969
		Total	**1,248,376**

Table 2-3. Large Water Users[a]

(a) Customer meters using at least 30,000 gpd based on City-provided billing data in January 2020. Large water users were identified based on the "LOCATION_NO" field in City billing records. Each "LOCATION_NO" generally corresponds to a single water meter.
(b) "LOCATION_NO" from City billing data.

As part of the General Plan Update, De Novo Planning Group authored a Land Use Alternatives Report (LUA Report), which evaluates locations throughout the City that can "accommodate future growth, support economic development, maintain fiscal sustainability, and ensure adequate protection of natural resources and open space" (LUA Report). These "Opportunity Areas" are shown on Figure 2-4 of this report, which is adapted from Figure 2-2 of the LUA Report.

West Yost coordinated with the City's Planning Department and HydroScience Engineers, Inc. (HydroScience), who is developing the City's Sewer Master Plan, to develop land use planning assumptions for future residential dwelling units and non-residential square footage for use in the Water and Sewer Master Plans. Table 2-4 summarizes the buildout land use assumptions used in this report. In addition to assigning a preferred land use designation to each Opportunity Area, Table 2-4 breaks down the proposed Milpitas Gateway-Main Street Specific Plan (Gateway Specific Plan) and Milpitas Metro Specific Plan areas into specific land use components. For the purposes of developing and analyzing future system facility and capacity needs, the proposed residential developments have been assigned a range of potential new dwelling units based on coordination with the City's Planning Department.

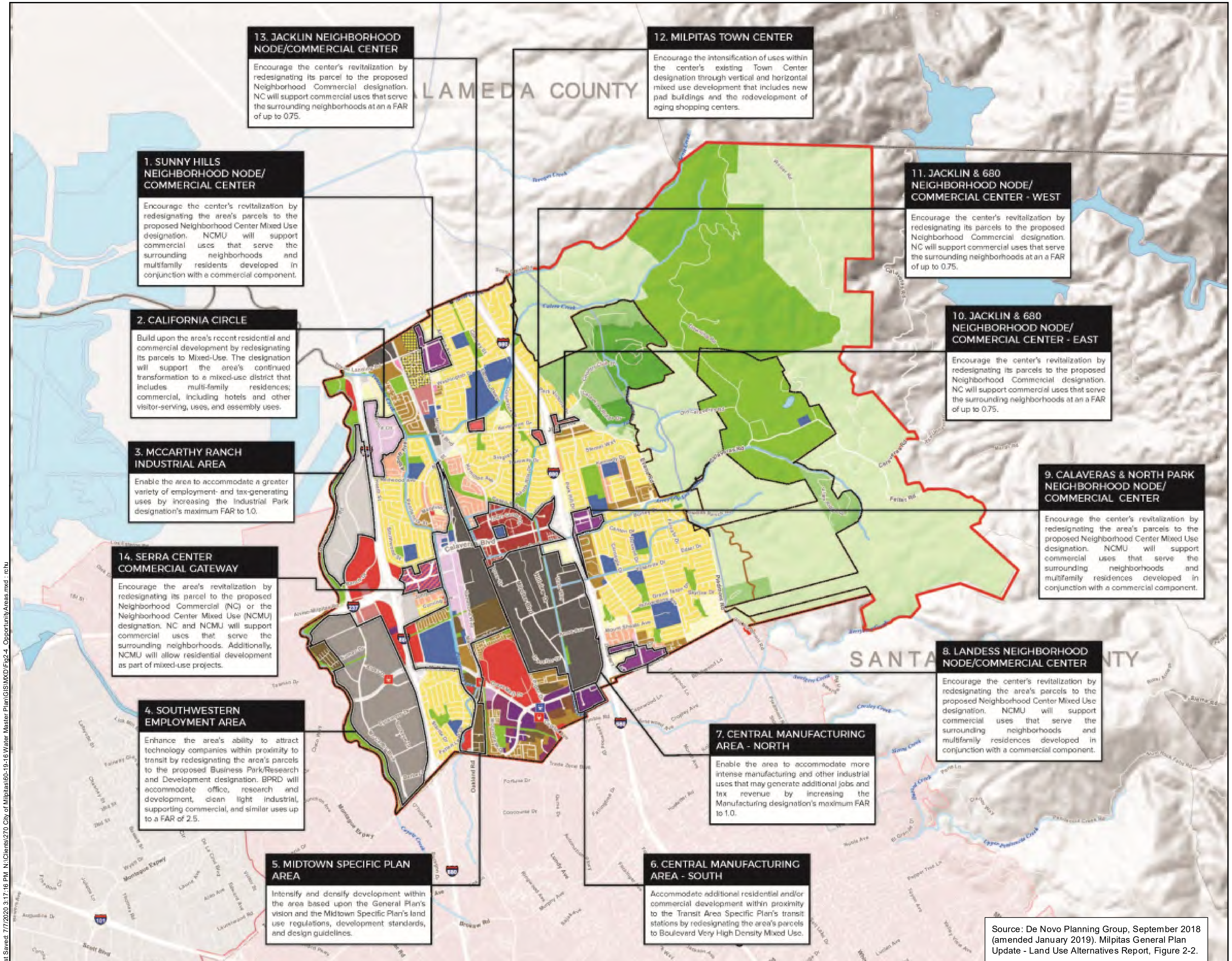


Source: De Novo Planning Group, August 2020. Draft General Plan 2040. Figure LU-1.

Figure 2-3

Preferred Land Use

City of Milpitas
2020 Water Master Plan



Legend

- HVL - Hillside Very Low Density
- HLD - Hillside Low Density
- HMD - Hillside Medium Density
- SFL - Single Family Low Density
- SMD - Single Family Medium Density
- MFM - Multi-Family Medium Density
- MFH - Multi-Family High Density
- VHD - Multi-Family Very High Denisty
- URR - Urban Residential
- MHP - Mobile Home Park
- MXD - Mixed Use
- RRMU - Residential Retail High Density Mixed Use
- BVMU - Boulevard Very High Density Mixed Use
- NCMU - Neighborhood Commercial Mixed Use*
- HDTOR - High Density Transit Oriented
- PAO - Professional & Administrative Office
- RSC - Retail Subscenter
- GNC - General Commercial
- NC - Neighborhood Commercial*
- HWS - Highway Service
- TWC - Town Center
- INP - Industrial Park
- BPRD - Business Park/Reseach & Development*
- MFG - Manufacturing
- PF - Public Facilities
- POS - Permanent Open Space
- WW - Waterway

Planning Areas

- City of Milpitas
- Milpitas Sphere of Influence
- Milpitas Urban Service Area
- San Jose Planning Limits of Urban Growth
- County Boundary

Transit Stations

- BART Station
- VTA Station

* Proposed Land Use Designation

Figure 2-4

Opportunity Areas

City of Milpitas
2020 Water Master Plan

Table 2-4. Potential New Growth at Buildout[(a)]

Development	Land Use Designation[(b)]	Total Acres	Range of Potential New Dwelling Units		New Non-Residential Building Square Footage
			Low	High	
Opportunity Areas - Residential					
Sunny Hills Neighborhood Node/Commercial Center	NCMU	19.92	275	350	569,573
California Circle	NCMU	54.10	248	360	551,816
California Circle	HDR	18.26	252	365	551,816
Landess Neighborhood Node/Commercial Center	NCMU	38.03	450	625	521,274
Calaveras & North Park Neighborhood Node/Commercial Center	NCMU	28.28	325	425	416,836
Milpitas Town Center	HDR[(c)]	38.07	400	525	434,872
	Subtotal	196.66	1,950	2,650	3,046,187
Opportunity Areas - Non-Residential					
McCarthy Ranch Industrial Area	INP	192.29	-	-	3,049,301
Southwestern Employment Area	BPRD	488.26	-	-	5,126,097
Central Manufacturing Area - North	MFG	492.14	-	-	2,602,882
Jacklin & 680 Neighborhood Node/Commercial Center - East	NC	7.95	-	-	152,321
Jacklin & 680 Neighborhood Node/Commercial Center - West	NC	6.42	-	-	75,502
Jacklin Neighborhood Node/Commercial Center	NC	9.79	-	-	99,629
	Subtotal	1,196.85	-	-	11,105,732
Milpitas Gateway-Main Street Specific Plan					
HDR Subset of Gateway-Main Street	HDR[(c)]	46.70	478	637	-
VHDR Subset of Gateway-Main Street	VHDR[(e)]	74.58	781	1,041	-
MDR Subset of Gateway-Main Street	MDR[(f)]	62.70	242	322	483,391
Non-Residential Subset of Gateway-Main Street	MFG[(g)]	300.30	-	-	954,012
	Subtotal	484.28	1,500	2,000	1,437,403
Milpitas Metro Specific Plan					
VHDR Subset of Metro Plan Area	VHDR	99.00	2,000	4,000	-
HDR Subset of Metro Plan Area	HDR	113.52	3,000	3,000	-
NC Subset of Metro Plan Area[(h)]	NC	85.35	-	-	2,087,075
	Subtotal	297.87	5,000	7,000	2,087,075
	Total	**2,176**	**8,450**	**11,650**	**17,676,397**

(a) Source: City of Milpitas - Buildout Land Use Condition Assumptions, HydroScience Engineers, August 3, 2020.

(b) Land Use Designations based on Preferred Land Use Map (PLUM), Figure 2-3.

(c) Originally Multifamily High Density (MFH), which has been renamed High Density Residential (HDR) in the PLUM.

(d) Originally Boulevard Very High Density Mixed Use (BVMU), which has been renamed Very High Density Mixed Use (VHDMU) in the PLUM.

(e) Originally Multi-Family Very High Density (VHD), which has been renamed Very High Density Residential (VHDR) in the PLUM.

(f) Originally Mixed Use (MXD), which has been retired in the PLUM. This subset has been recategorized as Medium Density Residential (MDR) based on housing density. MDR is the updated name for Multi-Family Medium Density (MFM).

(g) Originally multiple land uses, Manufacturing (MFG) selected because it is the most conservative (i.e., highest water use).

(h) Includes the "Central Manufacturing Area - South" Opportunity Area, which has been combined with MMSP.

To remain conservative, this Master Plan assumes the high end of the dwelling unit range will be constructed. In addition, this Master Plan assumes areas listed in Table 2-4 represent new development and not replacing existing developed areas. As detailed in Section 5.3.3 of this report, this means that water demands from growth areas will be in addition to (and not replacing) any existing water demands in those areas. Lastly, land use assumptions in Table 2-4 are preliminary and will be refined as future updates are made to the City's future development plans.

2.2.1 Specific Plans

Specific Plan areas, including the Milpitas Metro Specific Plan (formerly the Transit Area Specific Plan or TASP) and the Milpitas Gateway-Main Street Specific Plan (formerly the Midtown Specific Plan or MSP), are designated by the General Plan Land Use Map (see Figure 2-3). These areas have been designated as Special Planning Areas and each has an adopted or soon to be updated Specific Plan to facilitate comprehensive planning of the large strategic areas. The City is planning significant redevelopment in these Specific Plan areas, each of which had previously completed Specific Plans that are currently being updated.

The following subsections detail land use objectives for each area, based on discussions with the City Planning staff.

2.2.1.1 Milpitas Gateway-Main Street Specific Plan (Gateway Specific Plan)

Originally known as the Midtown Area, the Gateway-Main Street Area has an existing Specific Plan (Midtown Specific Plan, adopted by the City in March 2002) that was last updated in 2010. The Gateway-Main Street Area spans 589 acres and is set between I-880, I-680, Calaveras Boulevard, and the Montague Expressway in the western portion of the City. Per the 2010 plan, the overall strategy for the area is to create a mixed-use community with high-density, transit-oriented housing, a central gathering place, and necessary industrial, service, and commercial uses. Significant development has already occurred within the Gateway-Main Street Area, including new housing units and reinvestment in the Great Mall (which is outside the Gateway-Main Street Area but encompasses its vision) to expand entertainment activities.

While the City is currently updating the Milpitas Gateway-Main Street Specific Plan (henceforth known as the Gateway Specific Plan), the overall strategy is expected to remain generally the same.

As shown in Table 2-4, preliminary projections estimate an additional 1,500 to 2,000 residential dwelling units and approximately 1.4 million square feet of non-residential development at buildout within the Gateway-Main Street Area. These projections are subject to change as the Gateway Specific Plan is updated.

2.2.1.2 Milpitas Metro Specific Plan

The City adopted the current Milpitas Metro Specific Plan (then known as Transit Area Specific Plan) in June 2008, amending it in December 2011. The Metro Plan Area spans approximately 370 acres in southern Milpitas and includes two light rail stations, the new BART station, and the Great Mall. While the Metro Plan Area is within the area covered by the Gateway Specific Plan (except for a 40-acre area between Piper Drive and Milpitas Boulevard and the Great Mall, which was already outside the Gateway-Main Street Area), the Gateway Specific Plan called for the creation of a separate, detailed plan for the area near the BART station.

The Milpitas Metro Specific Plan fulfills that requirement and is independent of the Gateway Specific Plan. Currently an older industrial area in the City, the Metro Plan Area is re-envisioned in the Milpitas Metro Specific Plan as a high-density, mixed use neighborhood that encourages walking, biking, and use of public transit. The Milpitas Metro Specific Plan is currently being updated and is expected to maintain this Metro Plan Area vision.

As shown in Table 2-4, preliminary projections estimate an additional 5,000 to 7,000 residential dwelling units, approximately 2.1 million square feet of commercial development within the Milpitas Metro Specific Plan area. These projections are subject to change as the Milpitas Metro Specific Plan is updated.

CHAPTER 3
Existing Water System Facilities

This chapter provides a summary of the City's existing key water facilities, which are shown on Figure 3-1. To provide context and understanding of the City's water system, a summary of the current water system configuration and pressure zones is provided before detailing the City's water supply and distribution facilities.

3.1 EXISTING WATER SYSTEM CONFIGURATION, OPERATIONS, AND PRESSURE ZONES

As described further in Chapter 4, the City receives water supplies from SFPUC and VW. Under normal conditions, the City operates its potable water system such that the SFPUC and VW supplies remain separate. Isolation valves prevent mixing and create two distinct water service areas. The SFPUC service area includes the City's valley floor and hillside areas, while the VW service area only encompasses the City's valley floor area. Under emergency conditions (e.g., a loss of supply from either SFPUC or VW), the City can open isolation valves that normally separate the SFPUC and VW service areas to move water between the service areas (see further discussion in Section 3.3.4).

The City's valley floor area is generally served directly from SFPUC or VW turnouts, with pressure reducing valves (PRVs) reducing pressures for lower elevation customers. Storage reservoirs and their associated pump stations in the valley floor area help supply peak demands and meet emergency conditions. Additional pump stations deliver water from the valley floor area to the hillside areas and are operated based on hillside storage reservoir levels. A water system schematic profile is provided in Appendix A, along with a detailed operations narrative in Appendix B.

There are six main pressure zones within the City's water service area, four served by the SFPUC (Zones SF1 through SF4), and two served by VW (Zones VW1 and VW2)[4]. Water purchased from SFPUC enters the distribution system through Zone SF2 (directly) or Zone SF1 (via PRV). Zones SF3 and SF4, in the hillside areas, are supplied water from Zone SF2 through a pump station. Significant elevation differences in Zone SF4 require reducing pressures for the lower portions of the zone. As a result, Zone SF4 is split into two subzones: Zone SF4-2 (unregulated) and Zone SF4-1 (regulated via three PRVs).

VW water is regulated through a PRV before entering Zone VW2 and through additional PRVs into Zone VW1. The key characteristics of each pressure zone are summarized in Table 3-1.

[4] Note that the pressure zone designations have been renamed based on the Santa Clara Valley Water District agency name change to Valley Water. Zones VW1 and VW2 were previously known as SC1 and SC2, respectively. The rest of this Water Master Plan will use these updated pressure zone designations.

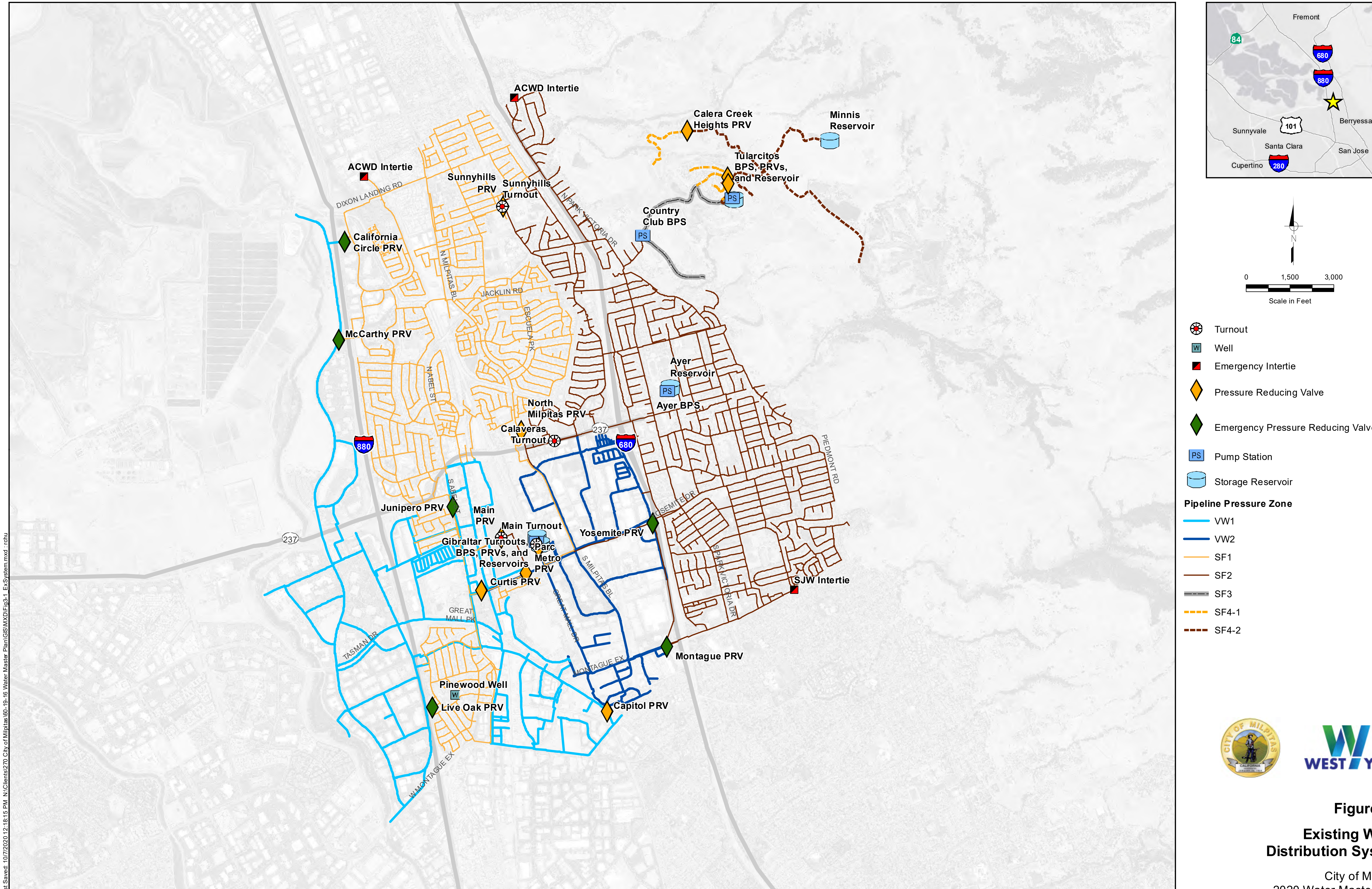


Figure 3-1

Existing Water Distribution System

City of Milpitas
2020 Water Master Plan

Table 3-1. Existing Pressure Zones

Pressure Zone	Range of Service Elevations[a], feet msl	Nominal HGL[b], feet msl	Static Service Pressure[c], psi	Water Supply Source(s)
SF1	10 – 112	200	38 - 82	Intertie Turnout via the Gibraltar Pump Station (PS) and Zone SF2 via PRVs (Main, North Milpitas, and Sunnyhills)
SF2	17 – 212	340	55 - 140	SFPUC BDPL No. 3 & 4 Turnouts (Sunnyhills, Calaveras, and Main Street)
SF3	233 – 456	545	38 - 135	Zone SF2 via Country Club PS and Tularcitos Tank
SF4-1[d]	477 – 638	740	44 - 114	Tularcitos Tank, PS, and PRVs; Minnis Tank via Zone SF4-2 and Calera Creek Heights PRV
SF4-2[d]	493 – 715	885	74 - 170	Minnis Tank (filled by Tularcitos PS)
VW1	11 – 54	200	63 - 82	Zone VW2 via Capitol, Curtis (East and West), and Parc Metro PRVs
VW2	22 – 75	325	108 - 131	VW Milpitas Pipeline Gibraltar Turnout and Gibraltar PRV

(a) Source: Valley Water LiDAR contours covering the City water service area.
(b) Source: City of Milpitas Water Distribution System Plan Schematic Profile (HydroScience Engineers) unless otherwise noted.
(c) Calculated by subtracting the highest or lowest customer service elevations within the zone from the HGL, and converting from pressure head in feet, to pressure in psi.
(d) Elevation differences in Zone SF4 require breaking pressure and splitting the zone into Zones SF4-1 and SF4-2. Zone SF4-2 is unregulated, while Zone SF4-1 is regulated by the Tularcitos North, Tularcitos South, and Calera Creek Heights PRVs.

3.2 EXISTING SUPPLY FACILITIES

The City's existing supply facilities include the following:

- Five turnouts
- One emergency groundwater well
- Three emergency interties

Normally, the City obtains all of its potable water from SFPUC and VW turnouts. However, in emergencies, it can also pump groundwater and receive water from San Jose Water (SJW) and the Alameda County Water District (ACWD) through emergency interties shown on Figure 3-1.

3.2.1 Turnouts

The City receives wholesale potable water through five turnouts, four from SFPUC Bay Division Pipelines Nos. 3 and 4, and one from VW's Milpitas Pipeline[5]. Under normal operations, water from these turnouts comprises the City's entire potable water supply. Total SFPUC turnout capacity is approximately 37 million gallons per day (mgd), while VW turnout capacity is 14.4 mgd. The SFPUC supply enters the City's system at a hydraulic grade line (HGL) of 340 feet, while VW supply enters the City's system at an HGL of 425 feet. The source, location, pressure zone(s) served, and capacity for each turnout is summarized in Table 3-2.

Table 3-2. Existing Turnouts

Name	Location	Meter Type	Meter ID(s)	Pressure Zone(s) Served	Capacity, mgd[(a)]
SFPUC Service Area					
Sunnyhills	405 Washington Drive	2-8" Neptune High Performance Turbo	4572810858 4572810888	SF1, SF2	10.1
Calaveras	584 East Calaveras Blvd.	2-8" Neptune High Performance Turbo	5000000628 5000000975	SF1, SF2	13.0
Main	534 Hammond Way	1-8" and 1-6" Neptune High Performance Turbo	9338710434 9338710803	SF1, SF2	7.9
Intertie	641 Gibraltar Court	1-10" Neptune High Performance Turbo	3117952820	SF1[(b)]	5.8
				SFPUC Total	**36.8**
VW Service Area					
Gibraltar	641 Gibraltar Court	1-20" WaterMaster Electromagnetic	3K220000195 183	VW2[(c)]	14.4
				VW Total	**14.4**
				City Total	**51.2**

(a) Source: 2009 WMPU, Table 4-1.
(b) Turnout can be reconfigured to deliver SFPUC water directly to Zone VW2.
(c) Zone VW2 serves Zone VW1 via four PRVs. Refer to Table 3-1.

3.2.2 Emergency Groundwater Wells

The City currently maintains one groundwater well, the Pinewood Well, for use in emergencies. It is connected to Zone SF1 but is not used as an active potable water supply source. The Pinewood Well is permitted as an emergency well, so it cannot be operated more than 15 calendar days per year, and not more than five consecutive days each year. The Pinewood Well can produce approximately 1.7 mgd (per the 2009 WMPU) and is equipped with a chlorination facility and a plug-in adapter and transfer switch to receive power from a portable generator.

[5] Also known as the East Pipeline.

The City anticipates adding two additional wells, Curtis Well and McCandless Well, to its supply portfolio in the future. These future wells are discussed in Chapter 4 of this report.

3.2.3 Emergency Interties

The City has three interties with two partner agencies, SJW and ACWD, for a total capacity of approximately 7.1 mgd. These emergency interties are all manually activated with mutual agreement between the City and the partner agency with at least two hours' notice. The 8-inch intertie with SJW is located at Landess Avenue and Corktree Lane and can serve Zones SF2, SF3, and SF4. Per City operations staff, the SJW intertie has no flushing points and needs to be upgraded to allow routine operation and flushing. There are two 8-inch interties with ACWD, with one serving Zone SF1 and the other serving Zone SF2. However, the City and ACWD water systems normally operate under significantly different pressures. Key information for all three emergency interties is summarized in Table 3-3. The SJW intertie has not been used, while the Milmont and Green Valley Road interties were last used in May 2010 and January 2016, respectively.

Table 3-3. Existing Emergency Interties

Partner Agency	Location	Pressure Zone(s) Served	Intertie Type	Intertie Diameter, in	Pressure Difference[a], psi	Capacity, mgd[b]
SJW[c]	Landess Avenue and Corktree Lane	SF2, SF3, SF4	Hard piped, closed valve	8	20	2.60
ACWD[c]	Milmont Drive	SF1	Hard piped, closed valve	8	10	2.25
	Park Victoria Drive/ Green Valley Road	SF2	Hard piped, closed valve	8	20	2.25
					City Total	**7.1**

(a) City pressure minus partner agency pressure. Typical partner agency pressures provided by City in February and March 2021.
(b) Source: 2009 WMPU, Table 4-3. It is assumed that each ACWD intertie has equal capacity.
(c) Intertie can be opened with mutual agreement and at least two hours' notice.

3.3 EXISTING DISTRIBUTION FACILITIES

The City's distribution facilities include:

- Five storage reservoirs
- Five pump stations
- 17 PRVs (including six emergency PRVs)
- 49 isolation valves
- 964,000 linear feet (LF) (approximately 183 miles) of pipelines

Under normal operations, the City separates its water system by source water zone (SFPUC vs. VW), meaning that Zones SF1 through SF4 are isolated from Zones VW1 and VW2. During emergencies, the City can open isolation valves to allow supply mixing. Emergency PRVs are also set to automatically operate and allow SFPUC water to flow to VW zones if pressures in the VW zones drop significantly. This emergency supply is unidirectional; it can only flow from SFPUC zones to VW zones.

The City's Gibraltar facility has storage, pumping, and pressure regulating facilities for both SFPUC and VW supplies. To distinguish between the pumps and storage reservoirs, references in the following sections will append parenthetical notes specifying the facility's service area/source (e.g., SF or VW). The PRVs at the station are uniquely named, so no disambiguation is necessary.

3.3.1 Storage Reservoirs

The City has five storage reservoirs, totaling approximately 16 million gallons (MG) of capacity. Four storage reservoirs serve the SFPUC service area, with Tularcitos and Minnis serving customers in the hillside areas (Zones SF3 and SF4) and Gibraltar (SF) and Ayer serving customers in the valley area (Zones SF1 and SF2). The remaining storage reservoir, Gibraltar (VW), serves Zone VW2 directly and Zone VW1 indirectly (via the Capitol, Curtis, and Parc Metro PRVs). The supply source, location, and key operational information for each storage reservoir is listed in Table 3-4.

Additional disinfection and deliberate reservoir operation help ensure stored water quality remains high. At each storage reservoir, chlorine liquid/tablets and liquid ammonia are added to create a chloramine residual.

Table 3-4. Existing Storage Reservoirs

Storage Reservoir	Location	Pressure Zone(s) Served	Year Built	Tank Material	Tank Diameter, ft	Tank Floor Elevation, ft msl	Normal Operating Level Range[(a)], ft	Capacity, MG[(b)]
SFPUC Service Area								
Gibraltar (SF)	641 Gibraltar Court	SF1	1993	Concrete	181	22	15 - 24.5	5.0
Ayer	1429 East Calaveras Boulevard	SF2	1995	Concrete	158	47	31.2 - 36	5.6
Tularcitos	1328 Tularcitos Drive	SF3	1982	Steel	48	544.2	15 - 21.5	0.30
Minnis	901B Downing Road	SF4	1982	Steel	51	885.5	15 - 21.5	0.34
							SFPUC Total	**11.2**
VW Service Area								
Gibraltar (VW)	641 Gibraltar Court	VW2	1993	Concrete	181	22	15 - 24.5	5.0
							VW Total	**5.0**
							City Total	**16.2**

(a) Source: City SCADA data (Gibraltar reservoirs) and City-provided circle charts (Ayer, Tularcitos, and Minnis).
(b) Source: As-builts provided by City in November 2019.

3.3.2 Pump Stations

Of the City's five pump stations, four serve the SFPUC service area, with the remaining pump station serving Zone VW2. Besides drawing from the Gibraltar (VW) reservoir to serve Zone VW2, the Gibraltar (VW) PS also has emergency pumps to increase delivery pressures from the Gibraltar turnout if pressures are not sufficient. While these pumps have been used sparingly, they provide valuable redundancy during peak summer periods or emergencies.

In the SFPUC service area, the Gibraltar (SF) PS delivers stored water from the Gibraltar (SF) reservoir to Zone SF1. Similarly, both the Ayer PS and the Tularcitos PS draw water from their respective storage reservoirs (Ayer and Tularcitos). The Ayer PS serves Zone SF2, while the Tularcitos PS serves Zone SF4. The Country Club PS draws from Zone SF2 to serve Zone SF3 and also fills the Tularcitos reservoir. Pump station service area, pump types and capacity, and backup power features are summarized in Table 3-5.

Table 3-5. Existing Pump Stations

Pump Station	Pressure Zone Served	Number of Pumps and Capacity[a], gpm	Pump Type[b]	Pump Drive Type[c]	Backup Generator?
Gibraltar (SF)	SF1	2 @ 5,500	SCHC	1 Electric, 1 Diesel	Yes
Ayer	SF2	3 @ 1,800	MVT	Electric	Yes
Country Club	SF3	2 @ 250	Submersible MVT	Electric	No
Tularcitos	SF4	2 @ 250	Submersible MVT	Electric	No
Gibraltar (VW)	VW2	2 @ 5,500[d]	SCHC	1 Electric, 1 Diesel	Yes
	VW2[e]	1 @ 5,000 1 @ 4,000 1 @ 2,000 1 @ 2,000	MVT MVT MVT SCHC	Diesel Electric Electric Electric	Yes (all)

(a) Source: City-provided asset spreadsheet (Master List 4.0) and pump curves.
(b) SCHC = split case horizontal centrifugal; MVT = multistage vertical turbine.
(c) All pumps are variable speed except for those at the Country Club and Tularcitos pump stations.
(d) One pump can be valved for either Zone SF1 or VW2.
(e) Emergency backup pumps located at VW turnout, activated when delivery pressures fall below 120 psi.

3.3.3 Pressure Reducing Valves

Eleven PRVs ensure that the City's water system pressures remain within acceptable operating range. Since SFPUC and VW supplies have an HGL of 340 feet and 425 feet, respectively, the City must reduce pressures when serving customers at lower elevations. Any inter-zone pipeline connections (e.g., between Zones VW2 and VW1) must also include PRVs or closed valves. Four PRVs serve Zone SF1, and three PRVs serve Zone SF4-1, a small sub-zone within Zone SF4. There are four PRVs in the VW service area, one serving Zone VW2 and three serving Zone VW1. The location, set points, HGL, and associated pressure zones for each PRV are shown in Table 3-6.

The City also has six emergency PRVs set to automatically operate if pressures in the VW service area fall below an HGL of 125 feet in Zone VW1 or 175 feet in Zone VW2. As a result, SFPUC supply can supplement VW supply when needed. Four emergency PRVs serve Zone VW1, and two serve Zone VW2. Emergency PRV locations and key operational information are summarized in Table 3-7.

Table 3-6. Existing Pressure Reducing Valves

PRV	Location	Set Point[a], psi	Hydraulic Grade Line[b], ft	From Zone	To Zone
Calera Creek Heights	Near 163 Calera Creek Heights Drive	70	787	SF4-2	SF4-1
Capitol	North Capitol Avenue b/w Montague Expressway and City Limits	68	201	VW2	VW1
Curtis East & West	West Curtis Avenue b/w Main Street and Abel Street	80	202	VW2	VW1
Gibraltar 21 & 21A	641 Gibraltar Court	136	325	VW[c]	VW2
Gibraltar 24	641 Gibraltar Court	76	194[d]	SFPUC[c]	SF1
Main	Hammond Way	80	207	SF2	SF1
North Milpitas	North Milpitas/Calaveras	79	207	SF2	SF1
Parc Metro	East Curtis Avenue/East Lane	82	218[d]	VW2	VW1
Sunnyhills	Washington/Escuela	67	199	SF2	SF1
Tularcitos North Vault	Near 1475 Pinehurst Court	67	707	SF4-2	SF4-1
Tularcitos South Vault	Near 1486 Tularcitos Drive	68	762	SF4-2	SF4-1

(a) Source: City-provided data in June 2020.
(b) Source: City of Milpitas Water Distribution System Plan Schematic Profile (HydroScience Engineers).
(c) PRV located immediately downstream of turnout.
(d) Estimated from set point (converted to pressure head in feet) and approximate elevation from as-builts.

Table 3-7. Existing Emergency Pressure Reducing Valves

Emergency PRV	Location	Upstream Setting[a], psi	Downstream Setting[a], psi	Hydraulic Grade Line[b], ft	From Zone	To Zone
Junipero	Junipero & South Abel Street	--[c]	--[c]	169	SF1	VW1
Live Oak	Live Oak Court and I-880	75	70	125	SF1	VW1
McCarthy	South of Cadillac Court	82	72	73	SF1	VW1
California Circle	California Circle and I-880	82	72	71	SF1	VW1
Montague	Montague Expressway and I-680	118	110	216	SF2	VW2
Yosemite	Sinclair Frontage Road and Yosemite Drive	118	110	211	SF2	VW2

(a) Source: City-provided data in February 2021.
(b) Source: City of Milpitas Water Distribution System Plan Schematic Profile (HydroScience Engineers).
(c) PRV is offline.

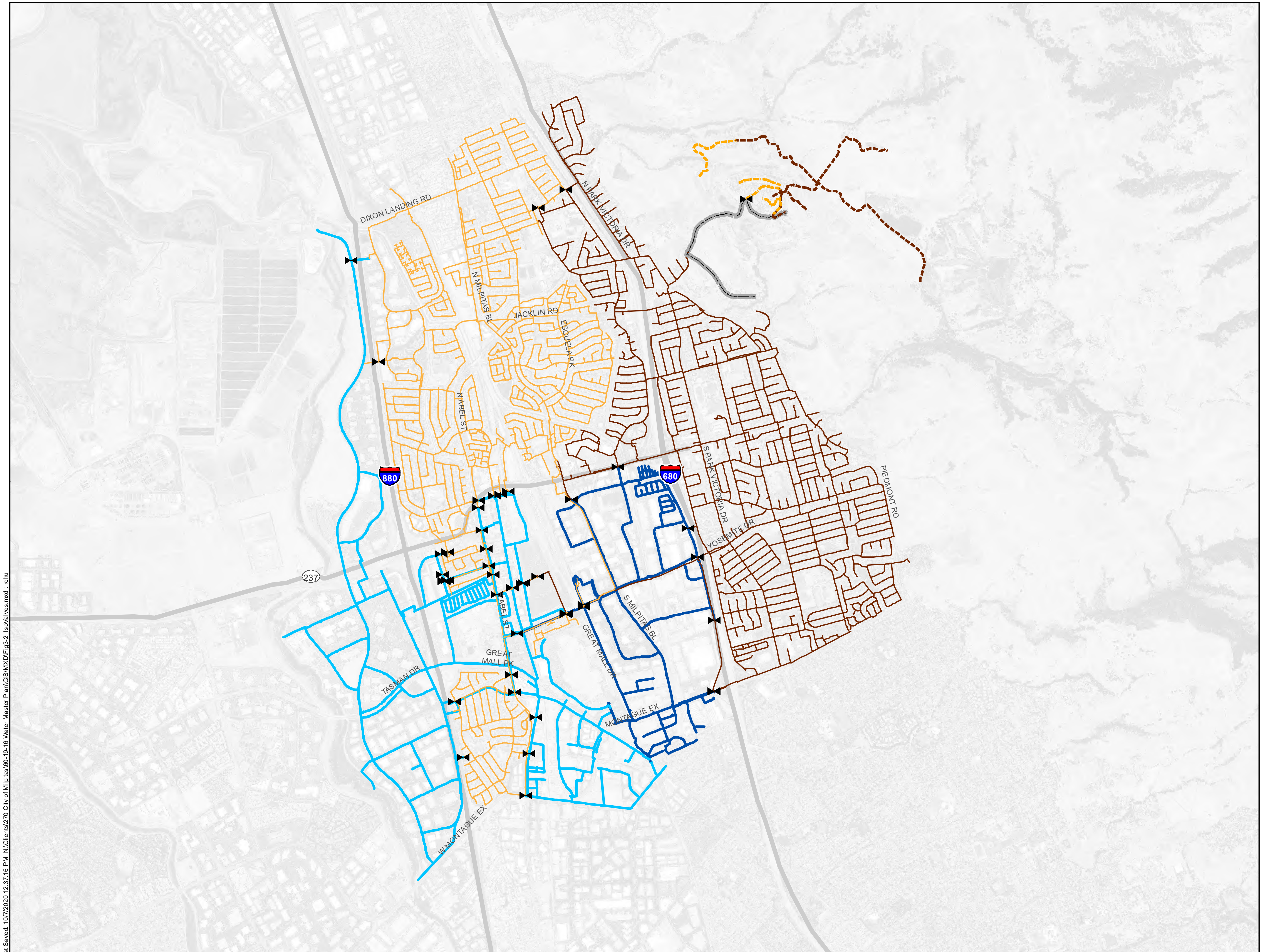
3.3.4 Isolation Valves

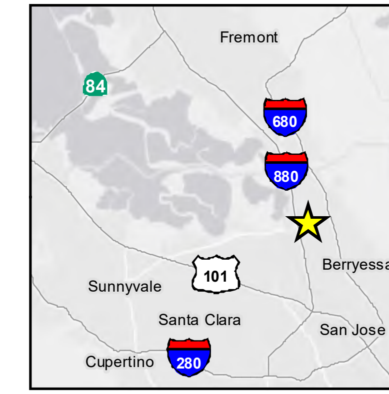
To prevent blending of the two water sources (SFPUC and VW) and better control water quality, the City has installed 49 isolation valves throughout the distribution system. Thirty-one are in Zone 1 (i.e., separating zones SF1 and VW1), and nine are in Zone 2. The remaining nine isolation valves separate pressure zones within the same service area (e.g., Zones SF1 and SF2) but do not have facilities to regulate flow (i.e., PRVs or booster pumps). Therefore, these nine valves should always remain closed.

Isolation valves increase supply reliability, as they can be opened during long-term water shortages from either SFPUC or VW. Existing isolation valves are shown on Figure 3-2 and listed in Table 3-8. Previous modeling performed for the 2009 WMPU demonstrated that the City does not have to open every valve to supply the entire system using one supply source. Per the 2009 WMPU, opening only four "key" valves allowed a single supply source to serve the City service area (refer to Chapters 8 and 9 of this Water Master Plan for updated recommendations). Current City emergency operations procedures are detailed in Appendix B.

3.3.5 Pipelines

The existing water distribution system consists of approximately 183 miles of pipeline with diameters ranging from 2 inches to 30 inches. By length, approximately 85 percent of the City's water pipelines are between 6 inches and 12 inches in diameter, and just over 73 percent are asbestos cement (AC). The diameter and material distributions of the City's water system pipelines are summarized in Table 3-9 and Table 3-10, respectively.





N

0 1,500 3,000

Scale in Feet

Isolation Valve

Pipeline Pressure Zone

- VW1
- VW2
- SF1
- SF2
- SF3
- SF4-1
- SF4-2

Figure 3-2

Existing Water System Isolation Valves

City of Milpitas
2020 Water Master Plan

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Table 3-8. Existing Isolation Valves			
Valve Number	Valve Size, in	Location	Classification[a]
Pressure Zone 1 (between SF1 and VW1)			
1	14	End of Live Oak Court	None
2	12	Starlite Dr/Capitol Avenue	None
2A	10	150 feet east of Evening Star Court	None
3	8	S. Main Street/S. Abel Street	None
4	12	S. Abel Street/Capitol Avenue	None
5	12	S. Abel Street/Capitol Avenue	None
5A	6	S. Main Street/Cedar Way	None
6	8	S. Main Street/Montague Expwy.	None
7	10	S. Main Street/Montague Expwy.	None
12X	14	South end of Rio Verde Place	None
13	12	S. Abbott Avenue near Economy Inn	None
13A	8	North end of Rio Verde Place	None
14	8	S. Abel Street/Corning Avenue	None
14A	6	Corning Ave/Palmer Avenue	None
15	8	S. Abel Street/Junipero Drive	None
18	12	S. Abel Street/Serra Way	None
18A	12	S. Abel Street south of Calaveras Boulevard	None
20	8	S. Main Street/Carlo Street	None
20A	6	Carlo Street/Calaveras Boulevard	None
20B	12	Carlo Street/Calaveras Boulevard	None
24	6	End of E. Carlo Street	None
25	8	South end of Railroad Avenue	None
26	6	S. Abel Street/Sylvia Avenue	None
27	8	Hammond Way near SFPUC Pipeline	None
28	8	Hammond Way near SFPUC Pipeline	None
30	12	S. Main Street near SFPUC Pipeline	None
31	24	S. Abel Street near SFPUC Pipeline	None
35	8	End of Corning Avenue	None
32045	14	End of Cadillac Court	None
32523	14	N. McCarthy Boulevard	None
35100	8	End of Corning Avenue	None
Pressure Zone 2 (between SF2 and VW2)			
8	8	Montague Expwy/Southbound 680 offramp	None
8A	10	Montague Expwy/Southbound 680 offramp	None
9	24	Sinclair Frontage Road/Yosemite Drive	Key
10	12	Sinclair Frontage Road south of Wrigley Way	None
23C	16	S. Milpitas Boulevard north of Los Coches Street	Key
32	24	S. Hillview Drive/Calaveras Boulevard	Key
137	16	650 feet west of Gibraltar Drive/Yosemite Drive	Key
174	12	650 feet west of Gibraltar Drive/Yosemite Drive	None
31219	12	Sinclair Frontage Road/Montague Court	None
Between Pressure Zones in the Same Service Area			
79	12	Near Main PRV (between SF1 and SF2)	Always Closed
99A	18	Curtis Avenue near Curtis PRV (between VW1 and VW2)	Always Closed
31660	8	Country Club Drive/Tularcitos Drive (between SF3 and SF4-1)	Always Closed
32818	8	Coelho Street/Diel Drive (between SF1 and SF2)	Always Closed
33788	8	Coelho Street/Roger Street (between SF1 and SF2)	Always Closed
34357	8	E. Curtis Avenue near Parc Metro PRV (between SF1 and SF2)	Always Closed
34358	8	E. Curtis Avenue near Parc Metro PRV (between SF1 and SF2)	Always Closed
34359	8	E. Curtis Avenue near Parc Metro PRV (between SF1 and SF2)	Always Closed
35727	12	S. Main Street near Tom Evatt Park (between SF1 and SF2)	Always Closed

(a) Isolation valves are normally closed to separate SFPUC and VW supplies. Per the 2009 WMPU, opening only the four key valves allows a single source (SFPUC or VW) to supply the entire system. Valves located between pressure zones shall remain closed at all times.

Table 3-9. Summary of Existing Pipelines by Diameter[a]

Pipe Diameter, inches	Total Pipeline Length, feet	Total Pipeline Length, miles	Percent of Water System
2	107	0.0	0.0%
4	11,542	2.2	1.2%
6	243,314	46.1	25.2%
8	246,992	46.8	25.6%
10	81,940	15.5	8.5%
12	242,814	46.0	25.2%
14	59,695	11.3	6.2%
16	32,961	6.2	3.4%
18	38,419	7.3	4.0%
20	320	0.1	0.0%
24	5,696	1.1	0.6%
30	216	0.0	0.0%
Total	**964,015**	**183**	**100%**

(a) Source: City GIS pipeline shapefile and as-builts provided February and March 2020.

Table 3-10. Summary of Existing Pipelines by Material[a]

Pipe Material	Abbreviation	Total Pipeline Length, feet	Total Pipeline Length, miles	Percent of Water System
Asbestos Cement	AC / ACP	704,997	133.5	73.1%
Concrete Cylinder	CCP	887	0.2	0.1%
Cast Iron	CIP	5,002	0.9	0.5%
Ductile Iron	DIP	80,772	15.3	8.4%
Polyvinyl Chloride	PVC	144,474	27.4	15.0%
Steel	STL	27,883	5.3	2.9%
	Total	**964,015**	**183**	**100%**

(a) Source: City GIS pipeline shapefile and as-builts provided February and March 2020.

CHAPTER 4
Water Supply Sources

This chapter summarizes the City's existing and future water supply sources. A reliable water supply is critical for ensuring the City can meet water demands through buildout and during emergency outages. The evaluation of water supply availability and reliability begins with understanding the City's supply sources and agreements, as well as the water quality associated with those supply sources. The City's historical and projected future use of its available water supplies is further described in Chapter 5 of this report.

4.1 EXISTING WATER SUPPLIES

The City's existing water supplies include imported water, groundwater, recycled water, and interties with neighboring agencies.

Under normal conditions, imported water comprises the City's entire water supply. The City purchases treated surface water from two agencies: the SFPUC and VW, which was previously known as the Santa Clara Valley Water District. In 2019, water supplies from SFPUC totaled 6,146 acre-feet (af) and represented about 59 percent of the City's total water supplies, while water supplies from VW totaled 3,182 af and represented about 31 percent of the City's total water supplies.

Recycled water is produced at the San José-Santa Clara Regional Wastewater Facility and delivered to the City by South Bay Water Recycling (SBWR). In 2019, the City used approximately 1,049 af of recycled water, mainly for landscape irrigation. This represented about 10 percent of the City's total 2019 water use.

In emergencies, the City can activate interties with SJW and the ACWD and/or pump groundwater. The City overlies the Santa Clara Valley Groundwater Sub-basin and currently has one groundwater well (Pinewood Well).

Each of the City's existing water supplies is described further below.

4.1.1 San Francisco Public Utilities Commission (SFPUC)

The SFPUC is a department of the City and County of San Francisco, which owns and operates the Hetch Hetchy Regional Water System (RWS). The RWS spans from Hetch Hetchy Valley in Yosemite National Park to the City of San Francisco and consists of over 280 miles of pipeline, eleven reservoirs, five pump stations, and two water treatment plants.

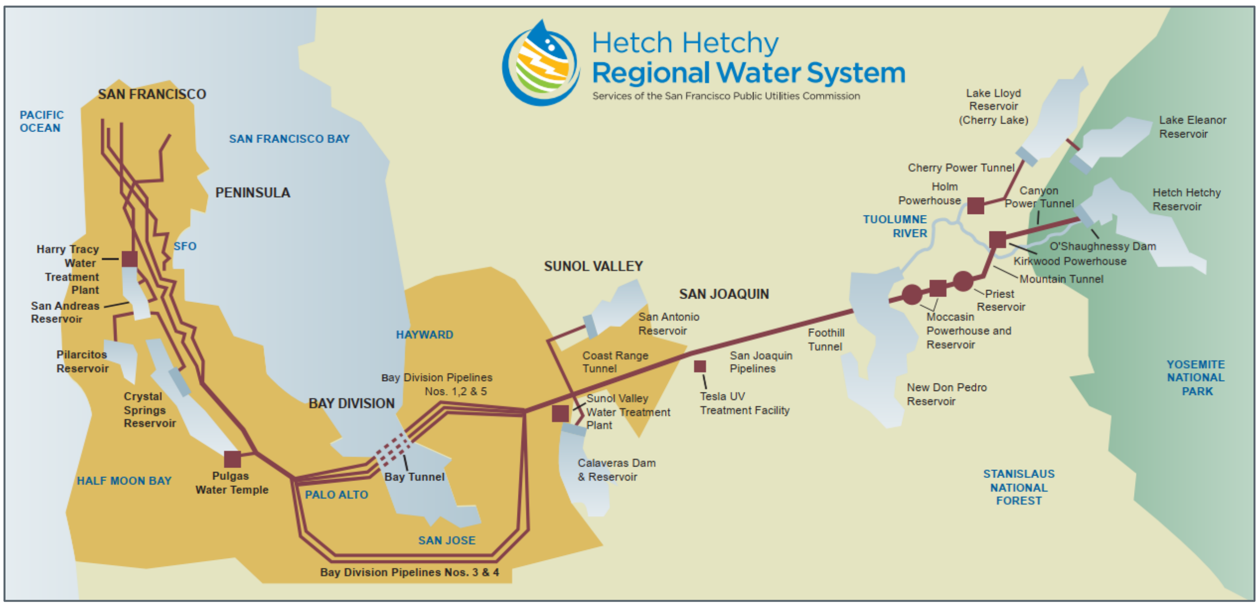
The Hetch Hetchy watershed, an area located in Yosemite National Park, is the major source of water for all of San Francisco's retail and wholesale water needs. Spring snowmelt runs down the Tuolumne River and fills Hetch Hetchy Reservoir, the largest reservoir in the Hetch Hetchy water system. This surface water in the Hetch Hetchy Reservoir is treated, but not filtered because it is of such high quality.

The Alameda and Peninsula watersheds produce the rest of the total water supply. The Alameda watersheds (the San Antonio Creek, Upper Alameda Creek, and Arroyo Hondo watersheds) located in Alameda and Santa Clara Counties, contribute surface water supplies captured and stored in two reservoirs: Calaveras and San Antonio. The Sunol Filter Galleries located near the Town of Sunol, are a groundwater source supplying less than one percent of San Francisco's water. The Peninsula watersheds (the San Mateo Creek and Pilarcitos Creek watersheds) in San Mateo County contribute surface water supplies captured and stored in lower and upper Crystal Springs and San Andreas Reservoirs and in two smaller reservoirs, Pilarcitos and Stone Dam. The six reservoirs in the Alameda and Peninsula watersheds capture rain and local runoff. Some also store Hetch Hetchy water for use by San Francisco. These local water sources and groundwater from the Sunol filter galleries are treated and filtered before delivery.

Although most of the SFPUC water deliveries originate from the Tuolumne River, typically comprising approximately 85 percent of SFPUC water deliveries, the SFPUC prioritizes local surface water supplies. However, in dry years, when local surface water supply is often decreased, Tuolumne River diversions can exceed 90 percent of SFPUC supplies.

The RWS serves the City of San Francisco as well as 25 wholesale customers located throughout Alameda, Santa Clara, and San Mateo Counties, including the City of Milpitas. Overall, the RWS serves approximately 2.7 million residential, commercial, and industrial customers throughout the San Francisco Bay Area.

A schematic of the RWS is provided on Figure 4-1.



Source: SFPUC website

Figure 4-1. SFPUC Regional Water System

4.1.1.1 City Supplies from SFPUC

The Bay Area Water Supply and Conservation Agency (BAWSCA) represents the interests of the 25 wholesale customers (who together manage 27 water systems), including the City of Milpitas. In 2009, the SFPUC and BAWSCA members entered into a Water Supply Agreement, a 25-year contract outlining the relationship between the two entities. A key component of the Water Supply Agreement is that it continued the “Supply Assurance,” a maximum supply of 184 mgd to be allocated among BAWSCA members, established by the Water Supply Agreement’s predecessor (the 1984 Settlement Agreement and Master Water Sales Contract). Though the Supply Assurance can be reduced due to drought, maintenance, or emergencies, the Water Supply Agreement established the 184 mgd delivery ceiling in perpetuity.

The Supply Assurance is allocated between 22 wholesale customers in the form of Individual Supply Guarantees (ISGs)[6]. ISGs are specified in the Water Supply Agreement and subject to change following the Water Supply Agreement's expiration in 2034. The City's ISG is 9.23 mgd, which is delivered through Bay Division Pipelines Nos. 3 and 4.

4.1.1.2 SFPUC Water Quality

The RWS delivers high quality water that meets all Federal and State requirements. Most of the water originates in the Tuolumne River, which is fed by spring snowmelt in a well-protected watershed in Yosemite National Park. Diverted water is stored in the Hetch Hetchy Reservoir and transported to the Bay Area in pipes and tunnels. According to the SFPUC's 2019 Water Quality Report, Hetch Hetchy water meets Federal and State drinking water quality standards by providing the following treatment: pH adjustment (to control corrosion), disinfection (including ultraviolet light and chlorination), fluoridation (for dental health protection), and chloramination (for maintaining disinfectant residual and minimizing disinfection byproducts). Filtration is not required due to the high water quality.

Local surface water supplies, which typically comprise about 15 percent of SFPUC supplies, require more typical treatment, including coagulation, flocculation, sedimentation, filtration, and disinfection. Most wholesale customers, including the City, receive a blend of Hetch Hetchy and local surface water supplies. The SFPUC does not anticipate any future degradation of water quality.

4.1.2 Valley Water (VW)

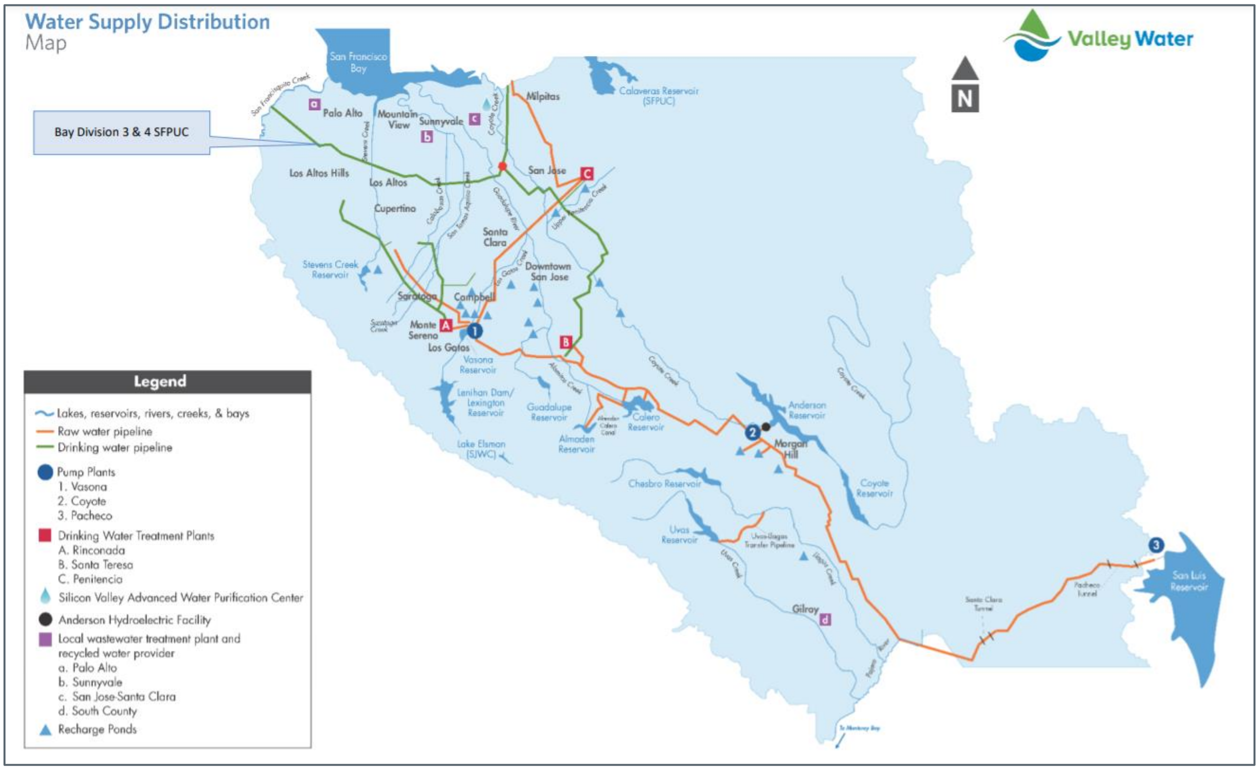
Valley Water, previously known as the Santa Clara Valley Water District, is an independent special district that provides wholesale water supply, groundwater management, flood protection and stream stewardship. Its service area includes all of Santa Clara County, which is located at the southern end of San Francisco Bay. Valley Water was formed as the Santa Clara Valley Water Conservation District in 1929 in response to groundwater overdraft and significant land subsidence. In 1954, it annexed the Central Santa Clara Valley Water District. In 1968, it merged with the countywide flood control district to form one agency to manage the water supply and flood programs for most of the county. The Gavilan Water District in southern Santa Clara County was annexed in 1987 and now Valley Water provides services for the entire county. Valley Water is governed by an elected seven-member Board of Directors following the District Act and its own Board Governance Policies.

Valley Water has been a leader in conjunctive use in California for decades, utilizing imported and local surface water to supplement groundwater and to maintain reliability in dry years. Conjunctive use helps protect local subbasins from overdraft, land subsidence, and saltwater intrusion and provides critical groundwater storage reserves for use during droughts or outages. After it was formed to address declining groundwater levels and land subsidence, Valley Water constructed reservoirs to capture more local water. However, local supplies were insufficient to meet the county's growing population. Valley Water began importing water from the State Water Project in 1965 and from the Central Valley Project's San Felipe Division in 1987. These investments, along with water recycling and conservation, have resulted in sustainable groundwater subbasins and reliable water supplies for the county.

[6] Three wholesale customers do not have ISGs: the cities of San Jose, Santa Clara, and Hayward. The cities of San Jose and Santa Clara are supplied on a temporary and interruptible basis and thus do not have an allocated share of the Supply Assurance. The City of Hayward has an unspecified allocation, equal to the difference between 184 mgd and the sum of the ISGs.

About half of the county's water supply currently comes from local sources and about half comes from imported water sources. Local sources include natural groundwater recharge and surface water supplies, including surface water rights held by Valley Water, San Jose Water, and Stanford University. Imported water includes Valley Water's State Water Project and Central Valley Project contract supplies (100,000 acre-feet per year [af/yr] from the SWP and 152,500 af/yr from the Central Valley Project [CVP]), as well as supplies delivered by the SFPUC to cities in northern Santa Clara County.

A schematic of the VW water supply system is provided on Figure 4-2.



Source: Valley Water, Water Supply Master Plan 2040, November 2019.

Figure 4-2. Valley Water Supply System

4.1.2.1 City Supplies from VW

VW delivers treated surface water to the City via the Milpitas Pipeline. Per the City's contract with VW, potable water deliveries consist of SWP and CVP water only, with amounts based on an annual request the City submits every three years. In each of the three years after submitting the request, the City is obligated to purchase at least 95 percent of the maximum amount listed on the schedule. Every month, VW guarantees the City can receive at least 15 percent of the annual delivery schedule.

4.1.2.2 VW Water Quality

The SWP and CVP convey water through the Sacramento-San Joaquin Delta (Delta). Delta supplies are threatened by sea level rise and climate change, with elevated nutrient concentrations (causing algal blooms and reducing dissolved oxygen) and disinfection byproducts presenting a more immediate challenge. The Central Valley Regional Water Quality Control Board is also focused on controlling pesticide and herbicide discharges into the Delta.

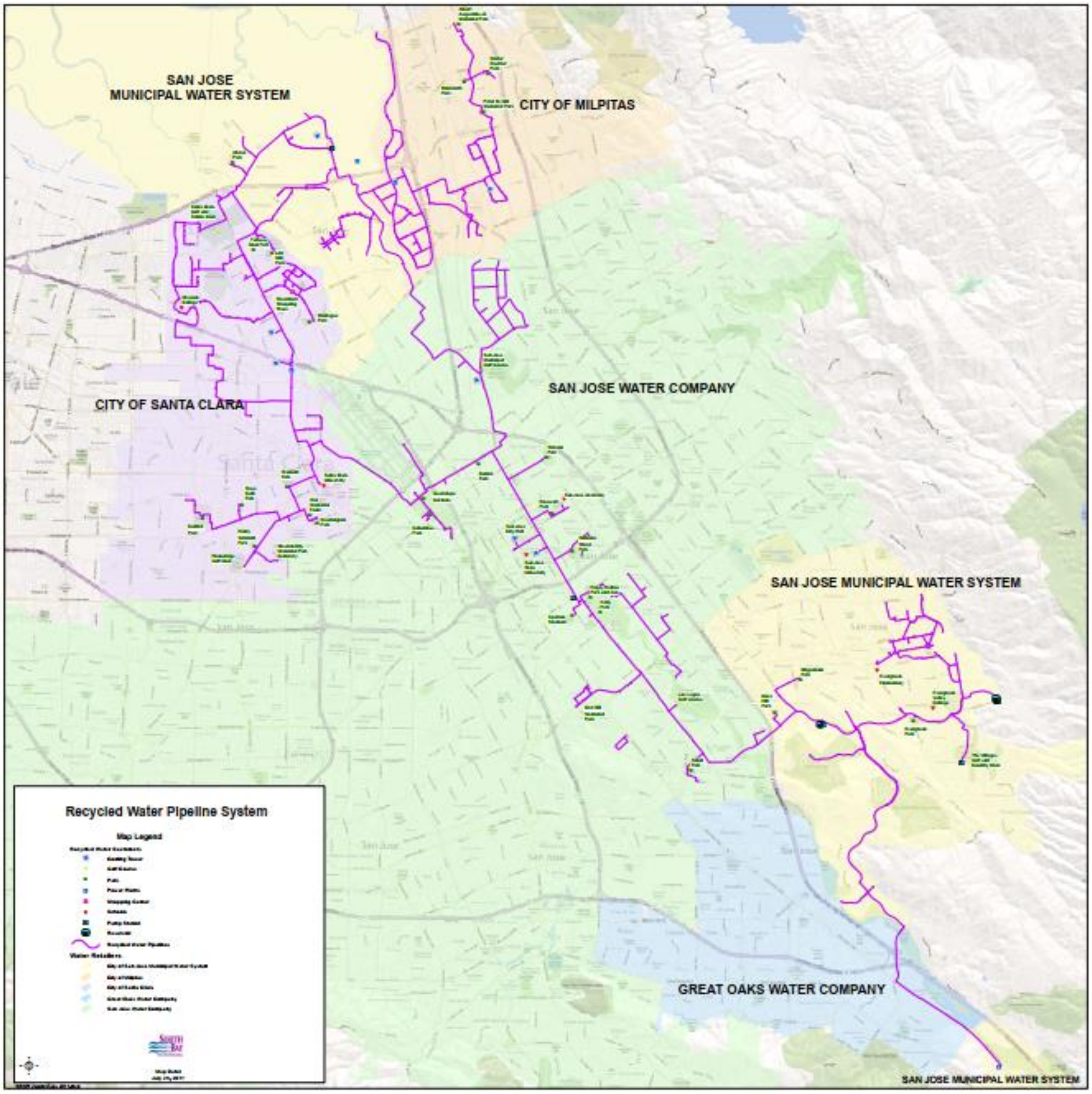
Surface water is treated at either the Penitencia or Santa Teresa Water Treatment Plants (WTPs) before delivery to the City. It should be noted that VW also operates a third WTP, the Rinconada WTP, but it primarily serves the west side of Santa Clara County, which does not include the City. The Penitencia and Santa Teresa WTPs began operations in 1974 and 1989, respectively. In 2006, disinfection facilities at each WTP were upgraded to use ozone instead of chlorine. Not only is ozone a strong disinfectant, but it can also improve taste and odor while also reducing the formation of disinfection byproducts. At both WTPs, raw water is treated via coagulation/flocculation (to remove silt and particles), ozone disinfection, and granular activated carbon filtration (to remove dissolved chemicals). Filtered water is then treated with chloramine to maintain a disinfection residual through the distribution system.

4.1.3 Recycled Water

South Bay Water Recycling (SBWR), a division within the City of San Jose’s Environmental Services Department, is the regional permit holder for recycled water in San José, Santa Clara and Milpitas, ensuring compliance with State regulations for recycled water quality and use. SBWR is a recycled water wholesaler to four retailers: San Jose Water, San José Municipal Water, City of Santa Clara, and City of Milpitas. Customers buy recycled water from the retailer in their location.

Tertiary treated recycled water is produced at the San José-Santa Clara Regional Wastewater Facility, one of the largest such treatment facilities in California. SBWR’s recycled water system consists of over 150 miles of pipeline, 5 pump stations, and 10 million gallons of storage in reservoirs. SBWR delivers more than 4 billion gallons of recycled water per year to more than 900 commercial customers, an average of 11 mgd.

A schematic of the SBWR system is provided on Figure 4-3.



Source: [SBWR website]

Figure 4-3. South Bay Water Recycling System

The use of recycled water is a priority for the City, which has adopted an ordinance that prohibits using potable water for irrigation if recycled water is available. While SBWR owns the distribution system, the City is responsible for operation and maintenance of any facilities within City boundaries.

In 2019, the City used approximately 1,049 af of recycled water, mainly for landscape irrigation. This represented about 10 percent of the City's total 2019 water use. According to the City's 2015 Urban Water Management Plan (UWMP), continued growth in landscape irrigation and industrial use, along with expansion to golf course irrigation, should increase recycled water use to approximately 2,690 af by 2040. In addition, the City is seeking to improve recycled water reliability via interties with SJW, also a SBWR retailer.

4.1.4 Emergency Groundwater Wells

The City overlies the Santa Clara Groundwater Subbasin, which is managed by VW. In its 2019 Basin Prioritization project, DWR identified the Santa Clara Groundwater Subbasin as a high priority basin for sustainable management. Overdraft and land subsidence have been challenges in the past, and VW actively manages surface recharge to alleviate subsidence.

Groundwater is not part of the City's current active water supply portfolio. Should SFPUC and/or VW supplies be interrupted, the City can activate the Pinewood Well, which draws water from an aquitard-protected area in the southwestern part of the City. While the Pinewood Well is currently permitted for emergency use only, the City may consider permitting it as an active, fully operational well in the future. The State Water Resources Control Board (SWRCB) Division of Drinking Water (DDW) defines emergency or standby water sources as not operating more than 15 calendar days nor more than five consecutive days in a year.

Per the 2009 WMPU, the Pinewood Well has a capacity of 1.7 mgd. Pump production testing would be required to confirm this capacity, but that is outside the scope of this Water Master Plan. Therefore, this Water Master Plan assumes the Pinewood Well capacity remains at 1.7 mgd. Pumped water meets primary drinking water standards; however, there are taste and odor concerns. In 2016, Water Solutions, Inc. conducted a Groundwater Well Evaluation that examined the Pinewood Well and potential sites for a new well. This Groundwater Well Evaluation recommended using ozone and surface water blending to control taste and odor. As discussed previously in Section 3.2.2, the Pinewood Well is equipped with a plug-in adapter and transfer switch to receive power from a portable generator. The City anticipates completing treatment and operational improvements at the Pinewood Well soon.

The City also has two other planned wells, the Curtis Well and the McCandless Well, which are described in Section 4.2 below.

4.1.5 Emergency Interties

The City has one intertie with SJW and two interties with ACWD. With a 2-hour notice and mutual consent, the City can receive water from either source. The ACWD intertie is a two-way intertie, allowing the City to either receive or provide water supplies, while the City can only receive water from SJW.

4.2 FUTURE WATER SUPPLIES

Groundwater can supplement reduced supplies from the SFPUC or Valley Water during prolonged droughts. As presented in the City's 2020 Urban Water Management Plan (UWMP), the City expects to rely on groundwater to augment supplies and meet demands during future dry years.

The City hopes to increase future supply reliability by expanding its groundwater capabilities. Two new wells, the Curtis Well and the McCandless Well, are expected to come online during the City's buildout horizon (i.e., by 2040). The Curtis Well was drilled in 2003, but the well was not equipped with above-grade infrastructure required for a functioning well, and the facility was never completed. As a result, bringing the Curtis Well online requires significant effort, including installing a submersible pump, piping, and treatment components, as well as conducting testing and permitting. Design for the Curtis Well improvements began in 2020. Construction of the McCandless Well began in 2020 and is anticipated to be completed by 2022. The Pinewood, Curtis, and McCandless wells, in addition to other future wells described in the City's 2020 UWMP that are triggered by future development in the City's service area, are critical components of the City's future water supply portfolio.

CHAPTER 5
Water Demand

This chapter reviews the City's existing potable water demands and develops future water demand projections based on refined Water Use Factors (WUFs) described in this chapter and planned future development (described in Chapter 2). Having accurate and thorough water demands allows for:

- Developing and calibrating the potable water system hydraulic model
- Identifying existing and potential future water system deficiencies and recommending improvements

5.1 HISTORICAL WATER PRODUCTION AND CONSUMPTION

As described in Chapter 4, the City imports surface water from SFPUC and VW. During normal operation, water production consists exclusively of water imports. Water consumption is defined as metered water use and is based on actual billing data provided by the City. The difference between water production and water consumption is non-revenue water (NRW).

The following subsections detail the City's historical production and consumption to help determine appropriate NRW, per capita water use, and peaking factors. This information, along with future land use plans, will serve as the foundation for future water demand projections.

5.1.1 Water Production

Table 5-1 summarizes annual water production from 2009 through 2019 and breaks down deliveries by source (SFPUC and VW). Total production decreased between 2014 and 2017 due to the drought and associated water conservation efforts. Production increased in 2018 and held steady in 2019 but remains below pre-drought levels. In recent years SFPUC imports have comprised approximately 60 to 66 percent of the City's total production, though recent production volume has dropped due to increased use of recycled water. VW imports have comprised about 34 to 40 percent of the City's total production in recent years.

Figure 5-1 shows the City's monthly water production from January 2009 through December 2019. As expected, the City's highest water production has occurred in the summer months (June through September), when temperatures are high and rainfall is minimal. Over this 10-year period, the lowest water production has most frequently occurred in December and March.

Table 5-1. Historical Water Production[a]

Calendar Year	SFPUC		VW		Total Production, af	Average Day Production, mgd
	Volume, af	Percent of Total Production	Volume, af	Percent of Total Production		
2009	7,563	68	3,509	32	11,072	9.9
2010	6,748	66	3,483	34	10,231	9.1
2011	6,855	67	3,395	33	10,250	9.2
2012	6,984	68	3,342	32	10,326	9.2
2013	7,506	70	3,251	30	10,758	9.6
2014	6,418	66	3,330	34	9,748	8.7
2015	5,288	60	3,487	40	8,774	7.8
2016	5,270	61	3,372	39	8,642	7.7
2017	5,707	64	3,191	36	8,898	7.9
2018	5,776	64	3,315	36	9,091	8.1
2019	6,146	66	3,182	34	9,328	8.3
Average	**6,387**	**66**	**3,351**	**34**	**9,738**	**8.7**

(a) Historical production data provided by City in January 2020.

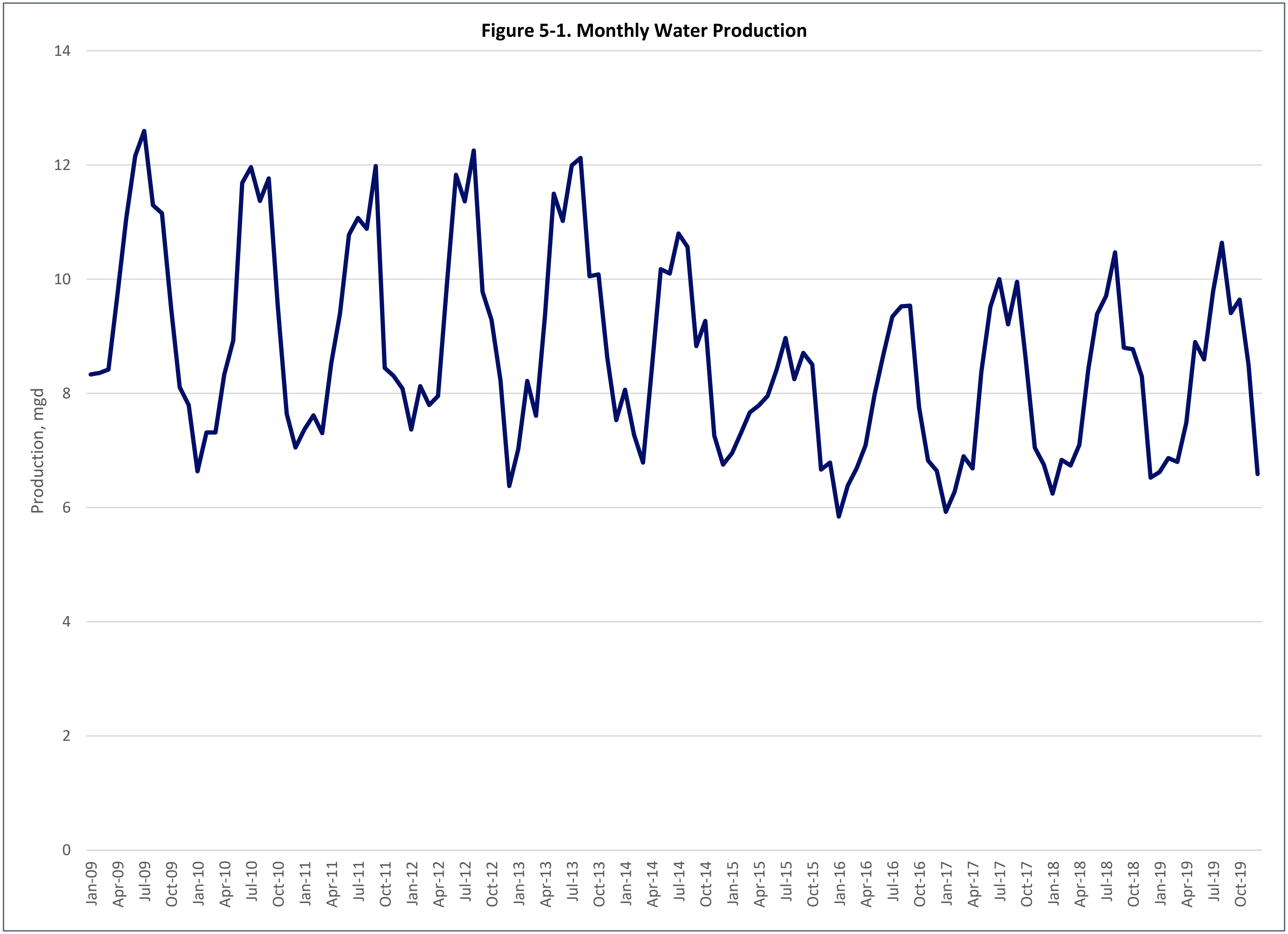


Figure 5-1. Monthly Water Production
Production, mgd
0
2
4
6
8
10
12
14
Jan-09
Apr-09
Jul-09
Oct-09
Jan-10
Apr-10
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Jan-19
Apr-19
Jul-19
Oct-19

5.1.2 Water Consumption

Table 5-2 summarizes historical water consumption (2013 through 2019) by customer type and was developed from City-provided billing data[7]. Over this 7-year period, residential customers averaged about 55 percent of the total City consumption. Commercial users averaged about 40 percent of total consumption, with Public (City and County) users making up the remainder (just over 4 percent). The overall consumption trend follows the City's production and is consistent across residential and commercial customers.

Table 5-2. Historical Metered Water Consumption[(a)]

Customer Type	CY 2013, mgd	CY 2014, mgd	CY 2015, mgd	CY 2016, mgd	CY 2017, mgd	CY 2018, mgd	CY 2019, mgd
Residential							
Water	4.39	4.08	3.82	3.74	3.97	4.31	3.92
Fire	0.00	0.00	0.00	0.00	0.04	0.00	0.00
Irrigation	0.36	0.32	0.21	0.24	0.29	0.31	0.34
Subtotal Residential	4.75	4.40	4.03	3.98	4.31	4.62	4.26
Commercial							
Water	2.95	2.68	2.73	2.57	2.65	2.71	2.43
Fire	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Irrigation	0.64	0.53	0.38	0.37	0.44	0.47	0.51
Subtotal Commercial	3.59	3.21	3.11	2.94	3.10	3.19	2.94
Public							
Water - City	0.04	0.03	0.02	0.03	0.03	0.03	0.04
Water - County	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Irrigation - City	0.38	0.23	0.58	0.17	0.28	0.23	0.18
Subtotal Public	0.42	0.26	0.61	0.20	0.32	0.27	0.22
Total	**8.76**	**7.87**	**7.75**	**7.12**	**7.72**	**8.09**	**7.43**

(a) Based on billing data provided by City in January 2020.

[7] Billing data was bi-monthly. Usage was grouped into calendar years based on the ending date of the billing period. As a result, annual consumption may not match other sources depending on how year-end water use is accounted for.

5.1.2.1 Large Water Users

Refer to Chapter 2 (Table 2-3) for the list of the Large Water Users in CY 2019 (those using more than 30,000 gpd).

5.1.3 Non-Revenue Water

NRW is the difference between the volume of water produced and the volume of water consumed or metered. Though there are many reasons why production may exceed consumption, the most common include system losses including, but not limited to, leakage, measurement errors, and unauthorized use. While water utilities try to minimize NRW, it is difficult to eliminate entirely.

Table 5-3 summarizes the City's historical NRW between 2013 and 2019. NRW is calculated from production and consumption data (Table 5-1 and Table 5-2, respectively) except where available from validated American Water Works Association (AWWA) water audits. NRW falls generally between 9 and 11 percent, though it peaked at 15.4 percent in 2016. The average NRW from 2013 to 2019 is approximately 10.9 percent.

West Yost recommends using a NRW of 11 percent to calculate the City's total future water production requirement.

Table 5-3. Historical Non-Revenue Water[a]

Calendar Year	Total Production, mgd	Total Consumption, mgd	Water Loss, mgd	Non-Revenue Water, %
2013	9.60	8.76	0.84	8.8
2014	8.70	7.87	0.84	9.6
2015	7.83	7.75	0.08	10.5[b]
2016	7.69	7.12	0.57	15.4[b]
2017	7.94	7.72	0.22	9.6[b]
2018	8.12	8.09	0.03	11.2[b]
2019	8.33	7.43	0.90	10.8
Average	**8.32**	**7.82**	**0.50**	**10.9**

(a) Refer to Table 5-1 and Table 5-2. Non-revenue water (NRW) equals Water Loss divided by Total Production, unless otherwise noted.
(b) NRW equals "Non-revenue water as percent by volume of Water Supplied" from City's water audits, received August 2020.

5.1.4 Per Capita Water Use

The City's historical per capita water use is presented in Table 5-4. While population continued to grow through the drought, per capita water use fell dramatically in 2015 and remained low in 2016 due to water conservation and mandatory water reduction measures implemented during the drought. Per capita water use rebounded slightly in 2017 and is holding steady but remains well below 2013 levels.

Table 5-4. Historical Per Capita Water Use[a]			
Calendar Year	Population[b]	Total Production, mgd	Per Capita Water Use, gpcd
2013	68,622	9.60	140
2014	70,701	8.70	123
2015	73,632	7.83	106
2016	74,766	7.69	103
2017	74,922	7.94	106
2018	75,083	8.12	108
2019	77,961	8.33	107
		Average	**113**
		Average (excluding 2015 and 2016)[c]	**117**

(a) Refer to Table 5-1.
(b) Population for 2013 through 2018 is from CA Department of Finance, E-4 Population Estimates (May 1, 2020). Population for 2019 is based on January 1, 2020 population from CA Department of Finance, E-1 Population Estimates (May 1, 2020).
(c) Data from 2015 and 2016 were excluded due to mandatory water restrictions implemented by the State Water Resources Control Board during these two years.
gpcd = gallons per capita per day

As described in Section 5.2.1 below, the City's per capita water use in 2015 and 2020 was well below (in compliance with) the City's per capita water use goals as required by the Water Conservation Act of 2009.

5.1.5 Peaking Factors

Peak demands are used to evaluate and size water system pipelines and storage facilities and define water supply and capacity requirements. Projecting peak demands typically involves applying a multiplier, or peaking factor, to average day demand (ADD), which is calculated by dividing a year's total water production by the number of days in that year (refer to Table 5-1).

Recent water use data help refine peaking factors for key demand conditions. To account for NRW, production totals are used. This subsection describes the methodologies utilized to update the City's maximum day demand (MDD) and peak hour demand (PHD) peaking factors and presents their revised values.

5.1.5.1 Maximum Day Demand Peaking Factor

The MDD peaking factor is calculated by dividing the calendar year's largest single day demand by the ADD of the same year. Under normal conditions, the City's water demands are served by supplies from either turnouts or pumped storage. As a result, determining daily demands requires data for both turnout flows and storage reservoir levels. Detailed historical reservoir information was unavailable, so West Yost reviewed daily flows from SFPUC and VW turnouts as a proxy for daily demands. Turnout flows are a valid substitute for demands if, as is assumed in this master plan, storage reservoir inflows are similar to pumped outflows over a 24-hour period.

Due to the different customer types in each service area, separate MDD peaking factors have been developed for the SFPUC and VW systems. The 2002 WMP (and the 2009 WMPU, which used the same peaking factors as in 2002) also acknowledged the impact of customer type on water use, going so far as to develop separate peaking factors for residential (1.9) and industrial/commercial (1.5) users. Data limitations preclude calculating land use-based peaking factors for this master plan. However, the portion of the City served by the SFPUC system has more residential customers, while the portion of the City served by the VW system has more industrial/commercial customers.

Based on daily turnout flows from 2016 through 2019, the recommended MDD peaking factor for the SFPUC system is 1.6. Table 5-5 summarizes the historical MDD peaking factors by calendar year, including the date and magnitude of maximum daily production. In 2019, the maximum day production was significantly higher than in previous years. On this date (June 20, 2019), VW turnout flows were less than 2,000 gallons, so it is assumed SFPUC turnouts were supplying the entire City (i.e., both SFPUC and VW service areas). Thus, the 2019 MDD peaking factor is excluded when determining the recommended MDD peaking factor for this master plan.

The City has observed especially high daily water use in Zones SF3 and SF4, so the MDD peaking factor will be doubled for those customers. As a result, the MDD peaking factor will be 1.6 for customers in Zones SF1 and SF2 and 3.2 for customers in Zones SF3 and SF4.

The recommended MDD peaking factor for the VW system is 1.9. This is based on daily turnout flows from 2017 through 2019, as 2016 data had some extreme outliers and thus was deemed less reliable. Maximum daily production was relatively consistent from 2017 to 2018 before jumping up significantly in 2019.

Table 5-5. SFPUC Historical Maximum Day Demand Peaking Factors

Calendar Year	Maximum Day Demand Date[a]	Average Day Production[b], mgd	Maximum Day Production[c], mgd	Maximum Day Demand Peaking Factor
2016	August 12	4.71	7.10	1.51
2017	October 15	5.10	8.25	1.62
2018	November 15	5.16	8.09	1.57
2019	June 20	5.48	9.59	1.75
	Average	**5.11**	**8.26**	**1.61**
	Average (excluding 2019)[d,e]	**4.99**	**7.81**	**1.56**

(a) SFPUC turnout flows used as a proxy for customer demands in Zones SF1 through SF4.
(b) Refer to Table 5-1.
(c) SFPUC daily production data provided by City in January 2020.
(d) Data from 2019 excluded due to minimal VW flows on date of maximum SFPUC production (June 20, 2019).
(e) Due to high peak water use in Zones SF3 and SF4, the maximum day demand peaking factor will be doubled for those pressure zones.

Table 5-6. VW Historical Maximum Day Demand Peaking Factors				
Calendar Year	Maximum Day Demand Date[a]	Average Day Production[b], mgd	Maximum Day Production[c], mgd	Maximum Day Demand Peaking Factor
2016[d]	--	3.00	--	--
2017	June 30	2.84	4.90	1.73
2018	April 25	2.96	5.26	1.78
2019	October 10	2.84	6.64	2.34
	Average	**2.91**	**5.60**	**1.95**

(a) VW turnout flows used as a proxy for customer demands in Zones VW1 and VW2.
(b) Refer to Table 5-1.
(c) VW daily production data provided by City in May 2020.
(d) 2016 data incomplete.

5.1.5.2 Peak Hour Demand Peaking Factor

The PHD peaking factor is calculated by dividing the calendar year's largest single hour demand by the ADD of the same year. In the absence of hourly customer water use data for an entire year, the PHD peaking factor is typically estimated by applying diurnal curves during a maximum day demand. A diurnal curve reflects variations in water use over a 24-hour period and often has two demand peaks, one in the morning before residents leave home and another in the evening when they return home.

The City does not have the monitoring and reporting infrastructure in place to provide hourly water use data that would be required to develop a diurnal curve, so the recommended PHD peaking factor is based on West Yost's recent experience and typical PHD peaking factors determined for similar water systems. West Yost recommends a PHD peaking factor of 1.8 times MDD, which is slightly lower than the 2.0 peaking factor utilized in the 2009 WMPU. The recommended PHD peaking factor translates to 2.9 times ADD (1.6 x 1.8) for Zones SF1 and SF2, 5.8 times ADD (3.2 x 1.8) for Zones SF3 and SF4, and 3.4 times ADD (1.9 x 1.8) for the VW service area.

5.1.5.3 Summary of Recommended Peaking Factors

Table 5-7 summarizes the recommended peaking factors for each service area. As shown, the peaking factors represent multipliers applied to average day demands.

Table 5-7. Recommended Peaking Factors			
Service Area	Pressure Zones	Maximum Day Demand Peaking Factor[a]	Peak Hour Demand Peaking Factor[a,b]
SFPUC	SF1, SF2	1.6	2.9
SFPUC	SF3, SF4[c]	3.2	5.8
VW	VW1, VW2	1.9	3.4

(a) Peaking factors shown are applied to average day demand.
(b) The Peak Hour Demand (PHD) peaking factor is calculated by multiplying the Maximum Day Demand (MDD) peaking factor by 1.8 as described in Section 5.1.5.2.
(c) Due to high peak water use in Zones SF3 and SF4, peaking factors are doubled for those pressure zones.

5.2 WATER CONSERVATION

Water conservation is a key component of water demands. Discussions regarding existing and potential future water conservation in the City are presented below. Additional detail regarding the City's conservation efforts are documented in the City's 2020 Urban Water Management Plan, which is currently being prepared.

5.2.1 Water Conservation Act of 2009

In February 2008, the Governor called for a statewide 20 percent reduction in urban per capita water use by 2020 and asked state and local agencies to develop a more aggressive water conservation plan to achieve that goal. A team of state and federal agencies (the 20x2020 Agency Team) was formed to develop a statewide implementation plan.

Subsequently, the Water Conservation Act of 2009 (Senate Bill [SB] X7-7) was enacted in November 2009 as part of a comprehensive set of new Delta and water policy legislation requiring all water suppliers to increase their efficiency. Overall, the objective of SB X7-7 was to reduce statewide urban water use by 20 percent by the year 2020. SB X7-7 required water retailers to establish and adopt per capita water use targets (an interim target for 2015 and a final target for 2020) using defined methodologies. Adopted per capita water use targets were required to be included in the 2010 UWMPs and could be updated as part of the 2015 UWMPs. The City's adopted per capita water use targets are as follows:

- 2015 Interim Per Capita Water Use Target: 164 gpcd
- 2020 Final Per Capita Water Use Target: 146 gpcd

Compliance with the 2015 per capita water use target was required to be reported in the City's 2015 UWMP. In 2015, the City's actual per capita water use was 106 gpcd (refer to Table 5-4), well below (and in compliance with) the City's interim target for 2015. This was due in large part to the on-going drought conditions and associated mandatory water use restrictions in place in 2015.

As reported in the City's 2020 UWMP, the City's 2020 actual per capita water use was 108 gpcd, well below (and in compliance with) the City's final target for 2020. The City exceeded its 2020 per capita water use target compliance by 26 percent. This is in part due to the City's on-going implementation of permanent water conservation measures outlined in Chapter 6 Water Conservation of the City's Code of Ordinances.

5.2.2 Making Water Conservation a California Way of Life

In May 2016, Governor Brown signed Executive Order B-37-16, instructing state agencies to help Californians adopt permanent changes to use water more wisely. The Executive Order laid out a framework for moving the state from temporary, emergency water conservation measures to a more lasting approach customized to the unique conditions of each local water agency.

In May 2018, the California State Legislature (Legislature) enacted two policy bills (SB 606 and Assembly Bill (AB) 1668) targeting long-term improvements in water conservation and drought planning that could withstand longer and more intense droughts resulting from climate change. These two bills expanded authorities and requirements to enable permanent changes and improve the state's water future. SB 606 and AB 1668 are direct outcomes of Governor Brown's Executive Order B-37-16.

The recommendations in the April 2017 report entitled "Making Water Conservation a California Way of Life, Implementing Executive Order B-37-16" and subsequent extensive legislative outreach efforts informed the development of SB 606 and AB 1668. The new laws focus on establishing water use objectives and long-term water efficiency standards that apply to urban retail water suppliers, including:

- **Indoor Residential Water Use:** Although not all standards have been developed, the indoor residential water use efficiency standard has been set by the Legislature. Until January 1, 2025, the standard is set at 55 gpcd, then it drops to the greater of 52.5 gpcd or a standard developed by the Department of Water Resources (DWR) between January 2, 2025 and January 1, 2030; and then the greater of 50 gpcd or a standard developed by DWR after January 1, 2030.
- **Outdoor Residential Water Use and Commercial, Industrial and Institutional (CII) Irrigation with Dedicated Meters**: Per SB 606 and AB 1668, the State Water Resources Control Board (SWRCB) is required to adopt long-term standards for outdoor irrigation of landscape areas by June 30, 2022. The standards to be set shall incorporate the principles of the Model Water Efficient Landscape Ordinance (MWELO), which considers evapotranspiration adjustment factors, landscape areas, maximum applied water allowance, reference evapotranspiration, and special landscape area.
- **Water Loss (due to leaks in water system pipes):** SB 555, passed in October 2015, requires the SWRCB to develop water loss performance standards for urban retail water suppliers. The SWRCB is required to evaluate the life-cycle cost of achieving these standards. The standards will incorporate local and operational conditions to determine economically achievable water loss reduction for each urban retail water supplier.

The recently passed water efficiency legislation only provides a "provisional standard" for indoor residential water use and does not currently provide specific information on what the water efficiency standards will be for outdoor residential water use and non-residential water uses. These standards will be developed in the coming years and should be further evaluated in subsequent planning studies. Also, there are no guarantees that urban retail water suppliers will meet the water efficiency standards to be set, so West Yost recommends that the City continue to consider more conservative water demand projections based on historical water use for their future water supply and system planning.

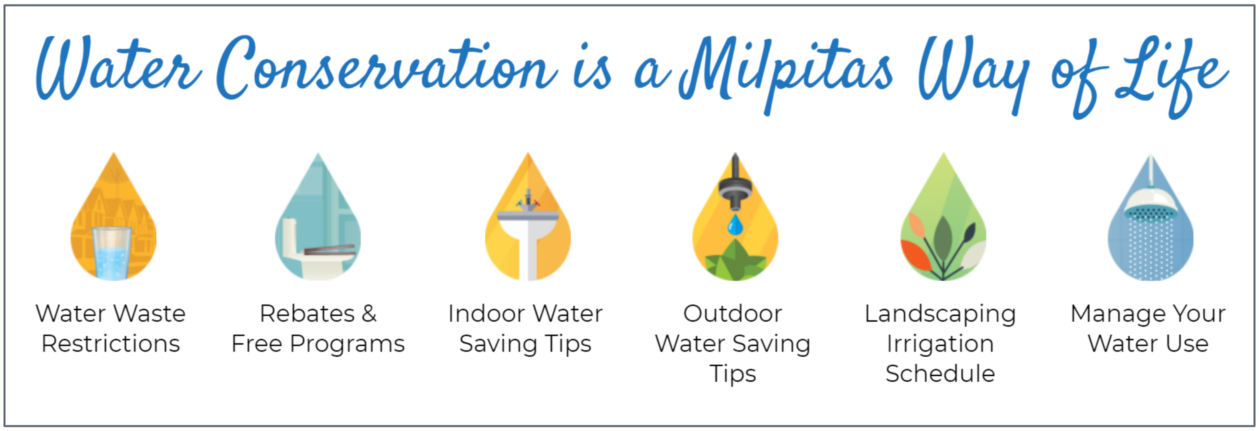
5.2.3 Current Water Conservation Programs

The City's UWMP describes the water conservation measures that have been implemented by the City. A Water Waste Ordinance (Ordinance 240.4) was in effect during the recent drought, along with a Water Conservation Program to facilitate reporting of water waste. The City also implemented the following measures:

- Conservation pricing
- Public education and outreach in conjunction with Valley Water and the BAWSCA
- Residential water surveys
- Free low-flow plumbing fixtures
- Irrigation submeter rebates
- Landscape water surveys and conversion rebates

- High-efficiency clothes washer rebates
- Rebates for process, technology, and equipment retrofits that save water
- High-efficiency toilet and urinal valve replacement rebates

These water conservation measures continue to be implemented in the City.



From savewatermilpitas.org

Current information on the City's water use restrictions and water conservation and rebate programs is posted on the City's water conservation webpage (savewatermilpitas.org). In addition, the City's water customers have access to MyWater Milpitas which is an on-line tool that allows customers to track and manage their water consumption.

From MyWater Milpitas

5.3 FUTURE WATER DEMAND PROJECTION

Future City water demands were projected based on land use data, the preferred method for water system master planning and hydraulic modeling. Population-based methods are appropriate for estimating overall water demands, but they fail to account for spatial variations in water use. In contrast, land-use based demand projections geographically allocate water use based on existing consumption and future development.

This section details the demand projection methodology and presents the associated results.

5.3.1 Demand Projection Methodology

Buildout water demands equal the sum of existing demands and projected future demands as a result of new development. Demand projections are typically calculated based on land use, with expected land area multiplied by a WUF. WUFs are developed from recent historical consumption data and vary by land use type. In other words, WUFs recognize that a 10-acre industrial processing plant would use more water than a similarly sized office park.

Establishing appropriate WUFs is a critical step in forming reliable water demand projections. The adopted factors will be used to calculate future demands for growth areas in the City, as defined by the City's General Plan and other on-going planning efforts. Future demands will then be adjusted for NRW to determine the required future water production.

5.3.2 Water Use Factors

A WUF is defined as the estimated water use per unit area of a given land use type. The following data was used to update WUFs:

- 2019 consumption data with service addresses (per billing records)
- Service address-Assessor's Parcel Number (APN) database
- General Plan land use parcel map with APNs (GIS file)

Water consumption was linked with spatially located land use based on customer service address and APN. Using a City-provided spreadsheet of customer service addresses and APNs, the 2019 water meter billing records were first linked to APNs using customer service addresses. Water usage could then be linked to land use via APN. Successfully assigning land use to a water billing record required a match for both service address and APN. Approximately 64 percent of 2019 demand could be linked.

West Yost developed preliminary WUFs for each existing General Plan land use designation by dividing the total linked water use by the total corresponding acreage. Due to the lower demand linkage rate, preliminary WUFs were refined by examining specific developments and estimated per capita water use based on estimated dwelling units per acre and people per dwelling unit. The City provided West Yost with a list of representative developments of various land uses (e.g., office park, apartment complex, commercial) to verify whether a development's actual consumption was in line with its WUF-based demand estimate. In addition, West Yost used General Plan density standards to compare per capita water use across residential and mixed use land use types and to the 2009 WMPU. Any WUFs that resulted in unusually high or low per capita consumption were adjusted accordingly. Most of the preliminary WUFs calculated from actual usage were only adjusted slightly to their recommended values. A handful of preliminary WUFs (e.g., Urban Residential) were unusually low, likely due to limited linked water use for that land use, and increased to their recommended values.

Recommended WUFs are summarized in Table 5-8, along with a comparison to 2009 WMPU values (where available). WUFs are generally lower than in the 2009 WMPU, which is consistent with conservation efforts and efficiency improvements implemented over the last decade. For some land uses, limited data prevented updating WUFs, so the 2009 WMPU values were used. This is a conservative approach, as actual WUFs have likely decreased.

