WATER TRANSMISSION AND STORAGE SYSTEM MASTER PLAN

Prepared for

City of Santa Fe, New Mexico

March 2009

(Revision: September 3, 2009)

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BROWN AND CALDWELL

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LIST OF ACRONYMS

ADD	average of average day demand
AF	acre-feet
BDD	Buckman Direct Diversion Project
CIP	capital improvements plan
EPS	extended period simulation
GIS	geographic information system
gpm	gallons per minute
MDD	average of maximum day demand
MG	million gallons
MGD	million gallons per day
MMD	average of minimum month demand
O&M	operations and maintenance
PHD	peak hour demand
PRV	pressure reducing valve
PVC	polyvinyl chloride pipe
PZ	pressure zone
QA/QC	quality assurance/quality control
SCADA	supervisory control and data acquisition
TM	technical memorandum
VFD	Variable Frequency Drive
WTP	Water Treatment Plant

WATER TRANSMISSION AND STORAGE SYSTEM MASTER PLAN

EXECUTIVE SUMMARY

This is an executive summary of the Water Transmission and Storage System Master Plan Report for the City of Santa Fe, New Mexico (City).

Statement of Purpose

The purpose of the Water Transmission and Storage System Master Plan Study was to provide the basis for a capital improvements program to improve and expand the City water system. The focus of the study was on the transmission and storage components of the system. Specific attention was given to the improvements needed to utilize the water that will be supplied by the Buckman Direct Diversion (BDD) project when it is completed. The specific objectives to be accomplished by the project were to:

- Establish a set of criteria by which the system could be evaluated and future improvements could be designed
- Develop a database of water demand that accounts for all existing and future demand on the City water system and that accurately distributes those demands throughout the system
- Determine the critical source of supply scenarios for which the system must have capacity to meet system demands
- Develop a calibrated hydraulic model of the City water system that could be used for this study and as an evaluation tool for City staff
- Evaluate the existing water transmission and storage system and the improvements required to utilize BDD supply and meet future water demands
- Create a hydraulic profile and mapping of the existing and future system
- Develop a capital improvements plan that can be implemented by the City

Existing Water System

The City's existing water system consists of several sources of supply, a pipe network divided into pressure zones, 10 pump stations and 9 storage tanks. The existing sources of supply include 1) Canyon Road Water Treatment Plant (CRWTP), 2) a group of wells referred to as the City Well Field (CWF), and 3) the Buckman Well Field (BWF). A fourth source, the Buckman Direct Diversion Water Treatment Plant (BDD WTP) will soon be added to the system. **Table ES-1** lists the capacity of each source in million gallons per day (MGD).

The capacity of each supply source is shown in **Table ES-1**. These capacities are used in this report and are based on the maximum rated hydraulic capacity for each source. These supply source capacities were used to design transmission and storage improvements needed to convey water throughout the system under various supply scenarios to meet maximum day demand (MDD). However, it is recognized that these supply source capacities are limited by such factors as water rights, the availability of surface supply, source water quality, operational decisions, equipment failures, and other similar factors.

Table ES-1. Maximum Capacity of Supply Sources	
Source	Maximum Daily Capacity (MGD)[1]
CRWTP	8.0
CWF	5.3
BWF	12.4
BDD WTP	15.0
Total	40.7

1. *Based on the maximum rated hydraulic capacity for each source*

The pipe network consists of more than 550 miles of pipes ranging in diameter from 2 to 36-inches. The 10 pump stations in the system are used to convey water from the sources of supply to higher elevations in the system. The nine storage tanks in the water system provide storage to serve daily fluctuations in demand, fire flow storage and storage for emergency use. Current total storage capacity is approximately 33 million gallons (MG).

Figure ES-1 shows the layout of the water system facilities. **Figure ES-2** is a hydraulic schematic of the system which illustrates the relationship between the source of supply, pumping and storage facilities.

Water Demands

An important part of the plan is the establishment and projection of water demands. It provides the basis for water supply needs and the determination of required transmission and storage system capacity. The most recent studies performed for the City water system were reviewed to ensure that the demands developed for this master plan are consistent with the information being used by other departments of the City. The review indicated that demands for this master plan study should be consistent with demand calculations contained in the "Long Range Water Supply Plan" (COSF, 2008) because they are based on the most up-to-date information available and are used by the City for current supply planning.

Water Service Agreements

In addition to serving water users within the City limits, the City has several contractual obligations (water service agreements) to serve water users in areas outside the City limits. These agreements include the Water Service Area Boundary Extension (WSABE) agreements, the Acequia agreements, the Las Campanas agreement and the Santa Fe County (County) agreement. Kyle Harwood was contracted on the project to assist in the review of the agreements to ensure that all obligations to meet future water demands were accounted for in the study.

Figure ES-3 shows the future service area of the City water system, based on the areas included in the agreements and proposed annexation area of the City. The area shown in the figure makes up the study area for this master plan.

Existing System Demand

Existing system demands were extracted from historical total system demand data recorded in the City's Supervisory Control and Data Acquisition (SCADA) system. The demands were distributed throughout the system based on the City's water billing data, which provides an address and monthly water use for each customer in the system including WSABE customers and the County. **Table ES-2** summarizes the total existing system demands for the average of minimum month demand (MMD), average day demand (ADD), maximum day demand (MDD) and peak hour demand (PHD).

Table ES-2. Existing Total System Demands				
Demand	Date	Total Volume (MG)	Average Demand (gpm)	Scaling Factor from ADD from 2007 Data
MMD	December 2007	195.9	4,390	0.74
ADD	2007	8.5	5,930	-
MDD	Sept. 27, 2007	13.8	9,560	1.61
PHD	Estimated from MDD	-	13,860	2.33

Future System Demand Projections

Future demands were derived from the City's General Land Use Plan using unit use rates and from County demand projections. City Staff from both the Water Division and the Long Range Planning Division were consulted in developing future water system demands. All demands were adjusted to match LRWSP demand projections to maintain consistency between the studies.

The County provided their demand projections through the year 2020. Demands for the year 2030 were extrapolated from the projections. **Table ES-3** shows the County demands for the three planning horizons used in this study.

Table ES-3. Future County Demand by County Service Area							
Year	Maximum Day Demand (MGD)[1]						
	Southeast	South	Southwest	Airport	South Meadows	West	Total
Delivery Point	*Richards Ave. Master Meter*	*BDD NM 599 & I-25 and Cerrillos Meter*	*BDD NM 599 & I-25 and Cerrillos Meter*	*BDD NM- 599*	*BDD S. Meadows and Agua Fria*	*Aldea Meter*	
2013	0.47	0.37	0.31	0.27	0.07	0.15	1.64
2020	0.85	0.67	0.61	0.49	0.14	0.27	3.03
2030[2]	1.45	1.14	1.11	0.82	0.24	0.44	5.20

1. *County uses a factor of 2 to calculate MDD from ADD.*
2. *Extrapolated from 2020 demand projections.*

Unit use rates for each land use type in the General Land Use Plan were developed from existing water use. The unit use rates were used to calculate water demand for all undeveloped area within the master plan study area. That water demand was scaled to match the City demand calculated in the LRWSP. **Table ES-4** summarizes City demands with the County demands and the resulting total system demand used in the evaluation.

Table ES-4. Future Total System Demand								
Year	City Demands [1]			County Demands			Total System Demand	
	Average Annual (AF/yr)	Average Day Demand (MGD)	Max. Day Demand (MGD)	Average Annual [2] (AF/yr)	Average Day Demand (MGD)	Max. Day Demand (MGD)	Max. Day Demand (gpm)	Max. Day Demand (MGD)
2013	12,392	11.1	18.6	1,350	0.8	1.6	13,990	20.1
2020	13,554	12.1	20.2	1,350	1.5	3.0	16,110	23.2
2030	15,061	13.5	22.4	1,350	2.6	5.2	19,170	27.6

1. *Includes City customer demand and delivery obligations to Acequias and WSABEs.*
2. *Contractual obligation for the City for drought year conditions.*

The distribution of demands has a significant impact on planning for future transmission and storage needs. **Table ES-5** summarizes City and County water demands by pressure zone for each planning horizon. The percent of the total system demand is shown for each pressure zone at each planning horizon to demonstrate the shift in the distribution of demands over time. **Table ES-5** shows that the majority of the growth in the City and County is expected to occur in the Southwest end of the City in Pressure Zones 5, 6, 7, 8 and 9. This is consistent with information provided by the City's Long Range Planning Division. By the year 2030 Pressure Zone 5, 6, 7, 8 and 9 will serve over 67% of the total system demand.

