

Appendix G. Task 500 Recommendations and Cost

FINAL

TASK 500 – PRIORITIZED RECOMMENDATIONS AND COSTS

B&V PROJECT NO. 401414

PREPARED FOR

The City of Santa Rosa

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1. Introduction

The purpose of this memo is to summarize the recommendations and costs from the following tasks:

- Task 200 – SCADA Reliability and Redundancy
- Task 300 – Technology, Equipment, and Software
- Task 400 – Water Master Plan Update
 - System Wide Fire Flow Evaluation
 - System Reliability Opportunities
 - Proctor Heights Evaluation
 - Off-Line Storage

2. Basis of Probable Costs

Probable costs were developed using a variety of sources, which included the City's unit cost estimate assumptions for water mains, bid tabs provided by the City for recent work, and recent cost estimates developed by Black & Veatch for similar projects. The contingencies applied to the costs were based on the contingency from the previous Master Plan and include a 20 percent construction contingency, 35 percent general contingencies for design and planning, administration and overhead, and an additional 7 percent for other contingencies. The total of all contingencies is 62 percent. Cost assumptions for various infrastructure are provided in following tables with the basis for the cost noted in the footnotes. Because of the Master Plan level of engineering used in defining the assumptions for the improvements, this cost estimate is considered Class 5, as outlined by the Association for the Advancement of Cost Engineering (AACE) Cost Estimate Classification System. The estimate is based on costs for January 2020 when the Engineering News Record, Construction Cost Index (ENR-CCI) (20 city average) was equal to 11,392.

3. SCADA Reliability and Redundancy Recommendations and Costs

This task focused on understanding the existing supervisory control and data acquisition (SCADA) system and identifying the alternatives considered to increase the reliability and redundancy of the SCADA system to address the issues discovered from the Tubbs fire. A detailed discussion is presented in the Task 200 Technical Memorandum (TM), and the following sections summarize the recommended improvements and their costs, where applicable.

3.1 COMMUNICATION BETWEEN THE RESERVOIRS AND THE PUMP STATIONS

Because of the unreliability of communication between the pump stations and the reservoirs with direct-buried cables, Black & Veatch recommended that the City consider adding to the SCADA operator screens a display that would indicate the reservoir level based on the discharge pressure of the pump when the pumps are not operating. This indication would be suppressed when the reservoir level indicators are operating or when the pumps are running. The cost of this recommendation is expected to be approximately \$20,000 to program the SCADA display.

Other recommendations related to communications between the reservoirs and pump stations are included in the Obsolete Serial Radio System recommendations.

3.2 OBSOLETE SERIAL RADIO SYSTEM

The City’s drinking water group is considering technology options to replace the existing near obsolescent serial point-to-point radio system. Currently, the City is undergoing a “like-for-like” replacement of the existing serial radios, and this project will continue with no changes. Black & Veatch recommends the City undertake a SCADA Master Plan that would identify the long-term needs, assess the current state, and develop a multiphase implementation plan. The City may want to include the following items in the Master Plan: SCADA redundancy, Mesh networks, cybersecurity, data integration, and staffing.

3.3 LIMITED POWER AT THE RESERVOIRS

Because of a sustained loss of electrical power from the Tubbs fire, Black & Veatch recommends further exploring the option to add solar panels and more batteries. A solar feasibility study is currently under way to estimate the amount of solar energy that is available to power the site and charge the batteries and identify equipment and infrastructure needed for implementation. The solar feasibility study cost estimate is \$30,000.

3.4 FIRE DAMAGE TO ELECTRONIC COMPONENTS

Reservoirs have chain link fencing with the programmable logic controller (PLC), sensor, electrical service entry, communication service entry, and other electronics cabinets mounted on the posts or boards near the site perimeter or near the reservoir. Although PLCs were not damaged during the Tubbs fire, Black & Veatch recommends the City consider protecting electronics at each site in conjunction with other upgrades or improvements. Masonry walls could be placed around individual cabinets or the entire site, depending on site configuration and neighborhood preferences. The cost for the electronics protection will vary by site according to the selected approach.

3.5 LIMITED REDUNDANCY IN THE SERIAL RADIO SYSTEM

Reservoirs 7 and 17 are relay stations; therefore, if electronics or power is lost at either location, the Utilities Field Operations (UFO) will lose indications for approximately 50 percent of the water and wastewater data. Outages are primarily due to loss of electricity. Black & Veatch recommends exploring options to maintain the current system but increase the reliability of power by providing additional batteries or solar power. The solar feasibility study was discussed in Section 3.3.

4. Technology, Equipment, and Software Recommendations and Costs

The Task 300 TM provides a detailed discussion on the Technology, Equipment, and Software recommendations. This task is separated into two categories: flow control opportunities and backup power generation. A detailed discussion is presented in the Task 300 TM, and the following sections summarize the recommended improvements.

4.1 FLOW CONTROL OPPORTUNITIES

During the Tubbs fire, connections to burned out buildings became open connections, leading to water loss until they could be manually closed. This TM evaluates alternatives to remotely isolate residential customers, commercial customers, and areas of the distribution system. Although multiple technologies exist to provide this capability, there are concerns related to maintenance, ownership, remote operation practices, and liability. Black & Veatch does not recommend that the

City pursue any of them at this time, primarily because of the liability associated with a false or unintended valve closing.

4.2 BACKUP POWER GENERATION

Because of the challenges of engine generators providing power to variable frequency drives (VFDs) at pump stations, Black & Veatch recommends that the City add harmonic filters to existing pump stations with generators and VFDs. In addition, the City should include a harmonic analysis for all power sources during design on any future pump stations.

