City of Victorville

Water Feasibility Study

for

PSUB19-00061 (EWTR19-00302)

(224-Unit Multifamily Apartment Complex)

Prepared for:

Prepared Under the Responsible Charge of:

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WSC
WATER SYSTEMS CONSULTING, INC.

Engineering Review:
Approved
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Date: 06/17/2021

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1 BACKGROUND AND PURPOSE

The City of Victorville (City) has requested that WSC complete a Water Feasibility Study (WFS) on behalf of the Victorville Water District (District) for PSUB19-00061 (EWTR19-00302) (Project). The Project is a proposed 224-unit multifamily apartment complex located in the District's Zone 3170. The proposed development is bounded by Winona Street to the north, Nisqualli Road to the south, Balsam Avenue to the west, and an existing apartment complex to the east. Figure 1 shows the location of the proposed Project.

Key objectives for this water feasibility study are to:

- Estimate the water demands associated with the development of the Project, including fire flow demands;
- Assess whether the District's existing water storage is sufficient to serve the Project in addition to existing customers;
- Assess whether the District's existing water supply sources are sufficient to serve the project in addition to existing customers;
- Determine the size and approximate location of pipeline improvements needed to provide adequate service pressure and fire flow to the Project. This includes improvements within the project as well as offsite and may include an evaluation of connecting to an alternative pressure zone if needed;
- Identify coordination needs or opportunities with other improvements planned by the City.

This study incorporates data from the District's 2015 Urban Water Management Plan (2015 UWMP), 2019 Water Master Plan (2019 WMP), facility inventory data as of October 2018, and water production data for the 2017 calendar year. WSC used the District's hydraulic model to determine the fire flow availability, pipeline velocities, and pipeline pressures in the Project area.