Table ES-5. Water System Demand by Pressure Zone

Pressure Zone	Existing		2013		2020		2030	
	MDD (MGD)	% Total MDD	MDD (MGD)	% Total MDD	MDD (MGD)	% Total MDD	MDD (MGD)	% Total MDD
00	0.05	< 1%	0.25	1%	0.33	1%	0.38	1%
0	0.05	< 1%	0.11	< 1%	0.13	< 1%	0.15	< 1%
1	0.39	3%	0.78	4%	0.89	4%	0.99	4%
2	0.89	6%	1.63	8%	1.78	8%	1.89	7%
3	1.58	11%	1.83	9%	1.92	8%	2.07	7%
4	2.97	22%	3.24	16%	3.34	14%	3.52	13%
5	2.94	21%	3.29	16%	3.50	15%	4.02	15%
6	1.63	12%	2.28	11%	2.35	10%	2.54	9%
7	2.12	15%	3.71	18%	5.25	23%	7.63	28%
8	1.15	8%	2.49	12%	2.98	13%	3.56	13%
9	-	0%	0.53	3%	0.72	3%	0.85	3%
Total	13.8		20.1		23.2		27.6	

Computer Model Development

An all new hydraulic computer model of the City's water system was created using H2OMAP Water software. After review of the available data, *TM 4 – Description of Hydraulic Model* was created to provide recommendations on the model development process. The TM was reviewed and approved by City staff. The model includes all of the water transmission and distribution piping contained in the City's Geographic Information System (GIS) data. City staff was interviewed and available system information was reviewed to add all major pump stations, storage tanks, pressure regulating and flow control valves. The water demands developed for the project were assigned to the model. Field testing was performed and the model was calibrated to match field test results. The model calibrated well for both steady-state and extended period simulations (EPS). City staff was trained to maintain the all-pipe model and use it for analysis.

System Evaluation Criteria

Evaluation and design criteria were developed to ensure the desired level of service to each customer and to maximize the efficiency of the future system. Current City design, utilization, operation and reliability criteria for the water system were reviewed and compared to New Mexico state regulations and recommendations and to industry standards. Recommendations for either establishing or changing existing criteria were documented in *TM 1 – System Design and Evaluation Criteria.* A workshop was held to discuss the proposed design and evaluation criteria, and the TM was reviewed by City staff. The final criteria established with the City are included in Section 5 of this report.

System Evaluation

The system evaluation criteria were used to evaluate the existing and future system. A number of improvements were developed to address deficiencies identified in the evaluation. The improvements were designed to the standards laid out in the evaluation criteria. The majority of the improvements developed are needed to convey water from the new BDD WTP to the existing system, add reliability to the system and meet growth in demands on the system.

Existing System Evaluation

The existing water system evaluation included an analysis of the transmission piping, pumping, storage and supply facilities. The "all-pipe" computer model developed for the project was used to simulate the demand conditions that represent the greatest strain on the system. Areas in the existing system that did not meet the evaluation criteria were identified as deficiencies that should be addressed.

Evaluation of the existing system piping indicated that the existing transmission piping is currently adequate but further evaluation of the distribution piping is needed. Results of the computer model evaluation indicate that, with a few minor exceptions, the water system has adequate water pressure; however, there are several areas where pressure exceeds the maximum allowable limit of 125 pounds per square inch (psi). There are also several areas where the system does not have capacity to meet the fire flow criteria. For the most part, these problems are limited to the distribution, not transmission, system piping. A few, minor transmission system improvements were recommended to meet fire flow and further evaluation of the distribution system, particularly for fire flow deficiencies and solutions to high pressure problems are recommended.

The evaluation indicated that all booster pump stations have adequate capacity to supply the existing MDD for their respective areas served; however, a number of reliability issues were identified. The City requires that pump stations supplying a single tank have sufficient capacity to meet average day demand (ADD) plus fire flow for times when the tank may be out of service. Based on this criterion the Summit and EHL Booster Stations do not have adequate capacity. A further evaluation of the need for back-up power supply to the pump stations is recommended.

A comparison of the existing system demands to the existing supply to the system shows that the system has adequate supply capacity. For the most part there is adequate reliability in the supply system; however, further evaluation of the need for back-up power supply to the wells is recommended.

The existing system storage analysis indicates that the Dempsey and EHL Tanks are the only tanks in the system that do not meet the storage capacity requirements. Additional future storage is required in these areas. However, the rest of the system has much more storage capacity than needed. The available emergency storage in rest of the system is more than 3 times greater than the required emergency storage volume. Excessive storage capacity can result in water age issues. Therefore, additional future storage should be avoided where possible.

Future System Evaluation

The system was evaluated at three future planning horizons; 2013, 2020 and 2030. 2030 is assumed to represent complete build-out of the master plan study area. Build-out system improvements were developed first followed by 2020 and 2013 improvements, respectively. This process ensures that all recommended improvements come together in a cohesive master plan. Four transmission system alternatives that satisfied the evaluation criteria were developed and evaluated in a business case evaluation (BCE) to select which of the four alternatives is most advantageous to the City.

The business case evaluation of the four alternatives is described in *TM 5 – Business Case Evaluation* included in **Appendix A**. The selected alternative (Alternative 2 – Southwest Tank Option) includes transmission system improvements that convey the majority of the supply from BDD and BWF directly to the Southwest Tank and Hospital Tank which serve 60% of 2030 demands. The improvements were designed to meet system demands for the proposed standard operation of the 2030 supply facilities and with either CRWTP or BDD out of service (see Section 5.2.1). The recommended transmission system improvements are shown in **Figure ES-4** and described in the sections that follow. **Figure ES-5** shows a schematic of the 2030 system with the proposed improvements. A description of the improvements is provided below.

Piping Improvements

The majority of the piping improvements are needed to convey water from BDD to existing transmission and storage facilities. The proposed piping was added to the model and laid out along the existing and future transportation corridors where possible. The major piping improvements evaluated include:

1. A new transmission pipeline to convey water from the BDD supply connection point located at the intersection of South Meadows Rd. and Agua Fria Dr. The new pipeline will be a dedicated transmission line (no connections of any type) up to the intersection of Airport Rd. and Cerrillos Rd. at which point it will be tied to Zone 7 transmission piping at the necessary locations. Limiting connections in this way minimizes the impacts on Zone 7 pressures. The Airport Rd. alignment was selected over a Jaguar Rd. alignment to facilitate delivery of water to the northeast region of Zone 7 and eliminate the need for the PRV on Airport Rd. to Zone 7.
2. A new pipeline parallel to the BS-5A transmission line from BDD to the intersection of South Meadows Rd. and Agua Fria Dr. The parallel line is needed to increase conveyance capacity from BDD to the Southwest Tank when capacity is added to BS-5A.
3. A new transmission pipeline to serve areas at the south end of Pressure Zones 8 and 9 that are currently served by Santa Fe County.
4. A new transmission pipeline to convey water from the proposed Southwest Booster Station to existing transmission piping in Zone 5.
5. New transmission pipelines to connect the La Tierra/Aldea area to the rest of the City Pressure Zones 4 and 5. The Zone 4 and 5 transmission lines will serve new development in the area, provide additional capacity to convey water from the Buckman Tank to the City system and provide redundant supply to the La Tierra/Aldea area.
6. A new pipeline to connect the 20" pipeline from the NW Quad Booster Station to existing transmission piping in Zone 2. This improvement is recommended to add reliability to the system. The new pipeline will allow demands in the north end of Zone 2 to be supplied by the NW Quad Booster Station instead of from the Dempsey Tank through PRVs, which would minimize the potential of a PRV failing and emptying the Dempsey Tank into Zone 2. The pipeline also provides redundant supply to the NW Quad service area.
7. Miscellaneous piping added to ensure that the transmission system has adequate capacity to meet fire flow requirements.
8. A new 12" transmission line from the Summit Booster Station to existing transmission piping in the Summit Tank service area to convey the higher flow rates from the pump station. The new transmission line should be constructed parallel to the existing pipe from the pump station to add redundancy to the system.