5.3.3 Water Demand Projection

West Yost developed water demand projections by applying the recommended WUFs to the future land use acreages detailed in Chapter 2. Total buildout demand is the sum of existing demands and new demands from future planned growth in Opportunity Areas and the Gateway and Milpitas Metro Specific Plan areas. Based on available data and to be conservative, growth was assumed to be new development, not redevelopment of existing developed areas, so future demands were added to existing demands. The land use-based demand projections are based on preliminary land use estimates that are subject to change as the City refines its planning documents.

Table 5-9 summarizes the buildout water demand projection. After adjusting for NRW, the City's projected water production required at buildout is approximately 13.9 mgd, or 15,600 af/yr. This is an increase of approximately 5.6 mgd, or 67 percent, over existing (2019) production (8.3 mgd).

The buildout water demand projection accounts for existing recycled water use but not additional recycled water use in either existing or future development areas. As discussed in Section 5.3.2, WUFs were based on actual potable water consumption, which reflects any existing recycled water use that would offset potable water use. However, the buildout water demand projection does not include any expanded recycled water use for irrigation or other non-potable uses. Increased recycled water use would mean that actual buildout water demands should be lower than the current projection. Since information on future development remains conceptual, the location and magnitude of future recycled water use are difficult to estimate. As a result, West Yost recommends proceeding with this conservative demand projection.

On a per capita basis, the projected future water use equates to 119 gpcd, slightly higher than the City's 2019 per capita water use (107 gpcd). Using U.S. Census data from 2014 to 2018, the City's household population density averages approximately 3.33 people per dwelling unit (DU). Assuming future housing densities will be similar to existing densities, adding 11,650 new DUs translates to approximately 38,794 new residents, for a total buildout population of approximately 116,755. Dividing the projected buildout demand (13.9 mgd) by the projected future population yields an overall per capita water use of approximately 119 gpcd, similar to the City's recent per capita water use average for the last several years (117 gpcd, see Table 5-4).

In the absence of specific timing for future development, required water production for intermediate planning years was linearly interpolated. Table 5-10 summarizes the land use-based water production projections in five-year increments through buildout (2040).

Table 5-8. Recommended Water Use Factors

Category	Existing General Plan Land Use[a]	Abbreviation[a]	Recommended WUF, gpd/ac	2009 WMPU WUF, gpd/ac	Percent Difference from 2009 WMPU
Residential	Hillside Very Low Density	HVL	300	800	-63
	Hillside Low Density	HLD	300	800	-63
	Hillside Medium Density	HMD	600	800	-25
	Single Family Low Density	SFL/LDR	1,300	2,240	-42
	Single Family Medium Density	SMD	2,400	NA[b]	--
	Multi-Family Medium Density	MFM/MDR	2,300	NA[b]	--
	Multi-Family High Density	MFH/HDR	4,500	5,310	-15
	Multi-Family Very High Density	VHD/VHDR	9,000	9,720	-7
	Urban Residential	URR	4,500	NA[b]	--
	Mobile Home Park	MHP	825	NA[b]	--
Mixed Use	Mixed Use	MXD	10,890	10,890	0[c]
	Residential Retail High Density Mixed Use	RRMU	10,890	NA[b]	--
	Boulevard Very High Density Mixed Use	BVMU/ VHDMU	10,890	NA[b]	--
	Neighborhood Commercial Mixed Use	NCMU	2,100	NA[b]	--
Commercial	Professional & Administrative Office	PAO	3,200	3,200	0[c]
	Retail Subcenter	RSC	2,800	4,290	-35
	General Commercial	GNC	1,400	2,400	-42
	Highway Service	HWS	2,000	NA[b]	--
	Town Center	TWC	2,100	NA[b]	--
	Neighborhood Commercial	NC	1,400	NA[b]	--
Industrial	Manufacturing	MFG	2,000	2,000	0[c]
	Industrial Park	INP	400	1,250	-68
	Business Park/Research & Development	BPRD	400	NA[b]	--
Public	Public Facilities	PF	600	1,000	-40
	Permanent Open Space	POS	1,300	1,300	0[c]
	Waterway	WW	1,300	NA[b]	--

(a) Categories and abbreviations based on land use information provided by the City in January 2020. Multiple abbreviations reflect existing and future iterations of the same land use category. The future abbreviation is listed second.
(b) NA = not applicable. WUF for this land use was not specified in the 2009 WMPU.
(c) WUF was not updated due to limited data.

Table 5-9. Buildout Potable Water Demand Projection

Development	Land Use Designation[a]	Total Acres[a]	WUF[b], gpd/ac	Demand, mgd
Opportunity Areas - Residential				
Sunny Hills Neighborhood Node/Commercial Center	NCMU	19.92	2,100	0.04
California Circle	NCMU	54.10	2,100	0.11
California Circle	HDR	18.26	4,500	0.08
Landess Neighborhood Node/Commercial Center	NCMU	38.03	2,100	0.08
Calaveras & North Park Neighborhood Node/Commercial Center	NCMU	28.28	2,100	0.06
Milpitas Town Center	HDR	38.07	4,500	0.17
			Subtotal	0.55
Opportunity Areas - Non-Residential				
McCarthy Ranch Industrial Area	INP	192.29	400	0.08
Southwestern Employment Area	BPRD	488.26	400	0.20
Central Manufacturing Area - North	MFG	492.14	2,000	0.98
Jacklin & 680 Neighborhood Node/Commercial Center - East	NC	7.95	1,400	0.01
Jacklin & 680 Neighborhood Node/Commercial Center - West	NC	6.42	1,400	0.01
Jacklin Neighborhood Node/Commercial Center	NC	9.79	1,400	0.01
			Subtotal	1.29
Milpitas Gateway-Main Street Specific Plan				
HDR Subset of Gateway-Main Street	HDR	46.70	4,500	0.21
VHDR Subset of Gateway-Main Street	VHDR	74.58	9,000	0.67
MDR Subset of Gateway-Main Street	MDR	62.70	2,300	0.14
Non-Residential Subset of Gateway-Main Street	MFG	300.30	2,000	0.60
			Subtotal	1.63
Milpitas Metro Specific Plan (MMSP)				
VHDR Subset of Metro Plan Area	VHDR	99.00	9,000	0.89
HDR Subset of Metro Plan Area	HDR	113.52	4,500	0.51
NC Subset of Metro Plan Area	NC	85.35	1,400	0.12
			Subtotal	1.52
			Total New Demand	4.99
			NRW (11%)	0.62
			New Water Production Required	5.60
			Existing (2019) Water Production	8.33
			Buildout Water Production Required	**13.9**

(a) Refer to Table 2-4.

(b) Refer to Table 5-8.

Table 5-10. Land Use-Based Water Demand Projection for Intermediate Planning Years		
Year	Required Water Production	
	mgd	af/yr
2020	8.33	9,334
2025	9.73	10,904
2030	11.1	12,474
2035	12.5	14,044
2040[a]	13.9	15,614

(a) Refer to Table 5-9.

5.3.4 Comparison with Other Demand Projections

5.3.4.1 2009 WMPU and 2015 UWMP

Table 5-11 compares current projections with the 2009 WMPU and the 2015 UWMP. At buildout (2040), the land use-based water demand projection presented above is approximately 3.5 mgd lower than projections from the 2009 WMPU. This represents a decrease of approximately 20 percent. The 2009 WMPU did not specify a growth timeline or buildout year, so intermediate planning year demands are blank in the table. Further, it was assumed the 2009 WMPU "future" coincides with the year 2040.

Demand projections in the 2015 UWMP follow the same timeline as this master plan. Throughout the planning horizon, the demand projections from this master plan are significantly lower than demand projections from the 2015 UWMP. At buildout (2040), demand projections are 4.6 mgd (about 25 percent) lower than the 2015 UWMP. Based on the available information, it is not clear why the demand projections in the 2015 UWMP were so high.

Table 5-11. Land Use-Based Water Demand Projection Comparison with Previous City Reports					
Source	Projected Demand, mgd				
	2020	2025	2030	2035	2040
2020 Water Master Plan[a]	8.33	9.73	11.1	12.5	13.9
2009 WMPU[b]	--[c]	--[c]	--[c]	--[c]	17.4
Difference vs. 2009 WMPU	NA[d]	NA[d]	NA[d]	NA[d]	-3.5
2015 UWMP[e]	10.0	12.1	14.3	16.4	18.5
Difference vs. 2015 UWMP	-1.7	-2.4	-3.2	-3.9	-4.6

(a) Refer to Table 5-10.
(b) Source: 2009 WMPU, Table 3-6 (Scenario 3). It is assumed future demand in the 2009 WMPU equals demand in year 2040.
(c) 2009 WMPU did not specify a timeline for demands.
(d) NA = not applicable.
(e) Source: 2015 UWMP, Table 4-2.

5.3.4.2 BAWSCA Regional Water Demand and Conservation Projections Demand Forecast for 2020 UWMP

Maddaus Water Management, Inc. (Maddaus) prepared a Regional Water Demand and Conservation Projections Project for the BAWSCA to support each member agency's preparation of their 2020 UWMPs. In February 2020, Maddaus prepared a technical memorandum (Technical Memorandum #2) to present the following: (1) the demand projection analysis methodology; (2) the demand analysis results including each BAWSCA member agency demand projections through 2045; and (3) the projections verification process to be completed and signed by each member agency to accept the demand projections.

The demand projection update for each BAWSCA member agency uses a combination of two different analytic models – the Econometric Model and the Least Cost Planning Decision Support System (DSS Model). The purpose of using two tools is to leverage the strengths of each tool to obtain a suite of demand recovery scenarios through the year 2045.

- The Econometric Model estimates the impact of various conditions on service area water demand. The model uses historical patterns to project the future rebound in demand associated with post-drought recovery, while taking into account other factors such as economy, rate increases, conservation activity, and weather. Since the Econometric Model is calibrated using historical data, its reliability depends on the historical relationship between water demand and its influencing factors remaining unchanged from the calibration period to the forecasting period.
- The DSS Model can accommodate historical and projected information reflecting how future service area and water use characteristics may differ from the past in each of the BAWSCA member service areas. Further into the future, changes in demographics, living patterns, housing stock, and industrial structure can alter the historical relationship with water demand. To accommodate all of these considerations, a number of scenarios were generated to model the post-drought demand recovery, including one scenario per member agency generated by each agency's respective Econometric Model. The DSS Model also has a conservation component that quantifies savings from plumbing codes and active conservation programs.

The Econometric Model for each BAWSCA member agency was used to generate water demand forecasts to the year 2023. The Econometric Model assumes temporary behavioral changes encouraged during the drought return to pre-drought norms. However, the water savings emanating from historical water rate increases and active conservation programs (e.g., non-behavior-based programs such as rebates) achieved through 2018 are assumed to be permanent and therefore do not rebound. The model assumes that the predicted demand recovery will occur gradually over an additional five years (2019-2023), based on BAWSCA's historical experience of the 1987-1992 drought.

The DSS Model was used to generate long-term demand forecasts for each BAWSCA member agency for 2019 to 2045. The DSS Model also includes a conservation component that quantifies savings from passive conservation (e.g., plumbing codes) and active conservation programs. The DSS Model's conservation component covers the entire forecast period of 2019-2045.

The City provided historical water use data and confirmed population and employment projections to be used by Maddaus for the demand projections. The resulting demand projections for the City, which include both potable and non-potable (i.e., recycled water) uses, are presented in Table 5-12.

Table 5-12. City of Milpitas Demand Projections as Calculated by Maddaus[a]						
Demand Forecast Scenario[b]	Demand Projections, mgd					
	2023	2025	2030	2035	2040	2045
Pre-Recession and Pre-Drought Demand Level Recovery	11.4	12.0	12.3	12.8	13.1	13.5
Pre-Drought Demand Level Recovery	10.7	11.1	11.4	11.9	12.3	12.6
Partial Rebound – Normal Economy, Weather Normalized	11.3	11.9	12.4	13.0	13.5	14.0
Current Water Demand Profile – Normal Economy, Weather Normalized	9.4	9.5	9.5	10.3	10.7	11

Source: Technical Memorandum #2 BAWSCA Regional Water Demand and Conservation Projection Demand Forecast, prepared for Bay Area Water Supply & Conservation Agency, prepared by Maddaus Water Management, Inc., February 21, 2020

(a) These demand projections include non-potable (i.e., recycled water) use (approximately 2 mgd by 2045). Savings from active conservation programs are not included in these projections.

(b) See text below for description of demand forecast scenarios.

The demand forecast scenarios are described as follows:

- Pre-Recession and Pre-Drought Demand Level Recovery: Demand projections are based on the City's 2000-2007 water use profile, starting with 2018 demand levels and recovering from the drought in five years.
- Pre-Drought Demand Level Recovery: Demand projections are based on the City's 2004-2013 water use profile, starting with 2018 demand levels and recovering from the drought.
- Partial Rebound–Normal Economy, Weather Normalized: Demand projections are based on the Econometric Model with the following assumptions: (1) normal weather, (2) normal economy, (3) price escalation projections that vary by agency, (4) historical active conservation efforts, and (5) passive conservation plumbing codes.
- Current Water Demand Profile: Demand projections are based on the following assumptions: (1) normal economy, and (2) weather normalized. This is water demand calculated from historical 2018 water production data submitted by each BAWSCA member agency. The 2018 data were weather normalized and assume a normal economy. This scenario does not include any additional post-drought demand recovery.

Savings from plumbing codes (also known as passive conservation) is based on federal and state legislated efficiency standards pertaining to plumbing fixtures and appliances. The impact of codes quantified here include the Energy Policy Act of 1992, CALGreen Building Code, AB 715, and SB 407 (governs the types of fixtures available on the market for toilets, showers, washers, etc.). The plumbing code savings have been added into all four scenarios shown above.

Though the BAWSCA projections include recycled water use and extend to 2045, five years beyond the scope of this Water Master Plan, the buildout demand projections are comparable. As discussed in Section 5.3.3, the Water Master Plan land use-based water demand projection counts any potential new (i.e., above existing) recycled water use as potable water use. Therefore, the projection of 13.9 mgd generally compares well with the Maddaus demand projections, particularly the Partial Rebound – Normal Economy, Weather Normalized scenario demand projection of 14.0 mgd.

CHAPTER 6
Hydraulic Model Update and Calibration

This chapter describes the process of updating and calibrating the City's water system hydraulic model to confirm it accurately represents the City's existing water system. The hydraulic model was then used to evaluate the adequacy of the City's water system under existing (Chapter 8) and future (Chapter 9) water demand scenarios.

The following sections detail the hydraulic model update and calibration process:

- Hydraulic Model Background
- Hydraulic Model Element Naming Scheme
- Hydraulic Model Update Methodology
- Hydraulic Model Review and Update
- Steady-State Hydraulic Model Calibration
- Summary of Findings and Conclusions

6.1 HYDRAULIC MODEL BACKGROUND

As part of the 2002 WMP, Raines, Melton & Carella (RMC) developed an operational water system hydraulic model for the City using H_2ONet. In the 2009 WMPU, RMC converted the hydraulic model to H_2OMAP and re-evaluated the City's water system using updated land use information. This H_2OMAP-based hydraulic model has not been regularly updated since the 2009 WMPU.

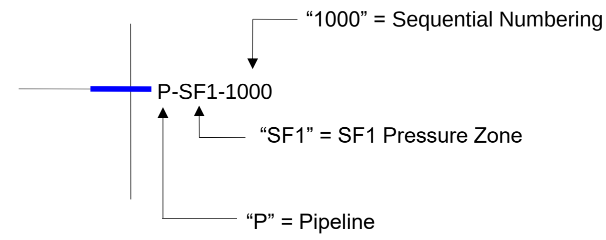
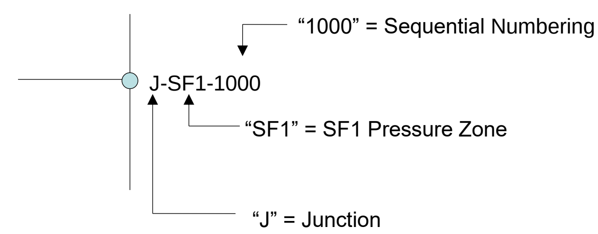
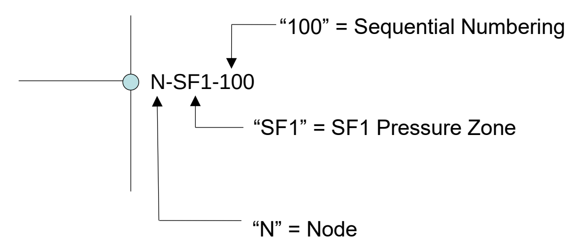
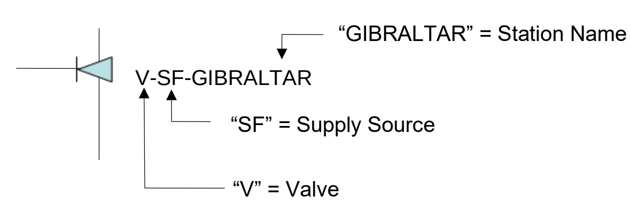
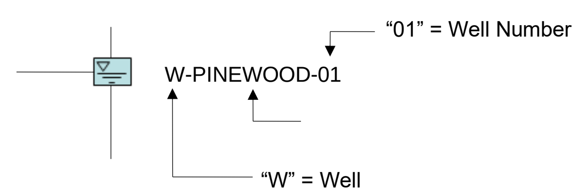
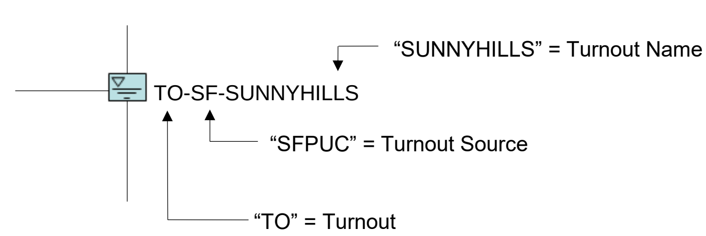
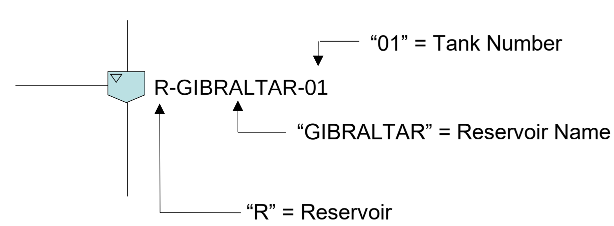
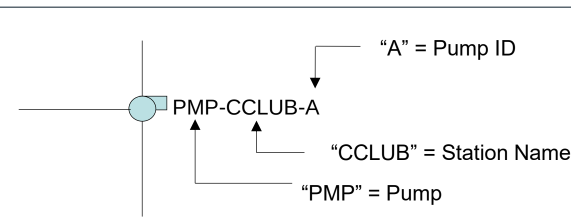
In 2017, Innovyze retired the H_2OMAP modeling platform in favor of InfoWater. As a result, West Yost rebuilt the City's hydraulic model in InfoWater using the latest information for major facilities (e.g., pumps, storage reservoirs, and valves) provided by the City.

6.2 HYDRAULIC MODEL ELEMENT NAMING SCHEME

A specific and consistent naming convention allows modelers to easily locate and identify modeling elements like pipes, junctions, pumps, and storage reservoirs. As each facility is created in the model, it is named logically and sequentially based on industry standards and West Yost's extensive modeling experience. Table 6-1 summarizes the hydraulic element functions, along with prefixes used in naming.

Table 6-1. Hydraulic Network Elements		
Type	Description	Prefix
Pipelines	Conveys water from one node to another. Pipelines are assigned hydraulic characteristics (e.g., diameter, roughness) and general information (e.g., pressure zone, year of installation).	P
Junctions	Removes (demand) or adds (inflow) water from/to the system. Junctions represent connections to customer service laterals, hydrants, turnouts, etc.	J
Nodes	Represents either a transition in pipeline characteristic (e.g., change in diameter) or a point where pressure and/or water quality are monitored. Nodes are similar to junctions but do not add or remove water to the system.	N
Valves	Controls flow or pressure in the system based on specified criteria. Valves typically represent pressure reducing valves (PRV) or pump variable frequency drives, using pressure settings provided by the City.	V
Wells	A water source with fixed head, representing the hydraulic grade of the groundwater.	W
Turnouts	A water source with fixed head, representing the incoming hydraulic grade from the supplier.	TO
Storage Reservoirs	Represents storage capacity. Storage reservoir characteristics (e.g., dimensions, capacity, elevation, operating levels) are based on information from the City.	R
Pumps	Raises the hydraulic grade to overcome elevation differences and friction losses. Pump operation is based on pump curves or design points provided by the City.	PMP

Table 6-2 details the model's naming scheme, which is primarily based on the hydraulic element prefix.

Table 6-2. Naming Scheme for Hydraulic Model Network Elements	
Model Element	Naming Scheme
Pipelines	
Junctions	
Nodes	
Valves	
Wells	
Turnouts	
Storage Reservoirs	
Pumps	

6.3 HYDRAULIC MODEL UPDATE METHODOLOGY

To rebuild and update the City's water system hydraulic model, West Yost performed the following key tasks:

- Imported existing pipelines from City's geographical information system (GIS) database
- Added new pipelines near the new Milpitas BART station, which were not in the GIS database when it was initially received and imported into the model
- Updated existing and added new water system facilities (e.g., storage reservoirs, booster pump stations, pressure regulating valves, and wells)
- Allocated existing water demands using the City's spatially located meter and billing information
- Performed field hydrant testing within the distribution system on March 11, 2020
- Deployed Hydrant Pressure Recorders (HPRs) throughout the distribution system to record system pressures from March 10 through April 1, 2020
- Calibrated the hydraulic model with the results from data collected during the hydrant testing
- Verified that the hydraulic model system configuration is generally representative of the City's current water system based on system pressures, flows, and tank elevations recorded in the field and from the City's charts and Supervisory Control and Data Acquisition (SCADA) system

As part of these efforts, West Yost coordinated closely with the City to obtain and review:

- Information on existing water supply turnouts, storage reservoirs, booster pump stations, pressure regulating valves, wells, and other water system facilities
- As-built drawings associated with water system improvements implemented since 2002, especially adjacent to the new BART station
- City's GIS database of water system facilities (e.g., pipelines, wells, booster pump stations, etc.), received January 2020
- Metered water consumption information
- Historical SFPUC and VW turnout data
- Historical circular chart and SCADA system data

6.4 HYDRAULIC MODEL REVIEW AND UPDATE

The following sections detail specific steps taken to rebuild the hydraulic model in InfoWater and accurately represent the City's existing water system.

6.4.1 Pipeline Import and Update

The City engaged HydroScience to update its GIS-based pipeline records by reviewing recent as-builts, reconciling any discrepancies, and adding any missing alignments. After completing this task, HydroScience transmitted the pipeline shapefiles (one for each pressure zone) to West Yost. The shapefiles, which contained only distribution mains, were then imported to InfoWater via the "Import Manager" tool.

West Yost also checked the pipeline network for connectivity issues using InfoWater's built-in network review tools. This multi-step process identified and helped resolve parallel pipes (i.e., inadvertent duplicates), pipes that should be connected, and pipes that cross but do not intersect.

6.4.2 Pipeline Roughness Factors

Pipeline roughness is represented by a coefficient, known as a C-factor, with higher values corresponding to smoother surfaces. Ideally, C-factors are assigned to pipelines based on material, diameter, and age. In the 2009 WMPU, all pipelines were assigned a roughness coefficient of 120. West Yost assigned preliminary C-factors to pipelines in the hydraulic model based on material and diameter, using an in-house database of C-factors developed from previous hydrant testing performed for numerous water systems. These preliminary C-factors, which were refined as part of the hydraulic model calibration process (Section 6.5), are presented in Table 6-3.

Table 6-3. Preliminary Pipeline C-factors Assigned in the Hydraulic Model

Pipeline Material	Abbreviation	C-Factor	
		Diameter ≤ 8 inches	Diameter > 8 inches
Asbestos Cement	AC / ACP	120	130
Concrete Cylinder	CCP	-[a]	130
Cast Iron	CIP	100	110
Ductile Iron	DIP	130	140
Polyvinyl Chloride	PVC	140	150
Steel	STL	120	130

(a) Material in this diameter range does not exist in City system.

6.4.3 System Elevations

Junction elevations in the hydraulic model are based on 1-foot contours[8] developed by VW using LiDAR. ESRI tools were used to interpolate between contours and create a detailed grid map (i.e., raster) of elevations in the City service area. Finally, InfoWater's "Elevation Extractor" tool used the raster map to assign elevations to each junction.

For facility sites (e.g., pump stations and storage tanks), junction elevations were further refined per available as-built drawings. Where elevation or depth information was missing from as-built drawings, junction elevations were unchanged from their original, raster-based values.

6.4.4 Existing System Facilities

West Yost reviewed City-provided as-built drawings for existing system facilities and added them to the hydraulic model. These include water supply turnouts, storage reservoirs, pump stations, PRVs, and the Pinewood Well. Operational parameters, including pump curves, PRV settings, and storage reservoir levels, were also confirmed with City staff.

In some cases, "equivalent" facilities were used in the model to simplify functionality without compromising simulation accuracy. For example, turnouts are represented by fixed head reservoirs using the hydraulic grade line of the source supply (SFPUC or VW). Additionally, pressure reducing valves are used to represent the discharge pressure setting for variable speed pumps.

6.4.5 Spatially Located Meter Accounts

The first step in spatially locating water consumption involved linking billed water consumption to spatially located meters using a unique identifier. The City provided West Yost bimonthly water billing data listing the consumption, service address, unique billing code (i.e., Location_ID), meter type, and billing period for each customer account from 2013 through 2019. Many (but not all) meters in a City-provided water meter GIS file contained this same Location_ID. Using this unique identifier, approximately 77 percent of 2019 demand was spatially located. Ideally, at least 95 percent of demand is spatially located, so additional effort was required.

To spatially locate the consumption that could not be linked using Location_IDs, West Yost utilized ESRI's "Geocode Addresses" tool. In short, this tool spatially locates addresses based on a user-provided street database containing details like street name, suffix, direction, and address numbers on each side of the street. Another 21 percent of demand was geocoded, resulting in a total of over 98 percent of demand being spatially located. Figure 6-1 shows the spatial distribution of metered consumption in the hydraulic model.

The goal is to spatially locate production, equal to consumption plus NRW. To this end, spatially located demands were globally scaled up to match the total 2019 consumption. Then, 2019 NRW was added to each location as a fixed proportion of consumption. The final demand included in the hydraulic model equals the City's average daily water production in 2019 (8.3 mgd).

[8] Valley Water Contours downloaded on 2/25/2020 from http://gis.valleywater.org/Download/LIDAR/

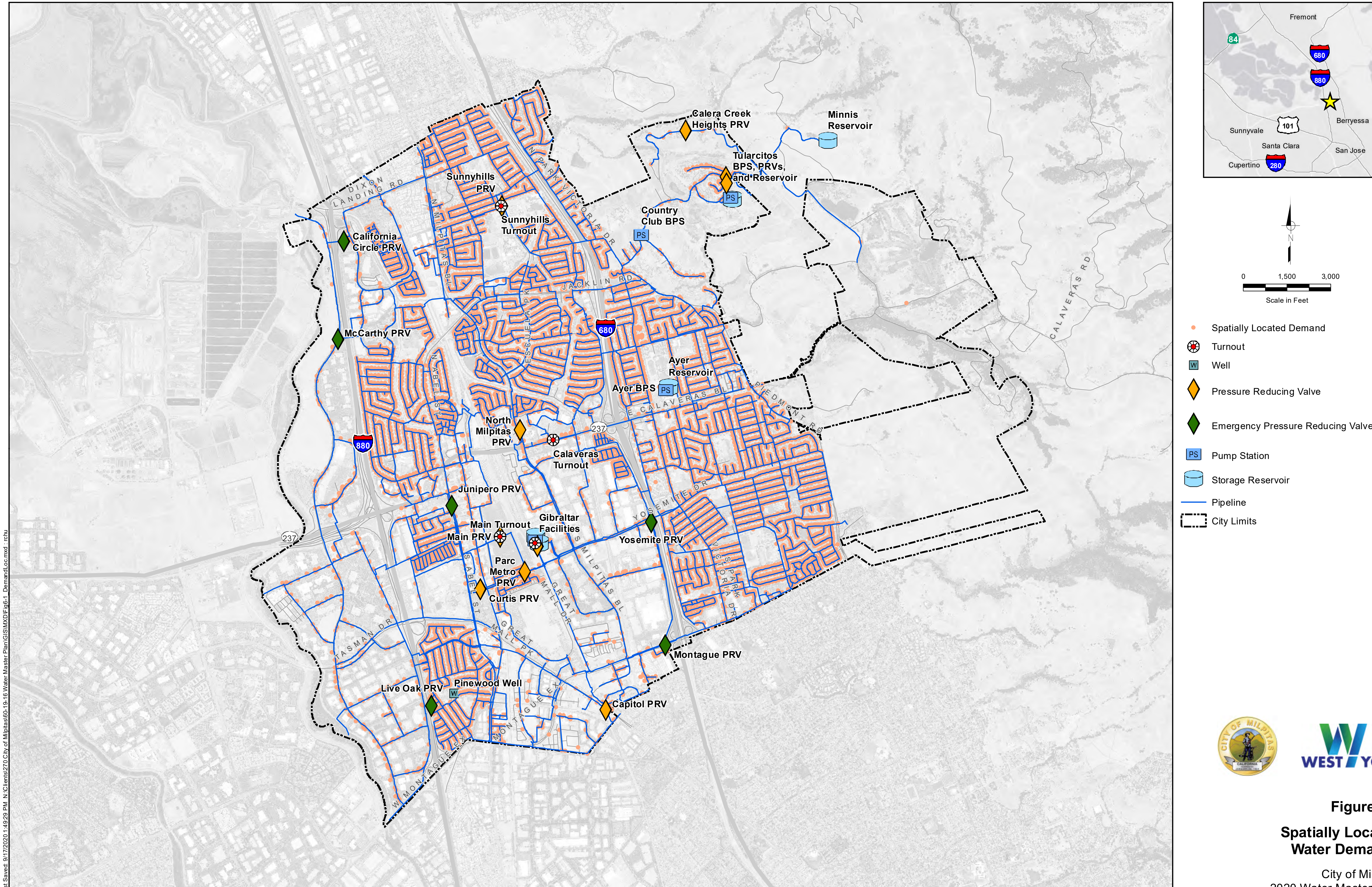


Figure 6-1

Spatially Located Water Demands

City of Milpitas
2020 Water Master Plan

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6.4.6 Water Demand Allocation

InfoWater's "Demand Allocator" tool assigns spatially located demands to the closest junction. Some junctions were excluded from the tool, including those on transmission mains (which typically do not have service connections) or facility sites (e.g., at a pump station). West Yost staff then reviewed the junctions with demands to confirm correct allocation with respect to service area and pressure zone.

The following demand sets were created in the model:

- **EX_ADD**: 2019 average day demand (8.3 mgd)
- **HT_BASE**: Average day demand for hydrant test day (3/11/2020; 8.4 mgd)

The "EX_ADD" demand set was used as the basis to create the "HT_BASE" demand set, which was scaled to equal the average demand on March 11, 2020 and used for steady-state calibration.

6.5 STEADY-STATE HYDRAULIC MODEL CALIBRATION

Hydrant test data was used to calibrate the hydraulic model by verifying whether the model can accurately simulate field-observed fire flow conditions. Part of the calibration process entails adjusting pipeline C-factors (within a typical range) to improve model accuracy. For additional detail on the hydrant test process, refer to West Yost's March 9, 2020 memorandum, which is provided as Appendix C. The following sections summarize the hydrant tests and hydraulic model calibration results.

6.5.1 Hydrant Tests

There were 14 hydrant test locations (10 primary and 4 alternate) initially identified based on pipeline diameter, material, and age. Pipeline connectivity was also considered, with priority given to locations requiring fewer valve closures to achieve unidirectional flow. Table 6-4 lists the field status of each test, while Figure 6-2 illustrates the test locations.

Table 6-4. Hydrant Test Field Status

Test No.	Pipeline Material Type	Pipeline Diameter, inches	Location	Field Status
1	PVC	8	Along Elkwood Drive	Completed
2	AC	6	Along Gosser Street	Completed
3	AC	6	Along Stirling Drive and Stratford Drive	Completed
4	AC	6	Along Greentree Way	Completed
5	PVC	8	Along Hammond Way	Completed
6	AC	8	Along Main Street	Completed
7	AC	8	Along Lacey Drive	Completed
8	AC	6	Along Clauser Drive	Not Performed[a]
9	AC	8	Along Calaveras Ridge Drive	Completed
10	DI	8	Within Crossing at Montague Apartments	Completed
11	AC	6	Along Las Lomas Drive and Pacheco Drive	Not Performed[b]
12	PVC	8	Along Costa Street and Mihalakis Street	Not Performed[b]
13	AC	8	Along Pebble Beach Court	Not Performed[b]
14	AC	8	Along Heath Street	Not Performed[b]

(a) Due to operational concerns, City advised against performing Test 8.
(b) Alternate tests were not performed due to time constraints.

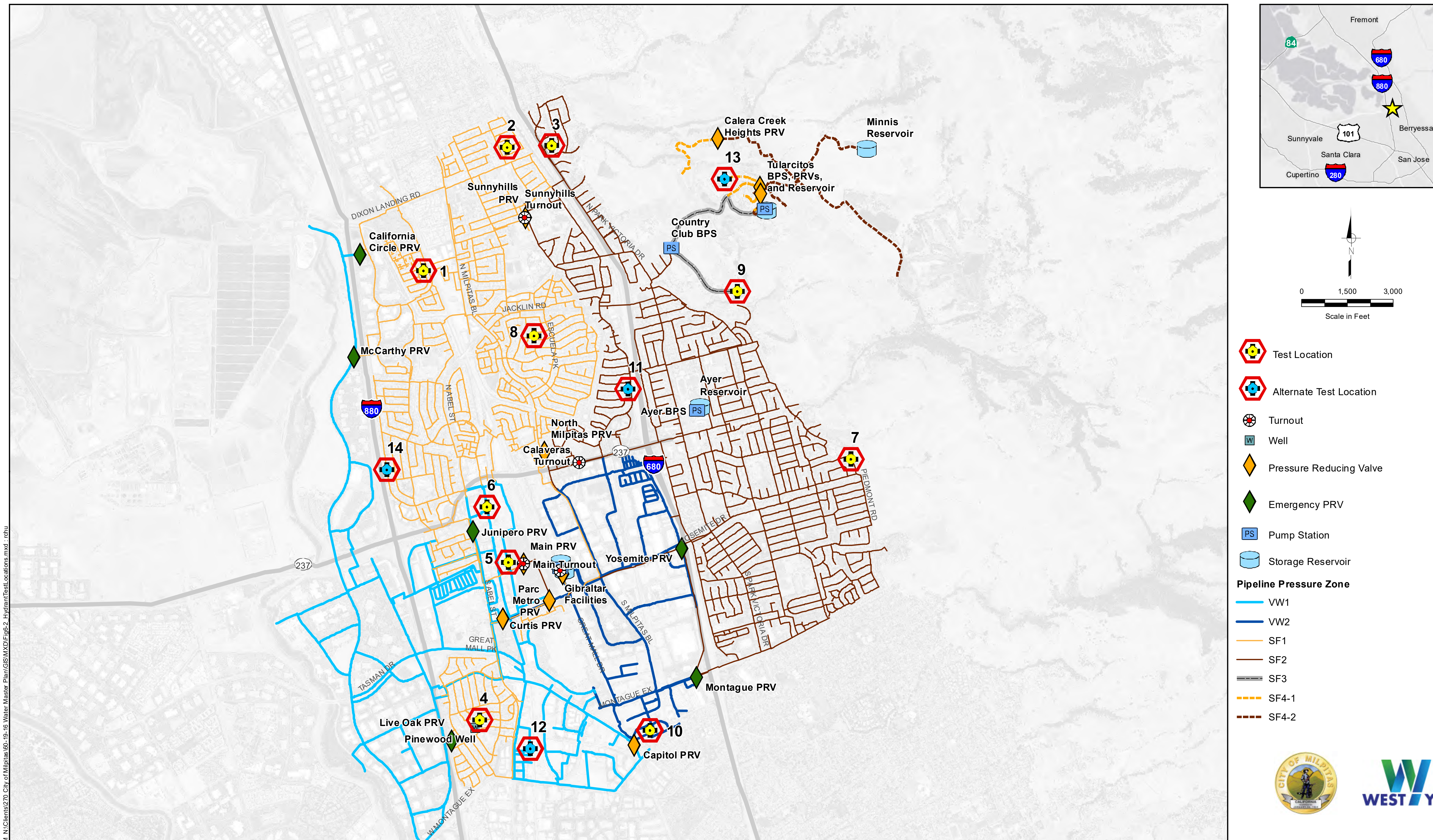

Figure 6-2

Hydrant Test Locations

City of Milpitas
2020 Water Master Plan

Each hydrant test included one flowing hydrant and three to four observation hydrants, which are identified by test number and an alphabetical designation based on proximity to the flowing hydrant. For example, Hydrant 1A is the observation hydrant closest to (flowing) Hydrant 1, while Hydrant 1D is the furthest.

To recreate operational and demand conditions for the hydrant test day (March 11, 2020), City staff provided water system data for turnouts and storage reservoirs. The City turned off booster pump stations during the test period; therefore turnouts were serving all demands in the valley floor. Data was limited for hillside demands during the test period, and since hillside demands are relatively low, demands during the hydrant test period were assumed to be equal to the combined flow from all turnouts. SFPUC turnout flows were provided in hourly increments and averaged from 8:00 am to 6:00 pm, while VW turnout flows were provided in minute increments and averaged from 8:30 am to 5:30 pm. The "test day demand" is the sum of the SFPUC and VW average flows. Spatially allocated average day demands were then scaled up such that the total system demand equals the test day demand.

Each completed hydrant test was simulated using the hydraulic model, and results were compared to field observations. Model performance was evaluated using differential pressure, which is defined as the difference between static and residual pressure for a given location. The model was considered calibrated if differential pressures were within 5 pounds per square inch (psi) of the field data. This psi tolerance is based on standard engineering practice for model calibration in water system planning.

6.5.2 Hydraulic Model Calibration Results

The hydraulic model was able to simulate hydrant tests accurately, with only minor adjustments to the preliminary C-factors presented in Table 6-3. Of the nine hydrant tests conducted, eight could be simulated such that differential pressures fell within 5 psi of field observations. The remaining hydrant test (No. 10) was abandoned due to likely incorrect valving during the test. Table 6-5 summarizes the calibration results, while the following sections detail the C-factor adjustments and issues that occurred with Hydrant Test No. 10.

6.5.2.1 Pipeline Roughness Factor Adjustments

Field data from hydrant tests indicated that preliminary C-factors for AC and polyvinyl chloride (PVC) pipes were slightly high. Consequently, the C-factors for AC and PVC pipes 8 inches in diameter and smaller were adjusted down to 110 and 130, respectively. Although no hydrant tests were conducted for AC and PVC pipes larger than 8 inches in diameter, West Yost assumed those preliminary C-factors were also high and decreased them accordingly.

Roughness factors for other pipe materials remain equal to their preliminary values. Table 6-6 summarizes the calibrated C-factors used in the City's hydraulic model.

Table 6-5. Hydrant Test Calibration Results

Hydrant	Field Data					Modeled Data			
	Static Pressure, psi	High Residual Pressure, psi	Low Residual Pressure, psi	Average Residual Pressure, psi	Differential Pressure, psi (Static - Residual)	Static Pressure, psi	Residual Pressure, psi	Differential Pressure, psi (Static - Residual)	Comparison of Differential Pressures between Field and Modeled Data
Hydrant Test No. 1 (8" PVC, 1990s, Zone SF1)									
Flowing 1	86					84			
1A	87	44	40	42	45	83	41	43	2
1B	88	52	50	51	37	83	50	33	4
1C	82	76	50	52	30	84	57	27	3
1D	86	64	62	64	22	84	66	18	4
Hydrant Test No. 2 (6" AC, 1960s, Zone SF1)									
Flowing 2	54					52			
2A	48	18	16	17	31	46	15	31	0
2B	51	31	29	30	21	48	30	19	2
2C	53	48	44	46	7	54	49	5	2
Hydrant Test No. 3 (6" AC, 1980s, Zone SF2)									
Flowing 3	98					94			
3A	96	28	24	26	70	91	24	67	3
3B	94	36	32	35	59	87	32	55	4
3C	84	42	38	40	44	81	41	41	3
3D	82	84	58	58	24	79	54	24	0
Hydrant Test No. 4 (6" AC, 1960s, Zone SF1)									
Flowing 4	78					76			
4A	80	41	29	30	50	76	25	51	-1
4B	82		45	46	36	75	38	37	-1
4C	78	60	53	58	20	74	54	20	0
Hydrant Test No. 5 (8" PVC, 1980s, Zone VW1)									
Flowing 5	80					80			
5A	84	40	40	41	43	80	40	41	3
5B	84	47	45	46	38	81	46	34	4
5C	80	60	50	54	26	81	52	28	-2
Hydrant Test No. 6 (8" AC, UNK, Zone VW1)									
Flowing 6	84					82			
6A	85	50	48	49	36	82	44	38	-2
6B	88	54	52	53	35	82	47	34	1
6C	81	56	52	54	27	81	53	28	-1
Hydrant Test No. 7 (8" AC, 1970s, Zone SF2)									
Flowing 7	60					59			
7A	70	52	50	51	19	67	52	15	4
7B	74	64	60	62	12	74	64	10	2
7C	84	81	78	80	4	84	81	3	1
Hydrant Test No. 9 (8" AC, 1980s, Zone SF3)									
Flowing 9	143					139			
9A	138	54	50	50	88	134	45	89	-1
9B	148	70	68	69	79	146	69	77	2
9C	141	84	78	78	63	140	76	64	-1
9D	136	136	80	85	51	132	83	49	2
Hydrant Test No. 10 (8" DI, 2000s, Zone VW2)									
Flowing 10	118					Test abandoned due to incorrect valving			
10A	120	94	90	92	28				
10B	122	95	92	94	28				
10C	116	92	82	90	26				
10D	119	92	89	90	29				

Table 6-6. Calibrated Pipeline C-factors Assigned in the Hydraulic Model			
		C-Factor	
Pipeline Material	Abbreviation	Diameter ≤ 8 inches	Diameter > 8 inches
Asbestos Cement	AC / ACP	110	120
Concrete Cylinder	CCP	-[(a)]	130
Cast Iron	CIP	100	110
Ductile Iron	DIP	130	140
Polyvinyl Chloride	PVC	130	140
Steel	STL	120	130
(a) Material in this diameter range does not exist in City system.			

6.5.2.2 Hydrant Test No. 10

Field observations suggest that Hydrant Test No. 10 did not achieve unidirectional flow through the 8-inch ductile iron pipe (DIP) loop within the Crossing at Montague Apartments. While setting up for the test, City staff could not confirm the valve configuration at the intersection between Hydrant 10 and Hydrant 10D. City staff closed a valve at this intersection, but since field-observed differential pressures are relatively consistent across all four observation hydrants, it seems that the isolation valve closed did not direct flow as intended. As a result, the C-factor for 8-inch diameter, DIP could not be confirmed, and Hydrant Test No. 10 should be disregarded.

Abandoning Hydrant Test No. 10 is not a fatal flaw. Only approximately 8 percent of the City's water system consists of DIP, and the preliminary DIP C-factors are based on an extensive list of roughness factors calibrated for other water systems. West Yost remains confident the hydraulic model can accurately simulate the City's water system under various conditions.

6.6 SUMMARY OF FINDINGS AND CONCLUSIONS

Hydrant test simulation results indicate that the hydraulic model can accurately replicate a fire flow or other large demand condition using the pipeline C-factors listed in Table 6-6. As a result, West Yost concludes that the hydraulic model is a reliable representation of the City's existing potable water distribution system and can be used as a planning tool. To ensure long-term accuracy and usefulness, it is recommended that the City regularly update and maintain the hydraulic model as facilities are constructed or replaced. In addition, as data availability increases, the City can augment the hydraulic model to run extended period simulations, which simulate the system operation over time, mimicking the operational controls and settings used for system operations.

CHAPTER 7
System Planning and Performance Criteria

This chapter presents the criteria used to size and evaluate the performance of the City's potable water system. Key criteria from the City's 2009 WMPU have been incorporated into this chapter; however, some of the previous criteria have been updated to reflect more recent or suitable standards based on West Yost's experience working with similar municipal water systems.

Table 7-1 summarizes the recommended criteria for this 2020 WMP. The following sections describe each criterion in more detail.

7.1 GENERAL WATER SYSTEM GUIDELINES

Before discussing specific planning and performance criteria, it is helpful to provide some general guidelines that a water system should meet. This section identifies the requirements for a reliable water system that delivers high-quality water.

7.1.1 Water System Reliability

Based on industry standards, a reliable water system is one that has sufficient storage, redundant pumping and distribution facilities, and emergency alternatives for both water and power supply. Thoughtful water distribution system design also enhances reliability through improved hydraulics and flexibility. For example, replacing pipeline dead-ends with looped configurations improves reliability and reduces the risk of stagnant water, which has poor taste and lower disinfectant residuals. Appropriate pipeline sizing and pressure regulation allows the system to serve peak demands at appropriate pressures while minimizing friction losses. Lastly, proper valve placement streamlines maintenance and repairs, while also increasing operational flexibility.

7.1.2 Water Quality Standards

The United States Environmental Protection Agency (USEPA) and the SWRCB DDW establish water quality standards to protect public health and help manage aesthetics. Primary drinking water standards are legally enforceable limits on contaminants that present a risk to human health. In contrast, secondary standards target contaminants that are not health threatening, but may cause taste, odor, or color issues. As a water retailer, the City is responsible for ensuring that all applicable water quality standards and regulations are always met. The City is currently updating a report on its water quality monitoring program.

Table 7-1. Summary of Recommended Potable Water System Planning and Performance Criteria		
Component	Criteria	Remarks/Issues
Water System Performance		
Fire Flow Requirements [(a)]		
Single Family Residential	1,500 gpm @ 2 hrs	Improvements for existing developments will be evaluated on a case-by-case basis because of varying historical standards.
Multi-family Residential	2,500 gpm @ 2 hrs	
Commercial	3,000 gpm @ 3 hrs	
Mixed[(b)]	3,000 gpm @ 3 hrs	
Industrial	4,000 gpm @ 4 hrs	
Peak Supply Capacity		
Normal Demand Conditions	Provide firm supply capacity equal to maximum day demand; meet peak hour demand from a combination of supply capacity and storage	Firm supply capacity defined as the total water supply with the largest turnout out of service.
Fire Flow Demand Conditions	Meet maximum day demand plus fire flow from a combination of supply capacity and storage	
System Pressures		
Minimum Pressure - Normal Conditions	Average and Maximum Day Demand: 40 psi at customer service connection Peak Hour Demand: 30 psi at customer service connection	Services with pressure less than 30 psi during an average day demand condition require an individual booster pump.
Minimum Pressure - Fire Flow Conditions	20 psi	
Maximum Pressure	Zone 1: 80 psi at customer service connection Zone 2 and Hillside Zones: 150 psi at customer service connection	New services with pressure greater than 80 psi require an individual pressure regulator.
Pipeline Sizing		
Transmission Main		
Diameter	16 inches or larger	
Maximum Velocity - Normal Conditions	6 ft/s	Criteria based on requirements for new development, existing transmission mains will be evaluated on a case-by-case basis. Evaluation will include age, material type, velocity, head loss, and pressure.
Maximum Head Loss - Normal Conditions	5 ft/kft	
Hazen Williams "C" Factor	130	For consistency in hydraulic modeling.
Distribution Main		
Minimum Pipeline Diameter	8 inches	New pipelines only.
Maximum Velocity - Normal Conditions	8 ft/s	Criteria based on requirements for new development, existing distribution mains will be evaluated on a case-by-case basis. Evaluation will include age, material type, velocity, head loss, and pressure.
Maximum Velocity - Fire Flow Conditions	12 ft/s	
Maximum Head Loss - Normal Conditions	10 ft/kft	
Hazen Williams "C" Factor	130	For consistency in hydraulic modeling.
Storage Facility Sizing		
Operational Storage	25 percent of maximum day demand	
Fire Storage	Fire flow demand for the most severe fire recommended in the pressure zone multiplied by the recommended duration	Refer to Table 7-2. Assumes only one fire flow event would occur in any pressure zone at a time.
Emergency Storage	50 percent of maximum day demand	
Groundwater Storage Credit	Volume of water pumped over a 24-hour period	The maximum credit cannot exceed the recommended emergency storage volume.
Total Storage Capacity	Operational + Fire + Emergency - Groundwater Credit	
Pumping Facility Sizing		
Pumping Capacity	Firm pumping capacity equal to maximum day demand (within the designated operational hours)	Firm pumping capacity defined as the total capacity of all operational pumps minus the capacity of the largest pumping unit. Pumps located in lower pressure zones must deliver the maximum day demand of all pressure zone(s) located above them.
Backup Power	All critical pumping facilities[(c)] should be equipped with an on-site, backup power generator	
Pressure Reducing Station Sizing		
Valve Capacity	In pressure zones with storage, valve capacity must supply the maximum day demand, and in pressure zones without storage, valve capacity must supply maximum day plus fire flow or peak hour demand, whichever is larger	

(a) Based on fire flow requirements adopted in the 2009 WMPU, updated to reflect current fire code.

(b) Includes High Density Multi-family Residential land uses in the MMSP area.

(c) A pump station is defined as critical if it serves a pressure zone(s) and/or service area(s) without sufficient fire or emergency storage and meets one of the following criteria:
- The largest facility that provides water to a particular pressure zone and/or service area;
- It is the sole source of water to single or multiple pressure zones and/or service areas;
- It provides water from a supply turnout; or
- It provides water from key groundwater supply wells.

7.2 WATER SYSTEM PERFORMANCE CRITERIA

This section describes the recommended system performance criteria for fire flows, supply capacity, and distribution system pressures.

7.2.1 Fire Flow Requirements

Municipal water systems providing supply during a fire flow condition must meet minimum standards for fire flow rate and duration and residual pressure. Based on the City's potable water design guidelines and recommendations from state agencies, the City's water system must concurrently meet maximum day demands and maintain at least 20 pounds per square inch (psi) residual pressure when delivering fire flow.

Minimum fire flow requirements are adopted from the 2009 WMPU (updated in coordination with the City's fire department to reflect current fire code) and summarized by land use type in Table 7-2. These requirements specify minimum distribution system capacities during fires and apply to new developments only (not existing system conditions). Existing buildings are assumed to meet fire flow standards that were in place at the time of construction, which are generally lower than current standards. Therefore, the evaluation of the City's water system under existing demand conditions presents systemwide available fire flow only and does not recommend pipeline improvements to increase existing fire flow capacity. However, the City can use these results as a guide for sizing pipeline improvements and to prioritize replacing existing smaller diameter pipelines to improve overall flows throughout the distribution system.

Table 7-2. Recommended Fire Flow Requirements for Future Development and Pipeline Replacement Planning[(a)]

Land Use Designation	Fire Flow, gpm	Duration, hours	Recommended Storage, MG
Single Family Residential	1,500	2	0.18
Multi-family Residential	2,500	2	0.30
Commercial	3,000	3	0.54
Mixed[(b)]	3,000	3	0.54
Industrial	4,000	4	0.96

(a) Based on fire flow requirements adopted in the 2009 WMPU, updated to reflect current fire code.
(b) Includes High Density Multi-family Residential land uses in the Milpitas Metro Specific Plan area.

7.2.2 Peak Supply Capacity

Under normal (i.e., non-emergency) demand conditions, the City must meet peak hour demands through a combination of available supplies and storage. In addition, the City must have a firm supply capacity capable of meeting a maximum day demand condition. Firm supply capacity is defined as the total potable water supply capacity with the largest turnout out of service.

Under fire flow demand conditions, the City must meet fire flows and maximum day demand from both available supply capacity and storage.

7.2.3 Distribution System Pressures

Water systems are typically evaluated based on pressure, pipeline velocity, and pipeline head loss. Pressures are the most critical criterion because they are used to evaluate satisfactory system performance under different demand conditions. Consequently, the City's existing water system will be evaluated using pressure as the primary criterion; secondary criteria, such as pipeline velocity, head loss, age, and material type, will be used as indicators to locate where water system improvements may be needed. Recommended improvements from existing and buildout system pressure evaluations are presented in Sections 8.5 and 9.6, respectively.

Minimum distribution system pressure criteria are based on industry standards and vary by demand condition. Under average day and maximum day demands, system pressures should remain above 40 psi. Under peak hour demand conditions, system pressures should remain above 30 psi. During fire flow conditions, residual pressures of 20 psi are allowed. Customer service connections with a pressure below 30 psi during an average day demand condition should have an individual booster pump installed.

Maximum distribution system pressure criteria are based on industry standards and vary by pressure zone. In the valley (Zone 1), pressures should remain below 80 psi. In Zone 2 and Hillside Zones (SF3 and SF4), the maximum pressure shall not exceed 150 psi. These pressure limits are consistent with the 2009 WMPU and the high end of typical operating pressures for municipal water systems. The Uniform Plumbing Code (UPC) requires new customer service connections with a pressure above 80 psi to have an individual pressure regulator installed. Since typical pressures in Zone 2 and the Hillside Zones exceed 80 psi, an alternative would be to install main-line PRVs and create pressure sub-zones within these existing pressure zones; however, this would make it more difficult to move water between these zones and could potentially reduce fire flow availability.

This distribution system pressure criteria will be applied to all areas that fall within the normal customer service elevation ranges for each pressure zone. Customers located above or below the normal service elevation ranges may require an individual booster pump or pressure regulator.

7.3 WATER FACILITY SIZING

This section describes the recommended sizing criteria for pipelines, storage facilities, booster pumping facilities, backup power, and pressure reducing stations within the City's service area

7.3.1 Pipeline Sizing

Pipeline sizing is based on velocity and head loss, which are directly related; higher velocities translate to higher head loss (increases operating costs). Velocity and head loss criteria are defined below for new pipelines and vary with pipeline diameter. Consistent with the 2009 WMPU, transmission mains are defined as pipelines with a diameter of 16 inches or larger, and distribution mains have a diameter less than 16 inches. However, all new pipelines should be required to have a minimum diameter of 8 inches. Compared to 6-inch diameter pipelines, 8-inch diameter pipelines can significantly reduce friction losses at a competitive cost. Phasing out 6-inch diameter (and smaller) pipelines will also help the City streamline its piping and appurtenance inventory.

The following criteria reflect industry standards and West Yost's experience with municipal water systems:

- For transmission mains, the maximum velocity should be limited to 6 feet per second (ft/s), and the maximum head loss should be 5 feet per 1,000 feet (ft/kft) of pipeline.
- For distribution mains, the maximum velocity should be limited to 8 ft/s under normal demand conditions. During fire flow demand conditions, the maximum velocity should be 12 ft/s. Maximum head loss for distribution mains should be 10 ft/kft.

7.3.2 Storage Facility Sizing

Storage facilities include reservoirs (i.e., tanks), clearwells, and, in certain cases, groundwater wells. The total recommended treated water storage capacity is the sum of the following three components:

- Operational Storage
- Fire Storage
- Emergency Storage

Each component is detailed below, along with a discussion of groundwater storage credit. West Yost will evaluate storage capacity requirements by pressure zone.

7.3.2.1 Operational Storage

Operational storage is defined as the amount of stored water needed to meet peak demands in excess of normal supply delivery. Since water supplies are generally designed to meet maximum day demands, operational storage is typically used to supply peak demands (e.g., the difference between peak hour and maximum day demand). Supplies replenish operational storage during periods of lower demand.

In accordance with American Water Works Association (AWWA) guidelines[9], West Yost recommends the operational storage volume be 25 percent of the maximum day demand. This is consistent with the operational storage criterion used in the 2009 WMPU.

7.3.2.2 Fire Storage

Fire storage is the volume of water reserved for fire suppression. For a given pressure zone, fire storage is determined by multiplying the maximum required fire flow rate by the required duration. Refer to Table 7-2 for fire storage recommendations by land use designation. Per industry standards, it is assumed that no more than one fire event would occur in a pressure zone at a time.

7.3.2.3 Emergency Storage

Emergency storage helps meet demands during an unplanned event that reduces the quality and/or quantity of potable water supplies. Determining the appropriate emergency storage volume is challenging, as it depends on the diversity of supplies, the reliability of production and distribution facilities, and the duration of the emergency event. The City's overall risk tolerance is also a factor. The

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[9] The *AWWA Water Distribution Systems Handbook* (AWWA, 2000) (Section 3.2.2.2 Storage) states that the volume of operational storage required is commonly estimated at 25 percent of the total maximum day demand.

AWWA suggests that individual utilities should determine its specific emergency storage requirements based on perceived system vulnerabilities.

West Yost recommends an emergency storage volume equal to 50 percent of the maximum day demand, consistent with the 2009 WMPU. Emergency storage is not required at every reservoir; one reservoir can hold emergency storage for multiple pressure zones if the zones are hydraulically connected and the stored water remains accessible in emergencies.

7.3.2.4 Groundwater Storage Credit

Based on the City's available emergency groundwater wells, groundwater storage could offset some of the recommended emergency storage. However, the following must be true to use the groundwater supply to offset the need to provide surface storage:

- Groundwater supply is of potable water quality and can be reliably accessed (i.e., wells are equipped with on-site backup power or a plug-in adapter and transfer switch)
- Groundwater supply is not already being relied upon to meet the City's average day demand requirements
- Sufficient water distribution facilities are available to distribute this water to demand areas

The groundwater storage credit equals the volume of water pumped over a 24-hour period. The maximum credit cannot exceed the recommended emergency storage volume (i.e., 50 percent of maximum day demand).

7.3.2.5 Recommended Total Storage Capacity

In summary, the City's recommended total water storage capacity is the sum of the following components:

- **Operational Storage**: Volume of water to meet diurnal peaks, assumed to be 25 percent of the maximum day demand; plus
- **Fire Flow Storage**: Volume of water to suppress a fire (varies by land use designation); plus
- **Emergency Storage**: Volume of water as emergency supply during unplanned events, assumed to be 50 percent of maximum day demand; minus
- **Groundwater Storage Credit**: Groundwater supply that can be reliably accessed in an emergency.

7.3.3 Pumping Facility Sizing and Backup Power

Based on industry standards, pumping capacity should be sufficient to meet a maximum day demand within the designated operational hours with pumps assumed to operate at firm pumping capacity. Firm pumping capacity is defined as the total pump station capacity with the largest pump out of service. Pumps located in lower pressure zones must deliver the maximum day demand of all pressure zone(s) located above them.

Critical pumping facilities are defined as those facilities that provide service to pressure zone(s) and/or service area(s) which do not have sufficient fire and/or emergency storage available and meet the following criteria:

- The largest pumping facility that provides water to a particular pressure zone and/or service area;
- A facility that provides the sole source of water to single or multiple pressure zones and/or service areas;
- A pumping facility that provides water from a supply turnout; or
- A pumping facility that provides water from key groundwater supply wells (depends on capacity, quality and location).

All critical pumping facilities should be equipped with an on-site, backup power generator.

7.3.4 Pressure Reducing Station Sizing

For pressure zones without available storage capacity and where pressure reducing station(s) are the sole supply source, the total capacity from the active pressure reducing station(s) should be equal to a maximum day demand plus fire flow condition or a peak hour demand condition, whichever is larger. For pressure zones with available storage capacity and where pressure reducing station(s) are the sole supply source, the total capacity from the active pressure reducing station(s) should be equal to a maximum day demand.

CHAPTER 8
Evaluation of Existing Water System

This chapter evaluates the City's existing water system and its ability to meet recommended planning and performance criteria described in Chapter 7 and summarized in Table 7-1 of this report. The evaluation encompasses both system capacity and hydraulic performance using existing water demands developed in Section 5.1 of this report. System capacity is evaluated based on potable water supply, storage, and pumping, while the hydraulic performance evaluation examines distribution system pressures under various demand and outage conditions. The following evaluations frequently refer to "normal" conditions, which are defined as non-emergencies (i.e., no fires or unplanned outages).

For reference, Appendix A contains a water system schematic profile that summarizes the supply and distribution facilities described in Sections 3.2 and 3.3 of this report, respectively.

This chapter also includes recommendations for addressing any deficiencies identified from the evaluation. These are incorporated in a recommended capital improvement program (CIP) described in Chapter 11 of this report. To simplify cross-referencing with Chapter 11, each proposed project is assigned a unique capital improvement program ID (CIP ID).

The following sections present the evaluation methodology and results:

- Existing Potable Water Demands
- Existing Potable Water Supply Capacity Evaluation
- Existing Potable Water Storage Capacity Evaluation
- Existing Pumping Capacity Evaluation
- Existing Water Distribution System Evaluation
- Summary of Findings and Recommended Improvements

8.1 EXISTING POTABLE WATER DEMANDS

Existing potable water demands are based on 2019 billing meter data, which was spatially allocated in the hydraulic model and scaled up to match the City's 2019 average daily water production (8.3 mgd). Maximum day and peak hour demands were calculated based on the adopted peaking factors of 1.6 and 2.9 times the average day demand, respectively, for Zones SF1 and SF2, and 3.2 and 5.8 times the average day demand, respectively, for Zones SF3 and SF4. In the VW service area, the maximum day and peak hour demand peaking factors are 1.9 and 3.4 times the average day demand, respectively. Table 8-1 summarizes existing potable water demands by pressure zone and service area.

Table 8-1. Summary of Existing Water Demands by Pressure Zone						
Pressure Zone	Average Day Demand[(a)]		Maximum Day Demand[(b)]		Peak Hour Demand[(c)]	
	gpm	mgd	gpm	mgd	gpm	mgd
SF1	1,748	2.52	2,797	4.03	5,069	7.30
SF2	1,798	2.59	2,877	4.14	5,214	7.51
SF3	14	0.02	44	0.06	81	0.12
SF4-1	19	0.03	61	0.09	110	0.16
SF4-2	17	0.02	54	0.08	98	0.14
SF Subtotal	3,596	5.18	5,833	8.40	10,571	15.2
VW1	1,238	1.78	2,351	3.39	4,208	6.06
VW2	951	1.37	1,806	2.60	3,232	4.65
VW Subtotal	2,188	3.15	4,158	5.99	7,440	10.7
Total	**5,784**	**8.33**	**9,990**	**14.4**	**18,011**	**25.9**

(a) Based on spatially allocated 2019 water meter data, scaled to match 2019 water production.

(b) Maximum day demand is 1.6 times the average day demand for Zones SF1 and SF2, 3.2 times the average day demand for Zones SF3 and SF4, and 1.9 times the average day demand for the VW service area.

(c) Peak hour demand is 2.9 times the average day demand for Zones SF1 and SF2, 5.8 times the average day demand for Zones SF3 and SF4, and 3.4 times the average day demand for the VW service area.

8.2 EXISTING POTABLE WATER SUPPLY CAPACITY EVALUATION

As described in Section 4.1 of this report, the City's potable water is supplied via turnouts from SFPUC and VW transmission pipelines. The recommended water system performance criteria specify that under normal demand conditions, the following must be satisfied:

- Provide firm supply capacity equal to maximum day demand
- Meet peak hour demand from a combination of supply capacity and storage

Firm supply capacity is defined as the normal water supply with the largest turnout out of service. In the SFPUC service area, the largest turnout is Calaveras (see Figure 3-1), which has a capacity of 13.0 mgd. The VW service area has only one turnout (Gibraltar), so firm supply is zero, as there is no redundant supply source from the VW system. However, as described in Section 3.3 of this report, if the VW turnout is not available, water can be moved from the City's SFPUC service area to the VW service area.

Table 8-2 summarizes the available and required firm supply capacity for each service area. Pinewood Well is not listed in Table 8-2 because it is not part of the City's existing normal water supply (it is only used for emergencies). The SFPUC service area has approximately 15.4 mgd of firm supply surplus, while the VW service area has a firm supply deficit equal to its maximum day demand (5.99 mgd), due to the lack of a redundant supply source from the VW system. Since SFPUC can supply the VW service area and the SFPUC surplus (15.4 mgd) exceeds the VW deficit (5.99 mgd), West Yost concludes that the City overall has sufficient firm supply capacity.

For the second supply capacity criterion listed above, the City can meet peak hour demands for each service area from supplies alone (i.e., before counting storage). Given this significant surplus in supplying peak hour demands, the criterion is not discussed further.

Table 8-2. Comparison of Available and Required Firm Supply Capacity

Supply Source	Turnout	Design Capacity	
		gpm	mgd
SFPUC	Sunnyhills	7,014	10.1
	Calaveras	9,028	13.0
	Main Street	5,486	7.90
	Intertie	4,000	5.76
	Total Supply Capacity[a]	**25,528**	**36.8**
	Firm Supply Capacity[b]	16,500	23.8
	Required Supply Capacity[c]	5,833	8.40
	Existing Firm Supply Capacity Surplus (Deficit)	10,667	15.4
VW	Gibraltar	10,000	14.4
	Total Supply Capacity[a]	**10,000**	**14.4**
	Firm Supply Capacity[b]	0	0
	Required Supply Capacity[c]	4,158	5.99
	Existing Firm Supply Capacity Surplus (Deficit)	(4,158)[d]	(5.99)[d]

(a) Total supply capacity assumes all turnouts are available for use.
(b) Firm supply capacity assumes largest turnout in each service area (Calaveras (SFPUC) and Gibraltar (VW)) is offline.
(c) Required supply capacity is equal to the maximum day demand (see Table 8-1).
(d) VW supply deficit can be met by SFPUC supply surplus.

8.3 EXISTING POTABLE WATER STORAGE CAPACITY EVALUATION

Potable water storage is critical for providing operational flexibility and emergency supply during outages or fires. The City's storage reservoir capacity must meet the following requirements (described in Section 7.3.2 of this report):

- Operational storage equal to 25 percent of maximum day demand
- Emergency storage equal to 50 percent of maximum day demand
- Fire storage equal to the largest fire flow demand in a pressure zone multiplied by the recommended duration

The total storage required is the sum of the operational, emergency, and fire storage requirements, less any groundwater credit, which can offset some of the emergency storage requirement. The groundwater credit includes both emergency wells and normally operating wells and equals the volume of water pumped over a 24-hour period. To offset surface storage needs, groundwater must be of potable water quality, and wells must have on-site backup power capabilities. In addition, the City must be able to meet average day demands without relying on groundwater. This is not an issue, since the City does not rely on groundwater as part of its normal (i.e., non-emergency) supply.

The City currently has one operational groundwater well (Pinewood Well), which meets water quality and backup power requirements. As a result, the Pinewood Well provides an emergency groundwater storage credit equal to its daily pumping capacity (1.7 MG).

For each pressure zone, Table 8-3 compares the City's existing potable water storage capacity with storage requirements. Since Zones 1 and 2 in each service area are interconnected through multiple pressure reducing valves (PRVs) that operate under normal conditions, they are combined in each service area (i.e., SF1/SF2 and VW1/VW2). As shown in Table 8-3, there is sufficient storage in the SFPUC service area and a deficit of 0.45 MG in the VW service area. This deficit is not considered critical, due to the flexibility of the Gibraltar facility. Simple valve operations allow the Gibraltar (SF) tank to supply Zone VW2, so the storage surplus for Zones SF1 and SF2 can cover the shortfall in Zones VW1 and VW2.

8.4 EXISTING PUMPING CAPACITY EVALUATION

As described in Section 7.3.3 of this report, industry standard is to have firm pumping capacity equal to maximum day demand. For a given pump station, firm capacity is defined as the total capacity of all operational pumps minus the capacity of the largest pumping unit. In addition, pumping capacity in lower pressure zones should also be able to deliver the maximum day demand of any zones above them. For example, the Zone SF3 pumps should be able to deliver the maximum day demand for Zones SF3 and SF4 (i.e., SF4-1 and SF4-2).

Critical pumping facilities should be equipped with an on-site, backup power generator. A pump station is considered critical if it serves a pressure zone with insufficient storage and meets one of the following criteria:

- It is the largest facility that provides water to a pressure zone and/or service area;
- It is the sole water source to a pressure zone and/or service area;
- It provides water from a supply turnout; or
- It provides water from a key groundwater well.

As discussed in Section 8.3, the pressure zones with insufficient storage are VW1 and VW2. Therefore, the Gibraltar (VW) pump station is deemed critical and should have backup power provisions (which it does). While Zones SF3 and SF4 have sufficient storage, each is served by a single pump station. The City should consider installing backup power generators at the Country Club and Tularcitos pump stations for additional redundancy. These backup power projects are included in Table 11-2 as CIP IDs ECIP-BG-CC and ECIP-BG-TL.

Table 8-4 compares the available and required firm pumping capacities for each pressure zone. Similar to the storage capacity evaluation, Zones 1 and 2 in each service area are combined. In Zones SF1 and SF2, firm pumping capacity consists of one 5,500-gpm pump at Gibraltar (SF) and two 1,800-gpm pumps at Ayer. At 9,100 gpm combined, the firm pumping capacity in Zones SF1 and SF2 exceeds the required firm pumping capacity, which equals the existing MDD of Zones SF1, SF2, and all higher zones (i.e., the entire SFPUC service area). The pumping capacity surplus in Zones SF1 and SF2 is approximately 3,270 gpm.

Table 8-3. Comparison of Available and Required Water Storage Capacity									
[A]	[B]	[C]	[D]	[E] = [C] + [D]	[F]	[G]	[H]	[I] = [F] + [G] + [H]	[J] = [E] - [I]
		Available Storage Capacity, MG			Required Storage Capacity, MG				
Station	Status	Reservoir Capacity	Emergency Groundwater Storage Credit[a]	Total Available Storage	Operational[b]	Emergency[c]	Fire Flow[d]	Total Required Storage	Storage Surplus (Deficit), MG
Zones SF1 and SF2									
Gibraltar (SF)	Active	5.00	--	**12.30**	2.04	4.08	0.96	**7.09**	**5.21**
Ayer	Active	5.60	--						
Pinewood Well	Standby	--	1.70						
Zone SF3									
Tularcitos	Active	0.30	--	**0.30**	0.02	0.03	0.18	**0.23**	**0.07**
Zones SF4-1 and SF4-2									
Minnis	Active	0.34	--	**0.34**	0.04	0.08	0.18	**0.30**	**0.04**
Zones VW1 and VW2									
Gibraltar (VW)	Active	5.00	--	**5.00**	1.50	2.99	0.96	**5.45**	**(0.45)**

(a) Credit based on 24 hours of pumping capacity. The credit cannot exceed the required emergency storage capacity.

(b) Based on 25 percent of a maximum day demand (see Table 8-1).

(c) Based on 50 percent of a maximum day demand (see Table 8-1).

(d) Based on storage required for largest potential fire flow within the pressure zone. Zones SF1/SF2 and VW1/VW2 = Industrial; Zones SF3 and SF4 = Single Family Residential.

(e) VW storage deficit can be met by SFPUC storage surplus.

Table 8-4. Comparison of Available and Required Firm Pumping Capacity

Pump Station	Critical Facility[a]	Existing On-site Backup Power	Status	Firm Capacity[b], gpm	Total Firm Pumping Capacity, gpm	Existing Maximum Day Demand[c], gpm	Pumping Capacity Surplus (Deficit), gpm
Zones SF1 and SF2							
Gibraltar (SF)		✓	Active	5,500	9,100	5,833	3,267
Ayer		✓	Active	3,600			
Zone SF3							
Country Club			Active	250	250	159	91
Zones SF4-1 and SF4-2							
Tularcitos			Active	250	250	115	135
Zones VW1 and VW2							
Gibraltar (VW) - from tank	✓	✓	Active	5,500	13,500	4,158	9,342
Gibraltar (VW) - from turnout[d]	✓	✓	Active	8,000			

(a) Pump stations are considered critical if they serve a pressure zone with insufficient storage and meet other criteria. Refer to Table 7-1.

(b) Firm pumping capacity was defined as the total pump station capacity with the largest pump out of service.

(c) Includes maximum day demands for higher pressure zones, per Table 7-1.

(d) These pumps are intended to boost pressures from the VW turnout but can be valved to draw from the Gibraltar (VW) tank.

Similarly, the firm pumping capacities in Zones SF3 and SF4 also exceed requirements. In Zone SF3, the firm pumping capacity consists of one 250-gpm pump at Country Club, while the combined existing MDD of Zones SF3 and higher (i.e., Zones SF3 and SF4) is 159 gpm. The pumping capacity surplus in Zone SF3 is approximately 91 gpm. In Zone SF4, the firm pumping capacity consists of one 250-gpm pump at Tularcitos. The existing MDD of Zone SF4 is only 115 gpm, resulting in a pumping capacity surplus of approximately 135 gpm.

Both sets of pumps at the Gibraltar (VW) PS are included in the pumping capacity evaluation for the VW service area. One set draws from the Gibraltar (VW) storage reservoir, while the other set boosts pressures from the Gibraltar turnout (if necessary). By adjusting valve operations, the “turnout” pumps can also draw from the Gibraltar (VW) storage reservoir. The combined firm capacity for both sets of pumps is 13,500 gpm, which exceeds the VW service area MDD (4,158 gpm) by approximately 9,340 gpm.

8.5 EXISTING WATER DISTRIBUTION SYSTEM EVALUATION

West Yost used the updated hydraulic model to conduct steady-state hydraulic analyses of the existing water distribution system. The goal of this evaluation is to identify necessary improvements to support the City’s existing water demands while meeting the recommended system performance criteria presented in Sections 7.2.1 and 7.2.3 of this report.

In evaluating the existing system, pressure criteria are prioritized over velocity criteria. This prioritization is typical, because older water systems tend to have many undersized pipes, and strictly adhering to velocity standards would identify those pipes as candidates for replacement, even though pressures meet recommended criteria. West Yost does not recommend replacing existing pipes solely for failing to meet velocity criteria, so while velocity results will be summarized for non-emergency scenarios, the following analyses focus on pressures and fire flow availability.

The following evaluations examine distribution system performance under existing water demand conditions:

- Average Day Demand Scenario: evaluates the potential for high customer service pressures in the system during an average day demand condition
- Peak Hour Demand Scenario: evaluates the potential for low customer service pressures in the system during a peak hour demand condition
- Maximum Day Demand Scenario: evaluates the potential for low customer service pressures in the system during a maximum day demand condition
- Maximum Day plus Fire Flow Scenario: evaluates fire flow availability in the system under a maximum day demand condition
- Emergency Operations (each scenario is evaluated under (a) maximum day demand conditions and (b) maximum day demand plus fire flow):
    - Outage Scenario 1: SFPUC turnouts are offline
    - Outage Scenario 2: VW turnout is offline
    - Outage Scenario 3: SFPUC and VW turnouts are offline
    - Outage Scenario 4: Power outage; all facilities without backup generators are offline
    - Outage Scenario 5: PRVs normally allowing flow between Zones 1 and 2 are offline.

To capture the entire range of normal water system operations, each non-emergency scenario above was evaluated using two operational alternatives. These alternatives are described in the following section.

8.5.1 Evaluation Alternatives

Throughout a normal day, the City varies water distribution system operations to achieve different goals. During morning (approximately 6:00 am to 10:30 am) and evening (approximately 5:00 pm to 11:00 pm) peak demand periods in the SFPUC service area, pumps at Gibraltar (SF) and Ayer draw from their respective tanks and deliver flows to the system. This supplements turnout flows and turns over water stored in reservoirs. During midday (approximately 11:00 am to 4:00 pm) and overnight (approximately 12:00 am to 5:00 am) low demand periods, the pumps are off. Turnouts alone supply the system, including refilling the Gibraltar (SF) and Ayer tanks.

In the hillside zones (i.e., Zones SF3 and SF4), operations also vary by pump status. Both the Country Club and Tularcitos pump stations operate on a two-pump lead lag system, with operation determined by the water level of the “destination” reservoir (i.e., Tularcitos reservoir for the Country Club pumps and Minnis reservoir for the Tularcitos pumps). The maximum water level in both reservoirs is 23 feet, and setpoints are the same for both pump stations. The lead pump turns on when the destination reservoir level is 15 feet and stops at 21.5 feet, while the lag pump starts at 14 feet and stops at 21 feet. When the Country Club and Tularcitos pumps are off, the Tularcitos and Minnis storage reservoirs serve zones SF3 and SF4, respectively, via gravity. When the Country Club and Tularcitos pumps are operating, they simultaneously serve the hillside zones and refill the elevated storage tanks.

The Gibraltar (VW) pumps also operate on a daily schedule, depending on the season. In the winter and spring, pumps operate during the day (approximately 6:30 am to 5:00 pm), and the Gibraltar (VW) reservoir fills overnight (approximately 7:00 pm to 4:00 am). The schedule reverses in the summer and fall, with the reservoir filling during the day (approximately 7:00 am to 5:00 pm) and pumps running overnight (approximately 9:00 pm to 5:00 am). Seasonal operations change around May 15th and November 15th, based on peak rate schedules set by Pacific Gas and Electric (PG&E).

West Yost identified two operational alternatives to represent the primary modes in which the water system normally functions. These operational alternatives are summarized in Table 8-5. In Base operations, all pumps are off, whereas Alternative 1 allows pump operation as needed. For both alternatives, all turnouts are open, and gravity tank levels are at their minimum. Since the Zone 1 and Zone 2 storage reservoirs (both Gibraltar tanks and the Ayer tank) feed booster pumps, their tank levels do not impact system pressures. Therefore, they are not listed in Table 8-5.

Table 8-5. Summary of Operational Alternatives

Facility	Base	Alternative 1 – Pumps On
SFPUC Service Area		
Turnouts[a]	Open	
Gibraltar (SF) Pump Station	**Closed**	Open
Ayer Pump Station	**Closed**	Open
Country Club Pump Station	**Closed**	Open
Tularcitos Tank Level	Minimum	
Tularcitos Pump Station	**Closed**	Open
Minnis Tank Level	Minimum	
VW Service Area		
Gibraltar Turnout	Open	
Gibraltar (VW) Pump Station	**Closed**	Open

(a) SFPUC turnouts include Sunnyhills, Calaveras, Main Street, and the Intertie turnout.

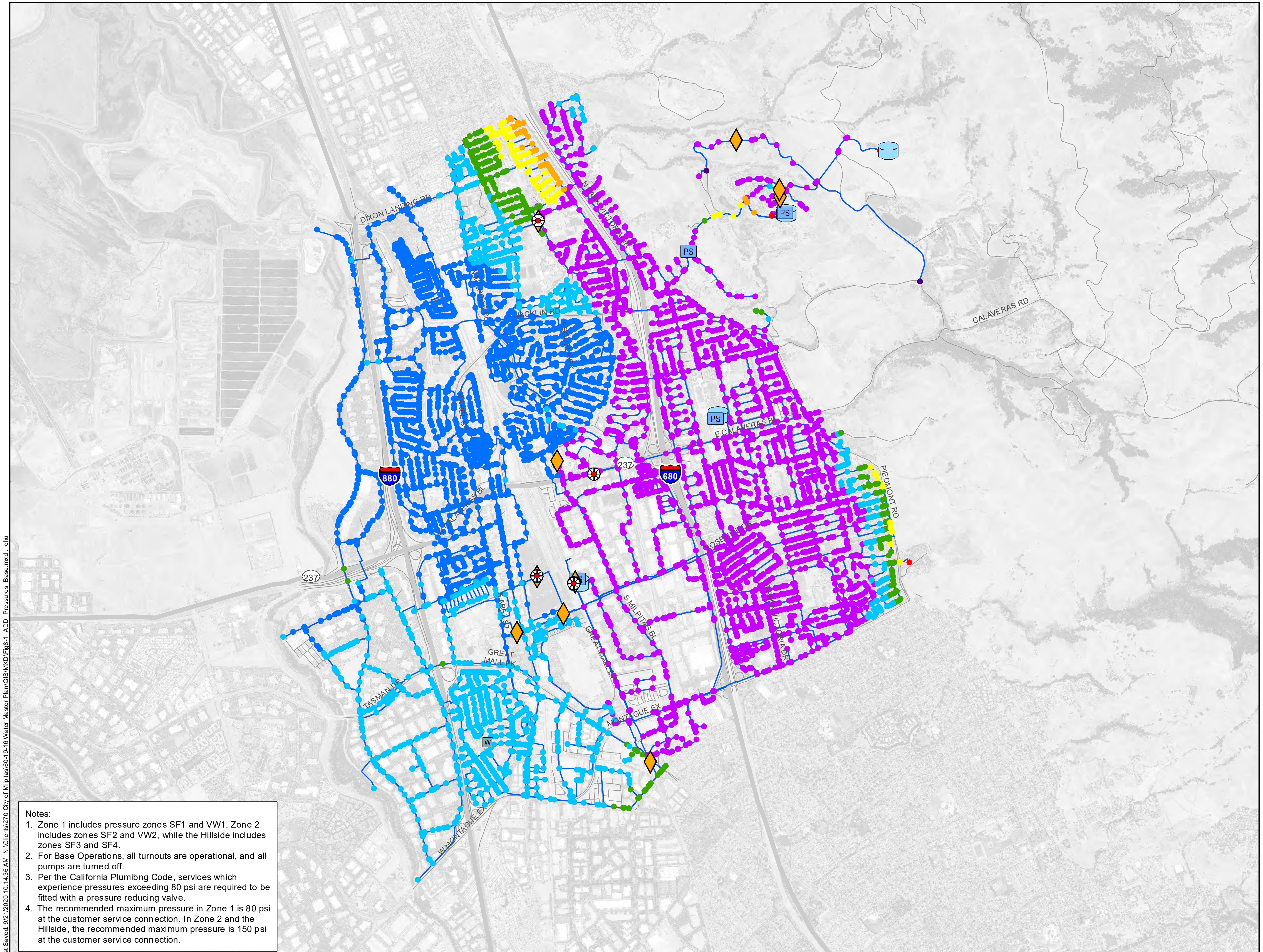
8.5.2 Average Day Demand Analysis

The hydraulic model was used to conduct a steady-state hydraulic analysis of the system during an existing average day demand (ADD) condition for each of the alternatives listed in Table 8-5. As shown in Table 8-1, the ADD for the existing water service area is approximately 5,784 gpm (8.33 mgd). Per recommended water system performance criteria detailed in Section 7.2.3 of this report, under ADD conditions pressures should be at least 40 psi at customer service connections. In addition, customer service pressures should not exceed 80 psi in Zone 1 (SF1 and VW1) or 150 psi in other zones.

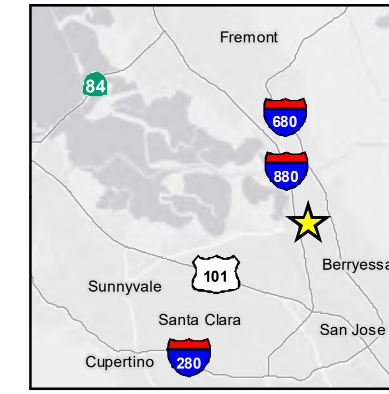
Results from the ADD simulations for Base and Alternative 1 operations are shown on Figure 8-1 and Figure 8-2, respectively. In each figure, color-coded circles represent distribution system pressures during an ADD condition. In both Base and Alternative 1 cases, there are no customer service locations with pressures below 40 psi. The lowest customer service pressure in the distribution system is approximately 42 psi (Base alternative), located at the eastern end of Manferd Street near I-680 in Zone SF1. The same location has the lowest pressure with pumps on (Alternative 1), but the pressure is slightly higher (44 psi).

Many customer service locations experience pressures above the recommended limit. Pressures are generally higher when pumps are on, so Alternative 1 (Figure 8-2) is a more conservative representation of high pressures within the system. Per Table 7-1, recommended maximum pressures vary by zone, so Figure 8-1 and Figure 8-2 classify high pressures (i.e., exceeding the maximum) accordingly.

In Zone 1 (SF1 and VW1), high pressures are defined as exceeding 80 psi, and corresponding locations are dark blue. Much of Zone SF1 and the northern portion of Zone VW1 experience high pressures during an ADD condition. In Zone 2 (SF2 and VW2) and above (SF3 and SF4), high pressures are defined as exceeding 150 psi, and corresponding locations are dark purple. As shown on Figure 8-2, the area north of Highway 237 and adjacent to I-680 in Zone SF2 experiences high pressures during an ADD condition.



Notes:
1. Zone 1 includes pressure zones SF1 and VW1. Zone 2 includes zones SF2 and VW2, while the Hillside includes zones SF3 and SF4.
2. For Base Operations, all turnouts are operational, and all pumps are turned off.
3. Per the California Plumibng Code, services which experience pressures exceeding 80 psi are required to be fitted with a pressure reducing valve.
4. The recommended maximum pressure in Zone 1 is 80 psi at the customer service connection. In Zone 2 and the Hillside, the recommended maximum pressure is 150 psi at the customer service connection.



N

0 1,500 3,000
Scale in Feet

Average Day Pressure
- Less than 40 psi
- 40 psi to 50 psi
- 50 psi to 60 psi
- 60 psi to 70 psi
- 70 psi to 80 psi

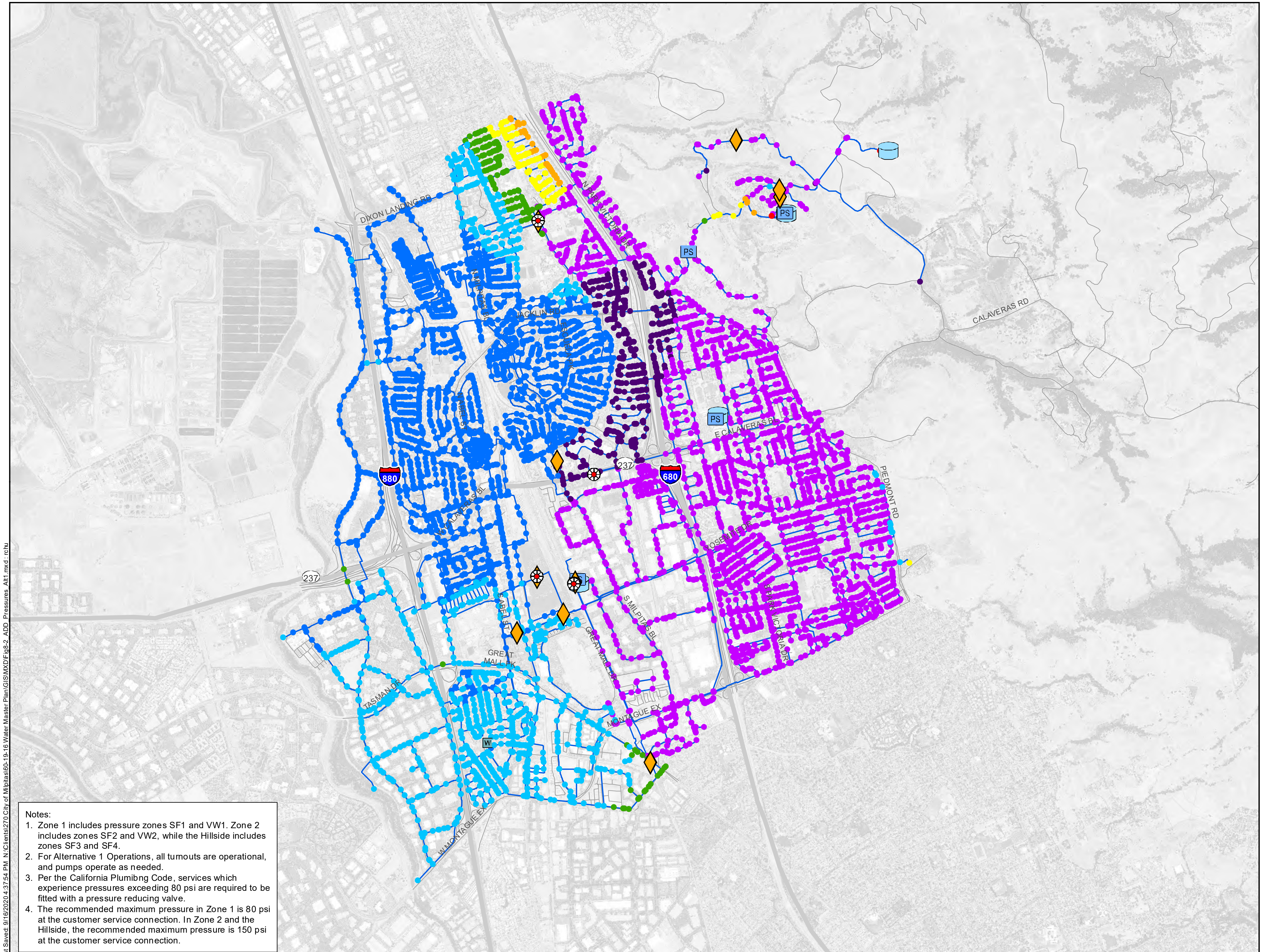
High Pressure (Zone 1)
- Greater than 80 psi

High Pressure (Zone 2 and Hillside)
- 80 psi to 150 psi
- Greater than 150 psi
- Turnout
- Groundwater Well
- Pressure Reducing Valve
- Pump Station
- Storage Reservoir
- Pipeline

Figure 8-1

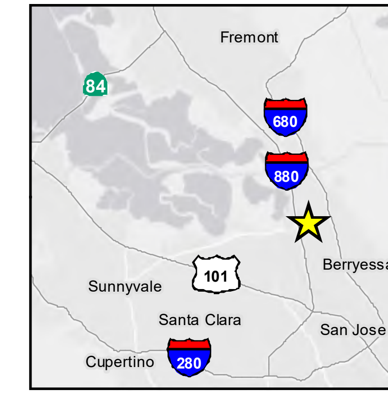
Existing System Pressures
Average Day Demand
Base Operations

City of Milpitas
2020 Water Master Plan



Notes:

1. Zone 1 includes pressure zones SF1 and VW1. Zone 2 includes zones SF2 and VW2, while the Hillside includes zones SF3 and SF4.
2. For Alternative 1 Operations, all turnouts are operational, and pumps operate as needed.
3. Per the California Plumibng Code, services which experience pressures exceeding 80 psi are required to be fitted with a pressure reducing valve.
4. The recommended maximum pressure in Zone 1 is 80 psi at the customer service connection. In Zone 2 and the Hillside, the recommended maximum pressure is 150 psi at the customer service connection.



N

0 1,500 3,000

Scale in Feet

Average Day Pressure

- Less than 40 psi
- 40 psi to 50 psi
- 50 psi to 60 psi
- 60 psi to 70 psi
- 70 psi to 80 psi

High Pressure (Zone 1)

- Greater than 80 psi

High Pressure (Zone 2 and Hillside)

- 80 psi to 150 psi
- Greater than 150 psi
- Turnout
- Groundwater Well
- Pressure Reducing Valve
- Pump Station
- Storage Reservoir
- Pipeline

Figure 8-2

Existing System Pressures
Average Day Demand
Alternative 1 Operations

City of Milpitas
2020 Water Master Plan

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California Plumbing Code requires new services with pressures greater than 80 psi be fitted with a PRV. West Yost recommends that the City verify that individual PRVs are installed on existing customer service laterals in high pressure areas (i.e., dark blue, light purple, and dark purple locations on Figure 8-2). Alternatively, the City could install PRVs on potable water mains and create pressure sub-zones within the existing pressure zones; however, creation of pressure sub-zones would restrict the ability to move water between the existing zones and would reduce the fire flow availability.

Per Table 7-1, under normal conditions the maximum recommended velocities for transmission and distribution mains is 6 and 8 ft/s, respectively. Transmission mains are pipelines 16 inches or larger in diameter, while distribution mains are pipelines smaller than 16 inches in diameter. Under an existing ADD condition, almost all pipelines meet recommended velocity criteria. The only high-velocity pipeline segments are on either side of the Sunnyhills PRV. This 6-inch diameter stretch of pipe experiences velocities of 16.5 ft/s in the Base alternative and 9.0 ft/s in Alternative 1. The remaining pipes meet recommended velocity criteria, with velocities ranging from 0.01 ft/s to approximately 6.1 ft/s.

8.5.3 Peak Hour Demand Analysis

The hydraulic model was used to conduct a steady-state hydraulic analysis of the system during an existing PHD condition for each of the alternatives listed in Table 8-5. As shown in Table 8-1, the PHD for the existing water service area is approximately 18,011 gpm (25.9 mgd). Under PHD conditions, the recommended minimum pressure is 30 psi. Any services experiencing pressures less than 30 psi during a PHD condition would require an individual booster pump.

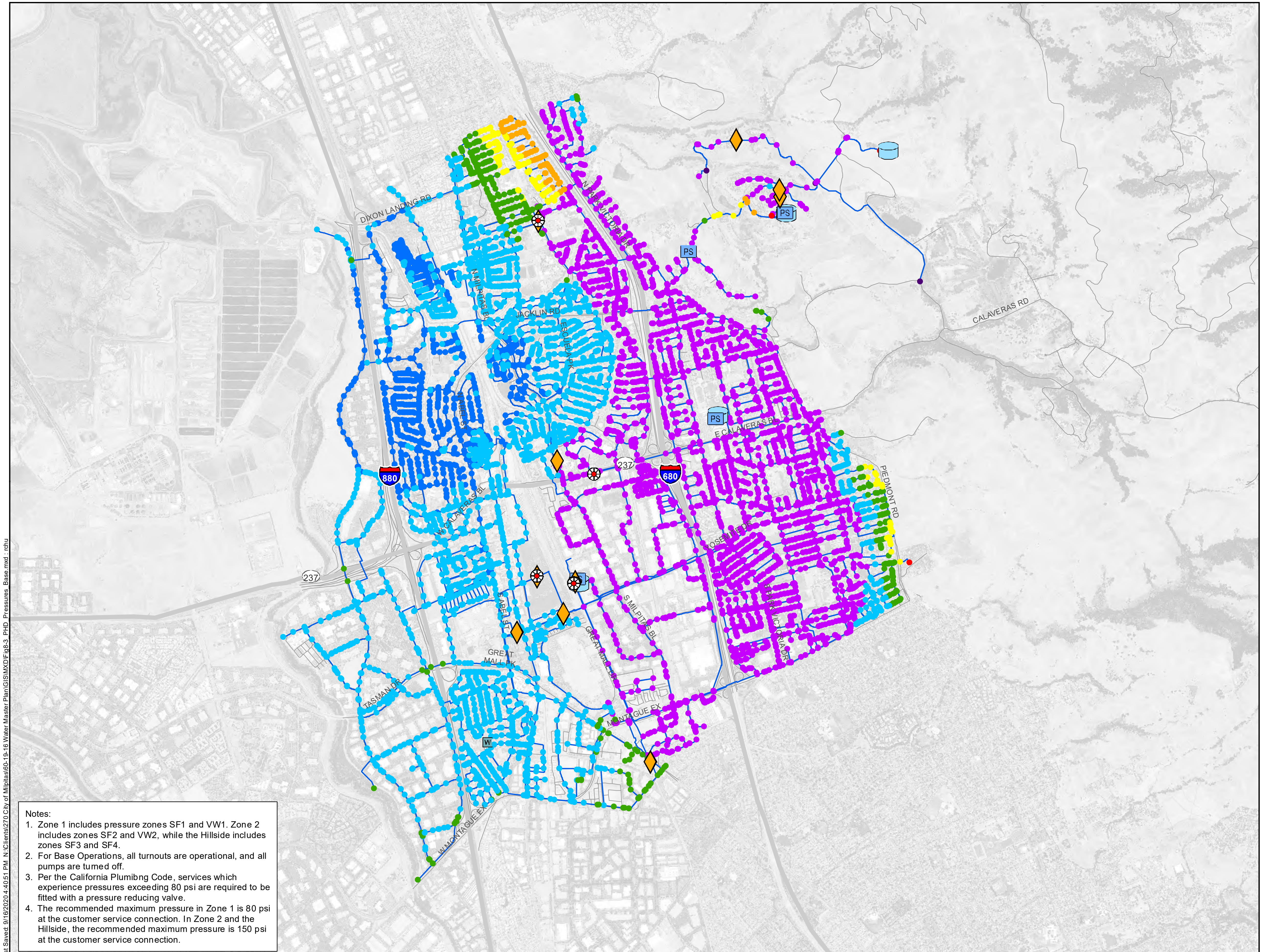
Results from the PHD simulations for Base and Alternative 1 operations are shown on Figure 8-3 and Figure 8-4, respectively. Figure 8-3 and Figure 8-4 are similar to Figure 8-1 and Figure 8-2, with distribution system locations color coded by pressure. Pressures are slightly higher for Alternative 1 (pumps on), but there are no significant differences in system performance based on operations. In both cases, there are no customer service locations with pressures below 30 psi.