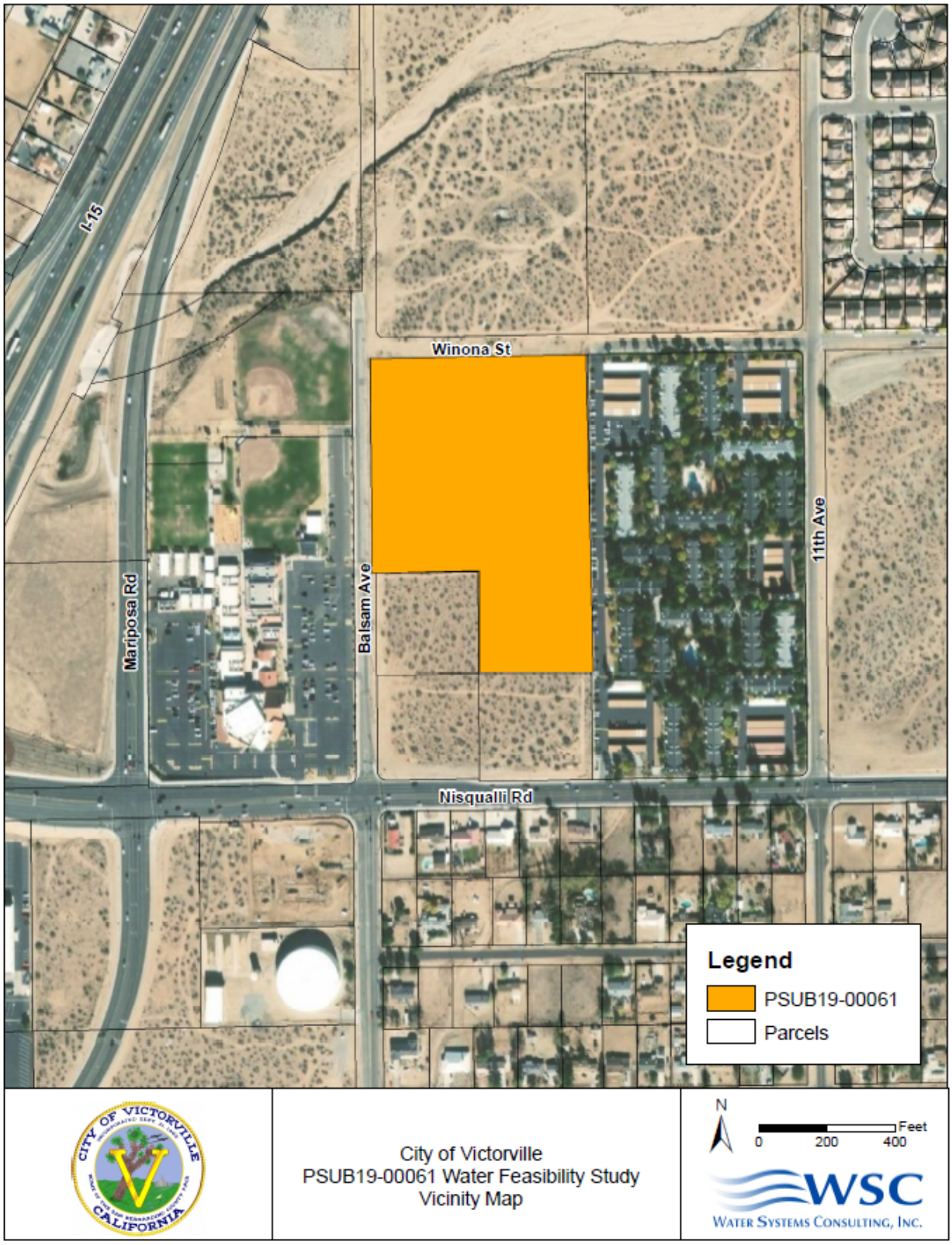

Figure 1. Vicinity Map for PSUB19-00061

2 PROJECT DEMANDS

Water demand factors, required fire flow, and storage requirements for the Project were determined using future demand projections from the 2015 UWMP and evaluation criteria presented in the 2019 WMP. This section summarizes the potable water demands, fire flow requirements, and storage requirements for the Project.

2.1 WATER DEMAND

Water demands for the Project were estimated using water demand projections presented in the 2015 UWMP. Table 5-7 and 5-8 in the 2015 UWMP present water demand projections for multi-family residential (MDR) services in Year 2020, which total 1,984 acre-ft per year (AFY) for an estimated 636 connections. These projections correspond to a demand factor of 3.1 AFY per MDR connection, or 2,783 gpd. For this analysis, it is assumed that the Project will have 13 connections, which corresponds to the number of proposed residential buildings plus one connection for the office, gym and pool area within the Project site. Using this methodology, the total estimated water demand for the Project is 36,200 gpd.

The water demand estimate above was converted to gpd per dwelling unit (DU) to compare with recent water demand estimates for multi-family housing published by the Water Research Foundation. The Project has a total of 224 DUs; therefore, the water demand factor is 162 gpd/DU. This water demand factor falls within a range of values reported in two recent studies, 138 gpd/DU[1] and 174 gpd/DU[2]. Therefore, the calculated demand estimate of 36,200 gpd is considered reasonable and is used for the purposes of this WFS.

Peaking factors presented in the 2019 WMP for Zone 3170 were used to calculate maximum day demand (MDD) and peak hour demand (PHD). Table 1 shows the ADD, MDD and PHD demand conditions for the Project.

[1] **Water Research Foundation.** *Fact Sheet Water Efficiency Water Use Estimates* . April 2017.
[2] —. *Water Use in the Multi-Family Housing Sector Project #4554, Table ES.1 Estimated dwelling units and annual average unit usage rates for five water utilities.*

Table 1. Project ADD, MDD and PHD Demand Condtions

Demands	Water demand Factor (gpd/connection)[1]:	2,783
	Assumed number of connections:	13
	ADD (gpd) = Connections x Water Demand Factor	36,200
	ADD (gpm)	25.2
	MDD Peaking Factor[2]	1.4
	MDD = ADD x MDD Peaking Factor, gpd	51,000
	MDD (gpm)	35.4
	PHD Peaking Factor[2]	1.7
	PHD = ADD x PHD Peaking Factor, gpd	62,000
	PHD (gpm)	43.1

[1]Source: 2015 Victorville Water District Urban Water Management Plan.
[2]Source: 2018 Victorville Water District Water Master Plan Update Table 4.10 or 4.11