5. Water Master Plan Update Recommendations and Costs

The Task 400 TM provides a detailed review of the water system evaluations performed to determine the necessary fire flow improvements both in terms of pipeline upgrades and improvements to storage or pumping stations. It also documents the evaluations for system reliability and potential reliability improvements, provides an assessment of the Proctor Heights tanks and off-line storage options, and discusses the water quality and water age evaluations. Detailed discussion is presented in the Task 400 TM, and the following sections summarize the recommended improvements along with their costs. Figures showing the improvements are included in Appendix A of the Task 400 TM.

5.1 FIRE FLOW PIPELINE IMPROVEMENTS – PRIORITY 1

The Priority 1 fire flow improvements are recommended to mitigate existing system deficiencies where the fire flow goals of 1,500 gallons per minute (gpm) at pressures of 20 pounds per square inch (psi) for a duration of 2 hours cannot currently be met. Priority 1 improvements for pipeline upgrades to existing infrastructure are provided in Table 1. Table 2 and Table 3 summarize the two areas where there are alternatives that will serve a similar purpose in meeting fire flow goals:

- The boundary between Pressure Zone A4 and Pressure Zone R4R3 along Hidden Valley Drive and Moss Rock Court (CIP Group 042).
- South of Montgomery Drive along Jackson Drive, Sullivan Way, and Bridle Trail (CIP Group 938).

For CIP Group 042, it is recommended to modify the pressure zone boundary to south of Moss Rock Court along Hidden Valley Drive. This is the least costly alternative, and only one section of pipe on the A4 Pressure Zone will need to be upsized with this alternative. The challenges with pressure zone modification will be pressures over 100 psi in some areas that experienced half that previously. Detailed consideration should be given to property owners and the potential need for individual pressure reducing valves to ensure that this option can be implemented with all stakeholders' involvement. Otherwise, to move the needed fire flow up into the area will require some larger pipeline improvements with the pressure zone remaining unchanged.

For CIP Group 938, either option presented provides a similar fire flow capacity in the area. It should be noted that there are a half-dozen parcels around Sullivan Court and Bridle Trail and also along Sullivan Way that cannot be provided with fire flow of 1,500 gpm directly on-site. Boosting from a hydrant at the bottom of the hill will be needed to fight a fire at one of these structures, and the fire department is aware of this area. The difference between the options listed in Table 3 is that one alternative provides a secondary feed into the area providing for extra redundancy. This alternative is slightly more costly than just upgrading the single feed into the area, but it does provide additional reliability under typical operating conditions and emergency conditions in case a pipe break occurred along the existing single feed.

Table 1 Priority 1 Fire Flow Improvements - Pipelines

CIP/CIP GROUP	PRESSURE ZONE	EXISTING DIAMETER (INCHES)	NEW DIAMETER (INCHES)	LENGTH (FEET)	LOCATION	CURRENT CIP STATUS	PRIORITY	ESTIMATED CONSTRUCTION COST (1)	CAPITAL COSTS (2)
FF IM NEW3	A1	6	8	830	Bluebell Drive from Coffey Lane to Lamberson Court	New	1	\$ 329,510	\$ 533,810
FF EX CIP041	A4	6	8	18	Salem Avenue at Elliott Avenue, connecting the proposed CIP 8 inch pipeline on Salem Avenue to the existing 14 inch pipeline on Elliott Avenue	Future	1	\$ 7,150	\$ 11,580
FF EX CIP041	A4	4	8	88	Albany Drive between Oliver Lane and Richmond Drive	Future	1	\$ 34,940	\$ 56,600
FF EX CIP041	A4	4	8	247	Albany Drive between Richmond Drive and Clement Avenue	Future	1	\$ 98,060	\$ 158,860
FF EX CIP041	A4	4	8	249	Albany Drive between Clement Avenue and Richmond Drive	Future	1	\$ 98,850	\$ 160,140
FF EX CIP041	A4	6	8	250	Clement Avenue between Albany Drive and Malano Court	Future	1	\$ 99,250	\$ 160,790
FF EX CIP041	A4	6	8	468	Salem Avenue between Elliott Avenue and Clement Avenue	Future	1	\$ 185,800	\$ 301,000
FF EX CIP041	A4	4	8	364	Clement Avenue between Malano Court and Emeritus Circle, and east of Emeritus Circle	Future	1	\$ 144,510	\$ 234,110
FF EX CIP923	A8	6	8	550	Rockgreen Place from Fairfield Drive to loop	Planning	1	\$ 218,350	\$ 353,730
FF EX CIP923	A8	6	8	719	Fairfield Drive from White Oak Drive to Rockgreen Place	Planning	1	\$ 285,440	\$ 462,410
FF EX CIP945	R10	8	16	215	Woodview Drive from Westline Court northeast toward Reservoir R10	Future	1	\$ 85,360	\$ 138,280
FF EX CIP945	R10	10	16	296	Woodview Drive southeast from Reservoir R10	Future	1	\$ 117,510	\$ 190,370
FF EX CIP945	R10	10	16	323	Woodview Drive north from Reservoir R10	Future	1	\$ 128,230	\$ 207,730
FF EX CIP945	R10	12	16	410	Skycrest Way, south of Skycrest Drive	Future	1	\$ 162,770	\$ 263,690
FF EX CIP945	R10	8	16	774	Woodview Drive from Deer Hollow Lane to Westline Court	Future	1	\$ 307,280	\$ 497,790
FF EX CIP945	R10	12	16	1,659	North of Reservoir R10 from Woodview Drive to Skycrest Way	Future	1	\$ 658,620	\$ 1,066,960
FF EX CIP919	R13	6	8	757	Northwest of Pump Station S13	Planning	1	\$ 300,530	\$ 486,860
FF EX CIP141	R14	8	12	1971	Pump Station S14	Scoping	1	\$ 782,490	\$ 1,267,630
FF IM NEW2	R4	6	8	334	Happy Valley Road from Grace Drive to Happy Valley Court	New	1	\$ 132,600	\$ 214,810
FF EX CIP953	R4R2	6	8	147	Stonecrest Court from Encina Court to hydrant	Future	1	\$ 58,360	\$ 94,540
FF EX CIP953	R4R2	6	8	235	Miraloma Drive from Buena Vista Drive to Stonecrest Court	Future	1	\$ 93,300	\$ 151,150
FF EX CIP953	R4R2	6	8	281	Miraloma Drive from Stonecrest Court to Encina Court	Future	1	\$ 111,560	\$ 180,730
FF EX CIP953	R4R2	8	12	55	Terra Linda Drive southeast from PRC 43	Future	1	\$ 21,840	\$ 35,380
FF EX CIP953	R4R2	6	12	275	Terra Linda Drive from Terra Linda Court to Buena Vista Drive	Future	1	\$ 109,180	\$ 176,870
FF EX CIP953	R4R2	6	12	1,039	Terra Linda Drive between PRC 43 and Terra Linda Court	Future	1	\$ 412,480	\$ 668,220