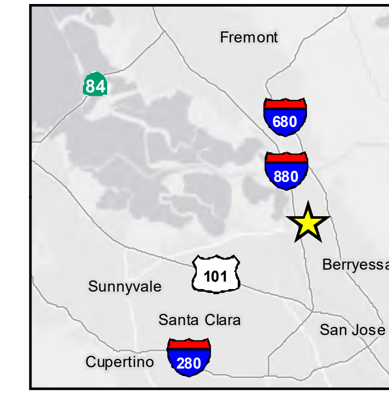
Almost all distribution system pipelines meet velocity criteria under PHD conditions. The 6-inch diameter pipes on either end of the Sunnyhills PRV continue to experience high velocities: 25.5 ft/s in the Base alternative and 19.9 ft/s in Alternative 1. Pipelines at the Gibraltar facility and at the Sunnyhills and Main turnouts also see high velocities (8-12 ft/s). For the rest of the system, velocities range from 0.01 ft/s to approximately 7.8 ft/s.

8.5.4 Maximum Day Demand Analysis

The hydraulic model was used to conduct a steady-state hydraulic analysis of the system during an existing MDD condition for each of the alternatives listed in Table 8-5. As shown in Table 8-1, the MDD for the existing water service area is approximately 9,990 gpm (14.4 mgd). Under MDD conditions, the recommended minimum pressure is 40 psi. The same maximum pressure criteria apply as described in the ADD analysis, but since pressures would be higher under ADD conditions, system performance relative to maximum pressures is not discussed here.

Results from the MDD simulations for Base and Alternative 1 operations are shown on Figure 8-5 and Figure 8-6, respectively. As with figures for ADD and PHD demand conditions, distribution system locations are color coded by pressure. Pressures are slightly higher for Alternative 1 (pumps on), but there are no significant differences in system performance based on operations. In both cases, there are no customer service locations with pressures below 40 psi.





N

0 1,500 3,000

Scale in Feet

Peak Hour Pressure

- Less than 30 psi
- 30 psi to 50 psi
- 50 psi to 60 psi
- 60 psi to 70 psi
- 70 psi to 80 psi

High Pressure (Zone 1)

- Greater than 80 psi

High Pressure (Zone 2 and Hillside)

- 80 psi to 150 psi
- Greater than 150 psi
- Turnout
- Groundwater Well
- Pressure Reducing Valve
- Pump Station
- Storage Reservoir
- Pipeline

Notes:

1. Zone 1 includes pressure zones SF1 and VW1. Zone 2 includes zones SF2 and VW2, while the Hillside includes zones SF3 and SF4.
2. For Base Operations, all turnouts are operational, and all pumps are turned off.
3. Per the California Plumibng Code, services which experience pressures exceeding 80 psi are required to be fitted with a pressure reducing valve.
4. The recommended maximum pressure in Zone 1 is 80 psi at the customer service connection. In Zone 2 and the Hillside, the recommended maximum pressure is 150 psi at the customer service connection.

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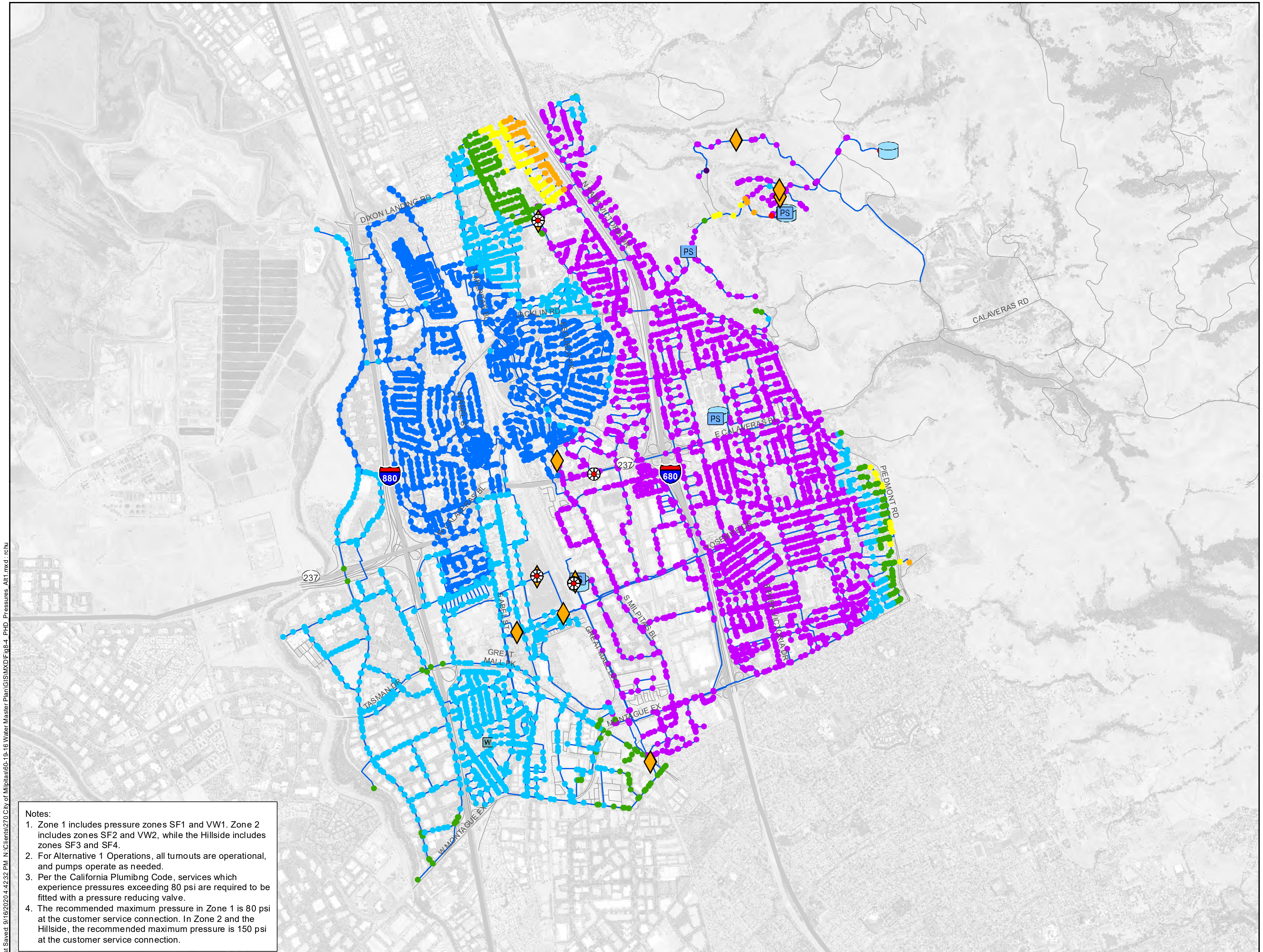
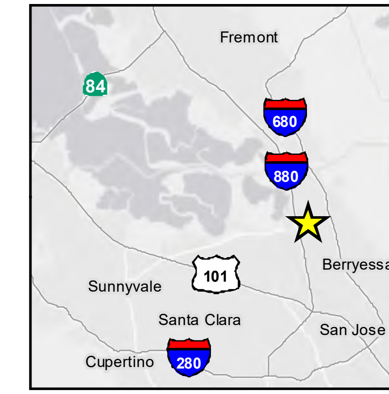
Figure 8-3

Existing System Pressures
Peak Hour Demand
Base Operations

City of Milpitas
2020 Water Master Plan





N

0 1,500 3,000
Scale in Feet

Peak Hour Pressure

- Less than 30 psi
- 30 psi to 50 psi
- 50 psi to 60 psi
- 60 psi to 70 psi
- 70 psi to 80 psi

High Pressure (Zone 1)

- Greater than 80 psi

High Pressure (Zone 2 and Hillside)

- 80 psi to 150 psi
- Greater than 150 psi
- Turnout
- Groundwater Well
- Pressure Reducing Valve
- Pump Station
- Storage Reservoir
- Pipeline

Notes:

1. Zone 1 includes pressure zones SF1 and VW1. Zone 2 includes zones SF2 and VW2, while the Hillside includes zones SF3 and SF4.
2. For Alternative 1 Operations, all turnouts are operational, and pumps operate as needed.
3. Per the California Plumibng Code, services which experience pressures exceeding 80 psi are required to be fitted with a pressure reducing valve.
4. The recommended maximum pressure in Zone 1 is 80 psi at the customer service connection. In Zone 2 and the Hillside, the recommended maximum pressure is 150 psi at the customer service connection.

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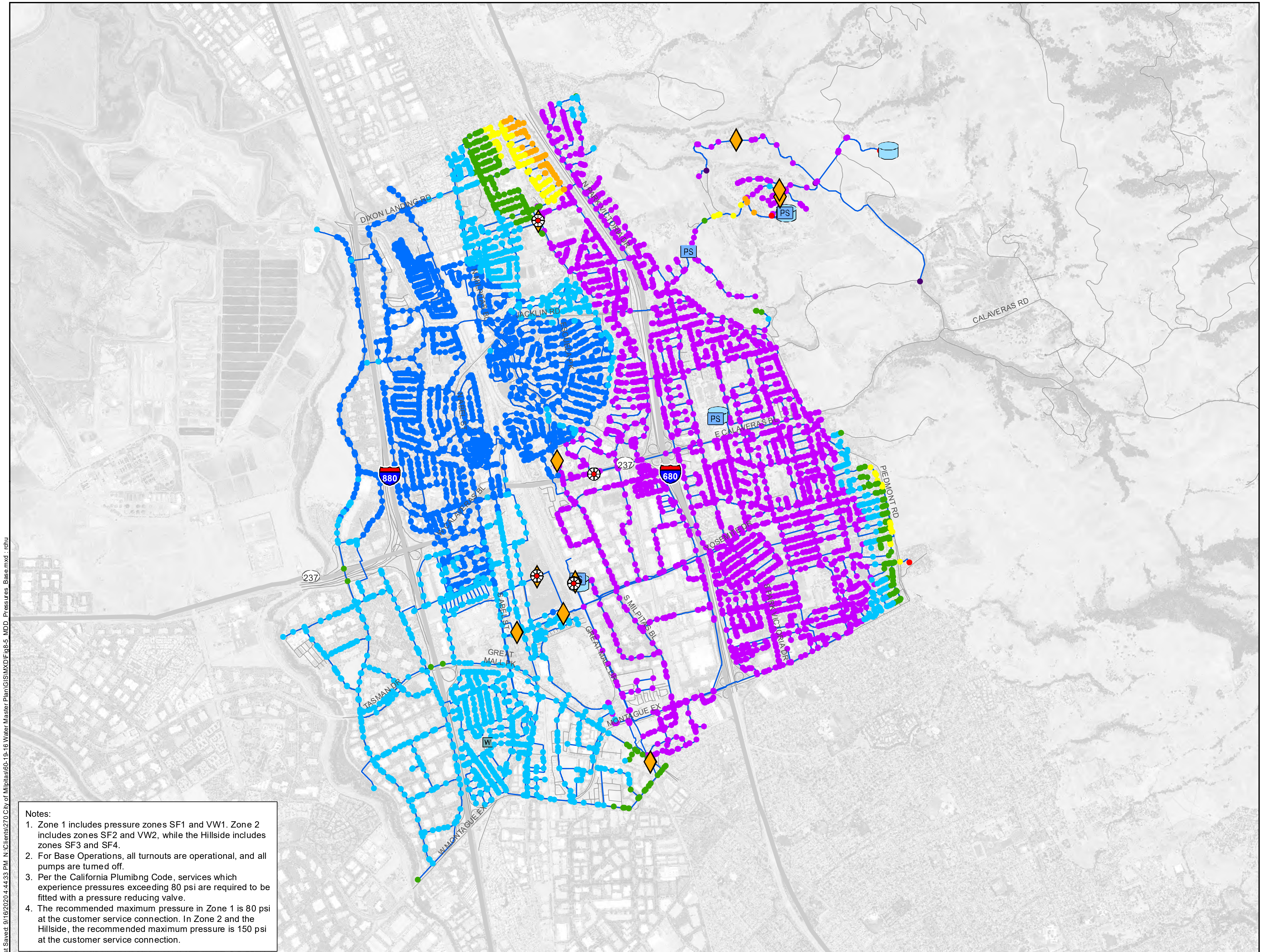
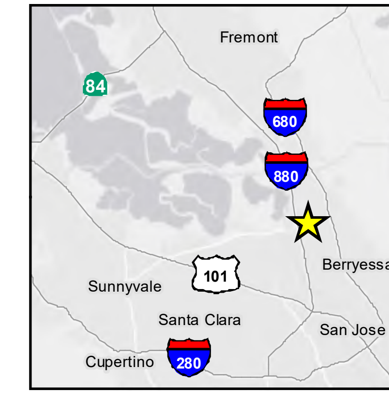
Figure 8-4

Existing System Pressures
Peak Hour Demand
Alternative 1 Operations

City of Milpitas
2020 Water Master Plan



Notes:
1. Zone 1 includes pressure zones SF1 and VW1. Zone 2 includes zones SF2 and VW2, while the Hillside includes zones SF3 and SF4.
2. For Base Operations, all turnouts are operational, and all pumps are turned off.
3. Per the California Plumibng Code, services which experience pressures exceeding 80 psi are required to be fitted with a pressure reducing valve.
4. The recommended maximum pressure in Zone 1 is 80 psi at the customer service connection. In Zone 2 and the Hillside, the recommended maximum pressure is 150 psi at the customer service connection.



N

0 1,500 3,000
Scale in Feet

Maximum Day Pressure
- Less than 40 psi
- 40 psi to 50 psi
- 50 psi to 60 psi
- 60 psi to 70 psi
- 70 psi to 80 psi

High Pressure (Zone 1)
- Greater than 80 psi

High Pressure (Zone 2 and Hillside)
- 80 psi to 150 psi
- Greater than 150 psi
- Turnout
- Groundwater Well
- Pressure Reducing Valve
- Pump Station
- Storage Reservoir
- Pipeline

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Figure 8-5

**Existing System Pressures
Maximum Day Demand
Base Operations**

City of Milpitas
2020 Water Master Plan

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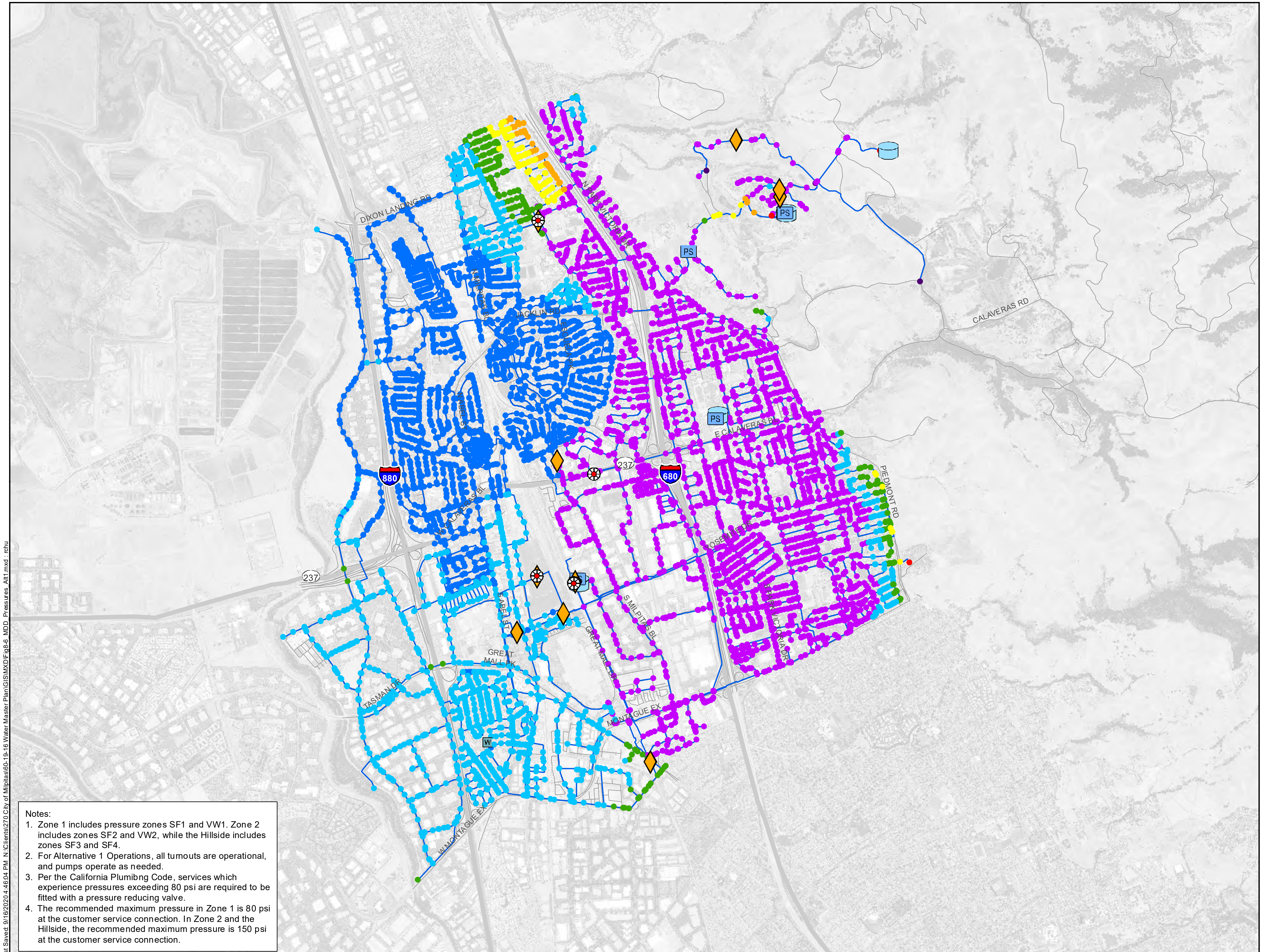

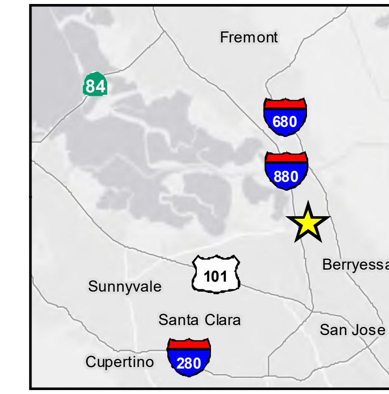

N

0 1,500 3,000

Scale in Feet

Maximum Day Pressure

- Less than 40 psi
- 40 psi to 50 psi
- 50 psi to 60 psi
- 60 psi to 70 psi
- 70 psi to 80 psi

High Pressure (Zone 1)

- Greater than 80 psi

High Pressure (Zone 2 and Hillside)

- 80 psi to 150 psi
- Greater than 150 psi
- Turnout
- Groundwater Well
- Pressure Reducing Valve
- Pump Station
- Storage Reservoir
- Pipeline

Notes:

1. Zone 1 includes pressure zones SF1 and VW1. Zone 2 includes zones SF2 and VW2, while the Hillside includes zones SF3 and SF4.
2. For Alternative 1 Operations, all turnouts are operational, and pumps operate as needed.
3. Per the California Plumibng Code, services which experience pressures exceeding 80 psi are required to be fitted with a pressure reducing valve.
4. The recommended maximum pressure in Zone 1 is 80 psi at the customer service connection. In Zone 2 and the Hillside, the recommended maximum pressure is 150 psi at the customer service connection.

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Figure 8-6

Existing System Pressures Maximum Day Demand Alternative 1 Operations

City of Milpitas
2020 Water Master Plan

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Almost all distribution system pipelines meet velocity criteria under MDD demand conditions. The 6-inch diameter pipes on either end of the Sunnyhills PRV experience high velocities: approximately 19.1 ft/s and 12.1 ft/s under Base and Alternative 1 operations, respectively. Also, on either side of the Gibraltar PRV, the 16-inch diameter pipes see velocities of 6.6 ft/s under Base operations. For the rest of the system, velocities range from 0.01 ft/s to approximately 7.7 ft/s.

8.5.5 Maximum Day Demand Plus Concurrent Fire Flow Analysis

Based on existing land use of adjacent parcels and recommended fire flows in Table 7-1, fire flows were assigned to hydrant locations throughout the distribution system. Where a hydrant may serve multiple land uses (e.g., commercial and industrial), the higher fire flow was assigned. In total, fire flows were assigned to approximately 2,150 locations throughout the distribution system.

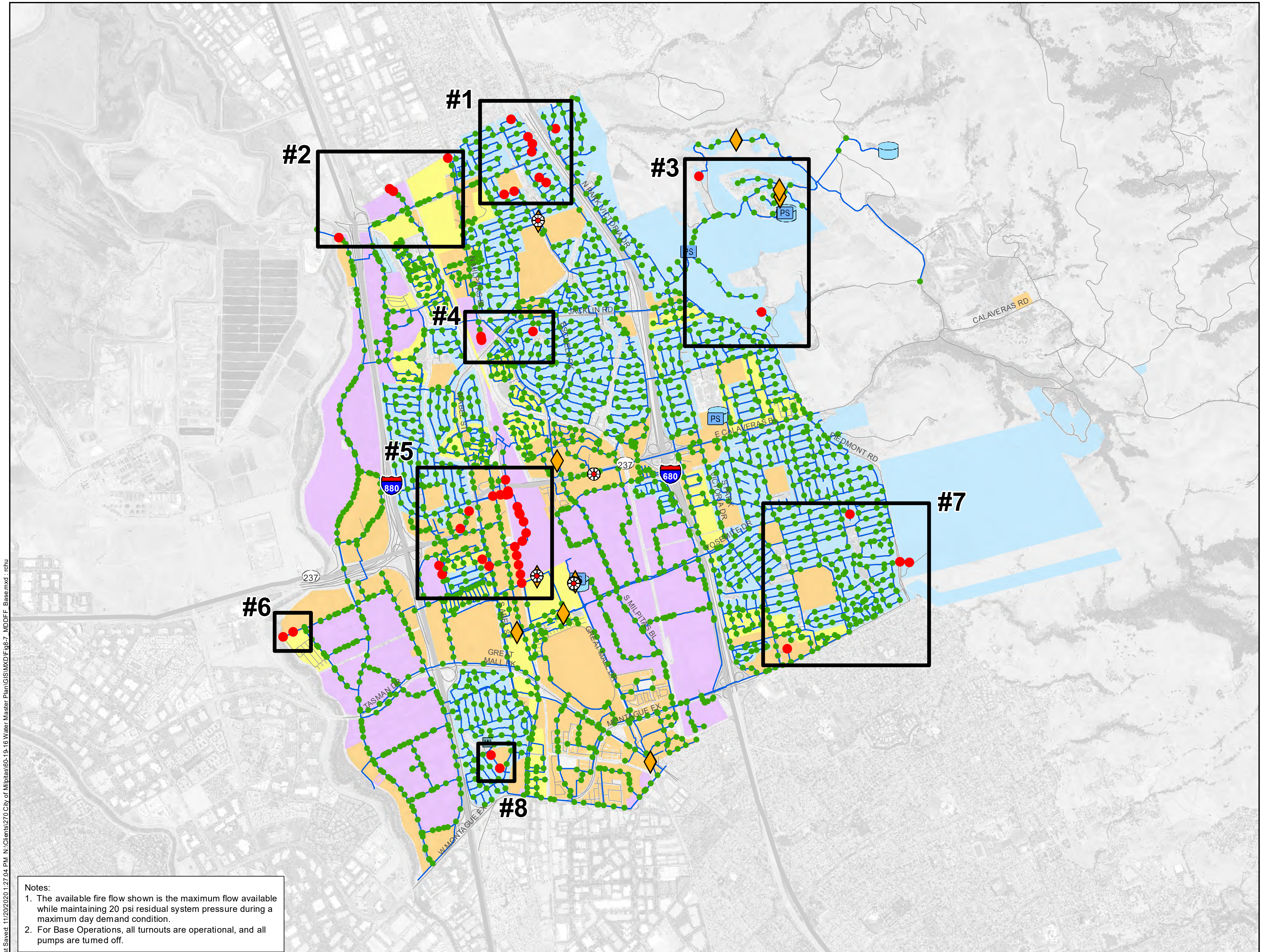
Fire flows were then simulated during an MDD condition using the hydraulic model. The hydraulic model conducts fire flow analyses by simulating a fire flow demand at one hydrant location and verifying whether the system can serve all other normal customer demands while maintaining desired residual pressures. This is repeated for all hydrant locations within the distribution system. Hydrant locations meet recommended fire flows if they can deliver the recommended fire flow while maintaining a 20-psi residual system pressure. Note, this fire flow analysis reflects distribution system capacity, as individual hydrants and their associated losses are not modeled.

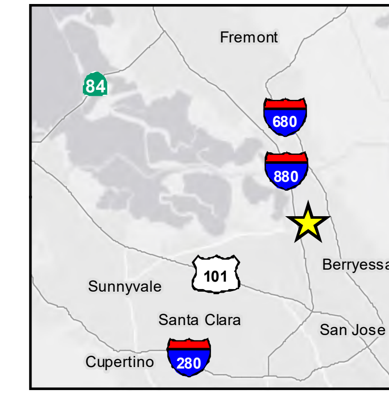
As discussed in Section 7.2.1, recommended fire flow criteria presented in Table 7-2 apply to future development and not existing system conditions. Much of the City's distribution system is older and was designed to earlier fire flow standards in place at the time the pipelines were installed. Therefore, the existing system fire flow evaluation presents systemwide available fire flow and does not recommend pipeline improvements to increase existing fire flow capacity. However, the City can use these results to prioritize replacing smaller diameter pipelines to improve overall flows throughout the distribution system, which is why potential improvement projects are discussed below.

Fire flow analyses were performed independently for each pressure zone, with Zones 1 and 2 combined for each service area. It was assumed that only one fire event would occur at a time, which is standard industry practice. Results from MDD plus concurrent fire flow simulations for Base and Alternative 1 operations are shown on Figure 8-7 and Figure 8-8, respectively. Hydrant locations are represented by circles and color coded by fire flow availability, while parcels are shaded according to recommended fire flow. For example, a green circle adjacent to a purple parcel means that the distribution system can meet a 4,000 gpm fire flow at that location while maintaining 20 psi in the rest of the system.

System performance is similar for the two operational alternatives. With pumps off (Base alternative), 51 locations do not meet recommended fire flows, while 45 locations are below the fire flow criterion under Alternative 1. All "below criterion" locations in Alternative 1 are also flagged in the Base alternative, so pump operation improves fire flow availability for six locations. Since pumps could be off during a fire event, recommended improvements address all 51 below criterion locations identified in the Base alternative.

Before evaluating system improvements, West Yost examined each below criterion location to verify whether the recommended fire flow could be adequately served by multiple hydrants. Distributing the recommended fire flow among multiple hydrants reduces friction losses, because only a portion of the flow reaches the hydrant closest to the simulated fire. The remainder of the fire flow is delivered by an adjacent hydrant served by a shorter (or entirely different) pipeline path. These reduced friction losses can be significant, in some cases allowing otherwise below criterion locations to meet recommended fire flows.





N

0 1,500 3,000

Scale in Feet

Available Fire Flow

- Below Recommended Fire Flow
- Meets Recommended Fire Flow
- Turnout
- Groundwater Well
- Pressure Reducing Valve
- Pump Station
- Storage Reservoir
- Pipeline

Recommended Fire Flow

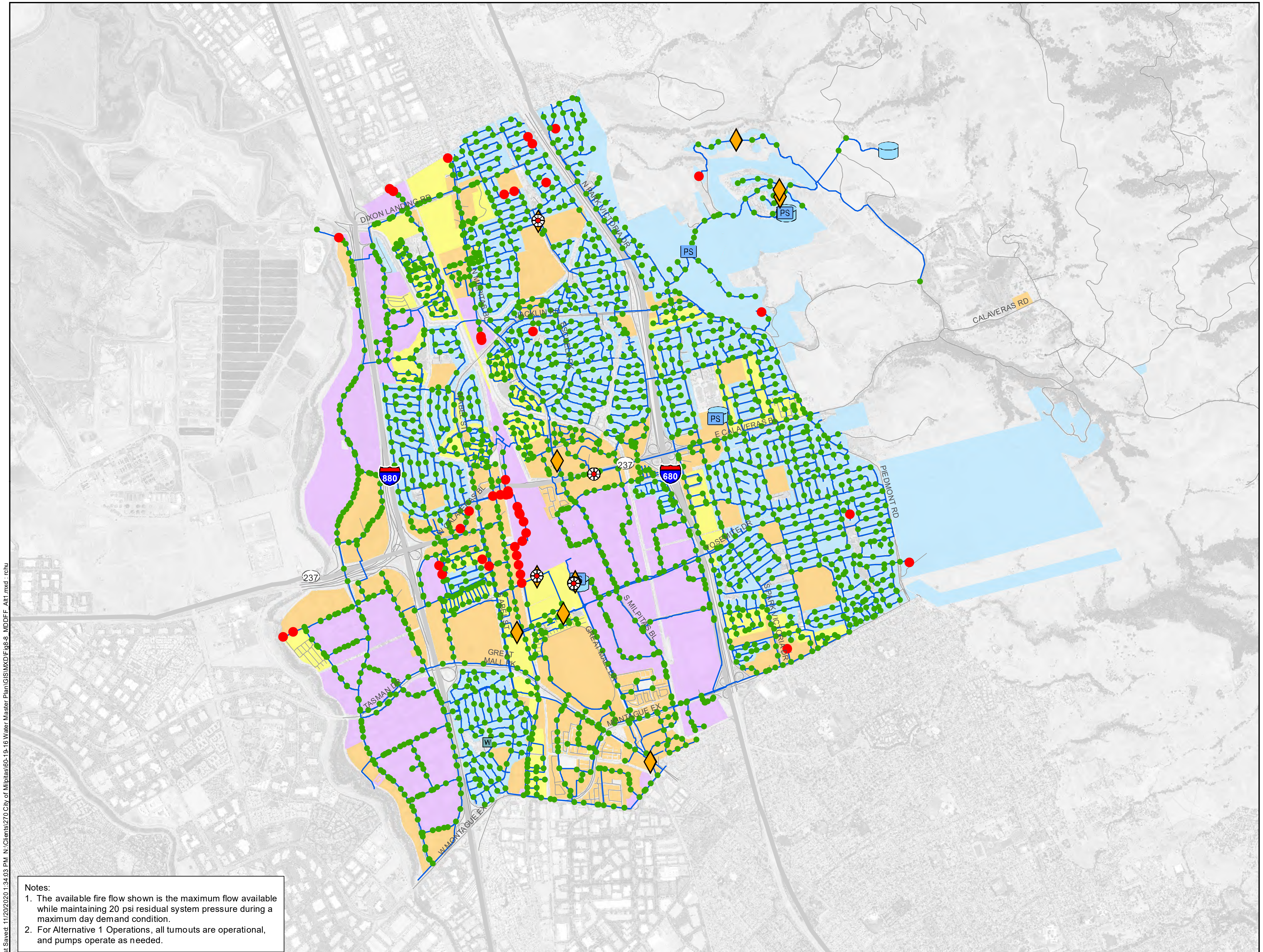
- 1,500 gpm
- 2,500 gpm
- 3,000 gpm
- 4,000 gpm

WEST YOST

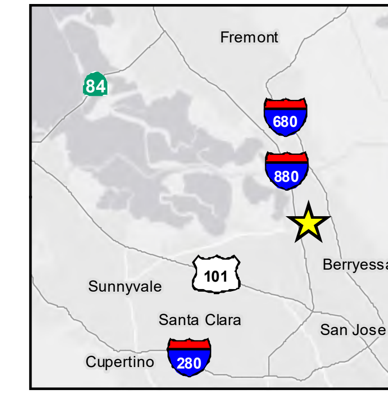
Figure 8-7

Existing System Available Fire Flow Base Operations

City of Milpitas
2020 Water Master Plan



Notes:
1. The available fire flow shown is the maximum flow available while maintaining 20 psi residual system pressure during a maximum day demand condition.
2. For Alternative 1 Operations, all turnouts are operational, and pumps operate as needed.



N

0 1,500 3,000
Scale in Feet

Available Fire Flow

- Below Recommended Fire Flow
- Meets Recommended Fire Flow
- Turnout
- Groundwater Well
- Pressure Reducing Valve
- Pump Station
- Storage Reservoir
- Pipeline

Recommended Fire Flow

- 1,500 gpm
- 2,500 gpm
- 3,000 gpm
- 4,000 gpm

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Figure 8-8

Existing System Available Fire Flow Alternative 1 Operations

City of Milpitas
2020 Water Master Plan

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It was assumed that any location with another hydrant within the City's hydrant spacing guidelines (500 feet for single family areas and 300 feet for all other areas) would qualify for delivering fire flows through multiple hydrants. If the qualifying hydrants could combine to deliver the recommended fire flow while maintaining a 20-psi residual system pressure, then the location was no longer considered below criterion" Of the 51 below criterion locations identified in the Base alternative, 13 met recommended fire flows after looking at multiple hydrants.

To organize discussion of the remaining below criterion locations, Figure 8-7 groups them into eight geographic areas. The recommended improvements for each area are discussed below. As mentioned earlier, each proposed project is assigned a CIP ID to simplify cross-referencing with Chapter 11. In general, to comply with the City's design guidelines, the City should also consider upsizing any pipelines smaller than 6 inches in diameter that serve hydrants. These are also listed below.

- Area No. 1
  - Along Sussex Place, replace approximately 190 LF of 4-inch diameter pipeline with 8-inch diameter pipeline (ECIP-PI-23)
- Area No. 2
  - Along Milmont Drive between Dixon Landing Road and the ACWD intertie, replace approximately 910 LF of 8-inch and 10-inch diameter pipeline with 12-inch diameter pipeline (ECIP-PI-06)
- Area No. 3
  - Along Calera Creek Heights Drive between approximately hydrants 4A-001 and 4A-005, replace approximately 1,480 LF of 6-inch diameter pipeline with 8-inch diameter pipeline (ECIP-PI-26)
- Area No. 4
  - Along Hanson Court, replace approximately 610 LF of 8-inch diameter pipeline with 12-inch diameter pipeline (ECIP-PI-05)
  - Along Merz Court, replace approximately 430 LF of 4-inch diameter pipeline with 8-inch diameter pipeline (ECIP-PI-21)
- Area No. 5
  - Along Sinnott Lane, Bothelo Avenue, and East Carlo Street, replace approximately 1,730 LF of 6-inch and 8-inch diameter pipeline with 12-inch diameter pipeline (ECIP-PI-01)
  - On Hammond Way near Tom Evatt Park, replace the (normally closed) isolation valve separating Zones VW1 and SF1 with an emergency pressure reducing valve (EPRV) to allow flows from Zone SF1 during a fire event along Hammond Way (ECIP-V-01). Alternatively, the City can replace approximately 1,300 LF of 8-inch diameter pipeline with 12-inch diameter pipeline (ECIP-PI-02).
  - Along Railroad Avenue between approximately hydrant 1A-355 and the southern end of Railroad Avenue, replace approximately 880 LF of 8-inch diameter pipeline with 12-inch diameter pipeline (ECIP-PI-07)

- For the below criterion locations near the western end of Corning Avenue, install a new isolation valve at the end of the existing Zone SF1 pipeline, immediately upstream of the tee connecting Zones VW1 and SF1. Should a fire occur at the adjacent industrial site, the City can open existing (normally closed) isolation valves (numbers 35 and 35100) to supplement flows to the area. The hydraulic model shows these locations meet recommended fire flows with this adjustment. The new isolation valve can be closed to maintain separation between Zones VW1 and SF1 (ECIP-V-02). Alternatively, the City can replace approximately 870 LF of 8-inch diameter pipeline with 12-inch diameter pipeline (ECIP-PI-03).
- Along South Abel Street between Sylvia Avenue and Corning Avenue, replace approximately 240 LF of 6-inch diameter pipeline with 8-inch diameter pipeline (ECIP-PI-11)

- Area No. 6
  - Along Technology Drive between Murphy Ranch Road and the western end of Technology Drive, replace approximately 740 LF of 4-inch diameter pipeline with 12-inch diameter pipeline (ECIP-PI-04)
- Area No. 7
  - Along Carlsbad Street between Carlsbad Court and Ben Rodgers Park, replace approximately 160 LF of 4-inch diameter pipeline with 8-inch diameter pipeline (ECIP-PI-25)
  - Along Pinard Street from Ridgemont Drive up to the Lee’s Orchard community, replace approximately 680 LF of 8-inch diameter pipeline with 12-inch diameter pipeline (ECIP-PI-16)
  - Within the shopping center east of the intersection of South Park Victoria Drive and Landess Avenue, replace approximately 450 LF of 4-inch diameter pipeline with 8-inch diameter pipeline (ECIP-PI-08)
- Area No. 8
  - Along Greenwood Way between Pinewood Way and Fallen Leaf Drive, replace approximately 860 LF of 6-inch diameter pipeline with 8-inch diameter pipeline (ECIP-PI-10)
- Pipelines less than 6 inches in diameter that serve hydrants
  - Along Santa Rita Drive near the intersection of Santa Rita Drive and Via Baja Drive, replace approximately 20 LF of 4-inch diameter pipeline with 8-inch diameter pipeline (ECIP-PI-32)
  - Along Calle del Prado, replace approximately 90 LF of 4-inch diameter pipeline with 8-inch diameter pipeline (ECIP-PI-33)
  - Along Kennedy Drive between Topham Court and Prada Drive, replace approximately 330 LF of 4-inch diameter pipeline with 8-inch diameter pipeline (ECIP-PI-34)
  - Along Ramos Court, replace approximately 60 LF of 4-inch diameter pipeline with 8-inch diameter pipeline (ECIP-PI-36)
  - Along Stemel Court, replace approximately 50 LF of 4-inch diameter pipeline with 8-inch diameter pipeline (ECIP-PI-37)

- Along Sepulveda Court, replace approximately 20 LF of 4-inch diameter pipeline with 8-inch diameter pipeline (ECIP-PI-38)
- Along Berg Court, replace approximately 110 LF of 4-inch diameter pipeline with 8-inch diameter pipeline (ECIP-PI-39)

8.5.6 Emergency Outage Scenarios

The following emergency outage evaluations identify how well the distribution system functions without one or more key facilities. For reference, the outage scenarios consist of:

- SFPUC turnouts are offline
- VW turnout is offline
- SFPUC and VW turnouts are offline
- Power outage; all facilities without backup generators are offline
- PRVs normally allowing flow between Zones 1 and 2 are offline

Emergency outage scenarios are not intended to evaluate the adequacy of emergency water supplies, which is outside the scope of this master plan. Instead, these evaluations examine system pressures and fire flow availability during an MDD condition. To be conservative, storage reservoir levels are assumed to be at the minimum of normal operating range (see Table 3-4).

Since emergency scenarios assume certain facilities are offline, the corresponding evaluations do not examine system performance under Base and Alternative 1 operations. Besides the assumed outage, there are no additional operational restrictions. All facilities not assumed offline as part of the scenario are assumed to be operational.

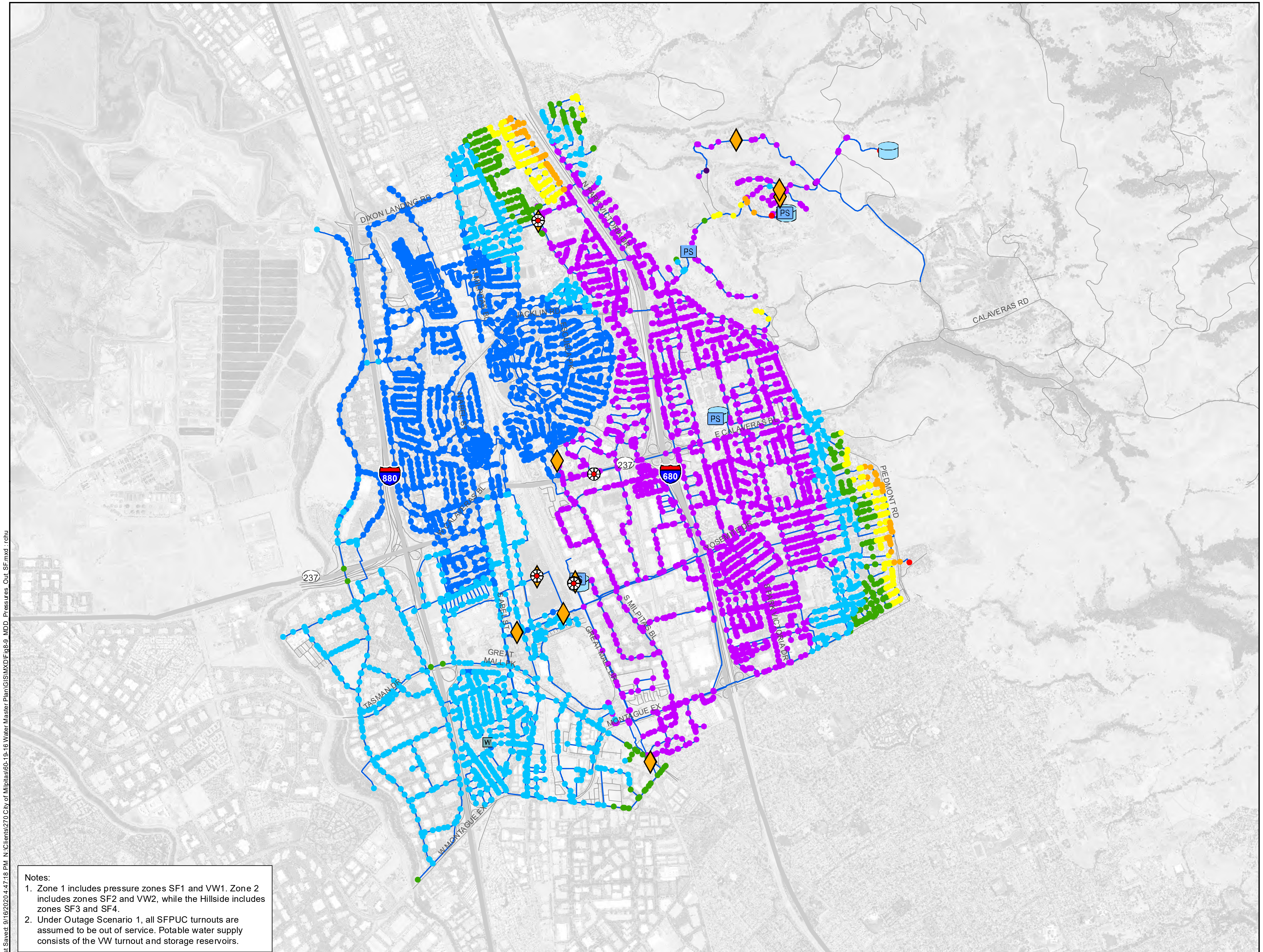
Results for each emergency outage scenario are summarized below. Where presented, figures showing system performance during emergency outages are similar to non-emergency figures discussed above. Distribution system locations are color coded by either pressure (for MDD evaluations) or fire flow availability (for fire flow evaluations).

8.5.6.1 Outage Scenario 1 – SFPUC Offline

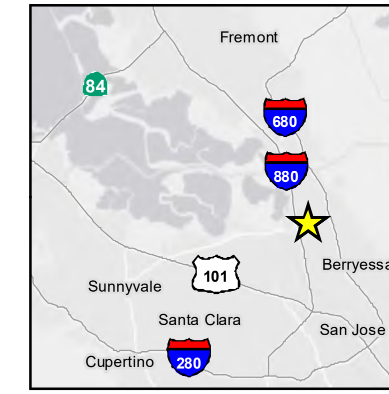
This outage scenario assumes supply from SFPUC is unavailable, so the Sunnyhills, Calaveras, Main Street, and Intertie turnouts are offline. As a result, the City's normally available potable water supply consists of VW (i.e., the Gibraltar turnout) and storage.

Figure 8-9 shows system pressures under MDD conditions in this outage scenario. Even without SFPUC turnout flows, the system is able to maintain adequate pressures. There are no customer service locations with pressures below 40 psi.

Fire flow availability is significantly hindered with SFPUC turnouts offline. As shown on Figure 8-10, in this outage scenario more than 260 locations do not meet recommended fire flows under this outage scenario. Compared to normal operations, this is over 200 additional below criterion locations, most of which are in Zone SF2. This is due to the relatively small pumps at the Ayer pump station. While the Gibraltar (SF) pumps can serve Zone SF1 fire flows, the pumps at the Ayer pump station cannot deliver Zone SF2 fire flows.



Notes:
1. Zone 1 includes pressure zones SF1 and VW1. Zone 2 includes zones SF2 and VW2, while the Hillside includes zones SF3 and SF4.
2. Under Outage Scenario 1, all SFPUC turnouts are assumed to be out of service. Potable water supply consists of the VW turnout and storage reservoirs.



N

0 1,500 3,000
Scale in Feet

Maximum Day Pressure
- Less than 40 psi
- 40 psi to 50 psi
- 50 psi to 60 psi
- 60 psi to 70 psi
- 70 psi to 80 psi

High Pressure (Zone 1)
- Greater than 80 psi

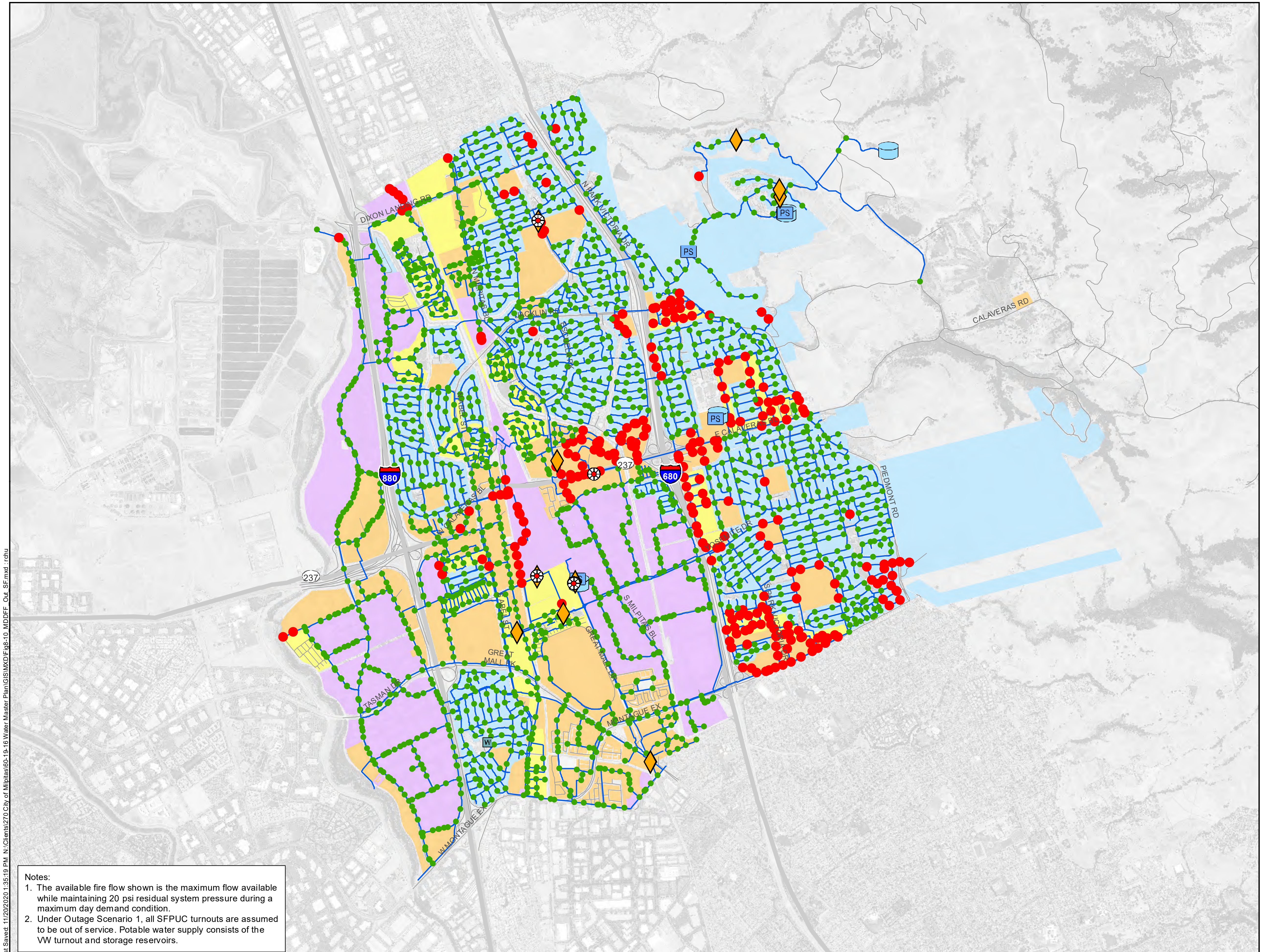
High Pressure (Zone 2 and Hillside)
- 80 psi to 150 psi
- Greater than 150 psi
- Turnout
- Groundwater Well
- Pressure Reducing Valve
- Pump Station
- Storage Reservoir
- Pipeline

WEST YOST

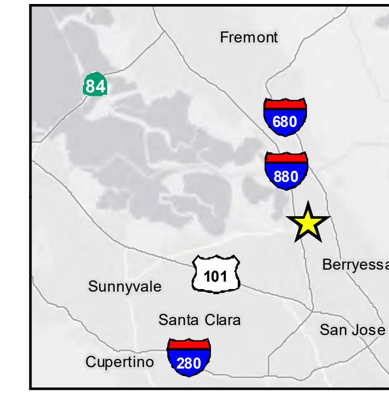
Figure 8-9

Existing System Pressures Maximum Day Demand Outage Scenario 1

City of Milpitas
2020 Water Master Plan



Notes:
1. The available fire flow shown is the maximum flow available while maintaining 20 psi residual system pressure during a maximum day demand condition.
2. Under Outage Scenario 1, all SFPUC turnouts are assumed to be out of service. Potable water supply consists of the VW turnout and storage reservoirs.



N

0 1,500 3,000
Scale in Feet

Available Fire Flow
- Below Recommended Fire Flow
- Meets Recommended Fire Flow
- Turnout
- Groundwater Well
- Pressure Reducing Valve
- Pump Station
- Storage Reservoir
- Pipeline

Recommended Fire Flow
- 1,500 gpm
- 2,500 gpm
- 3,000 gpm
- 4,000 gpm

WEST YOST

Figure 8-10

Existing System Available Fire Flow Outage Scenario 1

City of Milpitas
2020 Water Master Plan

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As a result, West Yost recommends installing a pump to meet fire flow at the Ayer pump station (ECIP-PS-AY) with a design capacity of 4,000 gpm at 285 ft of total dynamic head (TDH). Hydraulic model results show that with the pump installed, the distribution system actually slightly outperforms the existing system under normal conditions. While 45 locations were below criterion under Alternative 1 operations, 43 are below criterion with SFPUC turnouts offline and the new Ayer pump active.

8.5.6.2 Outage Scenario 2 – VW Offline

This outage scenario assumes supply from VW is unavailable, so the Gibraltar turnout is offline. As a result, the City's normally available potable water supply consists of SFPUC turnouts and storage.

Figure 8-11 and Figure 8-12 show system pressures and fire flow availability, respectively, under MDD conditions in this outage scenario. System performance is similar to the Alternative 1 MDD scenarios (Figure 8-6 and Figure 8-8). The Gibraltar (VW) pumps adequately substitute for the Gibraltar turnout, so there remain no customer service locations with pressures below 40 psi. Regarding fire flow availability, there are no additional below criterion locations resulting from the turnout outage. Thus, West Yost does not recommend any improvements based on Outage Scenario 2.

8.5.6.3 Outage Scenario 3 – SFPUC and VW Offline

This outage scenario assumes supplies from both SFPUC and VW are unavailable, so all turnouts are offline. As a result, the City's normally available potable water supply consists of storage only.

Figure 8-13 and Figure 8-14 show system pressures and fire flow availability, respectively, under MDD conditions in this outage scenario. Since the VW outage does not significantly impact the distribution system, this scenario is similar to Outage Scenario 1 (SFPUC offline). In other words, customer service pressures remain at or above 40 psi, but fire flow availability is significantly reduced.

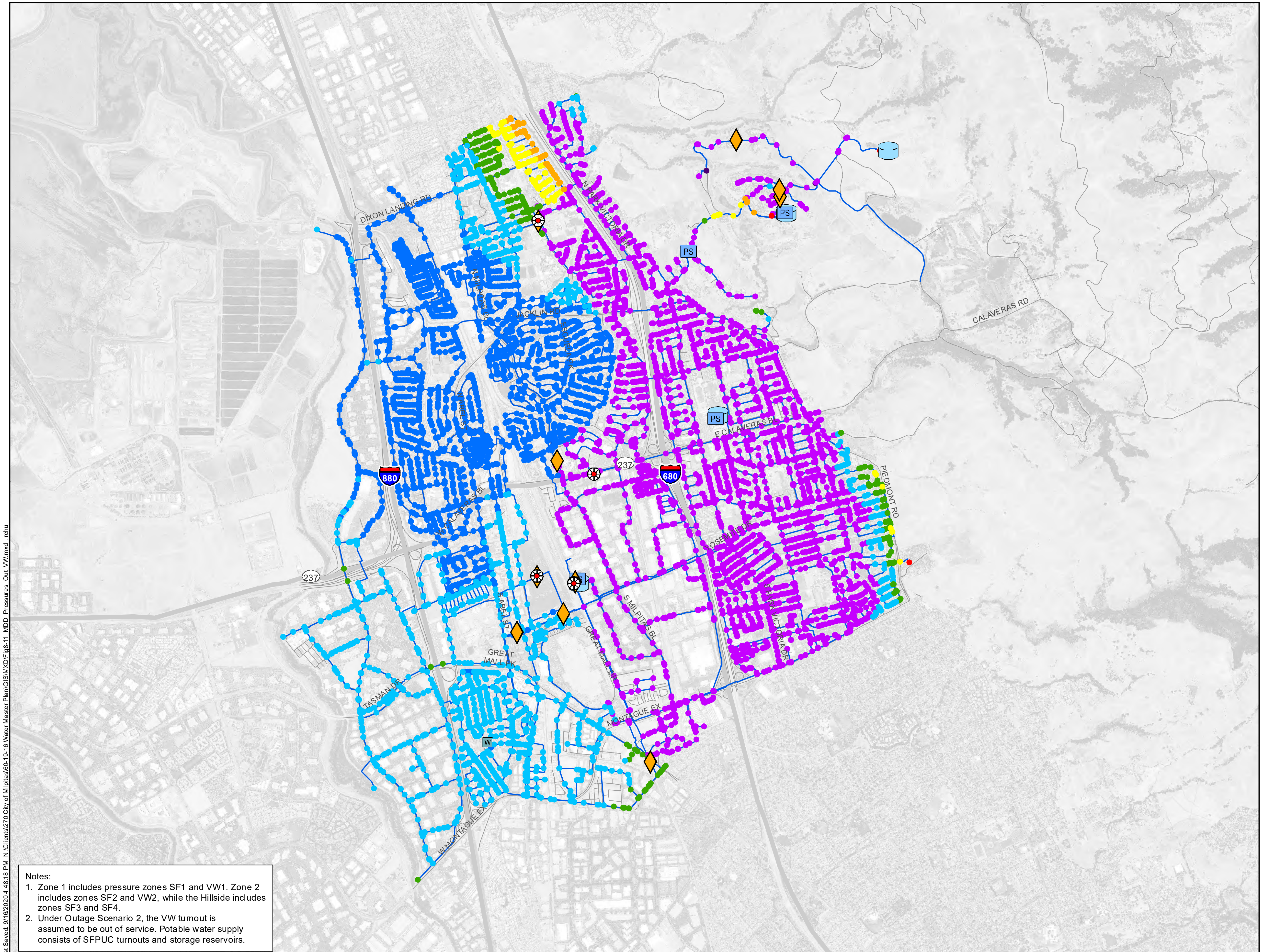
The additional pumping capacity at the Ayer pump station recommended in Outage Scenario 1 eliminates the fire flow impacts resulting from the turnout outage. No other improvements are needed to address issues created by this outage scenario.

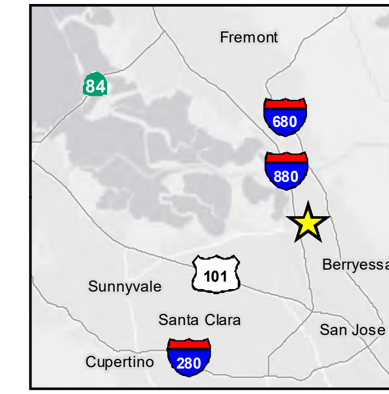
8.5.6.4 Outage Scenario 4 – Power Outage

This outage scenario assumes electrical power is unavailable, so any facilities without backup generators are offline. While this does not impact the City's normally available potable water supply, distribution system operations are hindered. The Country Club and Tularcitos pump stations have backup power plug-in adapters and transfer switches, but the City does not yet have portable generators. To be conservative, it is assumed the Country Club and Tularcitos pump stations are unavailable in a power outage. However, the Tularcitos and Minnis storage reservoirs can still serve Zones SF3 and SF4, respectively, during a power outage.

Figure 8-15 and Figure 8-16 show system pressures and fire flow availability, respectively, under MDD conditions in this outage scenario. The power outage does not significantly impact customer service pressures or fire flow availability, as the hillside storage reservoirs can adequately serve their respective pressure zones via gravity.

While there are no critical improvements associated with this outage scenario, having backup power capabilities at the Country Club and Tularcitos pump stations would provide redundancy. This could entail a backup generator or, as the City has discussed, purchasing a portable genset capable of powering either pump station.





N

0 1,500 3,000
Scale in Feet

Maximum Day Pressure
- Less than 40 psi
- 40 psi to 50 psi
- 50 psi to 60 psi
- 60 psi to 70 psi
- 70 psi to 80 psi

High Pressure (Zone 1)
- Greater than 80 psi

High Pressure (Zone 2 and Hillside)
- 80 psi to 150 psi
- Greater than 150 psi
- Turnout
- Groundwater Well
- Pressure Reducing Valve
- Pump Station
- Storage Reservoir
- Pipeline

Notes:
1. Zone 1 includes pressure zones SF1 and VW1. Zone 2 includes zones SF2 and VW2, while the Hillside includes zones SF3 and SF4.
2. Under Outage Scenario 2, the VW turnout is assumed to be out of service. Potable water supply consists of SFPUC turnouts and storage reservoirs.

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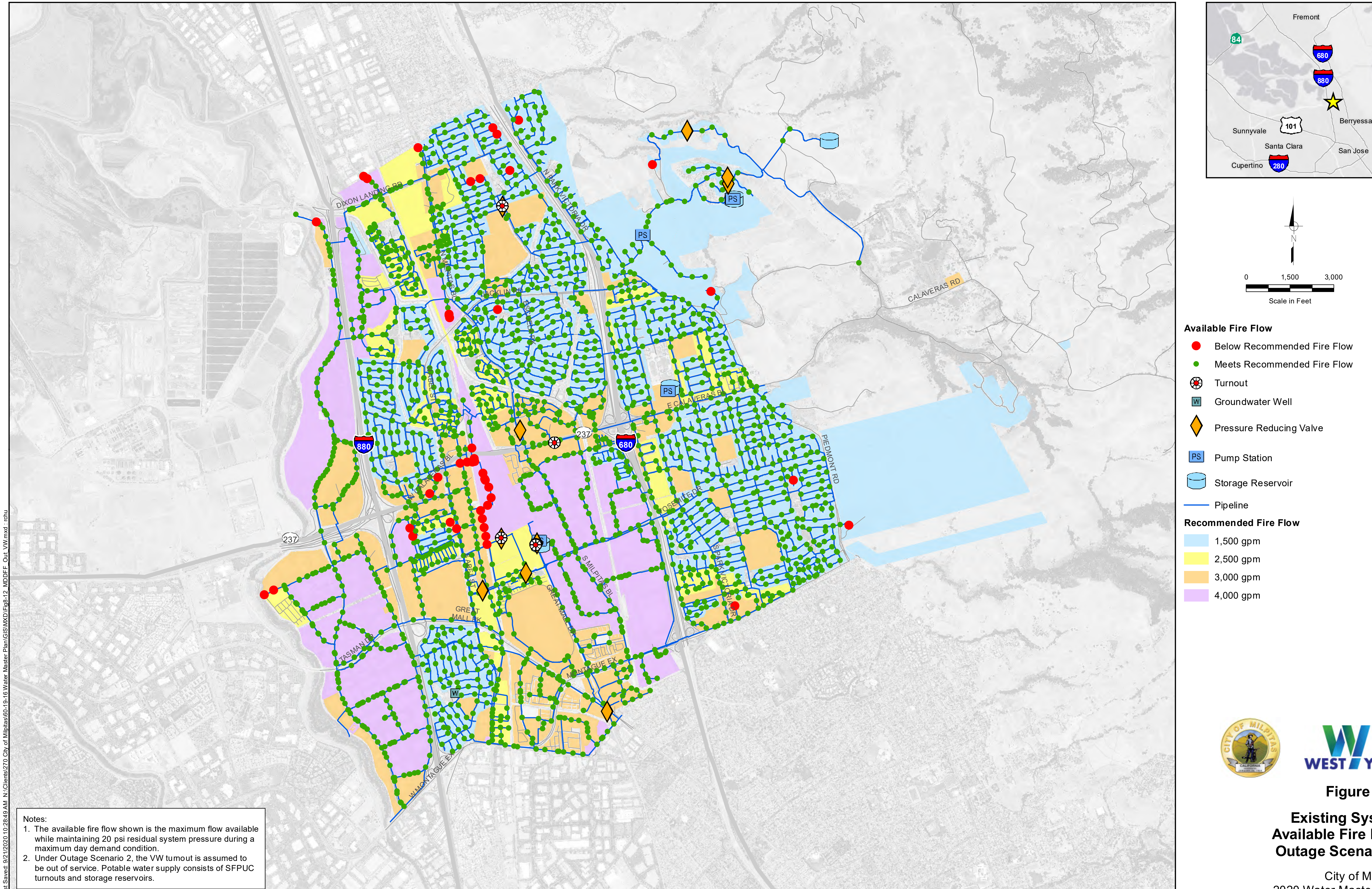
WEST YOST

Figure 8-11

Existing System Pressures Maximum Day Demand Outage Scenario 2

City of Milpitas
2020 Water Master Plan



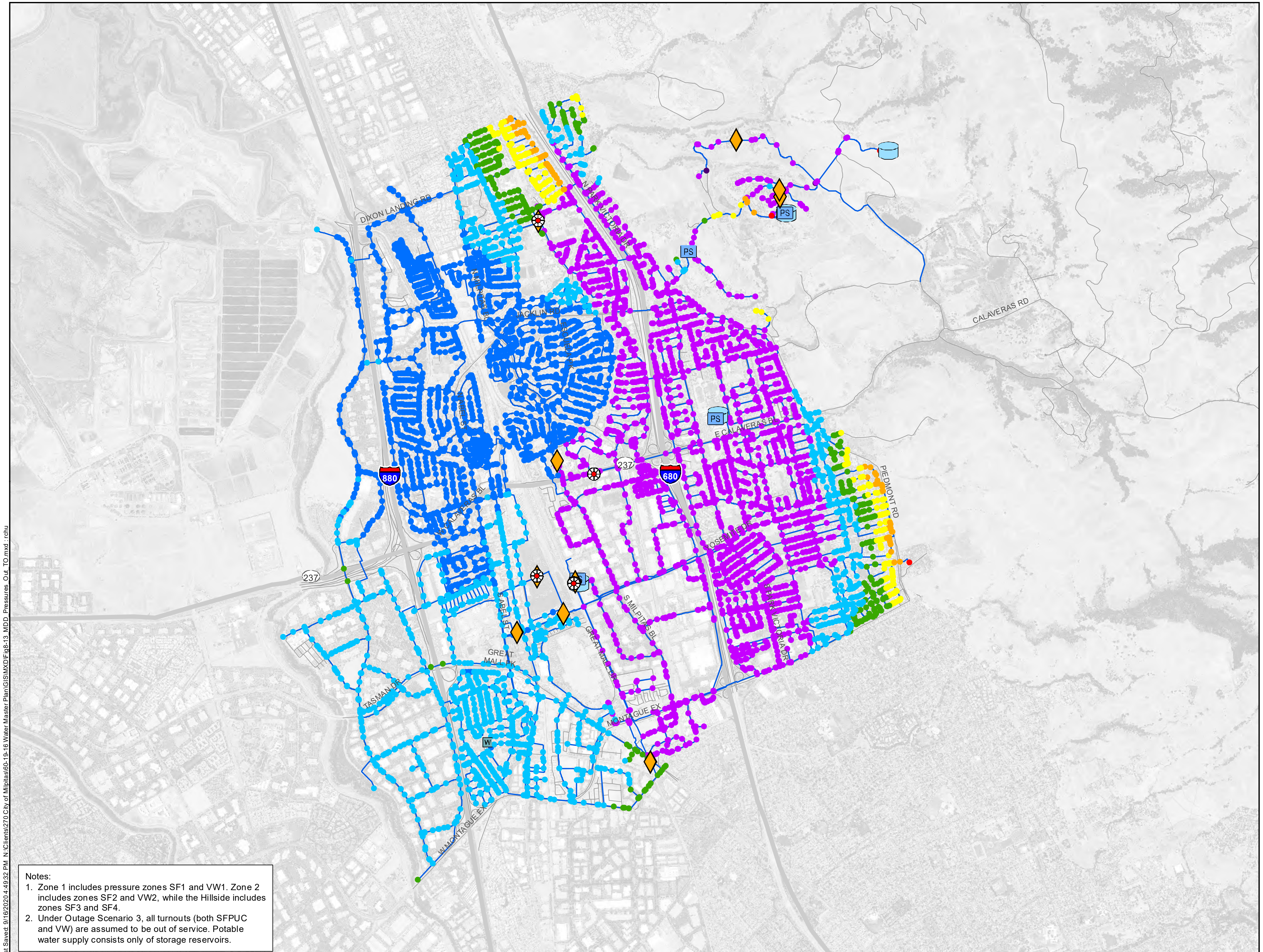
Notes:
1. The available fire flow shown is the maximum flow available while maintaining 20 psi residual system pressure during a maximum day demand condition.
2. Under Outage Scenario 2, the VW turnout is assumed to be out of service. Potable water supply consists of SFPUC turnouts and storage reservoirs.

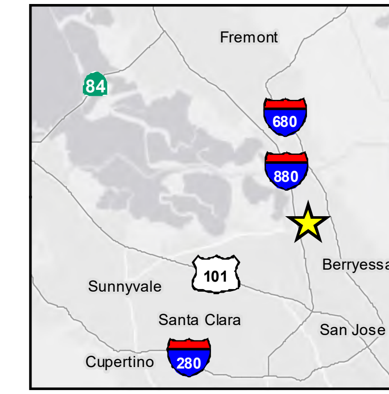
WEST YOST

Figure 8-12

Existing System Available Fire Flow Outage Scenario 2

City of Milpitas
2020 Water Master Plan





N

0 1,500 3,000
Scale in Feet

Maximum Day Pressure
- Less than 40 psi
- 40 psi to 50 psi
- 50 psi to 60 psi
- 60 psi to 70 psi
- 70 psi to 80 psi

High Pressure (Zone 1)
- Greater than 80 psi

High Pressure (Zone 2 and Hillside)
- 80 psi to 150 psi
- Greater than 150 psi
- Turnout
- Groundwater Well
- Pressure Reducing Valve
- Pump Station
- Storage Reservoir
- Pipeline

Notes:
1. Zone 1 includes pressure zones SF1 and VW1. Zone 2 includes zones SF2 and VW2, while the Hillside includes zones SF3 and SF4.
2. Under Outage Scenario 3, all turnouts (both SFPUC and VW) are assumed to be out of service. Potable water supply consists only of storage reservoirs.

WEST YOST

Figure 8-13

Existing System Pressures Maximum Day Demand Outage Scenario 3

City of Milpitas
2020 Water Master Plan

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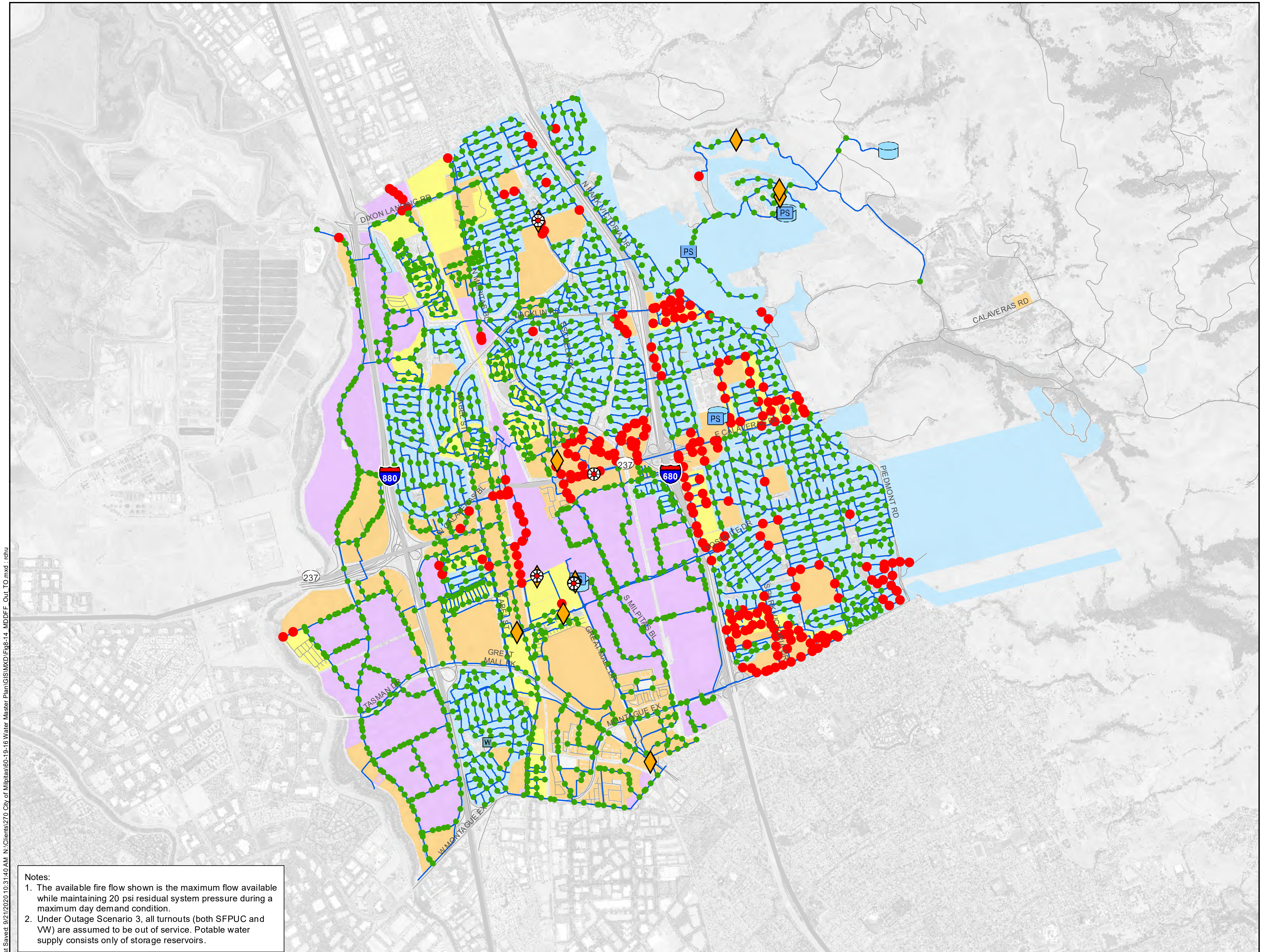
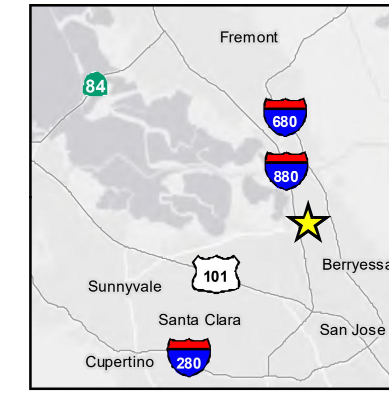




N

0 1,500 3,000

Scale in Feet

Available Fire Flow

- Below Recommended Fire Flow
- Meets Recommended Fire Flow
- Turnout
- Groundwater Well
- Pressure Reducing Valve
- Pump Station
- Storage Reservoir
- Pipeline

Recommended Fire Flow

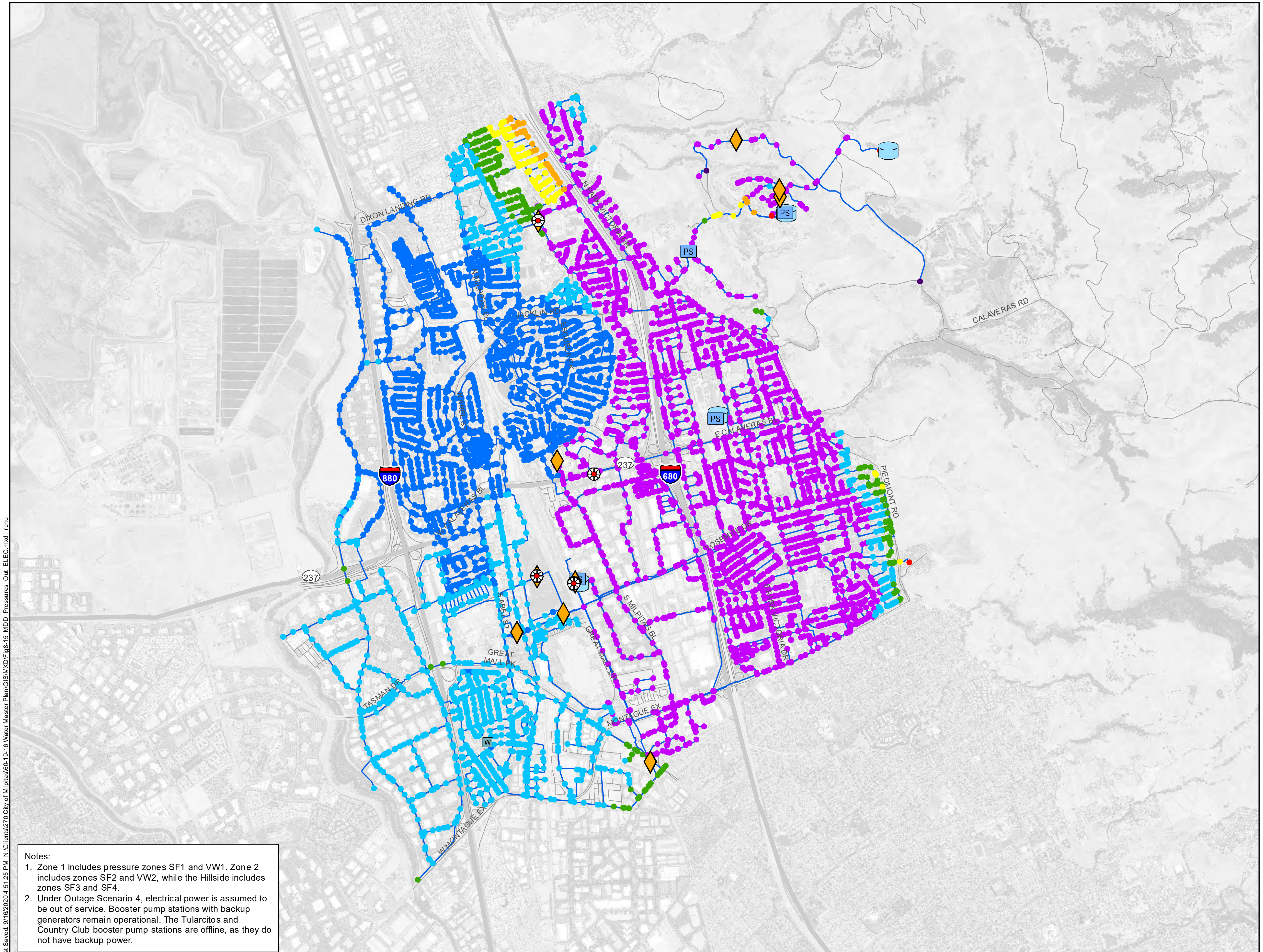
- 1,500 gpm
- 2,500 gpm
- 3,000 gpm
- 4,000 gpm

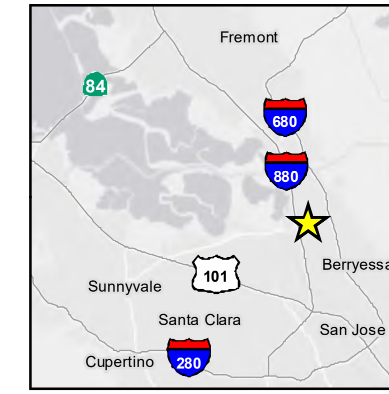
WEST YOST

Figure 8-14

Existing System Available Fire Flow Outage Scenario 3

City of Milpitas
2020 Water Master Plan





N

0 1,500 3,000
Scale in Feet

Maximum Day Pressure
- Less than 40 psi
- 40 psi to 50 psi
- 50 psi to 60 psi
- 60 psi to 70 psi
- 70 psi to 80 psi

High Pressure (Zone 1)
- Greater than 80 psi

High Pressure (Zone 2 and Hillside)
- 80 psi to 150 psi
- Greater than 150 psi
- Turnout
- Groundwater Well
- Pressure Reducing Valve
- Pump Station
- Storage Reservoir
- Pipeline

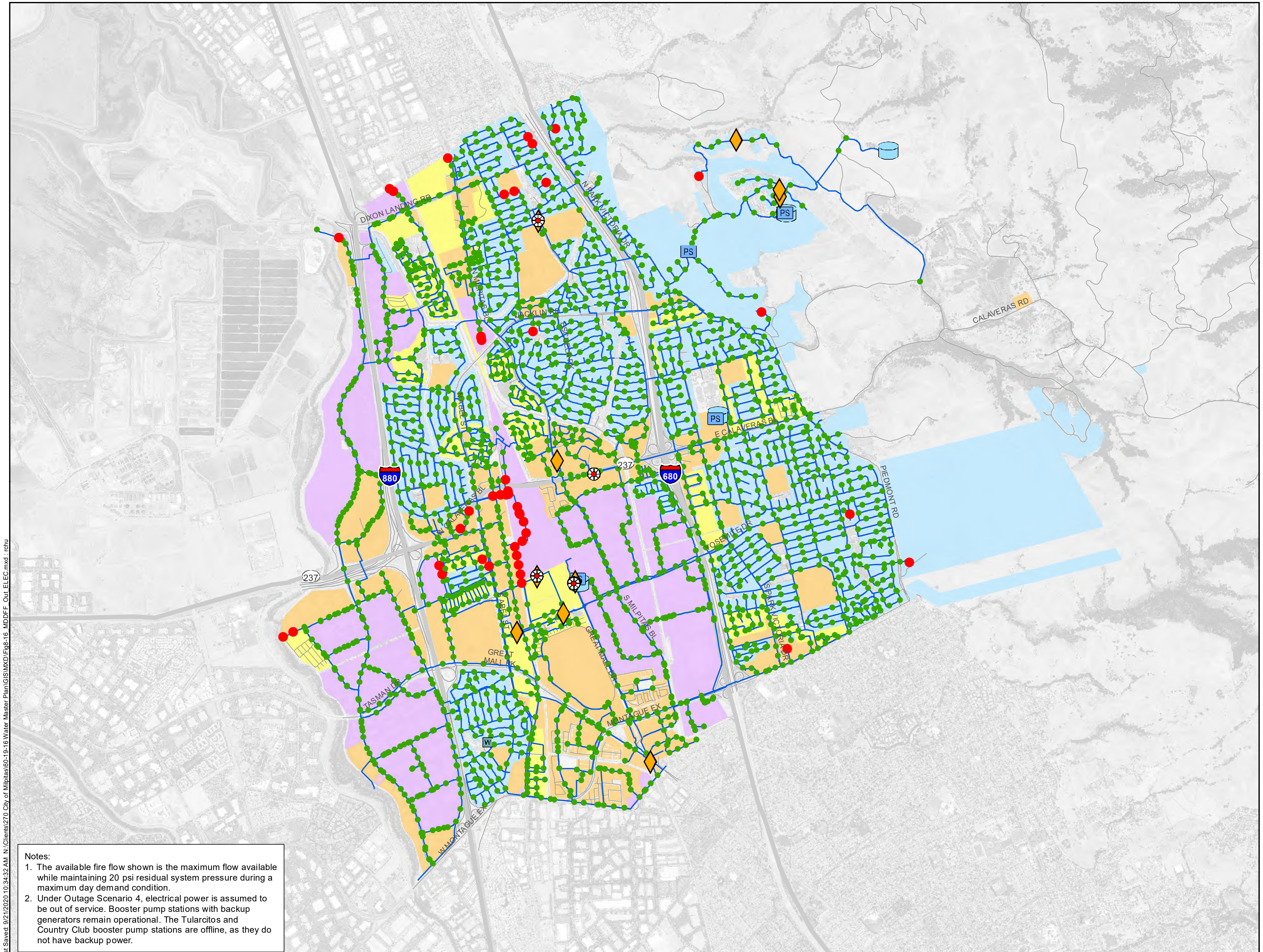
Notes:
1. Zone 1 includes pressure zones SF1 and VW1. Zone 2 includes zones SF2 and VW2, while the Hillside includes zones SF3 and SF4.
2. Under Outage Scenario 4, electrical power is assumed to be out of service. Booster pump stations with backup generators remain operational. The Tularcitos and Country Club booster pump stations are offline, as they do not have backup power.

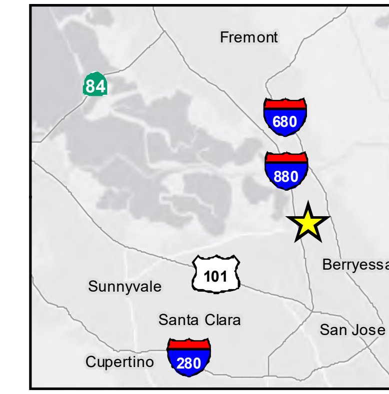
WEST YOST

Figure 8-15

Existing System Pressures Maximum Day Demand Outage Scenario 4

City of Milpitas
2020 Water Master Plan





N

0 1,500 3,000
Scale in Feet

Available Fire Flow

- Below Recommended Fire Flow
- Meets Recommended Fire Flow
- Turnout
- Groundwater Well
- Pressure Reducing Valve
- Pump Station
- Storage Reservoir
- Pipeline

Recommended Fire Flow

- 1,500 gpm
- 2,500 gpm
- 3,000 gpm
- 4,000 gpm

Notes:
1. The available fire flow shown is the maximum flow available while maintaining 20 psi residual system pressure during a maximum day demand condition.
2. Under Outage Scenario 4, electrical power is assumed to be out of service. Booster pump stations with backup generators remain operational. The Tularcitos and Country Club booster pump stations are offline, as they do not have backup power.

WEST YOST

Figure 8-16

Existing System Available Fire Flow Outage Scenario 4

City of Milpitas
2020 Water Master Plan

8.5.6.5 Outage Scenario 5 – Zone 1/2 PRVs Offline

Outage Scenario 5 assumes a PRV normally allowing flow between Zones 1 and 2 is offline. These “Zone 1/2" PRVs include Main, North Milpitas, and Sunnyhills in the SFPUC service area and Capitol, Curtis East, Curtis West, and Parc Metro in the VW service area. System performance is evaluated with one PRV closed at a time. It is assumed EPRVs are available as needed.

Under MDD conditions, customer service pressures are not significantly impacted by any single Zone 1/2 PRV outage. Should any of these PRVs fail, the remaining PRVs allow the distribution system to operate such that customer service pressures are at least 40 psi.

In contrast, fire flow availability can be significantly reduced depending on the PRV outage. For Main, North Milpitas, and Curtis (East and West), operational status did not significantly impact fire flow availability. However, when Sunnyhills, Capitol, or Parc Metro were offline, fire flow availability decreased. The fire flow impacts of these outages are shown on Figure 8-17 and discussed below, followed by a review of the recommended improvements.

8.5.6.5.1 Sunnyhills PRV Outage

Should the Sunnyhills PRV go offline, eight additional locations do not meet recommended fire flows. These locations are all in Zone SF1. West Yost recommends the following improvements to address these new below criterion locations:

- Near the intersection of Coelho Street and Diel Drive, replace the (normally closed) isolation valve separating Zones SF1 and SF2 with an EPRV to allow flows from SF2 during a fire event in the northern area of Zone SF1 (ECIP-V-03).
- Along Callan Street near the intersection of Callan Street and Arizona Avenue, replace approximately 140 LF of 6-inch diameter pipeline with 8-inch diameter pipeline (ECIP-PI-28).
- Along Gross Street, near the intersection of Gross Street and Conway Street, replace approximately 170 LF of 6-inch diameter pipeline with 8-inch diameter pipeline (ECIP-PI-31).

8.5.6.5.2 Capitol PRV Outage

Should the Capitol PRV go offline, 11 additional locations do not meet recommended fire flows. However, during a fire at any of these 11 locations (all in Zone VW1), the Live Oak and McCarthy EPRVs will allow sufficient flow from Zone SF1 to meet recommended fire flows. Thus, a Capitol PRV outage can be adequately handled by existing facilities, and no improvements are necessary.

8.5.6.5.3 Parc Metro PRV Outage

Should the Parc Metro PRV go offline, five additional locations do not meet recommended fire flows. At one of these locations, EPRV operation improves fire flows to meet the recommended criterion. West Yost recommends the following improvements to address the remaining below criterion locations:

- Along Curtis Avenue, connect the existing 10-inch diameter pipeline on the northern side of the street to the existing 18-inch diameter pipeline on the southern side of the street. This new connection should be a 12-inch diameter pipeline (approximately 30 LF) and installed downstream of the Curtis PRVs (i.e., in Zone VW1) (ECIP-PN-01).

- Along Hammond Way, east of Tom Evatt Park, connect the existing 8-inch diameter pipelines in Zone VW1. These pipelines are currently dead ends, created by normally closed isolation valves separating the SFPUC and VW service areas. This new connection should be an 8-inch diameter pipeline and is estimated to be approximately 60 LF (ECIP PN-02).

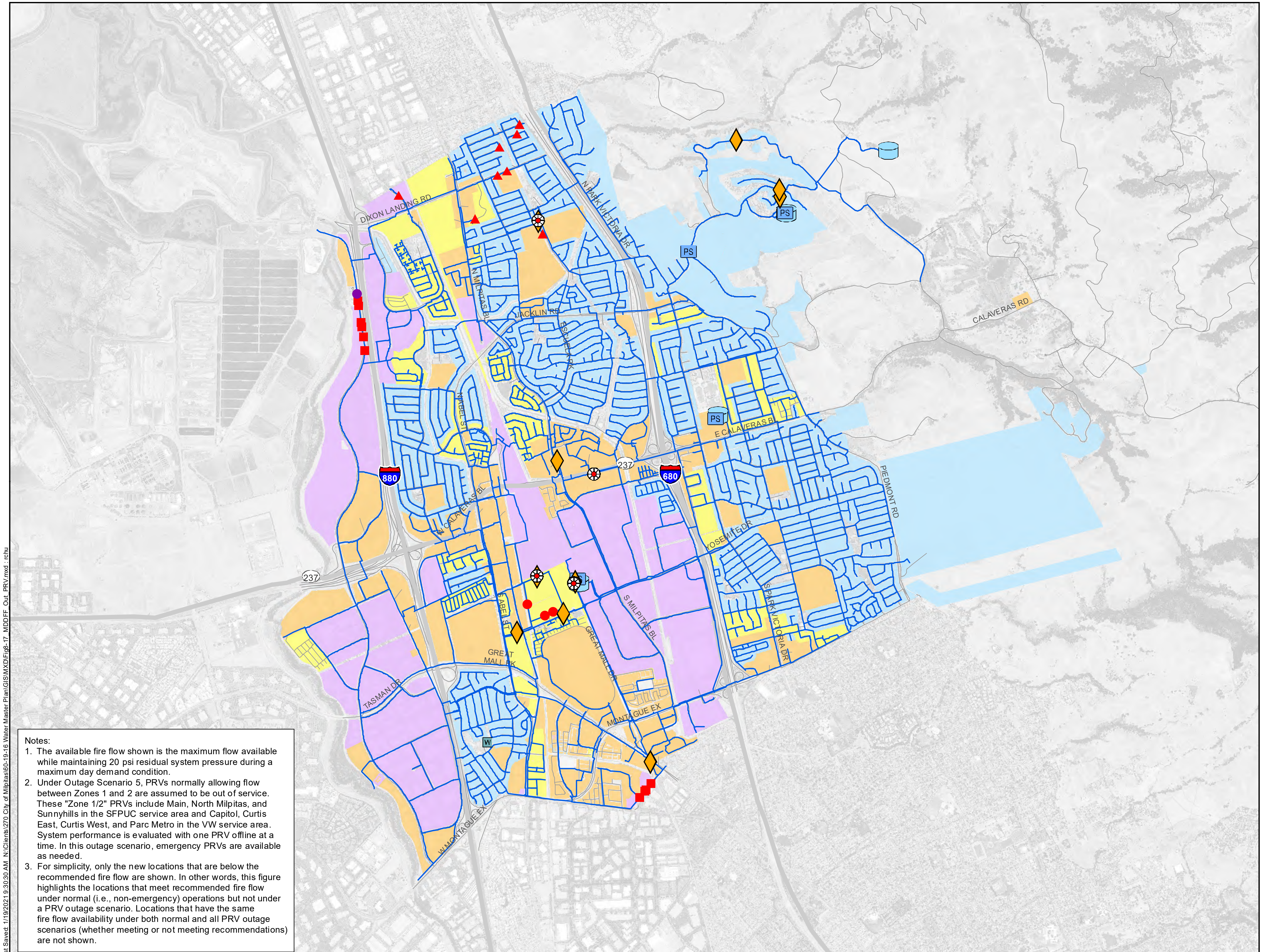
8.5.6.5.4 PRV Outage Priority

Table 8-6 summarizes distribution system performance for each PRV outage. As shown in Table 8-6, each PRV is assigned a priority based on the impact of its outage. Parc Metro and Sunnyhills are the highest priority PRVs, while Main, North Milpitas, and Curtis East/West are the lowest priority PRVs.

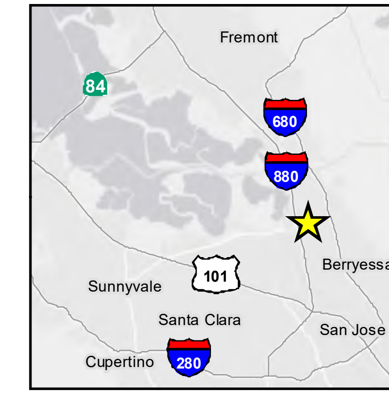
Table 8-6. PRV Outage Priority[a]

PRV	Priority (Low, Med, High)	No. of Additional "Below Criterion" Locations[b]	Notes
SFPUC Service Area			
Sunnyhills	High	8	Pipeline improvements recommended
Main	Low	0	No new below criterion locations from PRV outage
North Milpitas	Low	0	No new below criterion locations from PRV outage
VW Service Area			
Parc Metro	High	5	New pipelines recommended
Capitol	Med	11	New below criterion locations fixed via existing EPRVs
Curtis East	Low	0	No new below criterion locations from PRV outage
Curtis West	Low	0	No new below criterion locations from PRV outage

(a) Only PRVs normally allowing flow from Zone 2 to Zone 1 are assigned a priority.
(b) Below criterion locations cannot serve recommended fire flows while maintaining a 20-psi residual system pressure during maximum day demands. This represents the number of "below criterion" locations above normal operations (i.e., Base scenario).



Notes:
1. The available fire flow shown is the maximum flow available while maintaining 20 psi residual system pressure during a maximum day demand condition.
2. Under Outage Scenario 5, PRVs normally allowing flow between Zones 1 and 2 are assumed to be out of service. These "Zone 1/2" PRVs include Main, North Milpitas, and Sunnyhills in the SFPUC service area and Capitol, Curtis East, Curtis West, and Parc Metro in the VW service area. System performance is evaluated with one PRV offline at a time. In this outage scenario, emergency PRVs are available as needed.
3. For simplicity, only the new locations that are below the recommended fire flow are shown. In other words, this figure highlights the locations that meet recommended fire flow under normal (i.e., non-emergency) operations but not under a PRV outage scenario. Locations that have the same fire flow availability under both normal and all PRV outage scenarios (whether meeting or not meeting recommendations) are not shown.



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0 1,500 3,000

Scale in Feet

Locations Not Meeting Recommended Fire Flow Due to the Following PRV Outage(s)

- Sunnyhills
- Parc Metro
- Capitol or Parc Metro
- Capitol
- Turnout
- Groundwater Well
- Pressure Reducing Valve
- Pump Station
- Storage Reservoir
- Pipeline

Recommended Fire Flow

- 1,500 gpm
- 2,500 gpm
- 3,000 gpm
- 4,000 gpm

Figure 8-17

Existing System Available Fire Flow Outage Scenario 5

City of Milpitas
2020 Water Master Plan

8.6 SUMMARY OF FINDINGS AND RECOMMENDED IMPROVEMENTS

Below is a summary of findings and recommendations from the evaluations detailed in this chapter. Key recommendations for the existing system were used to develop a CIP, which is the focus of Chapter 11.

- Supply Capacity
  - Existing firm supplies exceed maximum day demand. While the VW service area has a firm supply deficit, it can be met by the surplus in the SFPUC service area. No additional supply facilities are recommended based on existing demands and normal operating conditions.
- Storage Capacity
  - There is sufficient storage in the SFPUC service area and a deficit of 0.45 MG in the VW service area. This deficit is not considered critical, as the Zone SF1 storage surplus can cover the shortfall in Zones VW1 and VW2. No additional storage is recommended based on existing demands and normal operating conditions.
- Pumping Capacity
  - Each pressure zone has a pumping capacity surplus. No additional pumping facilities are recommended based on existing demands and normal operating conditions.
- Distribution System
  - The existing distribution system meets all minimum pressure criteria under ADD, PHD, and MDD conditions.
  - West Yost identified potential improvements to address the locations not meeting recommended fire flows in the existing system. These mainly consist of upsizing existing 6-inch and 8-inch diameter pipelines, though some PRV and isolation valve improvements are also recommended. It is assumed these improvements will be implemented for the future water system evaluation in Chapter 9.
  - To comply with the City's design guidelines and improve fire flow capacity, the City should consider upsizing any 4-inch diameter pipelines that serve hydrants to 8-inch diameter pipelines.
  - Should SFPUC turnouts go offline, most of Zone SF2 has reduced fire flow capacity. As a result, West Yost recommends installing a pump at the Ayer pump station with a capacity of 4,000 gpm.
  - The existing system is well equipped to handle a power outage or a VW supply outage. No additional significant impacts arise in either emergency scenario.
  - To evaluate system performance during a PRV outage, PRVs normally allowing flow from Zone 2 to Zone 1 were simulated to be disabled one at a time. The Sunnyhills and Parc Metro PRVs are the most critical, as outages at either of these PRVs results in new locations not meeting recommended fire flows. Recommended improvements include a new EPRV, new pipelines, and pipeline upsizing.

CHAPTER 9
Evaluation of Future Water System

This chapter evaluates the City's future (i.e., buildout) water system and its ability to meet recommended planning and performance criteria described in Chapter 7 and summarized in Table 7-1 of this report. It is assumed complete buildout will occur in the year 2040. The evaluation encompasses both system capacity and hydraulic performance using buildout water demands developed in Section 5.1 of this report. System capacity is evaluated based on potable water supply, storage, and pumping, while the hydraulic performance evaluation examines buildout distribution facilities under various demand and outage conditions. The following evaluations frequently refer to "normal" conditions, which are defined as non-emergencies (i.e., no fires or unplanned outages).