2.2 FIRE FLOW REQUIREMENTS

Table 3.3 of the 2019 WMP Update was used to establish the fire flow requirements for the Project. The land use associated with the project is Multi Family Residential; therefore, a minimum fire flow requirement of 2,500 gallons per minute (gpm) for a 3-hour duration was used. The minimum residual pressure in water systems during fire flow conditions is 20 pounds per square inch (psi), in accordance with the California Waterworks Standards. Table 3.6 of the 2019 WMP identifies a maximum desired pipeline velocity of 15 feet per second (fps) during fire flow conditions. Both the 20 psi pressure minimum and the 15 fps velocity limit were used in the hydraulic model to determine the available fire flow for the Project.

2.3 STORAGE REQUIREMENT

The storage criteria established in the 2019 WMP were used to determine whether the District's existing storage facilities are adequate to provide the Project and the existing customers with sufficient water for operational, firefighting, and emergency demands. Table 3-4 of the 2019 WMP specifies the storage criteria used for this analysis. Storage is calculated separately for each pressure zone. Table 2 provides a summary of the storage requirements for the Project. The total required storage volume is comprised of the following three components:

- Operational storage, which relates to the daily variance in demand on the potable water system. Adequate storage is needed to supply water during peak hours when the system demand exceeds production capacity. Once production capacity becomes greater than system demands, the storage facilities are refilled, replenishing operational storage. Operational storage is calculated as 25% of MDD.
- Emergency storage is required to provide water during supply emergencies, unplanned system interruptions and/or planned system interruptions such as maintenance or construction events. Emergency storage is calculated as 50% of MDD.

- Firefighting storage requirements correspond to the volume of water needed to supply fire flow for a specified duration. The single largest fire flow requirement within each pressure zone is used to calculate the firefighting storage volume. For the Project, a demand of 2,500 gpm for three hours was used for multi-family residential development.

Table 2. Storage Requirements for Project

Storage	Requirement[1]	Volume, MG
Operational	25% of MDD	0.01
Emergency	50% of MDD	0.03
Firefighting	2,500 gpm x 3 hours	0.45
Total Storage Required for Project		**0.49**

[1] Source: 2018 Victorville Water District Water Master Plan Table 3-4

3 PROJECT WATER FEASIBILITY ANALYSIS

This section presents the supply, storage and distribution system analysis results of the Project water feasibility study. The water feasibility study analysis was performed using the criteria outlined in Chapter 3 of the 2019 WMP. The City provided WSC with an inventory of storage and supply facilities as of October 2017 and system wide production data for calendar year 2017, which was used to determine 2017 ADD. The data used for this analysis is summarized in Appendix A.

3.1 SUPPLY

The District's current water supply consists of 35 active wells, which pump from the Upper Mojave Groundwater Basin, and two turnouts from the Mojave Water Agency's Regional Recharge and Recovery Project (R^3), which pump from a seasonal storage aquifer that is recharged with imported water.

Available supply for the Project was evaluated on the basis of total system firm capacity. The 2019 WMP calculated firm capacity with the two largest wells and the R^3 supply being out of service. With these facilities out of service, the firm capacity of the system is 31,903 gpm. The 2019 WMP supply criteria state that firm capacity should be greater than MDD. The current system MDD as of 2017 is 23,483 gpm; this includes estimated demands for proposed projects which have been previously evaluated based on the City of Victorville 2010 Water Master Plan (2010 WMP) and the 2019 WMP and approved, but not yet constructed. Note that projects evaluated prior to the adoption of the 2010 WMP are not included in this total. Therefore, there is a current system wide firm capacity surplus of 8,420 gpm. The addition of the Project would decrease this surplus to 8,385 gpm. The firm capacity analysis shows that the system currently has sufficient firm capacity to meet the MDD. Table 3 outlines the supply analysis for serving the Project.