Control Valve Improvements

Three new PRVs and a new flow control valve (FCV) are proposed for the future system. The three PRVs include a PRV at the proposed Dempsey Booster Station 2, a PRV station from the Northwest Quadrant

service area to a new development area at the north end of Zone 3 and a PRV station to serve the future annexation area and new development at the south end of Zone 9. The PRV at the proposed Dempsey Booster Station 2 is to provide emergency supply to the NW Quad service area. The other two PRVs are required to serve future development at the appropriate pressure.

The proposed FCV will control flow to the Southwest Tank when the tank is filled from the Zone 5 instead of the BDD WTP. The Southwest Tank is currently filled from Zone 5 through a FCV connected to the 10-inch pipe on Via Caballero Del Sur. The 10-inch pipe limits the flow rate at which the tank can be filled, so the new FCV should be constructed as part of the Southwest Booster Station which includes a new 16-inch pipe connected to existing transmission piping in Zone 5. The existing Southwest Tank control valve would be abandoned.

Pump Improvements

The existing booster stations have capacity to supply 2030 MDD for their respective service areas, with the exception of three booster stations which need additional emergency capacity. New booster stations are also needed to convey BDD and BWF water through the system to meet demands under the three source-of-supply scenarios. The pump improvements evaluated include:

- **BS-5A Expansion** – Expansion of BS-5A from a 10 MGD to a 16.5 MGD booster station (11.500 gpm). The booster station expansion makes it possible to serve all demand for Zones 5 – 9 from BS-5A and the City Wells.
- **BS-4A Reverse Flow** – A new 13 MGD (9,000 gpm) booster station near BS-3 to pump water from BWF to the BDD 4 MG Tank through the Booster Station 4A (BS-4A) pipeline. This booster station is necessary to supplement supply to BS-5A and to meet system demands when BDD is out of service.
- **Southwest Booster Station** – A new 3.6 MGD (2,500 gpm) booster station at the Southwest Tank to convey water from BDD and BWF directly to the Hospital Tank and its service area.
- **Dempsey Booster Station 2** – A new 2.2 MGD (1,500 gpm) booster station to convey water from BDD and BWF to the Dempsey Tank.
- **Summit Booster Station Expansion** – Expansion of the Summit Booster Station to meet fire flow in the Summit Tank service area. This project would be constructed in conjunction with storage improvements at the Dempsey Tank. See Section 6.2.1.3.1 for more details.
- **EHL Booster Station Expansion** – Expansion of the EHL Booster Station to meet fire flow in the EHL Tank service area. See Section 6.2.1.3.2 for more details.

Storage Improvements

In addition to the need for additional storage in the Dempsey and EHL Tank service areas, the future system storage analysis identified the need for additional storage capacity in the Summit Tank service area. The need for a larger suction reservoir at BS-3 was also identified. Several alternatives were considered to meet the storage requirements of the Summit, Dempsey and EHL. They were presented to City staff, who then selected the preferred alternatives based on the advantages listed in the report. It is recommended that a detailed business case evaluation be performed on each of these projects prior to design and construction. The selected alternatives and the BS-3 Suction Reservoir replacement are described below.

Summit/Dempsey Storage Improvements – An additional storage facility at the Dempsey Tank site with increased pumping capacity in the Summit Booster Station is recommended. Due to the challenges of constructing storage tanks in this area of the City a combined solution is advantageous. The storage tank should have approximately 1 MG of capacity, which is enough to meet the future storage requirements of the of both service areas. The additional pumping capacity at the Summit Booster Station should be a pump with

1,500 gpm of capacity to serve fire flow in the Summit Tank service area from the Dempsey Tank. The new pump should be equipped with back-up power on-site to also convey emergency storage from the new tank.

East High Level Storage Improvements – Additional pump capacity in the EHL Booster Station is recommended in lieu of additional storage in the EHL Tank service area. A pump sized to meet fire demands in the EHL Tank service area should be added to the EHL Booster Station. In the event of a fire in the EHL Tank service area, the pump will supply 630,000 gallons of water from excess storage in the St. John's Tank, and eliminate the need for additional storage in the service area. The EHL Booster Station is downstream of the transmission pipeline in the arroyo, making it possible to utilize the additional pump capacity to supply peak hour demands in the EHL Tank service area if the pipeline were to get washed out.

Booster Station 3 Suction Reservoir – It is recommended that the existing 150,000 gallon suction reservoir at BS-3 be replaced with a 1 MG reservoir. The larger reservoir is needed to facilitate operations of BS-4A and provide buffer storage to BS-3 when switching between BWF supply and BS-4A supply. The new tank will also serve as suction reservoir for the proposed BS-4A Reverse Flow. Chlorination and fluoridation facilities should also be constructed at the site to allow treatment of BWF water prior to mixing with BDD water. This will add flexibility to the operations of BDD and BWF.

Recommendations

A Capital Improvements Plan (CIP) for the City water transmission and storage system was developed and recommendations for additional studies related to the water system were provided.

Capital Improvements Plan

A CIP was developed to assist the City in budgeting for the improvements needed to provide the required level of service to the City water customers. The improvement projects developed in the future system analysis were prioritized to meet system demands through build-out of the master plan study area. All projects were categorized into short, mid and long-term projects. Planning level costs were estimated for each project.

To prioritize the projects, the system was evaluated at four planning horizons. The planning horizons used for the evaluation were 2007 (existing), 2013 (short-term), 2020 (mid-term) and 2030 (build-out). Results of the evaluation at the different planning horizons were used to categorize the projects into short, mid and long-term projects. Projects within each category were assigned a year for completion based on importance of each project to meet system demands. For short-term projects, the timing of the completion of BDD was used as a benchmark for the completion of projects needed to utilize the new source of supply at full capacity. The population/demand projections were made prior to the slowdown in growth that the City is currently experiencing. If the slowdown in growth continues, it may be possible to delay the projects that are primarily growth related. The CIP should be updated in approximately 5 years to update the project implementation dates as revised land use, population and water use projections become available.

Figure ES-6 shows the location of the proposed improvement projects. **Table ES-6** lists the improvements and probable estimates of construction costs.

Description of Cost Estimates

Cost estimates provided in **Table ES-6** are based on a budgetary, planning level, engineer's opinion of probable project costs. The costs for each recommended improvement are presented in present day value. They were developed based on construction cost information provided in August 2008 at which time the Engineering News Record (ENR) Construction Cost Index Value (ENR, 2008) was 8,361.74.

Unit costs for pipelines and pump stations were developed from bid tab information from the BDD project. Storage and valve vault unit costs were determined from 2007-2008 construction projects in the area. All unit prices represent installed costs and include excavation, bedding, backfill, compaction, materials, appurtenances and delivery to the site.

The cost estimates include 25% for construction contingency and 15% for engineering, legal, administration, and CMS. The cost estimates are based on Brown and Caldwell's perception of current conditions in the project location.

After the cost estimates were developed for each improvement project, the costs were divided into growth related costs and service improvement costs as shown in **Table ES-6**. Assignment of an allocation category to each project was based on engineering judgment and is intended for budgetary use only. The City should quantify the specific growth related and service improvement related benefits of each project to determine from exactly where funding for the projects will come.

County Benefit from CIP Projects

Many of the improvements to the Southwest end of the system that are listed in the CIP are needed to serve County demands as well as City demands. Much of the BDD water owned by the County must pass through the City system prior to delivery. As such, a large portion of the growth in demand on the system is due to County growth. The CIP projects also add reliability to the County system supply. It is recommended that the City begin discussions with County staff to determine what costs for improvements could be shared. The hydraulic model can be used to quantify the total capacity of each improvement that is utilized to supply the County. However, prior to using the model to determine the capacity that will be used by the County, the County should provide demand projections through build-out of their service area and demands in the model should be updated accordingly. Projects providing benefit to both the City and County include projects S-1, S-2, S-5, M-1, M-2, M-5 and M-9 of the CIP.

