CITY OF
Marble Falls
TEXAS

MASTER WATER AND WASTEWATER PLAN

March 2016

Prepared By:
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CITY OF MARBLE FALLS

MASTER WATER AND WASTEWATER PLAN

For

CITY OF MARBLE FALLS
c/o Mr. Mike Hodge, City Manager
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MARCH 2016

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SECTION 1.

INTRODUCTION

This Water and Wastewater Master Plan of the City of Marble Falls (City) has been prepared as an overview of the entire Water System and partial Wastewater System located on the south side of Lake Marble Falls. The most recent previous study, completed in year 2002, entitled "Comprehensive Water System Evaluation – Year 2002 Update" and prepared by S.D. Kallman, L.P. -- Engineers and Environmental Consultants, evaluated only the City's Water System. This study outlines these two utility systems with respect to existing, proposed and recommended facilities in an effort to determine how water supply and distribution and wastewater treatment and collection demands are met at this time, and how increased demands should be contended with in the near and distant future through year 2044.

The City of Marble Falls has been in a period of steady growth. With this growth, it is a normal situation that an ever increasing demand on water supply and distribution results. In order that water supply and distribution stay ahead of demand, analysis and recommendations of construction of new facilities is required. This study details some of the improvements which will be required to be made immediately and within a five year period and analyzes the future approximately 30 year needs of the utility based on information supplied by the City's staff and this Consultant's findings.

With an increase in water demand, it is inherent that an increase in the need of wastewater treatment results with the recent planning efforts for an expansion to the existing wastewater treatment plant facilities for the City, to a capacity of 1.5 million gallons per day. Based on current average wastewater demands of 230 gallons per day per Living Unit Equivalent (LUE) and 2.41 persons per LUE, the City's 1.5 MGD wastewater treatment plant expansion will be capable of serving 15,717 persons and 6,521 LUE's. From Appendix "B", the City's average wastewater usage is 230 GPD per LUE and peak wastewater usage is 477 GPD per LUE. Long range concerns will be toward providing additional wastewater collection facilities and expanding capacity of the existing wastewater treatment plant facilities.

It should be noted that this study is being prepared for the Extra Territorial Jurisdiction for a study area of approximately 38.44 square miles, of which the current city limits of the City comprises only about 13.60 square miles.

The City of Marble Falls (City) was founded on July 12, 1887 by General Adam R. "Stovepipe" Johnson. Incorporating on May 18, 1907, the City has grown to a population of 6,406 residents in year 2015, not including retail and commercial water connection population equivalents. The 2010 census established a population in the City of 6,077. From year 2010 to year 2015, Marble Falls has experienced a growth rate of 5.41%. The population of this growing area in Burnet County is 26,718 within a 10-mile radius of the City.

The City limits encompass 8,696 acres or 13.59 square miles of area.

Where did the Name Marble Falls Originate?
Marble Falls sits on the banks of Lake Marble Falls. The falls were formed by a shelf of limestone running diagonally across the river from northeast to southwest. The upper layer of limestone, brownish on the exterior, but deep blue inside, was so hard and cherry it was mistaken for marble. The falls were actually three distinct formations at the head of a canyon 1.25 miles long, with a drop of some 50 feet through the limestone strata.

The natural lake was covered when the Colorado River was dammed with the completion of Max Starcke Dam in 1951. Lake Marble Falls sits between Lake LBJ to the north and Lake Travis to the south. The falls for which the City is named are now underwater, but are revealed every few years when the lake is lowered by the Lower Colorado River Authority for repairs.

Demographic and Economic Information
Median Housing Costs - $151,200.
Cost of Living: Average – 5.5% lower than the U.S. average.
Unemployment Rate: 4.4% (U.S. average is 6.0%).

Climate
Marble Falls area temperatures are moderate year-round. The climate is warm in the summers, but cooled by the lakes and hills in the region. Winters are mild and outdoor activities such as golf and tennis can be played throughout the year.