This chapter also includes recommendations for addressing any deficiencies identified from the evaluation. These are incorporated in a recommended CIP described in Chapter 11 of this report. To simplify cross-referencing with Chapter 11, each proposed project is assigned a unique CIP ID.

The following sections present the evaluation methodology and results:

- Buildout Potable Water Demands
- Potable Water Facilities for Buildout Analysis
- Buildout Potable Water Supply Capacity Evaluation
- Buildout Potable Water Storage Capacity Evaluation
- Buildout Pumping Capacity Evaluation
- Buildout Water Distribution System Evaluation
- Summary of Findings and Recommended Improvements

9.1 BUILDOUT POTABLE WATER DEMANDS

Buildout potable water demands are summarized in Table 9-1 and represent a combination of existing demands (presented in Table 8-1) and new demands from planned future growth and development in Opportunity Areas and the Gateway Specific Plan/Milpitas Metro Specific Plan areas. While existing demands were adjusted for NRW based on actual production data, future demands were assumed to have an NRW of 11 percent (as discussed in Section 5.1.3). Maximum day and peak hour peaking factors remain as listed in Table 5-7.

New water demand is concentrated in the VW service area, as most of the planned, future growth and development (including Gateway Specific Plan and Milpitas Metro Specific Plan) is anticipated in Zones VW1 and VW2. Existing demands in the SF service area are estimated to increase approximately 18 percent at buildout, while demands in the VW service area are expected to increase by almost 150 percent over the same period. Citywide, the buildout average day demand is estimated at approximately 13.9 mgd, a 67 percent increase from the existing (2019) average day demand of 8.3 mgd.

Table 9-1. Buildout (2040) Potable Water Demands by Pressure Zone

Pressure Zone	Average Day Demand[(a)]		Maximum Day Demand[(b)]		Peak Hour Demand[(c)]	
	gpm	mgd	gpm	mgd	gpm	mgd
SF1	2,213	3.19	3,541	5.10	6,417	9.24
SF2	1,973	2.84	3,157	4.55	5,722	8.24
SF3	14	0.02	44	0.06	81	0.12
SF4-1	19	0.03	61	0.09	110	0.16
SF4-2	17	0.02	54	0.08	98	0.14
SF Subtotal	4,236	6.10	6,857	9.87	12,429	17.90
VW1	3,464	4.99	6,582	9.48	11,779	16.96
VW2	1,974	2.84	3,752	5.40	6,713	9.67
VW Subtotal	5,439	7.83	10,334	14.88	18,492	26.63
Total	**9,675**	**13.93**	**17,191**	**24.75**	**30,920**	**44.53**

(a) Based on existing (2019) demands, plus new demands from Opportunity Areas, Gateway Specific Plan, and Milpitas Metro Specific Plan (see Table 5-9 of this report).

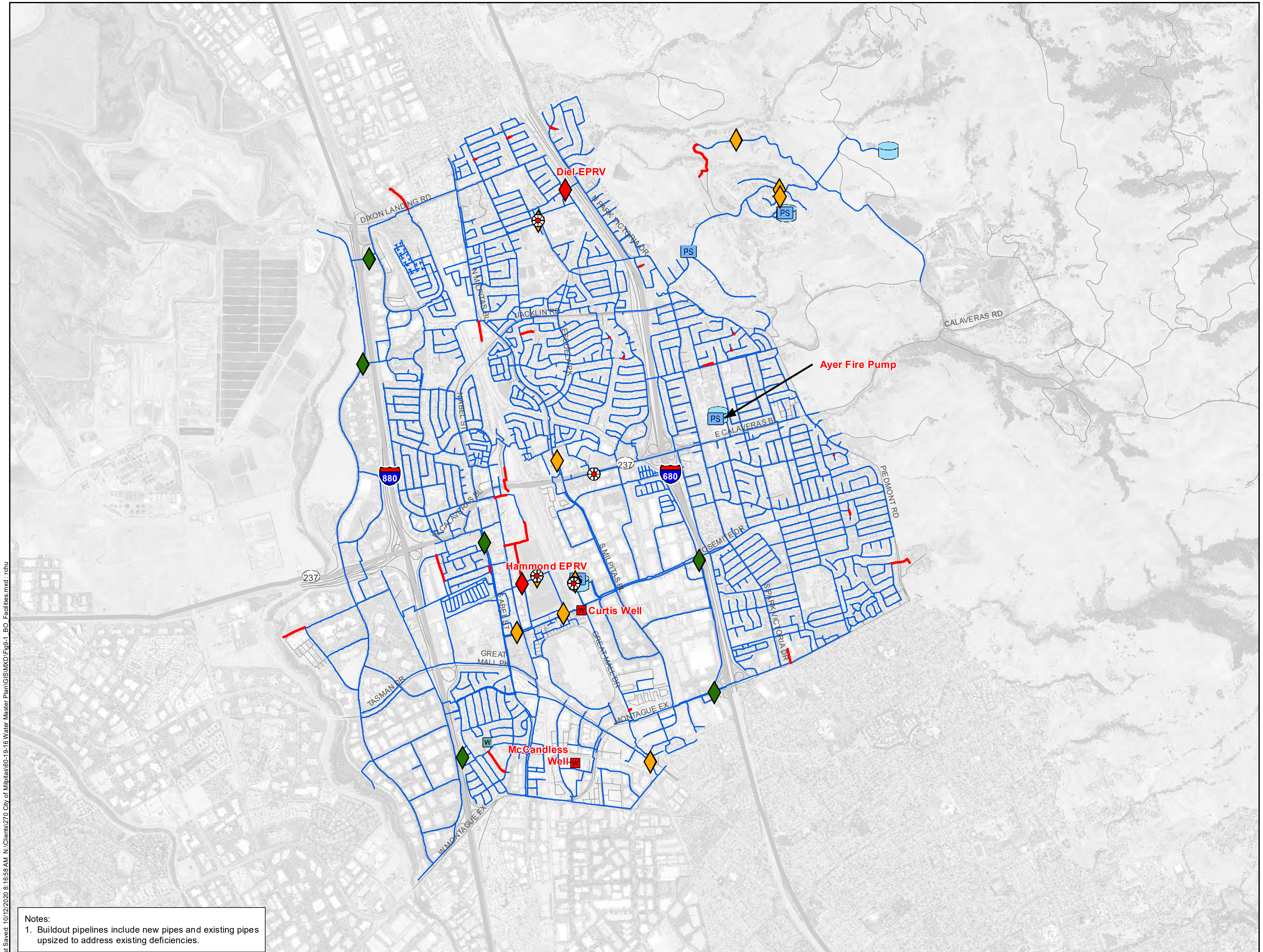
(b) Maximum day demand is 1.6 times the average day demand for Zones SF1 and SF2, 3.2 times the average day demand for Zones SF3 and SF4, and 1.9 times the average day demand for the VW service area.

(c) Peak hour demand is 2.9 times the average day demand for Zones SF1 and SF2, 5.8 times the average day demand for Zones SF3 and SF4, and 3.4 times the average day demand for the VW service area.

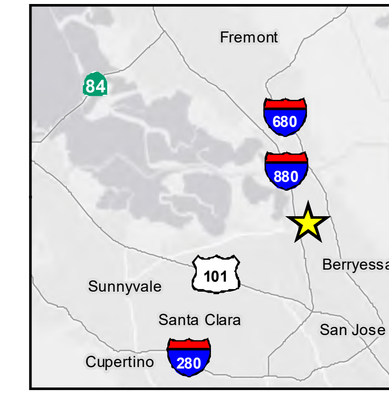
9.2 POTABLE WATER FACILITIES FOR BUILDOUT ANALYSIS

At buildout, the City expects three groundwater wells to be available for emergency use only (i.e., at the time of this report, the wells are not planned or intended to operate normally): Pinewood Well, Curtis Well, and McCandless Well. Table 9-2 summarizes the location and capacity for each of these wells. The capacity for Pinewood Well is from the 2009 WMPU (Table 4-3), while the capacity for McCandless Well (currently under construction) is based on discussions with the design team and production testing, which was performed at the end of 2020. It was conservatively assumed that Curtis Well would have the same capacity as McCandless Well, however the Curtis Well capacity is subject to change. While Curtis Well is located within Zone SF1, it is adjacent to transmission mains for Zones SF1, SF2, and VW2. Given the projected large increase in demands in the VW service area (approximately 3,250 gpm in additional average day demand), it is assumed that Curtis Well would serve Zone VW2.

While the City does not currently anticipate any other major water system changes, **the following buildout analyses assume that the existing system infrastructure recommendations detailed in Sections 8.5.5 and 8.5.6 of this report have been implemented**. This includes pipeline improvements, two new EPRVs (Diel and Hammond), and the additional 4,000 gpm pump at Ayer. West Yost recommends that the City complete these existing system CIP projects to optimize system performance and operations as the City approaches buildout. Figure 9-1 shows the existing potable water system with these improvements, Curtis Well, and McCandless Well. On Figure 9-1, the new facilities are highlighted in red.



Notes:
1. Buildout pipelines include new pipes and existing pipes upsized to address existing deficiencies.



N

0 1,500 3,000
Scale in Feet

Buildout Facilities
- Buildout Groundwater Well
- Buildout Emergency PRV
- Buildout Pipeline

Existing Facilities
- Existing Turnout
- Existing Groundwater Well
- Existing Pressure Reducing Valve
- Existing Emergency PRV
- Existing Pump Station
- Existing Storage Reservoir
- Existing Pipeline

WEST YOST

Figure 9-1
Potable Water Facilities for Buildout Analysis

City of Milpitas
2020 Water Master Plan

Table 9-2. Emergency Groundwater Wells at Buildout				
Well Facility	Location	Pressure Zone Served	Capacity	
			gpm	mgd
Pinewood Well[a,d]	227 Lonetree Court	SF1	1,181	1.70
Curtis Well[b,d]	330 East Curtis Avenue	VW2[e]	400	0.58
McCandless Well[c,d]	Near 1680 McCandless Drive	VW1	400	0.58

(a) Pinewood Well capacity per 2009 WMPU, Table 4-3.
(b) Curtis Well capacity is assumed to be equal to McCandless Well but is subject to change pending additional testing.
(c) McCandless Well capacity per discussions with design team in September 2020.
(d) Pinewood Well has a plug-in adapter and transfer switch to receive power from a portable generator. It is assumed Curtis Well and McCandless Well will also have these backup power features.
(e) While Curtis Well is located within Zone SF1, it is adjacent to transmission mains for Zones SF1, SF2, and VW2. Given the projected large increase in demands in the VW service area, it is assumed Curtis Well would serve Zone VW2.

9.3 BUILDOUT POTABLE WATER SUPPLY CAPACITY EVALUATION

As described in Section 7.2.2 of this report, the recommended water system performance criteria specify that under normal demand conditions, the following must be satisfied:

- Provide firm supply capacity equal to maximum day demand
- Meet peak hour demand from a combination of supply capacity and storage

Firm supply capacity is defined as the normal water supply with the largest turnout out of service, therefore, groundwater wells (which provide emergency supply) are excluded. In the SFPUC service area, the largest turnout is Calaveras, which has a capacity of 13.0 mgd. The VW service area has only the Gibraltar turnout, therefore, firm supply capacity is zero.

Table 9-3 summarizes the firm supply capacity evaluation for each service area at buildout. The SFPUC service area has a firm supply capacity surplus of approximately 13.9 mgd, while the VW service area has a firm supply capacity deficit of approximately 14.9 mgd. Since water can be moved from the City's SFPUC service area to the VW service area, the surplus in the SFPUC service area can offset most of the deficit in the VW service area. The resulting net deficit is approximately 1.0 mgd.

To address the firm supply capacity deficit and provide supply redundancy in the VW service area at buildout, West Yost recommends constructing a second VW turnout with a capacity of 10,000 gpm (or 14.4 mgd, equal to the Gibraltar turnout) (CIP ID BCIP-TO-01). This would increase the VW service area firm supply capacity to 14.4 mgd and change the City-wide firm supply deficit to a surplus of approximately 13.4 mgd. Without this new turnout, the City would fail to meet the firm supply capacity criterion described in Section 7.2.2 of this report.

Ideally, the second VW turnout would be adjacent to both VW's Milpitas Pipeline and existing City transmission mains. Locating the turnout is outside the scope of this report, though the City has identified one potential site: within a public service utility easement near the intersection of Piper Drive and Garden Street. The distribution system evaluation described in Section 9.6 below assumes this new "Piper" turnout is active, but other locations for a second VW turnout are possible.

By incrementally increasing existing demands, a firm supply capacity "trigger demand" can be identified. This is the demand at which existing supply facilities become insufficient, and any additional demand would require new supplies (i.e., turnouts or groundwater wells). Due to different peaking factors in each service area, the firm supply capacity trigger demand varies slightly depending on the location and timing of growth. Assuming the SFPUC service area would be fully built out prior to the VW service area, the firm supply capacity trigger demand is approximately 13.4 mgd. In the opposite scenario (i.e., VW service area built out before the SFPUC service area), the trigger demand decreases slightly to 13.3 mgd. Based on the linear demand growth projection summarized in Table 5-10 of this report, City demands will approach these levels around the year 2038. This trigger timing is similar for the Maddaus demand projections (Partial Rebound – Normal Economy, Weather Normalized) discussed in Section 5.3.4.2 of this report.

Table 9-3. Comparison of Available and Required Firm Supply Capacity at Buildout

Supply Source	Facility	Design Capacity, gpm	Design Capacity, mgd
SFPUC	Sunnyhills Turnout	7,014	10.1
	Calaveras Turnout	9,028	13.0
	Main Street Turnout	5,486	7.90
	Intertie Turnout	4,000	5.76
	Total Supply Capacity[a]	**25,528**	**36.8**
	Firm Supply Capacity[b]	16,500	23.8
	Required Supply Capacity[c]	6,857	9.9
	Buildout Firm Supply Capacity Surplus (Deficit)	**9,643**	**13.9**
VW	Gibraltar Turnout	10,000	14.4
	Total Supply Capacity[a]	**10,000**	**14.4**
	Firm Supply Capacity[b]	0	0
	Required Supply Capacity[c]	10,334	14.9
	Buildout Firm Supply Capacity Surplus (Deficit)[d]	**(10,334)**	**(14.9)**

(a) Total supply capacity assumes all turnouts and wells are available for use.
(b) Firm supply capacity assumes largest turnout in each service area (Calaveras and Gibraltar) is offline.
(c) Required supply capacity is equal to the maximum day demand (see Table 9-1).
(d) Most of the VW service area supply capacity deficit can be met by SFPUC service area supply surplus. A deficit of 1.0 mgd remains if the SFPUC supply capacity surplus is considered.

For the second criterion listed above, Table 9-4 compares total supply plus storage to peak hour demands. Total supply equals the combined capacity from all turnouts, while storage consists of the firm pumping capacity from storage reservoirs. This includes the Ayer, Gibraltar (SF), and Gibraltar (VW) pump stations. To be conservative, firm pumping capacity is assumed (i.e., the largest pump is out of service at each pump station). Also, it is assumed the 4,000 gpm pump recommended in Section 8.5.6.1 of this report has been installed at Ayer.

As shown in Table 9-4, the SFPUC service area has a peak hour supply surplus of approximately 24,000 gpm and can even meet peak hour demands with supplies alone. In the VW service area, peak hour supplies exceed demands by approximately 5,000 gpm. Achieving this surplus in the VW service area requires utilizing the Gibraltar turnout and both sets of pumps at the Gibraltar (VW) pump station. In other words, the City would need to operate valves within the Gibraltar (VW) pump station so the pumps that normally boost Gibraltar turnout pressures would instead draw from the Gibraltar (VW) reservoir.

Table 9-4. Comparison of Available and Required Peak Hour Supply at Buildout

Supply Source	Total Supply Capacity[(a)], gpm	Firm Pumping Capacity from Storage[(b)], gpm	Total Peak Hour Supply Capacity[(c)], gpm	Peak Hour Demand[(d)], gpm	Peak Hour Supply Surplus (Deficit), gpm
SFPUC	25,528	10,900	36,428	12,429	23,999
VW	10,000	13,500	23,500	18,492	5,008

(a) Equals the total capacity from turnouts. Refer to Table 9-3.
(b) Firm pumping capacity assumes the largest pump is offline at each pump station. Pump stations drawing from storage include Ayer, Gibraltar (SF), and Gibraltar (VW). It is assumed the 4,000-gpm pump recommended in Section 8.5.6.1 of this report has been installed at the Ayer pump station.
(c) Equals the sum of total supply capacity and firm pumping capacity from storage.
(d) Refer to Table 9-1.

9.4 BUILDOUT POTABLE WATER STORAGE CAPACITY EVALUATION

As described in Section 7.3.2 of this report, the required storage reservoir capacity in each pressure zone is the sum of the following components:

- Operational storage equal to 25 percent of maximum day demand
- Emergency storage equal to 50 percent of maximum day demand
- Fire storage equal to the largest fire flow demand in a pressure zone multiplied by the recommended duration

The total storage required is the sum of the operational, emergency, and fire storage requirements, less any groundwater credit, which can offset some of the emergency storage requirement.

The groundwater storage credit is calculated for each pressure zone and equals the volume of water pumped over a 24-hour period. The credit cannot exceed the recommended emergency storage volume (i.e., 50 percent of maximum day demand). To offset surface storage needs, groundwater must be of potable water quality, and wells must have backup power capabilities. In addition, the City must be able to meet average day demands without relying on groundwater (which it can).

For each pressure zone, Table 9-5 compares the City's buildout potable water storage capacity with storage requirements. Since Zones 1 and 2 are interconnected through multiple PRVs that operate under normal conditions (see Figure 3-1), they are combined in each service area (i.e., SF1/SF2 and VW1/VW2). As shown in Table 9-5, all three wells qualify for the emergency groundwater storage credit and contribute a storage capacity equivalent to their 24-hour pumping capacities. As a result, there is a 4.11 MG storage surplus in Zones SF1/SF2 and a deficit of 5.97 MG in Zones VW1/VW2. Since stored SFPUC water at Gibraltar can be delivered to VW customers, the surplus in Zones SF1/SF2 can reduce the VW service area shortfall, up to a maximum of 5 MG (the capacity of the Gibraltar (SF) storage reservoir). However, even after accounting for this offset (4.11 MG), there remains a net storage deficit in the VW service area of approximately 1.86 MG.

Table 9-5. Comparison of Available and Required Water Storage Capacity at Buildout									
[A]	[B]	[C]	[D]	[E] = [C] + [D]	[F]	[G]	[H]	[I] = [F] + [G] + [H]	[J] = [E] - [I]
		Available Storage Capacity, MG			Required Storage Capacity, MG				
Facility	Status	Available Reservoir Capacity	Emergency Groundwater Storage Credit[(a)]	Total Available Storage	Required Operational[(b)]	Emergency[(c)]	Fire Flow[(d)]	Total Required Storage	Storage Surplus (Deficit), MG
Zones SF1 and SF2									
Gibraltar (SF)	Active	5.00	--	**12.30**	2.41	4.82	0.96	**8.19**	**4.11**
Ayer	Active	5.60	--						
Pinewood Well	Standby	--	1.70						
Zone SF3									
Tularcitos	Active	0.30	--	**0.30**	0.02	0.03	0.18	**0.23**	**0.07**
Zones SF4-1 and SF4-2									
Minnis	Active	0.34	--	**0.34**	0.04	0.08	0.18	**0.30**	**0.04**
Zones VW1 and VW2									
Gibraltar (VW)	Active	5.00	--	**6.15**	3.72	7.44	0.96	**12.12**	**(5.97)**
Curtis Well	Standby	--	0.58						
McCandless Well	Standby	--	0.58						

(a) Credit based on 24 hours of pumping capacity. The credit cannot exceed the required emergency storage capacity.

(b) Based on 25 percent of a maximum day demand (see Table 9-1).

(c) Based on 50 percent of a maximum day demand (see Table 9-1).

(d) Based on storage required for largest potential fire flow within the pressure zone. Zones SF1 and VW1/VW2 = Industrial; Zone SF2 = Commercial; Zones SF3 and SF4 = Single Family Residential.

As a result, West Yost recommends the City construct a new, 2 MG storage reservoir in the VW service area (CIP ID BCIP-S-01). While additional groundwater wells would also reduce the storage capacity deficit, lower than expected productivity at the McCandless Well suggests new storage reservoir(s) may be a more reliable investment. The City is currently evaluating potential locations for this new storage reservoir.

To deliver water stored in this new reservoir to the distribution system, West Yost recommends constructing a new pump station (CIP ID BCIP-PS-01) with a firm capacity of 4,000 gpm (approximately 5.8 mgd). This ensures that pumps can meet the largest (i.e., industrial) fire flows in the service area. Also, at this capacity pumps can empty the reservoir in approximately eight hours.

By incrementally increasing existing demands, a storage capacity "trigger demand" can be identified. This is the demand at which existing storage facilities (Gibraltar and Ayer Reservoirs plus Pinewood Well) become insufficient, and any additional demand would require new storage (i.e., reservoirs or groundwater wells). Due to different peaking factors in each service area, the storage capacity trigger demand varies slightly depending on the location and timing of growth. Assuming the SFPUC service area would be fully built out prior to the VW service area, the storage capacity trigger demand is approximately 11.8 mgd. In the opposite scenario (i.e., VW service area built out before the SFPUC service area), the trigger demand decreases slightly to 11.7 mgd. Based on the linear demand growth projection summarized in Table 5-10 of this report, City demands will approach these levels around the year 2032.

This trigger timing is significantly sooner based on the Maddaus demand projections (Partial Rebound – Normal Economy, Weather Normalized) discussed in Section 5.3.4.2 of this report. Because Maddaus projects more demand to be added by 2025 (and more gradual growth from 2025 through 2045), City demands will reach storage trigger levels by around 2024, about eight years sooner than the linear growth projection.

Note, storage and timing requirements may change as actual potable water demands adjust to conservation efforts, efficiency standards, and expanded recycled water use. In addition, if Curtis Well production exceeds expectations, the increased groundwater storage credit would also reduce the overall storage capacity deficit. The City should monitor demands and groundwater well feasibility as it continues to grow and approaches buildout.

9.5 BUILDOUT PUMPING CAPACITY EVALUATION

As described in Section 7.3.3 of this report, the City should have firm pumping capacity equal to MDD. For a given pump station, firm capacity is defined as the total capacity of all operational pumps minus the capacity of the largest pumping unit. In addition, pumping capacity in lower pressure zones should also be able to deliver the maximum day demand of any zones above them. For example, the Zone SF3 pumps should be able to deliver the maximum day demand for Zones SF3 and SF4 (i.e., SF4-1 and SF4-2).

For each pressure zone, Table 9-6 compares the available and required pumping capacities at buildout. In Zones SF1 and SF2, firm pumping capacity consists of one 5,500 gpm pump at Gibraltar (SF) and three 1,800 gpm pumps at Ayer. It is assumed the 4,000-gpm pump recommended in Section 8.5.6.1 of this report has been installed at Ayer, so firm capacity assumes that pump is offline. As a result, the combined firm pumping capacity in Zones SF1 and SF2 is 10,900 gpm, which exceeds the required firm pumping capacity (i.e., the buildout MDD of the entire SFPUC service area). The pumping capacity surplus in Zones SF1 and SF2 is approximately 4,040 gpm.

Table 9-6. Comparison of Available and Required Firm Pumping Capacity at Buildout

Pump Station	Critical Facility[a]	On-site Backup Power	Status	Firm Capacity[b], gpm	Total Firm Pumping Capacity, gpm	Buildout Maximum Day Demand[c], gpm	Pumping Capacity Surplus (Deficit), gpm
Zones SF1 and SF2							
Gibraltar (SF)		✓	Active	5,500	10,900	6,857	4,043
Ayer[d]		✓	Active	5,400			
Zone SF3							
Country Club			Active	250	250	159	91
Zones SF4-1 and SF4-2							
Tularcitos			Active	250	250	115	135
Zones VW1 and VW2							
Gibraltar (VW) - from tank	✓	✓	Active	5,500	13,500	10,334	3,166
Gibraltar (VW) - from turnout[e]	✓	✓	Active	8,000			

(a) Pump stations are considered critical if they serve a pressure zone with insufficient storage and meet other criteria. Refer to Table 7-1.

(b) Firm pumping capacity was defined as the total pump station capacity with the largest pump out of service.

(c) Includes maximum day demands for higher pressure zones, per Table 7-1.

(d) It is assumed the 4,000 gpm fire pump recommended in Section 8.5.6.1 has been installed at the Ayer pump staiton.

(e) These pumps are intended to boost pressures from the VW turnout but can be valved to draw from the Gibraltar (VW) tank.

No changes are anticipated at either the Country Club or Tularcitos pump stations, therefore, firm pumping capacities in Zones SF3 and SF4 remain at 250 gpm each. This comfortably exceeds buildout pumping requirements. Firm pumping capacity surpluses in Zones SF3 and SF4 are 91 and 135 gpm, respectively.

Both sets of pumps at the Gibraltar (VW) PS are included in the pumping capacity evaluation for the VW service area. One set draws from the Gibraltar (VW) storage reservoir, while the other set boosts pressures from the Gibraltar turnout (if necessary). By adjusting valve operations, the "turnout" pumps can also draw from the Gibraltar (VW) storage reservoir. The combined firm capacity for both sets of pumps is 13,500 gpm, which exceeds the VW service area buildout MDD (10,334 gpm) by approximately 3,170 gpm.

9.6 BUILDOUT WATER DISTRIBUTION SYSTEM EVALUATION

West Yost used the updated hydraulic model to conduct steady-state hydraulic analyses of the buildout water distribution system. The goal of this evaluation was to identify necessary improvements to support the City's buildout water demands while meeting the recommended system performance criteria presented in Sections 7.2.1 and 7.2.3 of this report.

This evaluation assumes infrastructure recommendations detailed in Sections 8.5.5 and 8.5.6 of this report have been implemented and that the new VW Piper turnout introduced in Section 9.3 is active. The new VW Piper turnout is assumed to be a 20-inch diameter connection and include a PRV that will evenly distribute VW flows between the Piper and Gibraltar turnouts.

In evaluating the buildout system, pressure criteria are prioritized over velocity criteria. This prioritization is typical, because older water systems tend to have many undersized pipes, and strictly adhering to velocity standards would identify those pipes as candidates for replacement, even though pressures meet recommended criteria. West Yost does not recommend replacing existing pipes solely for failing to meet velocity criteria. While velocity results will be summarized for non-emergency scenarios, the following analyses focus on pressures and fire flow availability.

The following evaluations are intended to identify distribution facility sizing and capacity requirements at buildout. As a result, they examine system performance under high demand scenarios only (i.e., Peak Hour Demand and Maximum Day Demand plus Fire Flow).

- **Peak Hour Demand Scenario**: evaluates the potential for low customer service pressures in the system during a peak hour demand condition
- **Maximum Day Demand plus Fire Flow Scenario**: evaluates fire flow availability in the system under a maximum day demand condition
- **Emergency Operations** (each scenario is evaluated under maximum day demand plus fire flow):
  - Outage Scenario 1: SFPUC turnouts are offline
  - Outage Scenario 2: VW turnouts are offline
  - Outage Scenario 3: SFPUC and VW turnouts are offline
  - Outage Scenario 4: Power outage; all facilities without backup generators are offline
  - Outage Scenario 5: PRVs normally allowing flow between Zones 1 and 2 are offline

To capture the entire range of normal water system operations, each non-emergency scenario above was evaluated using the two operational alternatives summarized in Table 8-5 of this report. In the Base alternative, all pumps are off, whereas Alternative 1 allows pump operation as needed. For both alternatives, all turnouts are open, and gravity tank levels are at their minimum of normal operating range.

9.6.1 Peak Hour Demand Analysis

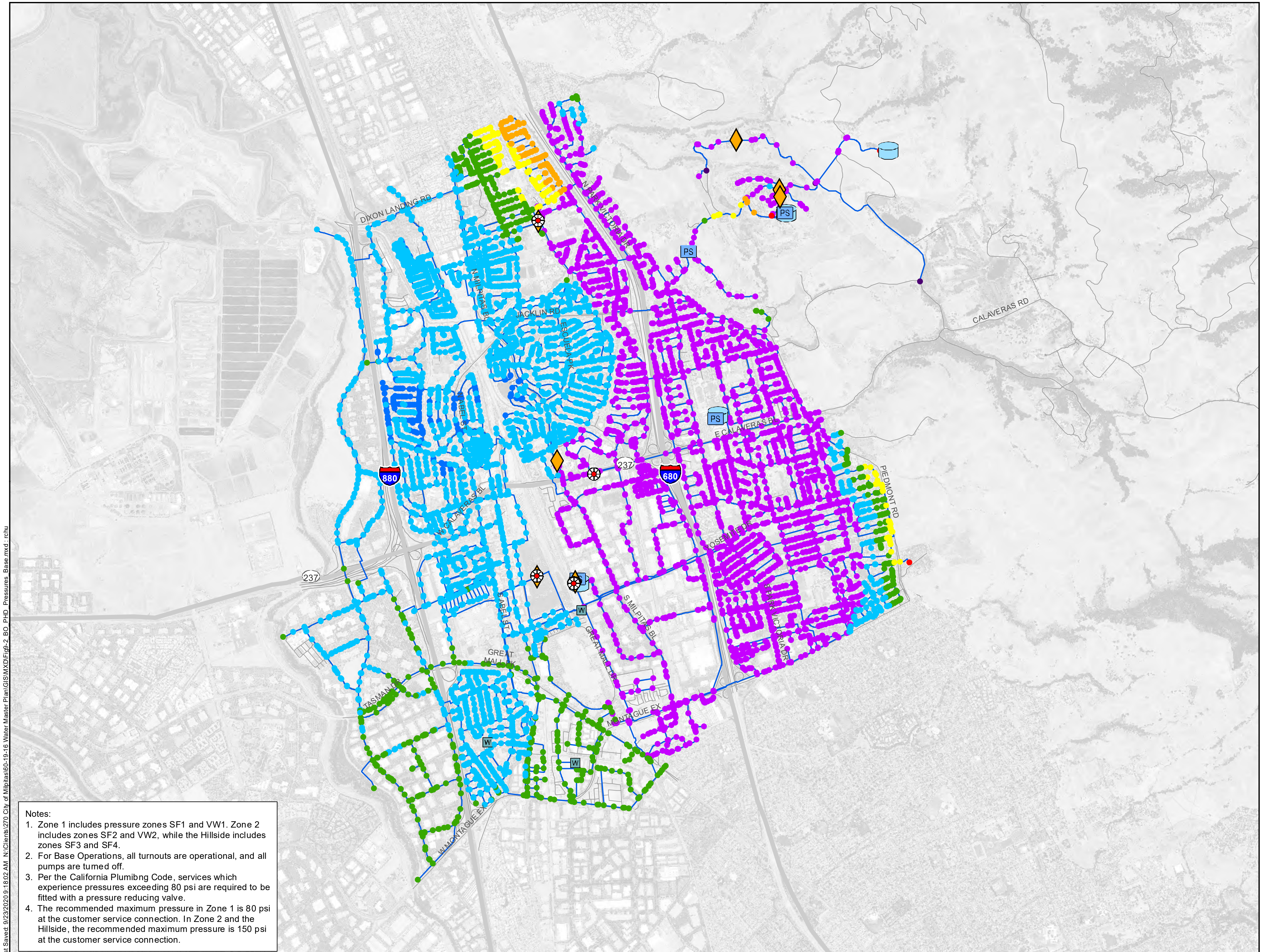
The hydraulic model was used to conduct a steady-state hydraulic analysis of the system during a buildout PHD condition. As shown in Table 9-1, the PHD for the buildout water service area is approximately 30,776 gpm (44.3 mgd). Under PHD conditions, the recommended minimum pressure is 30 psi. Any services experiencing pressures less than 30 psi during a PHD condition would require an individual booster pump.

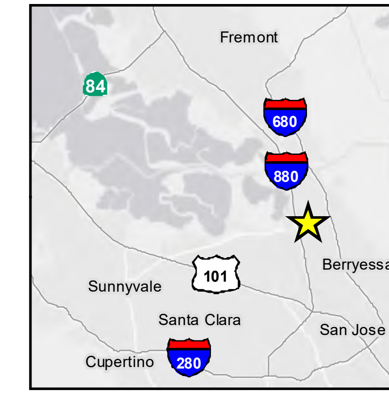
Results from the PHD simulations for Base and Alternative 1 operations are shown in Figure 9-2 and Figure 9-3, respectively. In each figure, color-coded circles represent distribution system pressures during a PHD condition. Pressures are slightly higher for Alternative 1 (pumps on), but there are no significant differences in system performance based on operations. In both cases, there are no customer service locations with pressures below 30 psi.

Per Table 7-1 of this report, under normal conditions the maximum recommended velocities for transmission and distribution mains is 6 and 8 ft/s, respectively. Transmission mains are pipelines 16 inches or larger in diameter, while distribution mains are pipelines smaller than 16 inches in diameter. Under PHD conditions, pipeline velocities exceed recommended limits near supply sources (i.e., turnouts and pump stations) and PRVs.

In the SFPUC service area, high velocity pipelines include those adjacent to the Sunnyhills PRV (over 24 ft/s in both Base and Alternative 1 operations) and downstream of the Sunnyhills, Main, and Calaveras turnouts (between approximately 9 and 11 ft/s under Base operations). When pumps are on (Alternative 1), turnout flows are lower. As a result, during Alternative 1 operations, pipeline velocities near the Sunnyhills, Main, and Calaveras turnouts are below the recommended limit.

In the VW service area, high velocity pipelines are located at and adjacent to the Gibraltar facility and PRVs. This includes the transmission main along Curtis Avenue and Yosemite Drive (between South Abel Street and South Milpitas Boulevard). Transmission mains in this area and downstream of the Gibraltar facility have velocities between 7 and 17 ft/s during Base operations (pumps off) and between 7 and 12 ft/s during Alternative 1 operations (pumps on). Pipeline velocities near PRVs are the same for Base and Alternative 1 operations. The pipelines adjacent to the Curtis East and Parc Metro PRVs have velocities of 7.1 and 8.4 ft/s, respectively, during a PHD condition. Velocities in the pipelines near the Capitol PRV are approximately 10.7 ft/s.





0 1,500 3,000
Scale in Feet

Peak Hour Pressure
- Less than 30 psi
- 30 psi to 50 psi
- 50 psi to 60 psi
- 60 psi to 70 psi
- 70 psi to 80 psi

High Pressure (Zone 1)
- Greater than 80 psi

High Pressure (Zone 2 and Hillside)
- 80 psi to 150 psi
- Greater than 150 psi
- Turnout
- Groundwater Well
- Pressure Reducing Valve
- Pump Station
- Storage Reservoir
- Pipeline

Notes:
1. Zone 1 includes pressure zones SF1 and VW1. Zone 2 includes zones SF2 and VW2, while the Hillside includes zones SF3 and SF4.
2. For Base Operations, all turnouts are operational, and all pumps are turned off.
3. Per the California Plumibng Code, services which experience pressures exceeding 80 psi are required to be fitted with a pressure reducing valve.
4. The recommended maximum pressure in Zone 1 is 80 psi at the customer service connection. In Zone 2 and the Hillside, the recommended maximum pressure is 150 psi at the customer service connection.

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Figure 9-2

Buildout System Pressures
Peak Hour Demand
Base Operations

City of Milpitas
2020 Water Master Plan

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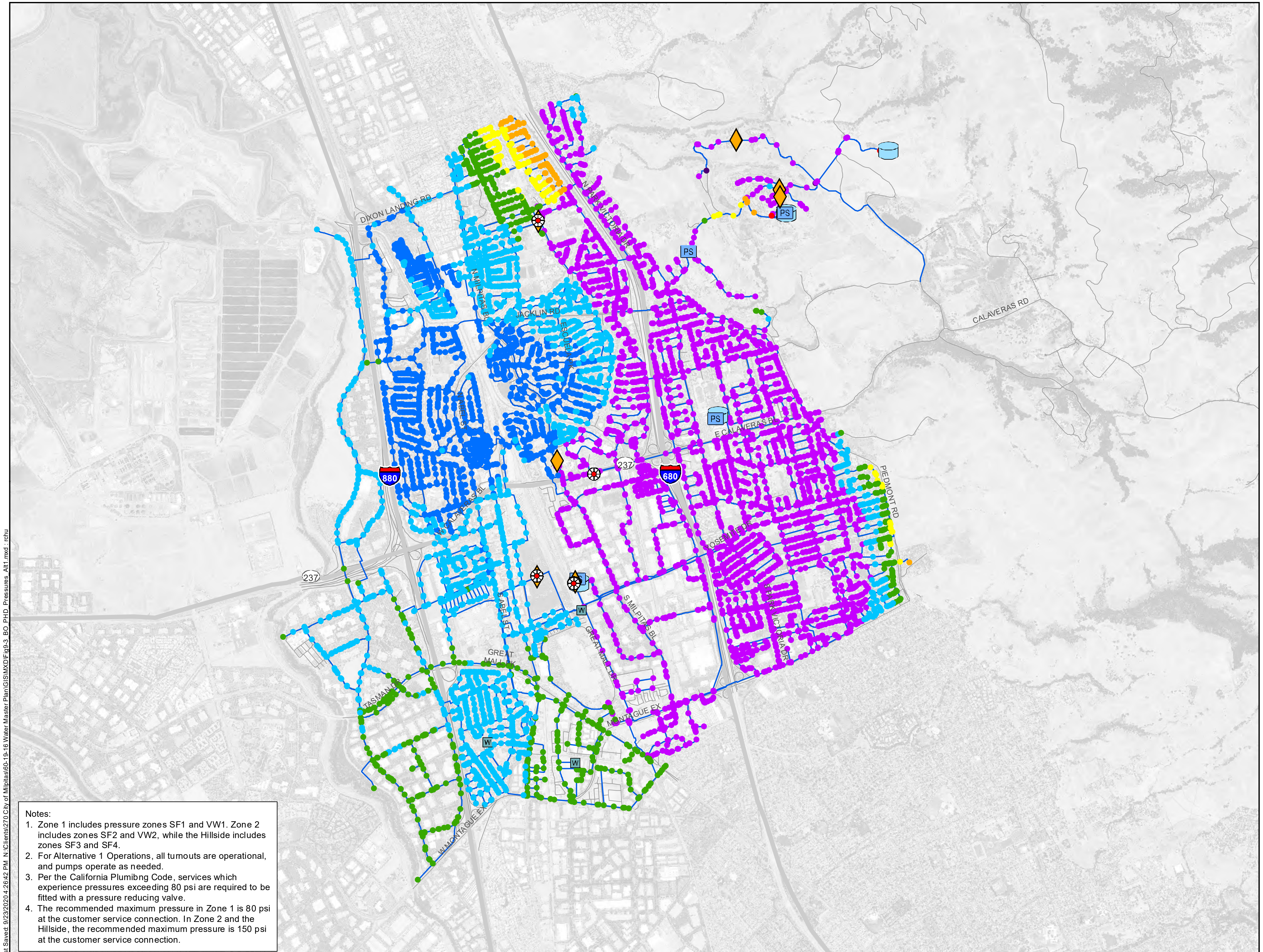

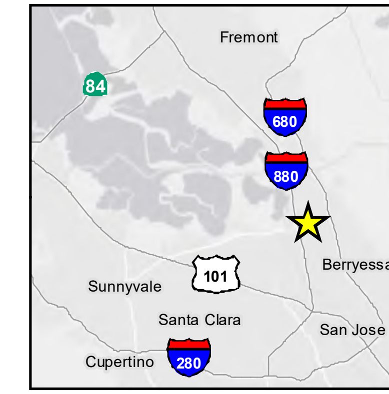

N

0 1,500 3,000

Scale in Feet

Peak Hour Pressure

- Less than 30 psi
- 30 psi to 50 psi
- 50 psi to 60 psi
- 60 psi to 70 psi
- 70 psi to 80 psi

High Pressure (Zone 1)

- Greater than 80 psi

High Pressure (Zone 2 and Hillside)

- 80 psi to 150 psi
- Greater than 150 psi
- Turnout
- Groundwater Well
- Pressure Reducing Valve
- Pump Station
- Storage Reservoir
- Pipeline

Notes:

1. Zone 1 includes pressure zones SF1 and VW1. Zone 2 includes zones SF2 and VW2, while the Hillside includes zones SF3 and SF4.
2. For Alternative 1 Operations, all turnouts are operational, and pumps operate as needed.
3. Per the California Plumibng Code, services which experience pressures exceeding 80 psi are required to be fitted with a pressure reducing valve.
4. The recommended maximum pressure in Zone 1 is 80 psi at the customer service connection. In Zone 2 and the Hillside, the recommended maximum pressure is 150 psi at the customer service connection.

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Figure 9-3

Buildout System Pressures Peak Hour Demand Alternative 1 Operations

City of Milpitas
2020 Water Master Plan

9.6.2 Maximum Day Demand Plus Concurrent Fire Flow Analysis

Fire flows in the model were updated based on buildout land uses in growth areas and the Gateway Specific Plan and Milpitas Metro Specific Plan areas. Outside of these areas, fire flows remain as originally assigned in Section 8.5.5 of this report. Fire flows were then simulated during a buildout MDD condition using the hydraulic model. The hydraulic model conducts fire flow analyses by simulating a fire flow demand at one hydrant location and verifying whether the system can serve all other normal customer demands while maintaining desired residual pressures. This is repeated for all hydrant locations within the distribution system. Hydrant locations meet recommended fire flows if they can deliver the recommended fire flow while maintaining a 20-psi residual system pressure. Note, this fire flow analysis reflects distribution system capacity, as individual hydrants, and their associated losses are not modeled.

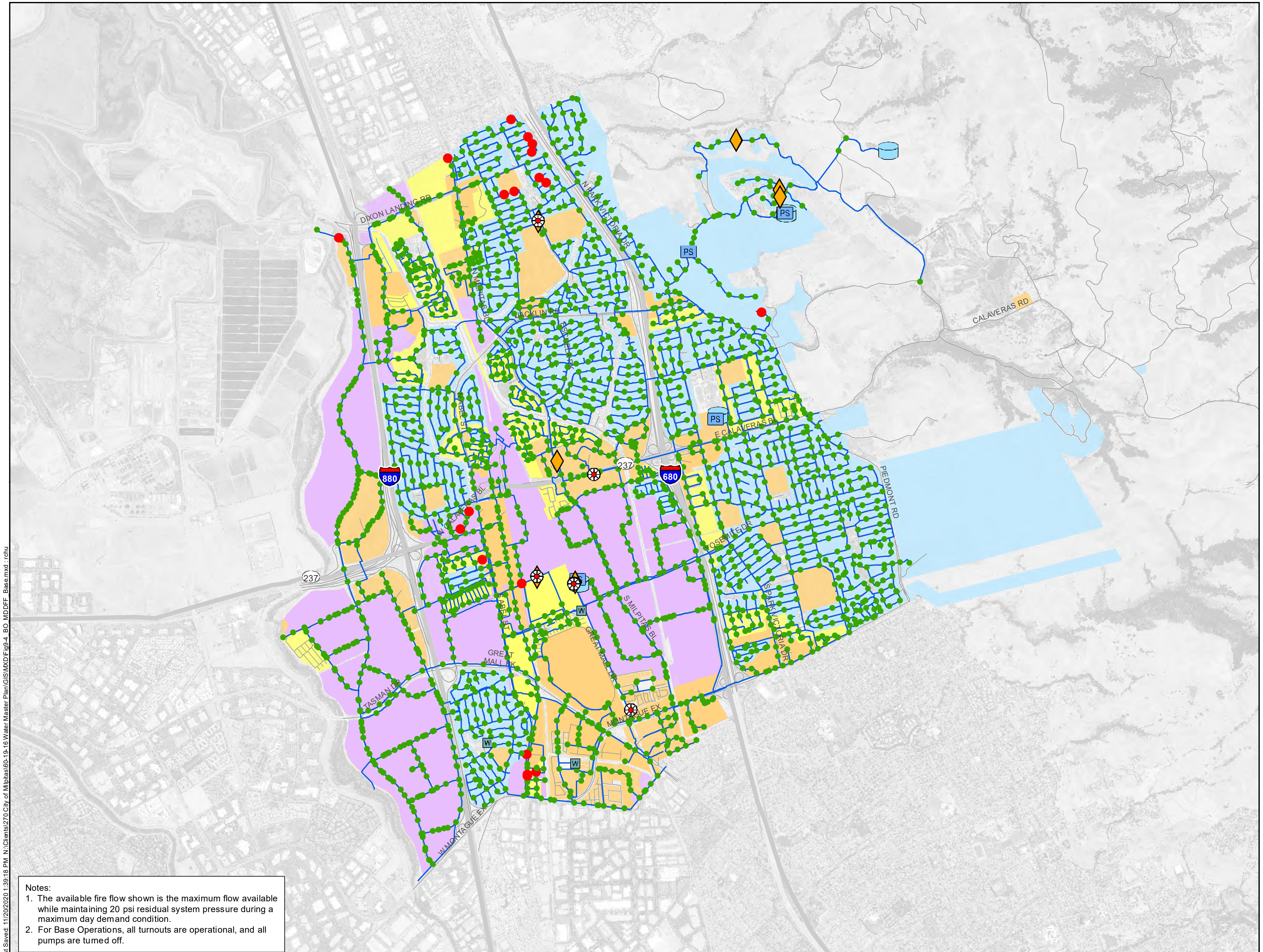
Fire flow analyses were performed independently for each pressure zone, with Zones 1 and 2 combined for each service area (i.e., VW1/VW2 and SF1/SF2). It was assumed that only one fire event would occur at a time, which is standard industry practice. Results from MDD plus concurrent fire flow simulations for Base and Alternative 1 operations are shown on Figure 9-4 and Figure 9-5, respectively. Hydrant locations are represented by circles and color coded by fire flow availability, while parcels are shaded according to the recommended fire flow. For example, a green circle adjacent to a purple parcel means that the distribution system can meet a 4,000 gpm fire flow at that location while maintaining 20 psi in the rest of the system.

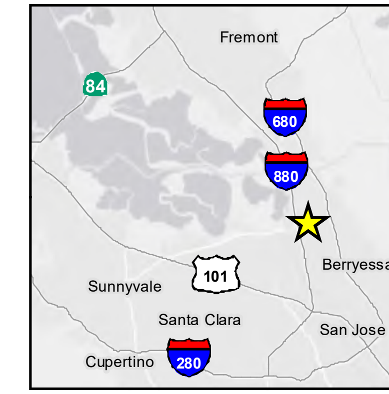
System performance is similar for the two operational alternatives. With pumps off (Base alternative), 19 locations do not meet recommended fire flows, while 15 locations are below the fire flow criterion under Alternative 1. All “below criterion” locations in Alternative 1 are also flagged in the Base alternative, therefore, pump operation improves fire flow availability for four locations. Since pumps could be off during a fire event, recommended improvements address all 19 below criterion locations identified in the Base alternative.

As discussed in Section 8.5.5 of this report, some below criterion fire flows can be eliminated by delivering the recommended flow through multiple hydrants. It was assumed that any location with another hydrant within the City’s hydrant spacing guidelines (500 feet for single family areas and 300 feet for all other areas) would qualify for delivering fire flows through multiple hydrants. If the qualifying hydrants could combine to deliver the recommended fire flow while maintaining a 20 psi residual system pressure, then the location was no longer considered below criterion. Of the 19 below criterion locations identified in the Base alternative, 16 met recommended fire flows after looking at multiple hydrants.

The three remaining below criterion locations are all at the southern end of Zone VW1, near South Main Street. To address these locations, West Yost recommends installing a new EPRV between Zones SF1 and VW1 near the intersection of Cedar Way and South Main Street (CIP ID BCIP-V-01). This emergency 8-inch connection would replace a normally closed isolation valve and allow flow from Zone SF1 if pressures in Zone VW1 fall 5 psi below PHD pressures. In addition to improving fire flows under normal operations, this “Cedar” EPRV also provides redundancy for a Capitol PRV outage (detailed below in Section 9.6.3.5).

The proposed Cedar EPRV location is based on the MDD plus concurrent fire flow hydraulic analysis described in this section and the existing connection between Zones SF1 and VW1 at the intersection of Cedar Way and South Main Street. Additional study is required to determine whether this location is feasible or if other locations would also solve the below criterion locations in this area.





Available Fire Flow

- Below Recommended Fire Flow
- Meets Recommended Fire Flow
- Turnout
- Groundwater Well
- Pressure Reducing Valve
- Pump Station
- Storage Reservoir
- Pipeline

Recommended Fire Flow

- 1,500 gpm
- 2,500 gpm
- 3,000 gpm
- 4,000 gpm

Notes:
1. The available fire flow shown is the maximum flow available while maintaining 20 psi residual system pressure during a maximum day demand condition.
2. For Base Operations, all turnouts are operational, and all pumps are turned off.

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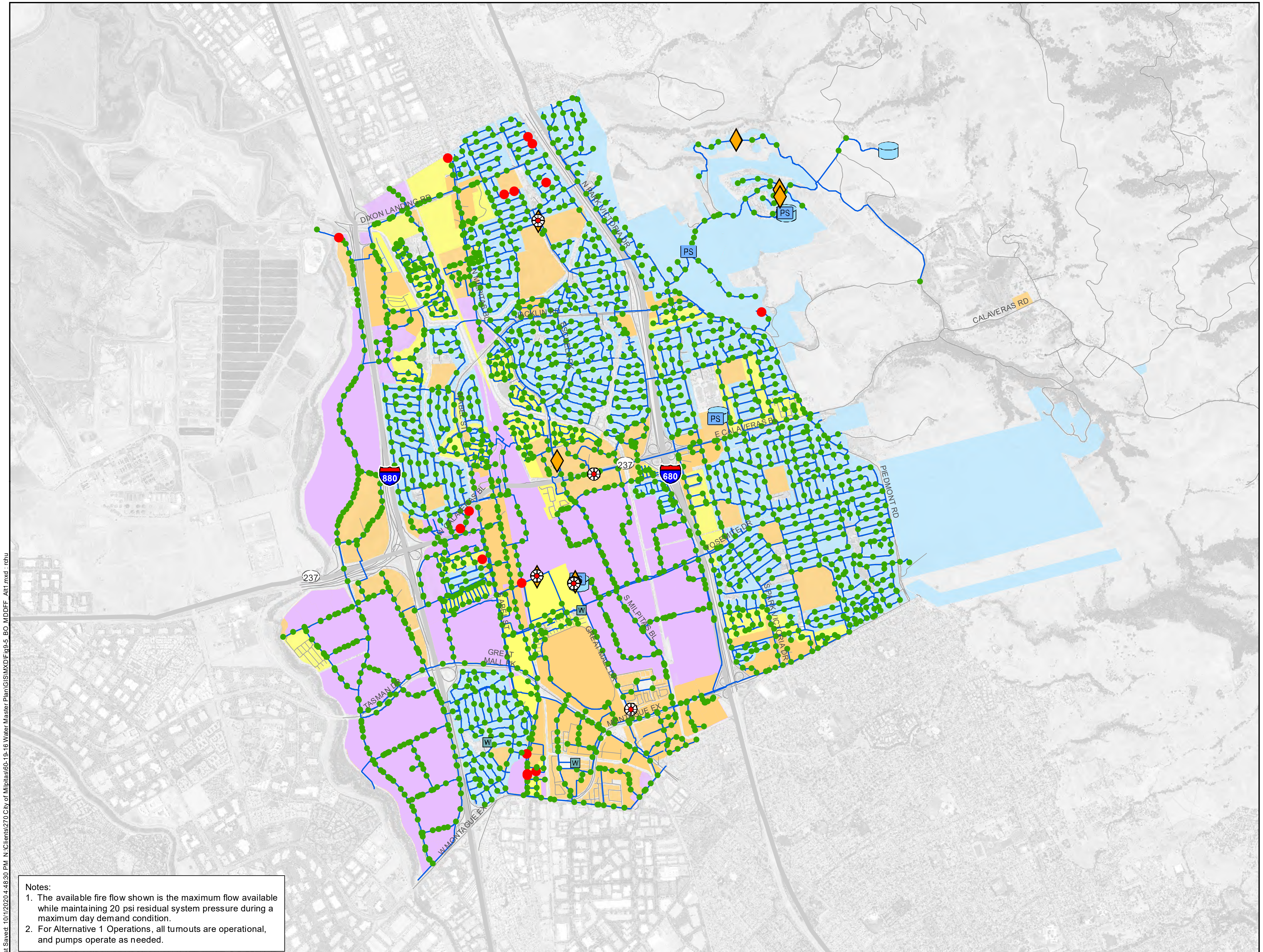
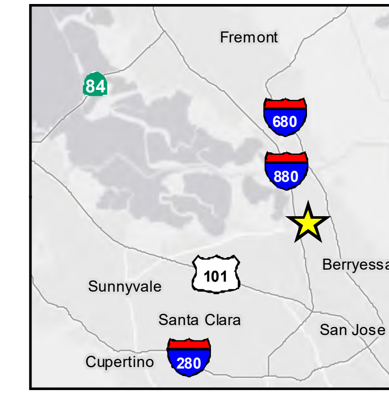
Figure 9-4

Buildout System Available Fire Flow Base Operations

City of Milpitas
2020 Water Master Plan





0 1,500 3,000

Scale in Feet

Available Fire Flow

- Below Recommended Fire Flow
- Meets Recommended Fire Flow
- Turnout
- Groundwater Well
- Pressure Reducing Valve
- Pump Station
- Storage Reservoir
- Pipeline

Recommended Fire Flow

- 1,500 gpm
- 2,500 gpm
- 3,000 gpm
- 4,000 gpm

Notes:
1. The available fire flow shown is the maximum flow available while maintaining 20 psi residual system pressure during a maximum day demand condition.
2. For Alternative 1 Operations, all turnouts are operational, and pumps operate as needed.

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Figure 9-5

Buildout System Available Fire Flow Alternative 1 Operations

9.6.3 Emergency Outage Scenarios

The following emergency outage evaluations identify how well the distribution system functions without one or more key facilities. For reference, the outage scenarios consist of:

- SFPUC turnouts are offline
- VW turnouts are offline
- SFPUC and VW turnouts are offline
- Power outage; all facilities without backup generators are offline
- PRVs normally allowing flow between Zones 1 and 2 are offline

Emergency outage scenarios are not intended to evaluate the adequacy of emergency water supplies, which is outside the scope of this master plan. Instead, these evaluations examine system pressures and fire flow availability during an MDD condition. To be conservative, storage reservoir levels are assumed to be at the minimum of normal operating range (see Table 3-4).

Since emergency scenarios assume certain facilities are offline, the corresponding evaluations do not examine system performance under Base and Alternative 1 operations. Besides the assumed outage, there are no additional operational restrictions. All facilities not assumed offline as part of the scenario are assumed to be operational.

Results for each emergency outage scenario are summarized below. Where presented, figures showing system performance during emergency outages are similar to non-emergency figures discussed above. Distribution system locations are color coded by fire flow availability (for fire flow evaluations).

9.6.3.1 Outage Scenario 1 – SFPUC Offline

This outage scenario assumes supply from SFPUC is unavailable, therefore, the Sunnyhills, Calaveras, Main Street, and Intertie turnouts are offline. As a result, the City's normally available potable water supply consists of VW (i.e., the Gibraltar and Piper turnouts) and storage.

After implementing the distribution system improvements summarized in Section 8.6 of this report, fire flow availability is not significantly impacted with SFPUC turnouts offline. There are no new below criterion locations in this outage scenario. In other words, the pumps at Gibraltar and Ayer alone can adequately serve fire flows in the SFPUC service area during an MDD condition. Thus, West Yost does not recommend any improvements based on Outage Scenario 1.

9.6.3.2 Outage Scenario 2 – VW Offline

This outage scenario assumes supply from VW is unavailable, therefore, the Gibraltar and Piper turnouts are offline. As a result, the City's normally available potable water supply consists of SFPUC turnouts and storage.

Fire flow availability is not significantly impacted with VW turnouts offline. There are no additional below criterion locations in this outage scenario, though adequately serving fire flows during an MDD condition required adjusting pump operation. In addition to the two pumps that normally draw from the Gibraltar (VW) storage reservoir, one 5,000-gpm pump that normally boosts turnout pressures was also drawing from the same reservoir. Since this operational flexibility already exists at the Gibraltar facility, West Yost does not recommend any improvements based on Outage Scenario 2.

9.6.3.3 Outage Scenario 3 – SFPUC and VW Offline

This outage scenario assumes supplies from both SFPUC and VW are unavailable, therefore, all turnouts are offline. As a result, the City's normally available potable water supply consists of storage only (i.e., Gibraltar (SF), Gibraltar (VW), Ayer, Tularcitos, and Minnis reservoirs).

Since neither the SFPUC nor the VW outages significantly impacted fire flow availability, the same is true for the simultaneous outage of both supplies. During an MDD condition, the Gibraltar (SF) and Ayer pumps can adequately serve fire flows in Zones SF1/SF2. In the VW service area, the same three pumps as Outage Scenario 2 are necessary to serve fire flows: two pumps that normally draw from the Gibraltar (VW) storage reservoir and one 5,000-gpm pump that normally boosts turnout pressures. There are no new below criterion locations in Outage Scenario 3. Thus, West Yost does not recommend any improvements based on Outage Scenario 3.

9.6.3.4 Outage Scenario 4 – Power Outage

This outage scenario assumes electrical power is unavailable, therefore, any facilities without backup generators are offline. While this does not impact the City's normally available potable water supply, distribution system operations are hindered. Because the Country Club and Tularcitos pump stations only have plug-in adaptors and transfer switches to allow for use of portable generators, and do not have on-site emergency generators, they are assumed to be unavailable in a power outage. However, the Tularcitos and Minnis storage reservoirs can still serve Zones SF3 and SF4, respectively, during a power outage.

A power outage does not significantly impact fire flow availability. There are no new below criterion locations associated with this outage scenario, which makes sense, as the impact of a power outage is similar to Base operations (pumps off). As a result, no improvements are necessary from Outage Scenario 4.

9.6.3.5 Outage Scenario 5 – Zone 1/2 PRVs Offline

Outage Scenario 5 assumes a PRV normally allowing flow between Zones 1 and 2 is offline. These "Zone 1/2" PRVs include Main, North Milpitas, and Sunnyhills in the SFPUC service area and Capitol, Curtis East, Curtis West, and Parc Metro in the VW service area. System performance is evaluated with one PRV closed at a time. It is assumed EPRVs are available as needed.

Impacts to fire flow availability vary depending on which PRV is offline. At buildout, the Capitol PRV is most critical. Should the Capitol PRV go offline, 17 additional locations do not meet recommended fire flows. Activating EPRVs and the McCandless Well allows 14 locations to meet recommended fire flows. The remaining three are solved via the proposed Cedar EPRV. While Sunnyhills, Curtis East, and Parc Metro PRV outages also create new below criterion locations, all can be solved by EPRVs (Diel, McCarthy, and Hammond). Outages of the Main, North Milpitas, and Curtis West PRVs did not result in any new below criterion locations.

9.7 SUMMARY OF FINDINGS AND RECOMMENDED IMPROVEMENTS

Below is a summary of findings and recommendations from the evaluations detailed in this chapter. Key recommendations for the buildout system were used to develop a CIP, which is the focus of Chapter 11 of this report.

- Supply Capacity
  - Buildout firm supplies fall short of maximum day demands. The firm supply surplus in the SFPUC service area cannot make up for the deficit in the VW service area. Thus, West Yost recommends constructing a new VW turnout near the intersection of Piper Drive and Garden Street with the same capacity as the Gibraltar turnout.
- Storage Capacity
  - Buildout storage capacity is insufficient. The storage capacity surplus in the SFPUC service area cannot make up for the deficit in the VW service area. West Yost recommends constructing a new, 2 MG storage reservoir in the VW service area.
  - To deliver water from this new storage reservoir, West Yost recommends constructing a new pump station with a firm capacity of 4,000 gpm.
- Pumping Capacity
  - Each pressure zone has a pumping capacity surplus. No additional pumping facilities are recommended based on buildout demands.
- Distribution System
  - The buildout distribution system meets the minimum pressure criterion under a PHD condition.
  - To address locations not meeting recommended fire flows in Base operation and PRV outage scenarios, West Yost recommends installing a new EPRV near the intersection of Cedar Way and South Main Street. The Cedar EPRV would allow flows from Zone SF1 to Zone VW1 should pressures in Zone VW1 drop significantly.

CHAPTER 10
Asset Renewal and Replacement

This chapter presents a summary of the Water Utility Condition Assessment Technical Memorandum prepared in conjunction with this Water Master Plan, provides a discussion of risk management guidelines and asset profiling, and recommends projects and activities to manage infrastructure risk. Recommended projects are incorporated in a recommended CIP described in Chapter 11 of this report.

A summary of the Seismic Risk Assessment of the City's water system facilities, conducted in parallel to this Water Master Plan as part of the compliance with the America's Water Infrastructure Act of 2018, is also provided in this chapter.

10.1 SUMMARY OF WATER UTILITY CONDITION ASSESSMENT FINDINGS

The Water Utility Condition Assessment Technical Memorandum, included in Appendix D, summarizes the condition assessment that was performed for the City's water utility assets under Task 3 – Water Utility Asset Condition Assessment of this Water Master Plan. That technical memorandum presents assessment methodologies, asset valuations, likelihood and consequence of failure factors, and business risk scores for assets in the City's water distribution system.

The analysis focused on asset and facility risk. Risk is a combination of an asset's likelihood to fail and an asset's consequence if it should fail as shown below.

- Likelihood of Failure (LOF), which estimates the probability that a failure will occur in an asset by meeting the end of its physical, design, service, or economic useful life
- Consequence of Failure (COF), which estimates the impacts of asset failure expressed either qualitatively or quantitatively, being a loss, injury, or disadvantage from a social, economic, environmental, or regulatory standpoint
- Risk is estimated using the conventional risk equation: *Risk = LOF x COF*

Risk was defined on a scale from Low to High based on COF ratings of Negligible to Severe and LOF ratings of Unlikely to Very Likely. Table 10-1 presents the adopted risk matrix.

Table 10-1. Risk Methodology

			LOF Rating			
			1 Unlikely	2 Possible	3 Likely	4 Very Likely
COF Rating and Definition	1 Negligible	No fiscal/operational impact	Low	Low	Low	Low
	2 Minimal	Slight pressure loss, minor public response, possible slight injury, minor detours	Low	Low	Medium	Med-High
	3 Moderate	Water service interrupted over local area, increased media coverage, increased injury potential, public transit impacted, restoration up to one-month impact	Medium	Medium	Med-High	High
	4 Severe	Water service interrupted over wide area including fire capacity, potential local media coverage, potential consent order, transit impacts to BART or other outside agencies, long-term economic impact, greater than one-month restoration	Medium	Med-High	High	High

Assets were classified by type and evaluated for LOF and COF to determine a risk rating. Water Meter, Line Valve and Fire Hydrant assets were evaluated as individual assets. Other individual asset assessments were aggregated into PRVs, Wells, Turnouts, Interties, Reservoirs, Pipelines and Pump Stations. Table 10-2 presents a summary of risk by these asset groupings. Some asset groups are represented in more than one risk level since individual assets or facilities are currently at different risk levels.

Table 10-2. Water System Risk Level

		LOF			
		1 Unlikely	2 Possible	3 Likely	4 Very Likely
COF	1 Negligible	Hydrants Valves Pipelines	Hydrants Valves Meters Pipelines	Hydrants Meters Pipelines	Meters Pipelines
	2 Minimal	Hydrants Valves Pipelines	Hydrants Valves PRVs Intertie Meters Pipelines	Hydrants Valves Well Reservoir PRVs Intertie Meters Pipelines	Meters Pipelines
	3 Moderate	Hydrants Valves Pipelines	Hydrants Valves PRVs Intertie Reservoirs Pipelines	Hydrants Valves PRVs Turnouts Reservoirs Pump Stations Pipelines	Pump Stations Pipelines
	4 Severe	Pipelines	Pipelines	Pipelines	Pipelines

10.2 RISK MANAGEMENT GUIDELINES AND ASSET PROFILING

Risk management applied to utility planning and management leverages the assessment of LOF and COF into asset life-cycle decision-making. The combination of LOF and COF together provides a risk rating for assets and facilities. Risk Triggers are defined in this section.

10.2.1 Risk Threshold Triggers

Leveraging risk management involves more than just applying a decision point based on a current condition or risk rating to prioritize a project. Risk management affords the utility manager knowledge of the system to optimize maintenance, plan condition assessment activities, anticipate fiscal expenditures and prioritize refurbishment and replacement. Establishing risk threshold triggers is a valuable tool to anticipate when to modify current practices.

10.2.1.1 Risk Threshold Triggers

Risk threshold triggers can be set at many levels and for many responses; however, it is best to keep them simple and few to avoid complicating maintenance and asset management practices. To keep the analysis simple as the City begins developing its risk management efforts, triggers have been set as follows:

- Level A - Watch
- Level B - Investigate
- Level C - Act

10.2.1.1.1 Level A - Watch

This initial action level represents the point an asset or facility depicts aging or performance that requires increased attention, health checks or predictive maintenance efforts. Vertical assets such as mechanical and electrical equipment and structures warrant this attention and effort based on visual observations, age and runtime. Due to limited access associated with distribution systems, pipeline assets may pass through this level without action.

A typical action associated with this trigger includes maintenance modifications which may be indicated when the likelihood of failure reaches a level where predictive maintenance may be implemented or additional maintenance efforts may benefit the asset. Predictive maintenance is typically a data collection effort that informs the maintenance manager of potential faults or failures that may be remedied prior to an asset component failure.

10.2.1.1.2 Level B - Investigate

This secondary action level is consistent with condition assessment activities. Once an asset or facility reaches this level, a focused condition assessment may be planned to evaluate where the asset is on its useful life curve and identify potential operational or maintenance activities that may support extending its life. Condition assessment also provides the utility manager with valuable forecasting data for fiscal planning. Water distribution pipelines typically fit this profile based on age, combined with failure history and local conditions, such as aggressive soils and pipe type. Vertical assets fit this profile based on age, performance and predictive maintenance data collection.

A typical action associated with this trigger includes condition assessment activities which may be indicated when the risk rating of an asset or a facility reaches a level that advanced planning should be performed to identify its point on the useful life curve. Identifying this point supports advanced planning for rehabilitation and replacement as well as modifications to asset condition monitoring. Preventative maintenance efforts can support condition assessment.

10.2.1.1.3 Level C - Act

The third action level is the beginning of renewal activities. This may be as long-term as placement on a mid-range capital improvement plan or as immediate as design development and construction.

Rehabilitation and replacement (R&R) are indicated when the asset or facility risk does not support its intended level of service and, as such, requires some form of renewal. Rehabilitation and replacement must be planned sufficiently ahead of time to complete the activity prior to failure.

10.2.1.1.4 Risk Threshold Trigger Setpoints

Triggers were applied to the risk threshold matrix to identify trigger levels that will support long-term risk management of the water utility infrastructure. These triggers were also used to develop and prioritize recommendations to improve the water system. Table 10-3 presents the risk threshold triggers (Level A, Level B and Level C) as defined above.

<table>
<tr><th colspan="7">Table 10-3. Risk Threshold Triggers</th></tr>
<tr><th colspan="2" rowspan="2"></th><th rowspan="2"></th><th colspan="4">LOF Rating</th></tr>
<tr><th>1
Unlikely</th><th>2
Possible</th><th>3
Likely</th><th>4
Very Likely</th></tr>
<tr><td rowspan="4">COF Rating and Definition</td><td>1
Negligible</td><td>No fiscal/operational impact</td><td>No Action</td><td>No Action</td><td>No Action</td><td>Level C</td></tr>
<tr><td>2
Minimal</td><td>Slight pressure loss, minor public response, possible slight injury, minor detours</td><td>No Action</td><td>Level A</td><td>Level B</td><td>Level C</td></tr>
<tr><td>3
Moderate</td><td>Water service interrupted over local area, increased media coverage, increased injury potential, public transit impacted, restoration up to one-month impact</td><td>No Action</td><td>Level B</td><td>Level C</td><td>Level C</td></tr>
<tr><td>4
Severe</td><td>Water service interrupted over wide area including fire capacity, potential local media coverage, potential consent order, transit impacts to BART or other outside agencies, long-term economic impact, greater than one-month restoration</td><td>Level A</td><td>Level C</td><td>Level C</td><td>Level C</td></tr>
</table>

10.2.2 High Risk Assets Profiling

Risk Threshold Triggers were applied to asset risk ratings developed in the Water Utility Condition Assessment Technical Memorandum (see Appendix D).

10.2.2.1 Facilities

A summary of facilities and their risk threshold triggers are presented in Table 10-4 and Table 10-5. As noted earlier, some asset groups are represented in more than one risk level since individual assets or facilities are currently at different risk levels.

Table 10-4. Risk Threshold Triggers of Facilities by LOF and COF

		LOF Rating			
		1 Unlikely	2 Possible	3 Likely	4 Very Likely
COF	1 Negligible	Hydrants Valves Pipelines	Hydrants Valves Meters Pipelines	Hydrants Meters Pipelines	Meters Pipelines
COF	2 Minimal	Hydrants Valves Pipelines	Hydrants Valves PRVs Intertie Meters Pipelines	Hydrants Valves Well Reservoir PRVs Intertie Meters Pipelines	Meters Pipelines
COF	3 Moderate	Hydrants Valves Pipelines	Hydrants Valves PRVs Intertie Reservoirs Pipelines	Hydrants Valves PRVs Turnouts Reservoirs Pump Stations Pipelines	Pump Stations Pipelines
COF	4 Severe	Pipelines	Pipelines	Pipelines	Pipelines

Table 10-5. Facilities by Risk Threshold Trigger

Facility	Risk Threshold Trigger
Calera Creek Heights PRV	Level A - Watch
Main PRV	
Sunnyhills PRV	
SJW Intertie	
Curtis Well	Level B - Investigate
Live Oak PRV	
Tularcitos North Vault PRV	
Tularcitos South Vault PRV	
North Milpitas PRV	
Capitol PRV	
Junipero PRV	
Gibraltar PRV	
McCarthy PRV	
Yosemite PRV	
Minnis Reservoir	
Gibraltar (VW) Reservoir	
Gibraltar (SF) Reservoir	
ACWD Intertie	
SCVWD Intertie	
Curtis PRV	Level C - Act
Montague PRV	
Main Turnout	
Calaveras Turnout	
Sunnyhills Turnout	
Gibraltar Turnout	
Tularcitos Reservoir	
Ayer Reservoir	
Pinewood Well	
Country Club Pump Station	
Tularcitos Pump Station	
Gibraltar Pump Station	
Ayer Pump Station	

10.2.2.2 Horizontal Assets

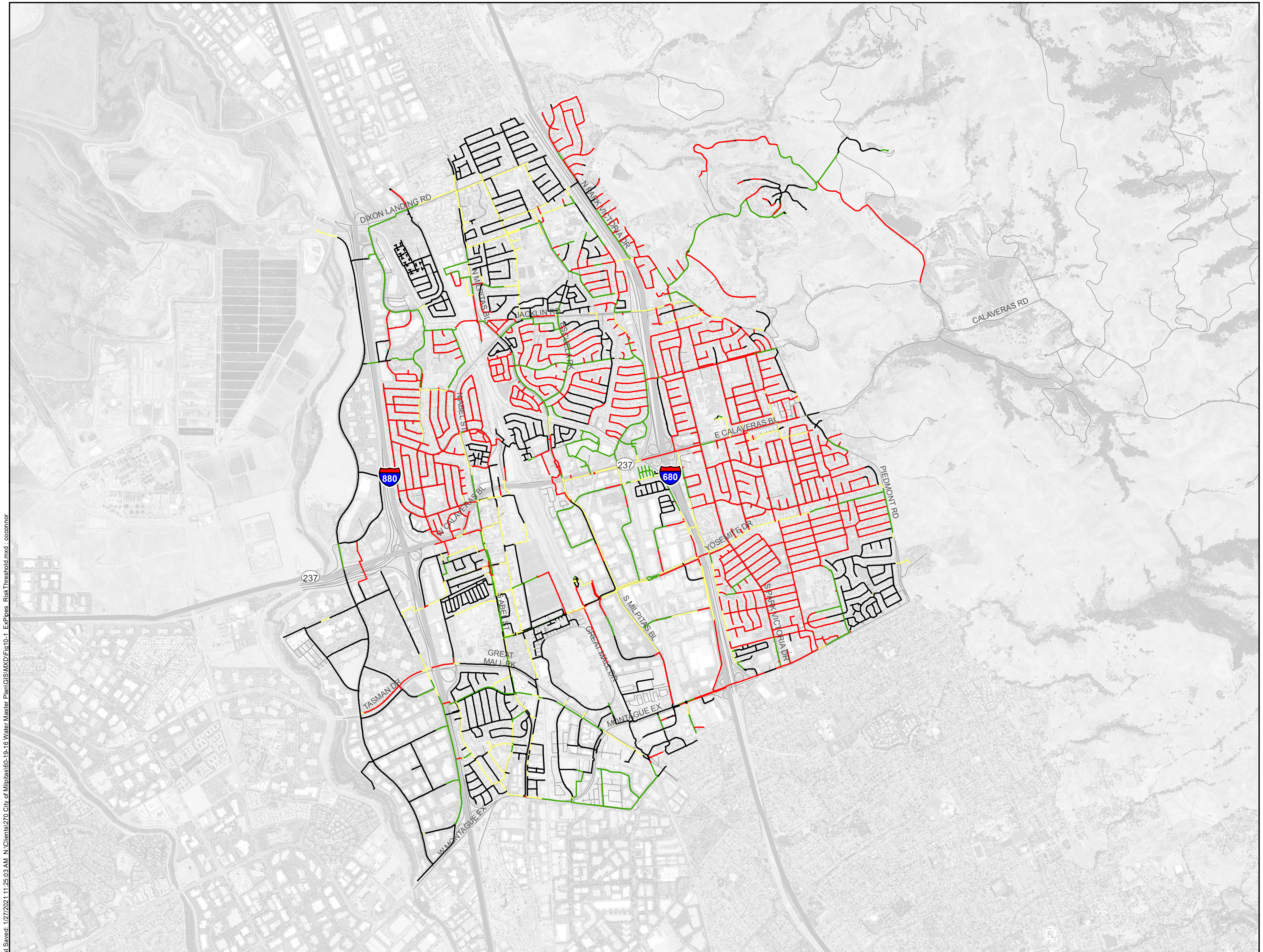
There are numerous other assets, not associated with facilities, that are associated with pipeline or horizontal assets. These include pipelines, fire hydrants, valves and water meters. Table 10-6 presents a summary of pipeline assets in each classification with their corresponding risk threshold level. Table 10-7 presents a summary count of non-pipeline assets by classification. Pipelines represented in Table 10-6 and Table 10-7 are shown on Figure 10-1. A full listing of each asset is included in the Water Utility Condition Assessment Technical Memorandum (see Appendix D).

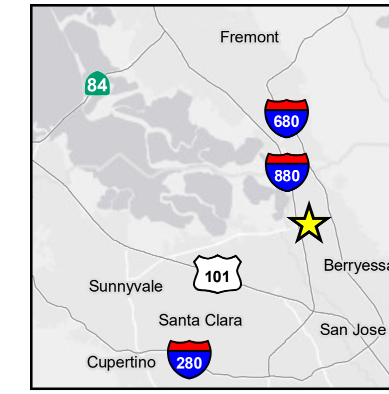
Table 10-6. Asset Count (Miles) of Risk Threshold Trigger by Asset Classification (April 2020 GIS)

Pipe Diameter	Risk Threshold Trigger		
	Level A	Level B	Level C
Pipeline, Miles			
4-inch	0.0	0.0	0.2
6-inch	0.5	0.9	3.2
8-inch	0.5	3.2	7.4
10-inch	0.4	2.9	11.8
12-inch	18.5	7.7	32.2
14-inch	2.7	1.8	7.0
16-inch	0.8	2.7	5.2
18-inch	0.7	1.2	3.9
20-inch	0.0	0.0	0.1
24-inch	0.0	0.2	1.1
30-inch	0.0	0.0	0.0
Total	**24.1**	**20.6**	**72.1**

Table 10-7. Asset Count of Risk Threshold Trigger by Asset Classification

Asset Classification	Risk Threshold Trigger		
	Level A	Level B	Level C
Water Meter	2	4	1815
Fire Hydrants	231	1265	3025
Line Valves	877	1970	4848





N

0 1,500 3,000

Scale in Feet

Pipeline Risk Threshold Trigger

- No Action
- Level A
- Level B
- Level C

WEST YOST

Figure 10-1

Existing Pipelines Risk Threshold Level

City of Milpitas
2020 Water Master Plan

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10.3 RECOMMENDED PROJECTS

Recommended projects were identified based on the asset classification and the risk prioritization developed above. They include general maintenance modifications, detailed condition assessment, refurbishment and replacement.

10.3.1 Water Meters

Most of the City's 16,351 Water Meters are beyond their typical useful life of roughly 15 years. Roughly 75 percent have exceeded this age in service. The City currently does not have a water meter replacement program other than replacement upon failure. For a water meter, failure is typically hidden resulting in an undetected meter accuracy reduction. The City is currently implementing an Advanced Metering Infrastructure (AMI) program that will ultimately replace existing water meters to conform to the new AMI system.

With the AMI replacement of the water meter inventory the City should investigate the creation of a water meter test program. The American Water Works Association recommends testing of water meters at a minimum of once every 20 years. This minimum test interval is beyond the nominal useful life of a meter and simply serves to confirm that replacement is, in fact, warranted. A meter test program can be established with a goal to test an appropriate sample of water meters and to profile meter performance specifically in the City's water system to confirm performance and useful life. A test program may begin at 10 years meter age with a goal to test 2 to 5 percent of the meter population per year.

As the AMI program evolves, the system will be selected, and it will be known if existing meters and meter components will be compatible with the new AMI system or if existing assets will require replacement. A new meter test program can then be configured based on the asset replacement rate associated with the AMI program and staffing resources.

10.3.2 Facilities

Each of the 32 facilities evaluated are at a risk trigger level of at least Level A which indicates each should be considered at a minimum for maintenance review.

Facilities at Level A consist of PRVs and Interties and, while they require little maintenance, the preventative maintenance (PM) program should be modified to include visual assessments at least annually to begin to collect condition data to support future decision-making.

Facilities at Level B and Level C include PRVs, wells, interties, reservoirs, pumping stations and turnouts. The PM program should be modified as noted for Level A, as well as a detailed condition assessment program. Since these ratings are based on only a desktop assessment, assets at Level C are not immediately identified for replacement but should be given priority in condition assessment.

10.3.3 Pipelines, Fire Hydrants and Line Valves

Pipeline assets are at risk trigger levels as high as Level C based on the desktop condition and risk assessment performed. Given the level of data available to support the desktop analysis, it is recommended that the maintenance program be reviewed to capture measurable performance data associated with pipeline failures and that a comprehensive condition assessment be conducted of representative portions of the distribution system.

Line valve and fire hydrant assets are at risk trigger levels as high as Level C based on the desktop condition and risk assessment performed. Slightly over half of the City's 9,330 fire hydrants and line valves exceed a typical useful life of 30 years. The City recently acquired equipment to support a valve and hydrant exercise program to provide mainline flushing and valve maintenance. The program is just now beginning. The exercise program should be developed with the objective to locate each valve in the field and confirm in GIS; confirm valves are operable, accessible and free of tuberculation; assure they are able to achieve a tight isolation; and, record depth, number of turns and turn direction. A valve exercise program should target the older system valves and hydrants rapidly in the first few years of the program and then settle into a pace of exercising all valves once every 5 years.

10.3.4 Summary of Asset Renewal and Replacement Recommendations

Capital and non-capital recommendations are presented in this section.

10.3.4.1 Capital and Non-Capital Recommendations

A list of capital and non-capital recommendations was developed based on the risk assessment and the risk thresholds presented in this chapter and the Water Utility Condition Assessment Technical Memorandum (included in Appendix D). Table 10-8 presents these recommendations which include projects (capital) and improvement measures (non-capital) that respond to the current state of the City's distribution system.

10.3.4.2 R&R Forecast and Methodology

R&R planning is a forecast of planned effort and expenditures for the renewal or improvement of an asset and ultimately the replacement of the asset. While not yet specifically indicated, pending actual condition assessment, a forecast of asset replacement was developed and included to establish a baseline order of magnitude estimate of asset R&R for fiscal planning. This forecast may be used for current fiscal planning but should be verified based on the findings of the recommended condition assessment studies. Assumptions are presented below:

- Forecast year of action based on remaining asset useful life
- Actual asset replacement assumed to be 20 percent of assets reaching project useful life

A forecast of R&R expenditures is presented on Figure 10-2 and in Table 10-9.

Figure 10-2. 30-Year R&R Forecast

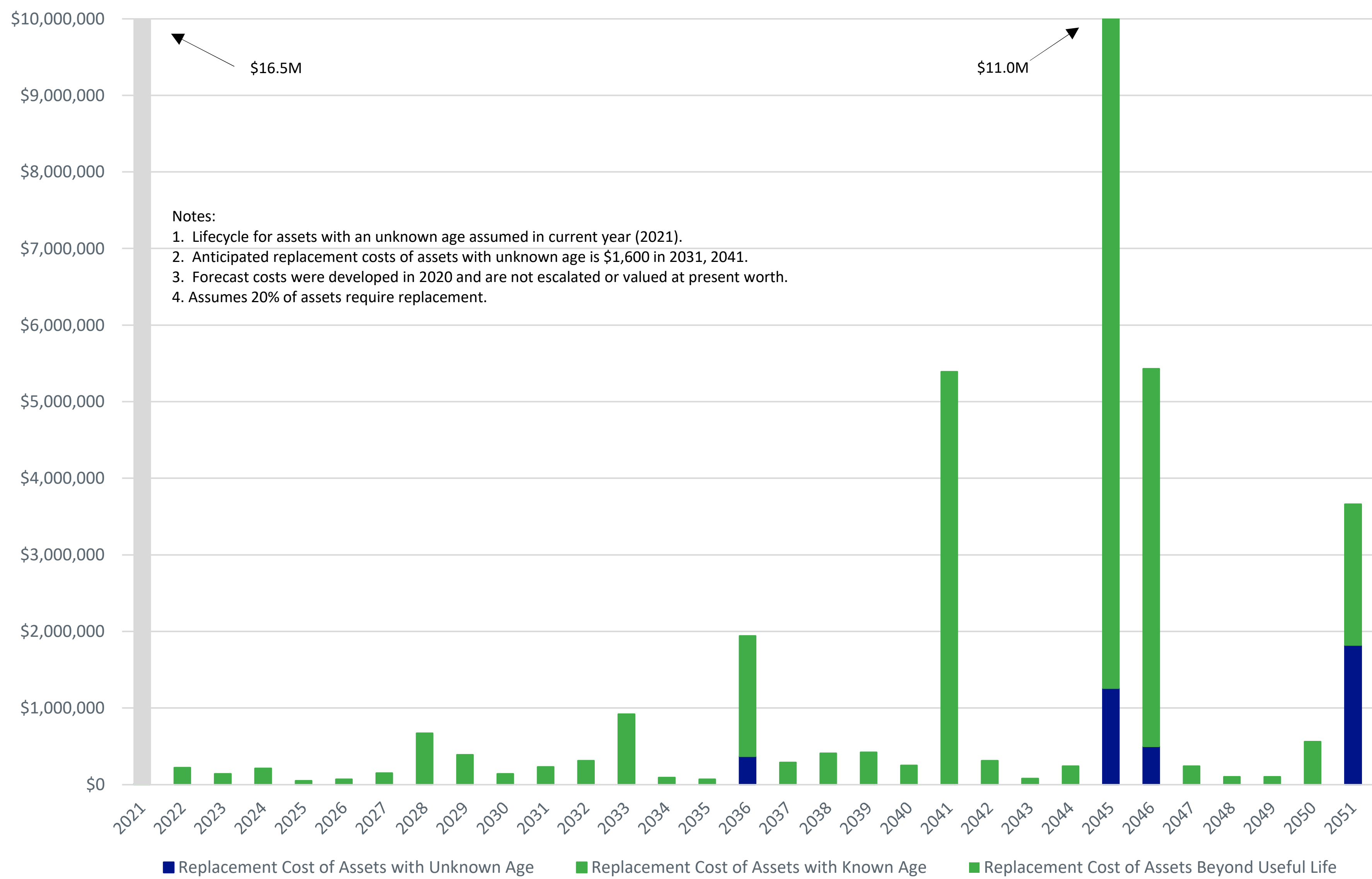

Table 10-8. Asset Renewal and Replacement Recommendations		
Title	**Description**	**Capital Cost Estimate, $**
Capital Projects		
Pipeline Condition Assessment	Conduct a comprehensive assessment of the pipeline distribution system using both destructive and non-destructive assessment techniques. Technologies may include cathodic protection resistivity surveys, coupon sampling and testing, acoustic surveys and electromagnetic surveys and leak detection monitoring. The condition assessment should include appurtenances to pipelines such as air valves, blow off assemblies, fire hydrants and valves. The assessment should focus on metallic and asbestos cement pipeline material segments to document a correlation between pipe material, diameter, age and soil conditions to better estimate remaining useful life.	$500,000
Detailed Facility Condition Assessment	Detailed facility condition assessment studies should be performed at all Level B and C facilities. Level C facilities should be prioritized for immediate assessment. Condition assessment efforts were valued at 2.5% of asset or facility replacement cost.	
	Level B Recommendations	
	PRV/Intertie/Turnout	
	• Live Oak PRV	5,000
	• North Vault PRV	15,000
	• South Vault PRV	15,000
	• Milpitas PRV	5,000
	• Capitol PRV	15,000
	• Abel PRV	5,000
	• Gibraltar PRV	15,000
	• McCarthy PRV	15,000
	• Sinclair PRV	5,000
	• ACWD Intertie	15,000
	• SCVWD Intertie	5,000
	Subtotal PRV/Intertie/Turnout	**$115,000**
	Well/Res/PS	
	• Curtis Well	75,000
	• Minnis Reservoir	80,000
	• Gibraltar Res (VW)	325,000
	• Gibraltar Res (SF)	325,000
	Subtotal Well/Res/PS	**$805,000**
	Level B Total Cost	**$920,000**
	Level C Recommendations	
	PRV/Intertie/Turnout	
	• Curtis PRV	15,000
	• Montague PRV	5,000
	• Main Street Turnout	20,000
	• Calaveras Turnout	15,000
	• Sunnyhills Turnout	15,000
	• Gibraltar Turnout	25,000
	Subtotal PRV/Intertie/Turnout	**$95,000**
	Well/Res/PS	
	• Tularcitos Reservoir	75,000
	• Country Club Pump Station	60,000
	• Tularcitos Pump Station	70,000
	• Ayer Reservoirs	355,000
	• Pinewood Well	105,000
	• Gibraltar Pump Station	435,000
	• Ayer Pump Station	125,000
	Subtotal Well/Res/PS	**$1,225,000**
	Level C Total Cost	**$1,320,000**
Water Meters	Develop a water meter test program	$100,000
Non-Capital Projects		
Data Gathering	Develop business processes and modify the CMMS to collect asset performance data. **Failure Hierarchy** – A failure hierarchy should be developed that supports the capture of problems, causes and remedies (PCR) employed for each asset. A sampling of PCR codes is included Appendix D for PUMP assets. Maintenance staff should then note the appropriate code in the work order when responding to asset problems. **Condition Assessment Data** – Visual and predictive data elements should be developed, and the CMMS modified to provide data fields to capture this data during PM activities. At a minimum visual data should be collected to capture corrosion observations, concrete spalling, burning or arcing, and evidence of leakage. A simple domain should be developed to index readings including a photo-based guide for standardization between staff. Predictive data should be consistent with the City's predictive maintenance program and may include oil analysis, vibration monitoring and thermal imaging. **CMMS Automation** - Business Processes and CMMS workflows should be developed or otherwise modified to require the completion of specific fields such as Failure Codes as part of work order completion. The completion of these fields will be controlled by automated workflow that does not allow the work order to advance from the work performer to the quality assurance reviewer unless all required fields are completed.	NA
Line Valves and Fire Hydrants	Develop a valve and hydrant exercise program.	NA
Review Maintenance Program	The existing maintenance program should be reviewed to identify additional monitoring of assets at Level A and B facilities.	NA

Table 10-9. 30-Year R&R Forecast

Year	Replacement Cost of Assets Beyond Useful Life, $	Replacement Cost of Assets with Known Age, $	Replacement Cost of Assets with Unknown Age, $	Total Replacement Costs, $
2021	16,500,000	10,000	-	16,510,000
2022	-	220,000	-	220,000
2023	-	140,000	-	140,000
2024	-	210,000	-	210,000
2025	-	50,000	-	50,000
2026	-	70,000	-	70,000
2027	-	150,000	-	150,000
2028	-	670,000	-	670,000
2029	-	390,000	-	390,000
2030	-	140,000	-	140,000
2031	-	230,000	-	230,000
2032	-	310,000	-	310,000
2033	-	920,000	-	920,000
2034	-	90,000	-	90,000
2035	-	70,000	-	70,000
2036	-	1,570,000	370,000	1,940,000
2037	-	290,000	-	290,000
2038	-	410,000	-	410,000
2039	-	420,000	-	420,000
2040	-	250,000	-	250,000
2041	-	5,390,000	-	5,390,000
2042	-	310,000	-	310,000
2043	-	80,000	-	80,000
2044	-	240,000	-	240,000
2045	-	9,690,000	1,260,000	10,950,000
2046	-	4,930,000	500,000	5,430,000
2047	-	240,000	-	240,000
2048	-	100,000	-	100,000
2049	-	100,000	-	100,000
2050	-	560,000	-	560,000
2051	-	1,840,000	1,820,000	3,660,000
Total	**-**	**$30,090,000**	**$3,950,000**	**$50,540,000**

10.4 OVERVIEW OF SEISMIC RISK ASSESSMENT OF CITY'S WATER SYSTEM FACILITIES

As part of the parallel preparation of the City's Risk and Resilience Assessment (RRA), in compliance with America's Water Infrastructure Act of 2018 (AWIA), a seismic risk assessment of the City's water system facilities was conducted. A technical memorandum was prepared to document the methodologies used and estimated consequences associated with an earthquake event affecting the City water system. The technical memorandum is included as Appendix E of this Water Master Plan.

The earthquake scenario selected for the City is the Hayward-Rodgers Creek event described in the United States Geological Survey (USGS) Northern California Legacy Catalog (also referred to as ShakeMaps). At magnitude 6.8, this event represents the largest magnitude event described by ShakeMap in relatively close proximity to key City utilities. According to USGS, this event has an estimated annual probability of approximately 0.74 percent (i.e., a 0.74 percent chance of occurring in any given year), and an approximately 31 percent chance of occurrence within the next 50 years.

The Hayward-Rodgers Creek 6.8 magnitude earthquake is estimated to cause significant damage to the City's non-linear and linear assets. The Hazus Method (for non-linear assets) estimates moderate damage to the buildings and moderate/severe damage to the pump stations and reservoirs. The ALA Method (for linear assets) estimates 8 breaks and 32 leaks from the transmission mains and 192 breaks and 58 leaks from the distribution pipelines. Repair and replacement costs are estimated using crew size, labor rate, shift duration, and order of magnitude material costs for the City. Specific recommendations resulting from the seismic risk analysis are included within the City's RRA and include retrofit of reservoirs to meet sloshing wave standards, implementation of seismically resilient design standards for pipelines, and installation of overland piping connections for critical pipelines that may be damaged during an earthquake, among others. Recommended projects are incorporated in the recommended CIP described in Chapter 11 of this report.

CHAPTER 11
Recommended Capital Improvement Plan

This chapter presents the recommended CIP for the City's existing and future water system based on the evaluations described in Chapters 8, 9, and 10 of this report, as well as the Risk and Resilience Assessment (RRA) conducted in parallel with this WMP. In addition to summarizing the recommended capital improvement projects, this chapter provides estimates of probable construction costs for each project. The recommended CIP identifies improvements at a Master Plan level and does not necessarily include all required on-site infrastructure or constitute design of improvements. Subsequent detailed design is required to determine the exact sizes and locations of these proposed improvements.

It should be noted that construction costs for the recommended capital improvement projects have been updated from those presented in the March 2021 Draft Water Master Plan to account for the recent bidding climate. Total CIP costs include mark-ups totaling 70 percent of the estimated base construction costs to allow for:

- Design and Construction Contingency: 35 percent
- Engineering Design: 10 percent
- Construction Management: 15 percent
- Permitting and Implementation: 10 percent

This chapter organizes the components of the recommended CIP according to the evaluation that identified the improvements. The final section of this chapter summarizes the recommendations and groups them into five-year CIP phases through the year 2051. Sections of this chapter include:

- Improvements from Renewal and Replacement Study
- Improvements from Existing System Analysis
- Improvements from Future System Analysis
- Improvements from Risk and Resilience Assessment
- Summary and Phasing of Recommended Improvements

Based on the recommendations of this Water Master Plan, as well as the City's recently completed Wastewater Master Plan and Stormwater Master Plan, the City of Milpitas retained Raftelis to prepare a comprehensive financial plan for the City's water, wastewater and stormwater utilities for the period from FY 2022 through FY 2040. The financial plan for the water utility (included in Appendix F) considers the projected revenues and expenditures and seeks to optimize the use of rate revenues and bond issues to minimize revenue adjustments while meeting annual revenue requirements, debt service coverage, and reserve targets. The City's water utility is financially self-sufficient with funding for capital and operating requirements derived primarily from rates.

11.1 IMPROVEMENTS FROM RENEWAL AND REPLACEMENT STUDY

Chapter 10 summarized the condition assessment of the City's water utility assets and recommended projects and activities to manage infrastructure risk. Each water utility asset was evaluated for risk in terms of likelihood and consequence of failure, with recommended projects prioritizing higher risk assets. Recommendations include general maintenance modifications, detailed condition assessment, and renewal and replacement.

Table 11-1 presents the costs for the recommended projects from Chapter 10. Facility condition assessment costs were estimated at 2.5 percent of asset or facility replacement cost. Note, the forecast of renewal and replacement costs is preliminary and based on asset age only. Renewal and replacement costs will change as the City performs detailed condition assessments.

Table 11-1. Probable Costs for Recommendations from Asset Renewal and Replacement Study[(a)]

Component	Description	CIP Cost, dollars
Pipeline Condition Assessment	Conduct a comprehensive assessment of the pipeline distribution system using both destructive and non-destructive assessment techniques.	500,000
Detailed Facility Condition Assessment[(b)]	Detailed facility condition assessment studies should be performed at all Level B and Level C facilities. Level C facilities should be prioritized for immediate assessment.	2,240,000
Water Meter Test Program	Develop a water meter test program.	100,000
Asset Renewal and Replacement[(c)]	30-year forecast of asset renewal and replacement.	50,540,000
	Total	**$ 53,380,000**

(a) Costs shown are in 2020 dollars.
(b) Facility condition assessment efforts were valued at 2.5 percent of asset or facility replacement cost.
(c) Forecast is preliminary and based on asset age only. Renewal and replacement costs will change pending condition assessment.

11.2 IMPROVEMENTS FROM EXISTING SYSTEM ANALYSIS

Chapter 8 summarized the evaluation of the City's existing potable water system and its ability to meet recommended operational and design criteria listed in Table 7-1 of this report. West Yost recommended projects to improve existing system operations. As discussed in Section 7.2.1, the existing system fire flow evaluation presents systemwide available fire flow and does not recommend pipeline improvements to specifically increase existing fire flow capacity. However, because results from the existing system fire flow analysis can help prioritize replacing smaller diameter pipelines to improve overall distribution system flows, recommended improvements from that analysis are included in the CIP.

Table 11-2 presents preliminary capital cost estimates for the recommended existing system improvements, which are organized by priority (high to low) and improvement type. West Yost assigned priorities based on the reason for the improvement, and these will help determine CIP phasing. High priority improvements address meeting recommended fire flows in normal conditions (i.e., no outages), while medium priority improvements address meeting recommended fire flows in emergency outage scenarios (e.g., SFPUC turnouts offline). Finally, low priority improvements consist of projects that generally improve system performance and/or reliability but do not address any specific issues (e.g., upsizing any 4-inch diameter pipelines that serve hydrants to comply with City design guidelines). Where recommendations consisted of either a pipeline or valve improvement for a particular location (e.g., ECIP-V-01 or ECIP-PI-02), valves were selected for the CIP due to comparable cost and less potential disruption during construction (e.g., traffic impacts). Appendix G contains figures showing the location of these recommended improvements and, for some larger projects (e.g., EPRVs and new Ayer pump), single-page project summaries.