Table ES-6. Capital Improvement Projects

Project Number	Project Name	Completion Year	Facilities to Construct	Project Description	Purpose	Total Estimated Cost[1]	Cost Allocation[1]		Comments
							Growth Cost	Service Improvement Cost	
Short-Term Projects									
S-1	Southwest Tank Supply Pipeline (Part A)	2010	New Transmission Pipeline Including: • 9,700 LF of 30" Dia. Pipe • 9,100 LF of 20" Dia. Pipe	Construct a new transmission pipeline from the BDD connection point at South Meadows Rd. and Agua Fria Dr. to the existing transmission line from the Southwest Tank at the intersection of Richards Ave. and Governor Miles Rd. The new pipeline will be a dedicated transmission line (no connections of any type) up to the intersection of Airport Rd and Cerrillos Rd. at which point it will be tied to Zone 7 transmission piping at the necessary locations. Limiting connections in this way minimizes the impacts on Zone 7 pressures.	Convey water from the BDD supply connection point to the Southwest Tank. MDD through at least 2013 can still be met without this project; however, capacity of BS-5A will be limited to a maximum flow rate of 8.2 MGD, which can only be achieved at PHD, and an average flow rate of 7 MGD on maximum day. Operating BS-5A at full capacity without this project would over-pressurize Zone 7. The BDD WTP can still be used at full capacity without this project.	$6,080,000	$4,560,000	$1,520,000	
S-2	Dempsey BS-2[2]	2012	New BS Including: • Pump House • 100,000 gal suction well • Two Pumps with combined capacity of 1,500 gpm @ 320 ft TDH • Back-up Pump • PRV	Construct a new pump station located at the intersection of Tano Rd. and Opera Dr. The BS pumps water from the 20" Northwest Quadrant pipeline to the 12" transmission pipe in Zone 1.	Provide secondary supply to the Dempsey and Summit Tank. A PRV at the station will provide emergency supply to the Northwest Quadrant. MDD of the Dempsey and Summit Tank service area must be supplied from the Hydro Tank when CRWTP is out of service if this booster station is not constructed. Dempsey Tank 2 will also have to be constructed sooner due to the higher emergency storage requirements for tanks without dual sources of supply.	$1,640,000	$410,000	$1,230,000	
S-3	EHL BS Expansion	2013	Expansion of Existing BS Including: • Pump with capacity of 3,500 gpm @ 285 ft TDH	Expand the EHL BS with a high volume pump for emergency operations and fire flow. Pump should be VFD controlled.	Eliminate the need for additional storage capacity in the East High Level (EHL) Tank service area. Provide emergency supply to the EHL Zone from St. John's Tank. If this project is not constructed the system will not have sufficient fire and emergency storage capacity for the EHL Zone.	$1,810,000	$0	$1,810,000	A more detailed analysis of fire storage requirements for the St. John's College should be performed prior to implementation of this project.
S-4	Southwest BS	2013	New Pump Station Including: • Pump House • Two Pumps with Combined Capacity of 2,500 gpm @ 310 ft TDH • Back-up Pump • Flow Control Valve New Transmission Pipeline Including: • 6,000 LF of 30" Dia. Pipe	Construct a new pump Station located at the Southwest Tank site. Includes a new transmission pipe to convey water from the pump station to existing transmission in Zone 5.	Convey Water from the Southwest Tank to the Zone 5 and 6 and the Hospital Tank. Replace the existing control valve used to fill the Southwest Tank from Zone 5. If this project is not completed in the 2013 the system will not have capacity to meet MDD with CRWTP out of service.	$2,540,000	$1,905,000	$635,000	
S-5	Miscellaneous Fire Flow Improvements	2013	Miscellaneous Pipe Improvements: • 4,500 LF of 8" Dia. Pipe • 500 LF of 10" Dia. Pipe • 9,300 LF of 12" Dia. Pipe • 100 LF of 16" Dia. Pipe	Construct pipeline improvements at various locations throughout the water system.	Increase capacity to meet fire flow demands in areas of the transmission system identified as deficiencies. System will not meet fire flow requirements in the areas identified if these improvements are not made.	$1,960,000	$0	$1,960,000	A more detailed fire flow analysis should be performed to determine improvements to the distribution system that are needed to meet fire flow.
Total Short-Term						$14,030,000	$6,875,000	$7,155,000	
Mid-Term Projects									
M-1	Aldea – Zone 5 Connection Pipeline 1	2015	New Transmission Pipeline Including: • 9,400 LF of 12" Dia. Pipe	Construct a new transmission pipeline from the end of the existing transmission pipe in Aldea at the intersection of Camino Del Centro and Avenida Aldea to the existing transmission pipe in Zone 5 at the intersection of West Alameda St. and La Joya Rd.	Provide redundant supply to the La Tierra/Aldea service area and provide supply from the Buckman Tank to Zone 5 through the La Tierra PRV station. If this project is not constructed the La Tierra/Aldea area could not be supplied in the event of a failure in the existing supply line from the Buckman Tank.	$1,460,000	$730,000	$730,000	

Table ES-6. Capital Improvement Projects

Project Number	Project Name	Completion Year	Facilities to Construct	Project Description	Purpose	Total Estimated Cost[1]	Cost Allocation[1]		Comments
							Growth Cost	Service Improvement Cost	
M-2	Southwest Tank Supply Pipeline (Part B)	2015	New Transmission Pipeline Including: • 7,600 LF of 12" Dia. Pipe	Construct a new transmission pipeline parallel to existing transmission pipe from the Southwest Tank. New pipeline extends the Southwest Tank Supply Pipeline from the intersection of Richards Ave. and Governor Miles Rd. to the Southwest Tank.	Increase capacity to convey water from the BDD supply connection point to the Southwest Tank. System will not have capacity to meet future MDD under all three source of supply scenarios without this improvement.	$1,970,000	$1,480,000	$490,000	
M-3	Dempsey Storage Tank 2	2015	New 1 MG Storage Tank (partially buried, concrete tank)	Construct a new 1 MG storage tank located at the Dempsey Tank site. Utilizes City owned land adjacent to the existing tank site.	Provide storage capacity for Zone 1 and eventually Zones 0 and 00. System will not have adequate fire and emergency storage in these zones if this tank is not constructed by the year listed.	$4,320,000	$2,160,000	$2,160,000	Additional lead time should be provided for this project to perform a business case evaluation.
M-4	Supply Loop to Zone 8 & 9 South Annexation Areas	2020	New Transmission Pipeline Including: • 29,000 LF of 12" Dia. Pipe PRV with Valve Vault	Construct a new transmission pipeline loop from the existing transmission pipe on Paseo Del Sol to the discharge or the existing Zone 9 PRV at the Airport.	Supply areas of Zone 8 and 9 currently served by the County but that will be annexed into the City. Supply pipeline from Paseo Del Sol is required to meet MDD. Supply pipeline from the Airport is required to meet fire flow.	$4,650,000	$4,650,000	$0	Should be constructed when the area is annexed into the City and in conjunction with growth in the area.
M-5	BS-3 Suction Tank Replacement	2020	• New 1 MG Storage Tank (partially buried, concrete tank) • On-site Chlorination and Fluoridation Facilities	Replace existing BS-3 suction tank with a 1 MG Storage Tank. Tank will fill from BWF supply line and BS-4A supply line. Construct Chlorination/fluoridation facilities to allow treatment of BWF water prior to mixing with BDD water.	Provide "buffer" capacity when switching between sources (i.e. BDD and BWF) and provide transient control for BS 2, 3, 4A and 4A Reverse Flow. BDD has been designed with enough flexibility that this project may not be needed to utilize BS-4A at full capacity. If not construction can be postponed until construction of Project M-5.	$4,530,000	$2,265,000	$2,265,000	
M-6	BS-4A Reverse Flow	2020	New Pump Station Including: • Pump House • 3 Pumps with Combined Capacity of 9,000 gpm @ 145 ft TDH • Back-up Pump New Piping at BDD Treatment Plant: • 500 LF of 30" Dia. Pipe	Construct a new booster station at the BS-3 site which pumps water from BWF to the finished water storage at BDD.	Convey water to the BS-5A when BDD is out of service. The improvement also provides the capability to run BWF water through the BDD WTP if the need were to arise (e.g. for arsenic removal). System will not have capacity to meet MDD with BDD out of service without the new booster station.	$2,010,000	$1,005,000	$1,005,000	An alternative to this project is to modify BS-3 to pump to BS-4 and BDD WTP. This would require new pumps and additional piping at the existing booster station.
M-7	La Tierra – Zone 4 Connection Pipeline	2020	New Transmission Pipeline Including: • 10,300 LF of 12" Dia. Pipe	Construct a new transmission pipeline from the existing La Tierra supply pipe to the existing transmission line in Zone 4 on Buckman Rd.	Provide redundant supply to the La Tierra service area and serve future development in the area. If this project is not constructed, the Zone 4 region of the La Tierra area could not be supplied in the event of a failure in the existing supply line from the Buckman Tank.	$1,600,000	$800,000	$800,000	Should be constructed as the area is developed.
M-8	Summit BS Expansion	2020	Expansion of Existing BS Including: • Pumps with Capacity of 1,500 gpm @ 400 ft TDH New Pipeline Including: • 1,000 LF of 12" Dia. Pipe • 4,100 LF of 10" Dia. Pipe	Expand the Summit BS with a high volume pump for emergency operations and fire flow. Pump should be VFD controlled. Construct a new pipeline to increase conveyance capacity from the pump station to existing transmission.	Eliminate the need for additional storage capacity in the Summit Tank service area. Provide emergency supply to the Zones 0 and 00 from Dempsey Tank. If this project is not constructed the system will not have sufficient fire and emergency storage capacity for the Zones 0 and 00.	$1,770,000	$1,330,000	$440,000	
M-9	Northwest Quadrant to Zone 3 Supply Pipeline and PRV	2020	New Transmission Pipeline Including: • 2,900 LF of 12" Dia. Pipe PRV with Valve Vault	Construct a new transmission pipe from existing Northwest Quadrant transmission pipe to the new PRV to Zone 3.	Serve new development in Zone 3 and stabilize pressures at the north end of Zone 3. Pressures and fire flow capacity will be inadequate in the area without this improvement.	$590,000	$590,000	$0	Should be constructed as the area is developed.