- Average Daily Summer Temperature - 85°F

- Average Daily Winter Temperature - 55°F
- Average Yearly Snowfall – Trace
- Average Yearly Rainfall – 30 inches
- Average Relative Humidity – 40%

Geography
- Average elevation – 823 feet
- Longitude – 30.34
- Latitude – 98.17
- City of Marble Falls Land Area – 13.59 square miles
- Burnet County Land Area – 1,021 square miles

This study will estimate the future water and wastewater demands of the area through service population and demand forecasting: it will then analyze the impact that these demands will have upon the existing water and wastewater systems and finally will make specific recommendations and provide construction scheduling and cost estimates for improvements to meet these demands for Demand Scenarios categorized as Immediate (improvements to be completed by end of year 2016), Near Term (improvements to be completed by end of year 2020), Intermediate 1 (improvements to be completed by year 2024), Intermediate 2 (improvements to be completed by end of year 2034) and Ultimate (improvements to be completed by end of year 2044). Water improvements beyond year 2034 through the Ultimate Demand Scenario in year 2044, may be shown on Figure 8 (page 71) – Capital Improvements Program for the Water System but are not scheduled or cost estimated due to the remoteness of these water improvements. Estimated costs for utility improvements for years beyond 2034 should be identified in future updates to this Master Water and Wastewater Plan.

SECTION 2.

SCOPE OF WORK – WATER SYSTEM

The Master Water Plan will evaluate the water supply system with respect to existing facilities, proposed current projects and recommended Capital Improvements Program (CIP) for year 2016 (Immediate Scenario), year 2020 (Near-Term Scenario), year 2024 (Intermediate 1 Scenario), year 2034 (Intermediate 2 Scenario) and year 2044 (Ultimate Scenario). This effort will determine how water supply and distribution demands are met at this time, and how increased demands should be contended with in the near term and distant future for a planning period of 30 years.

The scope of work for this Plan is detailed as follows:

- To evaluate key components of the City's existing water supply infrastructure to include:

    - Raw Water Pumping Facility
    - Raw Water Supply Line
    - Water Treatment Plant
    - Ground and Elevated Storage Reservoirs
    - Booster Pump Stations
    - Water Distribution Lines
    - Pressure Reducing Valves

- To determine current LUE water usage requirements for average and peak day demands utilizing the City's historical water usage reports.

- To develop a water hydraulic model utilizing Bentley's "WaterCAD" software for identifying existing weak points (low water pressure) in the water distribution system. Water demand projections for a 30 year planning period through year 2044 will be utilized by the model to assist in developing recommendations for Capital Improvements to adequately support the anticipated growth demands.

- To determine water service population and number of connections (Living Unit Equivalents – LUE's) for existing condition and up to a 30 year projection.

- To determine adequacy of the existing raw water supply contract with LCRA in meeting supply requirements through "Ultimate" water demand scenario of year 2044.

- To make recommendations for capacities and schedules for "Immediate" (end of year 2016), "Near Term" (end of year 2020), "Intermediate 1" Design Scenario (end of year 2024), "Intermediate 2" Design Scenario (end of year 2034) and "Ultimate" Design Scenario (end of year 2044) water system improvements.

- To make determination of site and easement requirements for the proposed water supply improvements.

- To prepare preliminary cost estimates for recommended immediate projects and Capital Improvements Program (CIP) projects for years 2016, 2020, 2024 and 2034.

SECTION 3

CONCLUSIONS AND RECOMMENDATIONS
WATER MASTER PLAN

In recent years, the City of Marble Falls has invested considerable funds in the upgrade of its existing water treatment plant and extensions of major water lines and construction of water storage tanks in the water distribution system. Notable projects at the water treatment plant site include one recently completed 500,000 gallon clearwell and two – 6.3 MGD treated water transfer pumps. Also, a second clarifier rated at 3.5 MGD is under construction. A major expenditure to the water distribution system was incurred with the creation of the "Flatrock" pressure plane by constructing two – 750 GPM high service pumps and 16" water line from the Gateway Park standpipe south along the Highway 281 corridor providing water to a new one million gallon composite-type elevated storage tank sited adjacent to the new Scott and White Hospital and Clinic.