Table 11-2. Probable Construction Costs for Recommended Improvements to Existing System[a]

Improvement Type	Improvement Description	CIP ID	Reason for Improvement	Priority	Quantity		Estimated Construction Cost[b], dollars	CIP Cost (includes mark-ups)[c,d], dollars
Interconnection	On Hammond Way near Tom Evatt Park, replace the existing (normally closed) isolation valve separating Zones VW1 and SF1 with a new emergency PRV (Hammond EPRV).	ECIP-V-01	Fire Flow	High	1	LS	$ 282,000	$ 479,000
Interconnection	Near the western end of Corning Avenue, install a new isolation valve at the end of the existing Zone SF1 pipeline, immediately upstream of the tee connecting Zones VW1 and SF1.	ECIP-V-02	Fire Flow	High	1	LS	$ 8,000	$ 14,000
Pipeline Improvement	Along Sinnott Lane, Bothelo Avenue, and East Carlo Street, replace existing 6-inch and 8-inch diameter pipeline with 12-inch diameter pipeline.	ECIP-PI-01	Fire Flow	High	1,731	lf	$ 605,850	$ 1,030,000
Pipeline Improvement	Along Technology Drive between Murphy Ranch Road and the western end of Technology Drive, replace existing 4-inch diameter pipeline with 12-inch diameter pipeline.	ECIP-PI-04	Fire Flow	High	742	lf	$ 259,700	$ 441,000
Pipeline Improvement	Along Hanson Court, replace existing 8-inch diameter pipeline with 12-inch diameter pipeline.	ECIP-PI-05	Fire Flow	High	611	lf	$ 213,850	$ 364,000
Pipeline Improvement	Along Milmont Drive between Dixon Landing Road and the ACWD intertie, replace existing 8-inch and 10-inch diameter pipeline with 12-inch diameter pipeline.	ECIP-PI-06	Fire Flow	High	907	lf	$ 317,450	$ 540,000
Pipeline Improvement	Along Railroad Avenue between approximately hydrant 1A-355 and the southern end of Railroad Avenue, replace existing 8-inch diameter pipeline with 12-inch diameter pipeline.	ECIP-PI-07	Fire Flow	High	880	lf	$ 308,000	$ 524,000
Pipeline Improvement	Within the shopping center east of the intersection of South Park Victoria Drive and Landess Avenue, replace existing 4-inch diameter pipeline with 8-inch diameter pipeline.	ECIP-PI-08	Fire Flow	High	450	lf	$ 157,500	$ 268,000
Pipeline Improvement	Along Greenwood Way between Pinewood Way and Fallen Leaf Drive, replace existing 6-inch diameter pipeline with 8-inch diameter pipeline.	ECIP-PI-10	Fire Flow	High	861	lf	$ 301,350	$ 512,000
Pipeline Improvement	Along South Abel Street between Sylvia Avenue and Corning Avenue, replace existing 6-inch diameter pipeline with 8-inch diameter pipeline.	ECIP-PI-11	Fire Flow	High	240	lf	$ 84,000	$ 143,000
Pipeline Improvement	Along Pinard Street from Ridgemont Drive up to the Lee's Orchard community, replace existing 8-inch diameter pipeline with 12-inch diameter pipeline.	ECIP-PI-16	Fire Flow	High	680	lf	$ 238,000	$ 405,000
Pipeline Improvement	Along Merz Court, replace existing 4-inch diameter pipeline with 8-inch diameter pipeline.	ECIP-PI-21	Fire Flow	High	425	lf	$ 148,750	$ 253,000
Pipeline Improvement	Along Sussex Place, replace existing 4-inch diameter pipeline with 8-inch diameter pipeline.	ECIP-PI-23	Fire Flow	High	192	lf	$ 67,200	$ 114,000
Pipeline Improvement	Along Carlsbad Street between Carlsbad Court and Ben Rodgers Park, replace existing 4-inch diameter pipeline with 8-inch diameter pipeline.	ECIP-PI-25	Fire Flow	High	160	lf	$ 56,000	$ 95,000
Pipeline Improvement	Along Calera Creek Heights Drive between approximately hydrants 4A-001 and 4A-005, replace existing 6-inch diameter pipeline with 8-inch diameter pipeline.	ECIP-PI-26	Fire Flow	High	1,476	lf	$ 516,600	$ 878,000
Pump Station[e]	Install a 4,000 gpm (5.76 mgd) fire pump at Ayer Pump Station.	ECIP-PS-AY	Fire Flow (Outage)	Med	1	LS	$ 1,216,733	$ 2,068,000
Interconnection	Near the intersection of Coelho Street and Diel Drive, replace the existing (normally closed) isolation valve separating Zones SF1 and SF2 with a new emergency PRV (Diel EPRV).	ECIP-V-03	Fire Flow (Outage)	Med	1	LS	$ 282,000	$ 479,000
Pipeline Improvement	Along Callan Street near the intersection of Callan Street and Arizona Avenue, replace existing 6-inch diameter pipeline with 8-inch diameter pipeline.	ECIP-PI-28	Fire Flow (Outage)	Med	145	lf	$ 50,750	$ 86,000
Pipeline Improvement	Along Gross Street, near the intersection of Gross Street and Conway Street, replace existing 6-inch diameter pipeline with 8-inch diameter pipeline.	ECIP-PI-31	Fire Flow (Outage)	Med	171	lf	$ 59,850	$ 102,000
New Pipeline (Developed Area)	Along Curtis Avenue, connect the existing 10-inch diameter pipeline on the northern side of the street to the existing 18-inch diameter pipeline on the southern side of the street with a new, 12-inch diameter pipeline.	ECIP-PN-01	Fire Flow (Outage)	Med	30	lf	$ 10,500	$ 18,000
New Pipeline (Developed Area)	Along Hammond Way, east of Tom Evatt Park, connect the existing 8-inch diameter pipelines in Zone VW1 with a new, 8-inch diameter pipeline.	ECIP-PN-02	Fire Flow (Outage)	Med	57	lf	$ 19,950	$ 34,000
Backup Generator	Install a backup generator at the Country Club Pump Station.	ECIP-BG-CC	General Reliability	Low	1	LS	$ 200,000	$ 340,000
Backup Generator	Install a backup generator at the Tularcitos Pump Station.	ECIP-BG-TL	General Reliability	Low	1	LS	$ 200,000	$ 340,000
Pipeline Improvement	Along Santa Rita Drive near the intersection of Santa Rita Drive and Via Baja Drive, replace existing 4-inch diameter pipeline with 8-inch diameter pipeline.	ECIP-PI-32	Hydrant Service[f]	Low	21	lf	$ 7,350	$ 12,000
Pipeline Improvement	Along Calle del Prado, replace existing 4-inch diameter pipeline with 8-inch diameter pipeline.	ECIP-PI-33	Hydrant Service[f]	Low	89	lf	$ 31,150	$ 53,000
Pipeline Improvement	Along Kennedy Drive between Topham Court and Prada Drive, replace existing 4-inch diameter pipeline with 8-inch diameter pipeline.	ECIP-PI-34	Hydrant Service[f]	Low	331	lf	$ 115,850	$ 197,000
Pipeline Improvement	Along Ramos Court, replace existing 4-inch diameter pipeline with 8-inch diameter pipeline.	ECIP-PI-36	Hydrant Service[f]	Low	62	lf	$ 21,700	$ 37,000
Pipeline Improvement	Along Stemel Court, replace existing 4-inch diameter pipeline with 8-inch diameter pipeline.	ECIP-PI-37	Hydrant Service[f]	Low	45	lf	$ 15,750	$ 27,000
Pipeline Improvement	Along Sepulveda Court, replace existing 4-inch diameter pipeline with 8-inch diameter pipeline.	ECIP-PI-38	Hydrant Service[f]	Low	21	lf	$ 7,350	$ 12,000
Pipeline Improvement	Along Berg Court, replace existing 4-inch diameter pipeline with 8-inch diameter pipeline.	ECIP-PI-39	Hydrant Service[f]	Low	107	lf	$ 37,450	$ 64,000
							Total	$ 9,929,000

(a) Costs shown are in 2020 dollars and have been updated from those presented in the March 2021 Draft Water Master Plan to account for the recent bidding climate.

(b) Estimated construction costs do not reflect an adjustment to account for the current economic bidding climate.

(c) Costs include mark-ups equal to 70 percent (Design and Construction Contingency: 35 percent; Engineering Design: 10 percent; Construction Management: 15 percent; and Permitting and Implementation: 10 percent).

(d) Total rounded to the nearest $1,000.

(e) Since this an upgrade to an existing pump station (and not a new pump station), the estimated cost is discounted 50 percent.

(f) To comply with the City's design guidelines, West Yost also recommends upsizing pipelines less than 6 inches in diameter that serve hydrants.

The total CIP cost (including mark-ups) for improvements to the existing system is approximately $9.9 million. This includes a 50 percent discount for the new pump at the Ayer pump station, since the cost basis assumes an entirely new pump station, while the recommendation is to provide an additional pump at an existing pump station. In other words, a cost was developed for a new pump station with a firm capacity of 5.76 mgd (4,000 gpm), and half that cost was used to estimate installing a new 4,000-gpm pump at Ayer.

11.3 IMPROVEMENTS FROM FUTURE SYSTEM ANALYSIS

Chapter 9 summarized the evaluation of the City's future (i.e., buildout) potable water system and its ability to meet recommended operational and design criteria listed in Table 7-1 of this report. Evaluation of the buildout system assumed that improvements recommended from the existing system analysis were implemented. Any buildout system deficiencies were then addressed via additional improvements.

Table 11-3 presents preliminary capital cost estimates for the recommended buildout system improvements. With demands in the VW service area increasing over 65 percent from existing levels, supply and storage capacity improvements are recommended. In addition to a new storage reservoir, the Curtis Well helps address the storage capacity deficiency at buildout by providing an emergency groundwater storage credit. The Cedar EPRV will help serve fire flows in Zone VW1 and improve system reliability. Since these projects address capacity deficiencies or improve fire flow, all are considered high priority. Appendix G contains project summary sheets for each of these recommended improvements.

The total CIP cost (including mark-ups) for improvements to the buildout system is approximately $16.6 million. This total does not include land acquisition costs, which may be necessary for the new storage reservoir. A public service utility easement is available for the Piper turnout, but space is limited. As a result, it is assumed a pump station will not be constructed at the Piper turnout. While the Gibraltar facility has a pump station to boost low pressures from the Gibraltar turnout, to date the City has not used it. Therefore, constructing the Piper turnout without a booster pump station is acceptable.

11.4 IMPROVEMENTS FROM RISK AND RESILIENCE ASSESSMENT

West Yost conducted an RRA in compliance with the requirements of the 2018 America's Water Infrastructure Act. This effort includes assessments of both cyber and physical risks and resilience and development of a risk and resilience strategy. Recommendations from the RRA, referred to as risk and resilience management strategies (RRMS), include physical upgrades, planning efforts, and cyber security projects.

Table 11-4 presents the recommended RRMS, organized by project type, along with a project description and priority as assigned in the RRA. High-level cost estimates were developed for four of the 23 RRMS. These four projects and their costs, which total approximately $2.1 million (2020 dollars), are included in the CIP summary and phasing detailed in Section 11.5.

Table 11-3. Probable Construction Costs for Recommended Improvements to Future System[a]

Improvement Type	Improvement Description	CIP ID	Reason for Improvement	Priority	Quantity		Estimated Construction Cost[b], dollars	CIP Cost (includes mark-ups)[c,d], dollars
Turnout	New VW turnout near the intersection of Piper Drive and Garden Street with a capacity of 10,000 gpm (14.4 mgd).	BCIP-TO-01	Firm Supply Capacity	High	1	LS	$ 313,000	$ 532,000
Storage Reservoir[e]	2.0 MG reservoir in VW service area.	BCIP-S-01	Storage Capacity	High	1	LS	$ 3,254,000	$ 5,532,000
Pump Station	Firm capacity of 4,000 gpm (5.76 mgd) for new storage reservoir.	BCIP-PS-01	Storage Capacity	High	1	LS	$ 2,433,466	$ 4,137,000
Groundwater Well[f]	Construct Curtis Well.	BCIP-W-01	Storage Capacity	High	1	LS	$ 3,500,000	$ 5,950,000
Interconnection	Near the intersection of Cedar Way and South Main Street, replace the existing (normally closed) isolation valve separating Zones SF1 and VW1 with a new emergency PRV (Cedar EPRV).	BCIP-V-01	Fire Flow	High	1	LS	$ 282,000	$ 479,000
							Total	**$ 16,630,000**

(a) Costs shown are in 2020 dollars.

(b) Estimated construction costs do not reflect an adjustment to account for the current economic bidding climate.

(c) Costs include mark-ups equal to 70 percent (Design and Construction Contingency: 35 percent; Engineering: 10 percent; Construction Management: 15 percent; and Program Implementation: 10 percent).

(d) Total rounded to the nearest $1,000.

(e) Recommended active volume. Cost assumes the storage reservoir will be an aboveground steel tank. Land acquisition costs are not included.

(f) Estimated construction cost assumes Curtis Well capacity is between 500 and 1,000 gpm. A higher capacity may result in higher costs.

Table 11-4. Risk and Resilience Assessment Management Strategies[a]

Project Type	Project No.	Project Name[b]	Project Description[b]	Priority	CIP Cost[c], dollars
Physical Upgrade	1	Physical Security Updates - Perimeter Fencing	Enhance security of site perimeters by establishing and implementing a minimum fencing standard (e.g., 8-feet high, anti-climb fabric, barbed wire).	High	$ 30,000
	2	Physical Security Updates - Turnout	Enhance security of turnout site perimeter by installing minimum 8-ft fencing. Property owned by SFPUC. Work with SFPUC to make improvements.	High	
	3	Warning Signage	Install signage at all facilities to inform that trespassing, tampering, and vandalism are criminal acts under relevant federal statutes.	High	
	4	Site Security Protocols	Implement policy of keeping all gates and doors locked at reservoir and pump station sites, and require key or access card to open.	High	$ 20,000
	5	Harden Critical Transmission Mains against Earthquakes - Emergency Connections	Install overland piping connections for critical pipelines that may be used to provide temporary distribution capacity.	High	
	6	Harden Critical Transmission Mains against Earthquakes - Emergency Connections Exercises	Conduct periodic exercises for existing overland piping connections across faults.	High	
	7	Harden Critical Transmission Mains against Earthquakes - Replace Isolation Valves	Following implementation of a program to locate and assess isolation valves on critical transmission mains (see Harden Critical Transmission Mains against Earthquakes - Identify Isolation Valves). Replace isolation valves according to priority.	High	$ 2,000,000
	8	Harden Critical Reservoirs against Earthquakes - Isolation Valves	Assess and replace (as needed) isolation valves and buried connections at reservoirs.	Medium	
	9	ShakeAlert Participation	Enroll in program to receive early warning indications from USGS (or other agencies). Development of protocols for responding to ShakeAlert signals included in other RRMS projects	Medium	$ 85,000
	10	Valve Integration with ShakeAlert	Install new or modify existing automatic valves to be integrated with or informed by ShakeAlert. Develop remote valve closure protocol to prevent leakage of safe drinking water from reservoirs during and following an earthquake. Coordinate valve closure protocol with Distribution.	High	
	11	Equipment Integration with ShakeAlert	Integrate ShakeAlert with process controls to prevent or reduce earthquake damage. Develop protocols for equipment shutdowns based on risk.	High	
	12	Retrofit Steel Reservoirs to Meet Sloshing Wave Standard	Evaluation of the City's reservoir roof and overflow heights and reservoir operating levels revealed that maximum potential sloshing wave height triggered by an earthquake would exceed the reservoir roof heights for all of the City's reservoirs. This could result in structural damage to the reservoirs. Steel reservoirs may be physically retrofitted to increase the roof height to meet the sloshing wave standard. It is recommended that the reservoirs be retrofitted to meet the standard.	Low	
	13	Implement Seismic Design Standards for Pipeline Upgrades and Replacements	Seismic design standards for pipelines were previously identified in the 2006 City of Milpitas Water System Seismic Improvements Strategic Plan (prepared by DWSA). This project would be a continuation of implementation of the recommended upgrades to pipelines within the system.	Medium	
	14	Security Cameras for Critical and Remote Facilities	Where feasible, install PTZ security cameras at the most critical and remote assets. Evaluate feasibility of storing footage from new cameras. This effort is currently in progress.	High	
	15	Fire Pump at Ayer Pump Station	Install fire pump at the Ayer Pump Station to increase fire flow capacity when the SFPUC turnouts are offline. Note that this project is also included in the recommendations for the 2020 Water Master Plan.	High	
Planning and Studies	16	Harden Critical Transmission Mains against Earthquakes - Identify and Assess Isolation Valves	Locate distribution system PRVs and isolation valves, determine if the valves are functional, evaluate the condition of the valves, and record and summarize the data collected during the field investigation. Following evaluation of the distribution valves prioritize valves for maintenance/replacement.	Medium	
	17	Evaluate Concrete Reservoirs Ability to Withstand Sloshing Wave Forces	Evaluation of the City's reservoir roof and overflow heights and reservoir operating levels revealed that maximum potential sloshing wave height triggered by an earthquake would exceed the reservoir roof heights for all of the City's reservoirs. This could result in structural damage to the reservoirs. Concrete roofs may be capable of withstanding forces produced by the sloshing wave if the roof height does not meet the standard, however, further evaluation by a structural engineer is recommended to confirm this.	Complete	
Cyber Security	18	Develop and Implement a SCADA Master Plan	Prepare a SCADA Master Plan to provide a road map for utility-wide SCADA system policies, procedures and improvements; provide increased security and uniformity across utility. This project would include or provide definition to the projects listed here. This effort is currently in progress.	High	
	19	Conduct Day Without SCADA Exercises & Document Capabilities	Following implementation of the City's new SCADA system, conduct emergency preparedness exercises to test operation of distribution system without automation (SCADA). Since the City currently operates the system without the use of SCADA, the purpose of this excercise is to maintain staff knowledge and capabilities.	High	
	20	Engage DHS for Cybersecurity Services	Engage Cybersecurity Infrastructure Security Agency (CISA) for cybersecurity services including assessments, tools, and recommendations. CISA offers a wide range of assessments. At a minimum, this project will engage DHS for a Phishing Campaign Assessment and a Remote Penetration Test. To be implemented following implementation of SCADA.	Medium	
Shorter Term Activities or Projects	21	Business Continuity Plan	Develop a Business Continuity Plan to outline the policies and procedures the City must follow to resume business operations following a major disruption (fire, flood, earthquake, cyberattack, etc.).	High	
	22	Day without Phone Exercises	Exercise radio skills on bi-annual basis with monthly radio call ins. Planning for this exercise is currently in progress.	High	
	23	Functional Training on ERP	Conduct functional training exercises on the City's ERP to prepare staff for emergency events.	Medium	
				Total	$ 2,135,000

(a) Costs shown are in 2020 dollars.

(b) Project names and descriptions have been generalized to not identify specific system vulnerabilities.

(c) Costs were only developed for four projects recommended in the Risk and Resilience Assessment.

11.5 SUMMARY AND PHASING OF RECOMMENDED IMPROVEMENTS

This section combines the above recommendations and organizes them into five-year CIP periods according to project priority. CIP phasing generally consists of five-year periods spanning from 2021 through 2051. This period is 31 years, so the final CIP period spans six years (2046-2051). It was assumed that improvements from the existing system analysis would be implemented in the next ten years (i.e., by 2030), while improvements from the future system analysis would be implemented when existing facilities can no longer meet operational criteria summarized in Table 7-1 of this report.

It was assumed that condition assessments, water meter test development, and physical upgrades would occur by 2025. Asset renewal and replacement follows the schedule presented in Table 10-9 of this report. Note, the asset renewal and replacement schedule was developed based on asset age and is subject to change pending findings from the recommended detailed condition assessments.

For the existing system analysis, high priority improvements are assigned to the 2021-2025 CIP period, while medium and low priority improvements are assigned to the 2026-2030 CIP period. As noted in Section 9.4 of this report, storage capacity is expected to become insufficient around 2032. Therefore, the new storage reservoir and Curtis Well (which reduces the storage requirement via an emergency groundwater storage credit) are assigned to the 2031-2035 CIP period. In contrast, firm supplies (i.e., largest turnout in each service area offline) can meet demands until around 2038, so the Piper turnout can be pushed to the 2036-2040 CIP period.

Table 11-5 summarizes the proposed CIP phasing and cost in 2020 dollars. Improvements are grouped according to their “source” (e.g., Renewal and Replacement Study), and their costs are assigned to a five-year CIP period. The total CIP cost through 2051 is approximately $82.1 million (2020 dollars).

Table 11-5. Capital Improvement Program Phasing

Improvement	Capital Cost, $M[a]						
	2021-2025	2026-2030	2031-2035	2036-2040	2041-2045	2046-2051[b]	Total
Improvements from Renewal and Replacement Study (Chapter 10)							
Pipeline Condition Assessment	$0.5	-	-	-	-	-	$0.5
Detailed Facility Condition Assessment	$2.2	-	-	-	-	-	$2.2
Water Meter Test Program	$0.1	-	-	-	-	-	$0.1
Asset Renewal and Replacement	$17.1	$1.4	$1.6	$3.3	$17.0	$10.1	$50.5
Subtotal	$20.0	$1.4	$1.6	$3.3	$17.0	$10.1	$53.4
Improvements from Existing System Analysis (Chapter 8)							
Hammond EPRV and Corning Isolation Valve	$0.5	-	-	-	-	-	$0.5
Pipeline Improvements - Fire Flow	$5.6	-	-	-	-	-	$5.6
Fire Pump at Ayer Pump Station	-	$2.1	-	-	-	-	$2.1
Diel EPRV	-	$0.5	-	-	-	-	$0.5
Pipeline Improvements and New Pipelines - Fire Flow (Outage)	-	$0.2	-	-	-	-	$0.2
Backup Generators at Country Club and Tularcitos Pump Stations	-	$0.7	-	-	-	-	$0.7
Hydrant Service Pipeline Improvements	-	$0.4	-	-	-	-	$0.4
Subtotal	$6.1	$3.9	$0.0	$0.0	$0.0	$0.0	$9.9
Improvements from Future System Analysis (Chapter 9)							
Piper Turnout	-	-	-	$0.5	-	-	$0.5
VW Storage Reservoir	-	-	$5.5	-	-	-	$5.5
Pump Station for VW Storage Reservoir	-	-	$4.1	-	-	-	$4.1
Curtis Well	-	-	$6.0	-	-	-	$6.0
Cedar EPRV	-	-	$0.5	-	-	-	$0.5
Subtotal	$0.0	$0.0	$16.1	$0.5	$0.0	$0.0	$16.6
Improvements from Risk and Resilience Assessment[c]							
Perimeter Fencing	$0.030	-	-	-	-	-	$0.030
Site Security Protocols	$0.020	-	-	-	-	-	$0.020
Replace Isolation Valves	$2.0	-	-	-	-	-	$2.0
ShakeAlert Participation	$0.085	-	-	-	-	-	$0.085
Subtotal	$2.1	$0.0	$0.0	$0.0	$0.0	$0.0	$2.1
Total	**$28.2**	**$5.3**	**$17.7**	**$3.8**	**$17.0**	**$10.1**	**$82.1**

(a) Costs shown are in 2020 dollars and have been updated from those presented in the March 2021 Draft Water Master Plan to account for the recent bidding climate.

(b) Includes forecasted renewal and replacement costs for the year 2051.

(c) Costs were only developed for four projects recommended in the Risk and Resilience Assessment.

CHAPTER 12
References

Below is a list of references used for the preparation of this Water Master Plan, sorted alphabetically by author.

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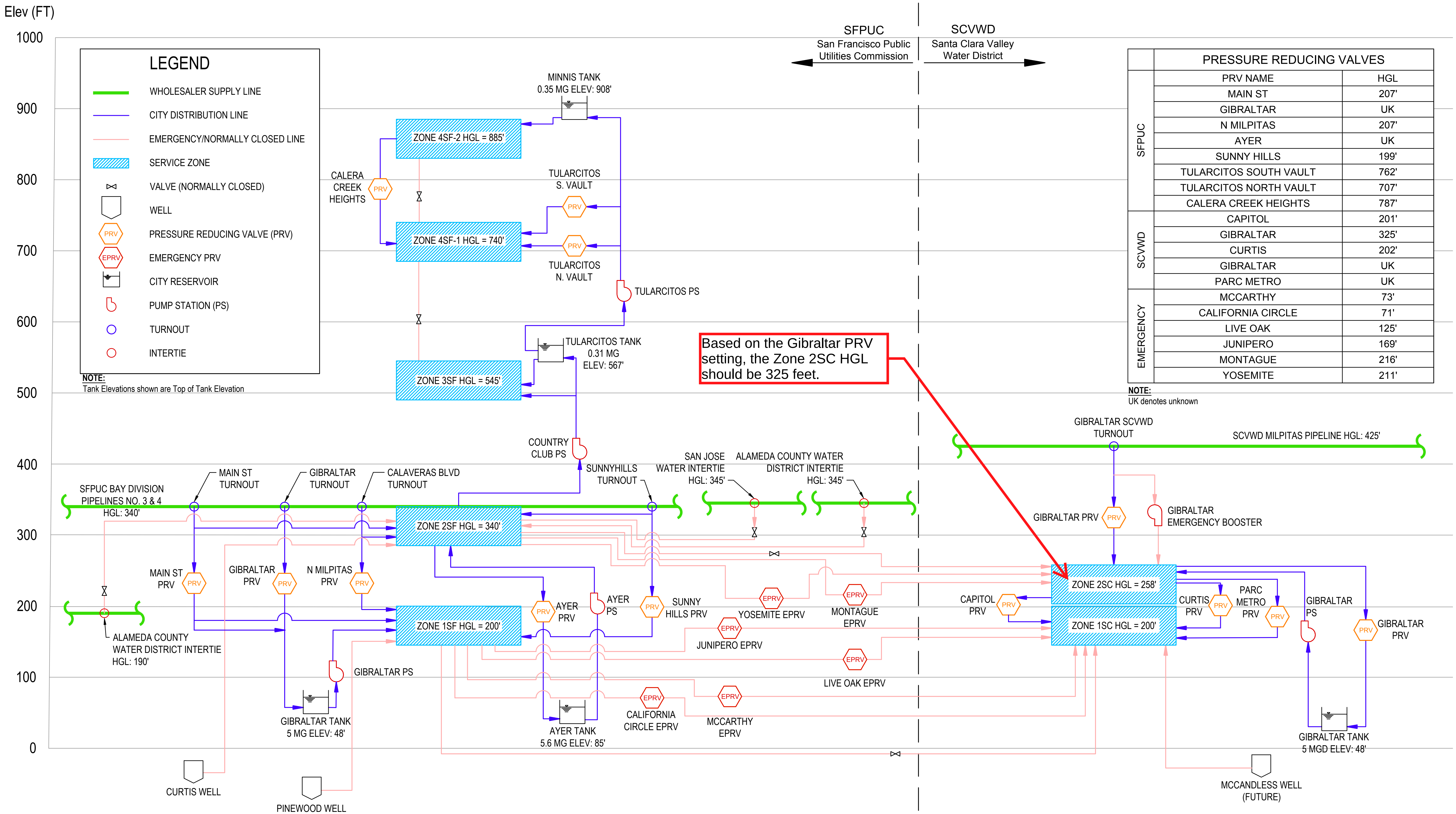
Appendix A

Water System Schematic Profile



	PRESSURE REDUCING VALVES	
	PRV NAME	HGL
SFPUC	MAIN ST	207'
	GIBRALTAR	UK
	N MILPITAS	207'
	AYER	UK
	SUNNY HILLS	199'
	TULARCITOS SOUTH VAULT	762'
	TULARCITOS NORTH VAULT	707'
	CALERA CREEK HEIGHTS	787'
SCVWD	CAPITOL	201'
	GIBRALTAR	325'
	CURTIS	202'
	GIBRALTAR	UK
	PARC METRO	UK
EMERGENCY	MCCARTHY	73'
	CALIFORNIA CIRCLE	71'
	LIVE OAK	125'
	JUNIPERO	169'
	MONTAGUE	216'
	YOSEMITE	211'

NOTE:
UK denotes unknown

HydroScience

City of Milpitas
Water Distribution System Plan
Schematic Profile

Appendix B

System Operations Narratives

City of Milpitas Distribution System Operation

General Description

WATER SUPPLY

The City of Milpitas receives water from two wholesale agencies, San Francisco Public Utilities Commission (SFPUC) and Valley Water (VW). Water from SFPUC is brought through the City by two transmission lines, Bay Division Pipelines 3 & 4, supplies Milpitas through 3 turnouts – Sunnyhills, Calaveras, and Main Street. Valley Water is brought to the City via the East Pipeline, and has one turnout at the City's Gibraltar Pump Station. There is an Intertie connection between Valley Water and SFPUC which runs from the end of the East Pipeline at Gibraltar Pump station and proceeds approximately 1,000 feet north the the SFPUC/VW Intertie Pump Station. Milpitas has a connection to this pipeline which can serve as an additional turnout to SFPUC, which we call the Intertie Turnout. When the SFPUC/VW Intertie is not in operation to transport water from SFPUC to VW or vice versa, the Intertie turnout is used by Milpitas to receive water from SFPUC, thus keeping the Intertie pipeline with fresh water in it.

The City also currently has one operational well, Pinewood Well, can be used to supply water to a portion of the City's zone 1SF distribution system. This well is currently premitted as a Standby Well, and thus can only be used for emergency operations only. An additional well, Curtis Well, has been drilled and developed, but there is no pump station and no connection to distribution system infrastructure. Curtis Well contains manganese and will require treatment. Possible infrastructure connections are to zones 1SC, 2SC and 2SF. In addition, a connection to Gibraltar Pump Station for blending purposes is also in consideration. A third well is in the planning stages now, McCandless Park Well. A test hole had been drilled and the above and below ground portions of the main well are in design with an anticipated completed date of sometime in 2022. This well will also require manganese removal treatment, and will serve zone 1SC.

Pressure Zones

Milpitas does not blend water from the two wholesalers that serve the City. As a result, Milpitas distinct areas that are served water from one or the other wholesaler, and they are designated by the letter codes SF and SC. Each wholesaler served area has two main pressure zones in the area of the City that resides on the valley floor. Zones are identified as low pressure or high pressure. Low pressure zones have a number designation of 1, and are regulated by pressure reducing valves to have a maximum pressure of about 80 psi in the zone. High pressure zones have a number designation of 2. The high pressure zone served by SF is not regulated and is set by the pressure supplied by SFPUC at the turnouts, which is typically between 130 and 140 psi. For the high pressure zone served by VW, it is set by a pressure reducing valve at Gibraltar Pump Station to between 135 and 140 psi. Valley Water is typically supplied from the East Pipeline at a pressure of 170 – 180 psi.

There are two additional pressure zones that cover the developed area of the hills in Milpitas which includes the Summit Pointe Golf and Country Club. This water system was originally called La Questa and is now commonly referred to as "The Hillside". Water is transported to these zones, designated 3 and 4a and 4b. These system will be described in more detail later in this document.

DISTRIBUTION SYSTEM OPERATION

VW System

The area of Milpitas which is served by Valley Water (formerly known as Santa Clara Valley Water District, or SCVWD) was carved out in the late 1980s to be served separately from the rest of the City's distribution system, which was formerly completely serviced by SFPUC. The area selected was primarily commercial/industrial. See the zone map for visual reference. Gibraltar Pump Station was constructed as part of this effort and has two 5 MG storage tanks, one designated for VW water and one for SFPUC water. The station is really 3 stations in one, and was intended to serve multiple purposes. For the distribution of VW water, the turnout connection to the East Pipeline was located on the station grounds. Water from the turnout goes through a revenue meter and vault, maintained by VW, and then goes through a Pressure Reducing Valve (PRV) to enter the City's zone 2SC distribution system. Water is also sent to the VW reservoir for storage directly from the turnout. Water from the reservoir can be pumped out of the reservoir and into zone 2SC by one of two pumping systems. When pumping from storage, flow from the turnout is generally halted. Once water enters zone 2SC, it is maintained at about 135 psi. There are three PRV stations that then take water from zone 2SC and reduce the pressure to send it to zone 1SC. Pressure in zone 1SC is maintained to have a maximum of about 80 psi as the highest pressure within the zone. The three PRVs that send water to zone 1SC are Curtis, Parc Metro and Capitol. The Curtis PRV is actually two PRVs in parallel, designated East and West.

In addition to the main PRVs that control pressure in zones 1SC and 2SC, there are also Emergency PRV stations. These are standby PRV stations that will only open and supply water if the pressure in zone they are supplying falls below a certain setpoint. For zone 2SC, there are two stations, Yosemite and Montague, that will allow water to pass from zone 2SF to zone 2SC if the pressure in zone 2SC falls below about 120 psi. For zone 1SC, there are 4 emergency PRV stations, Live Oak, McCarthy, California Circle, and Junipero. These stations will supply water from zone 1SF to zone 1SC if the pressure in zone 1SC falls below about 60 psi at the point of highest pressure. It is important to note that the emergency PRVs for both zones only flow in *one* direction, from the SF zones to the SC zones, and *not* in the opposite direction. The SC zones were intentionally set up to have higher pressures than the corresponding SF zones so that this system could work this way.

SFPUC System

The portion of the City supplied by water from SFPUC is primarily residential, with some commercial. Water is supplied to these zones from the 3 primary turnouts, Sunnyhills (called Washington by SFPUC), Calaveras, and Main Street (called Hammond by SFPUC). Each turnout has connections to the two Bay Division Pipelines, 3 and 4. There are two parallel revenue meters that supply a manifold to which the city connects for our supply. At the Sunnyhills and Main St. turnouts, there are two types of connections. Connections that go directly to zone 2SF are unregulated, fed directly at the pressure supplied by SFPUC. Connections that go to zone 1SF are fed through two parallel PRVs located within the turnout vault structure. At the Calaveras turnout, the connections are all to zone 2SF, and therefore unregulated. There is an associated PRV station a short distance away next to Milpitas City hall, called the Milpitas PRV station, that takes water from the Calaveras turnout and sends it to zone 1SF. This station has two PRVs in parallel, but one larger than the other. All turnout PRV stations with parallel PRVs operate in a lead/lag fashion, with one set to a slightly higher pressure setpoint than the other.

Water from zone 2SF supplies zone 3SF by acting as the supply to the first of two booster pumping stations, Country Club. Country Club booster pump station recieves water from zone 2SF as the suction supply that is then pumped into Zone 3SF. There is a 12" supply line that travels from the output of Country Club pump station up to the next station, Tularcitos, where it both supplies water to zone 3SF and fills the 310,000 gallon reservoir there. Both the pumps and the reservoir supply water to zone 3SF. The pumps at Country Club are activated by the level of the Tularcitos Reservoir. Then the level gets down to 15 feet the lead pump is turned on. Usually this is enough to start filling the reservoir, but if demand is high enough for the reservoir level to continue to fall to 14 feet, the lag pump will also turn on. Once the reservoir reaches 21.5 feet the pumps are shut off.

In the same manner, pumps at Tularcitos pull water from the reservoir and pump it into zone 4SFa and up to the Minnis Reservoir. Tularcitos pumps are controlled by the level of the Minnis Reservoir. Zone 4SF is broken into two subzones, a and b. Water from zone 4SFa feeds three PRVs called North Vault, South Vault, and Calera Creek Heights. Due to the elevation differences in zone 4, the PRVs are necessary to break the pressure midway in the zone. Zone 4SFa is unregulated, and the lower part of the zone, zone 4SFb is the portion regulated by the three PRV stations.

Each reservoir, Minnis and Tularcitos, has a nozzle type mixing system which uses a pump to circulate water from the tank through the pump and back in through the side of the tank and out a nozzle mounted inside which faces up at an angle to circulate the water both vertically and horizontally to avoid thermal and chemical stratification. Each also has a sampling pump and equipment for conducting water quality testing onsite.

Ayer Pump Station is located within zone 2SF and has 3 vertical turbine pumps and a 5.6 MG reservoir. The station has a single inlet/outlet which can be used to either fill the reservoir with water from zone 2SF or pump water into zone 2SF, but it cannot do both at the same time. Operation of this station is set up on a fill and pump basis, twice per day, pumping into the zone during morning and evening peak times, and filling from the zone during afternoon and overnight low demand periods.

Gibraltar Pump Station is located within zone 2SC, but also receives water from zone 1SF as well as the Intertie turnout. Gibraltar has a 5 MG reservoir and is also set up on a daily pump and fill cycle, pumping during morning and evening peak times to zone 1SF and filling during afternoon and overnight low demand periods from the Intertie turnout when not in use by SFPUC/VW, or from zone 1SF when the Intertie turnout is not available.

Pinewood Well is located in the southwest portion of the City in the neighborhood called The Pines and is in Pinewood Park. This well can produce about 1200 gallons per minute at an output pressure of about 70 psi. It is currently permitted as a Standby well and is need of further renovation, but it is eventually planned to be permitted as an active well and used to supplement the zone 1SF supply.

Curtis Well is located in Curtis Park, and has no pump station or connection to infrastructure yet. It was originally designed to provide emergency water supply to zone 2SF, but it's location facilitates a connection to both zones 1 & 2SC, as well as zone 2SF. In addition, a sleeve was put in crossing under the railroad tracks to allow a future line to connect the well to Gibraltar Pump Station for possible mixing or treatment to take place at Gibraltar. This would allow Curtis Well to run and blend water for pumping to zone 2SC or zone 1SF from Gibraltar.

INTERTIES

There are three inter-city interties. Two are with Alameda County Water District. The first one is located on Milmont drive at the border of Fremont and Milpitas. The second is on North Park Victoria, also at the border of Milpitas and Fremont. Both are manual interties, with significant pressure differences in the normal operating pressures of each system. Both interties have been used successfully to supply water from Milpitas to ACWD.

The third intertie is with San Jose, and is located on Landess Avenue. It is also manual. This intertie has no planned flushing points, and needs to be upgraded to allow routine operation and flushing.

City of Milpitas Water System Emergency Operations Scenarios

This document is a simplified overview of some of the possible emergency conditions that may arise and what changes to system operations are possible to mitigate the impacts of those conditions on the delivery of water to the City's water system customers. This is not a comprehensive how-to manual, as each emergency condition is unique, and the exact circumstances will dictate the actual actions to be taken. This document is intended as a guide to what is possible, and to help guide the responder to considering all possible actions in response to any specific emergency condition. The scenarios below are listed individually, but may occur in any combination, and each will have to be taken into consideration and weighed against the existing system conditions at the time.

SCENARIOS

1. Loss of Supply
    a. Loss of SFPUC Supply
    b. Loss of SCVWD (VW) Supply
    c. Loss of both SFPUC & VW Supply
    d. Loss of Well Supplies
2. Pump Station Issues
    a. Loss of PG&E power
        i. Ayer
        ii. Gibraltar
        iii. Hillside
        iv. Wells
    b. Loss of water supply
        i. Gibraltar
        ii. Ayer
        iii. Hillside

3. Distribution System Issues
    a. PRV Station loss/malfunction
    b. Zone interconnection
    c. Agency interconnection
    d. Contamination
    e. Fire suppression aid
    f. Main Line break
    g. Fire hydrant hit
    h. Construction shutdowns/tie-ins

1. Loss of Supply
    a. Loss of SFPUC supply

    The loss of SFPUC supply may can occur in three ways: Loss of a single turnout, a reduction in quantity from SFPUC, or the total loss of supply from SFPUC.

        i. Loss of a Turnout

        SFPUC water is supplied to the City by four turnouts: Sunny Hills, Calaveras, Main Street and the SFPUC/SCVWD Intertie (when available). The loss of a single turnout can be compensated by the other turnouts. Changes in flow patterns within the distribution system will occur which can result in lower pressures in the extremities of the system and dirty water in areas where the flow has reversed or increased. These changes are most significant in zone SF2. The use of Ayer pump station to support peak use times is recommended.

        ii. Reduction of Supply from SFPUC

        In the event SFPUC cannot meet demands there may be a reduction in supply. Here are the possible ways to add supply to zones SF1 and SF2:

            1. Pump from storage at Gibraltar and Ayer;
            2. Activate Pinewood Well to pump to zone SF1;
            3. (FUTURE) Activate Curtis Well to pump to either Gibraltar or zone SF2;
            4. Use water from SCVWD at Gibraltar to supply zone SF1 through the use of the Intertie turnout;
            5. Use water from SCVWD at Gibraltar to fill SFPUC reservoir and pump to zone SF1;
            6. Use water from SCVWD by opening isolation valves in zones SC1 and/or SC2;

7. Contact ACWD and/or SJ Muni to activate intercity interties for zones SF1 & 2 – significant pressure differences exist, and this is a last resort.

iii. Total loss of supply from SFPUC

In the unlikely event we lose all supply from SFPUC or are required to isolate from SFPUC, the options are similar to the partial loss scenario above but may require a combination of options. Pumping from storage is the most immediate remedy while the other options are set up. Storage will not last long and is dependent on the amount of water in storage at that moment and the time of year the outage occurs. If the outage will last more than a few days, use of Pinewood and (future) Curtis Wells may be significant, as SCVWD will likely be tasked to help provide water to SFPUC and their supply may also be limited.

b. Loss of SCVWD Supply

SCVWD water is only supplied to the City through a single turnout located at Gibraltar Pump Station. Loss of supply may occur as a reduction in available water or as a total loss.

i. Supply Reduction and Total Loss Options

1. Pump from storage at Gibraltar and use the VW turnout only to provide water to the SCVWD reservoir;
2. Use SF water from the SFPUC/VW Intertie directly from the Intertie turnout using the Intertie PRV into zone SC2 – pressure will be reduced to about 130 to 135 psi, max;
3. Use water from zone SF1 to provide water to the SCVWD reservoir either directly (pumping to zone

SF1 will not be possible in this configuration) or by floating the two reservoirs, while pumping to zone SC2.

c. Total Loss of both VW and SFPUC Supplies
    i. In the event both wholesale suppliers lose the ability to provide water to the City, the remaining supplies are limited to
        1. Storage at Ayer and Gibraltar;
        2. Pinewood, McCandless and Curtis Wells;
        3. Intercity Interties with ACWD and SJWC.
    ii. Pumping from storage would be the first recourse until the other two options are brought online. Ayer can supply water from the center of zone SF2. Gibraltar can provide water to zones SF1 and SC2.
    iii. Pinewood Well can pump to zone SF1 directly. Future options may allow it to pump to zone SC1.
    iv. McCandless Well, when completed, will be able to pump directly to zone SC1.
    v. Curtis Well, if completed, will be able to pump to any of the following:
        1. Gibraltar Pump Station, either or both reservoirs;
        2. Zone SF2;
        3. Zone SC2; or
        4. Zone SC1
    vi. Intercity Interties with ACWD can provide water to zones SF1 and SF 2 if ACWD has water to provide, along the City's north border.
    vii. An Intercity Intertie with SJWC can provide water to zone SF2 along the southeast border of the City if SJWC has water to provide and the zone pressure in our zone SF2 is low enough to accept water from SJWC.

d. Loss of Well Supplies
    i. Currently, the only well capable of supplying water to the City is Pinewood Well. It is currently permitted as

an Emergency Standby Well. Loss of this well would remove it from the options to provide water in the scenarios listed previously.

ii. Once all three of the City's wells are completed and brought into service as everyday supplies, the loss of supply from these wells would increase the amount of water the City would pull from its wholesale providers, which could have contract implications. In the event of an emergency, the loss of these wells as backup water supplies would eliminate the ability of the City to have an independent water supply under its control and eliminate this option as a means to provide water under any of the other emergency scenarios listed previously.

2. Pump Station Issues
    a. Loss of PG&E Power
        i. Ayer
            1. Ayer Pump Station is equipped with a 1,000 KW Caterpillar Genset which is capable of automatically starting and completely powering the station and all three pumps in the event of the loss of outside power.
            2. The station has a 1,000 gallon (900 gallon useable) above ground fuel storage tank that is capable of running the station for 24 hours before requiring refueling.
        ii. Gibraltar
            1. Gibraltar Pump Station is equipped with a 2.5 MW Genset which is capable of automatically starting and completely powering the pump station and all pumps in the event of the loss of outside power.
            2. The station has a 10,000 gallon (9,000 gallons useable) above ground fuel tank that is capable

of running the genset for 72 hours before refueling would be required.

3. The station also has 3 diesel powered pumps which can run independently with local controllers even if the station has no power. Pump 2 can be used to pump to zone SC2, pump 3 can be used to pump to zone SF1, and Pump 7 can be used as a booster to pump water directly from the SCVWD turnout into zone SC2.

iii. Hillside

1. All three Hillside stations are reliant on PG&E power for operation. All three do have a UPS battery emergency supply that will maintain power to the control panel and communications only.
2. Country Club and Tularcitos pump stations have a quick connect transfer switch mounted on the outside of the control building enclosures to be used with a portable trailer genset in the event of a power outage.
3. Country Club and Tularcitos also have pumper connections that can be used with either a trailer mounted portable pump or with a fire truck to act as emergency pumps and bypass the station to pump water to the next station. The City has a portable Paco trailer mounted pump with a capacity of approximately 1,000 gpm that can be used at either station.

iv. Wells

1. Pinewood well is not currently set up to easily take power from a portable generator set, nor does it have any installed backup power generator set. Loss of PG&E Utility power will render the well essentially inoperable and unable to serve water into the distribution system.

2. McCandless Well is being designed with a quick connect backup power transfer connection switch similar to the Hillside pump stations and should be operable to at least serve water on an emergency basis.
3. Curtis Well will likely be designed to the same standard as McCandless and able to use a portable generator as backup power to serve water on an emergency basis.

b. Loss of Water Supply
   i. Gibraltar
      1. Gibraltar Pump Station has three water supply sources:
         a. 42" pipeline from VW, known as the Milpitas Pipeline or the East Pipeline;
         b. 24" distribution line from Zone 1SF which can draw water from Main Street Turnout PRVs and Milpitas PRV (the Zone 1SF connection to the Calaveras Turnout);
         c. 10" connection to the VW/SFPUC Intertie which we call the Intertie Turnout, and normally draws SF water and is closed when VW is using the Intertie to send water to SFPUC.
      2. Virtually any of these supplies can be used to support the loss of any other supply through the use of valving at the pump station and/or the use of the two reservoirs onsite. The pump station was designed with versatility in mind, both in the manner and number of pump installations and in the use of valves and bypass pipelines. There are too many combinations possible to list them out individually. Here we will list the general possibilities – the Operator is encouraged to

carefully examine the potential water pathways for each situation to arrive at the best possible solution and to ensure no harm will be done.

3. Loss of the 42" VW supply:
    a. Intertie supply can be used through the Intertie PRV by setting to its highest pressure setpoint and closing the normally open connection to Zone 1SF and then opening the normally closed connection to Zone 2SC - PRV will support about 130 – 135 psi, so zone will run at a slightly lower pressure - the SF reservoir cannot be filled while in this mode;
    b. Booster or Peak Shaving pumps can be used to supply water from storage by using a Flow Through setup to supply the reservoir from Zone 1SF – Pumps can be run in conjunction with the Intertie PRV by setting the pumps to the same pressure as the PRV or the pumps can run in lead at a higher pressure with the Intertie PRV acting as a backup supply. Pumps 3 and 4 cannot be used to pump water from the SF reservoir while supplying water to the SC reservoir from zone 1SF.
    c. The 30" suction lines from the two 5 MG reservoirs can be linked together by opening valve BFV 101 between pumps 2 and 3. The level between the two reservoirs should be as close to the same as possible – the larger the difference between them, the higher the water velocity will be as valve BFV 101 is opened and the levels begin to equalize. This

method allows filling to occur through the SF reservoir from either zone 1SF or the Intertie PRV.

4. Loss of 24” zone 1SF line supply:
    a. Use the Intertie supply to fill reservoir and supply zone 1SF directly. Do not run pump 4 or 3 at the same time as filling the reservoir from zone 1SF, water will only recirculate and not supply the zone.
    b. Use the SC reservoir by opening valve BFV 101 to equalize the SC and SF reservoirs. See 2.b.i.3.c. above for caveats about opening valve BFV 101.
    c. Use the zone 2SC supply by closing valve BFV 020 and then opening valve BFV 021A to fill the SF reservoir from zone 2SC and use pump 4 and/or 3 to supply zone 1SF. This CANNOT be used to directly supply zone 1SF from zone 2SC due to the higher pressure.
5. Loss of 10” VW/SFPUC Intertie supply
    a. This supply is normally only used when the Intertie is not being used to send water from VW to SFPUC or vice versa. Normal configuration sends SFPUC water through this connection to our zone 1SF. Loss of this supply is made up from the 18” connection to zone 1SF which draws water through the distribution system from the low pressure supply PRV at Main St turnout and/or the Milpitas PRV, which is a nearly direct connection to the Calaveras Turnout.
    b. If it is not possible to fill the SF reservoir through the distribution system connection

to zone 1SF, there is a normally closed connection to zone 2SC which can be used to fill the SF reservoir. Since this is a high pressure zone, it cannot be used to directly supply zone 1SF – this must be done through use of pumps 3 and/or 4.

c. An additional method to use VW water to supply zone 1SF is to open the 30” isolation valve between the two reservoirs so they are both filled from the VW supply and use pumps 3 and/or 4 to send water to zone 1SF.

ii. Ayer

1. Ayer is supplied solely from zone 2SF. The station currently has a single inlet/outlet design, so water can only flow one way into or out of the station at any given time, meaning the station can pump out water or fill the reservoir, but cannot do both at the same time.
2. Calaveras Turnout is the main source of supply to Ayer pump station via large mains that come directly east on Calaveras Blvd from the Calaveras Blvd turnout and valve lot.
3. Loss of supply to Ayer would only occur if there were a loss of the pipeline that supplies the station from Calaveras Blvd, or if that segment of line was not in operation. There is no alternative supply for Ayer in either of those events, and Ayer would not be able to pump water out to the system, regardless of the quantity of water in storage.
4. A CIP project to provide a secondary pipeline connection from zone 2SF to the station has been proposed, but is not currently in design or under construction.

iii. Hillside

1. The Hillside, or La Questa, water system has only a single supply source – zone 2SF. Water is supplied from system pressure in zone 2SF to Country Club Pump Station. CCPS then pumps water into zone 3SF through a 12 inch transmission and distribution line via 2 250 gpm submersible vertical turbine pumps. This line both supplies the zone and delivers water to a 350,000 gallon reservoir (Tularcitos) at the top of the zone. This reservoir provides gravity pressure to the zone when the pumps are not in use.
2. There is no alternative source of supply if water cannot be delivered from zone 2SF to CCPS. If CCPS experiences failure that results in neither of the 2 pumps being able to pump water, then a backup potable water trailer pump must be brought in to act as the pump station. This pump would hook up to a fire hydrant at the pump station that would provide water from zone 2SF to the suction side of the trailer pump, and then the discharge line from the trailer pump would be connected to a special pumper connection designed for this purpose to provide water to zone 3SF. If the trailer pump is not available for some reason, a fire engine pumper can also be used.
3. Tularcitos reservoir and pump station is the next step in the Hillside water system. Tularcitos Pump station is nearly identical to CCPS in that it has 2 250 gpm submersible vertical turbine pumps that send water from zone 3SF and/or the Tularcitos Reservoir and deliver it into a 12 inch combination distribution/transmission line that

serves zone 4SFa and Minnis Reservoir. Minnis Reservoir provides gravity head and flow for zones 4SFa and 4SFb.

4. Loss of the pumps at Tularcitos would result in the loss of water supply to Minnis and zones 4SFa&b. Use of a trailer pump would be needed to replace the function of those pumps, similar to CCPS. Supply would come from a connection on the Tularcitos Reservoir, and discharge would be connected to a special pumper connection, similar to CCPS, to supply water to zone 4SFa and Minnis Reservoir.
5. Loss of the Tularcitos Reservoir would result in the loss of gravity supplied water to zone 3SF. There are two ways to compensate for this reservoir being out of service.
    a. At CCPS there is a pressure relief valve located in a vault with a manhole cover between the fenced pump station and Country Club Drive. This pressure relief valve is specifically there to enable the CCPS pumps to be run constantly to supply water to zone 3SF at a constant pressure. The pumps at CCPS are single speed pumps and cannot be ramped up and down to respond to demand changes in the zone to maintain a constant pressure. Instead, the relief valve will open at a set pressure to relieve the excess discharge from the pumps back into zone 2SF. This is not a perfect solution because the water discharged back into zone 2SF simply returns to the suction side of the CCPS pumps, thus running in a circle, and will result in the water being heated

and boiled by the pumps if not relieved. The solution to this is to use hoses to run a constant flow from hose bib connections on the discharge of each pump to the storm drain so that a minimal flow of new water is always coming into the pumps to keep them cool.

b. The other method to replace the supply from Tularcitos Reservoir is to use a combination pressure relief valve/pressure reducing valve located at Tularcitos Pump Station. There is a double leaf hatch covered vault with this valve located within. This valve has dual pilot valve systems installed on it, and normally uses the pilot valve system that is configured to run the valve as a pressure relief valve. This pilot system must be shut down, and the pilot valve system on the other side opened to configure the valve as a pressure reducing valve. This valve is connected to zone 4SFa and zone 3SF. As a relief valve it opens to relieve excess pressure from zone 4SFa to zone 3SF. As a pressure reducing valve, it opens to maintain use water from zone 4SFa/Minnis Reservoir to maintain a set pressure in zone 3SF, thus doing what Tularcitos reservoir was doing. This is the preferred method to use when Tularcitos Reservoir is not in service to maintain pressure in zone 3SF.
c. Getting water from zone 3SF to zone 4SFa/Minnis when Tularcitos Reservoir is not in service is different depending on

which method you are using to maintain pressure in zone 3SF. If telemetry is still working between Minnis and Tularcitos, the pumps at Tularcitos will cycle according to the level in Minnis reservoir and can be left to run on their own if using the CC pump method in a. above. The pumps at CC will supply water to the pumps at Tularcitos. Only one pump at Tularcitos should be used in auto to fill Minnis so that the capacity of the CC pumps are not exceeded. If using the pressure reducing valve method in b. above to maintain zone 3SF pressure, the pumps at CC and at Tularcitos will need to be run manually and at the same time. The level at Minnis will need to be monitored, and the pumps both shut down at the same time.

6. Loss of the Minnis Reservoir will result in the loss of gravity pressure and flow for zones 4SFa&b. This is compensated by using the combination relief and pressure reducing valve at Tularcitos in a manner similar to using the relief valve at CC when Tularcitos Reservoir is offline. With the combo valve operating on the pressure relief pilot system the pumps can be used to maintain the pressure in the system. Similar to the CC method, hoses need to be connected to the hose bibs on the discharge side of the pumps in order to keep a minimum flow through the pump and prevent the water from recirculating through the pump and overheating/boiling. See 5.a above.

3. Distribution System Issues
    a. PRV Station Loss/Malfunction
        i. Pressure Reducing Stations take water from a higher zone and feed it into a subsequent zone at a lower pressure. They are both a source of supply and pressure regulator. When I PRV fails, it will usually show signs before having a catastrophic failure. The regulated pressure will begin to increase and become more difficult to control to the desired set point. A gradually rising pressure on the regulated downstream side of the PRV can be a sign that the valves main diaphragm has a pinhole in it and needs to be replaced. It can also be a sign that the pilot valve is failing. If a PRV has failed or needs to be taken out of service the valve can usually be isolated by closing the up and down stream line valves and allowing the lag PRV to take over the load, assuming there is a lag PRV – most stations are configured with lead/lag parallel valves, but not all of them (Capital Ave and Parc Metro, for instance). If a valve does not have a parallel lead/lag to take over, the system balance may need to be adjusted by checking the other PRV stations and making minor pressure setpoint changes. Since possible flow direction changes may occur in the distribution system, this may result in dirty water calls and the need for flushing/NO-DES use to respond to the water flow changes.
    b. EPRV Station Loss Malfunction
        i. The EPRV stations are single PRVs set to allow water to move from SF zones into corresponding SC zones in the event that pressure falls in the SC zone below the minimum setpoint of the EPRV. When this happens, the EPRV will open and allow water to flow from the SF zone to the SC zone and will try to regulate the SC zone toe the EPRV setpoint pressure. Malfunction of an

EPRV will not result in overpressure of any zone, since the served zone is normally higher than the supplying zone, and water cannot flow in reverse through a PRV, even if it has failed. Loss of the function of this station only results in the loss of protection for the served zone in the event that zone incurs a pressure reduction. Zone isolation valves can be opened to directly supply water from the SF zone to the SC zone if needed as an alternative to the EPRV.

c. Zone Interconnection
   i. There are 44 zone isolation valves throughout the City. These are valves that were closed when the City went from being solely supplied by SFPUC to being supplied by both SFPUC and SCVWD (VW). There valves were marked by using large G12 valve boxes and painting them red. The are only to be opened in the event a zone has a supply failure that results in the loss of supply and pressure and all other means of supplying the zone are not available. Opening of these valves will need to be accompanied by flushing of the lines up and downstream and there will likely be dirty/stagnant water.

d. Agency Interconnection
   i. Milpitas has 3 intercity interties, two with ACWD and one with SJWC. Similar to the zone isolation valves, use of these valves is a last resort emergency response measure. Pressures are not the same between the separate agencies, and use must be coordinated between both agencies before opening the valves.
   ii. Connections with ACWD are located with one in zone 1SF on Milmont and one in 2SF on Churchill. The connection with SJWC is located in zone 2SF at the south end of the zone on Landess Ave.

Appendix C

Hydrant Testing and HPR Placement Plan

MEMORANDUM

DATE:	March 9, 2020	Project No.: 270-60-19-16 SENT VIA: EMAIL
TO:	Harris Siddiqui, PE, City of Milpitas Glen Campi, City of Milpitas	
FROM:	Roger Chu, PE, RCE #87591	
REVIEWED BY:	Amy Kwong, PE, RCE #73213	
SUBJECT:	City of Milpitas – 2020 Water Master Plan Update – Hydrant Testing and HPR Placement Plan	

This memorandum summarizes the proposed hydrant testing and pressure data collection procedures required to calibrate the City of Milpitas's (City) potable water system hydraulic model. West Yost Associates' (West Yost) recommended plan for hydrant testing and hydrant pressure recorder (HPR) placement is provided for your review and comment, as summarized in the following sections:

- Hydrant Testing
- Hydrant Pressure Recorder Placement
- Summary of Hydrant Testing and HPR Placement Plan

It is recommended the City shares this plan with the appropriate parties (e.g., water operations and/or Fire Department staff), so they are aware of the equipment being used or installed at the proposed testing/pressure monitoring locations. Field pressure monitoring is scheduled to occur beginning March 10 through March 18 (monitoring period), and hydrant testing is scheduled for March 11, 2020.

HYDRANT TESTING

The purpose of hydrant testing is to confirm the assignment of roughness factors (C-factors) to pipelines in the City's hydraulic model. West Yost will use data collected though hydrant testing to ensure the assigned pipeline C-factors are appropriate and representative of actual field conditions. Hydrant tests were selected based on the combination of pipeline material type, diameter, and age that represents the majority of the City's water distribution system.

Details related to hydrant testing are presented in the following sections:

- Personnel and System Data Requirements
- Hydrant Testing Schedule
- Testing Requirements and Procedure
- City's Responsibilities

Personnel and System Data Requirements

West Yost would like to request the following City personnel and system data to accomplish the recommended hydrant testing under West Yost's direction:

- Three (3) to five (5) City staff members (with vehicles) that will be available during regular working hours to assist with, but not limited to the following:
  - Closing and re-opening valves, as needed, before and after hydrant testing
  - Reading and recording hydrant pressure data
  - Flowing the test hydrant and de-chlorination
  - Directing and controlling traffic and hydrant flows (i.e., to the nearest drainage inlet) to ensure safety
  - Public outreach and interface, as needed
- System information during the monitoring period that includes the following:
  - Available SCADA and telemetry data from all water distribution system facilities:
    - Turnout flows and pressures
    - Reservoir levels [feet]
    - Booster Pump Station information (pump operational status, speed settings, discharge pressures [psi], and flow rate [gpm])
    - Pressure Reducing Valve information (upstream pressure [psi], downstream pressure [psi], and flow rate [gpm], if available)

Hydrant Testing Schedule

West Yost requests that hydrant testing be scheduled from **7:30 AM to 4:30 PM on March 11, 2020**. West Yost will meet with the City staff before hydrant testing at the City's Public Works Department, located at 1265 North Milpitas Boulevard, to conduct a brief field coordination meeting to review hydrant testing procedure and protocol (i.e., where to go and what to do). West Yost will also use this coordination meeting to distribute pressure gauges necessary to complete hydrant testing (hydrant wrenches to be provided by City staff). In addition, West Yost will also discuss with City staff what order they prefer to conduct tests (i.e., avoid school traffic or commuter traffic, etc.) and to review hydrant tests that may present challenges.

Testing Requirements and Procedure

West Yost plans to conduct up to ten (10) hydrant tests within the City's water system. Figure 1 shows the proposed hydrant test locations. In addition, four (4) alternative hydrant tests have been identified. If any of the primary test locations are unable to be completed, an alternative location may be used. Table A-1 in Attachment A lists the proposed test locations. Details regarding each of the proposed tests (e.g., flowing hydrant, observation hydrants, closed valves, etc.) is also provided in Attachment A (Figures A-1 through A-14).

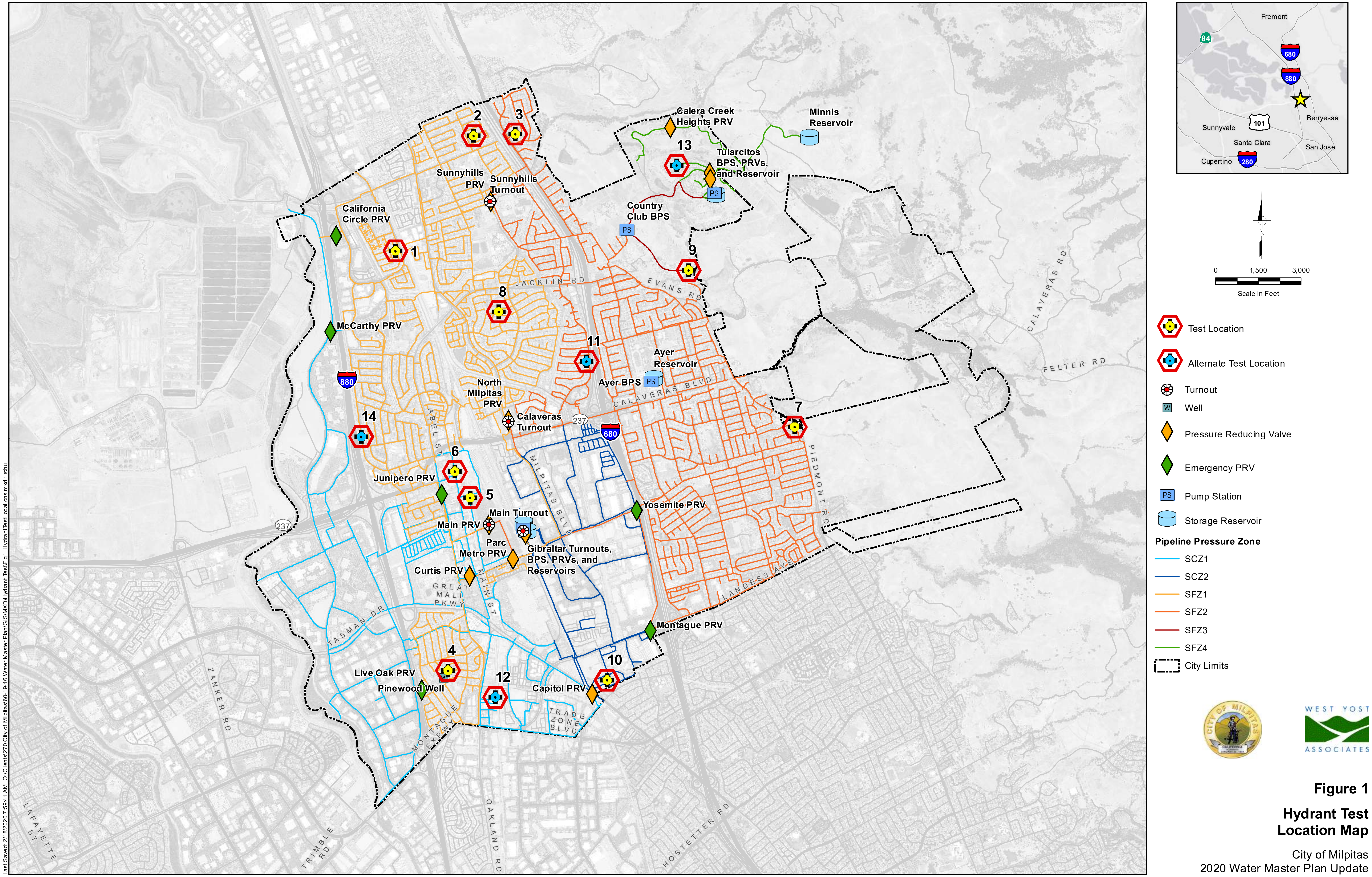


Figure 1

Hydrant Test Location Map

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Each hydrant test will involve maintaining flow from a single hydrant while monitoring the residual pressure at two (2) to four (4) observation hydrants located near the flowing hydrant. The field-observed static and residual pressure readings will then be used to confirm pipeline C-factors to calibrate the hydraulic model to observed conditions. Hydrant test locations have been selected to isolate pipelines of a particular material type, diameter, and age. Some tests will require City staff members to close one (1) or more isolation valves prior to the test and then re-open these isolation valves following the test.

The general testing procedure at each of the hydrant test locations is outlined below and illustrated on Figure 2:

Step 1. Before attaching the pressure gauge, flush the test (flowing) hydrant and each observation hydrant to remove sediments, which might damage the gauge or cause faulty readings.

Step 2. Attach the pressure gauge to the hydrant with the gauge's test cock valve open. Slowly open the hydrant and bleed off the gauge with the gauge's test cock until the hydrant is fully pressurized.

Step 3. Close the gauge test cock valve, and then measure the static pressures at the designated test hydrant and each observation hydrant.

Step 4. Flow the designated test hydrant and measure the discharge flow and pressure.

Step 5. Measure the residual pressures at the designated test hydrant and at each observation hydrant while the test hydrant is flowing.

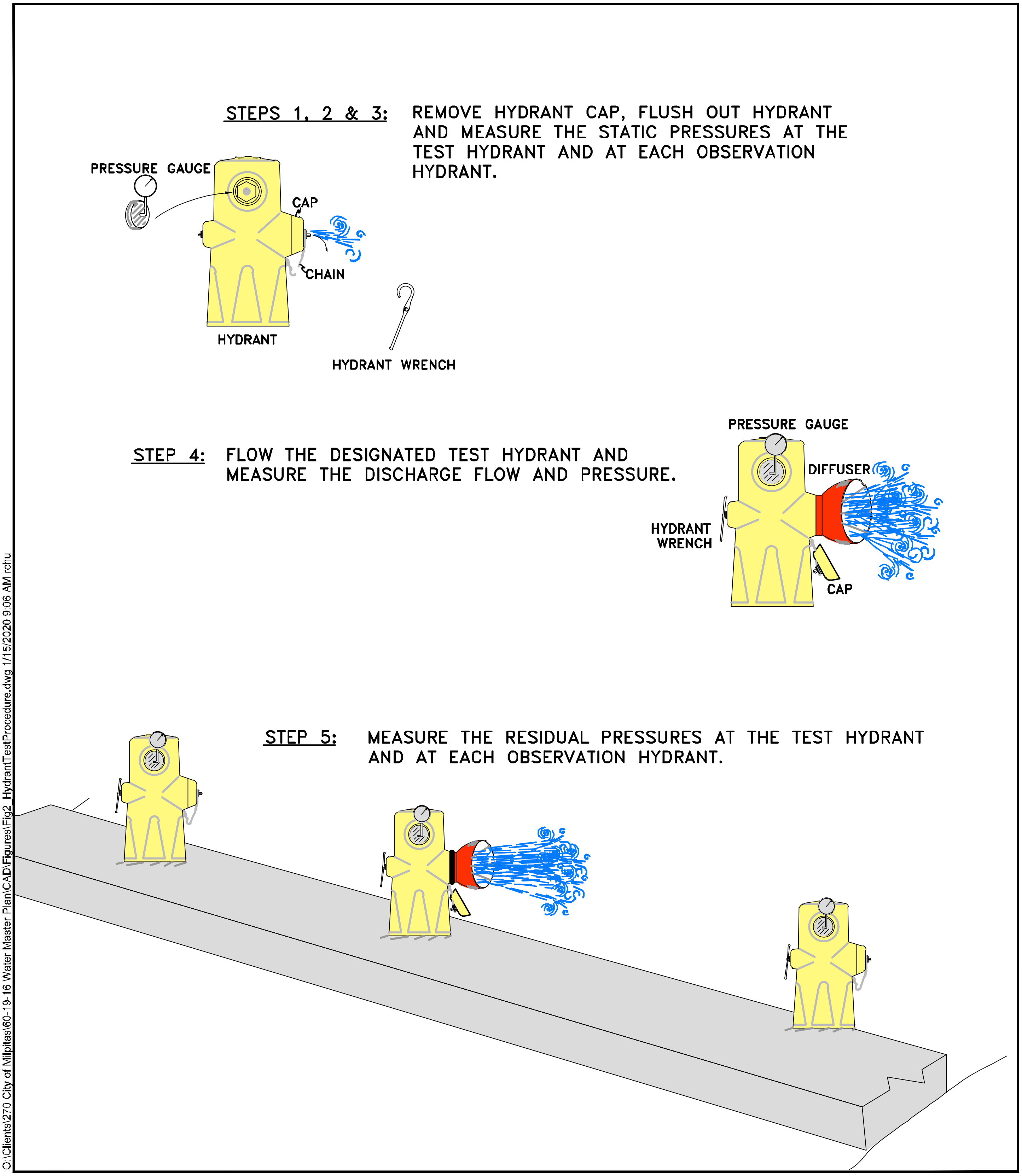
Step 6. Continue monitoring pressure until the "all clear" is given by a West Yost employee. Record the static pressure and then detach the pressure gauge. ***IMPORTANT:*** *Before closing the hydrant, be sure the gauge's test cock valve is open and bleeding while the hydrant is being closed.*

At least one (1) City staff member will be required at the flowing test hydrant and up to two (2) additional City personnel will be required in the field to assist with the opening and closing of valves (refer to Attachment A). West Yost will provide three (3) staff members to direct, oversee, and assist in the field data collection work effort.

It is anticipated that each hydrant test will take no more than 30 minutes and that each hydrant will be flowing for no more than 10 minutes during a test.

Testing Equipment

West Yost will provide a 4.5-inch diameter Swivel Piezo Diffuser and pressure gauges during the hydrant testing program. It is our recommendation that the 4.5-inch diameter Swivel Piezo Diffuser be used for all proposed hydrant tests. For any hydrant test where is it not possible to use this type of diffuser due to drainage or traffic control issues, an alternative method will need to be further evaluated and confirmed before the day of field testing.



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Note:
1. Figure is not to scale.

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Figure 2

Hydrant Test Procedure

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City's Responsibilities

The City will be responsible for providing the following hydrant testing equipment:

1. Vehicles
2. Hydrant wrenches
3. Equipment for closing valves and controlling traffic
4. De-chlorination equipment[1]
5. Two-way portable communication for each testing personnel

The City is also responsible for notifying residents, and other City staff and departments (i.e., Fire Department) about the scheduled hydrant testing, obtaining approvals that may be required, and providing proper drainage of the hydrant flow.

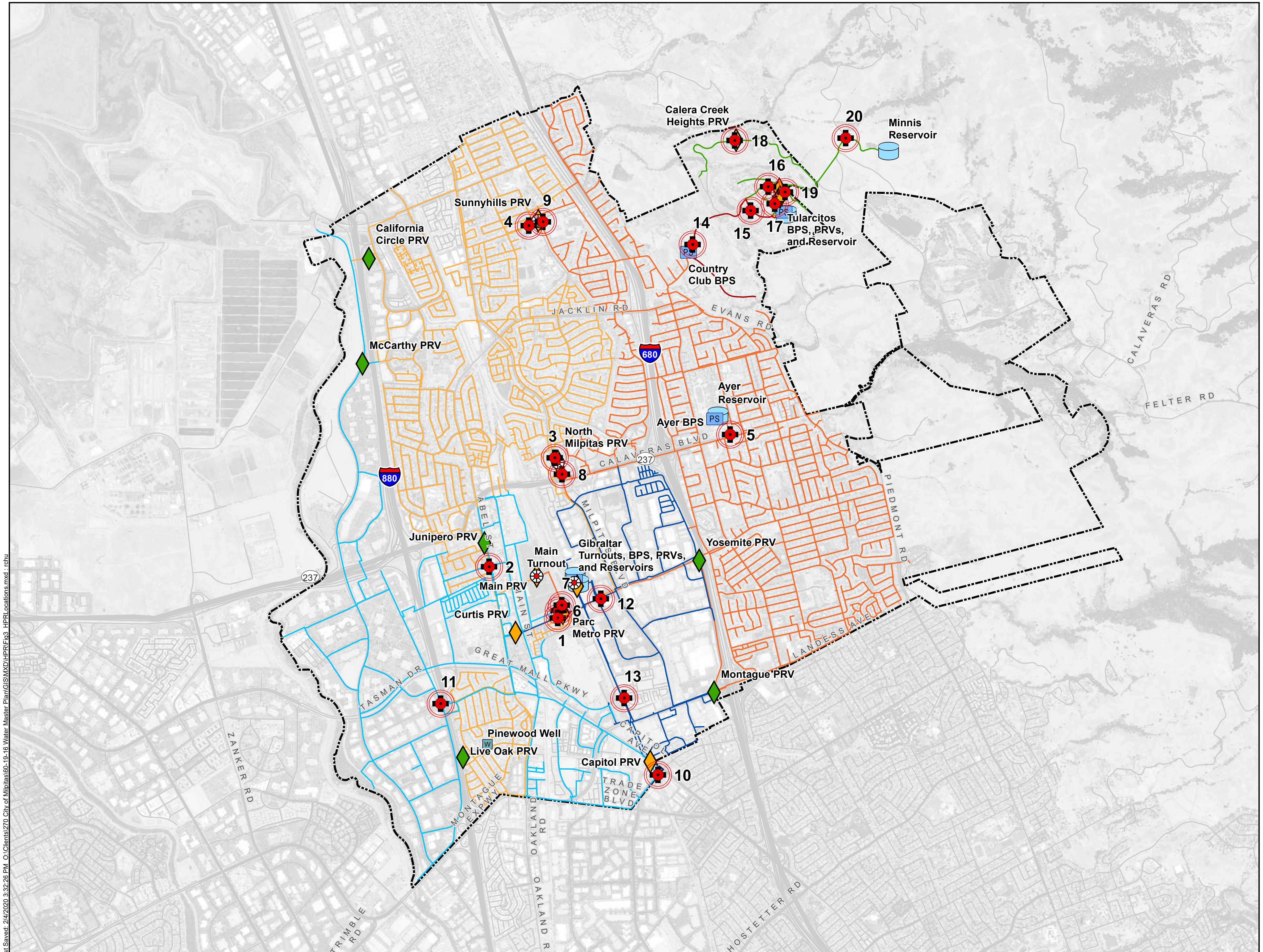
West Yost requests that the City staff review and inspect each of the proposed test locations before the testing date to identify any potential problems or hazards with the selected locations. Of concern is the potential for flooding landscaping or building basements or creating hazardous traffic conditions. West Yost recommends that all drainage inlets/manholes be inspected near the testing site to confirm proper drainage. Additionally, the City should check the location and status of hydrants and valves that will be operated during hydrant testing. Detailed figures, which illustrate the flowing hydrant, observation hydrants, and valves to be closed, are provided in Attachment A.

HYDRANT PRESSURE RECORDER PLACEMENT

Placement of HPRs at key hydrants within the City's water system allows West Yost to verify pressures simulated in the City's hydraulic model. West Yost has identified twenty (20) hydrants to monitor water system pressures with HPRs. The selected HPR locations are typically downstream of water supply facilities (e.g., turnouts, booster pump stations, and pressure reducing valves).

West Yost is proposing to install the twenty (20) HPRs on March 10, 2020 to collect pressure information for a total of one (1) week. West Yost plans to attach the HPRs to the 2.5-inch port on specified hydrants and lock them in place with a padlock. After the seven-day monitoring period is complete, West Yost will remove the HPRs from their locations (March 18, 2020) and download and review the collected data. Figure 3 shows the general location of each HPR. Table B-1 (in Attachment B), describes the approximate location of each HPR and the water supply facility being monitored. Attachment B also includes detailed figures showing the specific location of each hydrant selected for HPR placement (Figures B-1 through B-20). West Yost requests that City staff review and inspect each of the proposed HPR placement locations before the placement date to identify any potential problems with the selected locations.

[1] Handling of water released from each hydrant test will need to comply with City Operations procedures and be consistent with the City's NPDES permit for planned releases from hydrant tests.



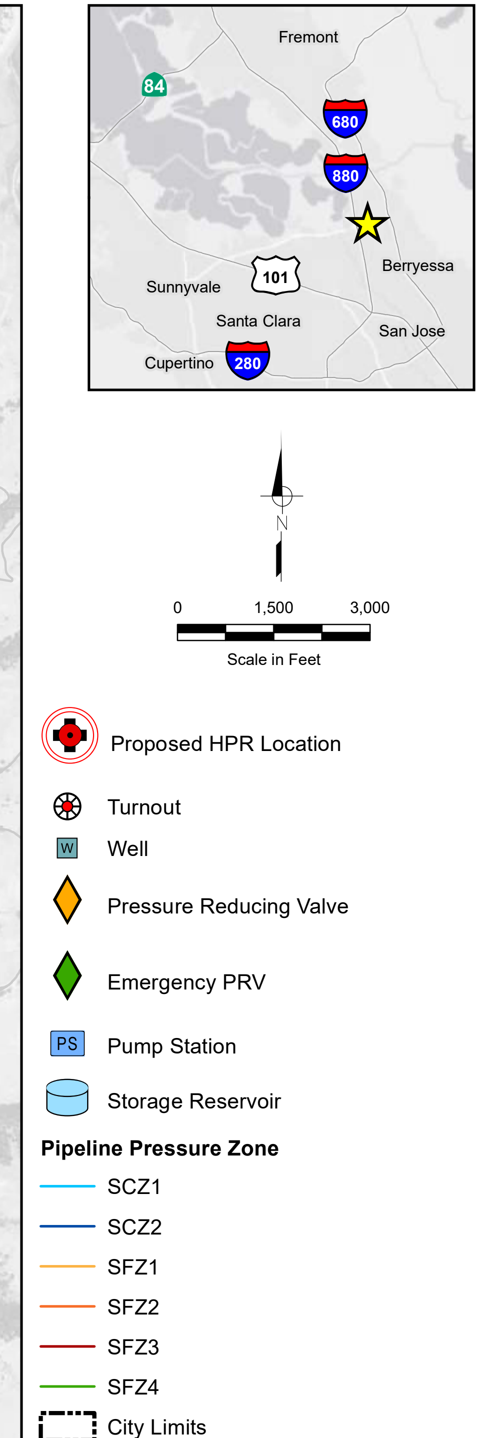


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Figure 3

Hydrant Pressure Recorder Location Map

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It is important for City staff to coordinate with the Fire Department and any other appropriate parties regarding the HPR locations and duration of monitoring. This will help reduce the chance of inadvertently shutting off a hydrant with an HPR installed and may also reduce the risk of an HPR being removed or tampered with. *Each HPR is equipped with a padlock and a set of keys will be provided to the City staff. However, in case of an emergency, the Fire Department can break the lock to remove the HPR.* If an HPR is required to be removed during a non-emergency, or if the associated hydrant needs to be shut off, West Yost requests that the Fire Department inform City staff and that City staff will then coordinate with West Yost.

SUMMARY OF HYDRANT TESTING AND HPR PLACEMENT PLAN

Hydrant testing will be performed as described above beginning at 7:30 AM on Wednesday, March 11, 2020. West Yost proposes to install HPRs on Tuesday, March 10, 2020 and remove them on Wednesday, March 18, 2020. The locations and associated detailed location maps of the designated hydrants for testing and HPR placement are presented in Attachments A and B, respectively.

West Yost requests a conference call with City staff on Wednesday, March 4, approximately one week before the scheduled testing day, to review and finalize preparations for the hydrant testing and HPR placement. An Outlook meeting request will be sent to City staff to finalize a suitable meeting date and time.

Please feel free to contact Roger Chu at (925) 425-5631 or Amy Kwong at (925) 461-6788 if you have any questions or comments.

ATTACHMENT A

Table A-1. Hydrant Test Locations[a]

Test No.	Pipeline Material	Installation Decade	Pipeline Diameter, Inches	Location	Pressure Zone	No. of Closed Valves	Comments
1	PVC	1990s	8	Along Elkwood Drive	SF1	1	-
2	AC	1960s	6	Along Gosser Street	SF1	1	-
3	AC	1980s	6	Along Stirling Drive and Stratford Drive	SF2	2	-
4	AC	1960s	6	Along Greentree Way	SF1	3	-
5	PVC	1980s	8	Along Hammond Way	SC1	1	-
6	AC	UNK[b]	8	Along Main Street	SC1	2	-
7	AC	1970s	8	Along Lacey Drive	SF2	1	-
8	AC	1970s	6	Along Clauser Drive	SF1	3	-
9	AC	1980s	8	Along Calaveras Ridge Drive	SF3	0	-
10	DI	2000s	8	Within Crossing at Montague Apartments	SC2	1	-
11	AC	1980s	6	Along Las Lomas Drive and Pacheco Drive	SF2	1	Alternate
12	PVC	2000s	8	Along Costa Street and Mihalakis Street	SC1	2	Alternate
13	AC	1980s	8	Along Pebble Beach Court	SF4-1	0	Alternate
14	AC	1960s	8	Along Heath Street	SF1	2	Alternate

(a) 10 test locations and 4 alternate test locations, if time permits.