CIP/CIP GROUP	PRESSURE ZONE	EXISTING DIAMETER (INCHES)	NEW DIAMETER (INCHES)	LENGTH (FEET)	LOCATION	CURRENT CIP STATUS	PRIORITY	ESTIMATED CONSTRUCTION COST (1)	CAPITAL COSTS (2)
FF EX CIP953	R4R2	6	10	1,353	Buena Vista Drive from Terra Linda Drive to Miraloma Drive	Future	1	\$ 537,140	\$ 870,170
FF IM CIP941	R6	6	8	1,526	Fistor Drive from Brush Creek Road to Cox Drive and Bridgewood Drive from Greenmeadow Drive to first hydrant toward Eastside Court		1	\$ 605,820	\$ 981,430
FF IM CIP930	R9R1	6	8	1,019	Ronne Drive between Deer Run and Neotomas Avenue and Townview Avenue from Post Ranch Road to Ronne Road and Post Ranch Road from Neotomas Avenue to Townview Avenue		1	\$ 404,540	\$ 655,350
FF IM CIP935	R9R1	4/6	8	1,746	Hoan Avenue from Eliggi Court to Glencannon and Devonshire Place from Stonehedge Drive to end and Stonehedge Drive from Glencannon Street toward Westminster Place		1	\$ 693,160	\$ 1,122,920
FF IM NEW (PZ 10 Suction)	R9	8	12	1,400	Along Woodview Drive from Summerfield Road to S10	New	1	\$ 555,800	\$ 900,400
FF IM OAK ISLAND CIRCLE	R12	6	8	1,137	Oak Island Circle from Oak Island Drive to northwest end of street		1	\$ 389,850	\$ 631,560
Total Costs for Priority 1 Pipeline Improvements								\$ 8,170,280	\$ 13,235,870

(1) Unit cost of \$397 per lineal foot are used for pipelines.

(2) Includes construction contingency of 20%, design/planning/administration/overhead contingency of 35%, and 7% other contingencies.

Table 2 Priority 1 Fire Flow Improvements – CIP Group 042 Alternatives

ALTERNATIVE DESCRIPTION	PRESSURE ZONE	EXISTING DIAMETER (INCHES)	NEW DIAMETER (INCHES)	LENGTH (FEET)	LOCATION	PRIORITY	ESTIMATED CONSTRUCTION COST (1)	CAPITAL COSTS (2)
Pressure Zone Boundary Remains Unchanged	A4	6	16	250	Parsons Drive from Terrace Way to Hidden Valley Drive	1	\$ 99,250	\$ 160,790
	A4	6	16	650	Hidden Valley Drive from Parsons Drive to Moss Rock Court	1	\$ 258,050	\$ 418,040
	A4	6	16	144	Hidden Valley Drive from Moss Rock Court to Winding Ridge Road	1	\$ 57,170	\$ 92,620
	A4	6	16	715	Hidden Valley Drive from Winding Ridge Road to Hollow Tree Court	1	\$ 283,860	\$ 459,850
Total for Unchanged Boundary							\$ 698,330	\$ 1,131,300
Pressure Zone Boundary Moved to South of Moss Rock Court along Hidden Valley Drive	A4	6	12	250	Parsons Drive from Terrace Way to Hidden Valley Drive	1	\$ 99,250	\$ 160,790
Total for Modified Boundary (recommended but with additional considerations)							\$ 99,250	\$ 160,790
(1) Unit cost of \$397 per lineal foot are used for pipelines.								
(2) Includes construction contingency of 20%, design/planning/administration/overhead contingency of 35%, and 7% other contingencies.								