From the development of this Master Water Plan, it is concluded that additional water system improvements are warranted that will:

1) Assure compliance with TCEQ rules and regulations
2) Improve water distribution system pressures throughout the seven (7) existing pressure planes
3) Improve fire protection within all pressure planes, and
4) Position the City to maintain a first class water system, while serving new growth in the City's ETJ and CCN water service area.

We recommend that the new projects listed in Table 16 (pages 64 through 70) – City of Marble Falls – Project List, Schedule and Probable Estimate of Cost for Recommended Water System Improvements, herein, be funded, designed and constructed in the years scheduled based on:

1) Immediate – construction completed by end of year 2016 – total 4,818 LUE's existing
2) Near Term – construction completed by end of year 2020 – total 5,430 LUE's projected
3) Intermediate 1 – construction completed by end of year 2024 – total 6,044 LUE's projected
4) Intermediate 2 – construction completed by end of year 2034 – total 7,132 LUE's projected
5) Ultimate – no projects identified – total 8,217 LUE's projected

If it is decided to ultimately add only one additional 1.5 MGD gravity filter (Project No. 1 on page 64) at the existing water treatment plant, rather than two 1.5 MGD filters (Project No. 1A on page 64), and upgrade the existing filters from 2.9 MGD to 3.3 MGD, resulting in a total filter capacity of 4.8 MGD, we recommend that a second water treatment plant be designed and constructed on the south side of Lake Marble Falls. The recommended upgrade to the three (3) old existing gravity filters to increase their flow-through rate from 2.9 MGD to at least 3.3 MGD include the following items:

1) Upgrade chlorine injectors and feed pumps
2) Install ultrasonic meters in yard piping in 2 locations to improve treatment operations, install wiring and SCADA
3) Install "flow pacing" equipment on chemical feed system. Install wiring and SCADA
4) Install upsized chemical feed system pumps, tanks and spare pumps and tubes
5) Electrical and VFD for backwash pump

The existing filters have needed an upgrade for years and can barely keep up with summer water demands, thanks to the water plant operators daily diligence and supervision.

As detailed in the City's existing "Capital Improvements Plan" document, a $16 million water treatment plant (PP5) is proposed in fiscal years 2019 – 2029 to be located adjacent to Max Starke Dam. Related to Project PP5 in the CIP document is Project PP6, which is a water line, budgeted at $3 million, from this new water treatment plant to the Gateway Park Pressure Plane. Refer to Appendix D.

It is also recommended that the Master Water Plan be updated every five (5) years to amend the new project list from Table 16 and to evaluate and update estimated costs of projects that may be required for the planning periods from Intermediate 2 (year 2034) through Ultimate (year 2044).

SECTION 4.

EXISTING WATER SYSTEM

4.1 Raw Water Supply

The City obtains all of its potable water following treatment from a raw water intake pumping system in Lake Marble Falls (Colorado River). The City purchases water from the Lower Colorado River Authority (LCRA) in accordance with the Water Sale Contract dated June 25, 1991. The contract provides for a maximum raw water diversion rate of 2,000 acre-feet (651.8 million gallons) of raw water per annum (1.79 MGD average). The water is to be released by LCRA as needed from upstream Lake Buchanan. The City is required to furnish and bear expenses of pumping facilities and metering equipment, as well as keep the metering equipment calibrated to within 5% accuracy.

4.2 Certified Service Area

The City of Marble Falls holds a Certificate of Convenience and Necessity (CCN No. 11137) for water service to areas generally within the City limits. Refer to Figure 1 – CCN Map of Water Service Area, herein for a map of the water CCN boundaries.