Table 3. Project Supply Analysis Summary

Supply Analysis	Proposed Project MDD, gpm	35.4
	Firm Capacity[1], gpm	31,903
	Current MDD[2], gpm	23,483
	MDD Supply Required for Approved Projects[3], gpm	2,478
	Current Surplus/(Deficit), gpm	8,420
	Proposed System Surplus/(Deficit) + Project MDD, gpm	8,385
	Is Available System Wide Supply Sufficient?	YES

[1] See Appendix A for firm capacity calculations
[2] Based on 2017 MDD, includes MDD for previously approved projects
[3] See Appendix B for Approved Projects since the 2010 WMP

3.2 STORAGE

An inventory of the City's water storage facilities is included in Appendix A. Based on this inventory, Zone 3170 currently has a total storage capacity of 12.50 million gallons (MG). As discussed previously, the fire flow storage requirement for each zone is based on the single largest fire flow requirement in the zone. The 2019 WMP based fire flow storage for Zone 3170 on a fire flow requirement of 6,000 gpm for four hours. This equates to a fire storage need of 1.4 MG for Zone 3170, leaving 11.10 MG of existing storage capacity to meet the operational and emergency (O & E) storage needs for the zone.

A summary of the estimated water demands in each pressure zone is included in Appendix A. Based on the 2017 demands plus the storage needs for projects that were evaluated based on the 2010 WMP and approved but not constructed, the current O & E storage requirements for Zone 3170 total 6.10 MG, which leaves 5.00 MG available storage capacity for future demands.

As outlined in Section 2.3, the total storage required to serve the Project is 0.49 MG (0.45 MG for fire flow and 0.04 MG for O & E). Table 4 provides a summary of the storage analysis performed for the Project.

Table 4. Project Storage Analysis Summary for Zone 3170

Storage Analysis	Current Storage Capacity, MG	12.5
	Allocated FF Storage Capacity, MG	1.40
	Remaining Storage Capacity for O & E, MG	11.10
	O & E Storage Required for Existing and Proposed Demands[1], MG	6.10
	O & E Storage Available for Future Demands, MG	5.00
	Proposed Project FF Storage Requirement, MG	0.45
	Proposed Project O & E Storage Requirement, MG	0.04
	Is Available FF Storage Sufficient?	YES
	Is Available Zone O & E Storage Sufficient?	YES

[1] Includes O & E Storage allocated to previously approved projects since the 2019 WMP

3.3 DISTRIBUTION PIPELINES

The proposed project was added to the City's existing InfoWater hydraulic model to determine fire flow availability, pipeline velocities and system pressures in the Project area. The original hydraulic model was developed as a component of the 2019 WMP and has been maintained to reflect the current water system.

The Project shall make two connections for domestic service and two connections for fire service to the existing water system for redundancy: two connections to the existing 24-inch pipeline on Balsam Avenue and two connections to the proposed 8-inch pipeline on Winona Street. The Project shall include approximately 660-LF of new 8-inch pipeline on Winona Street along the extent of the Project site and connect to the existing 24-inch pipeline in Balsam Avenue and to the existing 8-inch in Winona Street. There is an existing 18-inch and 24-inch pipelines within the Project area, which are transmission mains serving pressure Zone 3065 and shall not be connected to. The exact number and location of domestic and fire service laterals shall be confirmed with the City during design and the size shall be determine by the Developer based on onsite hydraulic requirements. The Project shall have at least two domestic connections for redundancy.

Figure 2 depicts the layout of the Project pipelines in relation to the existing water system.

The hydraulic analysis indicated that static pressures will be in the range of 45-52 psi for all of the junctions in the proposed Project, which is greater than the 20 psi requirement. Model results indicate that under MDD conditions, velocities within the Project area do not exceed the maximum velocity of 15 feet per second (fps). Similarly, at PHD conditions, system pressures at all junctions within the Project were above 50 psi and pipeline velocities remained below 5 fps. Model results indicate that the system pressures and velocities meet the criteria established in the 2019 WMP.

A fire flow simulation was performed in the model to predict available fire flow within the Project under MDD conditions. Fire flow analysis was performed with initial tank level settings at 50 percent of maximum levels and all supply sources off. The model predicted available fire flow in excess of the 2,500 gpm requirement at all junctions, with residual pressures ranging from 33 to 38 psi. Appendix C provides a summary of the available fire flow within the proposed pipe network for the Project.