Table 3 Priority 1 Fire Flow Improvements – CIP Group 938 Alternatives

ALTERNATIVE DESCRIPTION	PRESSURE ZONE	EXISTING DIAMETER (INCHES)	NEW DIAMETER (INCHES)	LENGTH (FEET)	LOCATION	PRIORITY	ESTIMATED CONSTRUCTION COST (1)	CAPITAL COSTS (2)
Upgrade Single Feed Into Area	R6	8	12	1,045	Jackson Drive from Montgomery Drive to Sullivan Way	1	\$ 414,870	\$ 672,090
	R6	6	8	575	Bridle Trail from Jackson Drive to the east	1	\$ 228,280	\$ 369,810
	R6	6	8	141	Bridle Trail from Jackson Drive to west (existing short segment of 6 inches)	1	\$ 228,280	\$ 369,810
Total for Improvements to Existing Single Feed							\$ 579,630	\$ 939,000
Add secondary Feed to Area From Montgomery Drive to Eastern End of Existing Pipe Along Bridle Trail	R6	-	12	270	New feed into area from Montgomery Drive to east end of existing pipe along Bridle Trail	1	\$ 107,190	\$ 173,650
	R6	6	8	1,440	Bridle Trail from Jackson Drive to the east	1	\$ 571,680	\$ 926,120
	R6	8	12	540	Jackson Drive from Bridle Trail to Sullivan Way	1	\$ 214,380	\$ 347,300
Total for Improvements with Backup Feed into Area (recommended for reliability)							\$ 893,250	\$ 1,447,070

(1) Unit cost of \$397 per lineal foot are used for pipelines.

(2) Includes construction contingency of 20%, design/planning/administration/overhead contingency of 35%, and 7% other contingencies.

5.2 FIRE FLOW FACILITY IMPROVEMENTS – PRIORITY 1

In addition to the Priority 1 pipeline improvements, Priority 1 facility improvements for tanks or pump stations are also necessary to meet fire flow goals in Pressure Zone 10, Pressure Zone 13 (potentially), Pressure Zone 14 (potentially), and Pressure Zone 17. Alternatives for these improvements are listed in Table 4; a high-level summary is presented in the following sections. Detailed discussions are provided in the Task 400 TM.

Table 4 Priority 1 Fire Flow Improvements - Facilities

PRIORITY 1 FACILITY IMPROVEMENTS		
Station 10 Pumping Capacity and R10 Improvement Alternatives		
Mandatory - S10 Suction Improvements (1)	Pipeline Unit Cost (2)	\$397 per foot
	Length	1,400 feet
	Estimated Construction Costs	\$ 555,800
	Capital Cost	\$ 900,400
Mandatory - S10 Additional Pumping Capacity	Expansion Unit Cost (3)	\$ 1,279,125
	ENR CCI Adjustment (4)	1.173
	Estimated Construction Cost	\$ 1,500,414
	Capital Cost (5)	\$ 2,430,670
Alternative 1 - New Tank with Higher Overflow (ideal but low feasibility)	Tank Volume (gal)	\$ 200,000
	Unit Cost (\$/gal) (6)	\$ 3
	Estimated Construction Cost	\$ 600,000
	Capital Cost (4)	\$ 972,000
Alternative 2 - Pressure Sustaining Valve + Check Valve (12" pipe) for Tank Inlet/Outlet	Unit Cost (7)	\$ 70,000
	Estimated Construction Cost	\$ 70,000
	Capital Cost (5)	\$ 113,400
Pressure Zone 10 – Total Capital Cost Alternative 1		\$ 4,303,070
Pressure Zone 10 - Total Capital Cost Alternative 2 (recommended)		\$ 3,444,470
Station 13 Pumping Capacity		
Potential S13 Additional Pumping Capacity (Necessary if the three existing pumps cannot be operated simultaneously.)	Expansion Unit Cost (3)	\$ 1,279,125
	ENR CCI Adjustment (4)	1.173
	Estimated Construction Cost	\$ 1,500,414
	Capital Cost (5)	\$ 2,430,670
Station 14 Pumping Capacity		
S14 Additional Pumping Capacity (Necessary if the three existing pumps cannot be operated simultaneously.)	Expansion Unit Cost (3)	\$ 1,279,125
	ENR CCI Adjustment (4)	1.173
	Estimated Construction Cost	\$ 1,500,414
	Capital Cost (5)	\$ 2,430,670

PRIORITY 1 FACILITY IMPROVEMENTS		
R17 Improvement Alternatives		
Alternative 1 - New Tank with Higher Overflow	Tank Volume (gal)	\$ 750,000
	Unit Cost (\$/gal) (6)	\$ 3
	Estimated Construction Cost	\$ 2,250,000
	Capital Cost (5)	\$ 3,645,000
Alternative 2 - Pressure Sustaining Valve + Check Valve (12" pipe) for Tank Inlet/Outlet	Unit Cost (7)	\$ 70,000
	Estimated Construction Cost	\$ 70,000
	Capital Cost (5)	\$ 113,400

(1) Pipeline costs are also provided in Table 1.
 (2) Unit cost for pipeline is \$397 per foot.
 (3) Expansion unit cost is based on bid tabs for Station 3 expansion.
 (4) CCI adjustment is based on ratio of December 2019 CCI (11,381) to May 2014 (9,702).
 (5) Capital cost includes total contingencies of 62 percent.
 (6) Tank volume unit cost is based on \$3.00 per gallon for tanks smaller than 1 million gallons.
 (7) Unit cost for valve vault and tank inlet configuration is based on project cost estimates for similar projects.

5.2.1 Pressure Zone 10

Additional high flow pumping capacity is needed at Station 10. The station should be able to pump 1,500 gpm at minimum pressures of 20 psi at high ground unless a taller tank were to be constructed. Suction pipeline improvements (listed in Table 1 as FF IM New) are recommended to increase suction pressures at Station 10 to a minimum of 20 psi. Pipeline improvements are needed along Woodview Drive from the pump discharge through the zone up to Skycrest Way and Skycrest Drive.