4.3 Existing Water Treatment Plant Site Location

The City's existing water treatment plant is located adjacent to and northeast of the U.S. Highway 281 Bridge over Lake Marble Falls.

4.4 Existing Water Treatment Plant Facilities

The existing Water Treatment Plant (WTP) is located on an approximately 1.45-acre site at 2502 Circle Drive in Marble Falls, Texas. Access to the site is through a gate off Circle Drive, which leads to a driveway and subsequently to parking and chemical storage at the northwest corner of the property.

Topographically, the site slopes to the south, towards Lake Marble Falls. The ground elevations range from 790 feet at the northeast side of the property to an elevation of 747 feet at the southern property line. The slope of the first 150 feet of the property from the northern property line is approximately 10%. The remaining approximately 60-foot portion of the property adjacent to the lake drops in elevation 27 feet within 60 linear feet, making part of the property impractical for facility construction. The project site is underlain by weathered remnants and rock of the Marble Falls Limestone Formation. The Marble Falls Limestone is described as gray, very hard, very fine grained (crystalline), cherty limestone. The combination of steep slopes, confined space, and geotechnical conditions increases construction costs of expansion of facilities on the site.

Raw water is pumped through an existing off-site 18" raw water line directly to the City's water treatment plant from a remote intake structure located west of the Water Treatment Plant site. The water treatment plant is regulated by the Texas Commission on Environmental Quality (TCEQ). The plant was built in the 1960s, and underwent extensive remodeling in 1983, with the addition of a new clearwell and transfer pumps last year (2015). It consists of the following items:

- Two 1,200-GPM and one 900-GPM raw water pumps with 70-foot total dynamic head (TDH) pumping capability
- One 60-foot diameter by 21-foot side water depth solids contact clarifier (No. 1)
- One 500,000 gallon, 46 foot diameter, 40 foot high prestressed concrete clearwell (recently completed in 2015)
- Two 4,400 GPM (6.3 MGD) with 56-foot TDH vertical turbine transfer pumps (recently completed in 2015)
- One 422,770 gallon, 60 foot diameter, 21 foot sidewater depth solids contact clarifier (No. 2) - (currently under construction)
- Three 11-foot by 16-foot dual media gravity filters
- One 34-foot by 31-foot by 11-foot old clearwell located beneath the 3 filters (No. 1)
- One 48-foot by 30-foot by 10-foot clearwell (No. 2)
- Five 1,000-GPM high service pumps with 279-foot TDH.