3.4 COORDINATION WITH OTHER PROJECTS

There are several other proposed projects in pressure zone 3170 that have approved Water Feasibility Studies but have not yet been developed.

- Tract 20131, located east of the Project at the intersection of 9th Avenue and Nisqualli Road
- APN 3092-421-08, located east of the Project at the intersection Cypress Avenue and Nisqualli Road

In the hydraulic model, this Project was analyzed with and without the demands and the pipeline improvements proposed by these tracts to assess whether this Project is dependent upon the development of nearby projects. The hydraulic analysis showed that this Project meets all the requirements from the 2019 WMP with and without the demands and pipeline improvements proposed by Tract 20131 and APN 3092-421-08. Therefore, this Project is not dependent upon pipeline improvements proposed by these tracts.

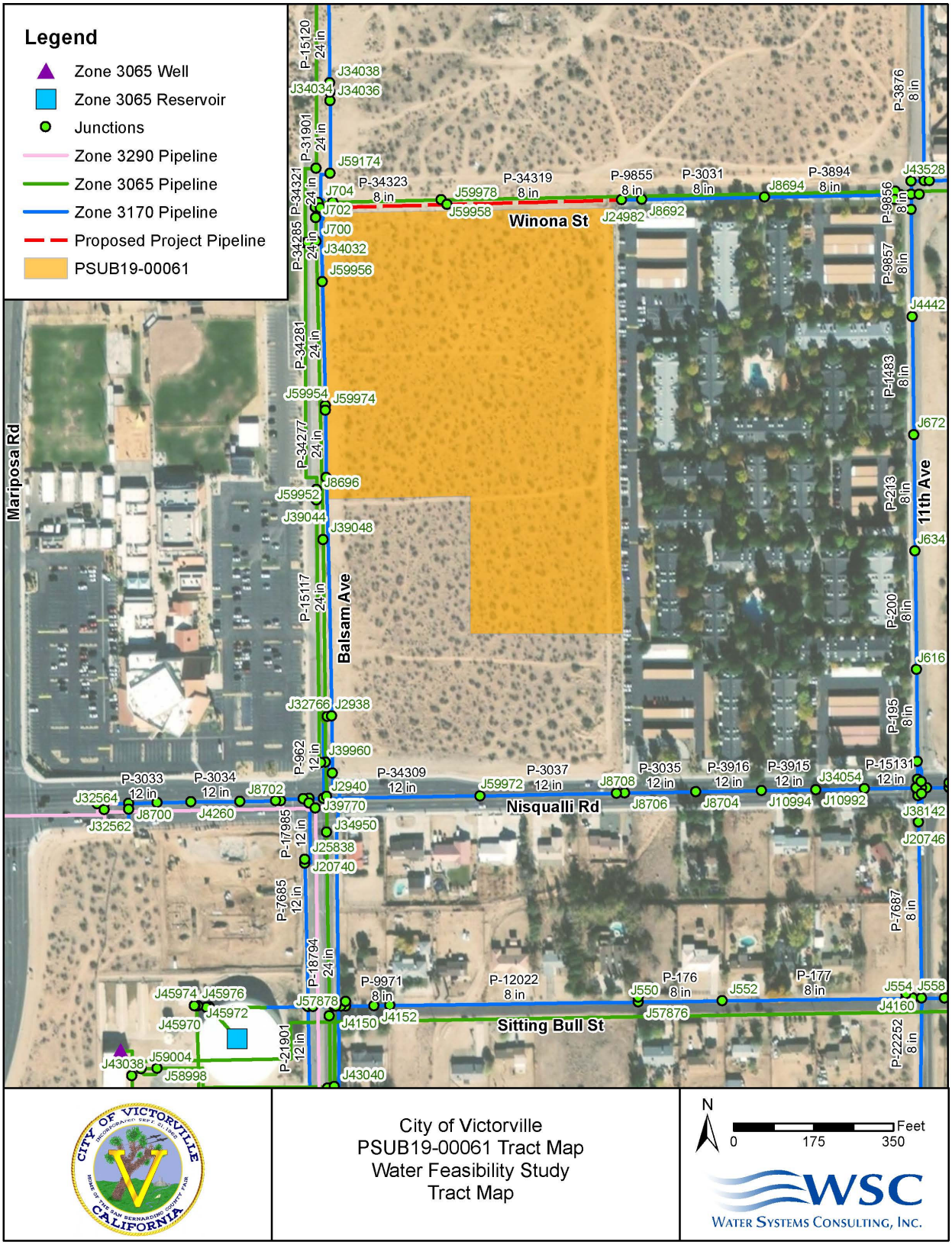

Figure 2. Existing and Proposed Water System

4 CONCLUSIONS AND RECOMMENDATIONS

The hydraulic analysis concluded that adequate storage is available to serve the Project and the water system has sufficient firm capacity to meet the MDD conditions. The Project will need to construct approximately 660 feet of 8-inch pipeline, as shown in Figure 2. The hydraulic analysis indicated that, with the installation of these pipelines, the system pressures, velocities, and fire flow capacities will meet the criteria identified in the 2019 WMP. The exact number and location of domestic and fire service laterals shall be coordinated and confirmed with the City during design and the size shall be determine by the Developer based on onsite hydraulic requirements.

The analysis presented in this WFS is based on the configuration of the water system as of the date of this report and the 2019 WMP and the 2015 UWMP, which are the most current water planning documents available. If a newer planning document becomes available prior to the time the Project develops, or if the District determines there have been significant changes in the water system that may impact the recommendations for this Project, the District may require re-evaluation of the Project based upon such new information.