Even with pipeline and pumping capacity improvements with a high flow pump, the concern is that high ground areas will experience fire flow issues even with the tank full or near full. The solution is to build a much taller tank or to hydraulically “over pressurize” the system when the pumps are operating. Ideally, a much taller tank would be the solution, but getting public buy-in would be extremely challenging and may not be feasible. Increasing the pressure in the zone by placing a back pressure sustaining valve at the tank inlet/outlet, in line with a check valve, is possible and is a relatively cost-effective improvement. However, this infrastructure improvement, by itself, will not automatically alert to a fire type demand which exceeds the capacity of the existing (low-flow) pumps and for which the high flow pump needs to be turned on. If it desired that a transition to the high-flow pump to meet fire demands be automatic rather than manual, telemetry controls with logic based on either the rate-of-pressure-drop or the tank-drain-rate, would need to be implemented. The phasing, design, and construction of all the Pressure Zone 10-related improvements should be carefully considered in pre-design in order to meet the fire flow goals in this area.

5.2.2 Pressure Zone 13

If all three pumps cannot be operated simultaneously, it will be necessary to add a high flow pump at Station 13. One pipeline improvement (listed in Table 1 as FF EX CIP919) is needed in Pressure Zone 13, regardless of pumping capacity.

5.2.3 Pressure Zone 14

If all three pumps cannot be operated simultaneously, it will be necessary to add a high flow pump at Station 14. Necessary pipeline improvements, independent of the pumping capacity, are listed in Table 1 for this pressure zone.

5.2.4 Pressure Zone 17

Concerns in this pressure zone are similar to those in Pressure Zone 10, namely, high ground. Station 17 can provide the needed 1,500 gpm fire flow with both pumps operating. Costs will be presented in the reliability section for consideration of increasing pumping capacity. However, the R17 tank is too low to meet fire flow goals unless full or near full. A tank with a higher overflow would resolve this but is likely not a feasible alternative. The same inlet/outlet configuration as discussed in Section 5.2.1 is a cost-effective solution.

5.3 FIRE FLOW PIPELINE IMPROVEMENTS – PRIORITY 2 THROUGH PRIORITY 5

Priority 1 improvements are needed to meet fire flow goals in a potentially deficient area. Priority 2 through Priority 5 are not needed to meet goals because a capable hydrant is located within a reasonable distance. However, these improvements will improve fire flow and provide more capable hydrants closer to any individual structure. They were individually prioritized according to the level of improvement or the characteristics of the surrounding area. Table 5 through Table 8 present the Priority 2 through Priority 5 pipeline improvements, respectively.

Table 5 Priority 2 Fire Flow Improvements - Pipelines

CIP/CIP GROUP	PRESSURE ZONE	EXISTING DIAMETER (INCHES)	NEW DIAMETER (INCHES)	LENGTH (FEET)	LOCATION	CURRENT CIP STATUS	PRIORITY	ESTIMATED CONSTRUCTION COST (1)	CAPITAL COSTS (2)
FF EX CIP051	A5	4	8	414	Raegan Way between Talbot Avenue and Alderbrook Drive	Future	2	\$ 164,360	\$ 266,260
FF EX CIP051	A5	6	8	677	Gilbert Drive between Montgomery Drive and Leonard Avenue	Future	2	\$ 268,770	\$ 435,410
FF EX CIP051	A5	6	8	252	Sherwood Drive between Leonard Avenue and Little John Lane	Future	2	\$ 100,040	\$ 162,060
FF EX CIP051	A5	6	8	250	Sherwood Drive between Little John Lane and Marian Lane	Future	2	\$ 99,250	\$ 160,790
FF EX CIP051	A5	6	8	113	Sherwood Drive between Marian Lane and Sherwood Court	Future	2	\$ 44,860	\$ 72,670
FF EX CIP051	A5	6	8	319	Sherwood Drive between Marian Lane and Sherwood Court	Future	2	\$ 126,640	\$ 205,160
FF EX CIP051	A5	6	8	118	Leonard Avenue between Alderbrook Drive and Sherwood Drive	Future	2	\$ 46,850	\$ 75,900
FF EX CIP921	A8	6	8	440	Valley Oaks Drive from Valley Lakes Drive to Valley Oaks Place	Planning	2	\$ 174,680	\$ 282,980
FF EX CIP922	A8	6	8	204	Autumn Leaf Drive from Autumn Leaf Place to Mockingbird Dir	Planning	2	\$ 80,990	\$ 131,200
FF EX CIP401	R4	12	16	25	Del Rosa Avenue between Sunrise Avenue and Piedra Lane	Planning	2	\$ 9,930	\$ 16,090
FF EX CIP401	R4	12	16	125	Del Rosa Avenue between Sunrise Avenue and Piedra Lane	Planning	2	\$ 49,630	\$ 80,400
Total Costs for Priority 2 Pipeline Improvements								\$ 1,166,000	\$ 1,888,920

(1) Unit cost of \$397 per lineal foot are used for pipelines.

(2) Includes construction contingency of 20%, design/planning/administration/overhead contingency of 35%, and 7% other contingencies.