(b) UNK = unknown

Flowing Hydrant
Observed Hydrant
Hydrant
Closed Valve (1 total)
Valve
Test Pipeline
Pipeline

0 150 300
Scale in Feet

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Figure A-1

Test 1 - Zone SF1 (8-inch PVC - 1990s)

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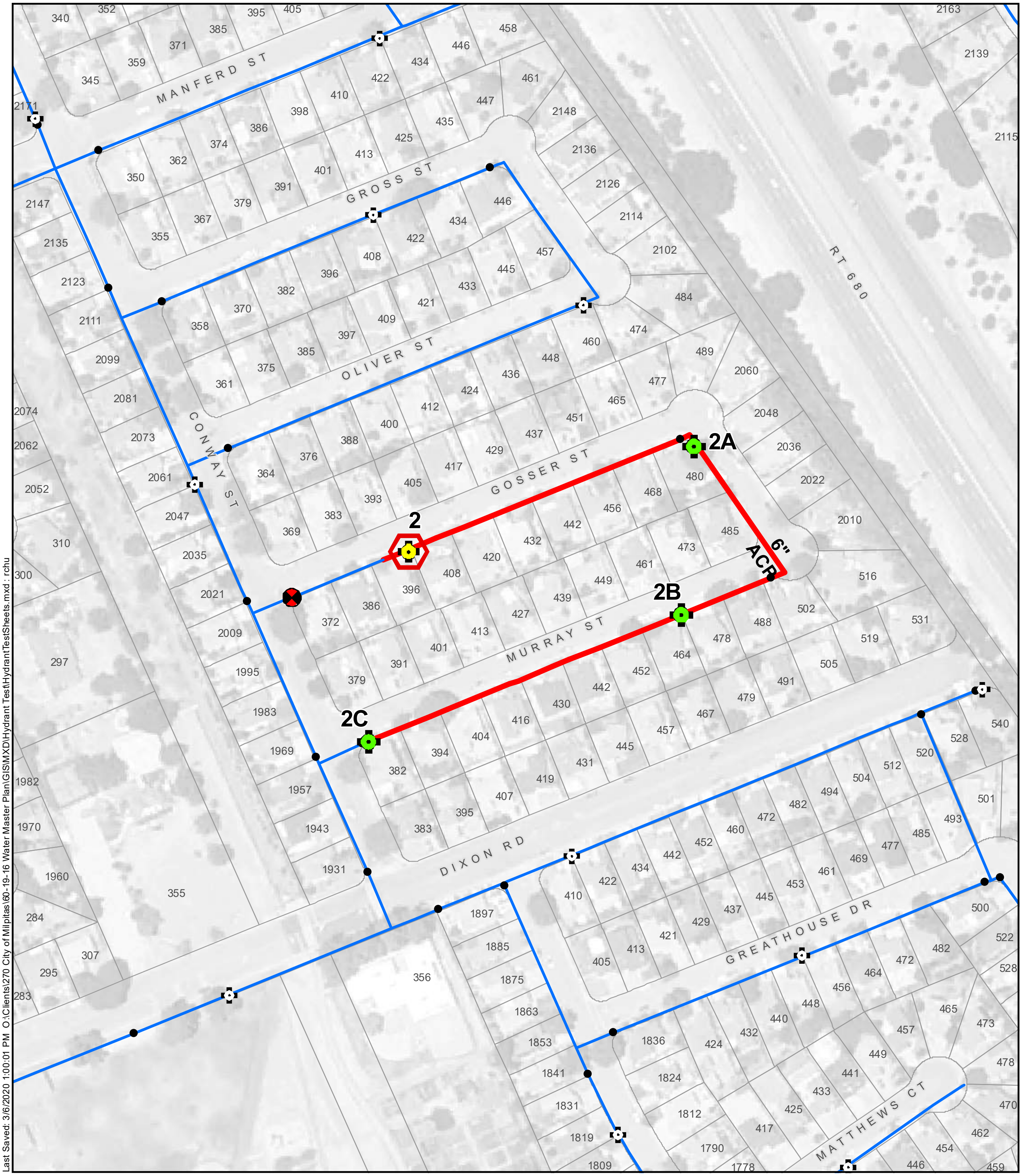

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Flowing Hydrant

Observed Hydrant

Hydrant

Closed Valve (1 total)

Valve

Test Pipeline

Pipeline

N

0 100 200

Scale in Feet

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Figure A-2

Test 2 - Zone SF1
(6-inch AC - 1960s)

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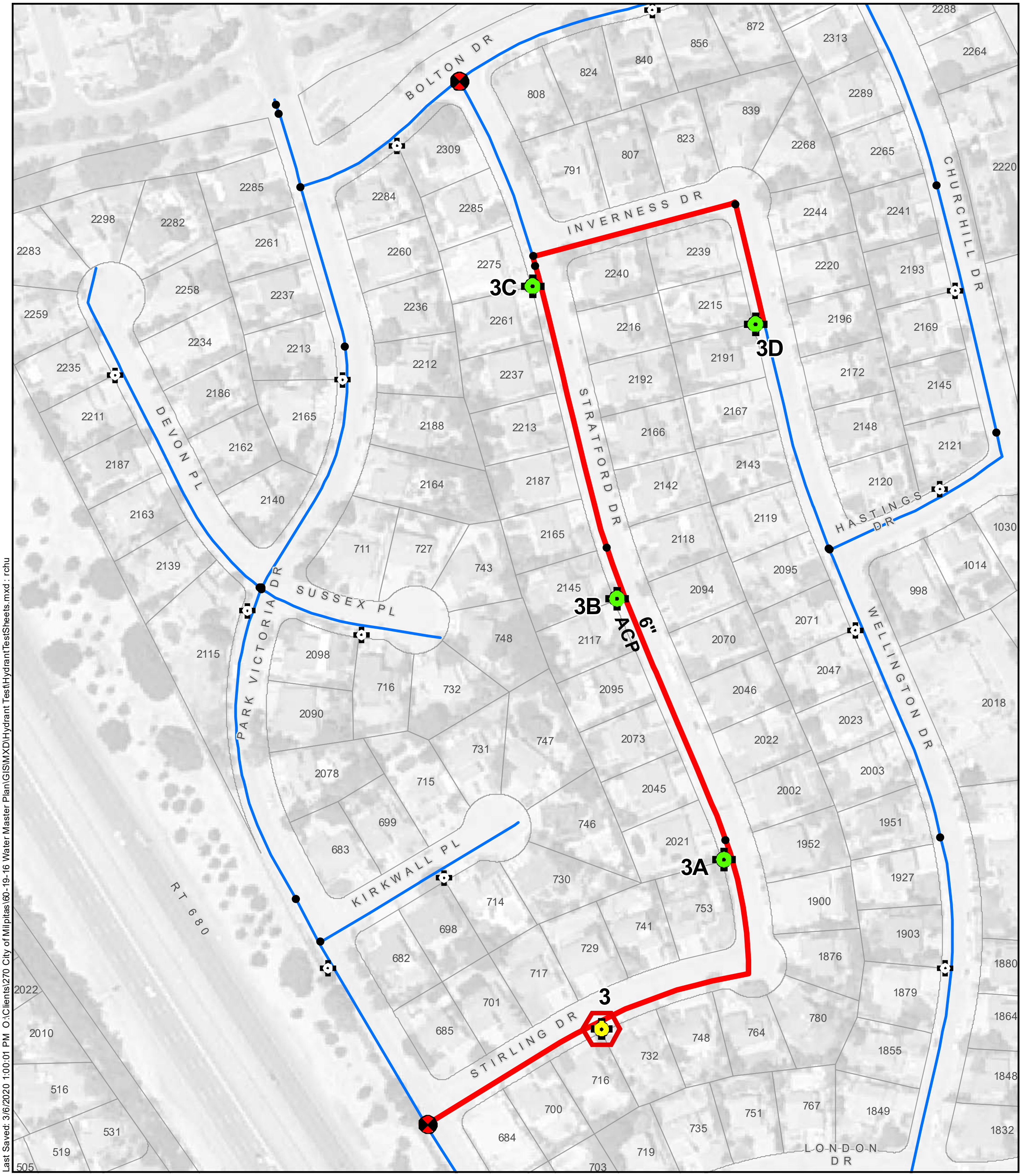

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Flowing Hydrant
Observed Hydrant
Hydrant
Closed Valve (2 total)
Valve

Test Pipeline
Pipeline

0 100 200
Scale in Feet

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Figure A-3

Test 3 - Zone SF2
(6-inch AC - 1980s)

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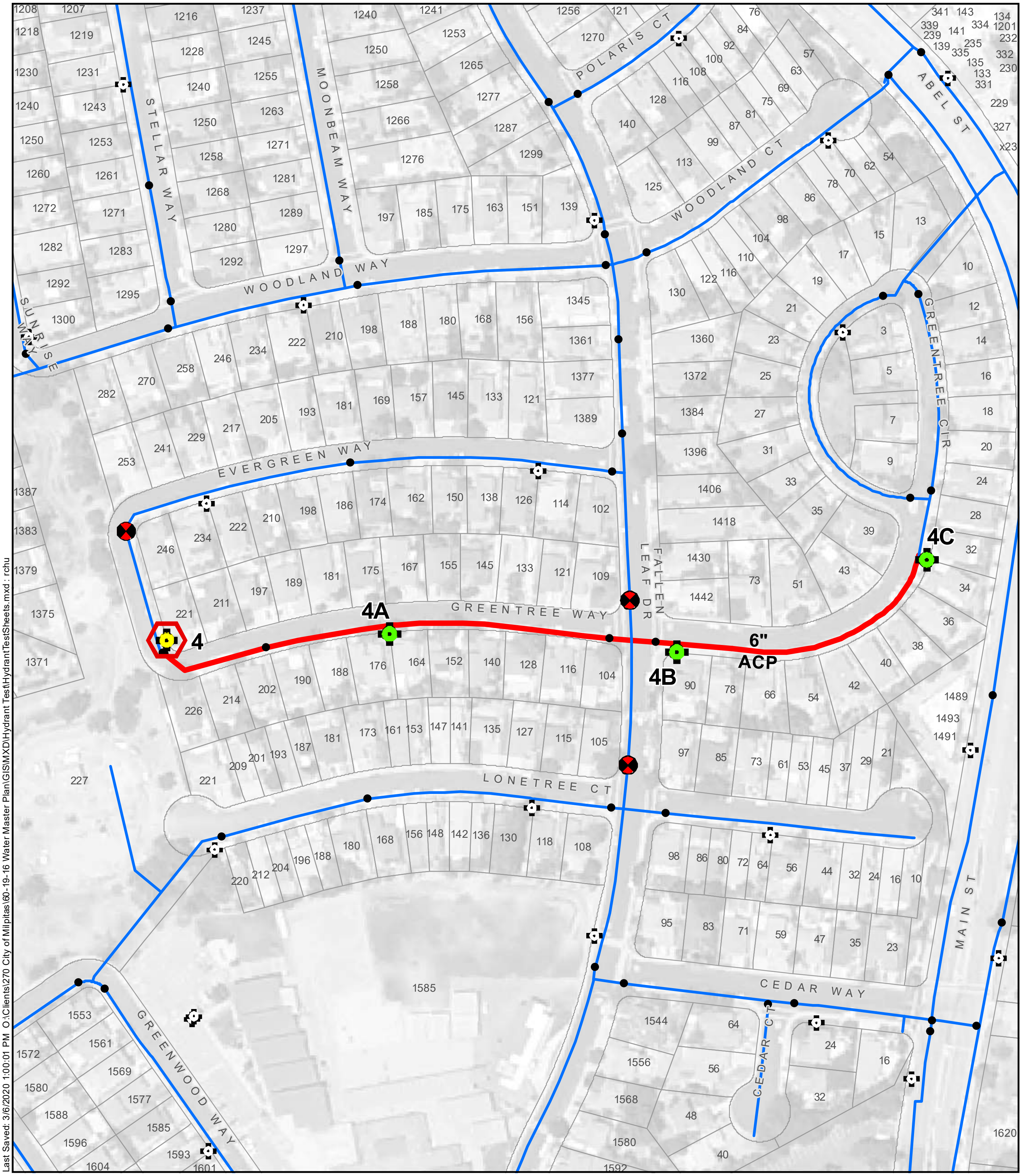

Flowing Hydrant

Observed Hydrant

Hydrant

Closed Valve (3 total)

Valve

Test Pipeline

Pipeline

N

0 100 200

Scale in Feet

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Figure A-4

Test 4 - Zone SF1
(6-inch AC - 1960s)

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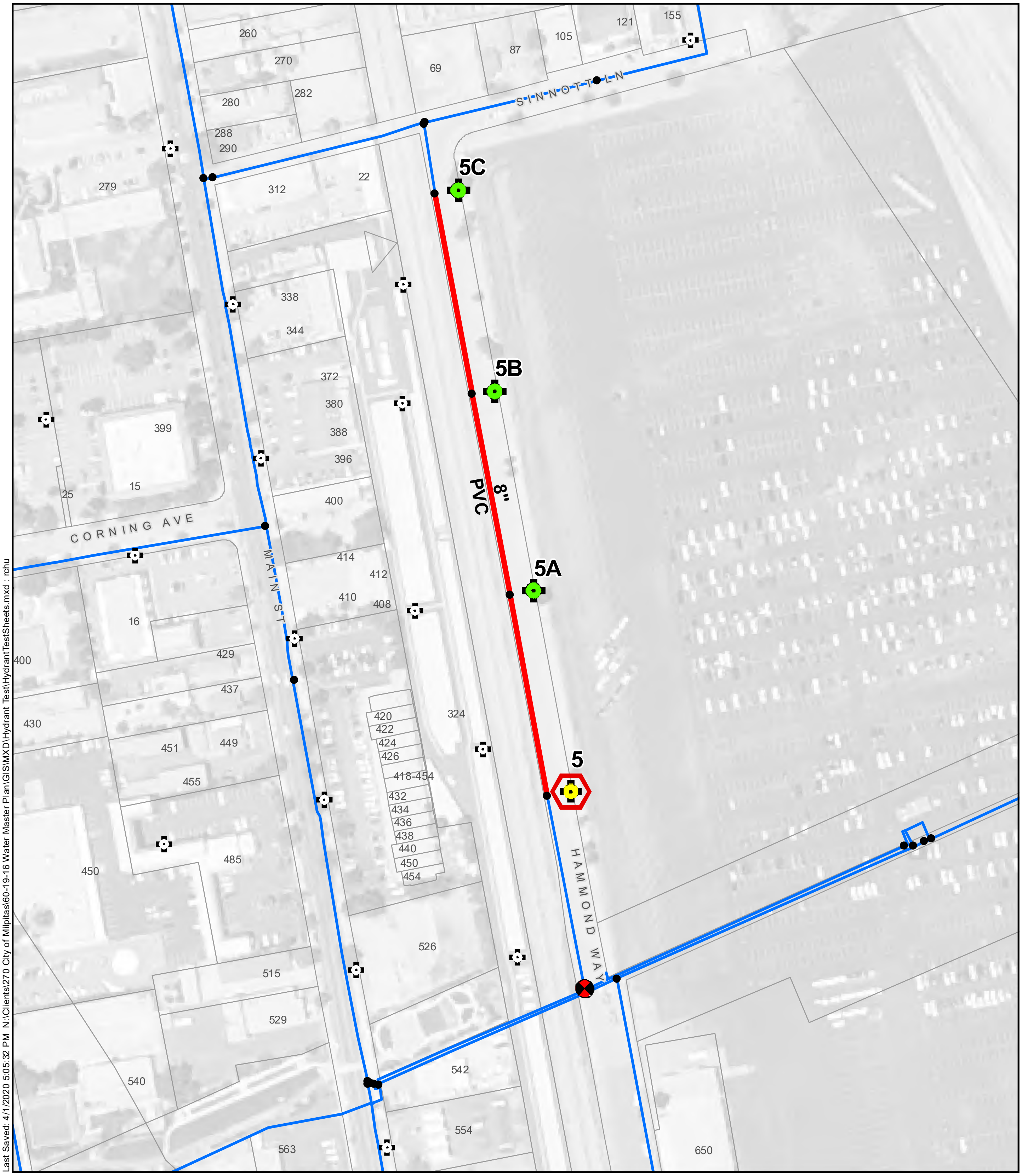

Flowing Hydrant
Observed Hydrant
Hydrant
Closed Valve (1 total)
Valve
Test Pipeline
Pipeline

0 100 200
Scale in Feet

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Figure A-5

Test 5 - Zone SC1 (8-inch PVC - 1980s)

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Flowing Hydrant
Observed Hydrant
Hydrant
Closed Valve (2 total)
Valve

Test Pipeline
Pipeline

N

0 75 150
Scale in Feet

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Figure A-6

Test 6 - Zone SC1 (8-inch AC - UNK)

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Flowing Hydrant
Observed Hydrant
Hydrant
Closed Valve (1 total)
Valve
Test Pipeline
Pipeline

N

0 150 300
Scale in Feet

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Figure A-7

Test 7 - Zone SF2
(8-inch AC - 1970s)

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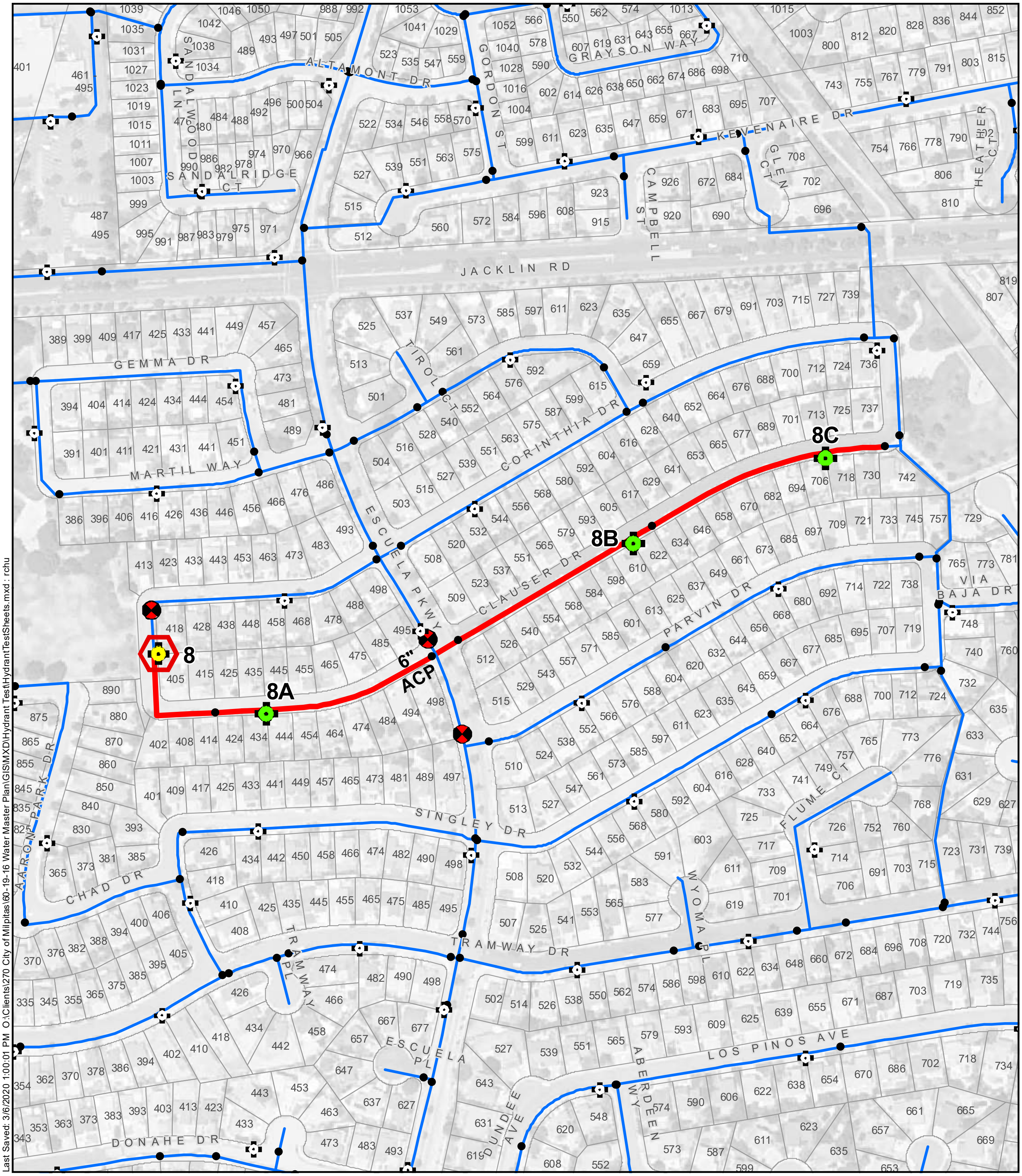

Flowing Hydrant
Observed Hydrant
Hydrant
Closed Valve (3 total)
Valve
Test Pipeline
Pipeline

N

0 150 300
Scale in Feet

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Figure A-8

Test 8 - Zone SF1
(6-inch AC - 1970s)

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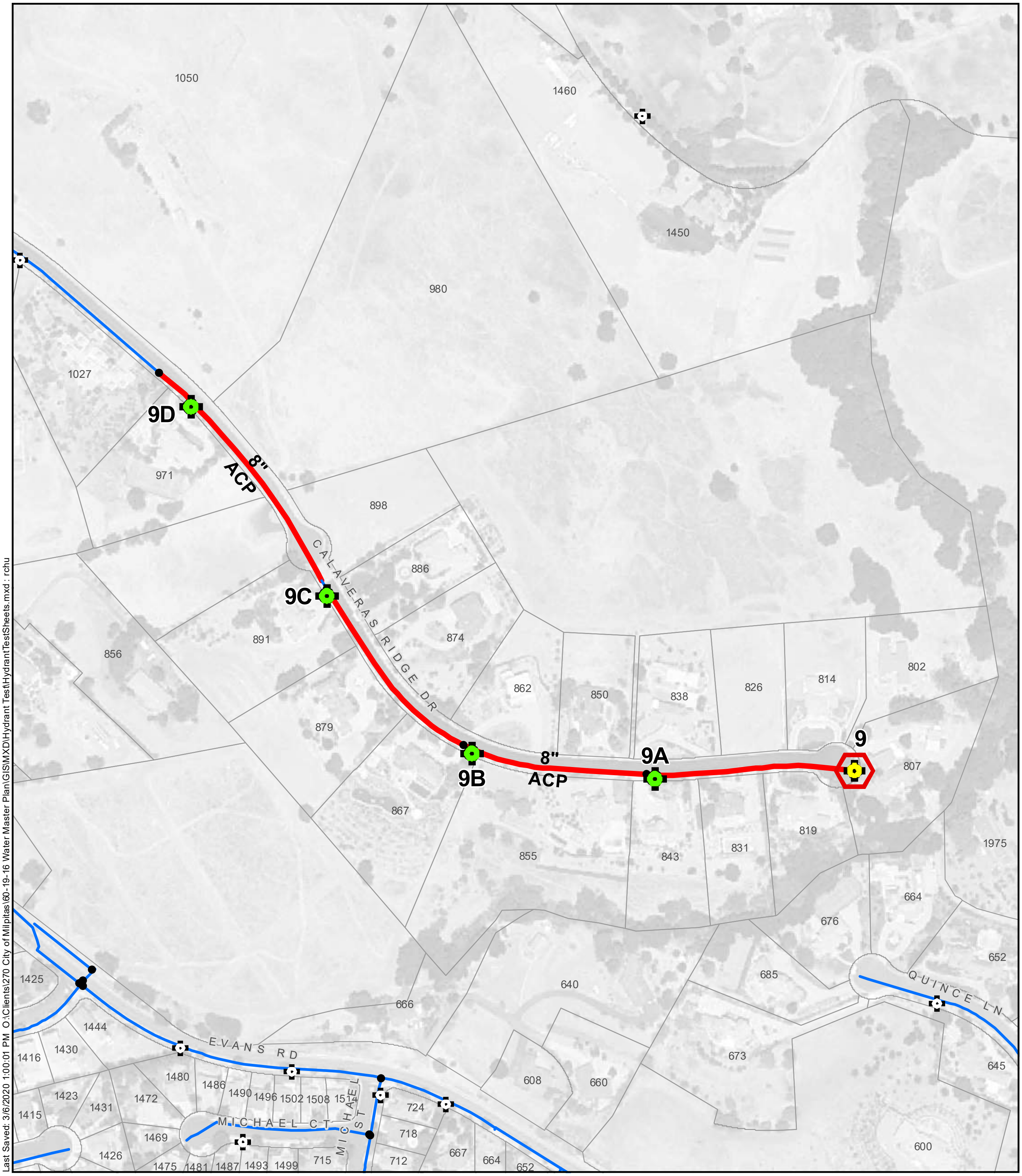

Flowing Hydrant
Observed Hydrant
Hydrant
Closed Valve (0 total)
Valve
Test Pipeline
Pipeline

0 150 300
Scale in Feet

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Figure A-9

Test 9 - Zone SF3
(8-inch AC - 1980s)

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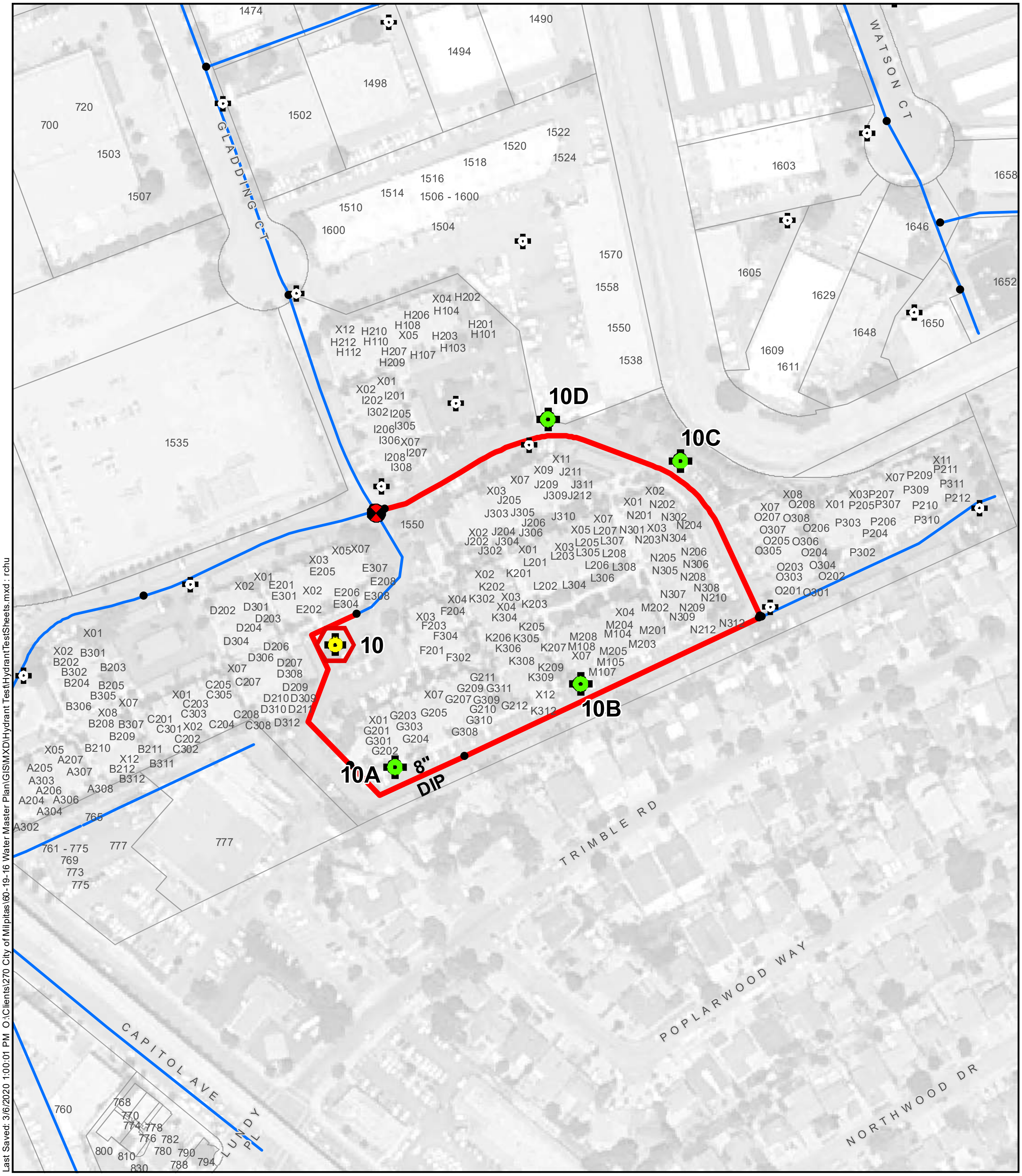

Flowing Hydrant
Observed Hydrant
Hydrant
Closed Valve (1 total)
Valve
Test Pipeline
Pipeline

0 100 200
Scale in Feet

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Figure A-10

Test 10 - Zone SC2
(8-inch DI - 2000s)

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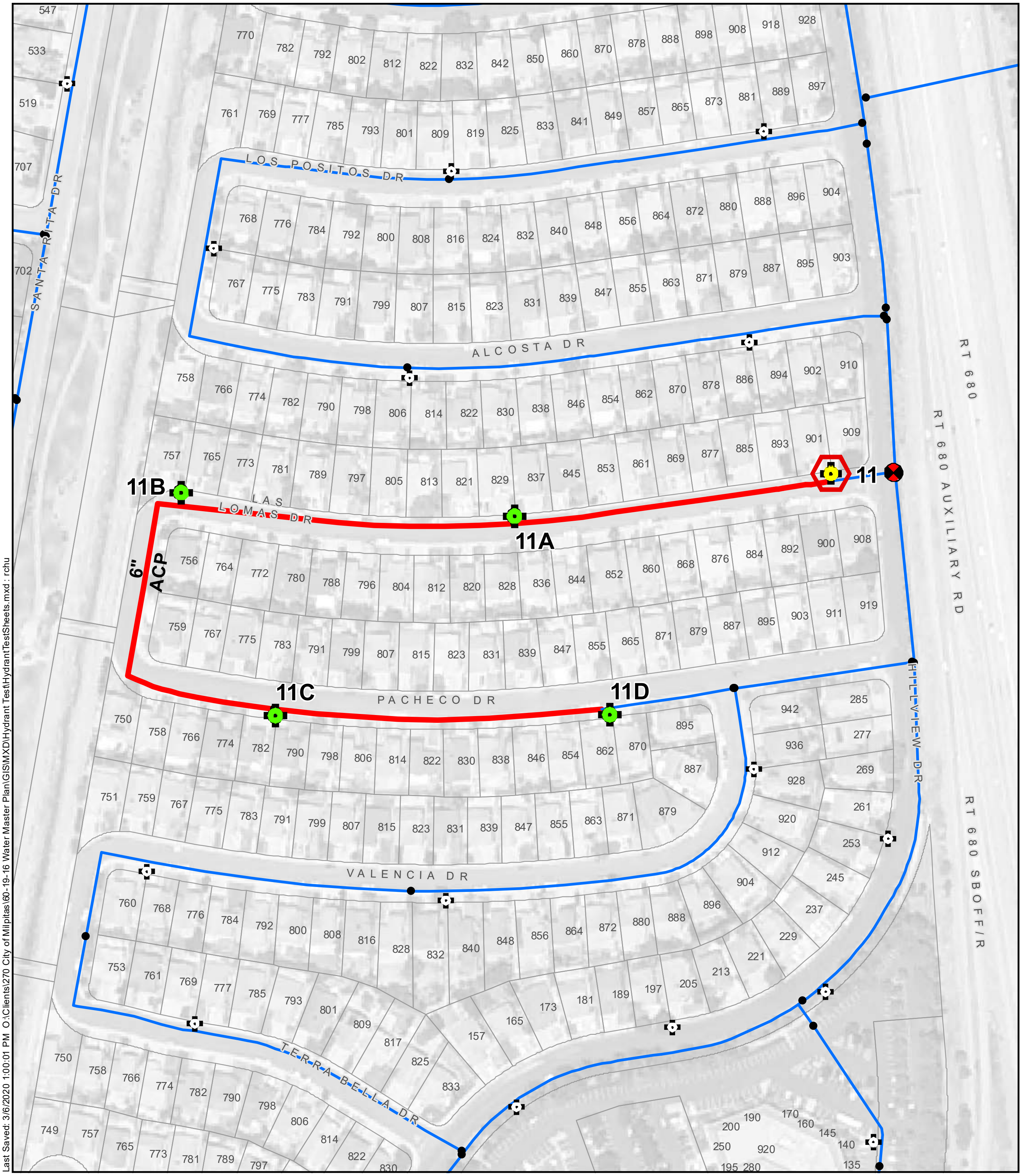

- Flowing Hydrant
- Observed Hydrant
- Hydrant
- Closed Valve (1 total)
- Valve
- Test Pipeline
- Pipeline

0 100 200

Scale in Feet

Figure A-11

Alternate Test 11
Zone SF2
(6-inch AC - 1980s)

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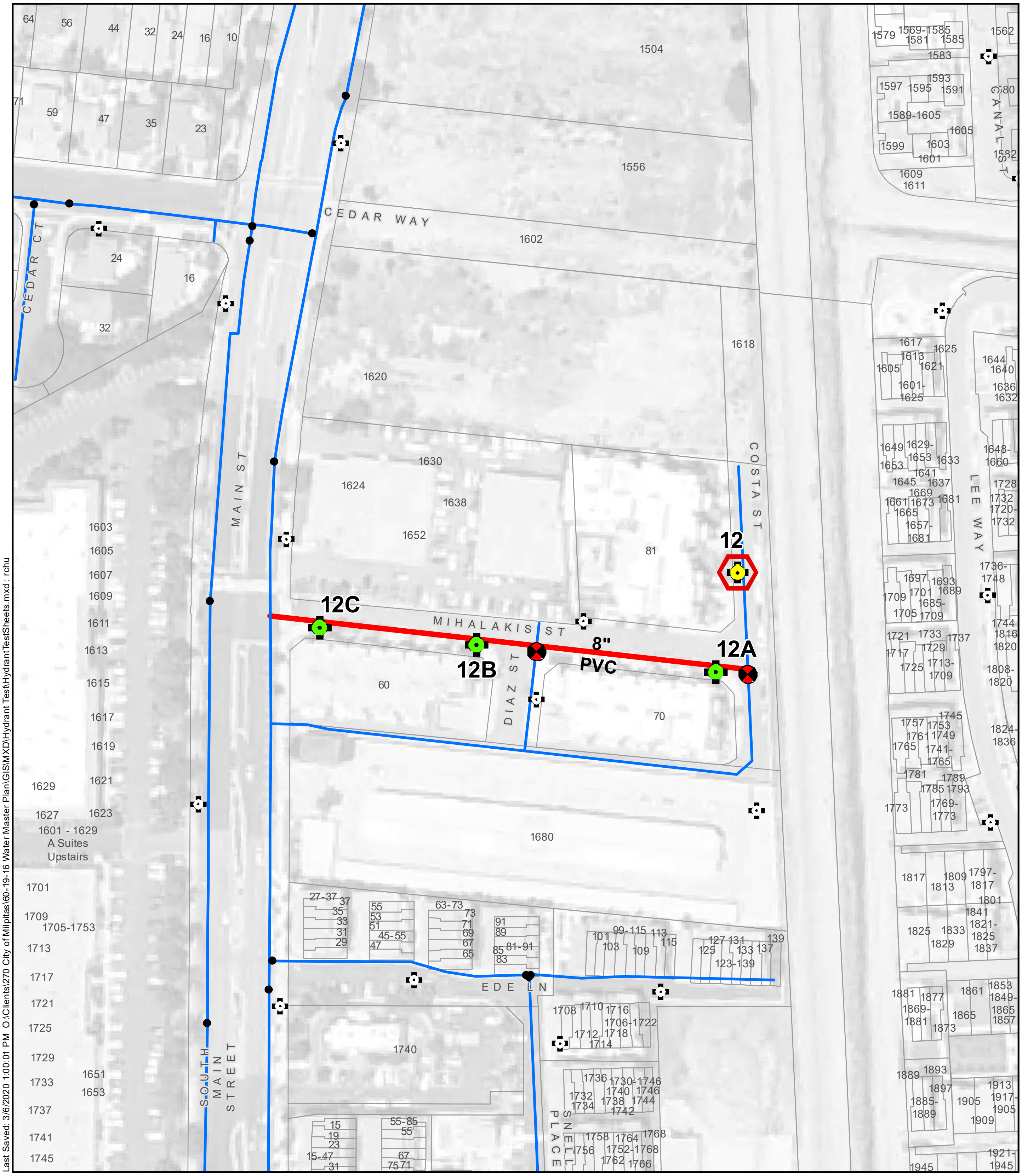

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Figure A-12

Alternate Test 12
Zone SC1
(8-inch PVC - 2000s)

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Flowing Hydrant

Observed Hydrant

Hydrant

Closed Valve (0 total)

Valve

Test Pipeline

Pipeline

0 100 200

Scale in Feet

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Figure A-13

Alternate Test 13
Zone SF4-1
(8-inch AC - 1980s)

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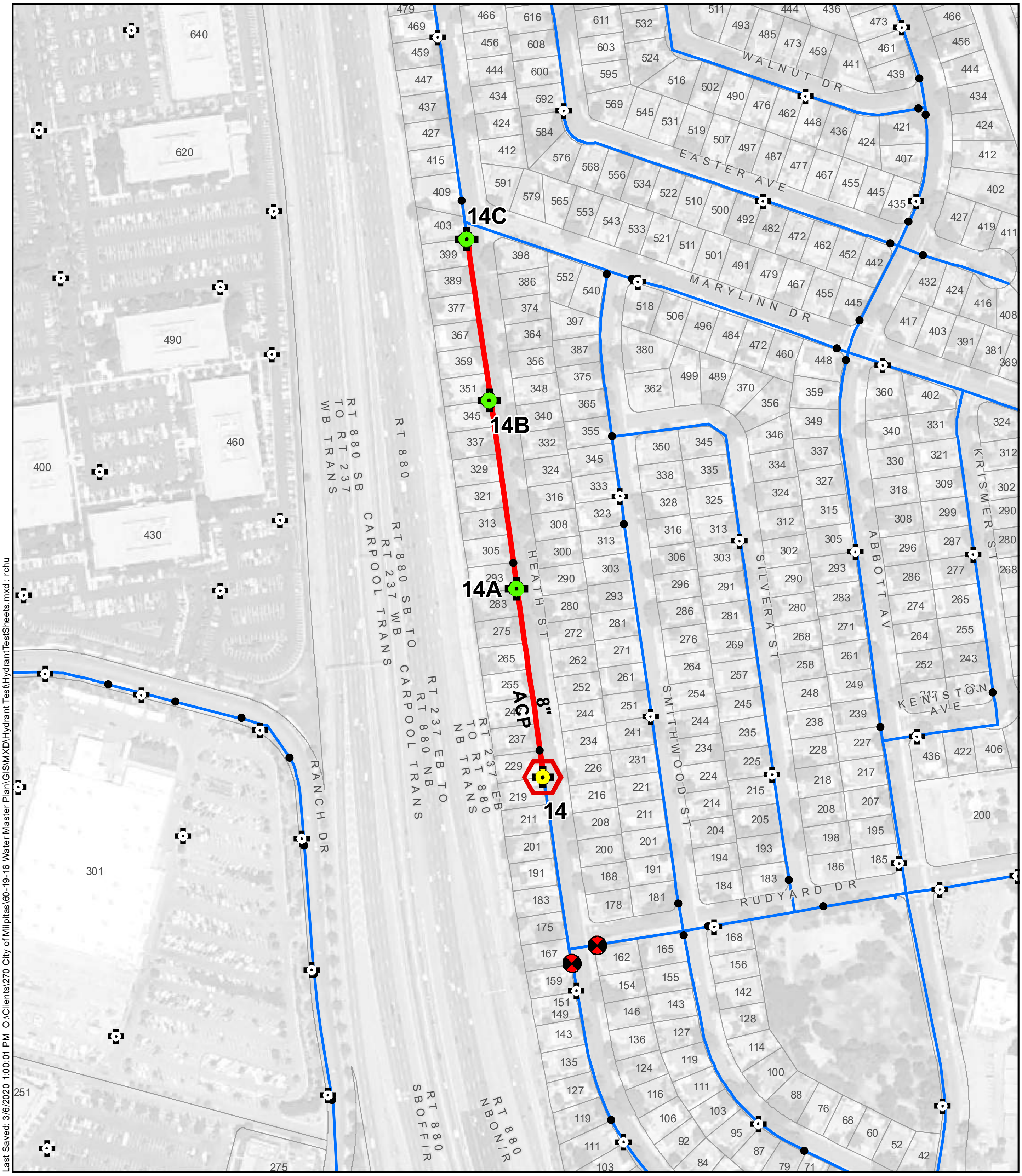

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Flowing Hydrant

Observed Hydrant

Hydrant

Closed Valve (2 total)

Valve

Test Pipeline

Pipeline

0 150 300

Scale in Feet

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Figure A-14

Alternate Test 14
Zone SF1
(8-inch AC - 1960s)

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ATTACHMENT B

Table B-1. Hydrant Pressure Recorder Locations			
HPR No.	Pressure Zone	Facility Monitored	Location
1	SF1	Gibraltar BPS	Near 819 E Curtis Ave
2	SF1	Main St PRV	SW corner of Corning Avenue and Abel Street
3	SF1	N Milpitas PRV	Near 70 N Milpitas Boulevard
4	SF1	Sunnyhills PRV	Near 361 Washington Drive
5	SF2	Ayer BPS	Near 1439 E Calaveras Boulevard
6	SC1	Parc Metro PRV	Near 232 Parc Place Drive
7	SF2	Main St Turnout	Near 271 Parc Place Drive
8	SF2	Calaveras Turnout	NE corner of N Milpitas Boulevard and E Calaveras Boulevard
9	SF2	Sunnyhills Turnout	Near 1589 Washington Drive
10	SC1	Capitol PRV	Lundy Pl near 880 E Capitol Avenue
11	SC1	Curtis PRV	Near 1189 Barber Lane
12	SC2	Gibraltar PRV	Intersection of Gibraltar Court and Gibraltar/Yosemite Drive
13	SC2	Gibraltar BPS	Piper Dr between Garden Street and Meridian Place
14	SF3	Country Club BPS	Country Club Drive, north of BPS
15	SF3	Tularcitos Tank	Near 1251 Tularcitos Drive
16	SF4-1	Tularcitos N PRV	Near 1772 Country Club Drive
17	SF4-1	Tularcitos S PRV	Near 1870 Saint Andrews Court
18	SF4-1	Calera Creek Heights PRV	Near 1631 Calera Creek Heights Drive
19	SF4-2	Tularcitos BPS	Near 1490 Tularcitos Drive
20	SF4-2	Minnis Tank	Near intersection of Monument Peak Road and Downing Road (Launch Site Road?)

Proposed HPR Location

Hydrant

Turnout

Pump Station

Storage Reservoir

Well

Pressure Reducing Valve

Emergency PRV

Pipeline

N

0 100 200

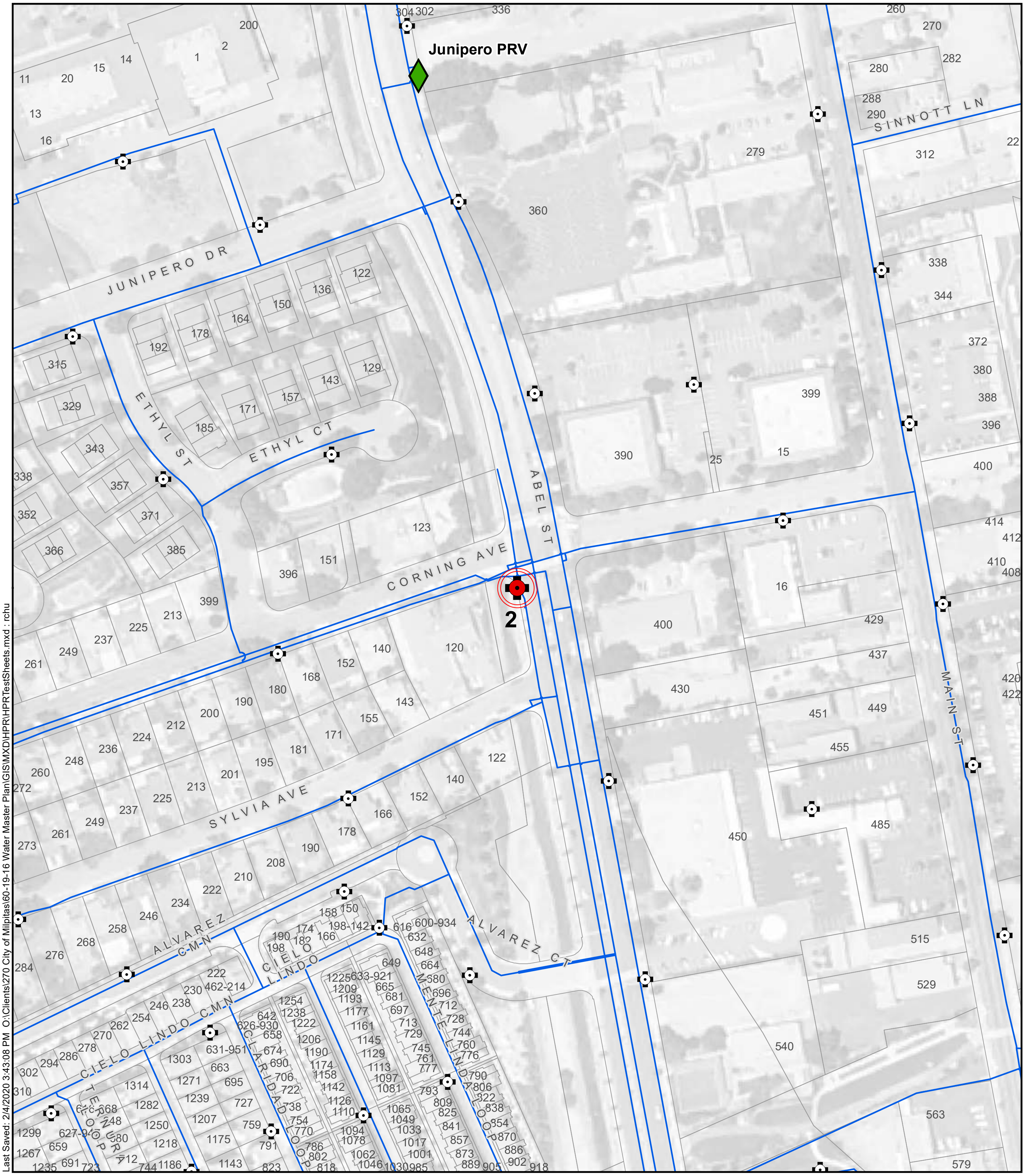
Scale in Feet

WEST YOST ASSOCIATES

Figure B-1

Hydrant Pressure Recorder Locations

City of Milpitas
2020 Water Master Plan Update



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Proposed HPR Location
Hydrant
Turnout
PS Pump Station
Storage Reservoir
W Well
Pressure Reducing Valve
Emergency PRV
Pipeline

N

0 100 200
Scale in Feet

WEST YOST ASSOCIATES

Figure B-2

Hydrant Pressure Recorder Locations

City of Milpitas
2020 Water Master Plan Update

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Proposed HPR Location
Hydrant
Turnout
Pump Station
Storage Reservoir
Well
Pressure Reducing Valve
Emergency PRV
Pipeline

N

0 100 200
Scale in Feet

WEST YOST ASSOCIATES

Figure B-3

Hydrant Pressure Recorder Locations

City of Milpitas
2020 Water Master Plan Update

Proposed HPR Location

Hydrant

Turnout

Pump Station

Storage Reservoir

Well

Pressure Reducing Valve

Emergency PRV

Pipeline

N

0 100 200

Scale in Feet

WEST YOST ASSOCIATES

Figure B-4

Hydrant Pressure Recorder Locations

City of Milpitas
2020 Water Master Plan Update

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Proposed HPR Location

Hydrant

Turnout

PS Pump Station

Storage Reservoir

W Well

Pressure Reducing Valve

Emergency PRV

Pipeline

N

0 100 200

Scale in Feet

WEST YOST ASSOCIATES

Figure B-5

Hydrant Pressure Recorder Locations

City of Milpitas
2020 Water Master Plan Update

Proposed HPR Location
Hydrant
Turnout
PS Pump Station
Storage Reservoir
W Well
Pressure Reducing Valve
Emergency PRV
Pipeline

N

0 100 200
Scale in Feet

WEST YOST ASSOCIATES

Figure B-6

Hydrant Pressure Recorder Locations

City of Milpitas
2020 Water Master Plan Update

Proposed HPR Location

Hydrant

Turnout

PS Pump Station

Storage Reservoir

W Well

Pressure Reducing Valve

Emergency PRV

Pipeline

0 100 200

Scale in Feet

N

Figure B-7

Hydrant Pressure Recorder Locations

City of Milpitas
2020 Water Master Plan Update

Proposed HPR Location

Hydrant

Turnout

Pump Station

Storage Reservoir

Well

Pressure Reducing Valve

Emergency PRV

Pipeline

N

0 100 200

Scale in Feet

WEST YOST ASSOCIATES

Figure B-8

Hydrant Pressure Recorder Locations

City of Milpitas
2020 Water Master Plan Update

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Proposed HPR Location

Hydrant

Turnout

Pump Station

Storage Reservoir

Well

Pressure Reducing Valve

Emergency PRV

Pipeline

0 100 200

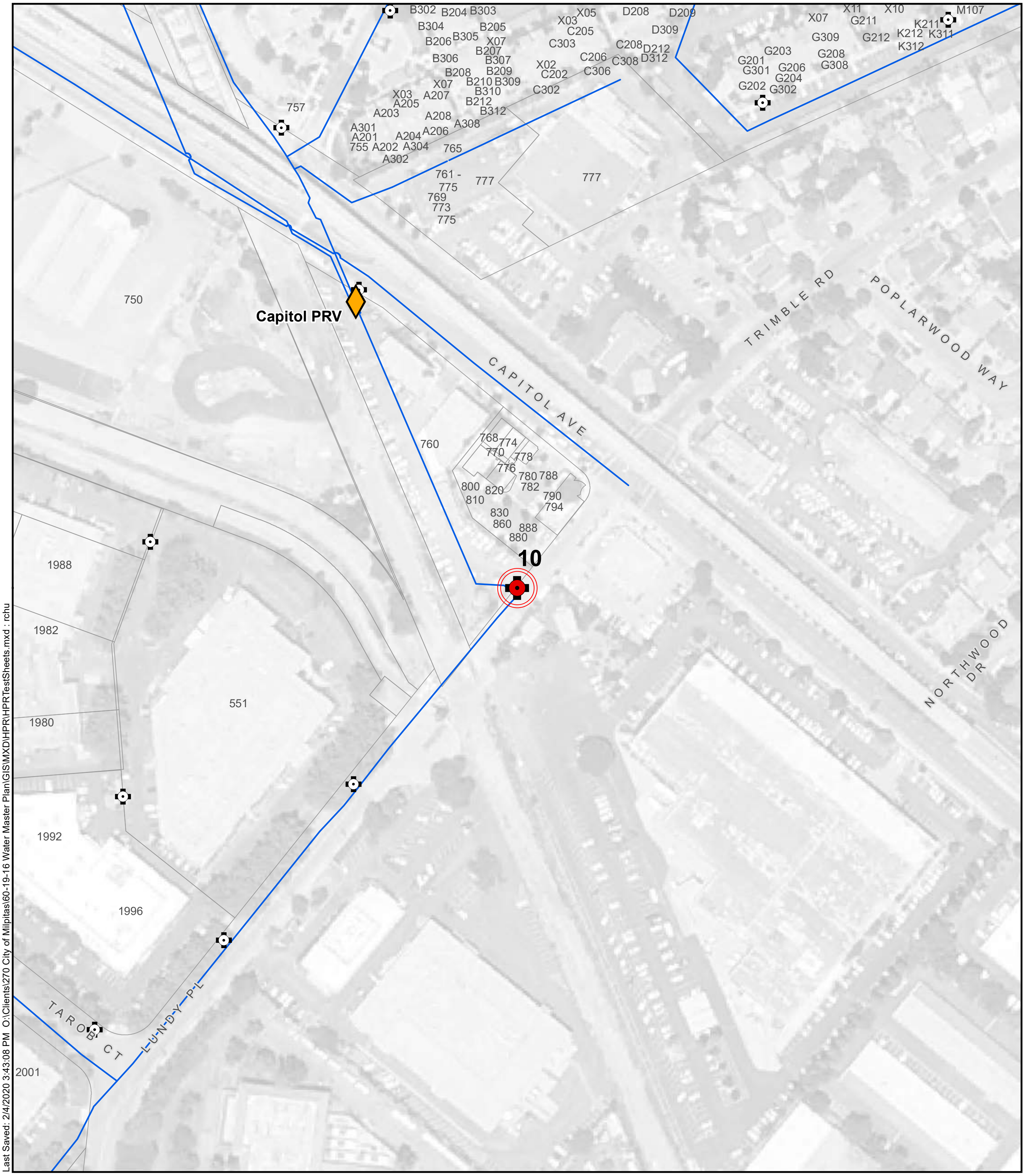
Scale in Feet

WEST YOST ASSOCIATES

Figure B-9

Hydrant Pressure Recorder Locations

City of Milpitas
2020 Water Master Plan Update



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Proposed HPR Location

Hydrant

Turnout

PS Pump Station

Storage Reservoir

W Well

Pressure Reducing Valve

Emergency PRV

Pipeline

N

0 100 200

Scale in Feet

WEST YOST ASSOCIATES

Figure B-10

Hydrant Pressure Recorder Locations

City of Milpitas
2020 Water Master Plan Update

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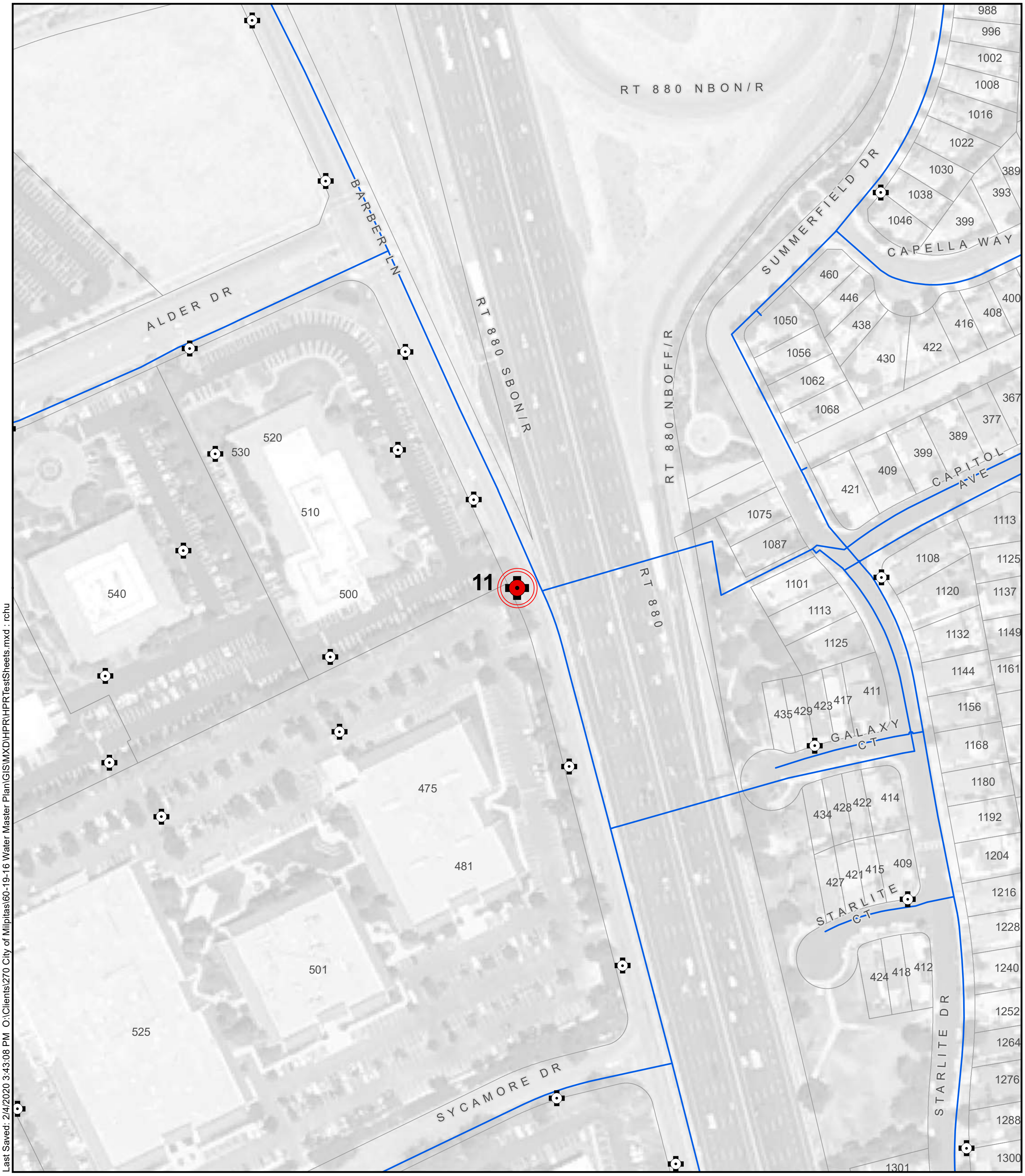


Proposed HPR Location

Hydrant

Turnout

Pump Station

Storage Reservoir

Well

Pressure Reducing Valve

Emergency PRV

Pipeline

N

0 100 200

Scale in Feet

WEST YOST ASSOCIATES

Figure B-11

Hydrant Pressure Recorder Locations

City of Milpitas
2020 Water Master Plan Update

Last Saved: 2/4/2020 3:43:08 PM O:\Clients\270 City of Milpitas\60-19-16 Water Master Plan\GIS\MXD\HPR\HPRTestSheets.mxd : rchu

Proposed HPR Location
Hydrant
Turnout
PS Pump Station
Storage Reservoir
W Well
Pressure Reducing Valve
Emergency PRV
Pipeline

N

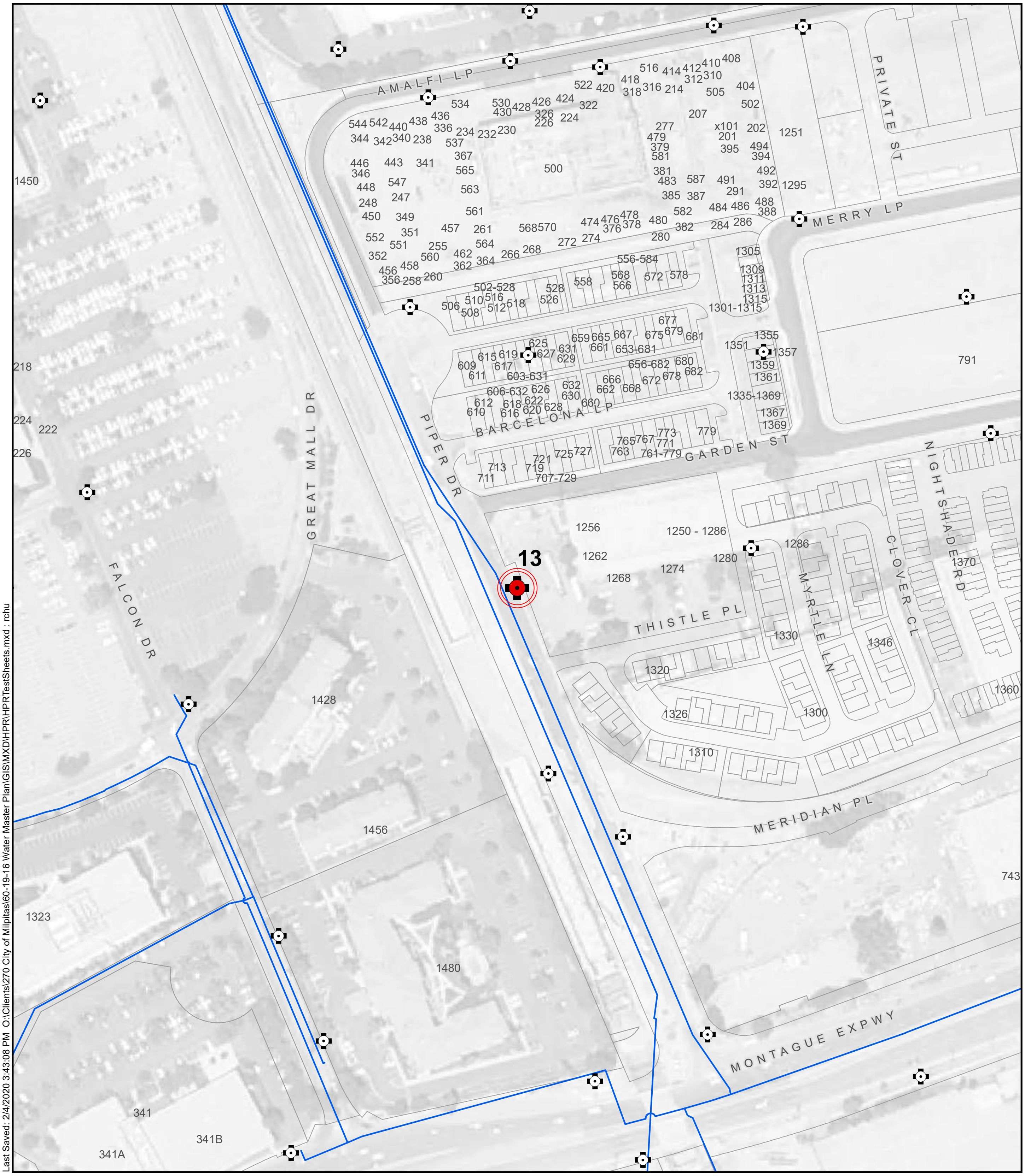
0 100 200
Scale in Feet

WEST YOST ASSOCIATES

Figure B-12

Hydrant Pressure Recorder Locations

City of Milpitas
2020 Water Master Plan Update



Proposed HPR Location
Hydrant
Turnout
PS Pump Station
Storage Reservoir
W Well
Pressure Reducing Valve
Emergency PRV
Pipeline

N

0 100 200
Scale in Feet

WEST YOST ASSOCIATES

Figure B-13

Hydrant Pressure Recorder Locations

City of Milpitas
2020 Water Master Plan Update

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Proposed HPR Location
Hydrant
Turnout
PS Pump Station
Storage Reservoir
W Well
Pressure Reducing Valve
Emergency PRV
Pipeline

N

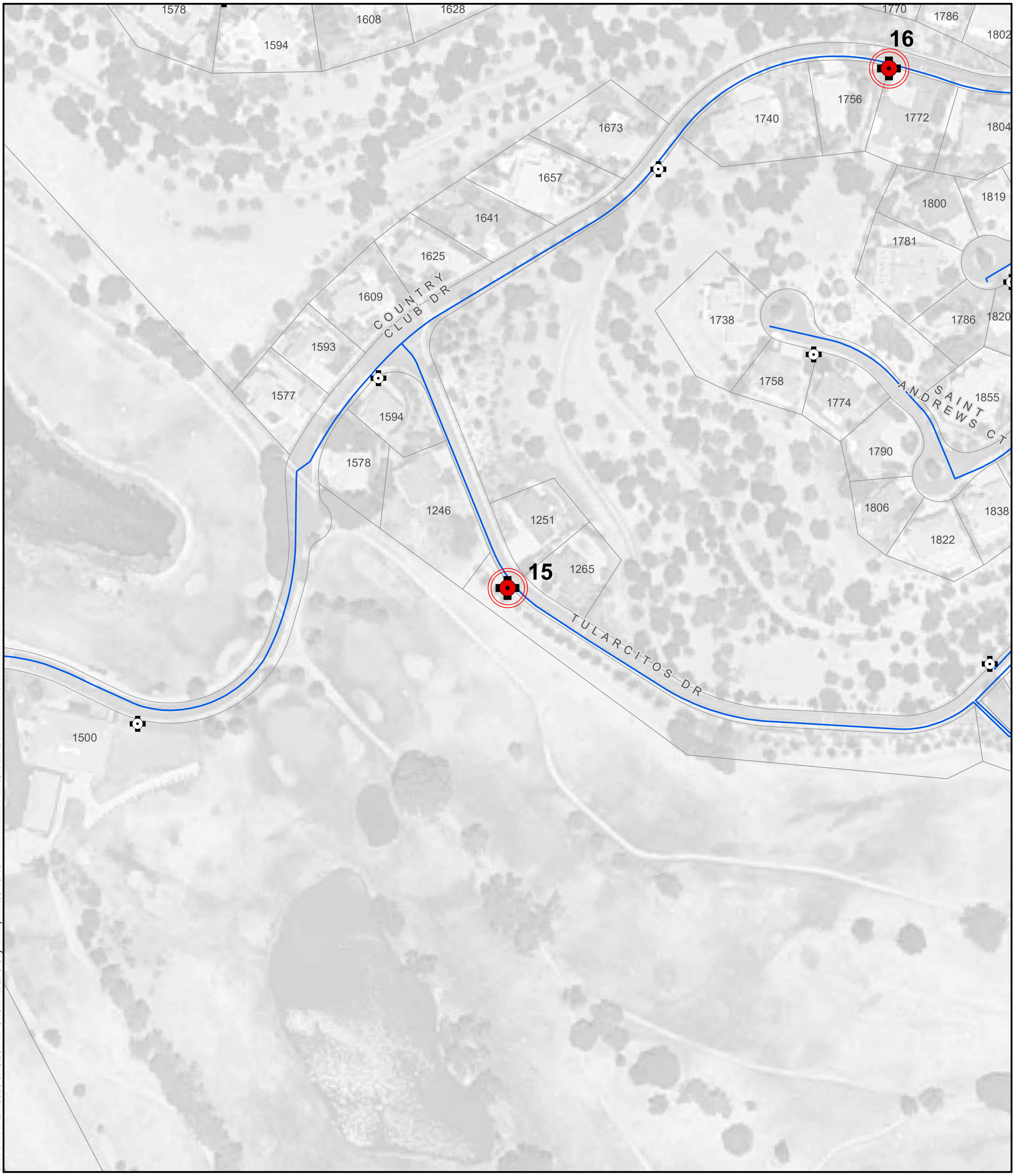
0 100 200
Scale in Feet

WEST YOST ASSOCIATES

Figure B-14

Hydrant Pressure Recorder Locations

City of Milpitas
2020 Water Master Plan Update



Proposed HPR Location
Hydrant
Turnout
PS Pump Station
Storage Reservoir
W Well
Pressure Reducing Valve
Emergency PRV
Pipeline

N
0 100 200
Scale in Feet

WEST YOST ASSOCIATES

Figure B-15

Hydrant Pressure Recorder Locations

City of Milpitas
2020 Water Master Plan Update

Proposed HPR Location
Hydrant
Turnout
PS Pump Station
Storage Reservoir
W Well
Pressure Reducing Valve
Emergency PRV
Pipeline

N

0 100 200
Scale in Feet

WEST YOST ASSOCIATES

Figure B-16

Hydrant Pressure Recorder Locations

City of Milpitas
2020 Water Master Plan Update

Last Saved: 2/4/2020 3:43:08 PM O:\Clients\270 City of Milpitas\60-19-16 Water Master Plan\GIS\MXD\HPR\HPRTestSheets.mxd : rchu

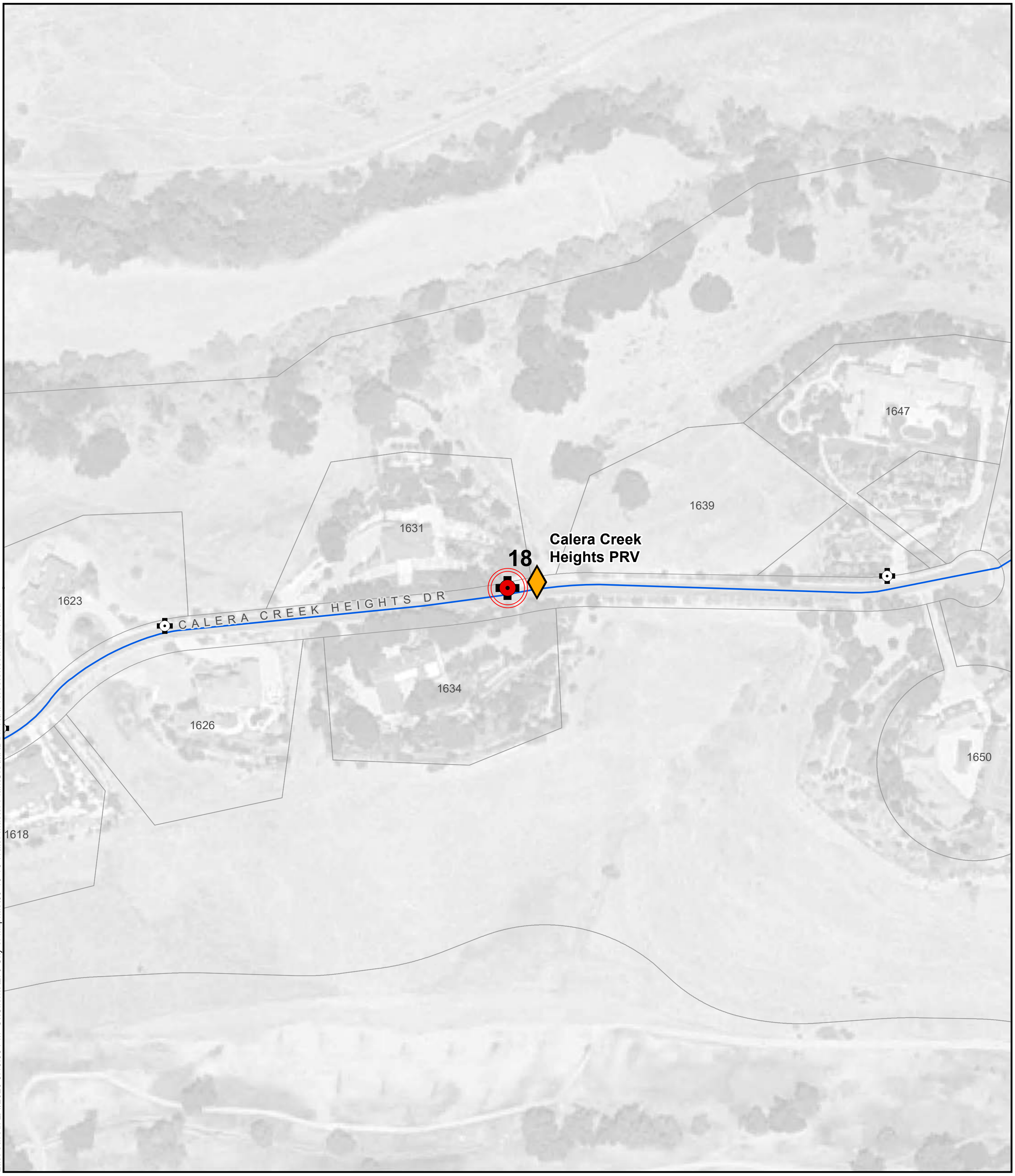
- Proposed HPR Location
- Hydrant
- Turnout
- Pump Station
- Storage Reservoir
- Well
- Pressure Reducing Valve
- Emergency PRV
- Pipeline

0 100 200
Scale in Feet

Figure B-17

Hydrant Pressure Recorder Locations

City of Milpitas
2020 Water Master Plan Update



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- Proposed HPR Location
- Hydrant
- Turnout
- PS Pump Station
- Storage Reservoir
- W Well
- Pressure Reducing Valve
- Emergency PRV
- Pipeline

N

0 100 200

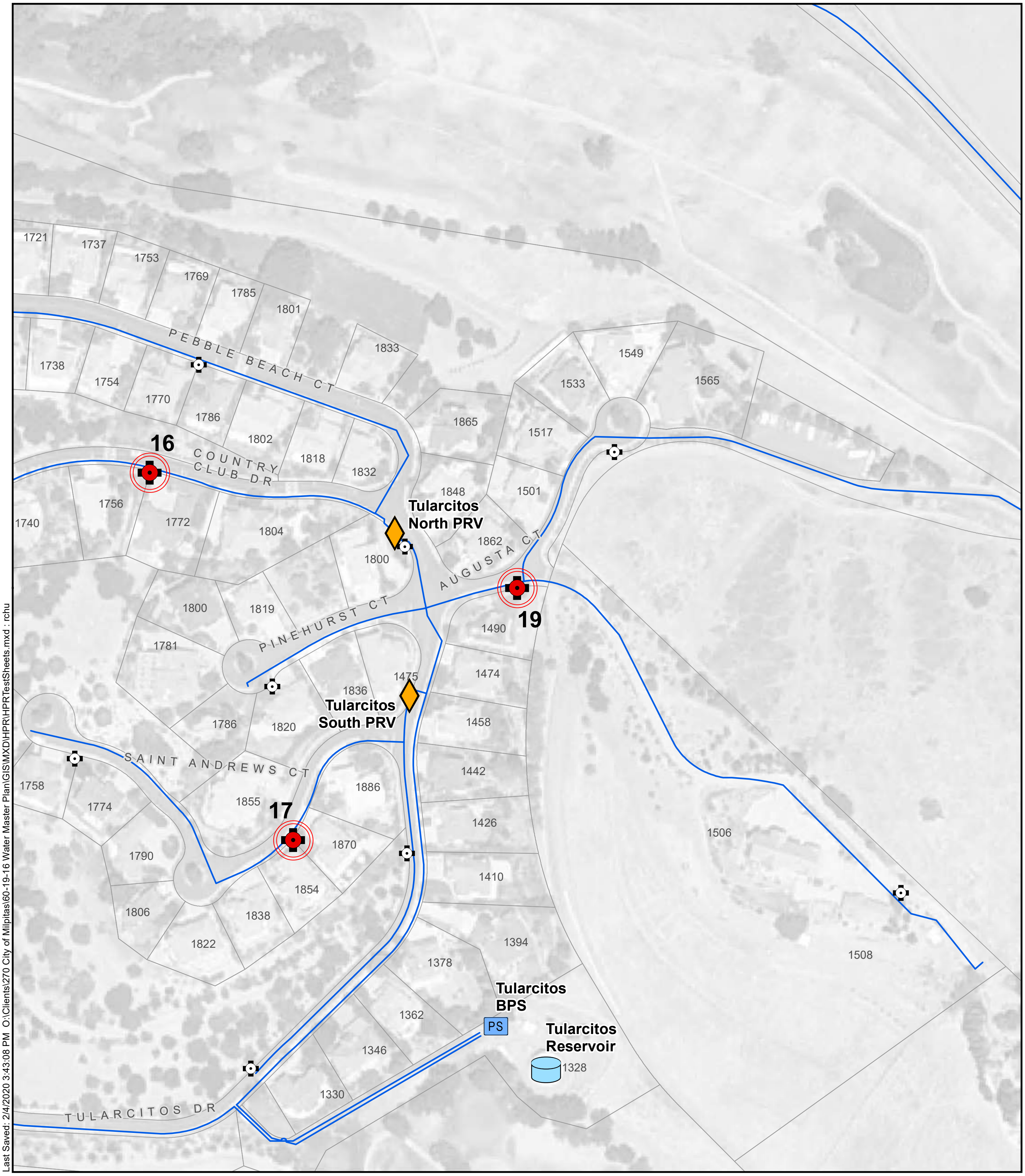
Scale in Feet

WEST YOST ASSOCIATES

Figure B-18

Hydrant Pressure Recorder Locations

City of Milpitas
2020 Water Master Plan Update



Proposed HPR Location

Hydrant

Turnout

PS Pump Station

Storage Reservoir

W Well

Pressure Reducing Valve

Emergency PRV

Pipeline

N

0 100 200

Scale in Feet

WEST YOST ASSOCIATES

Figure B-19

Hydrant Pressure Recorder Locations

City of Milpitas
2020 Water Master Plan Update

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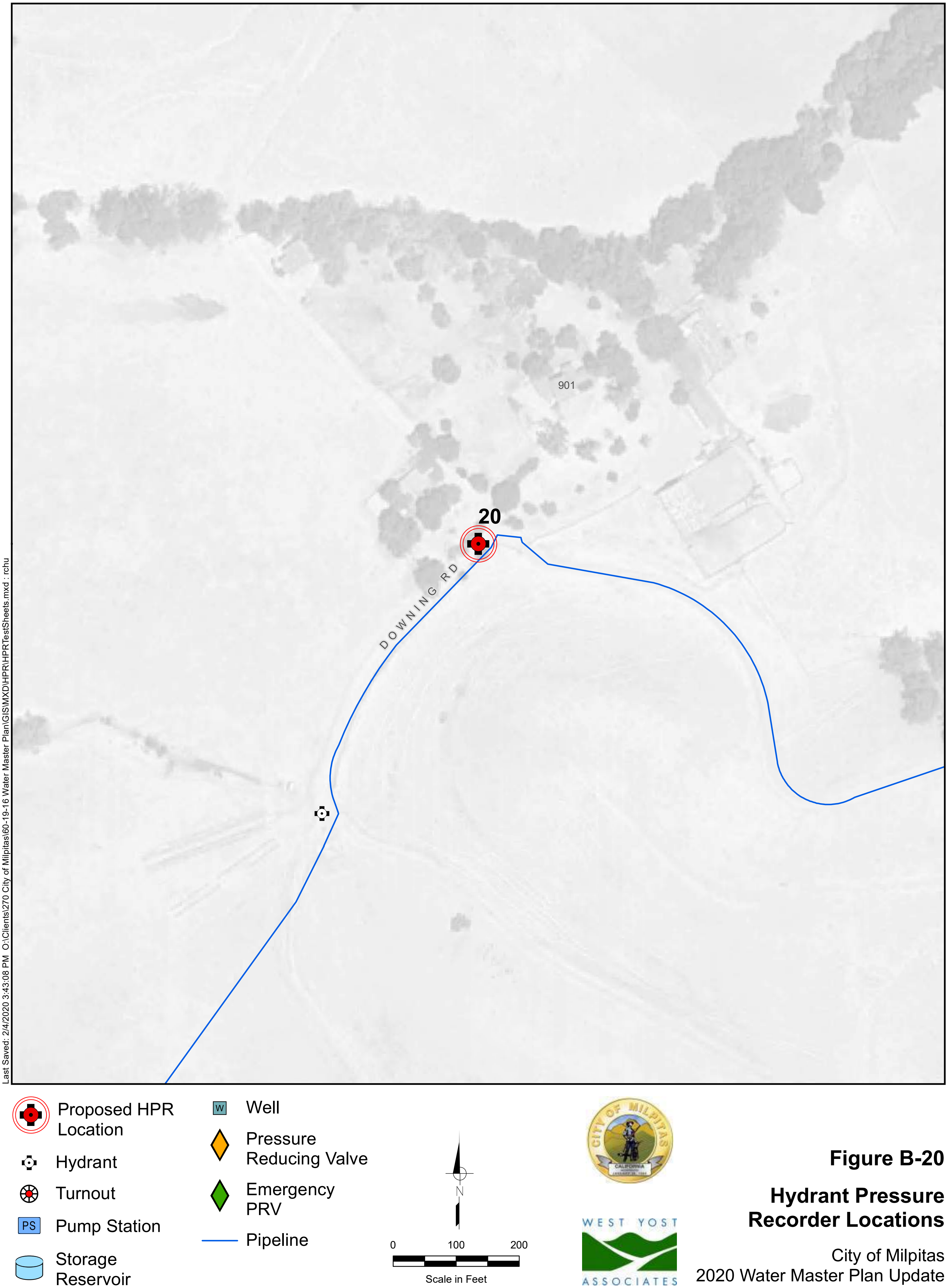

Figure B-20

Hydrant Pressure Recorder Locations

City of Milpitas
2020 Water Master Plan Update

Appendix D

Water Utility Condition Assessment

TECHNICAL MEMORANDUM | OCTOBER 2020

2020 Water Master Plan
Water Utility Condition Assessment

PREPARED FOR

City of Milpitas

PREPARED BY

WEST YOST
Water. Engineered.

2020 Water Master Plan
Water Utility Condition Assessment

Prepared for

City of Milpitas

Project No. 270-60-19-16

Michael Zacharia, PE	10-30-20 Date	Anne Girtz, PE	10-30-20 Date
QA/QC Review: Elizabeth Drayer PE	10-30-20 Date		

WEST YOST
Water. Engineered.

TECHNICAL MEMORANDUM | OCTOBER

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2020 Water Master Plan
Water Utility Condition Assessment

This Technical Memorandum (TM) summarizes the condition assessment that was performed of the City of Milpitas's (City) water utility assets under Task 3 – Water Utility Asset Condition Assessment of the 2020 Water Master Plan Update (Master Plan). This TM presents assessment methodologies, asset valuations, likelihood and consequence of failure factors, and risk scores as summarized in the following sections:

1.0 SCOPE OF WORK

The scope of this assessment includes:

- Preparing an estimate of remaining useful life and replacement cost of assets;
- Developing a risk policy consisting of likelihood of failure (LOF) factors, consequence of failure (COF) factors, and interpretation of both LOF and COF to define risk; and
- Performing a desktop risk analysis of utility assets.

Each asset was evaluated according to the risk policy, resulting in risk scores for each water system asset. Risk scores and corresponding risk action thresholds can be used for decision making including selection and prioritization of asset renewal or replacement efforts. The analysis results will be used to inform the Task 7 Rehabilitation and Replacement Study of the Master Plan.

The standardized evaluation process established in the risk policy can be used in future assessments of condition, risk, and valuation of water system assets. The policy framework was developed so that risk factor definitions are commensurate across assets from other City utilities and can be applied to other departments. Should new data become available to support additional or refined risk factors (e.g. pipe break data with failure cause, condition assessment data, etc.), these can be developed within the risk framework proposed herein.

2.0 REVIEW OF EXISTING INFORMATION

This section describes the existing information upon which the assessments were based, and any data processing required prior to undertaking the assessments.

2.1 Asset Data and Asset Registry

The City provided two data sources containing water system asset information: a master inventory spreadsheet and a GIS database.

The master inventory spreadsheet contained information on water facilities including wells, pump stations, reservoirs, PRVs, turnouts, interties, and isolation valves. In addition to facility data, the spreadsheet contained information on select individual assets at each facility (e.g., for a pump station, the pump size(s), manufacturer, model, and other attributes were provided).

The City's existing GIS database was outdated and was updated by HydroScience as part of their work on the City's Sewer Master Plan (being completed concurrently). The updated database contained geospatial and attribute information for horizontal water assets including pipelines, valves, backflow preventers, blow off assemblies, hydrants, and meters.

The master spreadsheet and GIS database were compiled to create an asset registry of all City water system assets. Upon comparison of the two data sources provided by the City, it was observed that several assets were present in both databases. Duplicate entries included: isolation valves (40), PRVs (18), and reservoirs (5). To reconcile the duplicates, a coordinate comparison was performed in GIS to identify duplicate isolation valves; and visual inspection in GIS was performed to identify duplicate PRVs and reservoirs. Duplicates were removed from the respective database prior to compiling the asset registry. The asset registry facilitated the condition and risk assessment discussed herein and provides a database for the City to track and manage their assets moving forward. This database is provided as a separate deliverable which consists of an Excel spreadsheet titled *Asset Registry and Risk Results.xlsx* and may be used to refresh the City's CMMS database.

The final asset registry contained 35,260 entries, consisting of 35,173 horizonal assets and 87 vertical assets. The breakdown of assets by type is presented in Table 1.

Table 1. Asset Registry – Count of Asset Types

Asset Type	Count
Horizontal Assets	
Pipelines	9,575 pipe segments (183 miles)
Hydrants	2,906
Valves	6,341
Meters	16,351
Total Horizontal Assets	**35,173**
Vertical Assets	
Fuel Tank	3
Engine	4
Generator	3
Motor	10
PLC	2
PRV	23
Pump	19
Reservoir	5
Turnouts and Interties	7
VFD	9
Well	2
Total Vertical Assets	**87**

2.2 2002 Utility Depreciation Study

A Utility Depreciation Study (Schaaf and Wheeler) was performed in 2002. The study included the following:

- An inventory of all City water system assets;
- Replacement costs for those elements; and
- A timetable for replacement of water system elements based on anticipated remaining useful life estimates.

This replacement cost analysis assumed unit costs based on a March 2003 ENR Construction Cost Index. Table 2 presents the resulting replacement costs from the 2002 study for the City's water system assets in 2002 dollars.

Table 2. Water System Replacement Costs, 2002 Utility Depreciation Study (2002 Dollars)

Asset Type	Replacement Cost Million dollars
Pipelines	131
Valves and Couplings	8.9
ACP Disposal	80.6
Storage Tanks	13.4
Pump Stations	10.6
Wells	1.1
Total	**$245.6**

2.3 2018 Soil Corrosivity Study

In 2018, the City commissioned a soil corrosivity study (JDH Corrosion Consultants, Inc.) to develop a comprehensive database related to corrosion potential of the soils throughout the City. The assessment was focused on water pipelines made of asbestos cement (AC), ductile iron, cast iron, dielectric coated steel, and mortar coated steel materials. Based on in-situ soil resistance measurements and a review of previous soil evaluations, strategies were developed for long-term corrosion control of AC and metallic pipelines.

3.0 ASSET REPLACEMENT COST AND CURRENT VALUATION

Asset replacement cost and current valuation estimates are asset management best practices that can afford utility agencies improved decision making. This information provides agencies more accurate and integrated information about their assets, and allows more productive relationships with governing authorities, ratepayers, and other stakeholders because they can provide better information in a more transparent way.

Asset Replacement Cost estimates can be used to guide rehabilitation and replacement budgeting. Typically, investment in replacement should cover at a minimum, the deprecation of the assets.

Asset Current Valuation estimates are required to support transactions (public-private partnerships, outright sale, etc.), insurance coverage or claims, and rates cases.

3.1 Water System Asset Replacement Cost

A water system asset replacement cost estimate was developed which represents the cost to replace the entire system in-kind, at current construction and design standards. Costs were developed based on a combination of data supplied by manufacturers, published industry standard cost data and curves, construction costs for similar facilities built by other public agencies, and construction costs previously estimated by West Yost for similar facilities with similar construction cost indexes. Details on cost estimating assumptions are provided in a separate appendix of the Water Master Plan.

A summary of the water system replacement costs is presented in Table 3a. Detailed replacement costs are provided in the *Asset Registry and Risk Results* Excel workbook.

Table 3a. Water System Replacement Costs (2020 Dollars)

Facility Type	Replacement Cost Million dollars
Pipelines	148.4
Valves	4.7
Hydrants	36.2
Meters	6.9
Storage Tanks	46.6
Pump Stations	27.6
Wells	7.2
PRVs	5.9
Turnouts and Interties	4.4
Total	**$287.9**

3.2 Water System Current Valuation

Using the 2020 replacement cost estimate presented in Table 3a, a current water system valuation was prepared using asset useful life estimates (discussed in detail in the Asset Useful Life section) and assuming a straight-line value reduction or depreciation. A straight-line depreciation assumes that the value of an existing asset is reduced gradually over its useful life in a linear relationship. For example, a pipe with 50 percent remaining useful life is valued at 50 percent of its total new replacement cost value. The water system asset valuation estimates the value of individual assets only, not the inherent value of the water system as a whole.

The 2020 water system asset valuation assuming straight-line depreciation is presented in Table 3b. Detailed asset valuation costs are provided in the *Asset Registry and Risk Results* Excel workbook.

Table 3b. Water System Asset Valuation (2020 Dollars)

Facility Type	Asset Valuation, Million dollars
Pipelines	43.5
Valves	1.2
Hydrants	9.1
Meters	0.7
Storage Tanks	16.1
Pump Stations	2.8
Wells	2.0
PRVs	1.5
Turnouts and Interties	1.1
Total	**$78.0**

4.0 RISK ASSESSMENT FRAMEWORK

Understanding the *risk* of each water system asset can help water utilities to prioritize highest-risk assets for renewal or replacement, allowing limited resources to be allocated most effectively. The two components of risk include:

- **Likelihood of Failure (LOF)**, which estimates the probability that a failure will occur in an asset by meeting the end of its physical, design, service, or economic useful life; and
- **Consequence of Failure (COF)**, which estimates the impacts of asset failure expressed either qualitatively or quantitatively, being a loss, injury, or disadvantage from a social, economic, environmental, or regulatory standpoint.

Risk is then estimated using the conventional risk equation:

$$Risk = LOF \times COF$$

The following sections present the LOF and COF methodology that was developed for the City's water system assets, and then calculates asset risk using the risk equation.

5.0 LIKELIHOOD OF FAILURE METHODOLOGY

A desktop assessment was performed on existing water utility assets to estimate the LOF of each asset. For this assessment, asset failure is defined by the asset's inability to perform as intended or needed in its application. The primary failure mode utilized for this assessment was physical mortality, which is defined as physical deterioration due to age, usage, or acts of nature. Operational efficiency failure was also evaluated to consider the reduction in pipeline asset performance due to pipe roughness. Supplemental asset data such as failure history and asset condition assessment can also be used to evaluate LOF. This data was not available at the time this analysis was performed.

For each asset type, one or more LOF factors were developed for each failure mode, as presented in Table 4a.

Table 4a. Asset Failure Modes and LOF Factors

Failure Mode	Failure Description	LOF Factor
Physical Mortality	The percent of useful life remaining considers that older assets are more likely to fail than newer ones due to the age of materials and wear from repeated use.	Remaining Useful Life (for pipelines, considering pipe material, pipe diameter, and soil conditions)
	Pipelines that operate at higher working pressures can undergo stress cycles and cause higher failure rates in older pipelines.	Operating Pressure[(a)]
Operational Efficiency Failure	The accumulation of corrosion byproducts and suspended particles on the inside wall of aged pipes can increase pipe roughness and reduce pipe diameter, thereby increasing operational costs to overcome to greater hydraulic losses.	Pipe Roughness[(a)] (change in Hazen-Williams C-Factor)

(a) LOF Factor only applicable to pipelines

LOF ratings were assigned for each factor using standard definitions presented in Table 4b. Ratings and definitions range from 1 – indicating that an asset is in good condition and asset failure is "unlikely", to 4 – indicating that asset is in poor condition and asset failure is "very likely". Finally, each asset was evaluated under each applicable LOF factor to develop an overall LOF rating.

Table 4b. LOF Definition and Ratings

	LOF Rating			
	1	2	3	4
LOF Definition	Unlikely	Possible	Likely	Very Likely

The following sections describe the development of each LOF factor utilized in the assessment.

5.1 Asset Useful Life Defined

Asset useful life is generally considered to be the time that an asset provides valued service, after which it does not meet its intended service level. End of life is not necessarily indicative of catastrophic failure, and in most cases an asset can still hold functionality when it has reached the end of its useful life. Absent quantifiable condition or performance data, the assumption is that the older the asset, the greater likelihood it will fail.

Municipal water system assets vary by type, manufacture, design, construction, and quality. They have different characteristics in how they operate and, consequently, will have different profiles of how they perform and ultimately fail. Asset useful life expectancies are documented by the American Water Works Association and Water Environment Research Foundation (WERF) in addition to other notable industry associations. Useful life values presented here are nominal and consistent with the water utility industry and are not specific to any geographic region.

5.1.1 Non-Pipeline Useful Life

Table 5a presents a summary of useful life by asset type which were used for the assessment of the City's vertical and non-pipeline horizontal water utility assets. Pipeline assets are discussed separately in the following section.

Table 5a. Useful Life by Asset Type

Asset Type	Useful Life, years
Vertical Assets	
Fuel Tank	15
Engine	15
Generator	15
Motor	25
PLC	15
PRV	25
Pump	25
Reservoir	50
Turnouts and Interties	30
VFD	10
Well	50
Non-Pipeline Horizontal Assets	
Hydrants	50
Meters	15
Valves	50

5.1.2 Pipeline Useful Life

Pipeline useful life can vary significantly based on pipe size, material, and environmental conditions. The City's 2018 soil corrosivity study indicated that the City's AC pipe was more susceptible to failure in clay soils due to the pipe stresses associated with contraction and expansion of the soil. Smaller diameter AC pipes were especially susceptible to failure due to their relatively low resistance to soil movement. The report recommended a range of AC pipe useful lives based on pipe diameter. The investigation also mapped soil corrosivity and found that soils throughout the City were "severely" to "moderately" corrosive to metallic pipes (cast iron, ductile iron, steel).

Table 5b presents the useful lives for pipelines based on industry standards and the JDH report. It includes a base useful life (not considering soil conditions) and an effective useful life for AC pipe in clayey soils and metallic pipes in corrosive soils. Reinforced concrete pipe was considered vulnerable to corrosive soils due to the potential for exposed reinforcement steel.

Table 5b. Useful Life – Pipelines

Pipe Material	Diameter, Inches	Base Useful Life, years	Effective Useful Life, years			
			Clay Soils	Moderately Corrosive Soils	Corrosive Soils	Severely Corrosive Soils
Asbestos Cement	4-10	30	24	-	-	-
	12+	90	72	-	-	-
Polyvinyl Chloride	all	70	-	-	-	-
Concrete Cylinder	all	75	-	68	64	60
Cast Iron	all	100	-	90	85	80
Ductile Iron	all	100	-	90	85	80
Steel	all	95	-	86	81	76

5.1.3 Asset Remaining Useful Life Defined

The asset useful life estimates discussed above were used to calculate the remaining useful life (RUL) of each asset with the following formulas:

RUL = Asset Useful Life – Asset Age

RUL (%) = (Asset Useful Life – Asset Age) / Asset Useful Life

5.1.4 Estimation of LOF based on Remaining Useful Life

Decay curves can be used to illustrate the progression of asset degradation (decay) over an asset's useful life. The curves in Figure 1 were developed by WERF[1] and represent empirical failure patterns at several

[1] WERF SIMPLE (Sustainable Infrastructure Management Program Learning)

polynomial rates that may be experienced in the water industry. For this assessment, Late Decay 2 curve was selected as the indicator of likelihood of failure based on the following assumptions:

- Once municipal assets are beyond the point of early mortality, only a gradual decline in asset condition is expected to occur for much of the asset life. Early mortality is characterized by asset failure very soon after the asset is commissioned and in service. The occurrence of early mortality is often associated with manufacturing and installation issues.
- Late Decay Curve 2 provides only a 30 percent reduction in asset condition for the first two-thirds of the asset life. This is considered a nominal reduction in condition for a major milestone in the asset lifecycle and represents a suitable objective for asset performance.
- Late Decay Curve 2 provides a progression that is not significantly steep in terms of asset degradation over the final, remaining, one-third lifecycle.

Figure 1 also shows how Late Decay Curve 2 is used to correlate asset remaining useful life with the LOF rating (e.g. for an asset with a % RUL of 30 percent, the LOF rating is 2).

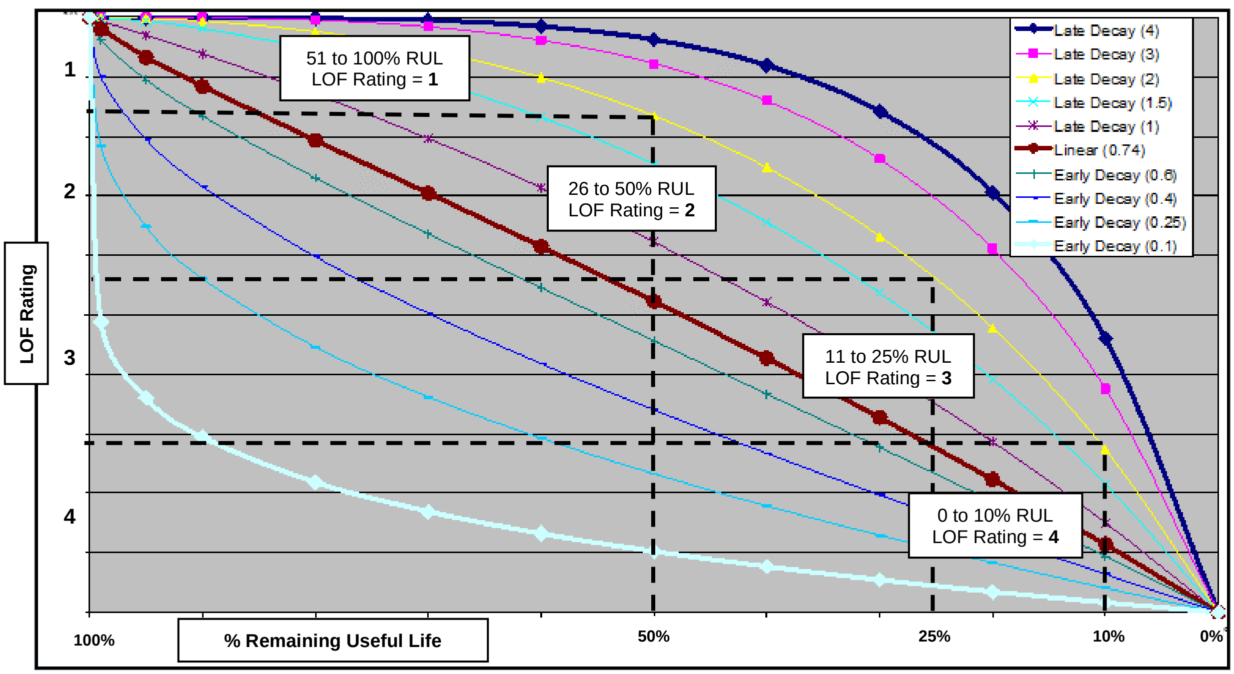


Figure 1. Percent Remaining Useful Life and LOF Rating

Several assets in the City databases were missing age or installation dates. These assets were assigned an LOF rating based on the following assumptions:

- AC pipe was assigned a rating of 4 under the assumption that AC pipe was not installed after the mid-1980s (and therefore the % RUL would be zero). 19 miles (894 pipe segments) of AC pipe had an unknown age/installation date.
- Remaining assets of unknown age were assigned a rating of 3 to account for the generally higher risk associated with unknown asset age and condition.

5.2 Pipeline Hydraulic Conditions

Pipeline conditions from the hydraulic model were considered to evaluate LOF factors of pipe roughness (operational efficiency failure mode) and operational pressure (physical mortality failure mode).

5.2.1 Pipe Roughness

Hydrant testing was performed over a portion of the distribution system to determine calibrated pipeline roughness, or C-Factors (see Task 4 of the Master Plan, presented in Chapter 6). Calibrated C-Factors from the hydraulic model were used to determine the reduction in C-Factor when compared to the C-Factor of a brand-new pipe of the same material. The result of the C-Factor comparison is presented in Table 6.

Table 6. Pipe Roughness: C-Factor Comparison

Pipe Material	Pipe Sizes	New Pipe C-Factor	Calibrated C-Factor	Percent of New C-Factor
Asbestos Cement	Diameter ≤ 8 inches	140	110	79%
	Diameter > 8 inches		120	86%
Polyvinyl Chloride	Diameter ≤ 8 inches	150	130	87%
	Diameter > 8 inches		140	93%
Concrete Cylinder	Diameter > 8 inches	140	130	93%
Cast Iron	Diameter ≤ 8 inches	130	100	77%
	Diameter > 8 inches		110	85%
Ductile Iron	Diameter ≤ 8 inches	140	130	93%
	Diameter > 8 inches		140	100%
Steel	Diameter ≤ 8 inches	140	120	86%
	Diameter > 8 inches		130	93%

5.2.2 Operating Pressure

Operating pressure was obtained from the calibrated hydraulic model under an average day scenario, with system pumps operating. Pipeline assets were evaluated for high operating pressure as an influence to increased LOF. Through discussions with the City, pipeline assets operating continually in excess of 135 psi regardless of design class were considered to be at higher risk of failure or increased LOF.

5.3 Supplemental Condition Data

Supplemental condition data typically consists of focused condition assessment studies of assets and facilities to determine condition based on an established set of metrics and criteria. Such assessments should be performed at intervals generally less than the asset's useful life to confirm condition and status on the useful life curve. Maintenance records may also capture details from asset failure and problems. This information can be used to document type and frequency of failures that serve as an indication of asset condition and be used in the future to develop additional LOF factors.

5.4 Likelihood of Failure Evaluation

Assets were evaluated under each applicable LOF factor to develop an overall LOF rating. Pipeline assets were assessed based on the criteria outlined above consisting of RUL and operating pressure. Non-pipeline assets considered only RUL alone. Since these criteria are baseline and easy to assess they serve as the *fixed* LOF criteria.

Given the availability of supplemental data, the other criteria were incorporated as *modifiers* to the LOF assessment. LOF scores were subjected to the other criteria as potential modifiers that could increase the LOF rating if additional data were available. These modifiers include pipeline roughness, failure history from maintenance or other failure data, and focused condition assessment activities.

Both fixed and modifier LOF factors were assigned a weight based on the relative importance of each factor. For the fixed LOF factors, RUL is weighted to represent 80 percent of the total rating, while operating pressure represents 20 percent of the total rating. The maximum possible weighted rating for the fixed LOF factors is 4. LOF modifiers are only evaluated if the fixed LOF rating is less than 4. LOF modifiers can increase the overall rating up to 1 additional score, resulting in a total possible LOF rating of 4. Table 7 presents the LOF criteria and rating definitions.

Table 7. LOF Factor and Ratings – Water System Assets

Factor	LOF Rating and Definition				Weight	Max Possible Rating
	1 Unlikely	2 Possible	3 Likely	4 Very Likely		
Fixed LOF Factors						
Remaining Useful Life (RUL)	51 to 100% RUL	26 to 50% RUL	11 to 25% RUL; Non-AC pipe asset with unknown age	0 to 10% RUL; AC pipe asset with unknown age	80%	3.2 (Pipelines) 4.0 (All other assets)
Operating Pressure[(a)]	<84 psi	85 psi to 99 psi	100 psi to 1 34 psi	>135 psi	20%	0.8
					Maximum Rating	**4.0**
LOF Modifiers						
Pipe Roughness[(a)]	85% to 100% of new C-Factor Rating	75% to 84% of new C-Factor Rating	65% to 74% of new C-Factor Rating	<64% of new C-Factor Rating	2.5%	0.10
Failure History	<2	3 to 5	6 to 9	>10	10%	0.40
Condition Assessment	New	Used	Worn	Pending Failure	12.5%	0.50
					Maximum Modifier	**1.0**
					Total Possible LOF Rating	**4.0**

(a) Factor only applicable to pipelines

5.5 Asset LOF Results

Table 8 presents the LOF rating results as a percent of total assets by type (i.e. for hydrants, 8 percent of all hydrants were evaluated to have a LOF rating of 1 and 17 percent of all hydrants have a LOF rating of 2, etc.). Individual asset LOF results are provided in the *Asset Registry and Risk Results* Excel workbook.

Table 8. Asset LOF Results, Percent of Total Assets by Type

	LOF Rating, total assets by type, percent			
	1	2	3	4
Horizontal Assets				
Pipelines[(a)]	25	18	20	37
Hydrants	8	17	75	0
Meters	0	3	22	75
Valves	16	23	61	0
Vertical Assets				
Fuel Tank	0	0	33	67
Engine	0	0	0	100
Generator	0	0	67	33
Motor	0	0	30	70
PLC	0	0	50	50
PRV	0	4	87	9
Pump	0	0	16	84
Reservoir	0	60	40	0
Turnouts and Interties	0	0	100	0
VFD	0	0	22	78
Well	50	0	50	0

(a) Pipeline results are shown as percent of total pipeline length, not pipe segments.

5.6 Facility LOF Results

The previous section describes the method for assigning an LOF rating for each asset. For vertical assets, multiple assets can constitute a larger facility; for example, the Ayer Pump Station facility includes a pump, motor, generator, fuel tank, PLC, and VFD. LOF can also be estimated at the facility level by considering the LOF of individual components within that facility. LOF was estimated for Milpitas water system facilities by averaging the associated component LOFs, weighted based on the individual component value. The applied weighting considers the fact that assets of a lower value should have a lesser impact on the overall facility LOF, whereas assets with a higher value should have a greater impact on the overall facility LOF.

$$\text{Facility LOF} = \frac{\sum_{i=1}^{n} Component\ LOF \times Compnent\ Value\ (\$)}{Total\ Facility\ Value\ (\$)}$$

Table 9 presents the LOF rating results for each facility on the same 1 to 4 scale, rounded to the nearest tenth.

Table 9. Facility LOF Results

Facility	LOF Rating
Curtis Well	1.7
Gibraltar Reservoir (SC)	2.0
Gibraltar Reservoir (SF)	2.0
Minnis Reservoir	2.0
ACWD Intertie	2.4
SJWC Intertie	2.4
Calera Creek Heights PRV	2.4
Capitol PRV	2.4
Main PRV	2.4
Milpitas PRV	2.4
Sunnyhills PRV	2.4
Curtis PRV	2.5
SCVWD Intertie	3.0
Gibraltar Turnout	3.0
Calaveras Turnout	3.0
Sunnyhills Turnout	3.0
Main Street Turnout	3.0
Abel PRV	3.0
Gibraltar PRV	3.0
Live Oak PRV	3.0
McCarthy PRV	3.0
Montague PRV	3.0
North Vault PRV	3.0
Sinclair PRV	3.0
South Vault PRV	3.0
Ayer Reservoir	3.0
Tularcitos Reservoir	3.0
Country Club Pump Station	3.2
Tularcitos Pump Station	3.2
Pinewood Well	3.4
Ayer Pump Station	3.6
Gibraltar Pump Station	3.7

6.0 CONSEQUENCE OF FAILURE METHODOLOGY

Consequence of failure (COF) rates the severity of consequences should an asset fail. Consequences typically include system performance impacts; economic or social impacts to the City, residents, or the community; safety impacts; and local or regional environmental impacts.

COF factors were developed in collaboration with City staff to reflect both City Council Core Goals and Priority Areas.

6.1 Consequence of Failure Framework

The Milpitas City Council has adopted a series of goals and priority areas that identify critical elements important to the City in the services it provides. These Goals and Priority Areas are outlined in the City's 2020 fiscal budget as shown below.

Core Goals	Priority Areas
• Superior Customer Service • Integrity and Accountability • Recognition and Celebration • Open Communication • Trust and Respect	• Public Safety • Transportation and Transit • Neighborhoods and Housing • Governance and Administration • Environment • Economic Development and Job Growth • Community Wellness and Open Space

Council objectives such as these can typically align with the critical objectives of a utility's performance and can therefore be related to asset performance and the consequence of an asset failing. A COF framework was developed based on the Council Goals and Priority Areas. Each goal and priority area were evaluated for applicability to asset COF and, for those that could be developed, were categorized, measured, and rating definitions developed. Every objective except for: Recognition and Celebration; Open Communication; Neighborhoods and Housing; and Community Wellness and Open Space were developed into factors within the COF framework. Table 10 presents the COF framework and eight proposed COF factors.

Table 10. COF Framework

Council Goals and Priority Areas	Category	COF Factor	Rating and Metric: 1 Negligible	2 Minimal	3 Moderate	4 Severe
Superior Customer Service	Reliable, High Quality Customer Service in General	(1) Water Service Interruptions	Negligible Impact to Water Service	Water pressure below 30 psi	Interruption of Water Service Over Localized Area	Interruption of Water Service Over Large Area
Integrity and Accountability Trust and Respect	Public Perception/Response	(2) Magnitude and Method of Public Response	No Public Response	May result in telephone calls	May Result in Social Media Coverage	May Result in Local or Greater Media Coverage or Public Comment
Public Safety	Health and Safety of Public and City Employees	(3) Severity of Injury or Illness	No Health or Safety Impact	Minor Injury, First Aid	Injury, Medical Attention	Severe Injury or Loss of Life
Environment	Compliance with Environmental Regulations or other Water Quality Concern	(4) State and Federal Regulatory Violations or Public Response	No Impact	Reportable violation, no enforcement action	May Result in Strong Warning or Fine	Non-compliance resulting in administrative or consent order
Transportation and Transit	Public Transit Service	(5) Public Transit Service Interruptions	No Impact	Minor Detours	Bus Service is impacted >15% to sensitive groups/locations	Community Access to BART is Interrupted Requires Coordination with Outside Agencies i.e., County, CalTrans, VTA, etc.
Economic Development and Job Growth	Economic Impacts	(6) Local Business Impact	No Impact	Localized Short-term Business Impact, no Adverse Impact on Economic Vitality		Long-term or Area-wide Economic Impact, Adverse Impact to Economic Vitality
Governance and Administration	Utility Operations	(7) Response Time to Restore an Asset	Recovery measured in days	Recovery could require up to Two (2) weeks	Recovery Could Require up to One (1) Month	Recovery Requires Greater Than One (1) Month
		(8) Restoration Costs or Impact on Utility Rates	Can be absorbed within fiscal budget without adjustment	Could impact multiple budget objects	May Require Council Action	May Impact Reserves

6.2 Consequence of Failure Rating Defined

The COF framework presented in Table 10 was further developed into a model to assess COF for both horizontal and vertical assets by defining rating interpretations for all factors. Interpretations were developed into metrics such that COF ratings could easily be assigned with asset characteristics or geospatial data, avoiding manual evaluation of individual assets. For horizontal assets, this included assessment based on pipe size, street classification, land use, and hydraulic modeling. For vertical assets this included similar assessment criteria along with asset type.

COF ratings were assigned for each factor using standard definitions presented in Table 11. Ratings range from 1 – indicating the consequence of asset failure would be "negligible", to 4 – indicating the consequence of asset failure would be "severe". Tables 11 and 12 present the COF factors, metrics, and ratings for horizontal and vertical assets, respectively.