Table ES-6. Capital Improvement Projects

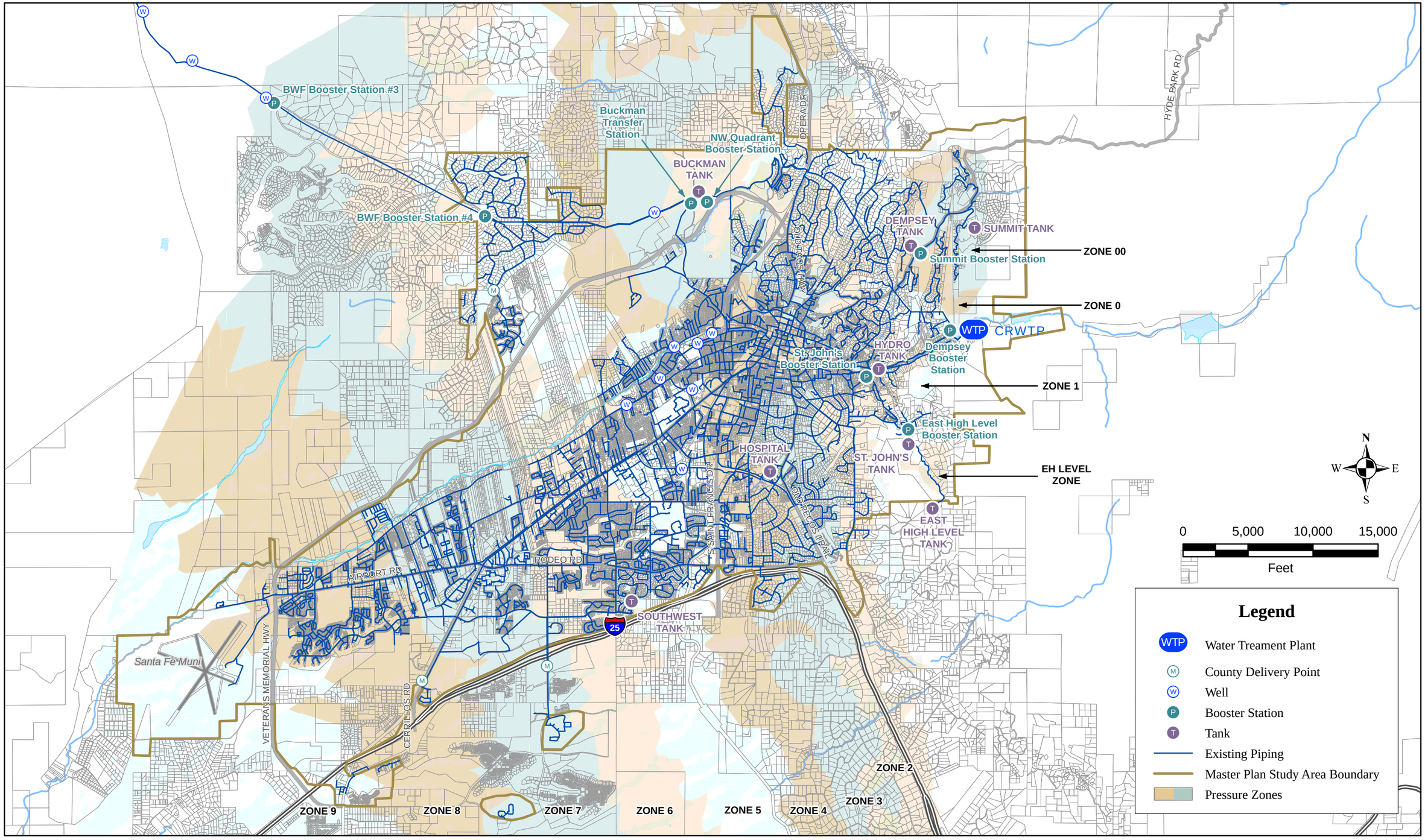
Project Number	Project Name	Completion Year	Facilities to Construct	Project Description	Purpose	Total Estimated Cost[1]	Cost Allocation[1]		Comments
							Growth Cost	Service Improvement Cost	
M-10	BS-5A Expansion	2020	New Pump Station Including: • Pumps with Combined Capacity of 11,500 gpm @ 400 ft TDH • Back-up Pump New Transmission Pipeline Including: • 27,400 LF of 20" Dia. Pipe	Replace existing BS-5A pumps with higher capacity pumps. Construct a new parallel transmission pipe from the pump station to the City system connection point at the intersection of South Meadows Rd. and Agua Fria Dr.	Supply MDD for Zones 5 to 9 directly from BDD. Without this improvement the system will not be able to meet MDD with CRWTP out of service.	$14,740,000	$11,055,000	$3,685,000	
Total Mid-Term						$37,640,000	$26,065,000	$11,575,000	
Long-Term Projects									
L-1	La Tierra – Zone 5 Connection Pipeline 2	2025	New Transmission Pipeline Including: • 19,200 LF of 12" Dia. Pipe	Construct a new transmission pipeline from the La Tierra PRV to the existing transmission line in Zone 5 at the intersection of West Alameda St. and La Joya Rd.	Provide fire flow in future development area and provide supply from the Buckman Tank to Zone 5 through the La Tierra PRV station.	$2,970,000	$2,970,000	$0	Should be constructed as the area is developed.
L-2	Northwest Quadrant - Zone 2 Connection Pipeline	2025	New Transmission Pipeline Including: • 4,800 LF of 12" Dia. Pipe	Construct a new transmission pipeline from the existing transmission pipe at the intersection of NM 599 and Avenida Rincon to the existing transmission pipe on Calle Estado.	Provide redundant supply to the Northwest Quadrant service area. Utilize Northwest Quadrant pump station to its full capacity to alleviate demand on Dempsey Tank and reliance on PRVs serving the north end of Zone 2 from Zone 1.	$740,000	$0	$740,000	
Total Long-Term						$3,710,000	$2,970,000	$740,000	
Combined Total						$55,380,000	$35,910,000	$19,470,000	

1. *See Section 7.1.2 for description of cost estimates and allocation.*
2. *BS stands for Booster Station*
3. *Initial cost estimates used in the BCE were refined to develop the cost estimates shown in Table 7-1. Estimates used in the BCE did not include costs such as the fire flow improvements which were the same between each of the alternatives evaluated and, therefore, did not affect the comparison of alternatives. Those costs do, however, affect the budgeting for the City and have been included in the final CIP as shown in Table 7-1.*

Additional Recommendations

Based on the findings of this study, Brown and Caldwell recommends more detailed study of the items listed below. A detailed description of each item is provided in Section 7 of the report.