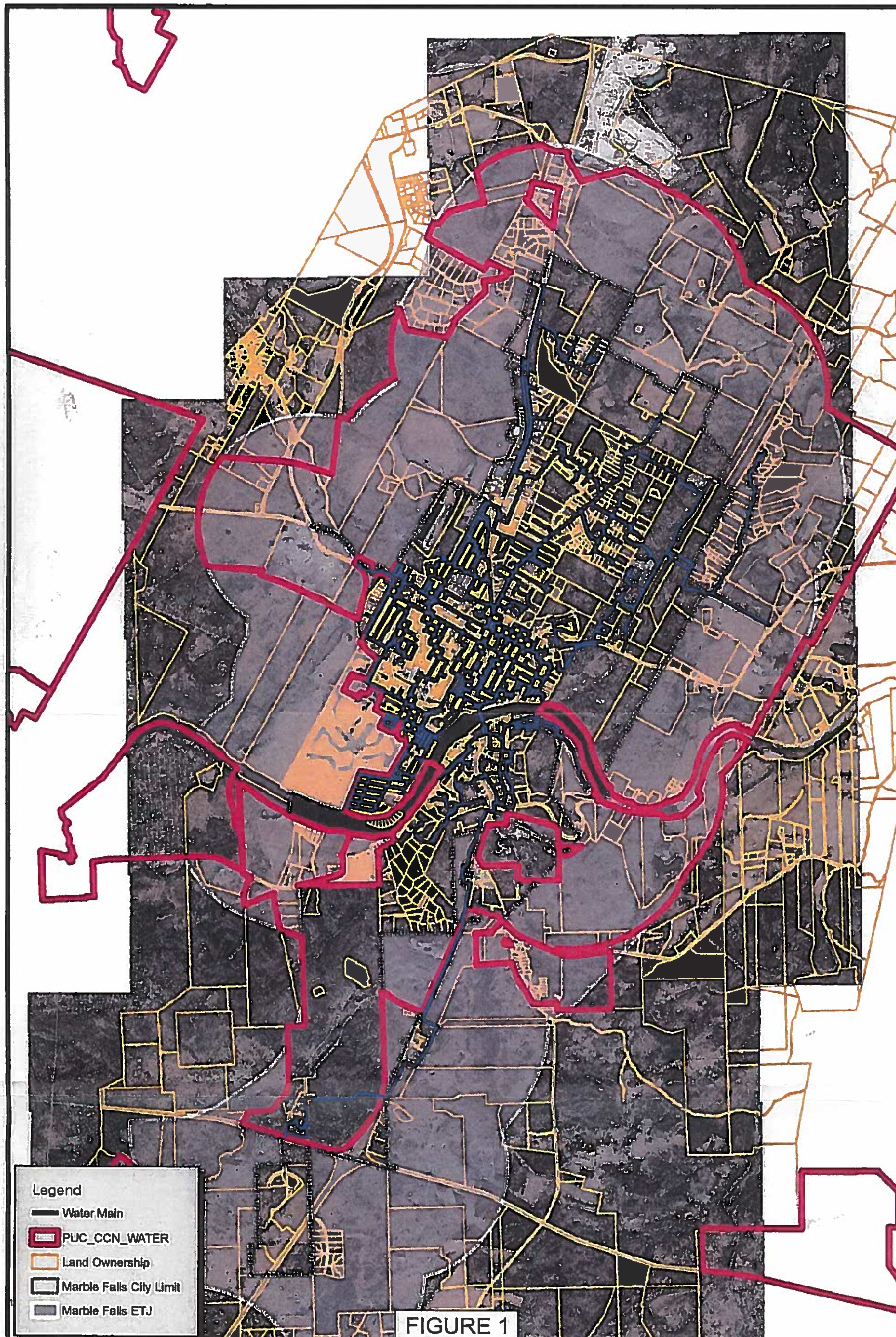

FIGURE 1

WATER CCN MAP

This product is for informational purposes and may not have been prepared for or be suitable for legal, engineering, or surveying purposes. It does not represent an on-the-ground survey and represents only the approximate relative location of boundary properties. Map by D. [illegible], GIS Planner, Development Services, Direct: [illegible], Email: [illegible]

Chlorine dioxide is added at the raw water pump site and chlorine prior to clearwell storage at the Water Treatment Plant. Chloramines are introduced prior to pumping treated water into the distribution system.

The future addition of filtration capacity and raw water pump expansions will bring the plant rating up to 4.8 MGD or 6.3 MGD (ultimate water treatment plant capacity for this site), depending on the decision by the City on whether to add one or two filters in the next construction phase.

4.5 Existing Water Usage

The highest monthly flow rate yet experienced of 71.074 million gallons of treated water for the plant was the month of August 2011. The daily average for this highest month to date was 2.30 MGD for treated water (refer to Table 1). The maximum one-day flow during the month of August, 2011 was 2.77 million gallons. Thus, during peak days in the summer of 2011, the plant operated at approximately 96% of nominal capacity (2.77 ÷ 2.90). The monthly flow information for an eleven (11) year period from year 2005 through 2015 is presented in Table 1.