APPENDIX A. SYSTEM STORAGE, SUPPLY AND DEMAND SUMMARIES

Existing Water Supply and Firm Capacity.

Supply Source	Pressure Zone	Status	Well Capacity (gpm)[1]	Total Capacity (MGD)
Well 133	2890	Active	994	1.43
Well 135	2890	Active	660	0.95
Well 102	2890	Inactive	0	0
Well 147	2890	Inactive	0	0
Well 118	2906	Active	737	1.06
Well 119	2906	Active	552	0.79
Well 105	3065	Inactive	0	0.00
Well 116	3065	Active	863	1.24
Well 121 (4)	3065	Inactive	0	0
Well 127	3065	Active	915	1.32
Well 130	3065	Active	857	1.23
Well 132	3065	Active	781	1.12
Well 136	3065	Active	381	0.55
Well 139	3065	Active	2,944	4.24
Well 141	3065	Active	1,692	2.44
Well 143	3065	Active	1,149	1.65
Well 146(3)	3065	Inactive	0	0.00
Well 120	3170	Active	1,835	2.64
Well 122	3170	Active	1,789	2.58
Well 140	3170	Active/Largest	3,266	4.70
Well 145(3)	3170	Inactive	0	0
R3 Turnout 3(6)	3170	Active/Not Guaranteed	2,107	3.03
Well 109	3290	Active	838	1.21
Well 123	3290	Active	890	1.28
Well 126	3290	Active	857	1.23
Well 128	3290	Active	609	0.88
Well 131	3290	Active	1357	1.95
Well 134	3290	Active	709	1.02
Well 137	3290	Active	1075	1.55
Well 138	3290	Active	778	1.12

Supply Source	Pressure Zone	Status	Well Capacity (gpm)[1]	Total Capacity (MGD)
Well 142[(3)]	3290	Inactive	0	0
Well 144[(5)]	3290	Active/Largest	4600	6.62
Well 129	3485	Active	800	1.15
Well 201	3485	Active	903	1.30
Well 203	3485	Active	864	1.24
Well 204	3485	Active	997	1.44
Well 205	3485	Active	916	1.32
Well 206	3485	Active	876	1.26
Well 207	3485	Active	448	0.65
Well 208	3485	Active	858	1.24
Well 209	3485	Active	616	0.89
Well 212[(5)]	3485	Active	1363	1.96
R3 Turnout 6[(6)]	3485	Active/Not Guaranteed	2,106	3.03
		Total System Supply Capacity	**43,982**	**63.3**
		Total System Firm Capacity[(2)]	**31,903**	**45.9**

[1]Current well capacities were provided to WSC by the City in October 2017

[2]The firm capacity is the total supply capacity without the largest well in each Improvement District and R[3].