Table 11. COF Definition and Ratings

	LOF Rating			
	1	2	3	4
COF Definition	Negligible	Minimal	Moderate	Severe

Table 12. COF Factors and Ratings – Horizontal Assets (Pipes, Valves, Hydrants, Meters)

Factor	Description	Data Source	Rating and Metric 1 Negligible	2 Minimal	3 Moderate	4 Severe
(1) Water Service Interruption	Asset failure may cause interruptions to water service	GIS Pipe Diameter[c]; GIS Meter Size	Pipes ≤8-inch	Pipes 10 to 12-inch; All Other Meters	Pipes 14 to 18-inch; Meters 6 to 8-inch	Pipes >18-inch
(2) Magnitude and Method of Public Response	Asset failure may cause a loss in public confidence	GIS Pipe Diameter[c]; Critical Facilities[a]	-	Pipes ≤8-inch; All Other Meters	Pipes 10 to 12-inch; Meters 6 to 8-inch	Pipes >14-inch within 500 feet of a Critical Facility
(3) Severity of Injury or Illness	Asset failure may cause injury or illness to public or utility operations staff	GIS Pipe Diameter[c]	Pipes ≤8-inch; All Other Meters	Pipes 10 to 12-inch; Meters 6 to 8-inch	Pipes 14 to 18-inch	Pipes >18-inch
(4) State and Federal Regulatory Violations or Public Response	Asset failure may result in violation of state or federal environmental regulations	Asset Type	All Valves; All Meters	All Pipes; All Hydrants	-	-
(5) Public Transit Service Interruptions	Asset failure may cause an impedance to public and private transportation function	GIS Road Speed; GIS Land Use; BART stations; and Sensitive Groups/Locations[b]	Streets with speeds up to 25 mph	Streets with speeds from 30-50 mph in Residential LU	Streets with speeds from 30-50 mph in Non-Residential LU; or Adjacent to a Sensitive Group/ Location	Highways, Highway crossings, or Within 100-feet of BART station
(6) Local Business Impact	Asset failure may have a negative impact to the City economy	GIS Land Use (LU)	All Other LU Types	-	LU types including PF, RRMU, M	LU types including TWC, VHDMU, GNC, RSC, INP, MFG, PAO
(7) Response Time to Restore an Asset	The City's ability to respond depends on the location of the asset	GIS Road Speed	Streets with speeds up to 25 mph	Streets with speeds from 30-50 mph in Residential LU	Streets with Speeds from 30-50 mph in Non-Residential LU	Highways or Highway Crossings
(8) Restoration Costs or Impact to Utility Rates	The asset failure may have an impact to utility fiscal performance	GIS Pipe Diameter[c]	Pipes ≤12-inch; All Meters	Pipes 14 to 16-inch	Pipes 18 to 24-inch	Pipes >24-iinch or Highway Crossings

(a) Critical Facilities include Schools, Fire Stations, and Hazardous Pipelines.
(b) Sensitive Groups/Locations include Fire Stations and Schools.
(c) Hydrants were assigned the rating of adjacent/service pipeline; Valves were assigned the rating of connecting pipeline.

Table 13. COF Factors and Ratings – Vertical Assets

Factor	Description	Data Source	Rating and Metric			
			1 Negligible	2 Minimal	3 Moderate	4 Severe
(1) Water Service Interruption	Asset failure may cause interruptions to water service	Asset Type	-	-	PRVs	Interties, Turnouts, Reservoirs, Pumping Stations, Wells, Emergency PRVs
(2) Magnitude and Method of Public Response	Asset failure may cause a loss in public confidence	Asset Type	-	-	-	Interties, Turnouts, Reservoirs, Pumping Stations, Wells, PRVs
(3) Severity of Injury or Illness	Asset failure may cause injury or illness to public or utility operations staff	Asset Type	-	-	PRVs	Interties, Turnouts, Reservoirs, Pumping Stations, Wells, Emergency PRVs
(4) State and Federal Regulatory Violations or Public Response	Asset failure may result in violation of state or federal environmental regulations	Asset Type and location	All Others	-	Wells	Wells within 50-feet to a surface water source and Surface Water Interties
(5) Public Transit Service Interruptions	Asset failure may cause an impedance to public and private transportation function	GIS Road Speed; GIS Land Use; BART stations; and Sensitive Groups/Locations[b]	Streets with speeds up to 25 mph	Streets with speeds from 30-50 mph in Residential LU	Streets with speeds from 30-50 mph in Non-Residential LU; or Adjacent to a Sensitive Group/ Location	Highways, Highway crossings, or Within 100-feet of BART station
(6) Local Business Impact	Asset failure may have a negative impact to the City economy	GIS Land Use	All Other LU Types	-	LU types including PF, RRMU, M	LU types including TWC, VHDMU, GNC, RSC, INP, MFG, PAO
(7) Response Time to Restore an Asset	The City's ability to respond depends on the location of the asset	Asset Type	-	PRVs, Interties	Turnouts	Reservoirs, Pumping Stations, Wells
(8) Restoration Costs or Impact to Utility Rates	The asset failure may have an impact to utility fiscal performance	Asset Type	PRVs, Interties	Turnouts	-	Reservoirs, Pumping Stations, Wells

(a) Sensitive Groups/Locations include Fire Stations and Schools

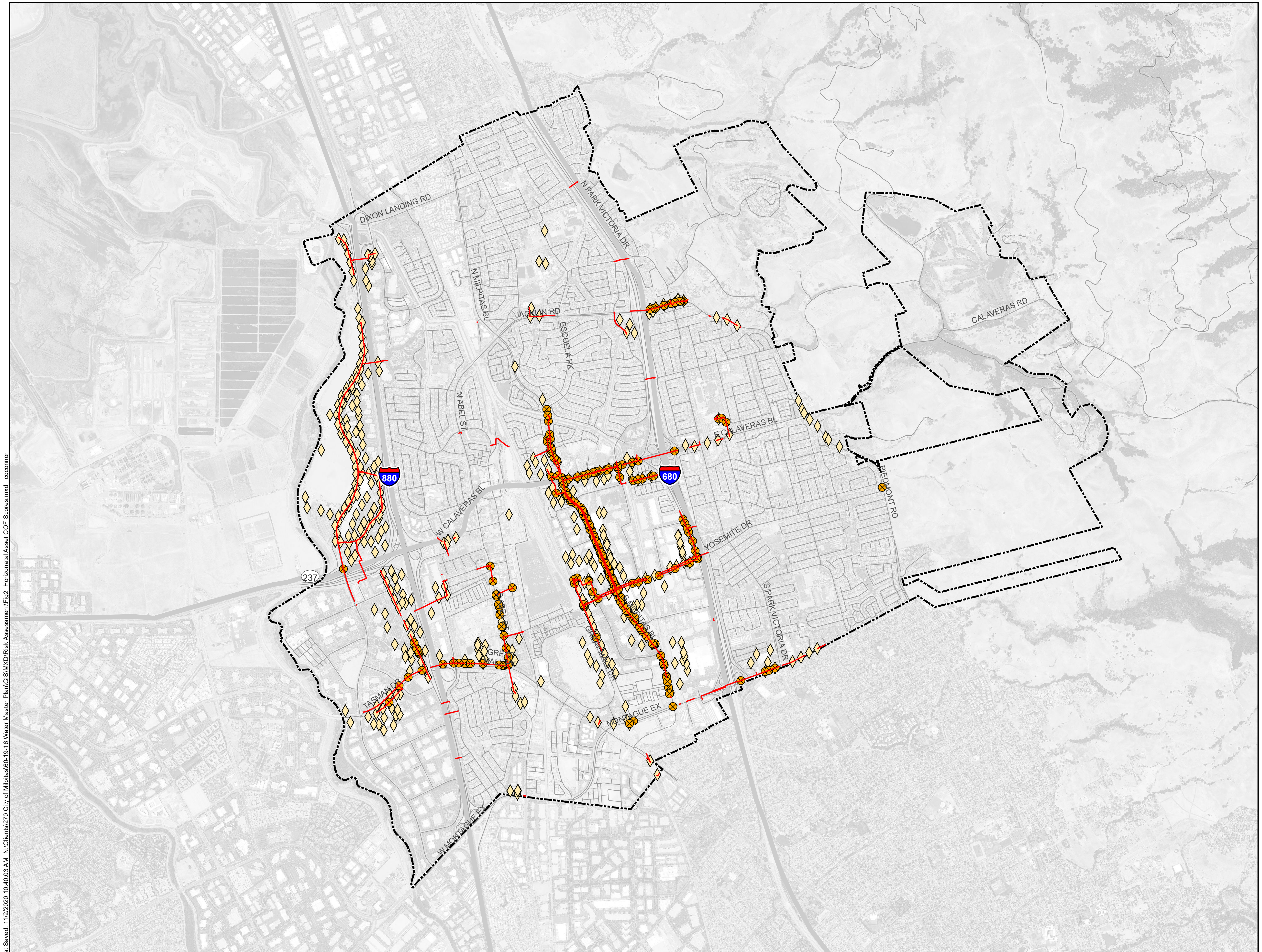
6.3 Horizontal Asset COF Results

The eight asset COF ratings were averaged to obtain an overall COF rating on the 1 to 4 scale. Table 14 presents the COF rating results for horizontal assets, summarized by percent of total asset type (i.e. for hydrants, 32 percent of all hydrants were evaluated to have a COF rating of 1). Horizontal assets with a moderate (3) COF rating are shown spatially in Figure 2. Individual asset COF results are provided in the *Asset Registry and Risk Results* Excel workbook.

Table 14. Horizontal Asset COF Results, Percent of Total Asset by Type

Horizontal Assets	COF Rating, percent			
	1	2	3	4
Pipelines[a]	45	46	9	0
Hydrants	32	53	15	0
Meters	100	0	0	0
Valves	43	52	5	0

(a) Pipeline results are shown as percent of total pipeline length.



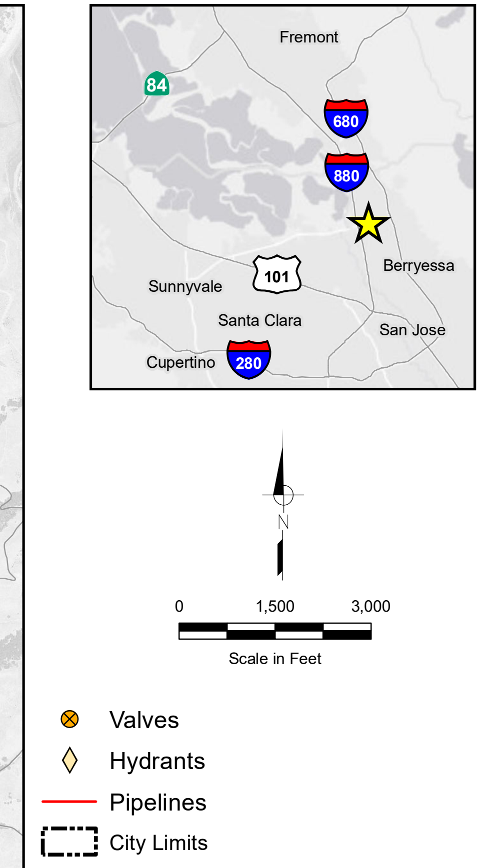


Figure 2

Existing Horizontal Assets with COF Score ≥ 3

City of Milpitas
2020 Water Master Plan Update

6.4 Facility COF Results

For vertical assets, COF ratings were assigned at the facility level (i.e. pump station, reservoir, well, etc.), with all facility components inheriting the COF rating of its parent facility. Table 15 presents the overall COF rating results for each facility on the same 1 to 4 scale, rounded to the nearest decimal.

Table 15. Facility COF Results

Facility	COF Rating
Live Oak PRV	2.0
Main PRV	2.0
North Vault PRV	2.0
South Vault PRV	2.0
Calera Creek Heights PRV	2.0
SCVWD Intertie	2.3
SJWC Intertie	2.3
Abel PRV	2.3
Gibraltar PRV	2.4
McCarthy PRV	2.4
Sinclair PRV	2.4
Sunnyhills PRV	2.4
Milpitas PRV	2.5
Main Street Turnout	2.5
ACWD Intertie	2.6
Capitol PRV	2.6
Curtis PRV	2.6
Montague PRV	2.6
Calaveras Turnout	2.8
Sunnyhills Turnout	2.8
Country Club Pump Station	2.9
Tularcitos Pump Station	2.9
Minnis Reservoir	2.9
Tularcitos Reservoir	2.9
Gibraltar Turnout	2.9
Ayer Reservoir	3.1
Gibraltar Pump Station	3.3
Gibraltar Reservoir (SC)	3.3
Gibraltar Reservoir (SF)	3.3
Curtis Well	3.3
Pinewood Well	3.3
Ayer Pump Station	3.4

7.0 RISK ASSESSMENT

Risk combines both LOF and COF to determine the resulting level of risk exposure that an agency is likely to confront through a potential failure of an asset. Assets with the highest risk have both a high likelihood of failure (i.e., poor condition or increased potential to underperform) and a high consequence of failure (i.e., significant consequences should failure occur).

The conventional risk equation, which was employed in this assessment, is the product of LOF and COF:

$$Risk = COF \times LOF$$

7.1 Risk Interpretation

Individual COF and LOF factor definitions were combined to define the overall risk of each asset, interpreted as a Low, Medium, Medium-High, or High risk level. Table 16 presents the risk level matrix and risk definitions.

Table 16. Risk Level Matrix

		LOF Rating and Definition			
		1 Unlikely	2 Possible	3 Likely	4 Very Likely
COF Rating and Definition	1 Negligible	Low	Low	Low	Low
	2 Minimal	Low	Low	Medium	Med-High
	3 Moderate	Medium	Medium	Med-High	High
	4 Severe	Medium	Med-High	High	High

7.2 Risk Results

The risk results are summarized in the tables below, including notation of the median risk rating for each asset type.

7.2.1 Pipelines

Table 17 presents the risk results for pipelines by percent of total pipeline length in each risk level. Table 18 presents the detailed LOF and COF ratings by pipeline length. The median risk level for pipelines is Low, with an associated LOF of 3 and COF of 1. Pipeline risk is also presented spatially in Figure 3.

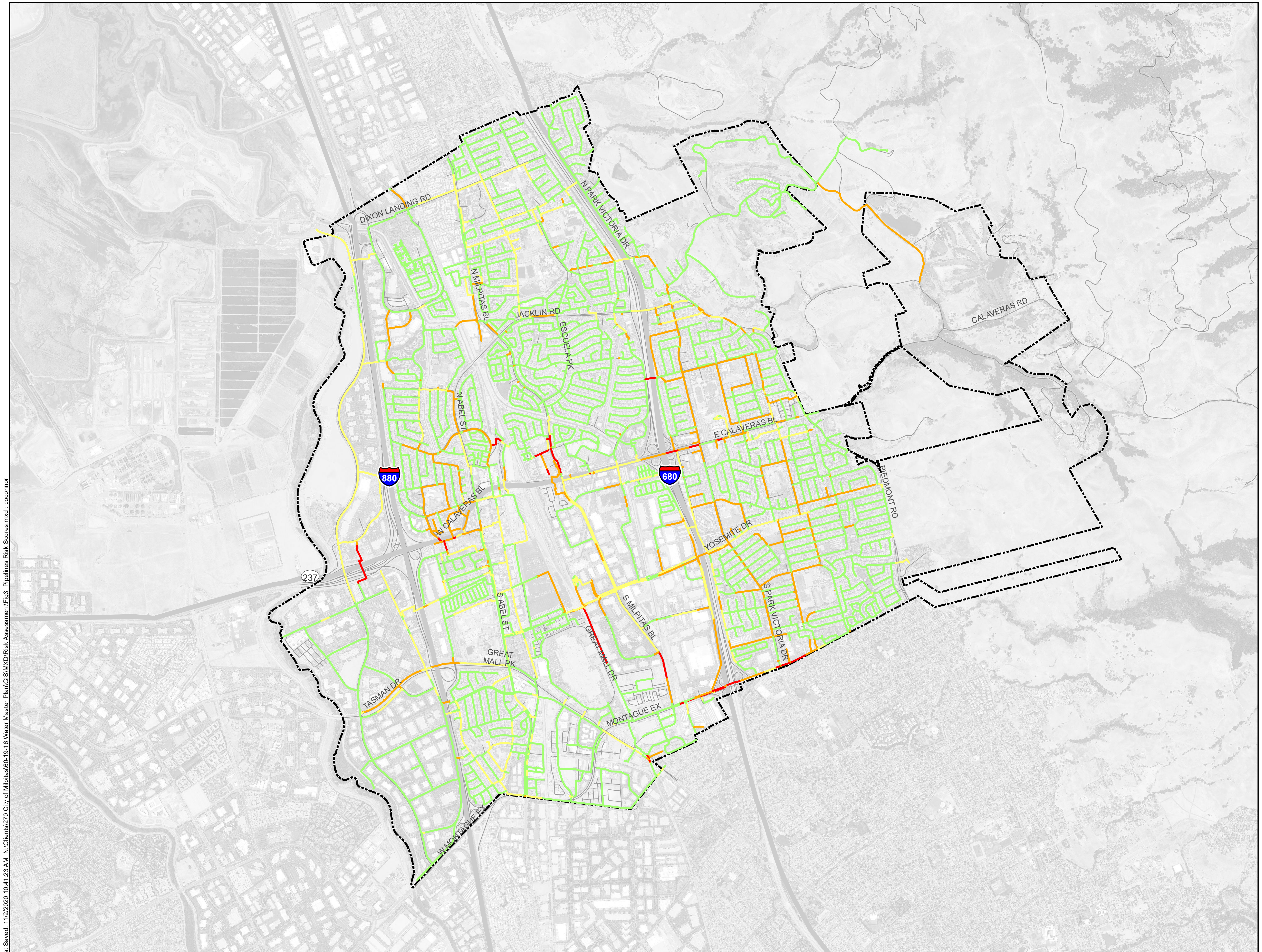
Table 17. Pipeline Risk, Percent of Total Pipeline Length by Risk Level

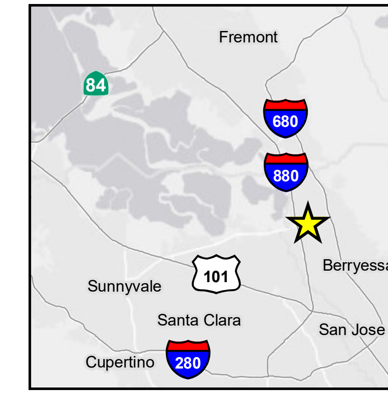
Risk Level	Percent
Low	71
Medium	15
Medium-High	13
High	1

Table 18. Pipeline Risk by LOF and COF, Miles of Pipeline

		LOF				Total Length
		1	2	3	4	
COF	1	15.1	3.0	17.2[a]	46.4	81.8
	2	23.6	24.7	15.7	19.8	83.8
	3	5.7	5.6	2.9	1.9	16.2
	4	0.3	0.2	0.4	0.1	0.9
Total		**44.7**	**33.5**	**36.2**	**68.2**	**183**

(a) Denotes the median risk score for all pipelines





N

0 1,500 3,000
Scale in Feet

City Limits
Low
Medium
Med-High
High

WEST YOST

Figure 3

Existing Pipelines Risk Classifications

City of Milpitas
2020 Water Master Plan Update

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7.2.2 Hydrants

Table 19 presents the risk results for hydrants by percent of total hydrants in each risk level. Table 20 presents the detailed LOF and COF ratings for all hydrants. The median risk level for hydrants is Low, with an associated LOF of 2 and COF of 2.

Table 19. Hydrant Risk, Percent of Total Hydrants by Risk Level

Risk Level	Percent
Low	78
Medium	22
Medium-High	<0.5
High	0

Table 20. Hydrant Risk by LOF and COF, Count of Hydrants

		LOF				Total Hydrants
		1	2	3	4	
COF	1	71	523	329	0	923
	2	114	1,219[(a)]	216	0	1,549
	3	54	376	4	0	434
	4	0	0	0	0	0
Total		**239**	**2,118**	**549**	**0**	**2,906**

(a) Denotes the median risk score for all pipelines

7.2.3 Valves

Table 21 presents the risk results for valves by percent of total valves in each risk level. Table 22 presents the detailed LOF and COF ratings for all valves. The median risk level for valves is Low, with an associated LOF of 2 and COF of 2.

Table 21. Valve Risk, Percent of Total Valves by Risk Level

Risk Level	Percent
Low	87
Medium	13
Medium-High	<0.5
High	0

Table 22. Valve Risk by LOF and COF, Count of Valves

		LOF				Total Valves
		1	2	3	4	
COF	1	412	1,370	967	0	2,749
	2	509	2,248[a]	549	0	3,296
	3	83	187	26	0	296
	4	0	0	0	0	0
	Total	**1,004**	**3,794**	**1,542**	**0**	**6,341**

(a) Denotes the median risk score for all pipelines

7.2.4 Meters

Table 23 presents the risk results for meters by percent of total meters in each risk level. Table 24 presents the detailed LOF and COF ratings for all meters. The median risk level for meters is Low, with an associated LOF of 4 and COF of 1.

Table 23. Meter Risk, Percent of Total Meters by Risk Level

Risk Level	Percent
Low	>99.9
Medium	<0.1
Medium-High	<0.1
High	0

Table 24. Meter Risk by LOF and COF, Count of Meters

		LOF				Total Meters
		1	2	3	4	
COF	1	0	476	3,555	12,312[a]	16,343
	2	0	2	4	2	8
	3	0	0	0	0	0
	4	0	0	0	0	0
	Total	**0**	**478**	**3,559**	**12,314**	**16,351**

(a) Denotes the median risk score for all pipelines

7.2.5 Vertical Assets

Table 25 presents the risk results for all vertical assets by percent of total assets in each risk level. Table 26 presents the detailed LOF and COF ratings for all vertical assets. The median risk level for all vertical assets is Medium-High, with an associated LOF of 3 and COF of 3.

Table 25. Vertical Asset Risk, Percent of Vertical Assets by Risk Level

Risk Level	Percent
Low	1
Medium	25
Medium-High	25
High	48

Table 26. Vertical Asset Risk by LOF and COF, Count of Vertical Assets

		LOF				Total Vertical Assets
		1	2	3	4	
COF	1	0	0	0	0	0
	2	0	0	13	0	13
	3	1	4	29[a]	40	74
	4	0	0	0	0	0
Total		**1**	**4**	**38**	**40**	**87**

(a) Denotes the median risk score for all pipelines

7.2.6 Facility Risk Results

The risk for each facility was evaluated based on the resulting facility LOF and COF ratings discussed previously and the risk equation. Table 27 presents the detailed LOF and COF ratings for each facility. Note the four-by-four risk matrix has been expanded to one decimal to provide greater granularity. The overall facility risk scores (LOF x COF) and risk levels are shown in Table 28 from lowest to highest risk.

Table 27. Risk of Facilities by LOF and COF

		LOF							
		0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
COF	0.5	--	--	--	--	--	--	--	--
	1.0	--	--	--	--	--	--	--	--
	1.5	--	--	--	--	--	--	--	--
	2.0	--	--	--	--	Calera Creek Heights PRV, Main PRV	Curtis Well, Live Oak PRV, North Vault PRV, South Vault PRV	--	--
	2.5	--	--	--	--	SJWC Intertie, Sunnyhills PRV, Milpitas PRV, ACWD Intertie, Capitol PRV, Curtis PRV	Abel PRV, SCVWD Intertie, Gibraltar PRV, McCarthy PRV, Sinclair PRV, Main Street Turnout, Montague PRV	--	--
	3.0	--	--	--	Minnis Reservoir	--	Calaveras Turnout, Sunnyhills Turnout, Tularcitos Reservoir, Gibraltar Turnout, Country Club Pump Station, Tularcitos Pump Station, Ayer Reservoirs	--	--
	3.5	--	--	--	Gibraltar Reservoir (SC), Gibraltar Reservoir (SF)	--	--	Pinewood Well, Gibraltar Pump Station, Ayer Pump Station	--
	4.0	--	--	--	--	--	--	--	--

Table 28. Facilities by Risk Score and Risk Level

Facility	Risk Score (LOF x COF)	Risk Level
Calera Heights PRV, Main PRV	4.8	Medium
SJWC Intertie	5.4	Medium
Curtis Well	5.5	Medium
Minnis Reservoir	5.8	Medium
Live Oak PRV, North Vault PRV, South Vault PRV,	6.0	Medium
ACWD Intertie, Capitol PRV	6.3	Medium-High
Gibraltar Reservoir (SC), Gibraltar Reservoir (SF)	6.5	Medium-High
Curtis PRV	6.6	Medium-High
Abel PRV, SCVWD Intertie	6.8	Medium-High
Gibraltar PRV, McCarthy PRV, Sinclair PRV	7.1	Medium-High
Sunnyhills PRV	5.7	Medium-High
Milpitas PRV	6.0	Medium-High
Main Street Turnout	7.5	Medium-High
Montague PRV	7.9	Medium-High
Calaveras Turnout, Sunnyhills Turnout	8.3	Medium-High
Tularcitos Reservoir, Gibraltar Turnout	8.6	Medium-High
Country Club Pump Station, Tularcitos Pump Station	9.2	Medium-High
Ayer Reservoir	9.4	Medium-High
Pinewood Well	11.1	High
Gibraltar Pump Station	12.0	High
Ayer Pump Station	12.2	High

8.0 CONCLUSIONS

8.1 Horizontal Assets

The desktop analysis indicates the horizontal infrastructure of the water system is well into its useful life curve with most assets rated 3 (“likely” asset failure) or higher for LOF.

The consequence of failure analysis indicates that horizontal assets expose mostly a negligible to minimal impact should they fail, with a small percentage of assets potentially yielding a moderate impact.

Overall, the majority (71%) of pipeline assets have a risk rating of Low, with a high LOF and low COF. There is a significant risk exposure to pipeline failure due to this high LOF, which is primarily due to asset age. Hydrants, valves, and meters are also at a Low risk level with generally advanced age contributing to a higher LOF but a relatively low COF.

8.2 Vertical Assets – Facilities

Facilities were generally rated 2 or higher for LOF. The City has developed most of its newer infrastructure in well and reservoir facilities (Curtis Well, Gibraltar Reservoirs, Minnis Reservoir), which are rated with an LOF of less than 3. Remaining facility LOF was consistently rated between 2.4 and 3, except for the Country Club Pump Station, Tularcitos Pump Station, Pinewood Well, Ayer Pump Station and Gibraltar Pump Station which were rated from 3.2 to 3.7. These higher LOF values are indicative of higher asset values with advanced age, suggesting a greater and more immediate investment need in asset renewal.

Facility COF ratings ranged from 2 to 3.4, with the highest ratings assigned to pump stations, reservoirs, and wells. PRVs, interties, and turnouts were all rated below 2.9.

8.3 System Level Risk Summary

The overall risk of the water system is low for horizontal infrastructure and medium-high for facilities. Table 29 illustrates the risk at the distribution system level, allocated by each asset type. Note that some facility types are noted in multiple risk levels.

Table 29. Risk at Water System Level

<table>
<tr><td colspan="2" rowspan="2"></td><td colspan="4">LOF</td></tr>
<tr><td>1</td><td>2</td><td>3</td><td>4</td></tr>
<tr><td rowspan="4">COF</td><td>1</td><td>--</td><td>--</td><td>Pipelines</td><td>Meters</td></tr>
<tr><td>2</td><td>--</td><td>Hydrants
Valves</td><td>Well
PRVs</td><td>--</td></tr>
<tr><td>3</td><td>--</td><td>Reservoir</td><td>PRVs
Turnouts
Reservoirs
Pump Stations</td><td>Well
Pump Stations</td></tr>
<tr><td>4</td><td>--</td><td>Reservoirs</td><td>--</td><td>--</td></tr>
</table>

Appendix E

Seismic Risk Assessment

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TECHNICAL MEMORANDUM

DATE:	October 28, 2020	Project No.: 270-60-19-16 SENT VIA: EMAIL
TO:	Harris Siddiqui	
FROM:	Whitney Sandelin, PE, RCE #86703 Amara Cairns	
REVIEWED BY:	Mel Damewood III, PE	
SUBJECT:	City of Milpitas - Summary of Methodologies and Results from Hazus® Earthquake Model and American Lifelines Alliance® Analysis	

PURPOSE AND INTRODUCTION

The purpose of this technical memorandum (TM) is to document the methodologies used to estimate consequences and risks associated with an earthquake event affecting the City of Milpitas (City) water system. The results of this analysis conclude in the estimation of the direct consequence of a representative earthquake scenario for the City. The consequence estimates presented herein do not include consideration of community economic losses (e.g. indirect or induced) that may occur due to extended periods without water service.

This TM is organized as follows:

- Introduction to Hazus and American Lifelines Alliance (ALA) Methodologies
- Earthquake Scenario Selection
- Estimated Damage States and Restoration Times
- Estimated Service Denial
- Conclusion and Disclaimer
- References

INTRODUCTION TO HAZUS AND ALA METHODOLOGIES

The Federal Emergency Management Agency (FEMA) has developed a standardized methodology for estimating losses from certain natural hazards, including earthquakes. The methodology, known as Hazus, addresses flooding, hurricanes, coast surge, tsunamis and earthquakes. Specifically, the Hazus Earthquake Model is designed to “produce loss estimates for use by federal, state, regional and local governments in planning for earthquake risk mitigation, emergency preparedness, response and recovery”.

The American Water Works Association (AWWA) J100 Standard, *Risk and Resilience Management of Water and Wastewater System* (J100 Standard), recommends the Hazus methodology to estimate the damage states and restoration times for individual facilities, such as pump stations and storage tanks. However, West Yost understands that the draft version of the forthcoming update to the J100 Standard recommends the use of the ALA methodology for estimating damages to pipelines and distribution systems under a selected earthquake event. The authors of Hazus acknowledge its limitation for pipelines. As described in the "Message to Users" section of the Hazus Manual, while the Hazus methodology has been tested against the judgment of experts and, to the extent possible, against records from several past earthquakes, limited and incomplete data about actual earthquake damage precludes complete calibration of the methodology.

Although the revised J100 Standard has not yet been released by AWWA, West Yost considers it to reflect best management practices for conducting earthquake consequence analyses for public water systems. Therefore, West Yost is using two methods in this analysis:

- Hazus for non-linear assets (i.e., storage tanks, pump stations, and treatment facilities). The methodologies presented herein are based on the *Hazus Multi-Hazard Technical Manual, Version 2.1* (Hazus Manual).
- *ALA Seismic Fragility Formulations for Water Systems, Part 1, April 2001 (ALA Manual)* for linear assets.

Hazus deals with all aspects of the built environment, including water system infrastructure. Chapter 8 focuses on direct damage to Utility Systems, including a loss estimation methodology for water system supply, storage, transmission, and distribution components. The ALA Manual provides recommended pipe vulnerability functions and fragility curves in Chapter 4.

The following sections document the specific steps taken to estimate consequences associated with an earthquake event, using the Hazus and ALA methodologies to assess select assets within the City's water system.

EARTHQUAKE SCENARIO SELECTION

In order to apply the Hazus and ALA methodologies, a user must first identify specific parameters associated with a potential ground shaking event, including peak ground acceleration (PGA), peak ground velocity (PGV), and peak ground deformation (PGD). The United States Geological Survey (USGS) Earthquake Scenario Catalogs (also referred to as ShakeMaps) were examined to identify a relevant earthquake scenario for the utility's service area.

The earthquake scenario selected for the City of Milpitas is the Hayward-Rodgers Creek event described in the USGS Northern California Legacy Catalog. At magnitude 6.8, this event represents the largest magnitude event described by ShakeMap in relatively close proximity to key City utilities. The scenario map from the USGS site is shown on Figure 1; the scenario selected for the utility is highlighted in blue. According to USGS, this event has an estimated annual probability of approximately 0.74 percent (i.e., a 0.74 percent chance of occurring in any given year), and an approximately 31.02 percent chance of occurrence within the next 50 years. This event is a scenario (i.e., it is not a historical event) and is intended for planning purposes only.

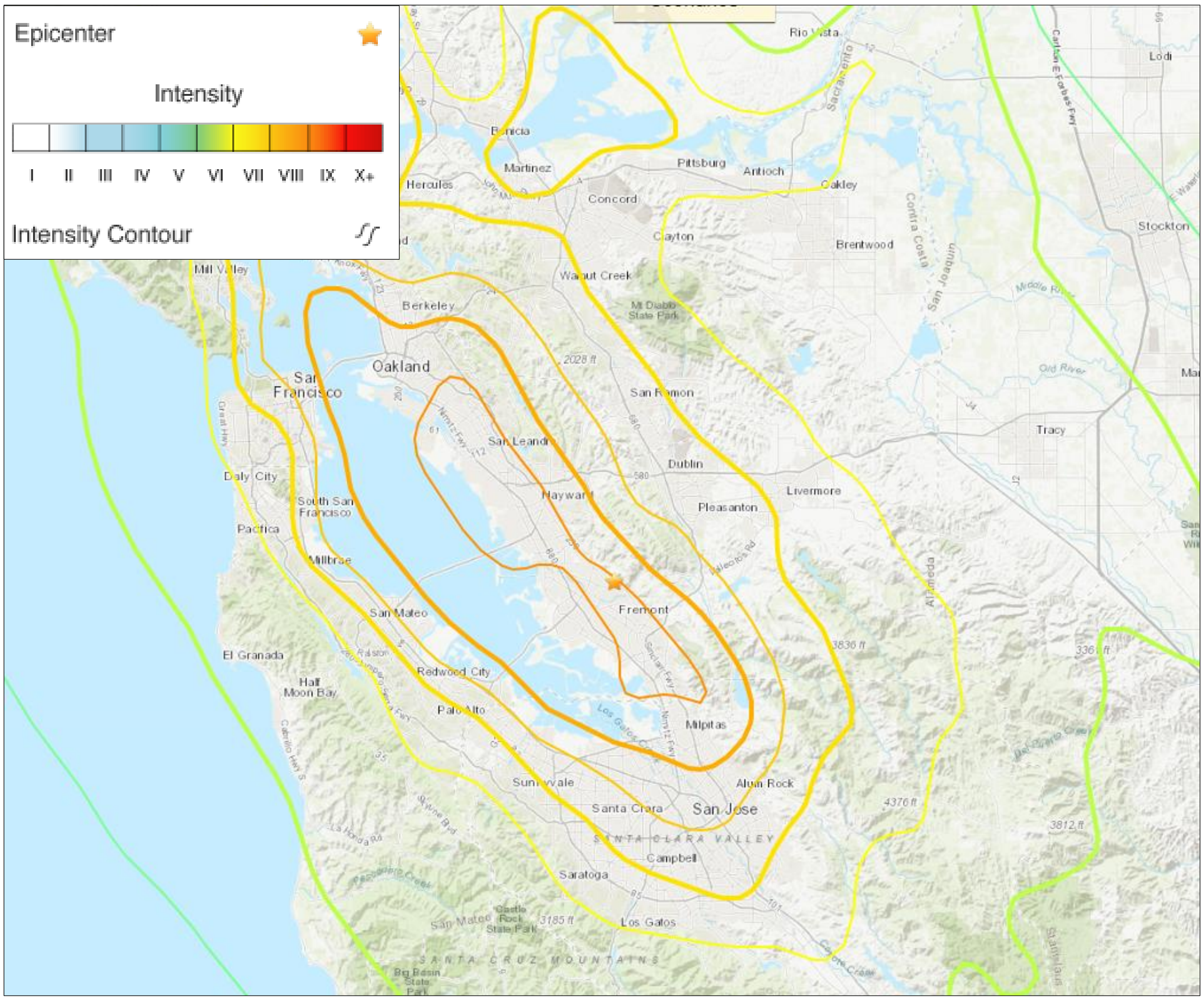

Figure 1. USGS ShakeMap—6.8 Magnitude Earthquake Event for the City of Milpitas

Utilizing the interactive geospatial data interface provided by USGS, ground motion contours were examined based on the scenario epicenter and fault location(s). Values for PGA and PGV were visually interpolated for the location of each asset. For the selected scenario, PGD values were not specified on the USGS ShakeMaps. Table A-1 of Attachment A shows the PGA values assigned to each of the City's selected non-linear assets.

ESTIMATED DAMAGE STATES AND RESTORATION TIMES

The Hazus and ALA methodologies are intended to provide a high-level estimate of damage states for select assets. The purpose of this evaluation is to identify and prioritize more detailed evaluation and mitigation measures in the future.

Based on the PGA and asset type, the Hazus methodology yields an estimate of the damage state for each non-linear asset, along with an associated restoration time as part of the Hazus program. Damage states estimated in this analysis include moderate and extensive for both pump stations and storage tanks. Descriptions of these damage states are included below.

Pump Stations

- **Extensive damage** for pump stations is defined as extensive damage to facility buildings or damage to pumps beyond repair.
- **Moderate damage** for pump stations is defined by the loss of electric power for approximately one-week, considerable damage to mechanical and electrical equipment, or moderate damage to buildings.

Storage Tanks

- **Extensive damage** for storage tanks is defined as damage to the tank extensive enough to require removal of the tank from service, including, for example, elephant foot buckling for steel tanks with loss of content or shearing of concrete tank walls.
- **Moderate damage** for storage tanks is defined by the tank being considerably damaged but with only minor loss of content. Examples of moderate damage include elephant foot buckling for steel tanks without loss of content, or moderate cracking of concrete tanks with minor loss of content.

Similarly, the ALA methodology yields estimated numbers of breaks and leaks among linear assets, based on PGV, PGD, and specific asset attributes (e.g., pipeline material, joint type, etc.). The following sections describe these methodologies and the results of their application to the City's assets in greater detail.

Restoration Times

Restoration time is defined as the time to restore the facility to a functioning level. This analysis considered the time to restore select assets owned and operated by the City. Assets which are required for the delivery of both San Francisco Public Utilities Commission (SFPUC) and Valley Water (VW) source water from the wholesaler to the City were not included in this analysis; it should be noted that, on a regional level, an earthquake event could disrupt supply infrastructure from SFPUC and VW to the City's distribution system, limiting the City's capacity to any wells that are repaired or remain functional.

In this analysis, total restoration time consists of the time to repair the damage (construction and repair activities) plus the preconstruction activities, such as the time involved with the immediate post event, pre-restoration assessment, planning, and mobilization activities. The total restoration time is estimated by using construction/repair duration provided in the Hazus method and adding to this an estimate of the time required for preconstruction activities. Engineering judgement and input from the City were utilized to fine tune the total restoration times. For linear assets (Pipelines) engineering judgement and input from the City were utilized to estimate restoration times.

Hazus conducted statistical analyses method to provide estimate of the amount of time needed to conduct construction and repair activities for a variety of non-linear assets and a range of damage states. They provide the “mean restoration time” and the standard deviation. This analysis is using the “mean restoration time” provided by Hazus.

Methodology Summary

The overall methodology to this analysis is to estimate the damage to non-linear and linear utility assets from an earthquake, estimate the restoration time for each damaged asset, and then calculate cost to restore the system based on the restoration time needed for each asset. Repair and replacement costs are calculated using the crew size available to the City, the labor rate, the shift duration and order of magnitude material costs for the City. The next section describes how damage is estimated for non-linear and linear assets.

Non-Linear Assets: Reservoirs, Pump Stations, and Key City Properties

Non-linear assets include reservoirs, pump stations, and key city properties. Each facility was assigned a Hazus “facility classification.” Classifications are generally based on the type of facility and whether the facility features anchored components/equipment. Hazus defines anchored as “equipment designed with special seismic tiedowns or tiebacks,” while unanchored equipment refers to equipment designed with no special considerations other than the manufacturer’s normal requirements. Based on review of previously prepared seismic facility assessments and observations made during site visits, all of the utility’s assets were assigned to the anchored component facility classification.

The resulting Hazus facility classifications for the City’s assets are presented in Table A-1. Hazus Tables 8.3, 8.6, 8.7 and 8.9 (reproduced in Figures A-1 through A-4 in Attachment A) were used to assign damage states based on PGA or PGV values obtained for the selected earthquake event. In the utility’s case, there are several non-linear facility classifications deemed susceptible to PGD, including reservoirs and pump stations.

Hazus Table 8.1.a (reproduced as Figure A-5 of Attachment A) was used to estimate the damage state and associated mean restoration time for each facility. Hazus-recommended restoration time estimates are based on Hazus restoration function curves and represent an average time for the facility classification. In addition to the restoration time suggested by Hazus, three days were added to account for the immediate post-event, pre-restoration assessment, planning, and mobilization activities. Table A-1 shows the resulting estimated restoration time for each asset.

Non-Linear Asset Damage State

Using the Hazus Method for non-linear assets, the Hayward-Rogers Creek 6.8 magnitude earthquake scenario is estimated to cause moderate damage to the City’s pump stations, storage tanks, and buildings. This is primarily due to the high Peak Ground Acceleration and Velocity (PGA, PGV) that the earthquake will produce in the City’s service area. Liquefaction susceptibility ranges from very low to moderate for non-linear assets in the City’s service area as well. Probabilities are assigned to each liquefaction susceptibility, as described in Table 3.

The Country Club, Tularcitos, and Ayer pump stations are expected to have extensive damage and require approximately seventeen days for restoration. Extensive damage for pump stations is defined as extensive damage to facility buildings or damage to pumps beyond repair. The Gibraltar pump station (SFPUC and VW) is expected to have moderate damage and take approximately six days for restoration. Moderate damage for pump stations is defined by the loss of electric power for approximately one-week, considerable damage to mechanical and electrical equipment, or moderate damage to buildings. By deploying portable generators in the event of an outage, the City can reduce service losses and associated costs lower than estimated using the Hazus Method.

The Tularcitos, Minnis, and Ayer reservoirs are expected to have extensive damage and require approximately 96 days each for restoration. Extensive damage for storage tanks is defined as damage to the tank extensive enough to require removal of the tank from service, including, for example, elephant foot buckling for steel tanks with loss of content or shearing of concrete tank walls.

Moderate damage was estimated for the Gibraltar Reservoirs (SFPUC and VW) and each are estimated to require six days for restoration. Moderate damage for storage tanks is defined by the tank being considerably damaged but with only minor loss of content. Examples of moderate damage include elephant foot buckling for steel tanks without loss of content, or moderate cracking of concrete tanks with minor loss of content.

The City Hall and Corporation Yard buildings are expected to have moderate damage and take approximately six days for restoration. Moderate damage could include rotation of steel members at connections, cracks through welds, or broken bolts for steel frame buildings; hairline cracks on beams and columns; and larger flexural cracks and concrete spalling. Buildings with red or yellow tags cannot be occupied until an onsite assessment is made by an engineer and will require additional time as needed for restoration.

Reservoir Sloshing Wave Assessment

To supplement the Hazus assessment, a review of the maximum operating levels of each of the City's water storage reservoirs was performed to determine if operating levels are appropriately set to mitigate against the impact of seismically induced sloshing waves. When operating levels within reservoirs are too high, the sloshing wave within the reservoir that is produced by the seismic forces can cause damage to the significant reservoir structure, including potential roof collapse.

The site-specific seismic design parameters for each reservoir site are summarized in Table 1; these parameters were used to calculate the height of the sloshing wave.

Table 1. Site-Specific Seismic Design Parameters

Reservoir	Seismic Risk Category	Site Soil Class[a]	TL[b]	SD1[c]	SDs[d]
Ayer	IV	D – Stiff Soil	12	0.82	1.341
Gibraltar	IV	D – Stiff Soil	12	0.682	1.147
Minnis	IV	C – Very Dense Soil and Soft Rock	8	0.886	1.638
Tularcitos	IV	C – Very Dense Soil and Soft Rock	8	0.828	1.535

(a) Site soil class from *City of Milpitas Seismic Isolation Study*, ABR Engineers, January 2002. Additional study of the site-specific soil conditions could change the soil classification, which would in turn impact the seismic design parameters.

(b) Long-period transition period

(c) Design spectral response acceleration parameter at a period of 1-s

(d) Design spectral response acceleration parameter at short periods

Typically, a reservoir is constructed so that the distance between the overflow and the reservoir roof is great enough to accommodate the full height of the produced sloshing wave. In concrete reservoirs, the concrete roof may be designed to withstand some of the force of the sloshing wave, allowing for less distance to be provided between the overflow and reservoir roof (potentially up to half of the sloshing wave height). West Yost reviewed the maximum operating water levels and reservoir roof heights for each of the reservoirs and compared this distance to the sloshing wave height. A sloshing wave height that is greater than the distance between the maximum water level and the roof indicates that that the standard is not met, and the sloshing wave could collide with the roof structure, potentially causing structural damage. The results of the sloshing wave analysis are presented in Table 2. The analysis shows that none of the City's reservoirs currently meet the standard for sloshing waves.

Table 2. Sloshing Wave Analysis

Reservoir	Inside Diameter, ft	Normal Operating Range (el.)	Overflow Height (el.)	Roof Height (el.)	Sloshing Wave Height, ft	Sloshing Wave Assessment
Ayer	181	78.2 – 83	85.0	89.96	14.2	Does not meet standard [a]
Gibraltar	158	37 – 46.5	48.0	49.7	10.4	Does not meet standard [b]
Minnis	51	900.5 – 907	908.5	909.5	10.0	Does not meet standard [c]
Tularcitos	48	559.2 – 565.7	567.2	568.2	9.2	Does not meet standard [d]

(a) A distance of 4.96 ft is provided between the reservoir roof and the overflow, and a distance of 6.96 ft is provided between the reservoir roof and the high operational level; the calculated sloshing wave height of 14.2 ft exceeds both distances. The concrete tank roof may be capable of withstanding the force of the sloshing wave, but additional structural analysis is needed to confirm this.

(b) A distance of 1.7 ft is provided between the reservoir roof and the overflow, and a distance of 3.2 ft is provided between the reservoir roof and the high operational level; the calculated sloshing wave height of 10.4 ft exceeds both distances. The concrete tank roof may be capable of withstanding the force of the sloshing wave, however, as a rule of thumb, the roof is typically assumed to be capable of withstanding a maximum of only half of the sloshing wave height.

(c) A distance of 1.5 ft is provided between the reservoir roof and the overflow, and a distance of 2.5 ft is provided between the reservoir roof and the high operational level; the calculated sloshing wave height of 10.0 ft exceeds both distances.

(d) A distance of 1.0 ft is provided between the reservoir roof and the overflow, and a distance of 2.5 ft is provided between the reservoir roof and the high operational level; the calculated sloshing wave height of 9.2 ft exceeds both distances.

For steel tanks (e.g., the Minnis and Tularcitos Reservoirs), the tank may be retrofitted to meet the sloshing wave standard by adding a steel ring to the top of the tank, thereby increasing the total tank height so that the height of the sloshing wave may be accommodated. Steel tanks typically have a distance between the tank overflow and the tank roof of the sloshing wave height plus one additional foot. When preparing detailed tank retrofit plans, other damage mechanisms should be considered to better reinforce the structure against potential risks, not limited to shearing off inlet/outlet pipes, anchorage system failure causing uplift, and tank shell failure.

Non-Linear Asset Restoration Time

Hazus Table 8.1.a (reproduced as Figure A-3 of Attachment A) was used to estimate the associated mean restoration time for each facility, using the damage state from Hazus Tables 8.6 and 8.9. Hazus-recommended restoration time estimates are based on Hazus restoration function curves and available crews for restoration and represent an average time for the facility classification. In addition to the restoration time suggested by Hazus, three days were added to account for the immediate post-event, pre-restoration assessment, planning, and mobilization activities. Table A-1 shows the resulting estimated restoration time for each asset.

Two, four- person crews working 12-hour days were assumed to be available to repair and restore facilities following the selected earthquake event. This assumption forms the basis of the overall restoration time for repair and replacement work. This assumption does not include utilizing mutual aid via the Water/Wastewater Agency Response Network (WARN). Utilizing WARN can significantly reduce the time of restoration, which is scalable in the results. The number of days vary based on the size and damage state severity of the facility. Table A-1 shows the resulting estimated restoration time for each asset.

Non-Linear Consequences Cost Estimates

Utility lost water production and utility economic loss were calculated using the total restoration time and service level for each facility, along with the City of Milpitas' cost of water ($7,981/million gallons). Replacement costs for reservoirs and pump stations were calculated using the replacement costs documented in the 2020 WY Asset Management TM scaled to reflect the severity of damage (50% for extensive and 25% for moderate damage). This value was selected to represent the repair/replacement cost for all reservoirs and pump stations.

As shown in Table A-1, the analysis found that Ayer Reservoir, Gibraltar Pump Stations (SFPUC and VW) and Gibraltar Reservoirs (SFPUC and VW) had the largest repair and replacement costs and water lost costs of all non-linear assets for the selected earthquake event. Repair and replacement costs are calculated using crew size, labor rate, shift duration and order of magnitude material costs.

The total cost consequence of the non-linear assets is $5,967,160. This cost includes the total cost of repair and the total cost of water loss.

Linear Assets: Pipelines

The City owns and maintains 183 miles of pipelines, with pipe sizes ranging in diameter from 6 inches to 24 inches. Based on available pipeline material information contained in the utility's pipeline geographic information system (GIS), the majority of the system is made up of asbestos cement (approximately 133.5 miles by length) and polyvinyl chloride (PVC) (approximately 27.4 miles by length) pipe. The system also contains concrete cylinder, cast iron, ductile iron, and steel pipelines. Using the ALA methodology, West Yost assed the distribution system as a whole to estimate the number of anticipated leaks and breaks. The results of this assessment are presented in Table B-2.

The City had previously identified a select subset of pipelines within the City's service area and designated it as the "backbone". The "backbone" pipelines are pipelines which transmit water from the sources to all parts of the service area. West Yost broke the "backbone" pipeline network into 28 individual pipeline reaches and assessed the individual reach to estimate the number of anticipate leaks and breaks that would occur on the individual pipeline reaches as a result of a seismic event. Pipeline reaches are identified in Figure B-1. The results of this assessment are presented in Table B-1.

Linear Asset Damage State

The ALA methodology considers two damage states for buried pipelines: leaks and breaks. The methodology assumes that damage due to seismic waves (represented by PGV) will consist of 80 percent leaks and 20 percent breaks, while damage due to ground failure (represented by PGD) will consist of 20 percent leaks and 80 percent breaks. Two damage algorithms are used to estimate the number of leaks and breaks:

1. **For Ground Shaking**: $Repair\ Rate / 1000\ ft = K_1 \times 0.00187 \times PGV$

   Where K_1 is a fragility constant related to the expected performance of a given pipe material[1]. Units for PGV are inches per second. Assigned K_1 values can be found on table B-1 and B-2 in Attachment B.

2. **For Peak Ground Deformation**: $Repair\ Rate / 1000\ ft = K_2 \times 1.06 \times PGD^{0.319} \times L_S$

   Where K_2 is a fragility constant related to the expected performance of a given pipe material[2], and L_S is the estimated probability that PGD will occur during ground shaking. Units for PGD are inches. Assigned K_2 values can be found on table B-1 and B-2 in Attachment B.

ShakeMap information was used to obtain an average PGV value for all pipelines. Spatial liquefaction susceptibility data published by USGS were used to identify areas within the distribution system with "very low", "low", "moderate", "high" and "very high" susceptibility to liquefaction (and therefore, PGD). The estimated probabilities of liquefaction occurring in each liquefaction susceptibility category are listed in Table 3 below. For very low, low, moderate, and high liquefaction susceptibility areas, a PGD of six inches was assumed in accordance with J100 Standard recommendations; for very high liquefaction susceptibility areas, a PGD of 12 inches was assumed. The PGV and PGD calculations were considered additive, and resulted in conservative estimates for breaks and leaks, as summarized on Tables B-1 and B-2 in Attachment B.

[1] See Figure B-1 in Attachment B for a reproduction of K_1 values recommended by the ALA methodology.

[2] See Figure B-2 in Attachment B for a reproduction of K_2 values recommended by the ALA methodology.

Table 3. Liquefaction Susceptibility and Probability

Liquefaction Susceptibility	Probability of Liquefaction
Very High	0.50
High	0.25
Moderate	0.10
Low	0.05[a]
Very Low	0.02[a]

(a) Hazus recommends using 0.05 for low and 0.02 for very low liquefaction susceptibility.

Two, four-person crews working 12-hour days were assumed to be available to repair breaks and leaks following the selected earthquake event. This assumption forms the basis of the overall restoration time for leaks and breaks. An additional 3 days were added to the resulting total to account for the immediate post-disaster assessment, planning, and mobilization time. Total restoration time and total pipeline repair labor and material cost is summarized on Table B-3 in Attachment B.

Using the ALA methodology for linear assets, the Hayward-Rodgers Creek - 6.8 magnitude earthquake scenario is estimated to cause 192 breaks and 58 leaks to the collective transmission pipeline and distribution pipeline. Break and leak estimates and total restoration time for transmission pipelines and distribution pipelines is summarized on Table B-2 in Attachment B. It is estimated to take approximately 113 days to reach total restoration. This includes 3 days for the immediate post-disaster assessment but does not assume the utilization of mutual aid for pipeline restoration, which would shorten the time of restoration significantly if pipe repair crews were to be brought in from other entities in an isolated event. However, the regional impacts of the anticipated earthquake scenario pose a threat to the availability of mutual aid resources, which consequently may need to be sourced from a significant distance away. The City's emergency response preparation should consider the regional impacts of this earthquake scenario.

Estimated Service Denial

Using the Hazus Method for non-linear assets, the Hayward-Rodgers Creek 6.8 magnitude earthquake scenario is estimated to cause extensive damage to the City's facilities due to an estimated maximum peak ground acceleration of 0.65 g, with g being earth's gravitational acceleration. Hazus predicts significant damage to City facilities would equate to loss of electrical power and backup power and extensive damage to pumping stations and storage tanks. It is also assumed that a loss of water quality would be imminent. Due to the damage anticipated it is expected that there would be a loss of service equivalent to approximately 165 million gallons.

Linear Consequences Cost Estimates

The analysis found the City's trunk lines could have 8 breaks and 32 leaks, as shown in Table B-1. The overall distribution system was estimated to experience 192 breaks and 58 leaks, as shown in Table B-2. Repair and replacement costs are calculated using crew size, labor rate, shift duration and order of magnitude material costs.

The direct linear consequence costs by type of pipeline are presented in Table B-3. The total cost consequence of the linear assets is $334,173 for the trunk lines and $2,515,349 for the overall distribution system. This total includes the cost of the estimated water loss and the cost of repair labor and material.

Consequence Costs Summary

The Hayward-Rodgers Creek - 6.8 magnitude earthquake is estimated to cause significant damage to the City's non-linear and linear assets, with a total consequence cost of approximately $10,322, 527. The consequence cost of all linear assets is approximately $4,355,366, and the consequence cost of all non-linear assets is approximately $5,967,160. The Hazus Method estimates moderate damage to the buildings and moderate/severe damage to the pump stations and reservoirs. The ALA Method estimates 8 breaks and 32 leaks from the trunk lines and 192 breaks and 58 leaks from the distribution pipelines. Table 4 below shows the consequence costs of each asset from the Hayward-Rodgers Creek earthquake. For the purposes of this TM, the costs indicated below reflect the repair and replacement costs and loss of service. See Table A-1 for a breakdown of these individual cost components.

Table 4. Earthquake Threat Asset Pair Consequence Costs

Threat	Asset	Consequence Cost, dollars
Earthquake / Landslide	Tularcitos Reservoir	1,550,471
Earthquake / Landslide	Minnis Reservoir	1,690,507
Earthquake / Landslide	Country Club Pump Station	1,235,196
Earthquake / Landslide	Tularcitos Pump Station	1,390,946
Earthquake / Liquefaction	City Hall	50,020
Earthquake / Liquefaction	Corporation Yard	50,020
Earthquake / Liquefaction	Reach 1 / McCarthy PRV	106,632
Earthquake / Liquefaction	Reach 2 / California Circle PRV	26,291
Earthquake / Liquefaction	Reach 3	12,984
Earthquake / Liquefaction	Reach 4 / Junipero PRV	34,911
Earthquake / Liquefaction	Reach 5 / Live Oak PRV	4,631
Earthquake / Liquefaction	Reach 6	11,516
Earthquake / Liquefaction	Reach 7 / Main PRV	14,069
Earthquake / Liquefaction	Reach 8 / Parc Metro PRV	8,335
Earthquake / Liquefaction	Reach 9 / Curtis PRV	13,982
Earthquake / Liquefaction	Reach 10	17,501
Earthquake / Liquefaction	Reach 11	31,285
Earthquake / Liquefaction	Reach 12 / Gibraltar PRV / Gibraltar Turnout	23,650
Earthquake / Liquefaction	Reach 13 / Capitol PRV	20,874
Earthquake / Liquefaction	Reach 14	8,672
Earthquake / Liquefaction	Reach 15 / Sunnyhills PRV	17,575
Earthquake / Liquefaction	Reach 16	2,569
Earthquake / Liquefaction	Reach 17	6,297
Earthquake / Liquefaction	Reach 18	4,424
Earthquake / Landslide	Reach 19 / Calera Creek Heights & Tularcitos PRVs	9,028
Earthquake / Liquefaction	Reach 20 / North Milpitas PRV	21,612
Earthquake / Liquefaction	Reach 21 / Montague PRV	4,882

Table 4. Earthquake Threat Asset Pair Consequence Costs

Threat	Asset	Consequence Cost, dollars
Earthquake / Liquefaction	Reach 22	11,495
Earthquake / Liquefaction	Reach 23 / Yosemite PRV	14,714
Earthquake / Liquefaction	Reach 24	3,830
Earthquake / Liquefaction	Reach 25	12,547
Earthquake / Liquefaction	Reach 26	6,210
Earthquake / Liquefaction	Reach 27	2,952
Earthquake / Liquefaction	Reach 28	7,433
Earthquake / Liquefaction	Distribution System	3,894,466
	Total	**10,322,527**

CONCLUSION AND DISCLAIMER

The methodology and results presented in this TM were based on the Hazus Earthquake Model Methodology and Manual and the ALA Methodology. The Hazus and ALA methodologies have been utilized as best management practice, as recommended in the J100 Standard. Data and assumptions used in the analysis were based on best available information. The methodologies have been interpreted to best suit specific City assets and site conditions. Also note that the ALA pipeline damage results are subject to a range of minus 50 percent to plus 100 percent in accuracy.

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Attachment A

Hazus Methodology Results for Non-Linear Assets

Table A-1. HAZUS Methodology Results for Non-Linear Assets

Facility/Asset	Year Built	Service Level, MGD	ShakeMap PGA, g	ShakeMap PGV, cm/s	Liquefaction Susceptibility, %	Assumed PGD, In	HAZUS Damage State, PWT1	HAZUS Mean Restoration Time, d	Days to assess and plan (pre-restoration time), d	Total Time to Restoration, d	Lost Water Production, MG	Utility Economic Loss – Water, $	Repair / Replacement Crew Cost, $/d	Repair / Replacement Cost, $
Reservoirs														
Tularcitos Reservoir	1980	0.06	0.42	41	2%, Very Low	-	extensive	93	3	96	5.76	45,971	8,200	1,504,500[a]
Minnis Reservoir	1980	0.17	0.42	41	5% Low	-	extensive	93	3	96	16.32	130,250	8,200	1,560,258[a]
Ayer Reservoir	1993	4.14	0.4	40	10%, Moderate	6	extensive	93	3	96	397.44	3,171,969	8,200	7,145,000[a]
Gibraltar Reservoir (SFPUC)	1991	4.03	0.35	37	10%, Moderate	6	moderate	3.1	3	6.1	24.58	196,197	8,200	3,272,500[a]
Gibraltar Reservoir (VW)	1991	5.99	0.35	37	10%, Moderate	6	moderate	3.1	3	6.1	36.54	291,618	8,200	3,272,500[a]
Pump Stations														
Country Club Pump Station	1981	0.06	0.42	49	2%, Very Low	-	extensive	13.5	3	16.5	0.99	7,901	8,200	1,227,295[a]
Tularcitos Pump Station	1981	0.17	0.42	41	2%, Very Low	-	extensive	13.5	3	16.5	2.81	22,387	8,200	1,368,560[a]
Ayer Pump Station	1995	4.14	0.4	40	10%, Moderate	6	extensive	13.5	3	16.5	68.31	545,182	8,200	2,489,563[a]
Gibraltar Pump Station (SFPUC)	1993	4.03	0.35	37	10%, Moderate	6	moderate	3.1	3	6.1	24.58	196,197	8,200	4,366,522[a]
Gibraltar Pump Station (VW)	1993	5.99	0.35	37	10%, Moderate	6	moderate	3.1	3	6.1	36.54	291,618	8,200	4,366,522[a]
Other														
City Hall	2000	-	0.365	39	10%, Moderate	6	moderate	3.1	3	6.1	-	-	8,200	50,020[b]
Corporation Yard	-	-	0.38	40	10%, Moderate	6	moderate	3.1	3	6.1	-	-	8,200	50,020[b]
Total	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**613.87**	**$4,899,288**		**30,673,259**

(a) Cost based on percentage of replacement cost as documented in the 2020 WY Asset Management TM (50% for extensive damage and 25% for moderate damage).

(b) Costs based on (Total Time to Restoration) X (Repair/Replacement Crew Cost)

Table 8.3: Damage Algorithms for Small Water Treatment Plants

Peak Ground Acceleration			
Classification	**Damage State**	**Median (g)**	**β**
Plants with anchored subcomponents (PWT1)	slight/minor	0.25	0.50
	moderate	0.38	0.50
	extensive	0.53	0.60
	complete	0.83	0.60
Plants with unanchored subcomponents (PWT2)	slight/minor	0.16	0.40
	moderate	0.27	0.40
	extensive	0.53	0.60
	complete	0.83	0.60

Figure A-1. Hazus Table 8.3

Table 8.6: Damage Algorithms for Small Pumping Plants

Peak Ground Acceleration			
Classification	**Damage State**	**Median (g)**	**β**
Plants with anchored subcomponents (PPP1)	slight/minor	0.15	0.70
	moderate	0.36	0.65
	extensive	0.66	0.65
	complete	1.50	0.80
Plants with unanchored subcomponents (PPP2)	slight/minor	0.13	0.60
	moderate	0.28	0.50
	extensive	0.66	0.65
	complete	1.50	0.80

Figure A-2. Hazus Table 8.6

Table 8.7: Damage Algorithms for Medium/Large Pumping Plants

Peak Ground Acceleration			
Classification	**Damage State**	**Median (g)**	**β**
Plants with anchored subcomponents (PPP3)	slight/minor	0.15	0.75
	moderate	0.36	0.65
	extensive	0.77	0.65
	complete	1.50	0.80
Plants with unanchored subcomponents (PPP4)	slight/minor	0.13	0.60
	moderate	0.28	0.50
	extensive	0.77	0.65
	complete	1.50	0.80

Figure A-3. Hazus Table 8.7

Table 8.9: Damage Algorithms for Water Storage Tanks

Peak Ground Acceleration			
Classification	**Damage State**	**Median (g)**	**β**
On-Ground Anchored Concrete Tank (PST1)	slight/minor	0.25	0.55
	moderate	0.52	0.70
	extensive	0.95	0.60
	complete	1.64	0.70
On-Ground Unanchored Concrete Tank (PST2)	slight/minor	0.18	0.60
	moderate	0.42	0.70
	extensive	0.70	0.55
	complete	1.04	0.60
On-Ground Anchored Steel Tank (PST3)	slight/minor	0.30	0.60
	moderate	0.70	0.60
	extensive	1.25	0.65
	complete	1.60	0.60
On-Ground Unanchored Steel Tank (PST4)	slight/minor	0.15	0.70
	moderate	0.35	0.75
	extensive	0.68	0.75
	complete	0.95	0.70
Above-Ground Steel Tank (PST5)	slight/minor	0.18	0.50
	moderate	0.55	0.50
	extensive	1.15	0.60
	complete	1.50	0.60
On-Ground Wood Tank (PST6)	slight/minor	0.15	0.60
	moderate	0.40	0.60
	extensive	0.70	0.70
	complete	0.90	0.70
Permanent Ground Deformation			
Classification	**Damage State**	**Median (in)**	**β**
Buried Concrete Tank (PST7)	slight/minor	2	0.50
	moderate	4	0.50
	extensive	8	0.50
	complete	12	0.50

Figure A-4. Hazus Table 8.9

Table 8.1.a: Continuous Restoration Functions for Potable Water Systems (After ATC-13, 1985)

Restoration Functions (All Normal Distributions)			
Classification	**Damage State**	**Mean (Days)**	**σ (days)**
Water Treatment Plants	slight/minor	0.9	0.3
	moderate	1.9	1.2
	extensive	32.0	31.0
	complete	95.0	65.0
Pumping Plants	slight/minor	0.9	0.3
	moderate	3.1	2.7
	extensive	13.5	10.0
	complete	35.0	18.0
Wells	slight/minor	0.8	0.2
	moderate	1.5	1.2
	extensive	10.5	7.5
	complete	26.0	14.0
Water Storage Tanks	slight/minor	1.2	0.4
	moderate	3.1	2.7
	extensive	93.0	85.0
	complete	155.0	120.0

Figure A-5. Hazus Table 8.1.a

Attachment B

ALA Methodology Results for Linear Assets

Table B-1. Trunk Pipeline Lengths and Fragility

Pipe Reach	Total Pipe Length, miles	Average Pipe Diameter, inches	Most Common Pipe Type	K1	K2	Average PGV, cm/s	No. Leaks			No. Breaks		
							Ground Shaking	Ground Deformation	Total	Ground Shaking	Ground Deformation	Total
1	3.9	13	DIP	0.5	0.6	35.5	0.6	11.4	11.9	0.1	2.8	3.0
2	1.6	12	ACP	0.5	0.8	40.8	0.3	2.5	2.7	0.1	0.6	0.7
3	0.5	11	ACP	0.5	0.7	39.8	0.1	1.3	1.4	0.0	0.3	0.3
4	3.3	12	ACP	0.5	0.8	36.5	0.5	2.9	3.4	0.1	0.7	0.8
5	0.4	11	ACP	0.5	0.7	33.8	0.1	0.2	0.3	0.0	0.1	0.1
6	1.0	12	DIP	0.5	0.6	34.3	0.1	0.5	0.6	0.0	0.1	0.2
7	0.5	18	ACP	0.5	0.7	36.5	0.1	0.6	0.7	0.0	0.2	0.2
8	0.7	19	DIP	0.5	0.5	36.3	0.1	0.3	0.4	0.0	0.1	0.1
9	1.1	18	DIP	0.5	0.5	36.3	0.1	0.6	0.7	0.0	0.1	0.2
10	0.9	14	ACP	0.5	0.6	36.5	0.1	0.7	0.9	0.0	0.2	0.2
11	0.2	24	STL	0.3	0.3	36.3	0.0	0.1	0.1	0.0	0.0	0.0
12	0.1	12	ACP	0.5	0.8	36.3	0.0	0.1	0.1	0.0	0.0	0.0
13	1.2	17	ACP	0.5	0.7	34.5	0.2	0.6	0.8	0.0	0.2	0.2
14	1.4	14	ACP	0.5	0.6	35.8	0.2	0.2	0.4	0.1	0.1	0.1
15	3.5	11	ACP	0.5	0.8	38.5	0.5	0.6	1.2	0.1	0.2	0.3
16	0.0	10	ACP	0.5	0.8	41.4	0.0	0.0	0.0	0.0	0.0	0.0
17	1.1	10	ACP	0.5	0.8	41.4	0.2	0.1	0.3	0.0	0.0	0.1
18	0.3	12	ACP	0.5	0.8	41.0	0.0	0.0	0.1	0.0	0.0	0.0
19	2.0	11	ACP	0.5	0.8	41.0	0.3	0.3	0.6	0.1	0.1	0.1
20	2.9	15	ACP	0.5	0.7	37.3	0.4	1.2	1.7	0.1	0.3	0.4
21	0.4	10	ACP	0.5	0.8	35.3	0.0	0.2	0.3	0.0	0.1	0.1
22	0.8	18	DIP	0.5	0.5	37.0	0.1	0.3	0.4	0.0	0.1	0.1
23	1.8	14	ACP	0.5	0.6	37.3	0.3	0.8	1.1	0.1	0.2	0.3
24	0.3	16	DIP	0.5	0.6	39.3	0.1	0.0	0.1	0.0	0.0	0.0
25	1.3	12	ACP	0.5	0.8	38.8	0.2	0.5	0.7	0.1	0.1	0.2
26	0.3	22	STL	0.2	0.2	38.3	0.0	0.0	0.1	0.0	0.0	0.0
27	0.1	18	DIP	0.5	0.5	39.0	0.0	0.0	0.1	0.0	0.0	0.0
28	0.8	11	ACP	0.5	0.8	39.5	0.1	0.4	0.5	0.0	0.1	0.1
Total	**32.6**	-	-	-	-	-	**4.8**	**26.7**	**31.5**	**1.2**	**6.7**	**7.9**

Table B-2. Overall Pipeline Distribution Lengths and Fragility

Pipe Material	Total Pipe Length, miles	Average Pipe Diameter	K1	K2	Average PGV, cm/s	No. Leaks			No. Breaks		
						Ground Shaking	Ground Deformation	Total	Ground Shaking	Ground Deformation	Total
AC/ACP	133.5	Small	0.5	0.8	36.1	7.4	36.2	43.7	1.9	144.9	146.8
CCP	0.2	Small	0.8	1.0	36.1	0.0	0.1	0.1	0.0	0.2	0.2
CIP	0.9	Small	0.8	0.8	36.1	0.1	0.3	0.3	0.0	1.0	1.1
DIP	15.3	Large	0.5	0.5	36.1	0.3	0.9	1.2	0.1	3.5	3.5
PVC	27.4	Small	0.5	1.0	36.1	0.0	0.1	0.1	0.0	0.5	0.5
STL	5.3	Large	0.15	0.15	36.1	0.0	0.1	0.1	0.0	0.4	0.4
Total	**182.6**	**-**	**-**	**-**	**36.1**	**10.3**	**47.2**	**57.5**	**2.6**	**188.9**	**191.4**

Table B-3. Pipeline Repair Cost Estimates

Evaluation	Total Repair Time, crew days	Total Pipeline Repair Labor and Material Cost, dollars
Trunk Lines	14.8	$334,173
Overall Distribution	113.0	$2,515,349

(a) Total Pipeline Repair Labor and Material Cost based on crew size 4 workers, 2 crews, $150/hr labor cost, $2500/crew day material cost, and a $50,000 administrative adder.

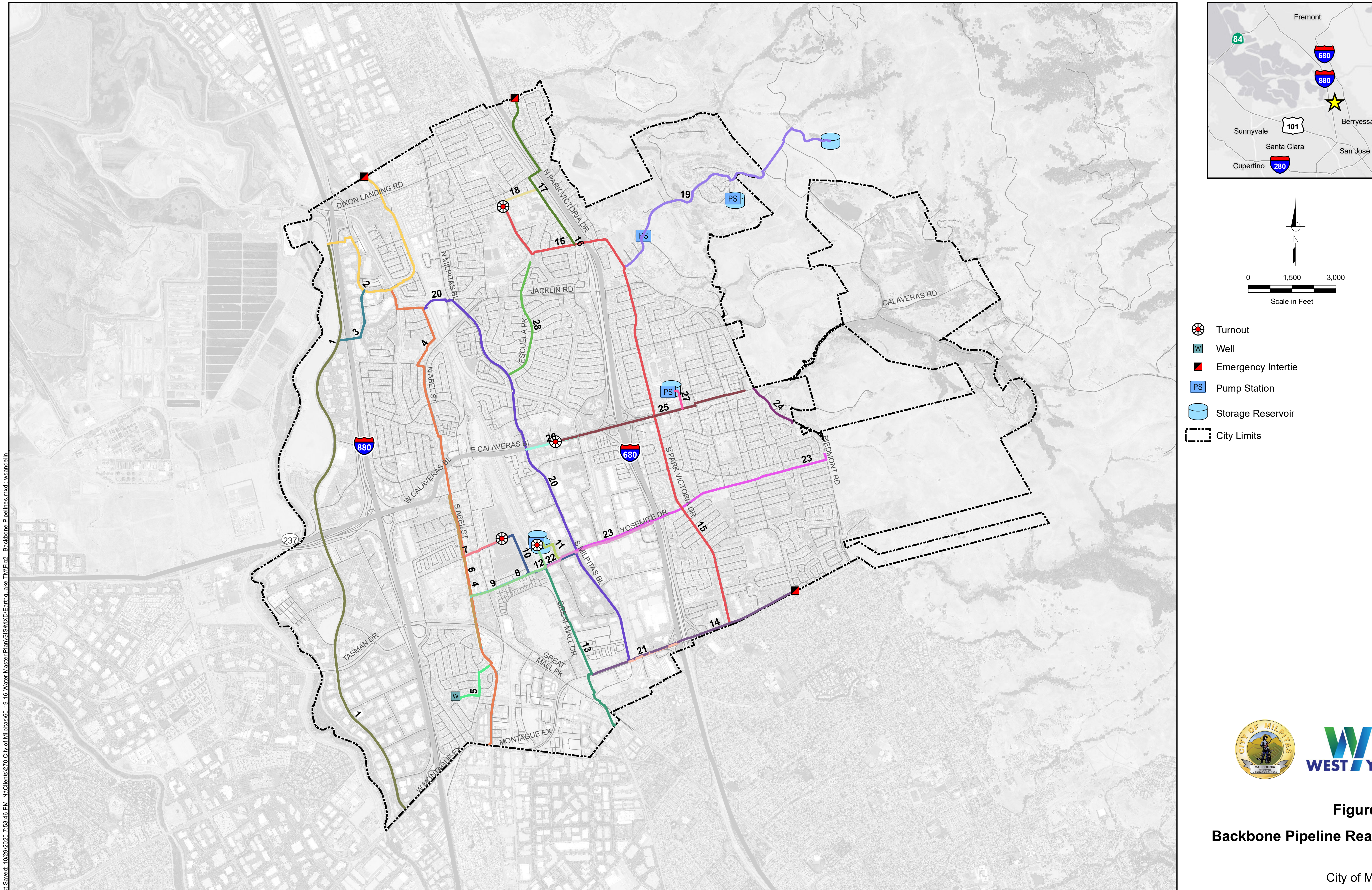

Figure B-1

Backbone Pipeline Reaches

City of Milpitas

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Pipe Material	Joint Type	Soils	Diam.	K_1	Reference Sections
Cast iron	Cement	All	Small	1.0	4.4.2
Cast iron	Cement	Corrosive	Small	1.4	4.4.2
Cast iron	Cement	Non-corrosive	Small	0.7	4.4.2
Cast iron	Rubber gasket	All	Small	0.8	4.4.2
Welded steel	Lap - Arc welded	All	Small	0.6	4.4.4
Welded steel	Lap - Arc welded	Corrosive	Small	0.9	4.4.4
Welded steel	Lap - Arc welded	Non-corrosive	Small	0.3	4.4.4
Welded steel	Lap - Arc welded	All	Large	0.15	4.4.4
Welded steel	Rubber gasket	All	Small	0.7	4.4.6
Welded steel	Screwed	All	Small	1.3	4.4.6 A.3.11
Welded steel	Riveted	All	Small	1.3	4.4.6
Asbestos cement	Rubber gasket	All	Small	0.5	4.4.3 4.4.5
Asbestos cement	Cement	All	Small	1.0	4.4.3
Concrete w/Stl Cyl.	Lap - Arc Welded	All	Large	0.7	4.4.6
Concrete w/Stl Cyl.	Cement	All	Large	1.0	4.4.6
Concrete w/Stl Cyl.	Rubber Gasket	All	Large	0.8	4.4.6
PVC	Rubber gasket	All	Small	0.5	4.4.6
Ductile iron	Rubber gasket	All	Small	0.5	4.4.5 4.4.6

Table 4-5. Ground Shaking - Constants for Fragility Curve

Figure B-2. ALA-Recommended K_1 Fragility Constants for Pipelines

Pipe Material	Joint Type	K_2	Reference Sections
Cast iron	Cement	1.0	4.4.2
Cast iron	Rubber gasket	0.8	4.4.2
Cast iron	Mechanical restrained	0.7	4.4.2
Welded steel	Arc welded, lap welds (large diameter, non corrosive)	0.15	4.4.4
Welded steel	Rubber gasket	0.7	4.4.3
Asbestos cement	Rubber gasket	0.8	4.4.3
Asbestos cement	Cement	1.0	4.4.6
Concrete w/Stl Cyl.	Welded	0.6	4.4.6
Concrete w/Stl Cyl.	Cement	1.0	4.4.6
Concrete w/Stl Cyl.	Rubber Gasket	0.7	4.4.6
PVC	Rubber gasket	0.8	4.4.6
Ductile iron	Rubber gasket	0.5	4.4.6

Table 4-6. Permanent Ground Deformations - Constants for Fragility Curve

Figure B-3. ALA-Recommended K_2 Fragility Constants for Pipelines

Appendix F

Water Utility Financial Plan

RAFTELIS

Project Memo

DATE:	June 9, 2022
TO:	Tony Ndah Public Works Director
FROM:	Todd Cristiano Senior Manager
SUBJECT:	Water Financial Plan Options

Introduction

The City of Milpitas retained Raftelis to complete a comprehensive financial planning forecast for their water, wastewater[1], and stormwater utilities[2]. Separate financial plans and memorandums were developed for each utility and this memorandum summarizes the water financial plan results. The analysis included the following:

1. ***Revenue forecast.*** Includes the projection of rate revenues, the number of accounts, growth in accounts, and billed volume per account; projection of other operating and non-operating income, and development fees.
2. ***Expenditures forecast.*** Includes the projection of operation and maintenance expenses, transfers to the general fund, payments on existing debt service, and capital projects identified in the most recent master plan documents.
3. ***Revenue adjustments***. Optimizing the use of rate revenues and bond issues to minimize revenue adjustments while meeting annual revenue requirements, debt service coverage, and reserve targets.

The forecast presented in this memo is for the study period FY 2022 through FY 2040. The City's water utility is financially self-sufficient with funding for capital and operating requirements derived primarily from rates.

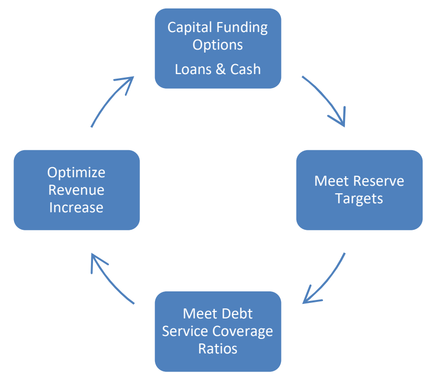
[1] Wastewater and sewer utility are used interchangeably throughout this memo.

[2] Stormwater activities are currently within the general fund and is not a stand-alone utility. For the purposes of this study, we created a cash flow consolidating the O&M costs for the various areas in the general fund and projects identified in the most recent master plan.

Financial Planning Process

A primary consideration in developing an 'optimal' financial plan is minimizing annual revenue increases by balancing the use of reserves, existing rate revenue, and debt proceeds. This balance is subject to the constraints of meeting the City's target reserve policies and debt service coverage requirements on any proposed debt.

This approach is an iterative process. For example, while issuing debt to fund a capital project may keep revenue increases low, new debt payments may decrease the coverage below the target level. As a result, a revenue increase may be needed to maintain compliance with the target. This revenue may produce an ending balance which exceeds the target reserve. This excess can be used to partially fund the capital project which, in turn, could reduce the proposed debt issuance amount.



Reserves

The City maintains three reserves for the wastewater utility. The excerpts below are from the City's financial reserve policy 11. These descriptions can also be found in the City's consolidated annual financial report. The proposed financial plan allows the City to maintain reserves in compliance with this policy.

Capital reserves for emergencies. The City will maintain capital reserves in the Water and Sewer utility enterprise funds to provide for future capital projects and unanticipated emergencies. The City will attempt to maintain a capital reserve of approximately 30% of the annual operating and maintenance expenses for the Water utility fund and 25% of the annual operating and maintenance expenses for the Sewer utility fund.

Rate stabilization reserve. The City will maintain a Rate Stabilization Reserve (RSR) in the Water and Sewer utility enterprise funds with a goal of at least 16.67% or two months of the respective annual operating expenditures after the Capital Reserve requirements have been met. The RSR shall be used to mitigate the effects of occasional shortfalls in revenue or unanticipated expenditures that cannot be rebalanced within existing budgeted resources in any given fiscal year.

Public Employees Retirement (PERS) Rate Stabilization Reserve. The City will maintain in the Utility Enterprise Funds or in a Section 115 Trust a Public Employees Retirement (PERS) Rate Stabilization Reserve to be funded by 20% of any General Fund or Enterprise Funds annual operating surpluses. The Water and Sewer Utility Enterprise Funds' portion of the Unfunded Actuarial Liability for the Miscellaneous Retirement Plan is 8.5% and 6.6%, respectively. The Utility Funds' portion of the contribution to the PERS Rate Stabilization Reserve shall be consistent with the General Fund contributions and only be funded after the Capital Reserve and Rate Stabilization Reserve (RSR) requirements in the Water and Sewer utility funds have been met.

Water Utility Findings

Raftelis used the assumptions shown in Table 1 to develop the financial plan options. Changes in these assumptions could materially affect the results. These assumptions were based on information provided by Staff over the course of the study including annual budgets, detailed billing data, forecasts of new customer connections, and master plan reports. The detailed water cash flows are attached at the end of this memorandum.

Table 1: Water Utility Assumptions

Item	Description	
FY 2022 Beginning Fund Balance		
Capital Reserve for Emergencies	$8,614,458	
Rate Stabilization Reserve	$4,347,276	
Capital Fund	$13,199,527	
TASP Fund	$17,869,842	
Average growth in number of accounts	2.2%	
Annual average O&M Inflation [1]	5.7%	
Average Annual Capital Projects Inflation	6.0% (FY 2023 – FY 2026) 4.0% (FY 2027 – FY 2040) Study period average ~4.3%	
Projected Wholesale Water Rate Increases [2]		
Year	**SFPU**	**Valley Water**
FY 2023	15.9%	15.0%
FY 2024	11.2%	15.0%
FY 2025	0.0%	15.0%
FY 2026	0.0%	9.1%
FY 2027	0.8%	9.1%
FY 2028	4.5%	9.1%
FY 2029	4.5%	9.1%
FY 2030 – FY 2040	4.5% Annually	5.0% Annually
[1] Includes the water purchase cost increases.		
[2] Current FY22 Rates		
SFPUC ($4.10/Ccf FY22 rate)		
Valley Water ($3.71/Ccf FY22 rate)		

The water utility financial plan consists of three sub-funds:

- ***Operating Fund.*** Funds activities associated with annual operation and maintenance of the utility, maintaining emergency and rate stabilization reserves, and transfers of any surplus to the Capital Fund.
- ***Capital Fund***. Tracks activities associated with debt service on bond issues, previously adopted CIP projects, and projects identified in the master plan. Sources of funding include capital fees, transfers from the operating fund, and debt issuance proceeds.
- ***TASP Fund***. Tracks funding and projects that have specifically been identified as being funded by TASP or future METRO development fees[3].

[3] Future METRO fees have not been adopted as of the date of this memorandum

Separation of these sub-funds ensures that sources of funds were being used for their appropriate purposes. For example, capital fees and bond issues fund the capital improvement program but should not fund operations.

Operating Fund

Sources of Funds

Sources of funds consist primarily of rate revenue, other operating income, and non-operating income. Rate revenue consists of a bimonthly base charge and a uniform volume rate. Rate revenues with proposed increases is projected to increase from $33.0 million in FY 2023 to $44.2 million in FY 2040. This includes an average annual account growth of 2.2% from FY 2023 to FY 2040 based on future METRO plan development forecasts.

Uses of Funds

Uses of Funds consist of operation and maintenance expense and transfers to the capital fund to assist in funding the capital improvement program. O&M consists of the items required to distribute water to customers as well costs associated with administration of the utility, and customer services.

Water purchases make up approximately 70% of O&M. The City purchases water from San Francisco Public Utilities Commission (SFPUC) and Santa Clara Valley Water District (Valley Water) on an annual basis. The wholesale rate is set annually by each wholesale water agency. The City expects the water purchase rate from SFPUC to increase by 15.9% in 2023 and 11.2% in 2024; 0.0% in FY 2025 and FY 2026, 0.8% in FY 2027, and 4.5% from FY 2028 through FY 2040. Valley Water purchased water rates are expected to increase by 15.0% each year from FY 2023 through FY 2025, 9.1% from FY 2026 to FY 2029, and 5.0% annually from FY 2030 through FY 2040.

O&M expenses for the City's core operations (personnel services, general supplies, contractual services excluding water purchases, etc.) will increase by 4.0% from FY 2023 through FY 2025. This short-term inflation estimates are based on publications from the Philadelphia Federal Reserve. Inflation from FY 2026 through FY 2040 is estimated at 3.0% based on historical trends of Consumer Price Index (CPI). Total O&M including water purchases will increase by an average of 5.7% annually over the study period or from $31.2 million in FY 2023 to $84.9 million in FY 2040.

Capital Fund

Sources of Funds

Funding includes the capital surcharge, transfers from the operating fund, and bond proceeds. The capital surcharge currently collects approximately $4.0 million per year. Transfers from the operating fund are made in years where operating revenue exceeds operating expenses and required transfers to reserve funds.

Uses of Funds

Expenditures include debt service on the City's existing Series 2019 bonds and capital projects identified in the adopted FY 2023 – FY 2040 capital budget and master plan. Capital improvement program costs total $82.0 million for the study period which includes an annual inflation of 6.0% from FY 2023 through FY 2025 and 4.0% from FY 2026 through FY 2040.

Revenue Requirement

Revenue from rates and other miscellaneous revenue should be sufficient to meet annual revenue requirements in the operating and capital funds. Revenue requirements include operation and maintenance expenses, capital project funding, and meeting target reserves. Raftelis and City staff developed a financial plan to fully fund expenses, including the master plan projects, using revenue derived from user rates and the capital surcharge.

Proposed Financial Plan

The financing plan developed by Raftelis and City staff proposes to fully fund the expenses described above using rate revenue.

- ***Operating Fund.*** Annual increases to water user charges of 6.0% are required in FY 2024 through FY 2026, 4.0% from FY 2027 through FY 2031, and 3.0% from FY 2031 through FY 2040. The revenue from these increases will adequately fund O&M, water purchases, reserve requirements, and provide surplus revenue to transfer to the CALPERS and capital funds.
- ***Capital Fund.*** The proposed financing plan does not require the use of bonds in any year of the forecast. Payment on existing debt service, the adopted CIP projects, and master plan projects can be fully funded by the capital surcharge with annual increases of 10.0% from FY 2024 through 2030.
- ***TASP Fund.*** Several projects in the master plan, including Curtis Well and assets associated with the Valley Water Second Water Supply, have been identified as requiring funding from the TASP fund. However, the existing fund balance and expected 2023 proceeds from TASP development fees are insufficient to fully fund all identified projects. This plan assumes that future METRO development fees will be able to provide an additional $4.1 million by FY 2027 to fully finance these projects.
- ***Water Monthly Bill Impact.*** Based on the rate increases proposed in this financial plan, the bimonthly bill for typical single-family residential customer with a 5/8" meter is projected to increase $9.19 from $143.02 to $152.51 based on usage of 14 hcf.

Reliance on City Provided Data

During this project, the City (and/or its representatives) provided Raftelis with a variety of technical information, including cost and revenue data. Raftelis did not independently assess or test for the accuracy of such data – historic or projected. Raftelis has relied on this data in the formulation of our findings and subsequent recommendations, as well as in the preparation of this memorandum.

There are often differences between actual and projected data. Some of the assumptions used for projections in this memorandum will not be realized, and unanticipated events and circumstances may occur. Therefore, there are likely to be differences between the data or results projected in this memorandum and actual results achieved, and those differences may be material. As a result, Raftelis takes no responsibility for the accuracy of data or projections provided by or prepared on behalf of the City, nor do we have any responsibility for updating this memorandum for events occurring after the date of this memorandum.