Table 6 Priority 3 Fire Flow Improvements - Pipelines

CIP/CIP GROUP	PRESSURE ZONE	EXISTING DIAMETER (INCHES)	NEW DIAMETER (INCHES)	LENGTH (FEET)	LOCATION	CURRENT CIP STATUS	PRIORITY	ESTIMATED CONSTRUCTION COST (1)	CAPITAL COSTS (2)
FF EX CIP926	A8	6	8	259	Meadowridge Drive from Meadowridge Court to Meadow Creek Lane	Planning	3	\$ 102,820	\$ 166,570
FF EX CIP926	A8	6	8	796	Meadowridge Drive from Stone Bridge Road to Aspen Meadows Circle	Planning	3	\$ 316,010	\$ 511,940
FF EX CIP927	A8		8	623	Woodgreen Street from Oakmont Drive to Hydrant on Woodgreen Street	Recommended	3	\$ 247,330	\$ 400,670
FF EX CIP925	R12	6	8	453	Singing Woods Lane from Oak Mesa Drive to Cliffwood Drive	Planning	3	\$ 179,840	\$ 291,340
FF EX CIP925	R12	6	8	492	Oak Mesa Place from Oak Mesa Drive to Singing Woods Lane	Planning	3	\$ 195,320	\$ 316,420
FF EX CIP925	R12	6	8	917	Cliffwood Drive from Overlook Drive to Singing Woods Lane	Planning	3	\$ 364,050	\$ 589,760
FF EX CIP950	R4	6	8	348	Los Olivos Avenue between Manzanita Avenue and Quail Court	Planning	3	\$ 138,160	\$ 223,820
FF EX CIP950	R4	6	8	92	Quail Court, west from Los Olivos Avenue	Planning	3	\$ 36,520	\$ 59,160
FF IM CIP934	R6R1	6	8	1,779	Mayeet Avenue from Evans to Princeton Way then North up Princeton Way		3	\$ 706,260	\$ 1,144,140
FF IM CIP936	R6R1	4/6	8	1,812	Yulupa Avenue from Montgomery to Sonoma and upsize sections on Magawan Drive and Midway Drive		3	\$ 719,360	\$ 1,165,360
Total Costs for Priority 3 Pipeline Improvements								\$ 3,005,670	\$ 4,869,180
<p>(1) Unit cost of \$397 per lineal foot are used for pipelines. (2) Includes construction contingency of 20%, design/planning/administration/overhead contingency of 35%, and 7% other contingencies.</p>									

Table 7 Priority 4 Fire Flow Improvements - Pipelines

CIP/CIP GROUP	PRESSURE ZONE	EXISTING DIAMETER (INCHES)	NEW DIAMETER (INCHES)	LENGTH (FEET)	LOCATION	CURRENT CIP STATUS	PRIORITY	ESTIMATED CONSTRUCTION COST (1)	CAPITAL COSTS (2)
FF IM CIP916	A1	6	8	726	Apache Street from W. Steele Lane to Huron Court and Apple Valley Lane from W. Steele Lane to Rockwood Court		4	\$ 288,220	\$ 466,920
FF IM CIP918	A1	6	8	902	McBride Lane from W. Steele Lane toward Terry Lane		4	\$ 358,090	\$ 580,110
FF EX CIP023	A2	6	8	778	Eardley Avenue between College Avenue and Tammy Way	Planning	4	\$ 308,870	\$ 500,370
FF EX CIP024	A2	NA	8	210	Dutton Avenue from Duncan Street south to end of pipeline on Dutton Avenue near Apple Creek Lane	Recommended	4	\$ 83,370	\$ 135,060
FF IM CIP917	A4	6	8	767	Schuman Drive from Mendocino Avenue to Rowe Drive and Meyers Drive from Steele Lane to Young Drive		4	\$ 304,500	\$ 493,290
FF EX CIP061	A6	6	8	625	Aston Avenue from Hendley Street to Miras Lane	Recommended	4	\$ 248,130	\$ 401,970
FF EX CIP920	R13R1	6	8	524	Coney Court from Wild Oak Drive to end	Planning	4	\$ 208,030	\$ 337,010
FF EX CIP920	R13R1	6	8	984	Wild Oak Drive from PRC 16 to Coney Court	Planning	4	\$ 390,650	\$ 632,850
FF IM CIP939	R6	6	8	784	Culebra Avenue from Primavera Drive to Las Raposas Court and Culebra Avenue from Mission Boulevard to Primavera Dt		4	\$ 311,250	\$ 504,230
FF IM CIP932	R6R1	6	8	208	Mayette Avenue from Wanda Way to Albert Drive		4	\$ 82,580	\$ 133,780
FF IM CIP933	R6R1	4	8	672	Matanzas Way from Hahman Drive to Rock Creek Drive		4	\$ 266,780	\$ 432,180
FF IM CIP940	R7	6	8	663	Del Monte Court from Street Francis Road to end		4	\$ 263,210	\$ 426,400
FF IM CIP928	R9R1	6	8	599	Tachevah Drive from Bethards Drive to Woodlake Drive and Woodlake Drive from Tachevah Drive entrance road to southeast		4	\$ 237,800	\$ 385,240
FF IM CIP929	R9R1	6	8	685	Knolls Hill Circle from Knolls Drive (northwest) to hydrant and Knolls Drive from Tachevah Drive to Knolls Hills Circle (northwest)		4	\$ 271,950	\$ 440,560
FF IM CIP931	R9R1	6	8	640	Sidney Square from Creekside Road to end		4	\$ 254,080	\$ 411,610
Total Costs for Priority 4 Pipeline Improvements								\$ 3,877,510	\$ 6,281,580

(1) Unit cost of \$397 per lineal foot are used for pipelines.

(2) Includes construction contingency of 20%, design/planning/administration/overhead contingency of 35%, and 7% other contingencies.