[3]Well is drilled but not equipped.

[4]Taken offline in 2014 due to levels of Chromium-6 approaching the new MCL established in 2014. May be returned to service if Chromium-6 levels decline.

[5]Two largest wells are not included in firm capacity.

[6]The City of Victorville receives a total of 6.06 MGD and can be used at either R[3] turnout. R[3]supply is not included in firm capacity due to non-guaranteed supply.

Finished Water Storage Reservoirs. *Table was adapted from Table 2-4 in 2019 WMP.*

Reservoir Number	Status	Material	Base Elevation (ft-msl)	Diameter (ft)	Depth (ft)	HWL (ft-msl)	Pressure Zone	Capacity (MG)
102	Active	Steel	2874	95	32	2906	2890	1.5
104	Active	Steel	2874	95	32	2906	2890	1.5
105	Active	Steel	3049	104	32	3081	3065	2.0
107	Active	Steel	3269	105	40	3309	3290	2.5
108	Active	Steel	3269	104	40	3309	3290	2.5
109	Active	Steel	2894	60	24	2918	2906	0.5
110	Active	Steel	3150	110	39	3189	3170	2.5
111	Active	Steel	3150	104	39	3189	3170	2.5
112	Active	Steel	3268	150	38	3306	3290	5.0
113	Active	Steel	3050	129	31	3081	3065	3.0
114	Active	Steel	3268	150	38	3306	3290	5.0
115	Active	Steel	3050	165	31	3081	3065	5.0
116	Active	Steel	3150	150	39	3189	3170	5.0
117	Active	Steel	3150	104	39	3189	3170	2.5
118	Active	Steel	3050	129	31	3081	3065	3.0
119	Active	Steel	3050	165	31	3081	3065	5.0
120	Active	Steel	3055	182	27	3081	3065	5.0
121	Active	Steel	2894	60	24	2918	2906	0.5
202	Active	Steel	3469	105	30.8	3500	3485	2.0
205	Active	Steel	3809	60	24	3832	3820	0.5
207	Active	Steel	3469	120	32.4	3501	3485	2.7
208	Active	Steel	3657	120	37.5	3694	3675	3.1
209	Active	Steel	3657	96	37.5	3694	3675	2.0
210	Active	Steel	3809	122	23.8	3832	3820	2.0
211	R[3(2)]	Steel	3465	165	32	3497	3485	5.0
							Active Storage Capacity	**66.8**
201	Inactive[(1)]	Steel	3469	105	30.8	3500	3485	2.0
203	Inactive[(1)]	Steel	3475	27		3499	3485	0.1
204	Inactive[(1)]	Steel	3475	38		3499	3485	0.2

[1]Reservoir 201 is currently disconnected from the system and is not included in active storage capacity. May be reconnected in the future. Reservoirs 203 and 204 are disconnected from the system due to lining issues and are not included in active storage capacity.

[2]Reservoir 211 has been incorporated into the R3 Project and is no longer a component of the active storage capacity. However, it is still hydraulically connected to the Zone 3485 distribution system and effectively increases the storage capacity in Zone 3485.

Demand Data. *Table was adapted from Table 4-11 of the 2019 WMP.*

Pressure Zone	2019 WMP MDD (MGD)[1]	2017 ADD (MGD)[2]	2017 MDD (MGD)[3]	2017 MDD (gpm)[3]
3820	0.3	0.2	0.2	144
3675	0.7	0.6	1.5	1022
3485	5.1	2.5	3.9	2734
3290	6.6	4.8	6.2	4310
3170	7.7	5.0	7.0	4880
3065	7.7	5.3	10.1	7013
2906	0.2	0.2	0.4	287
2890	0.4	0.6	0.9	615
Total	**28.7**	**19.2**	**30.2**	**21005**

[1] 2019 WMP MDD was based on calendar year 2015 water production data.
[2] Based on calendar year 2017 water production data provided by the City. Water served to the City of Adelanto and Phelan Pinon Hills Community Services District through intertie agreements is not included. 2017 pressure zone demands were calculated by multiplying the 2017 total ADD by the zone's proportional amount of 2019 WMP ADD demands.
[3] Pressure zone MDD was calculated by multiplying 2017 ADD by the 2019 WMP ADD to MDD peaking factors shown in Table 4-10.