1. Evaluation of back-up power supply to pump stations and sources of supply
2. Water quality analysis to maintain compliance with Stage 2 Disinfection Byproducts regulations (Stage 2 DBPR) from the Environmental Protection Agency (EPA)
3. PRV evaluation to determine if PRVs can be eliminated from the system
4. Detailed fire flow evaluation of the distribution system
5. Evaluation of BWF capacity upstream of BS-3
6. System wide energy optimization study
7. Detailed evaluation of high and low pressures in the distribution system
8. Update County demands in the model when the County provides updated demand projections through build-out
9. Begin discussion to determine what portion of the improvement costs could be shared with the County
10. Update of model IDs to be consistent with the new unique identifiers used in the latest pipe shapefiles used in the Cityworks program
11. Business case evaluation on the storage alternatives
12. Cost-benefit analysis to quantify the value of meeting 2030 MDD with BDD out of service (compare the cost of adding redundant supply capacity to the risk cost of not being able to meet 2030 MDD with BDD out of service)



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CITY OF SANTA FE

WATER TRANSMISSION AND STORAGE SYSTEM MASTER PLAN

Figure ES-1. Existing Water System

Pressure Zone Delineation Used for Design of System Expansions

Zone	Static Hydraulic Gradient	Ground Elevation *(Pressure)*	
		Maximum	Minimum
Zone 00 (Summit High Level)	7982'	7854' *(55 psi)*	7693' *(125 psi)*
Zone 0 (Summit Low Level)	7790'	7693' *(43 psi)*	7500' *(125 psi)*
Zone 1 North	7625'	7500' *(55 psi)*	7300' *(141 psi)*
Zone 1 South (EHL)	7712'	7596' *(50 psi)*	7448' *(114 psi)*
Zone 2	7437'	7300' *(59 psi)*	7150' *(124 psi)*
Zone 3	7288'	7150' *(60 psi)*	7000' *(125 psi)*
Zone 4	7178'	7040' *(60 psi)*	6890' *(125 psi)*
Zone 5	7028'	6890' *(59 psi)*	6740' *(124 psi)*
Zone 6	6890'	6740' *(65 psi)*	6620' *(117 psi)*
Zone 7	6759'	6620' *(61 psi)*	6470' *(125 psi)*
Zone 8	6608'	6470' *(60 psi)*	6320' *(125 psi)*
Zone 9	6458'	6320' *(60 psi)*	6170' *(125 psi)*

Note: This table lists the elevations and pressures used by the City to design system expansions . The elevations shown for the pressure zones in the figure are actual service connection elevations and may not be consistent with the table.