Table 8 Priority 5 Fire Flow Improvements - Pipelines

CIP/CIP GROUP	PRESSURE ZONE	EXISTING DIAMETER (INCHES)	NEW DIAMETER (INCHES)	LENGTH (FEET)	LOCATION	CURRENT CIP STATUS	PRIORITY	ESTIMATED CONSTRUCTION COST (1)	CAPITAL COSTS (2)
FF EX CIP022	A2	6	8	276	Agnew Place between 9th Street and 4 inch mains near Hydrant 1565	Planning	5	\$ 109,570	\$ 177,500
FF EX CIP022	A2	6	8	273	Blair Place between 91st Street and 4 inch mains near Hydrant 1449	Planning	5	\$ 108,380	\$ 175,580
FF EX CIP025	A2	6	8	264	Sovereign Lane between Donahue Avenue and Westgate Circle	Planning	5	\$ 104,810	\$ 169,790
FF EX CIP043	A4	6	8	56	Haven Drive between Hawthorne Court and Iris Court	Future	5	\$ 22,230	\$ 36,010
FF EX CIP043	A4	4	8	70	Geary Drive between James Avenue and Finlaw Street	Future	5	\$ 27,790	\$ 45,020
FF EX CIP043	A4	4	8	125	Haven Drive between Eleanor Avenue and Hawthorne Court	Future	5	\$ 49,630	\$ 80,400
FF EX CIP043	A4	4	8	213	Geary Drive between Bryden Lane and James Avenue	Future	5	\$ 84,560	\$ 136,990
FF EX CIP043	A4	4	8	223	Eleanor Avenue between Haven Drive and Belmont Court	Future	5	\$ 88,530	\$ 143,420
FF EX CIP043	A4	6	8	247	Geary Drive between James Avenue and Finlaw Street	Future	5	\$ 98,060	\$ 158,860
FF EX CIP043	A4	8	8	258	E. Foothill Drive between E. Haven Drive and Thomas Drive	Recommended	5	\$ 102,430	\$ 165,940
FF EX CIP043	A4	6	8	307	Haven Drive between Eleanor Avenue and Hawthorne Court	Future	5	\$ 121,880	\$ 197,450
FF EX CIP043	A4	6	8	395	Haven Drive between Iris Court and E. Foothill Drive	Future	5	\$ 156,820	\$ 254,050
FF EX CIP043	A4	6	8	538	Grahn Drive between Norte Way and E. Foothill Drive	Planning	5	\$ 213,590	\$ 346,020
FF IM CIP915	A6	6	8	479	Aston Avenue from Petaluma Hill Road to Johns Richards Way		5	\$ 190,160	\$ 308,060
FF EX CIP924	A8	6	8	431	Greenfield Circle, north from Oakmont Drive (west of Deerfield Circle)	Planning	5	\$ 171,110	\$ 277,200
FF IM CIP937	R6	6	8	290	Randall Lane		5	\$ 115,130	\$ 186,510
FF IM HEIDI PLACE	A1	6	8	982	Heidi Place from Steele Lane to the north		5 (needed at build-out)	\$ 389,850	\$ 631,560
FF IM MUIRFIELD COURT	R9	8	12	1,287	Muirfield Court from Summerfield Road to east end of street		5 (needed at build-out)	\$ 451,390	\$ 731,250
FF IM SLEEPY HOLLOW DRIVE	R4R1	6	8	525	Sleepy Hollow Drive from Bonita Vista to existing 8 inch at southeast		5 (needed at build-out)	\$ 510,940	\$ 827,720
Total Costs for Priority 5 Pipeline Improvements								\$ 3,116,860	\$ 5,049,330

(1) Unit cost of \$397 per lineal foot are used for pipelines.

(2) Includes construction contingency of 20%, design/planning/administration/overhead contingency of 35%, and 7% other contingencies.

5.4 RELIABILITY OPPORTUNITIES

Reliability improvements are detailed in the Task 400 TM and summarized in Table 9.

Table 9 Reliability Improvement Opportunities Costs

RELIABILITY OPPORTUNITIES		
Station 16 Pumping Capacity Improvements		
Optional for Reliability – Add High Flow Pump	Expansion Unit Cost (1)	\$ 1,279,125
	ENR CCI Adjustment (2)	1.173
	Estimated Construction Cost	\$ 1,500,414
	Capital Cost (3)	\$ 2,430,670
Option for Reliability – Install VFD for Each Pump	No. of Pumps	2
	Unit Cost (\$/VFD) (4)	\$ 120,000
	Estimated Construction Cost	\$ 240,000
	Capital Cost (3)	\$ 388,800
Station 17 Pumping Capacity Improvements		
Optional for Reliability – Add High Flow Pump	Expansion Unit Cost (1)	\$ 1,279,125
	ENR CCI Adjustment (2)	1.173
	Estimated Construction Cost	\$ 1,500,414
	Capital Cost (3)	\$ 2,430,670
Option for Reliability – Install VFD for Each Pump	No. of Pumps	2
	Unit Cost (\$/VFD) (4)	\$ 120,000
	Estimated Construction Cost	\$ 240,000
	Capital Cost (3)	\$ 388,800
Optional for Reliability – Add Operable PRC at S18 That Will Allow Flow from Pressure Zone 17 to Pressure Zone 3 (only should be implemented if high flow pump is added)	Unit Cost (5)	\$ 10,000
	Estimated Construction Cost	\$ 10,000
	Capital Cost (3)	\$ 16,200
Other Reliability Opportunities		
Automate Intertie Between Pressure Zone 4 and Pressure Zone 7	No. of Valves	4
	Unit Cost (5)	\$ 10,000
	Estimated Construction Cost	\$ 40,000
	Capital Cost (3)	\$ 64,800