2016 System Storage. *Table was adapted from Table 6-2 of the 2019 WMP. Table includes updated required storage and supply balance figures.*

Pressure Zone	2017 MDD (MGD)	Required Storage (MG)			Storage Balance (MGD)	
		Operational Storage	Fire Flow Storage	Total Storage	Available Storage	Storage Surplus/(Deficit)
2890	0.2	0.66	1.0	1.66	3.0	1.34
2906[1]	1.5	0.31	1.0	1.31	1.0	(0.31)
3065	3.9	7.57	1.0	8.57	23.0	14.43
3170	6.2	5.27	1.4	6.67	12.5	5.83
3290	7.0	4.65	1.0	5.65	15.0	9.35
3485	10.1	2.95	1.0	3.95	4.7	0.75
3675	0.4	1.10	1.0	2.10	5.1	3.00
3820	0.9	0.16	1.0	1.16	2.5	1.34
Total	**30.2**	**22.67**	**8.4**	**31.07**	**66.8**	**35.71**

[1]The existing Stoddard Wells Pipeline enables Zone 2906 to utilize excess storage in other zones.

APPENDIX B. WATER FEASIBILITY STUDIES APPROVED BUT NOT CONSTRUCTED

This list includes only projects with approved water feasibility studies based on the 2010 WMP. Previously approved studies which were based on the prior 1995 Water Master Plan are subject to re-evaluation based on the most current system condition and evaluation criteria in place at the time of development.

Project Name	Final Water Feasibility Study Date	Pressure Zone where Project is Located	Project MDD (gpm)	Project O&E Storage Allocation (MG)
Tract 17033	January 2012	3485	147	0.16
Tract 17541	January 2012	3485	110	0.12
Tract 17199	January 2012	3485	204	0.22
St. Mary's	March 2012	3675	335	0.36
Tract 18087	6/3/2014	3485	222	0.24
Tract 16588	11/17/2014	3170	43	0.05
Tract 17046[1]	1/14/2015	3485	-	-
Tract 16805[2]	2/5/2016	3485	-	-
Westcreek	11/17/2016	3170	431	0.47
Tract 17486	11/30/2016	3485	78	0.08
Tract 20064	1/30/2017	3485	143	0.15
Tract 20037	3/23/2017	3485	38	0.04
Tract 15297	4/12/2017	3675	162	0.17
Tract 18487	8/1/2017	3485	31	0.03
Tract 20131	11/13/2017	3170	58	0.06
Tract 20088	12/12/2017	3290	33	0.03
APN 3092-421-08	1/22/2018	3170	35	0.04
EWTR18-00270	3/28/2019	3290	8	0.01
EWTR18-00307	6/6/2019	3485	30	0.03
EWTR19-00093	7/15/2019	3170	186	0.21
EWTR19-00086	9/5/2019	3065	41	0.04
Tract 20274	9/17/2019	3485	79	0.08
Tract 20275	9/24/2019	3485	64	0.07
		Total MDD	2478	

[1]Tract 17046 replaced with Tract 20274.

[2]Tract 16805 replaced with Tract 20275.

APPENDIX C. HYDRAULIC MODEL OUTPUTS

***PSUB19-00061:** Available fire flow*

Junction ID	Fire Flow Demand (gpm)	Available Fire Flow at 20 psi Residual Pressure or 15 fps Max Velocity (gpm)	Residual Pressure at Required Fire Flow Demand (psi)
J59972	2,500.00	5,288	34
J59974	2,500.00	5,288	38
J59978	2,500.00	4,496	35

***PSUB19-00061:** Proposed Pipeline Properties*

ID	Length (ft)	Diameter (in)	Roughness
34319	382	8	130
34323	278	8	130