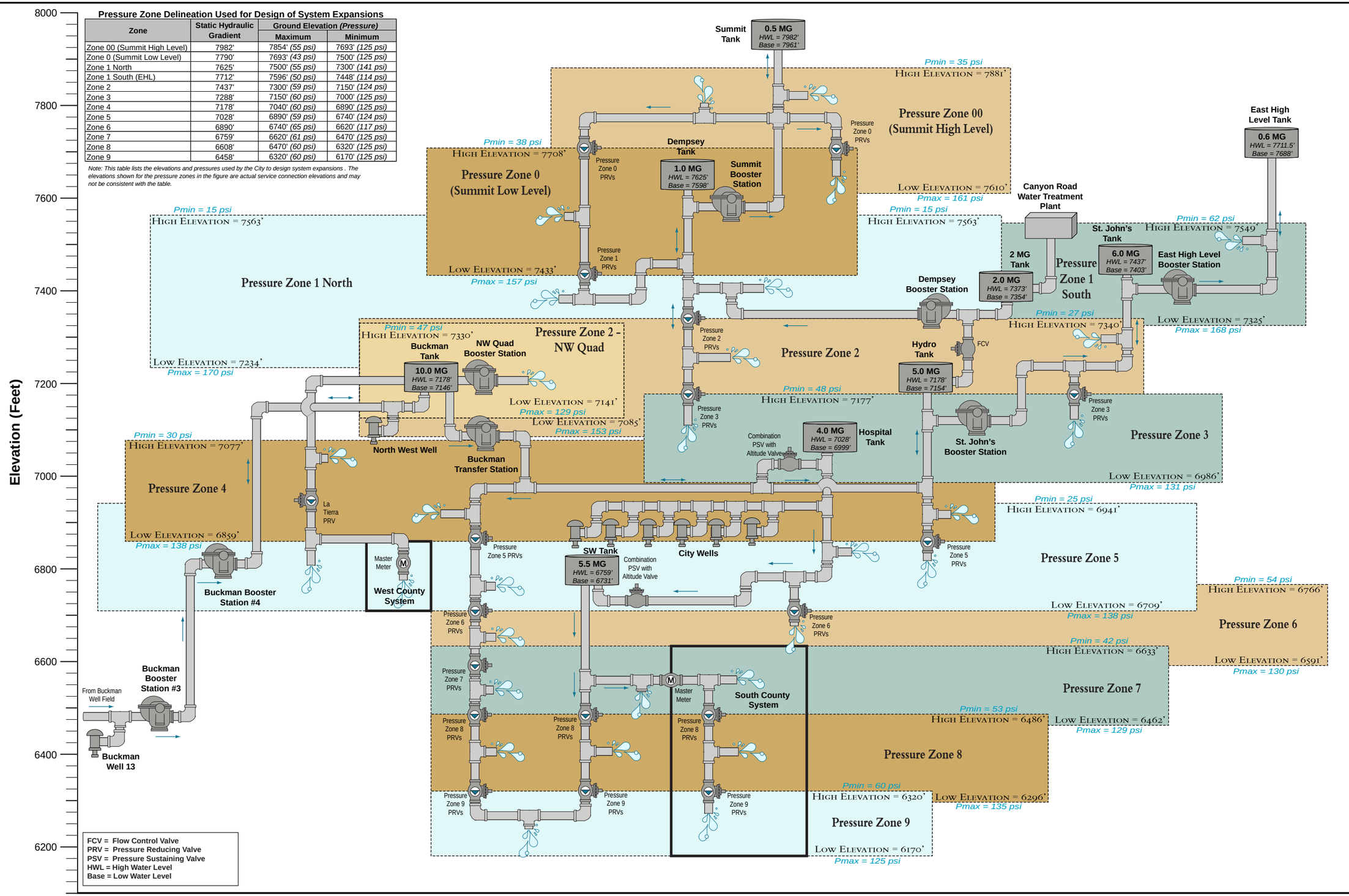

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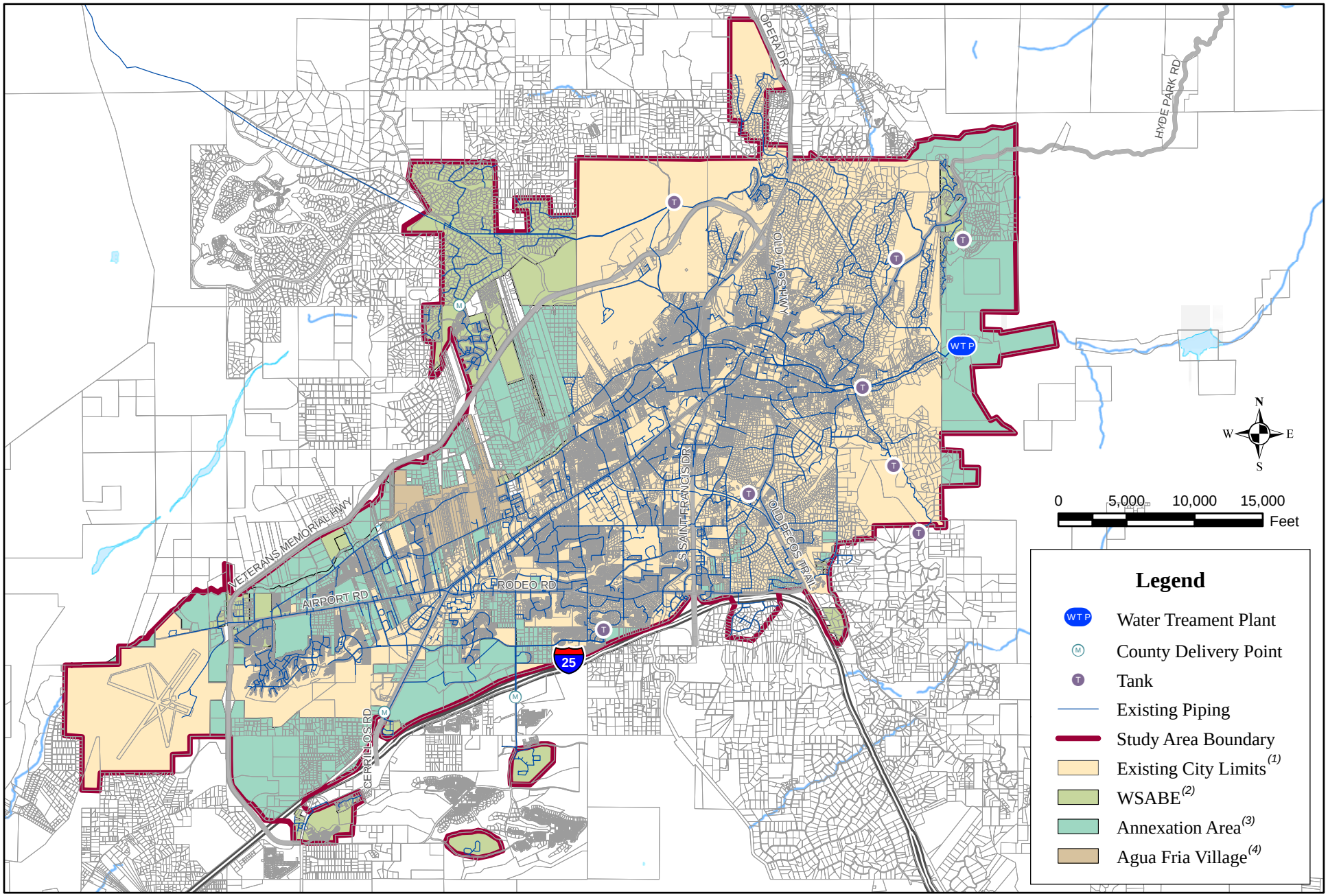
Figure ES-2. Hydraulic Schematic



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Notes:

1. *Revision Date: 05/22/2008*
2. *Revision Date: 07/09/2007*
3. *Revision Date: 05/21/2008*
4. *Revision Date: 05/22/2008 (Agua Fria Village Boundary was expanded after demand calculations were finalized. This figure shows the boundary used for demand calculations)*

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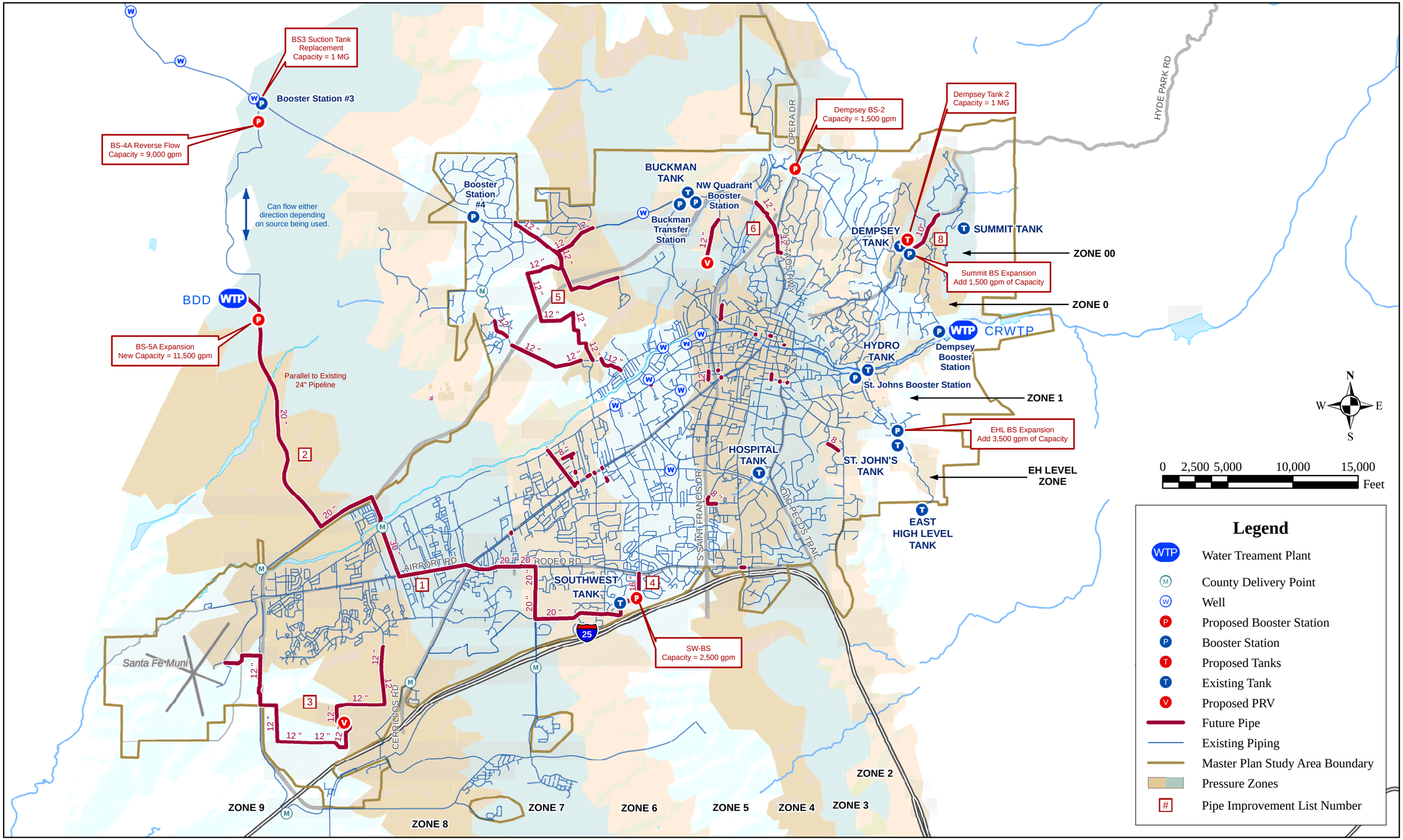
WATER TRANSMISSION AND STORAGE SYSTEM MASTER PLAN

Figure ES-3. Master Plan Study Area



7 *Miscellaneous fire flow improvements shown throughout system*

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WATER TRANSMISSION AND STORAGE SYSTEM MASTER PLAN

Figure ES-4. 2030 System Improvements

Pressure Zone Delineation Used for Design of System Expansions

Zone	Static Hydraulic Gradient	Ground Elevation *(Pressure)*	
		Maximum	Minimum
Zone 00 (Summit High Level)	7982'	7854' *(55 psi)*	7693' *(125 psi)*
Zone 0 (Summit Low Level)	7790'	7693' *(43 psi)*	7500' *(125 psi)*
Zone 1 North	7625'	7500' *(55 psi)*	7300' *(141 psi)*
Zone 1 South (EHL)	7712'	7596' *(50 psi)*	7448' *(114 psi)*
Zone 2	7437'	7300' *(59 psi)*	7150' *(124 psi)*
Zone 3	7288'	7150' *(60 psi)*	7000' *(125 psi)*
Zone 4	7178'	7040' *(60 psi)*	6890' *(125 psi)*
Zone 5	7028'	6890' *(59 psi)*	6740' *(124 psi)*
Zone 6	6890'	6740' *(65 psi)*	6620' *(117 psi)*
Zone 7	6759'	6620' *(61 psi)*	6470' *(125 psi)*
Zone 8	6608'	6470' *(60 psi)*	6320' *(125 psi)*
Zone 9	6458'	6320' *(60 psi)*	6170' *(125 psi)*

Note: This table lists the elevations and pressures used by the City to design system expansions . The elevations shown for the pressure zones in the figure are actual service connection elevations and may not be consistent with the table.