RELIABILITY OPPORTUNITIES		
R17 Improvement Alternatives		
Pressure Control Valve and Upsizing of Pipe Along Grace Drive from Foothill Drive to Grosse Avenue	Pipe Length (ft)	350
	Pipe Unit Cost (\$/LF)	\$ 397
	Pipe Estimated Construction Cost	\$ 138,950
	1 Control Valve Unit Cost (LS)	\$ 10,000
	Valve Estimated Construction Cost	\$ 10,000
	Valve and Pipe Capital Cost (62%)	\$ 241,299
Install Small Booster Pump at Base of Tank (which would allow for full use of volume during emergency)	Unit Cost (\$/booster station)	\$ 90,000
	No. of Booster Stations	1
	Estimated Construction Cost	\$ 90,000
	Capital Cost (62%)	\$ 145,800
(1) Expansion unit cost is based on bid tabs for Station 3 expansion. (2) CCI adjustment is based on ratio of December 2019 CCI (11,381) to May 2014 (9,702). (3) Capital cost includes total contingencies of 62 percent. (4) VFD cost estimate for low-voltage VFD. Does not include station expansion costs. (5) Unit cost for control valve estimated conservatively at \$10,000.		

5.4.1 Station 16 Pumping Capacity Improvements

Station 16 can currently deliver more than 1,500 gpm with both pumps operating simultaneously. Adding a high flow pump, which alone would be capable of providing 1,500 gpm, would be a reliability option for this pump station.

Also included in the options for Station 16, in response to discussions with the City, are the costs to add VFDs to both pumps. This option would provide flexibility in operations and allow the Operations group to vary pumping rates into Pressure Zone 16.

5.4.2 Station 17 Pumping Capacity Improvements

Station 17 can also currently deliver more than 1,500 gpm with both pumps operating simultaneously. Adding a high flow pump, which alone would be capable of providing 1,500 gpm, would be a reliability option for this pump station.

Also included in the options for Station 16, in response to discussions with the City, are the costs to add VFDs to both pumps. This option would provide flexibility in operations and allow the Operations group to vary pumping rates into Pressure Zone 16.

If the option of expansion of the pump station with a high flow pump is selected, it would make sense to allow for additional pumping into Pressure Zone 17 to be transferred through the area and into Pressure Zone 3. This arrangement would provide a limited backup supply into Pressure Zone 3 should something occur with Station 3 and it is unusable at the time of an emergency. Modeling shows that the rate of backup supply which could be transferred through Pressure Zone 17 into Pressure Zone 3 is approximately 2,500 gpm. The available duration of this supply transfer depends on the combination of the improvements at Station 16 and Station 17. With high flow pumping at Station 17, but not at Station 16, this rate of transfer could be sustained for period of a few hours because Station 17 would out-pump Station 16 and the R16 would empty over time. The

amount of time depends on the water level in R16 at the start of the period and the rate of pumping from Station 17 and a likely duration would range from approximately 2 hours to 6 hours. With high flow pumps implemented at both facilities, this rate could be sustained continually, provided that the pumping capacity into Pressure Zone 4 also be maximized during this time-period.

5.4.3 Other Reliability Improvement Options

Other reliability improvement options shown in Table 9 are detailed in the Task 400 TM and include the following:

- Automated valves along the intertie between Pressure Zone 4 and Pressure Zone 7. This option would allow instantaneous switching of the intertie to dedicate it to a Pressure Zone 6 pipeline or to use it as a transfer between Pressure Zone 4 and Pressure Zone 7.
- Additional PRCs between Central City (Aqueduct Zone 4) and Pressure Zone 4 at Chaparral Place and Grace Dr. This option would allow a small transfer of flow into Central City from Pressure Zone 4 if Central City pressures were to drop significantly because of a fire in the area.
- Additional small booster pumps at tank sites where low water level equates to unacceptable pressures and fire flow. This option would allow for the full use of storage volume in emergency conditions where lower tank levels would normally result in unacceptable pressures and could also help in terms of water quality by providing extra capability in tank cycling and drawing the tank all the way down.

5.5 PROCTOR HEIGHTS EVALUATION

The Proctor Heights evaluation, as presented in Chapter 5.0 of this report, evaluated 4 options to allow the City to utilize the Proctor Heights Tanks. Modeling indicates that the City should be able to move approximately 1.3 mgd through these tanks and the Proctor Heights Booster Pump Station into Pressure Zone 4. Option 2 – Dedicated feed from PRA-61 appears to be the best options to fill the Proctor Heights Tanks. However, because of the balancing required to reduce volume to manage residence time vs. the impact that the reduced volume would have on the emergency relief, the City should carefully weigh value of returning the Proctor Heights Tanks to service. In general, the costs for 4 options primarily included changes to settings or yard plumping/piping changes. However, Option 2, the concept of adding a new improvement to connect to the downstream side of PRA-61 to the pipe at Yulupa Circle just north of Montgomery Drive, includes pipeline costs that are shown Table 10.

Table 10 Proctor Heights Evaluation - Improvement Costs

PROCTOR HEIGHTS EVALUATION		
Option 2 – Dedicated feed from PRA-61		
New 12-inch Pipe from PRA-61 at Sonoma Avenue and Yulupa Circle to the Existing 12-inch Pressure Zone 6 Pipe at Yulupa Circle Just North of Montgomery Drive (Certain valves would need to be closed to transition this conveyance corridor to a dedicated Proctor Heights feed.)	Length (ft) (1)	1100
	Unit Cost (\$/LF)	\$ 397
	Estimated Construction Cost	\$ 436,700
	Capital Cost (2)	\$ 707,454
(1) Unit cost of \$397 per lineal foot are used for pipelines.		
(2) Includes construction contingency of 20%, design/planning/administration/overhead contingency of 35%, and 7% other contingencies.		