Table A-1
City of Milpitas, CA
Water Utility Cash Flow Analysis

Line No.	Operating Fund	Budget FY 2022	Projected FY 2023	FY 2024	FY 2025	FY 2026	FY 2027	FY 2028	FY 2029	FY 2030	FY 2031
	Sources of Funds										
1	Revenue from Adopted Water Rates	$ 31,013,210	$ 32,994,216	$ 33,108,574	$ 33,783,900	$ 34,458,744	$ 35,133,589	$ 35,808,434	$ 36,483,279	$ 37,158,124	$ 37,861,346
2	Add'l Revenue from Proposed Rate Increases	-	-	1,986,514	4,175,690	6,582,172	8,384,864	10,320,095	12,394,502	14,615,043	17,001,754
3	Total Water Rate Revenue	31,013,210	32,994,216	35,095,088	37,959,590	41,040,916	43,518,454	46,128,529	48,877,781	51,773,167	54,863,099
4	Investment Interest	$ 372,000	$ 369,729	$ 187,521	$ 202,530	$ 220,657	$ 231,585	$ 244,112	$ 260,891	$ 279,020	$ 294,383
5	Other Misc. Revenue	17,601	-	-	-	-	-	-	-	-	-
6	**Total Sources**	**$ 31,402,811**	**$ 33,363,945**	**$ 35,282,609**	**$ 38,162,120**	**$ 41,261,573**	**$ 43,750,038**	**$ 46,372,641**	**$ 49,138,671**	**$ 52,052,187**	**$ 55,157,482**
	Uses of Funds										
7	Operation and Maintenance Expense	$ 25,734,839	$ 28,566,070	$ 31,737,245	$ 33,869,560	$ 35,603,584	$ 37,601,626	$ 40,305,556	$ 43,231,859	$ 45,694,157	$ 48,324,559
8	Transfer to General Fund	2,571,407	2,687,393	2,794,889	2,906,684	2,993,885	3,083,701	3,176,212	3,271,499	3,369,644	3,470,733
9	**Total Uses of Funds**	**$ 28,306,246**	**$ 31,253,463**	**$ 34,532,133**	**$ 36,776,244**	**$ 38,597,469**	**$ 40,685,328**	**$ 43,481,769**	**$ 46,503,358**	**$ 49,063,801**	**$ 51,795,292**
10	**Operating Surplus**	$ 3,096,565	$ 2,110,482	$ 750,476	$ 1,385,876	$ 2,664,105	$ 3,064,711	$ 2,890,872	$ 2,635,313	$ 2,988,386	$ 3,362,190
	Reserve Fund Summary										
11	Capital for Emergencies	$ 8,614,458	$ 9,376,039	$ 10,126,515	$ 11,032,873	$ 11,579,241	$ 12,205,598	$ 13,044,531	$ 13,951,007	$ 14,719,140	$ 15,538,588
12	Rate Stabilization	4,718,651	5,209,952	5,209,952	5,689,469	6,434,198	6,782,244	7,248,411	7,752,110	8,178,936	8,634,275
13	CALPERS	545,038	716,558	716,558	716,558	991,160	1,409,221	1,726,376	1,971,403	2,330,089	2,747,569
14	Infrastructure	13,464,473	16,625,757	7,629,326	3,827,790	2,689,612	5,059,757	5,306,748	6,426,325	11,413,754	12,457,408
15	**Total Reserves**	**$ 27,342,620**	**$ 31,928,306**	**$ 23,682,351**	**$ 21,266,690**	**$ 21,694,210**	**$ 25,456,820**	**$ 27,326,065**	**$ 30,100,845**	**$ 36,641,919**	**$ 39,377,840**

Line No.	Reserve Fund Detail	Budget FY 2022	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027	FY 2028	FY 2029	FY 2030	FY 2031
	Capital Reserve for Emergencies										
1	Beginning Balance	$ 8,614,458	$ 8,614,458	$ 9,376,039	$ 10,126,515	$ 11,032,873	$ 11,579,241	$ 12,205,598	$ 13,044,531	$ 13,951,007	$ 14,719,140
2	Contribution		761,581	750,476	906,358	546,367	626,358	838,932	906,477	768,133	819,447
3	Use		-	-	-	-	-	-	-	-	-
4	**Ending Balance**	**$ 8,614,458**	**$ 9,376,039**	**$ 10,126,515**	**$ 11,032,873**	**$ 11,579,241**	**$ 12,205,598**	**$ 13,044,531**	**$ 13,951,007**	**$ 14,719,140**	**$ 15,538,588**
5	*Target*	*8,491,874*	*9,376,039*	*10,359,640*	*11,032,873*	*11,579,241*	*12,205,598*	*13,044,531*	*13,951,007*	*14,719,140*	*15,538,588*
	Rate Stabilization Reserve										
6	Beginning Balance	$ 4,347,276	$ 4,718,651	$ 5,209,952	$ 5,209,952	$ 5,689,469	$ 6,434,198	$ 6,782,244	$ 7,248,411	$ 7,752,110	$ 8,178,936
7	Contribution	371,375	491,301	-	479,517	744,729	348,046	466,167	503,699	426,826	455,340
8	**Ending Balance**	**$ 4,718,651**	**$ 5,209,952**	**$ 5,209,952**	**$ 5,689,469**	**$ 6,434,198**	**$ 6,782,244**	**$ 7,248,411**	**$ 7,752,110**	**$ 8,178,936**	**$ 8,634,275**
9	*Target*	*4,718,651*	*5,209,952*	*5,756,507*	*6,130,600*	*6,434,198*	*6,782,244*	*7,248,411*	*7,752,110*	*8,178,936*	*8,634,275*
	CALPERS Reserve										
10	Beginning Balance	$ -	$ 545,038	$ 716,558	$ 716,558	$ 716,558	$ 991,160	$ 1,409,221	$ 1,726,376	$ 1,971,403	$ 2,330,089
11	Contribution	545,038	171,520	-	-	274,602	418,061	317,155	245,027	358,686	417,481
12	**Ending Balance**	**$ 545,038**	**$ 716,558**	**$ 716,558**	**$ 716,558**	**$ 991,160**	**$ 1,409,221**	**$ 1,726,376**	**$ 1,971,403**	**$ 2,330,089**	**$ 2,747,569**
13	**Transfer to Infrastructure Replacement**	$ 2,180,152	$ 686,080	$ -	$ -	$ 1,098,407	$ 1,672,246	$ 1,268,619	$ 980,110	$ 1,434,742	$ 1,669,923
	Check	*TRUE*	*TRUE*	*TRUE*	*TRUE*	*TRUE*	*TRUE*	*TRUE*	*TRUE*	*TRUE*	*TRUE*
	Infrastructure Replacement										
14	Beginning Balance	$ 13,199,527	$ 13,464,473	$ 16,625,757	$ 7,629,326	$ 3,827,790	$ 2,689,612	$ 5,059,757	$ 5,306,748	$ 6,426,325	$ 11,413,754
15	Contribution	264,946	3,161,284	(8,996,431)	(3,801,537)	(1,138,178)	2,370,145	246,991	1,119,577	4,987,430	1,043,653
16	**Ending Balance**	**$ 13,464,473**	**$ 16,625,757**	**$ 7,629,326**	**$ 3,827,790**	**$ 2,689,612**	**$ 5,059,757**	**$ 5,306,748**	**$ 6,426,325**	**$ 11,413,754**	**$ 12,457,408**
17	*Target*	*2,000,000*	*2,000,000*	*2,000,000*	*2,000,000*	*2,000,000*	*2,000,000*	*2,000,000*	*2,000,000*	*2,000,000*	*2,000,000*
18	**Annualized Water Service Revenue Increase**	0.0%	0.0%	6.0%	6.0%	6.0%	4.0%	4.0%	4.0%	4.0%	4.0%
19	**Cumulative Revenue Increase**	0.0%	0.0%	6.0%	12.4%	19.1%	23.9%	28.8%	34.0%	39.3%	44.9%
20	**Debt Service Coverage**	6.71	5.77	4.87	5.98	7.78	8.79	9.33	9.41	10.10	10.61

Table A-1
City of Milpitas, CA
Water Utility Cash Flow Analysis

Line No.	Operating Fund	FY 2032	FY 2033	FY 2034	FY 2035	FY 2036 (Projected)	FY 2037	FY 2038	FY 2039	FY 2040
	Sources of Funds									
1	Revenue from Adopted Water Rates	$ 38,565,143	$ 39,269,521	$ 39,974,483	$ 40,680,033	$ 41,386,178	$ 42,092,920	$ 42,800,265	$ 43,508,218	$ 44,216,783
2	Add'l Revenue from Proposed Rate Increases	19,553,114	22,277,434	25,183,430	28,280,236	31,577,431	35,085,056	38,813,634	42,774,199	46,978,313
3	Total Water Rate Revenue	58,118,257	61,546,955	65,157,912	68,960,270	72,963,609	77,177,976	81,613,900	86,282,417	91,195,096
4	Investment Interest	$ 310,772	$ 328,230	$ 346,630	$ 366,013	$ 386,608	$ 408,284	$ 431,281	$ 455,659	$ 481,282
5	Other Misc. Revenue	-	-	-	-	-	-	-	-	-
6	**Total Sources**	**$ 58,429,029**	**$ 61,875,185**	**$ 65,504,542**	**$ 69,326,282**	**$ 73,350,217**	**$ 77,586,260**	**$ 82,045,181**	**$ 86,738,075**	**$ 91,676,378**
	Uses of Funds									
7	Operation and Maintenance Expense	$ 51,130,227	$ 54,089,550	$ 57,209,530	$ 60,528,366	$ 64,023,861	$ 67,735,937	$ 71,674,528	$ 75,817,014	$ 80,206,062
8	Transfer to General Fund	3,574,855	3,682,101	3,792,564	3,906,341	4,023,531	4,144,237	4,268,564	4,396,621	4,528,519
9	**Total Uses of Funds**	**$ 54,705,082**	**$ 57,771,651**	**$ 61,002,093**	**$ 64,434,707**	**$ 68,047,392**	**$ 71,880,174**	**$ 75,943,092**	**$ 80,213,635**	**$ 84,734,581**
10	**Operating Surplus**	$ 3,723,947	$ 4,103,535	$ 4,502,449	$ 4,891,575	$ 5,302,826	$ 5,706,086	$ 6,102,089	$ 6,524,441	$ 6,941,796
	Reserve Fund Summary									
11	Capital for Emergencies	$ 16,411,524	$ 17,331,495	$ 18,300,628	$ 19,330,412	$ 20,414,218	$ 21,564,052	$ 22,782,928	$ 24,064,090	$ 25,420,374
12	Rate Stabilization	9,119,337	9,630,534	10,169,049	10,741,266	11,343,500	11,982,425	12,659,713	13,371,613	14,125,255
13	CALPERS	3,220,759	3,755,232	4,354,193	5,012,108	5,735,465	6,518,930	7,360,115	8,266,391	9,232,765
14	Infrastructure	13,577,145	14,785,579	16,085,586	17,444,638	18,877,091	20,344,739	21,825,055	23,328,490	24,825,865
15	**Total Reserves**	**$ 42,328,765**	**$ 45,502,841**	**$ 48,909,456**	**$ 52,528,423**	**$ 56,370,274**	**$ 60,410,147**	**$ 64,627,811**	**$ 69,030,584**	**$ 73,604,258**

Line No.	Reserve Fund Detail	FY 2032	FY 2033	FY 2034	FY 2035	FY 2036	FY 2037	FY 2038	FY 2039	FY 2040
	Capital Reserve for Emergencies									
1	Beginning Balance	$ 15,538,588	$ 16,411,524	$ 17,331,495	$ 18,300,628	$ 19,330,412	$ 20,414,218	$ 21,564,052	$ 22,782,928	$ 24,064,090
2	Contribution	872,937	919,971	969,133	1,029,784	1,083,805	1,149,835	1,218,875	1,281,163	1,356,284
3	Use	-	-	-	-	-	-	-	-	-
4	**Ending Balance**	**$ 16,411,524**	**$ 17,331,495**	**$ 18,300,628**	**$ 19,330,412**	**$ 20,414,218**	**$ 21,564,052**	**$ 22,782,928**	**$ 24,064,090**	**$ 25,420,374**
5	*Target*	*16,411,524*	*17,331,495*	*18,300,628*	*19,330,412*	*20,414,218*	*21,564,052*	*22,782,928*	*24,064,090*	*25,420,374*
	Rate Stabilization Reserve									
6	Beginning Balance	$ 8,634,275	$ 9,119,337	$ 9,630,534	$ 10,169,049	$ 10,741,266	$ 11,343,500	$ 11,982,425	$ 12,659,713	$ 13,371,613
7	Contribution	485,062	511,197	538,515	572,217	602,235	638,925	677,288	711,899	753,642
8	**Ending Balance**	**$ 9,119,337**	**$ 9,630,534**	**$ 10,169,049**	**$ 10,741,266**	**$ 11,343,500**	**$ 11,982,425**	**$ 12,659,713**	**$ 13,371,613**	**$ 14,125,255**
9	*Target*	*9,119,337*	*9,630,534*	*10,169,049*	*10,741,266*	*11,343,500*	*11,982,425*	*12,659,713*	*13,371,613*	*14,125,255*
	CALPERS Reserve									
10	Beginning Balance	$ 2,747,569	$ 3,220,759	$ 3,755,232	$ 4,354,193	$ 5,012,108	$ 5,735,465	$ 6,518,930	$ 7,360,115	$ 8,266,391
11	Contribution	473,190	534,473	598,960	657,915	723,357	783,465	841,185	906,276	966,374
12	**Ending Balance**	**$ 3,220,759**	**$ 3,755,232**	**$ 4,354,193**	**$ 5,012,108**	**$ 5,735,465**	**$ 6,518,930**	**$ 7,360,115**	**$ 8,266,391**	**$ 9,232,765**
13	**Transfer to Infrastructure Replacement**	$ 1,892,759	$ 2,137,894	$ 2,395,841	$ 2,631,659	$ 2,893,428	$ 3,133,861	$ 3,364,740	$ 3,625,103	$ 3,865,496
	Check	*TRUE*	*TRUE*	*TRUE*	*TRUE*	*TRUE*	*TRUE*	*TRUE*	*TRUE*	*TRUE*
	Infrastructure Replacement									
14	Beginning Balance	$ 12,457,408	$ 13,577,145	$ 14,785,579	$ 16,085,586	$ 17,444,638	$ 18,877,091	$ 20,344,739	$ 21,825,055	$ 23,328,490
15	Contribution	1,119,737	1,208,434	1,300,008	1,359,052	1,432,453	1,467,648	1,480,316	1,503,435	1,497,375
16	**Ending Balance**	**$ 13,577,145**	**$ 14,785,579**	**$ 16,085,586**	**$ 17,444,638**	**$ 18,877,091**	**$ 20,344,739**	**$ 21,825,055**	**$ 23,328,490**	**$ 24,825,865**
17	*Target*	*2,000,000*	*2,000,000*	*2,000,000*	*2,000,000*	*2,000,000*	*2,000,000*	*2,000,000*	*2,000,000*	*2,000,000*
18	**Annualized Water Service Revenue Increase**	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%
19	**Cumulative Revenue Increase**	50.7%	56.7%	63.0%	69.5%	76.3%	83.4%	90.7%	98.3%	106.2%
20	**Debt Service Coverage**	11.08	11.57	12.10	12.63	13.20	13.71	14.24	14.75	15.34

Table A-2
City of Milpitas, CA
Water Utility
Water Capital Improvement Plan (CIP)

Line		Budget	Projected								
No.	**Capital Financing Plan**	**FY 2022**	**FY 2023**	**FY 2024**	**FY 2025**	**FY 2026**	**FY 2027**	**FY 2028**	**FY 2029**	**FY 2030**	**FY 2031**
	Sources of Funds										
1	Beginning Balance	$ 13,199,527	$ 13,464,473	$ 16,625,757	$ 7,629,326	$ 3,827,790	$ 2,689,612	$ 5,059,757	$ 5,306,748	$ 6,426,325	$ 11,413,754
2	Revenue Bonds	-	-	-	-	-	-	-	-	-	-
4	Capital Charge Revenue	3,913,678	3,926,784	4,333,879	4,868,338	5,466,553	6,135,726	6,884,069	7,229,405	7,589,265	7,737,742
5	Development Fees	297,000	1,002,155	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000
6	Misc. Revenue	7,216	7,215	7,431	7,654	7,884	8,121	8,364	8,615	8,874	9,140
7	Interest	221,000	192,000	332,515	152,587	76,556	53,792	101,195	106,135	128,526	228,275
8	Transfer of Surplus from O&M	2,180,152	686,080	-	-	1,098,407	1,672,246	1,268,619	980,110	1,434,742	1,669,923
9	**Subtotal: Sources**	$ 19,818,573	$ 19,278,707	$ 21,599,583	$ 12,957,905	$ 10,777,189	$ 10,859,496	$ 13,622,004	$ 13,931,013	$ 15,887,732	$ 21,358,834
	Uses of Funds										
10	CIP Projects	$ 5,310,050	$ 1,605,900	$ 12,925,806	$ 8,083,666	$ 7,043,128	$ 4,753,039	$ 7,267,306	$ 6,456,488	$ 3,426,528	$ 7,855,726
11	Debt Service	1,044,050	1,047,050	1,044,450	1,046,450	1,044,450	1,046,700	1,047,950	1,048,200	1,047,450	1,045,700
12	**Subtotal: Uses**	$ 6,354,100	$ 2,652,950	$ 13,970,256	$ 9,130,116	$ 8,087,578	$ 5,799,739	$ 8,315,256	$ 7,504,688	$ 4,473,978	$ 8,901,426
13	**Ending Balance**	$ 13,464,473	$ 16,625,757	$ 7,629,326	$ 3,827,790	$ 2,689,612	$ 5,059,757	$ 5,306,748	$ 6,426,325	$ 11,413,754	$ 12,457,408
	CIP Adjustments										
15	Completion Percentage	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
16	Annual Cost Inflation	0.0%	6.0%	6.0%	6.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%
17	Cumulative Inflation Rate	100.0%	106.0%	112.4%	119.1%	123.9%	128.8%	134.0%	139.3%	144.9%	150.7%

Table A-2
City of Milpitas, CA
Water Utility
Water Capital Improvement Plan (CIP)

Line No.	Capital Financing Plan	Projected FY 2032	FY 2033	FY 2034	FY 2035	FY 2036	FY 2037	FY 2038	FY 2039	FY 2040
	Sources of Funds									
1	Beginning Balance	$ 12,457,408	$ 13,577,145	$ 14,785,579	$ 16,085,586	$ 17,444,638	$ 18,877,091	$ 20,344,739	$ 21,825,055	$ 23,328,490
2	Revenue Bonds	-	-	-	-	-	-	-	-	-
4	Capital Charge Revenue	7,886,322	8,035,005	8,183,791	8,332,683	8,481,679	8,630,781	8,779,990	8,929,307	9,078,731
5	Development Fees	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000
6	Misc. Revenue	9,414	9,696	9,987	10,287	10,595	10,913	11,241	11,578	11,925
7	Interest	249,148	271,543	295,712	321,712	348,893	377,542	406,895	436,501	466,570
8	Transfer of Surplus from O&M	1,892,759	2,137,894	2,395,841	2,631,659	2,893,428	3,133,861	3,364,740	3,625,103	3,865,496
9	**Subtotal: Sources**	$ 22,795,050	$ 24,331,282	$ 25,970,910	$ 27,681,927	$ 29,479,234	$ 31,330,189	$ 33,207,605	$ 35,127,544	$ 37,051,213
	Uses of Funds									
10	CIP Projects	$ 8,169,955	$ 8,496,754	$ 8,836,624	$ 9,190,089	$ 9,557,692	$ 9,940,000	$ 10,337,600	$ 10,751,104	$ 11,181,148
11	Debt Service	1,047,950	1,048,950	1,048,700	1,047,200	1,044,450	1,045,450	1,044,950	1,047,950	1,044,200
12	**Subtotal: Uses**	$ 9,217,905	$ 9,545,704	$ 9,885,324	$ 10,237,289	$ 10,602,142	$ 10,985,450	$ 11,382,550	$ 11,799,054	$ 12,225,348
13	**Ending Balance**	$ 13,577,145	$ 14,785,579	$ 16,085,586	$ 17,444,638	$ 18,877,091	$ 20,344,739	$ 21,825,055	$ 23,328,490	$ 24,825,865
	CIP Adjustments									
15	Completion Percentage	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
16	Annual Cost Inflation	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%
17	Cumulative Inflation Rate	156.7%	163.0%	169.5%	176.3%	183.4%	190.7%	198.3%	206.2%	214.5%

Table A-3
City of Milpitas, CA
Water Utility
Water TASP Capital Improvement Plan (CIP)

Line No.	Capital Financing Plan - TASP	Budget FY 2022	Projected FY 2023	FY 2024	FY 2025	FY 2026	FY 2027	FY 2028	FY 2029	FY 2030	FY 2031
	Sources of Funds										
1	Beginning Balance	$ 17,869,842	$ 17,869,842	$ 24,484,221	$ 17,798,801	$ 17,798,801	$ 17,798,801	$ (4,037,526)	$ (4,037,526)	$ (4,037,526)	$ (4,037,526)
2	TASP Development Fees	-	6,932,379	-	-	-	-	-	-	-	$ -
3	**Subtotal: Sources**	$ 17,869,842	$ 24,802,221	$ 24,484,221	$ 17,798,801	$ 17,798,801	$ 17,798,801	$ (4,037,526)	$ (4,037,526)	$ (4,037,526)	$ (4,037,526)
	Uses of Funds										
4	CIP Projects	$ -	$ 318,000	$ 6,685,420	$ -	$ -	$ 21,836,327	$ -	$ -	$ -	$ -
5	**Subtotal: Uses**	$ -	$ 318,000	$ 6,685,420	$ -	$ -	$ 21,836,327	$ -	$ -	$ -	$ -
6	**Ending Balance**	$ 17,869,842	$ 24,484,221	$ 17,798,801	$ 17,798,801	$ 17,798,801	$ (4,037,526)	$ (4,037,526)	$ (4,037,526)	$ (4,037,526)	$ (4,037,526)
7	**Cumulative Inflation Rate**	100.0%	106.0%	112.4%	119.1%	123.9%	128.8%	134.0%	139.3%	144.9%	150.7%

Table A-3
City of Milpitas, CA
Water Utility
Water TASP Capital Improvement Plan (CIP)

Line No.	Capital Financing Plan - TASP	Projected FY 2032	FY 2033	FY 2034	FY 2035	FY 2036	FY 2037	FY 2038	FY 2039	FY 2040
	Sources of Funds									
1	Beginning Balance	$ (4,037,526)	$ (4,037,526)	$ (4,037,526)	$ (4,037,526)	$ (4,037,526)	$ (4,037,526)	$ (4,037,526)	$ (4,037,526)	$ (4,037,526)
2	TASP Development Fees	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
3	**Subtotal: Sources**	$ (4,037,526)	$ (4,037,526)	$ (4,037,526)	$ (4,037,526)	$ (4,037,526)	$ (4,037,526)	$ (4,037,526)	$ (4,037,526)	$ (4,037,526)
	Uses of Funds									
4	CIP Projects	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
5	**Subtotal: Uses**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
6	**Ending Balance**	$ (4,037,526)	$ (4,037,526)	$ (4,037,526)	$ (4,037,526)	$ (4,037,526)	$ (4,037,526)	$ (4,037,526)	$ (4,037,526)	$ (4,037,526)
7	**Cumulative Inflation Rate**	156.7%	163.0%	169.5%	176.3%	183.4%	190.7%	198.3%	206.2%	214.5%

Appendix G

Capital Improvement Program
Mapbook and Project Summary Sheets

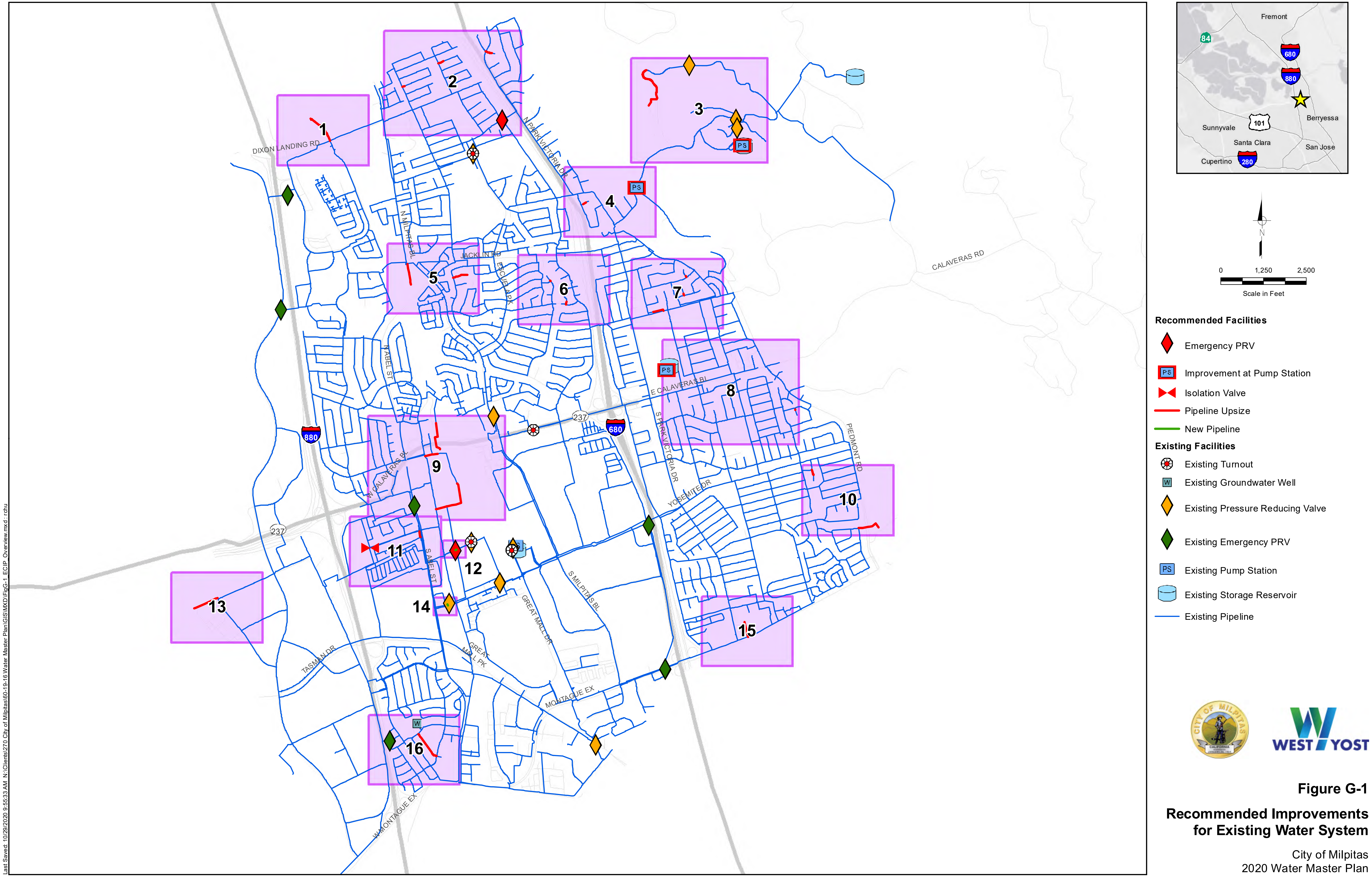
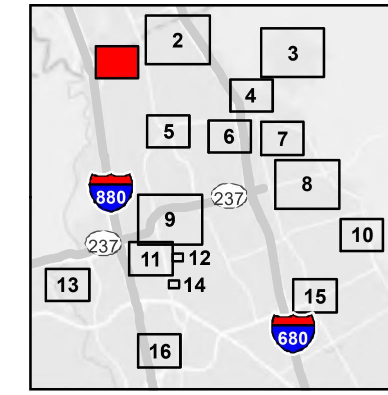


Figure G-1

Recommended Improvements for Existing Water System

City of Milpitas
2020 Water Master Plan



N

0 100 200

Scale in Feet

Recommended Facilities

- Emergency PRV
- Improvement at Pump Station
- Isolation Valve
- Pipeline Upsize
- New Pipeline

Existing Facilities

- Existing Turnout
- Existing Groundwater Well
- Existing Pressure Reducing Valve
- Existing Emergency PRV
- Existing Pump Station
- Existing Storage Reservoir
- Existing Pipeline

Figure G-1.1

Recommended Improvements for Existing Water System

City of Milpitas
2020 Water Master Plan

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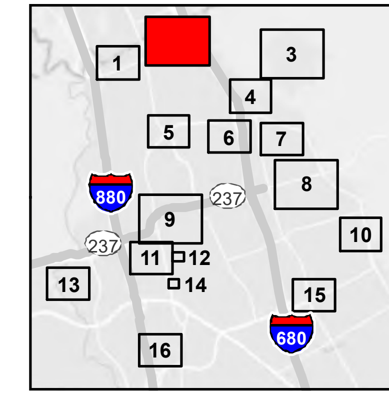

0 150 300
Scale in Feet

Recommended Facilities

- Emergency PRV
- Improvement at Pump Station
- Isolation Valve
- Pipeline Upsize
- New Pipeline

Existing Facilities

- Existing Turnout
- Existing Groundwater Well
- Existing Pressure Reducing Valve
- Existing Emergency PRV
- Existing Pump Station
- Existing Storage Reservoir
- Existing Pipeline

Figure G-1.2

Recommended Improvements for Existing Water System

City of Milpitas
2020 Water Master Plan

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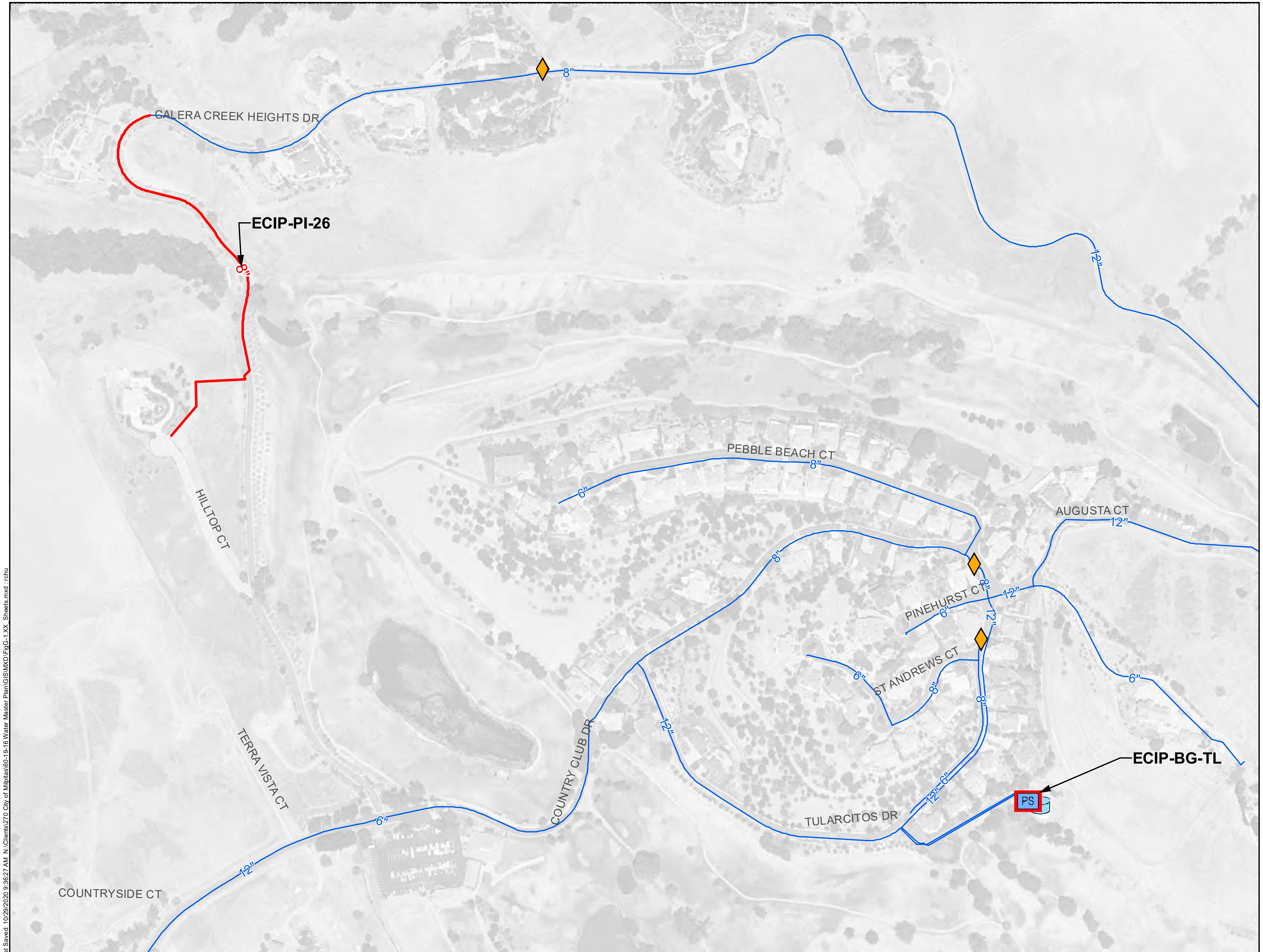

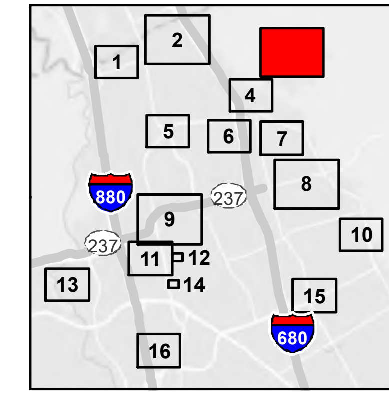

N

0 150 300
Scale in Feet

Recommended Facilities

- Emergency PRV
- Improvement at Pump Station
- Isolation Valve
- Pipeline Upsize
- New Pipeline

Existing Facilities

- Existing Turnout
- Existing Groundwater Well
- Existing Pressure Reducing Valve
- Existing Emergency PRV
- Existing Pump Station
- Existing Storage Reservoir
- Existing Pipeline

WEST YOST

Figure G-1.3

Recommended Improvements for Existing Water System

City of Milpitas
2020 Water Master Plan

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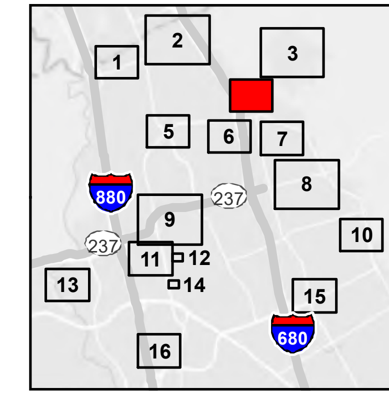

N

0 100 200
Scale in Feet

Recommended Facilities

- Emergency PRV
- Improvement at Pump Station
- Isolation Valve
- Pipeline Upsize
- New Pipeline

Existing Facilities

- Existing Turnout
- Existing Groundwater Well
- Existing Pressure Reducing Valve
- Existing Emergency PRV
- Existing Pump Station
- Existing Storage Reservoir
- Existing Pipeline

Figure G-1.4

Recommended Improvements for Existing Water System

City of Milpitas
2020 Water Master Plan

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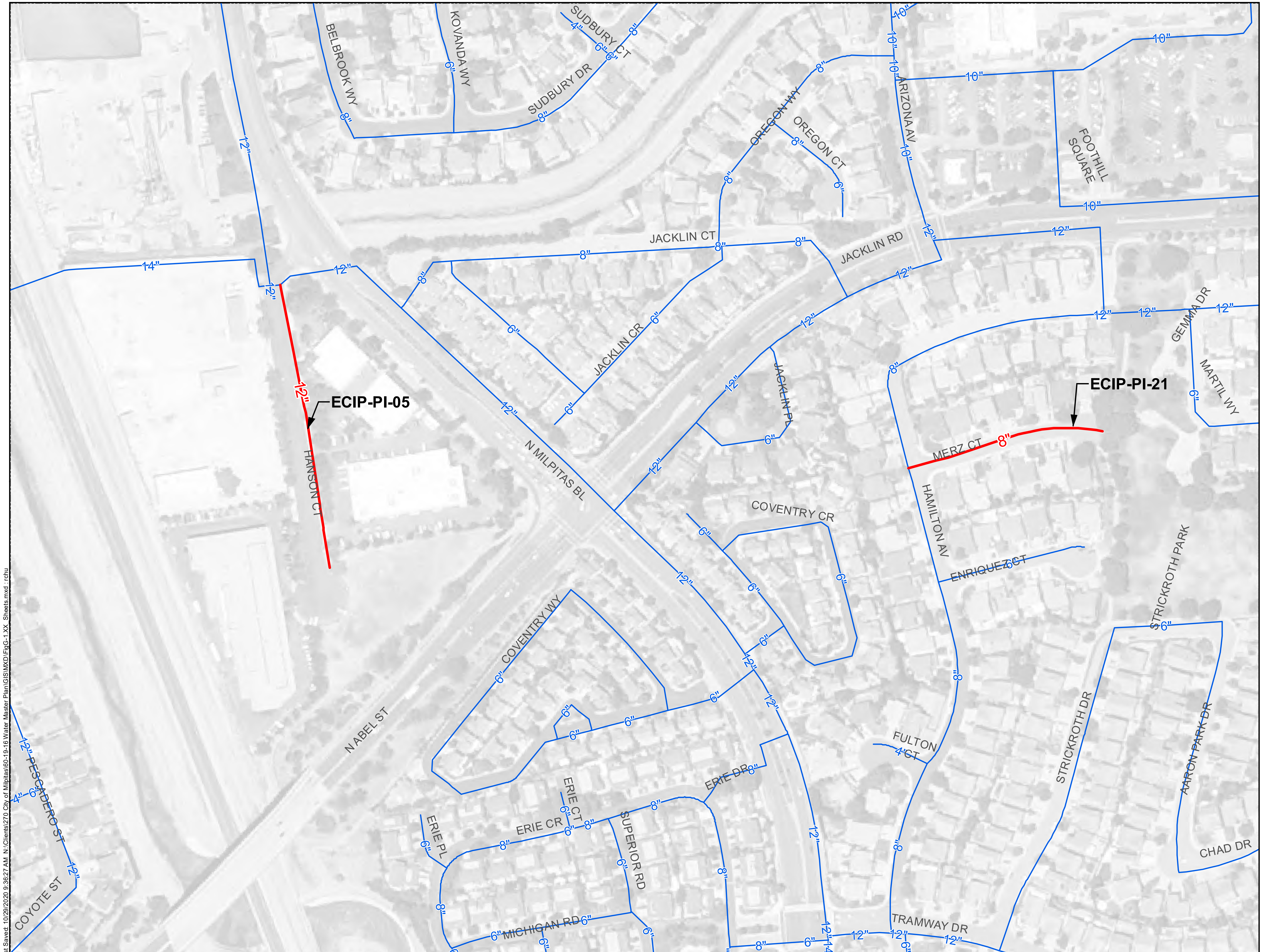
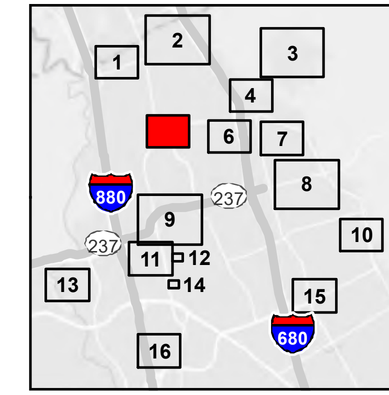




N

0 100 200
Scale in Feet

Recommended Facilities

- Emergency PRV
- Improvement at Pump Station
- Isolation Valve
- Pipeline Upsize
- New Pipeline

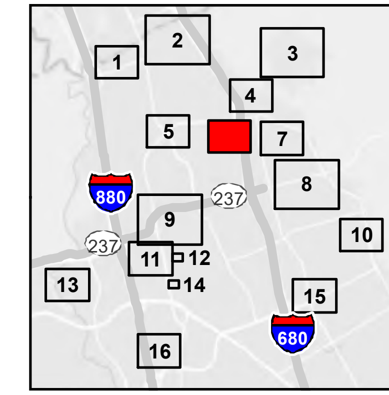
Existing Facilities

- Existing Turnout
- Existing Groundwater Well
- Existing Pressure Reducing Valve
- Existing Emergency PRV
- Existing Pump Station
- Existing Storage Reservoir
- Existing Pipeline

Figure G-1.5

Recommended Improvements for Existing Water System

City of Milpitas
2020 Water Master Plan



N

0 100 200
Scale in Feet

Recommended Facilities

- Emergency PRV
- Improvement at Pump Station
- Isolation Valve
- Pipeline Upsize
- New Pipeline

Existing Facilities

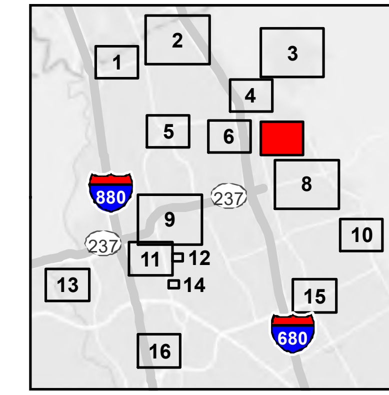
- Existing Turnout
- Existing Groundwater Well
- Existing Pressure Reducing Valve
- Existing Emergency PRV
- Existing Pump Station
- Existing Storage Reservoir
- Existing Pipeline

WEST YOST

Figure G-1.6

Recommended Improvements for Existing Water System

City of Milpitas
2020 Water Master Plan



N

0 100 200
Scale in Feet

Recommended Facilities

- Emergency PRV
- Improvement at Pump Station
- Isolation Valve
- Pipeline Upsize
- New Pipeline

Existing Facilities

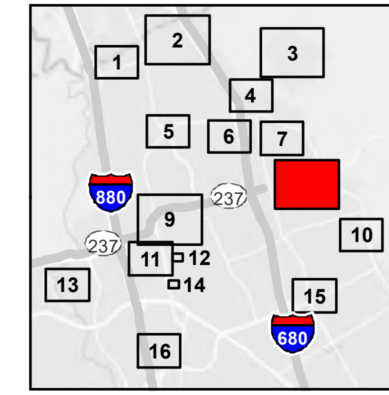
- Existing Turnout
- Existing Groundwater Well
- Existing Pressure Reducing Valve
- Existing Emergency PRV
- Existing Pump Station
- Existing Storage Reservoir
- Existing Pipeline

WEST YOST

Figure G-1.7

Recommended Improvements for Existing Water System

City of Milpitas
2020 Water Master Plan



N

0 150 300
Scale in Feet

Recommended Facilities

- Emergency PRV
- Improvement at Pump Station
- Isolation Valve
- Pipeline Upsize
- New Pipeline

Existing Facilities

- Existing Turnout
- Existing Groundwater Well
- Existing Pressure Reducing Valve
- Existing Emergency PRV
- Existing Pump Station
- Existing Storage Reservoir
- Existing Pipeline

Figure G-1.8

Recommended Improvements for Existing Water System

City of Milpitas
2020 Water Master Plan

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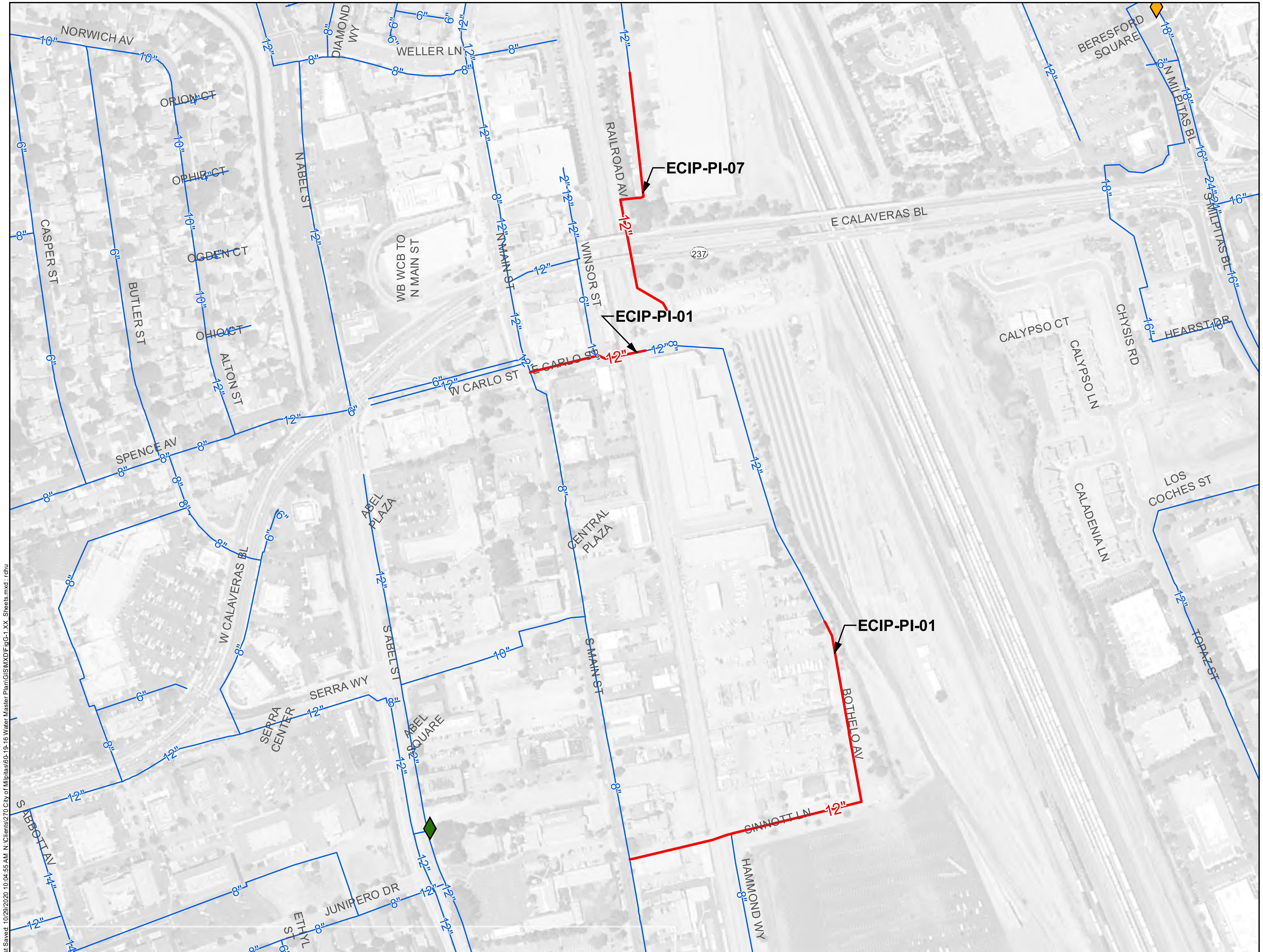

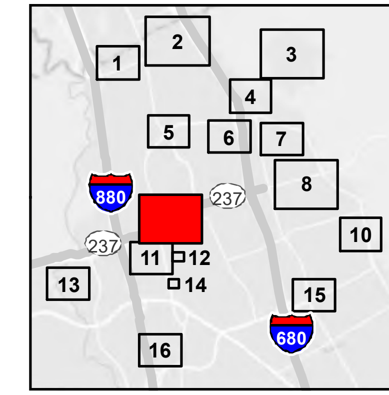

Recommended Facilities

- Emergency PRV
- Improvement at Pump Station
- Isolation Valve
- Pipeline Upsize
- New Pipeline

Existing Facilities

- Existing Turnout
- Existing Groundwater Well
- Existing Pressure Reducing Valve
- Existing Emergency PRV
- Existing Pump Station
- Existing Storage Reservoir
- Existing Pipeline

Figure G-1.9

Recommended Improvements for Existing Water System

City of Milpitas
2020 Water Master Plan

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0 100 200
Scale in Feet

Recommended Facilities

- Emergency PRV
- Improvement at Pump Station
- Isolation Valve
- Pipeline Upsize
- New Pipeline

Existing Facilities

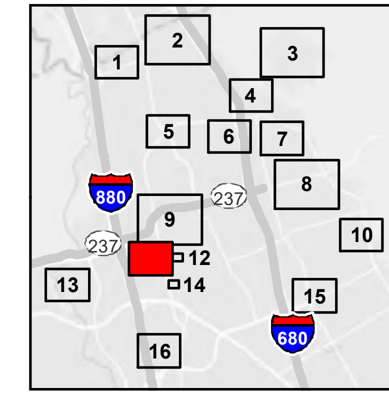
- Existing Turnout
- Existing Groundwater Well
- Existing Pressure Reducing Valve
- Existing Emergency PRV
- Existing Pump Station
- Existing Storage Reservoir
- Existing Pipeline

WEST YOST

Figure G-1.10

Recommended Improvements for Existing Water System

City of Milpitas
2020 Water Master Plan



N

0 100 200

Scale in Feet

Recommended Facilities

- Emergency PRV
- Improvement at Pump Station
- Isolation Valve
- Pipeline Upsize
- New Pipeline

Existing Facilities

- Existing Turnout
- Existing Groundwater Well
- Existing Pressure Reducing Valve
- Existing Emergency PRV
- Existing Pump Station
- Existing Storage Reservoir
- Existing Pipeline

WEST YOST

Figure G-1.11

Recommended Improvements for Existing Water System

City of Milpitas
2020 Water Master Plan

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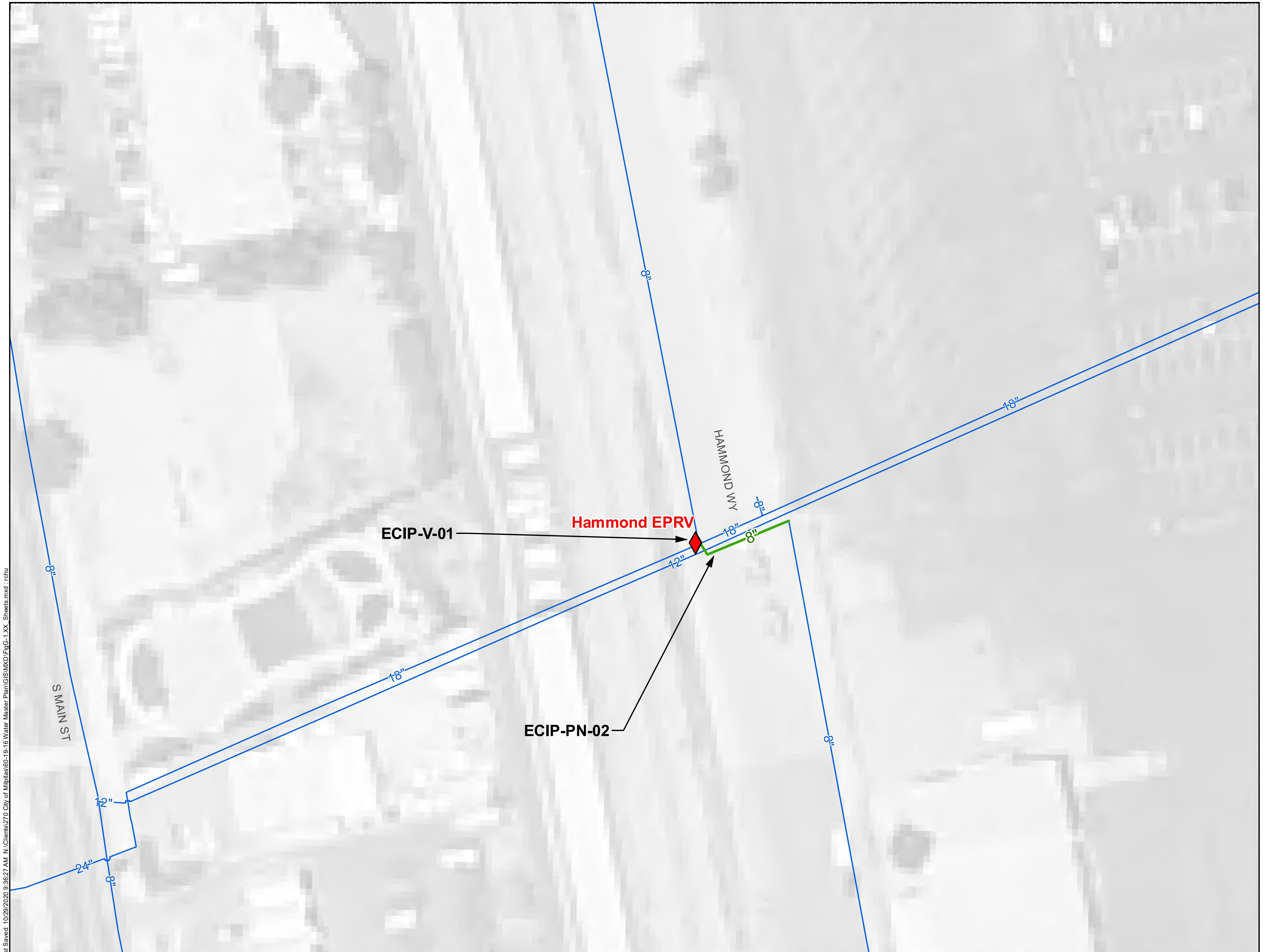

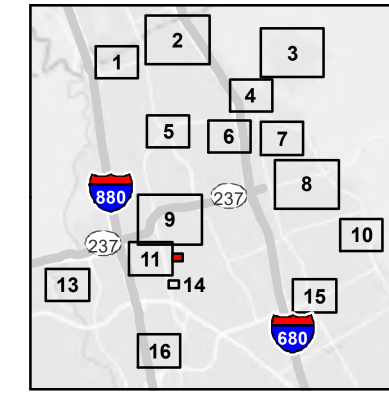

N

0 25 50

Scale in Feet

Recommended Facilities

- Emergency PRV
- Improvement at Pump Station
- Isolation Valve
- Pipeline Upsize
- New Pipeline

Existing Facilities

- Existing Turnout
- Existing Groundwater Well
- Existing Pressure Reducing Valve
- Existing Emergency PRV
- Existing Pump Station
- Existing Storage Reservoir
- Existing Pipeline

WEST YOST

Figure G-1.12

Recommended Improvements for Existing Water System

City of Milpitas
2020 Water Master Plan

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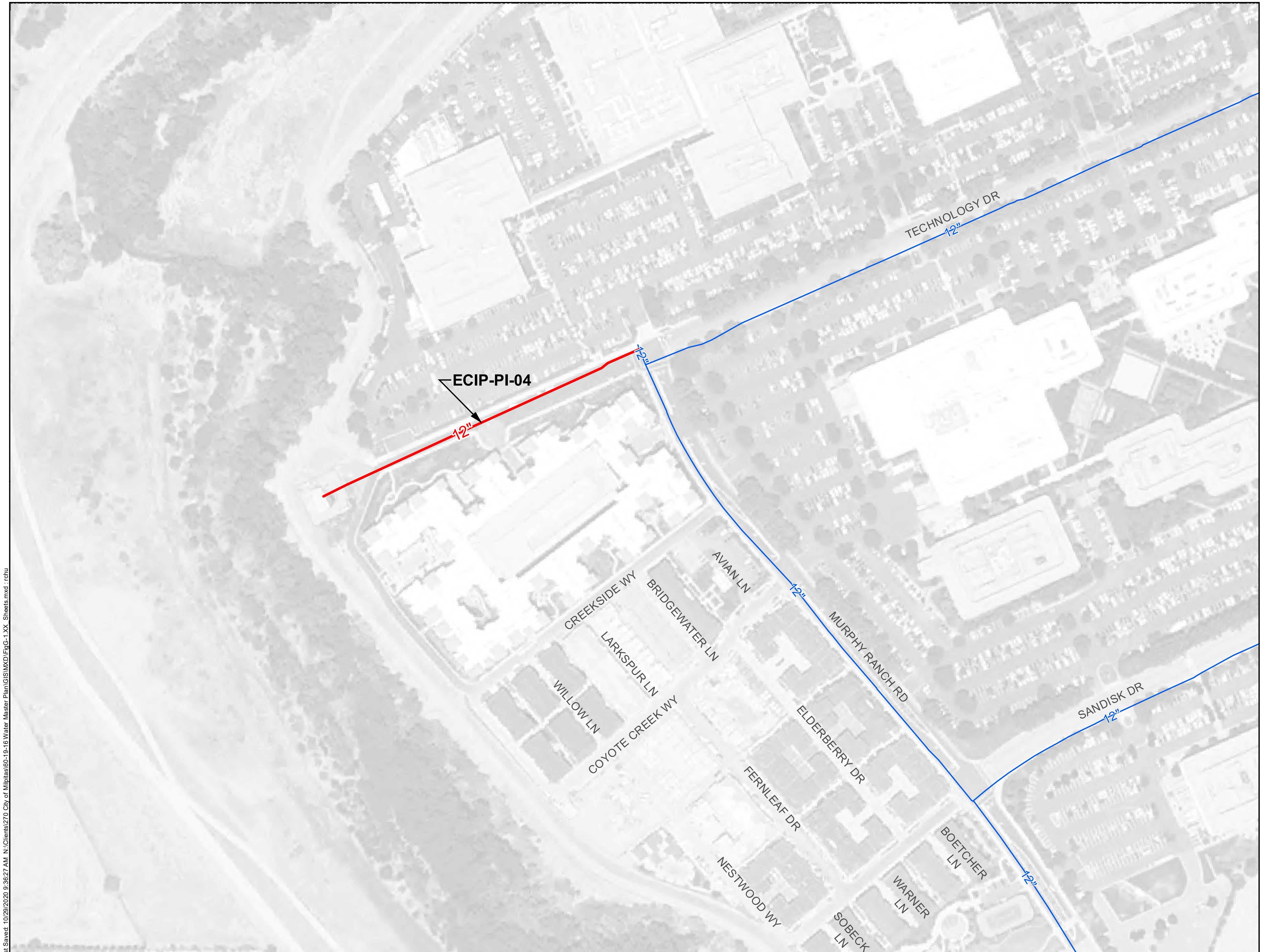

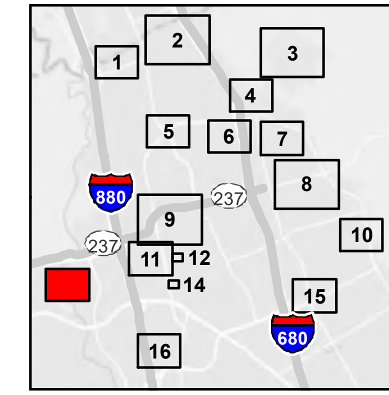

N

0 100 200

Scale in Feet

Recommended Facilities

- Emergency PRV
- Improvement at Pump Station
- Isolation Valve
- Pipeline Upsize
- New Pipeline

Existing Facilities

- Existing Turnout
- Existing Groundwater Well
- Existing Pressure Reducing Valve
- Existing Emergency PRV
- Existing Pump Station
- Existing Storage Reservoir
- Existing Pipeline

Figure G-1.13

Recommended Improvements for Existing Water System

City of Milpitas
2020 Water Master Plan

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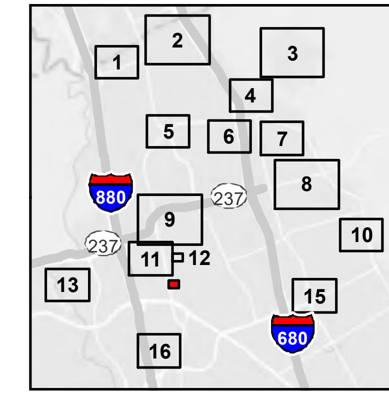


0 25 50
Scale in Feet

Recommended Facilities

- Emergency PRV
- Improvement at Pump Station
- Isolation Valve
- Pipeline Upsize
- New Pipeline

Existing Facilities

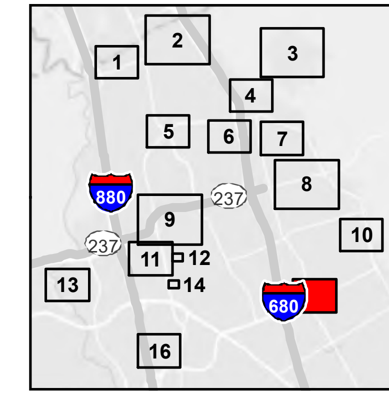
- Existing Turnout
- Existing Groundwater Well
- Existing Pressure Reducing Valve
- Existing Emergency PRV
- Existing Pump Station
- Existing Storage Reservoir
- Existing Pipeline

WEST YOST

Figure G-1.14

Recommended Improvements for Existing Water System

City of Milpitas
2020 Water Master Plan



0 100 200
Scale in Feet

Recommended Facilities

- Emergency PRV
- Improvement at Pump Station
- Isolation Valve
- Pipeline Upsize
- New Pipeline

Existing Facilities

- Existing Turnout
- Existing Groundwater Well
- Existing Pressure Reducing Valve
- Existing Emergency PRV
- Existing Pump Station
- Existing Storage Reservoir
- Existing Pipeline

Figure G-1.15

Recommended Improvements for Existing Water System

City of Milpitas
2020 Water Master Plan

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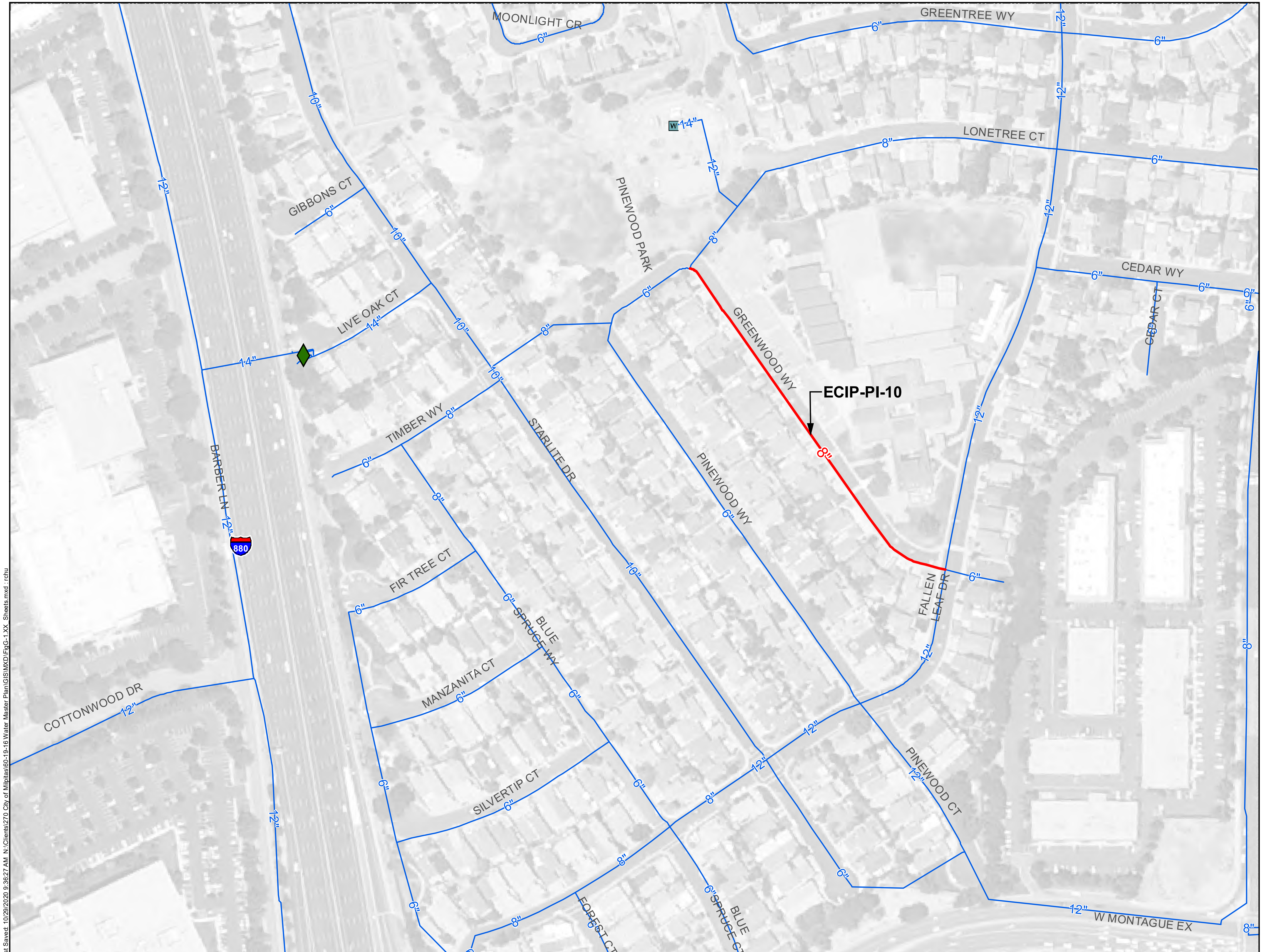
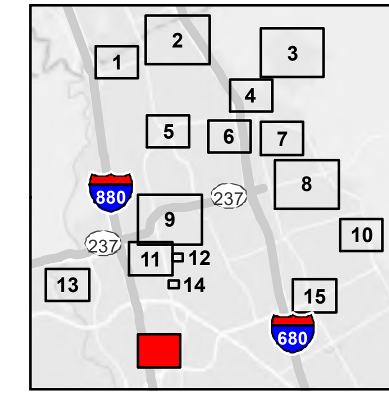




N

0 100 200

Scale in Feet

Recommended Facilities

- Emergency PRV
- Improvement at Pump Station
- Isolation Valve
- Pipeline Upsize
- New Pipeline

Existing Facilities

- Existing Turnout
- Existing Groundwater Well
- Existing Pressure Reducing Valve
- Existing Emergency PRV
- Existing Pump Station
- Existing Storage Reservoir
- Existing Pipeline

Figure G-1.16

Recommended Improvements for Existing Water System

City of Milpitas
2020 Water Master Plan

ECIP-V-01
Hammond Emergency PRV

CONSTRUCTION COST	$ 282,000
CAPITAL COST	$ 479,000
PRIORITY	High
PURPOSE	Fire Flow
LOCATION	Hammond Way near Tom Evatt Park
PRESSURE ZONE	SF1/VW1

Legend

Emergency PRV

Existing SF1 Pipeline

Existing VW1 Pipeline

N

1 inch = 200 feet

RECOMMENDED IMPROVEMENT SIZE

8-inch diameter PRV and piping.

REASON FOR IMPROVEMENT

Provide fire flows from Zone SF1 to Zone VW1.

PLANNING ASSUMPTIONS

Costs are in 2020 dollars and assume normal construction conditions. Special or difficult conditions would significantly increase costs. Capital costs are rounded to the nearest thousand dollars and include mark-ups equal to 70 percent (Design and Construction Contingency: 35 percent; Engineering Design: 10 percent; Construction Management: 15 percent; and Permitting and Implementation: 10 percent).

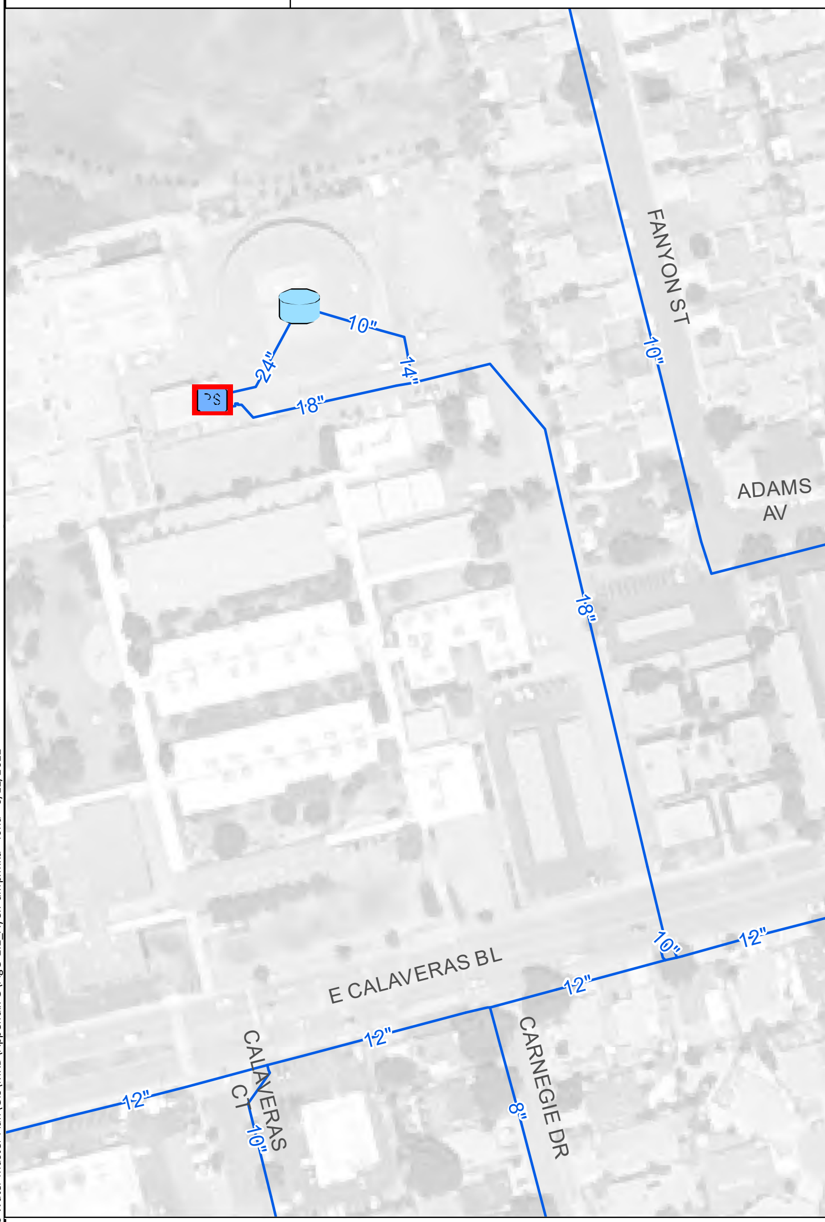
PRV costs include the installation of control valve(s), a concrete utility vault, access hatches, site piping, earthwork, paving, SCADA, and related sitework.

Figure G-2.1
City of Milpitas
Project Summary Sheet (ECIP-V-01)

WEST YOST - N:\Clients\270 City of Milpitas\60-19-16 Water Master Plan\GIS\MXD\Appendix G\FigG-2.1_HammondEPRV.mxd - rchu - 6/12/2022

ECIP-PS-AY
New Fire Pump at Ayer Pump Station

CONSTRUCTION COST	$ 1,216,733
CAPITAL COST	$ 2,068,000
PRIORITY	Medium
PURPOSE	Fire Flow Backup
LOCATION	Ayer Pump Station
PRESSURE ZONE	SF2



Legend

- Improvement at Pump Station
- Existing Storage Reservoir
- Existing Pipeline

N

1 inch = 200 feet

RECOMMENDED IMPROVEMENT SIZE

Install one new fire pump at the existing Ayer Pump Station. Capacity shall be 4,00 gallons per minute (gpm) (5.76 million gallons per day (mgd)).

REASON FOR IMPROVEMENT

Provide fire flows to Zone SF2 in the event of an SFPUC supply outage.

PLANNING ASSUMPTIONS

Costs are in 2020 dollars and assume normal construction conditions. Special or difficult conditions would significantly increase costs. Capital costs are rounded to the nearest thousand dollars and include mark-ups equal to 70 percent (Design and Construction Contingency: 35 percent; Engineering Design: 10 percent; Construction Management: 15 percent; and Permitting and Implementation: 10 percent).

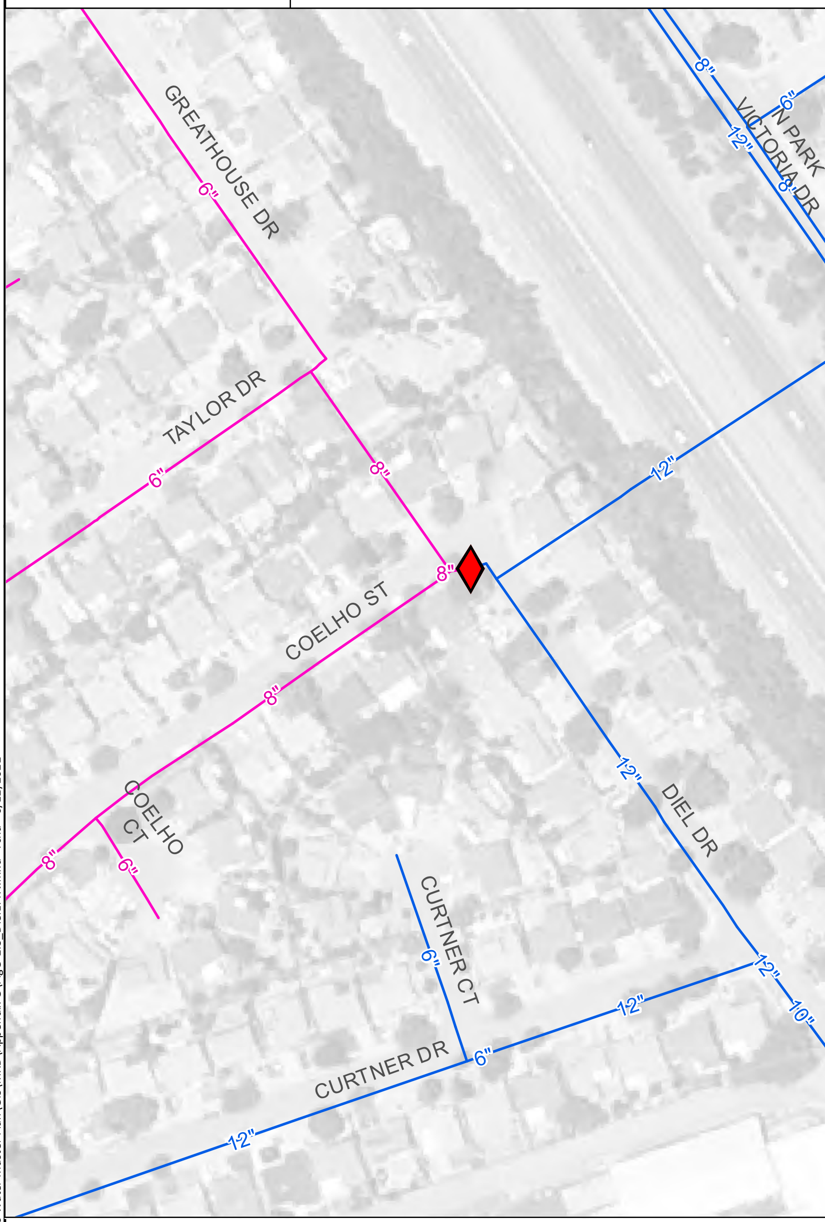
Pump station costs are based on enclosed stations with architectural and landscaping treatment suitable for residential areas. Since this improvement entails adding a pump to an existing pump station, costs for a new pump station (5.76 mgd firm capacity) have been discounted by 50 percent.

Figure G-2.2
City of Milpitas
Project Summary Sheet (ECIP-PS-AY)

WEST YOST - N:\Clients\270 City of Milpitas\60-19-16 Water Master Plan\GIS\MXD\Appendix G\FigG-2.2_AyerPump.mxd - rchu - 6/12/2022

ECIP-V-03
Diel Emergency PRV

CONSTRUCTION COST	$ 282,000
CAPITAL COST	$ 479,000
PRIORITY	Medium
PURPOSE	Fire Flow Backup
LOCATION	Intersection of Coelho Street and Diel Drive
PRESSURE ZONE	SF2/SF1



Legend

- Emergency PRV
- Existing SF1 Pipeline
- Existing SF2 Pipeline

N

1 inch = 200 feet

<u>RECOMMENDED IMPROVEMENT SIZE</u>

8-inch diameter PRV and piping.

<u>REASON FOR IMPROVEMENT</u>

Supplement existing Sunnyhills PRV in providing fire flows from Zone SF2 to Zone SF1.

<u>PLANNING ASSUMPTIONS</u>

Costs are in 2020 dollars and assume normal construction conditions. Special or difficult conditions would significantly increase costs. Capital costs are rounded to the nearest thousand dollars and include mark-ups equal to 70 percent (Design and Construction Contingency: 35 percent; Engineering Design: 10 percent; Construction Management: 15 percent; and Permitting and Implementation: 10 percent).

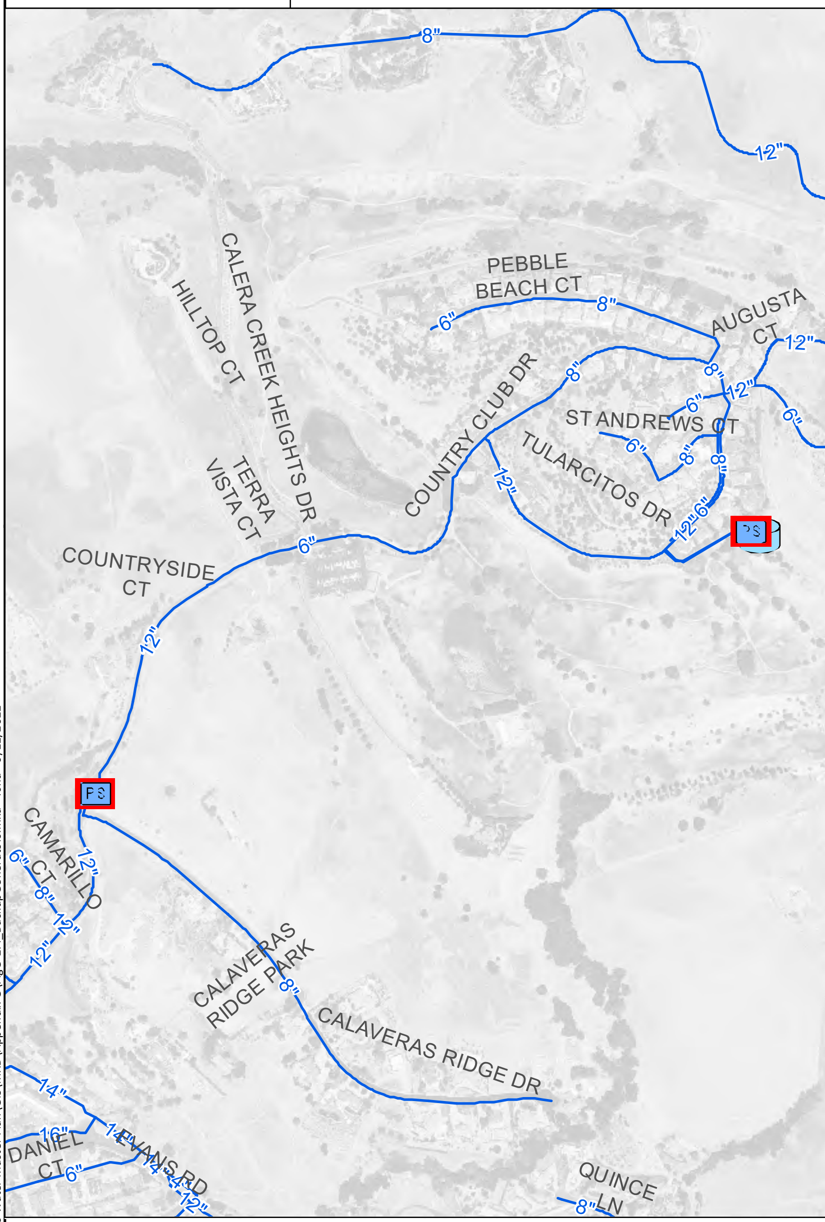
PRV costs include the installation of control valve(s), a concrete utility vault, access hatches, site piping, earthwork, paving, SCADA, and related sitework.

Figure G-2.3
City of Milpitas
Project Summary Sheet (ECIP-V-03)

WEST YOST - N:\Clients\270 City of Milpitas\60-19-16 Water Master Plan\GIS\MXD\Appendix G\FigG-2.3_DielEPRV.mxd - rchu - 6/12/2022

ECIP-BG-CC and ECIP-BG-TL
Backup Generators at Country Club and Tularcitos Pump Stations

CONSTRUCTION COST	$ 200,000 per generator ($400,000 total)
CAPITAL COST	$ 340,000 per generator ($680,000 total)
PRIORITY	Low
PURPOSE	General Reliability
LOCATION	Country Club and Tularcitos Pump Stations
PRESSURE ZONE	SF3 and SF4



Legend

- PS Improvement at Pump Station
- Existing Storage Reservoir
- Existing Pipeline

N

1 inch = 900 feet

RECOMMENDED IMPROVEMENT SIZE

Generators shall be sized to meet the power demands of each pump station.

REASON FOR IMPROVEMENT

Ensure continued pump operation in the event of a power outage.

PLANNING ASSUMPTIONS

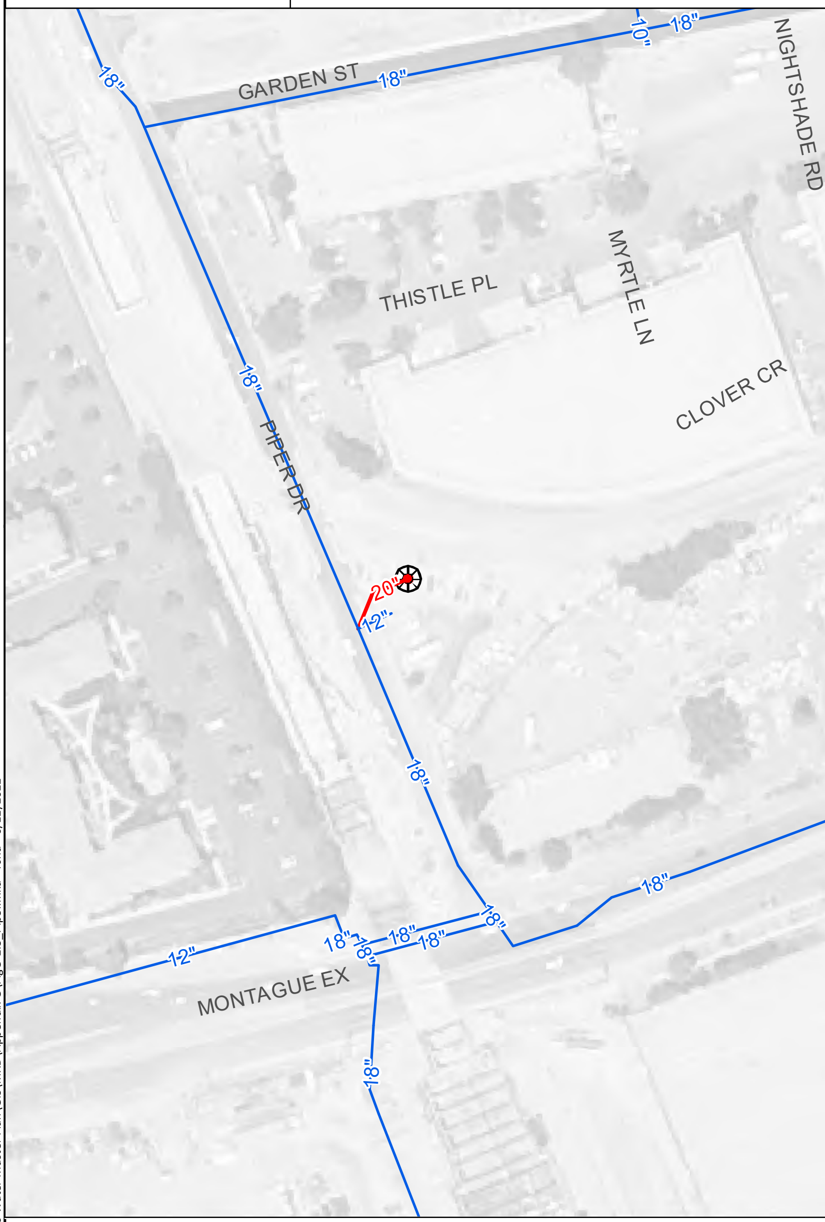
Costs are in 2020 dollars and assume normal construction conditions. Special or difficult conditions would significantly increase costs. Capital costs are rounded to the nearest thousand dollars and include mark-ups equal to 70 percent (Design and Construction Contingency: 35 percent; Engineering Design: 10 percent; Construction Management: 15 percent; and Permitting and Implementation: 10 percent).

Figure G-2.4
City of Milpitas - Project Summary Sheet (ECIP-BG-CC and ECIP-BG-TL)

WEST YOST - N:\Clients\270 City of Milpitas\60-19-16 Water Master Plan\GIS\MXD\Appendix G\FigG-2.4_BackupGenerators.mxd - rchu - 6/12/2022

BCIP-TO-01
Piper Turnout

CONSTRUCTION COST	$ 313,000
CAPITAL COST	$ 532,000
PRIORITY	High
PURPOSE	Firm Supply Capacity
LOCATION	Piper Drive south of Garden Street
PRESSURE ZONE	VW2



Legend

- Turnout
- Turnout Pipeline
- Existing Pipeline

N

1 inch = 200 feet

RECOMMENDED IMPROVEMENT SIZE

Same capacity as the existing Gibraltar turnout: 10,000 gallons per minute (gpm) (14.4 million gallons per day (mgd)).

Connection from the turnout to the existing 18-inch diameter transmission main on Piper Drive shall be a 20-inch diameter pipeline.

REASON FOR IMPROVEMENT

Insufficient firm supply capacity in the Valley Water service area at buildout.

PLANNING ASSUMPTIONS

Costs are in 2020 dollars and assume normal construction conditions. Special or difficult conditions would significantly increase costs. Capital costs are rounded to the nearest thousand dollars and include mark-ups equal to 70 percent (Design and Construction Contingency: 35 percent; Engineering Design: 10 percent; Construction Management: 15 percent; and Permitting and Implementation: 10 percent).

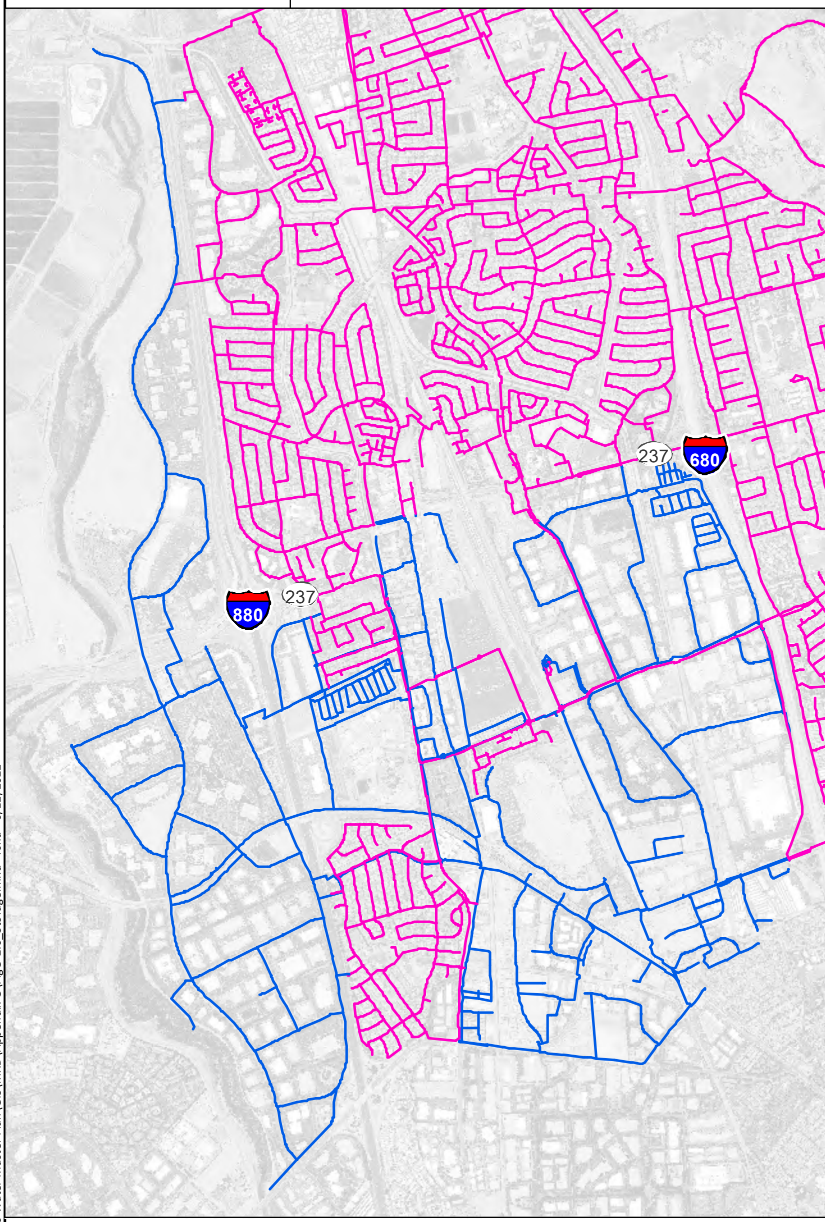
Turnout costs include the installation of control valve(s), a concrete utility vault, access hatches, site piping, earthwork, paving, SCADA, and related sitework.

Figure G-2.5
City of Milpitas
Project Summary Sheet (BCIP-TO-01)

WEST YOST - N:\Clients\270 City of Milpitas\60-19-16 Water Master Plan\GIS\MXD\Appendix G\FigG-2.5_Piper.mxd - rchu - 6/12/2022

BCIP-S-01
Storage Reservoir in Valley Water Service Area

CONSTRUCTION COST	$ 3,254,000
CAPITAL COST	$ 5,532,000
PRIORITY	High
PURPOSE	Storage Capacity
LOCATION	Valley Water Service Area (Specific Location TBD)
PRESSURE ZONE	VW1 or VW2



Legend

Existing SFPUC Pipeline

Existing VW Pipeline

N

1 inch = 3,500 feet

RECOMMENDED IMPROVEMENT SIZE

2.0 million gallons (MG).

REASON FOR IMPROVEMENT

Insufficient storage capacity in the Valley Water service area at buildout.

PLANNING ASSUMPTIONS

Costs are in 2020 dollars and assume normal construction conditions. Special or difficult conditions would significantly increase costs. Capital costs are rounded to the nearest thousand dollars and include mark-ups equal to 70 percent (Design and Construction Contingency: 35 percent; Engineering Design: 10 percent; Construction Management: 15 percent; and Permitting and Implementation: 10 percent).

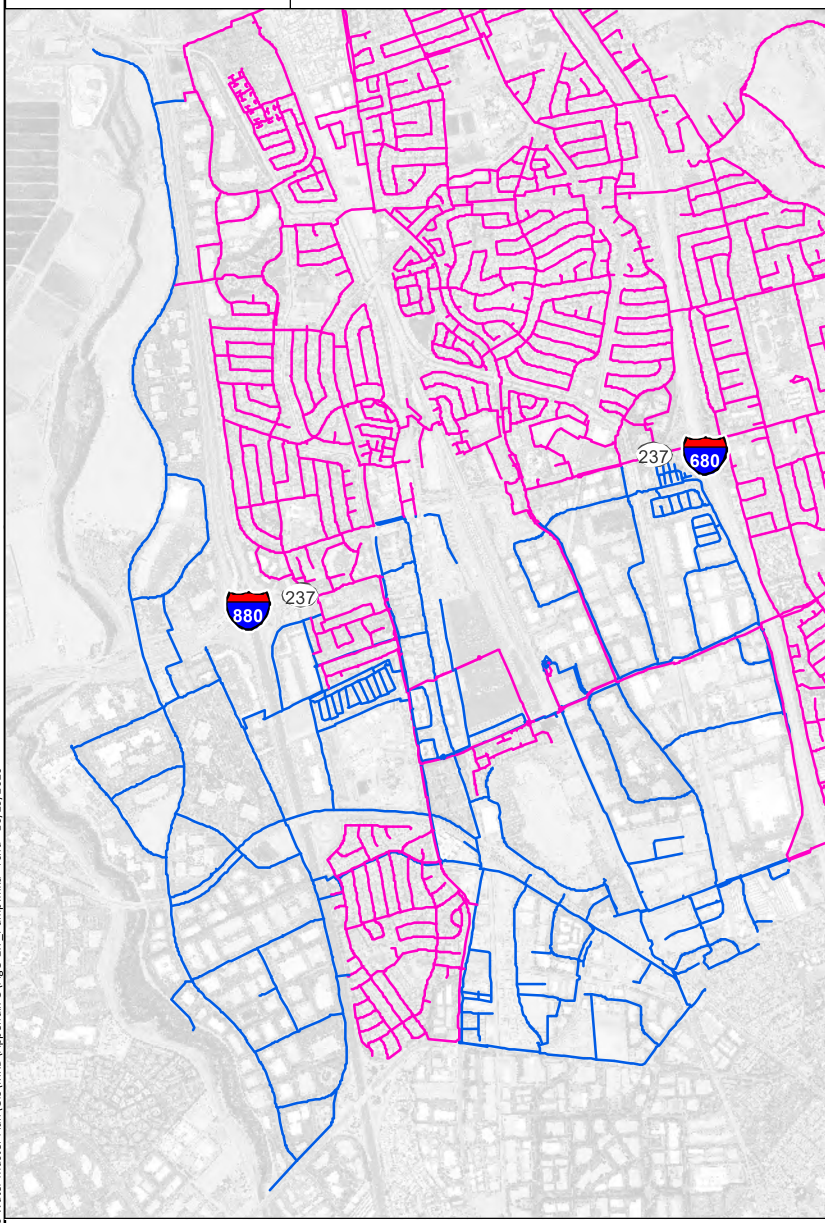
Storage reservoir will be aboveground steel tank. Costs include installation of the storage tank, site piping, earthwork, paving, instrumentation, and related sitework.

Figure G-2.6
City of Milpitas
Project Summary Sheet (BCIP-S-01)

WEST YOST - N:\Clients\270 City of Milpitas\60-19-16 Water Master Plan\GIS\MXD\Appendix G\FigG-2.6_Storage.mxd - rchu - 6/12/2022

BCIP-PS-01
Pump Station for Reservoir in Valley Water Service Area

CONSTRUCTION COST	$ 2,433,466
CAPITAL COST	$ 4,137,000
PRIORITY	High
PURPOSE	Deliver Stored Water from New Reservoir
LOCATION	Valley Water Service Area (Specific Location TBD)
PRESSURE ZONE	VW1 or VW2



Legend

Existing SFPUC Pipeline

Existing VW Pipeline

1 inch = 3,500 feet

RECOMMENDED IMPROVEMENT SIZE

4,000 gallons per minute (gpm) firm capacity.

REASON FOR IMPROVEMENT

Pump station for recommended storage reservoir (BCIP-S-01).

PLANNING ASSUMPTIONS

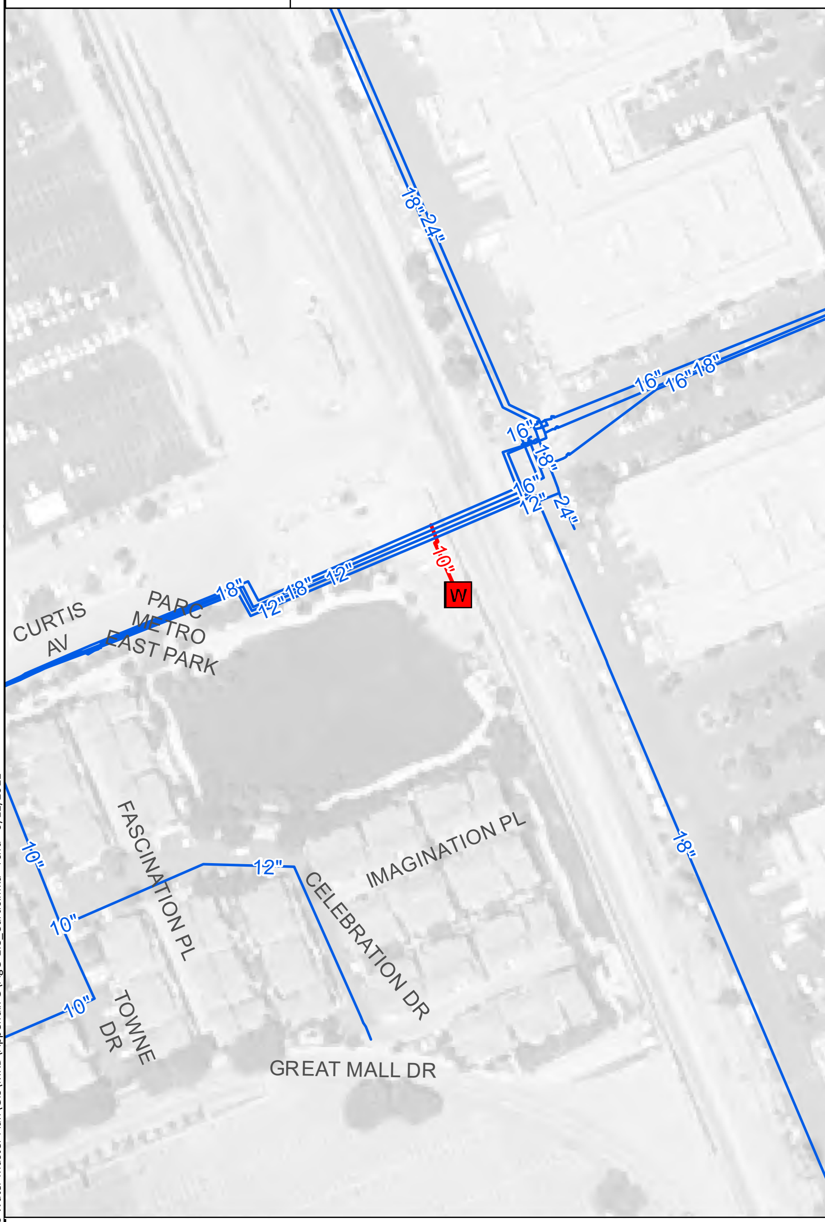
Costs are in 2020 dollars and assume normal construction conditions. Special or difficult conditions would significantly increase costs. Capital costs are rounded to the nearest thousand dollars and include mark-ups equal to 70 percent (Design and Construction Contingency: 35 percent; Engineering Design: 10 percent; Construction Management: 15 percent; and Permitting and Implementation: 10 percent).

Costs assume an enclosed pump station with architectural and landscaping treatment suitable for residential areas.

Figure G-2.7
City of Milpitas
Project Summary Sheet (BCIP-PS-01)

BCIP-W-01
Curtis Well

CONSTRUCTION COST	$ 3,500,000
CAPITAL COST	$ 5,950,000
PRIORITY	High
PURPOSE	Storage Capacity (Groundwater Credit)
LOCATION	Curtis Avenue near Parc Metro East
PRESSURE ZONE	VW2



Legend

- W Groundwater Well
- Well Pipeline
- Existing Pipeline

N

1 inch = 200 feet

RECOMMENDED IMPROVEMENT SIZE

Well capacity will be based on subsequent groundwater analysis that is not part of this report.

REASON FOR IMPROVEMENT

Increase supply reliability and reduce storage requirement via emergency groundwater storage credit.

PLANNING ASSUMPTIONS

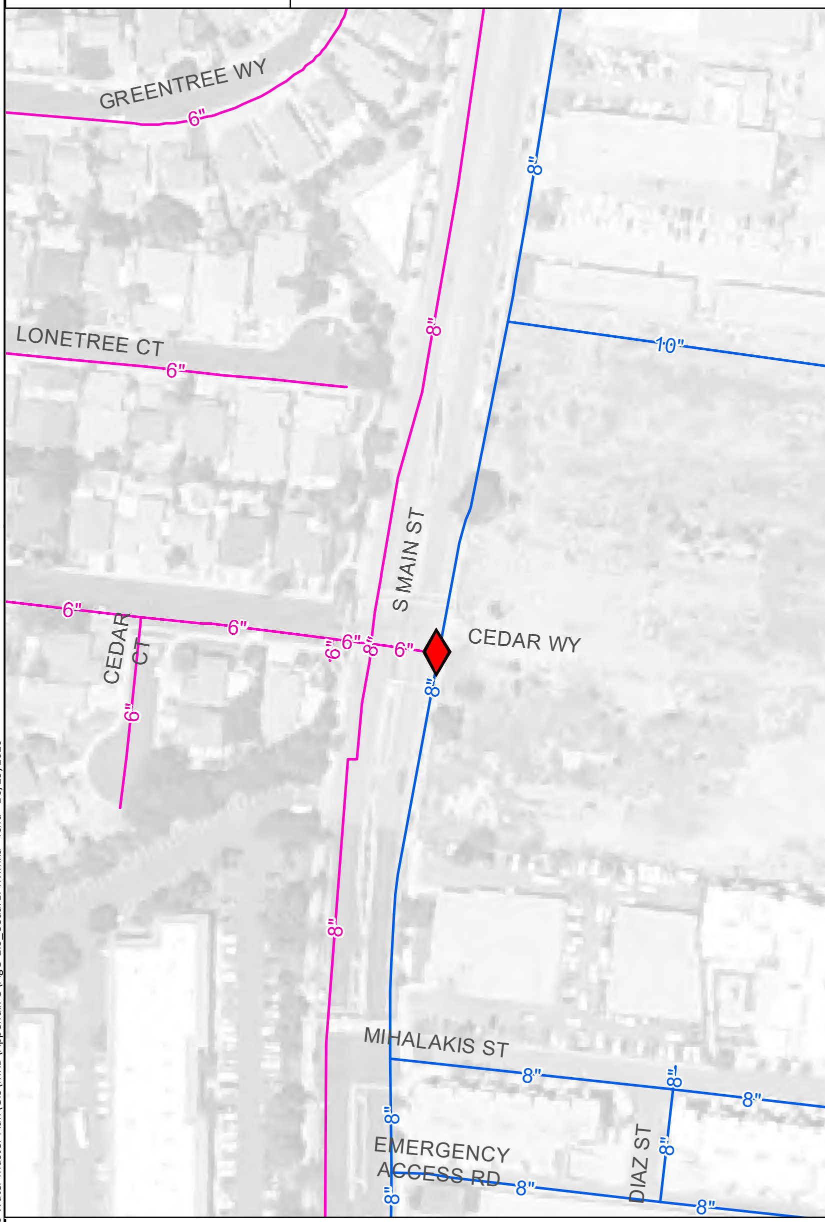
Costs are in 2020 dollars and assume normal construction conditions. Special or difficult conditions would significantly increase costs. Capital costs are rounded to the nearest thousand dollars and include mark-ups equal to 70 percent (Design and Construction Contingency: 35 percent; Engineering Design: 10 percent; Construction Management: 15 percent; and Permitting and Implementation: 10 percent).

Well construction consists of pilot hole drilling, water quality/soil sampling, pilot hole reaming, well construction, well development and providing the necessary housing, pump, motor, automatic control equipment, discharge piping, supervisory control and data acquisition (SCADA), disinfection equipment, and a backup power generator. Costs assume a well capacity between 500 and 1,000 gpm. A higher capacity may increase costs.

Figure G-2.8
City of Milpitas
Project Summary Sheet (BCIP-W-01)

BCIP-V-01
Cedar Emergency PRV

CONSTRUCTION COST	$ 282,000
CAPITAL COST	$ 479,000
PRIORITY	High
PURPOSE	Fire Flow
LOCATION	Intersection of Cedar Way and South Main Street
PRESSURE ZONE	SF1/VW1



Legend

Emergency PRV

Existing SF1 Pipeline

Existing VW1 Pipeline

N

1 inch = 200 feet

RECOMMENDED IMPROVEMENT SIZE

8-inch diameter PRV and piping.

REASON FOR IMPROVEMENT

Provide fire flows from Zone SF1 to Zone VW1.

PLANNING ASSUMPTIONS

Costs are in 2020 dollars and assume normal construction conditions. Special or difficult conditions would significantly increase costs. Capital costs are rounded to the nearest thousand dollars and include mark-ups equal to 70 percent (Design and Construction Contingency: 35 percent; Engineering Design: 10 percent; Construction Management: 15 percent; and Permitting and Implementation: 10 percent).

PRV costs include the installation of control valve(s), a concrete utility vault, access hatches, site piping, earthwork, paving, SCADA, and related sitework.

Figure G-2.9
City of Milpitas
Project Summary Sheet (BCIP-V-01)

WEST YOST - N:\Clients\270 City of Milpitas\60-19-16 Water Master Plan\GIS\MXD\Appendix G\FigG-2.9_CedarEPRV.mxd - rchu - 10/29/2020

WE SUPPORT OUR COMMUNITIES

WE ARE WATER FOCUSED

WE TAKE PRIDE IN WHAT WE DO

WE STRIVE TO BECOME OUR BEST

WE DO WHAT'S RIGHT

WE BELIEVE IN QUALITY

WE LISTEN

WE SOLVE CHALLENGING PROBLEMS

WE SEE THE BIGGER PICTURE

WE TAKE OWNERSHIP

WE COLLABORATE

WE HAVE FUN

WE ARE WEST YOST

WEST YOST
Water. Engineered.