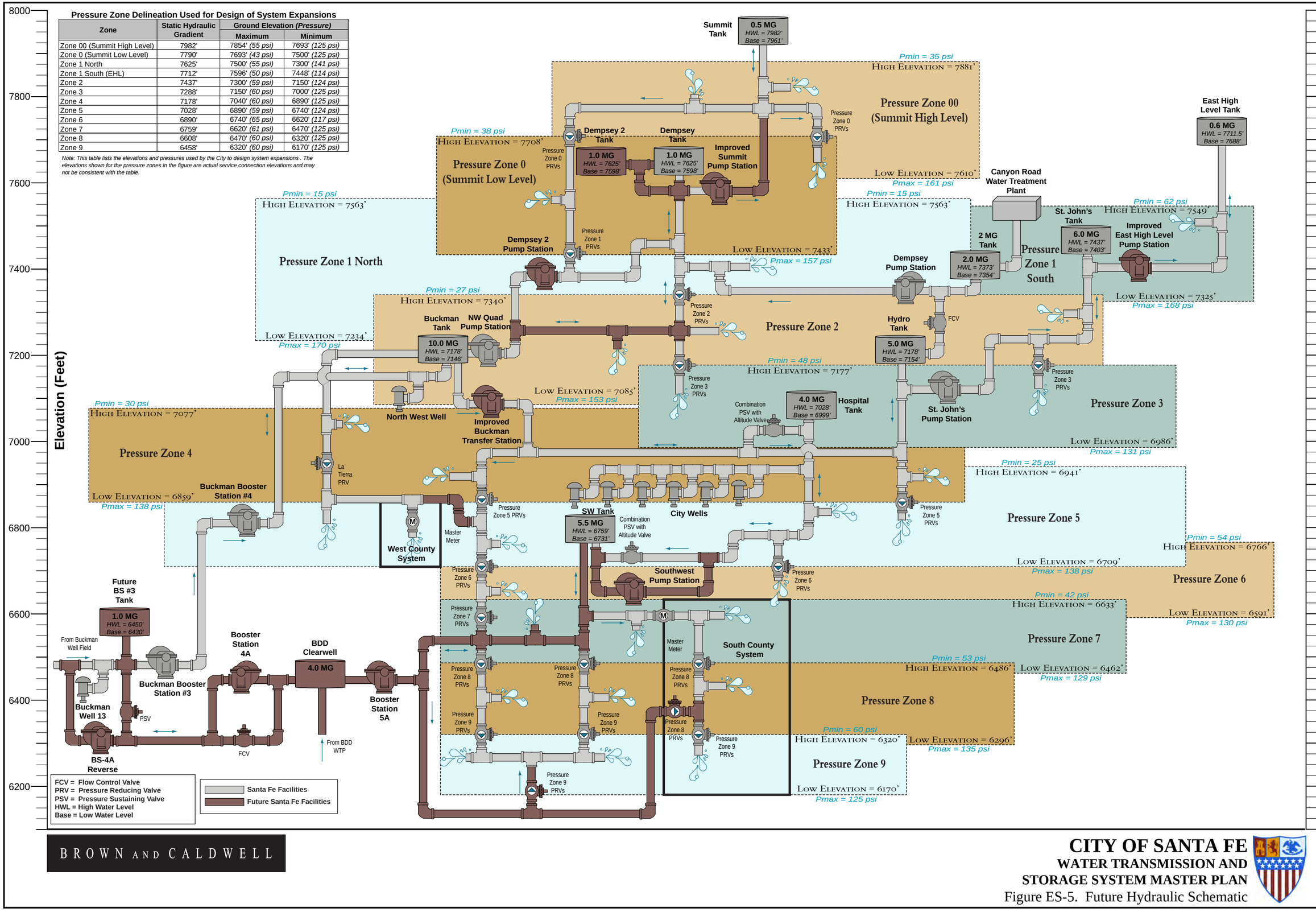

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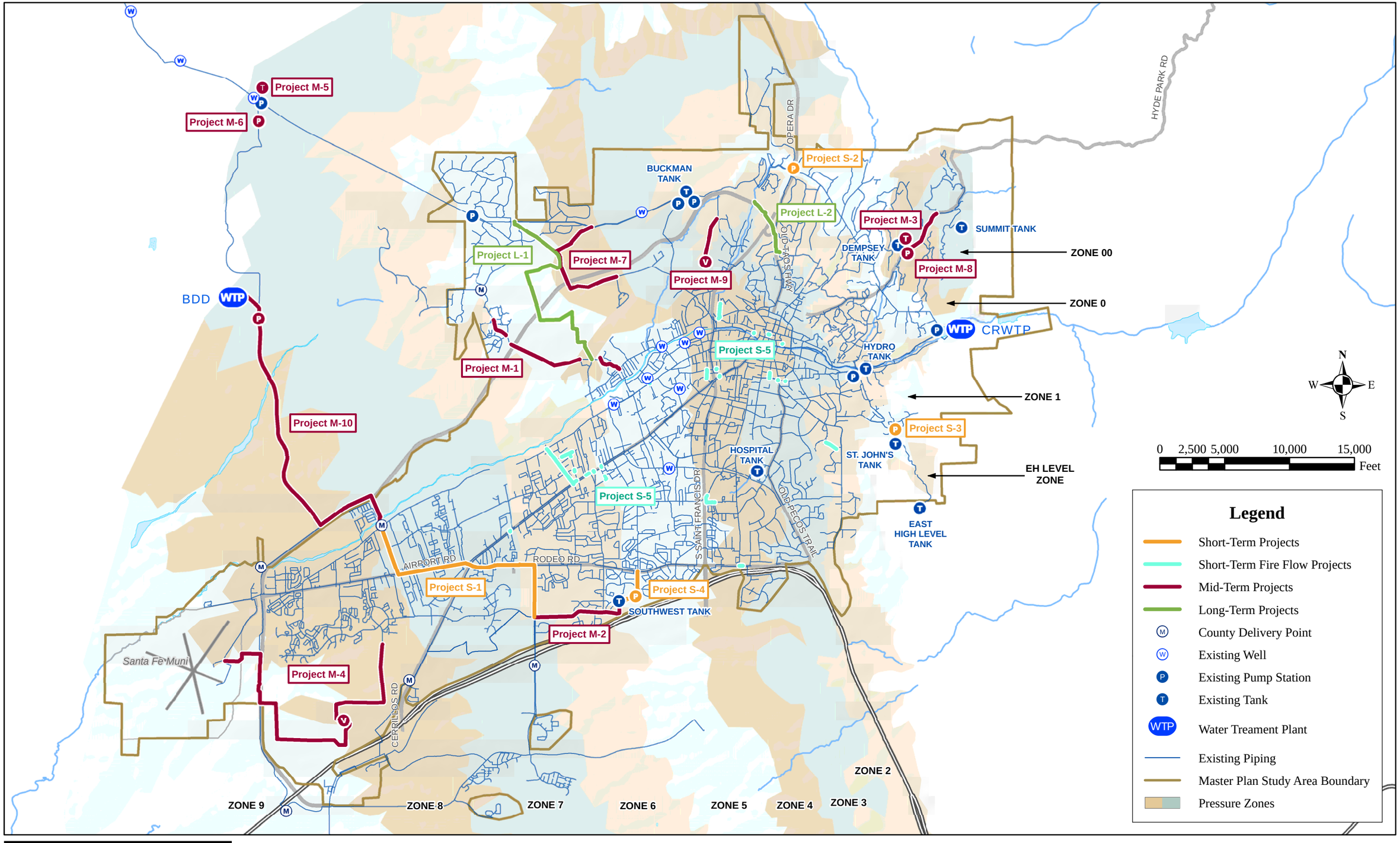
Figure ES-5. Future Hydraulic Schematic



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WATER TRANSMISSION AND STORAGE SYSTEM MASTER PLAN
Figure ES-6. Capital Improvement Projects