4.6 Existing Water Treatment Plant Facility Capacities

The limiting 3.024 capacity of the Water Treatment Plant is based on the current limitations of the raw water intake pumps. The Water Treatment Plant Superintendent reports that the existing gravity filters can only treat 2.9 MGD at this time, due to inlet piping restrictions on the filters. Table 2 below inventories the existing facilities including the design capacity and TCEQ permitted capacity, for comparison purposes.

TABLE 1: HISTORICAL RAW AND TREATED WATER USAGE
CITY OF MARBLE FALLS, TEXAS
2005 thru 2015
Source: City of Marble Falls TNRCC Monthly Reports

Month	2005 (MG)		2006 (MG)		2007 (MG)		2008 (MG)		2009 (MG)		2010 (MG)	
	Raw	Treated	Raw	Treated	Raw	Treated	Raw	Treated	Raw	Treated	Raw	Treated
January	30.700	29.806	35.733	32.750	31.691	27.393	31.998	31.232	39.012	37.862	31.406	30.096
February	26.320	25.609	32.006	29.343	30.766	27.137	32.484	31.612	37.074	35.215	27.830	26.311
March	31.938	31.358	37.884	34.906	36.152	32.251	36.143	35.397	42.098	40.477	30.408	29.047
April	38.157	35.437	43.384	39.969	34.017	30.687	38.578	36.365	42.123	40.435	37.148	35.549
May	44.811	40.883	46.976	43.976	38.237	36.768	46.913	42.368	49.641	47.357	46.853	44.889
June	53.011	49.264	57.563	53.452	38.380	37.661	73.303	63.525	62.003	59.101	57.162	54.976
July	57.892	53.745	64.447	60.006	36.185	34.990	72.195	58.825	70.324	66.913	49.285	46.979
August	60.607	56.329	69.990	64.937	47.811	47.573	62.519	57.044	67.733	64.863	64.839	62.830
September	55.452	51.598	43.928	39.579	45.568	43.887	58.651	55.040	44.849	43.578	46.768	45.498
October	44.944	41.618	40.757	37.154	46.065	44.871	56.674	51.179	32.757	32.298	48.521	47.025
November	37.392	34.252	36.604	33.716	38.506	37.867	46.639	41.413	32.203	31.474	38.400	36.324
December	34.059	31.175	36.028	31.954	32.675	31.592	40.448	36.936	35.202	33.582	36.619	35.567
Total MG per Year	515.283	481.074	545.300	501.742	456.053	432.677	596.545	540.936	555.019	533.155	515.239	495.091
Total (Annual) Acre-Feet	1581.345	1476.362	1673.464	1539.790	1399.575	1327.837	1830.729	1660.072	1703.291	1636.193	1581.210	1519.378
Daily Average (GPD)	1.412	1.318	1.494	1.375	1.249	1.185	1.634	1.482	1.521	1.461	1.412	1.356

Month	2011 (MG)		2012 (MG)		2013 (MG)		2014 (MG)		2015 (MG)	
	Raw	Treated	Raw	Treated	Raw	Treated	Raw	Treated	Raw	Treated
January	35.179	35.687	32.462	33.090	36.189	35.346	36.390	36.327	33.746	35.046
February	31.084	30.676	27.705	28.361	37.134	36.117	34.657	34.777	29.801	30.829
March	40.693	39.685	32.199	32.418	43.824	44.026	40.676	41.174	34.162	35.501
April	51.631	48.856	44.784	42.635	43.272	43.999	42.552	43.702	35.783	38.192
May	53.197	52.825	51.023	48.406	45.961	46.564	45.292	46.716	-	-
June	63.390	63.467	57.882	53.215	50.434	51.033	44.251	45.063	-	-
July	70.751	70.537	59.222	54.947	57.832	57.297	51.431	52.140	-	-
August	69.979	71.074	72.122	67.217	59.372	59.266	57.192	56.080	-	-
September	62.412	62.375	53.840	50.030	51.608	52.012	48.519	46.211	-	-
October	49.062	48.967	48.766	46.000	43.042	43.629	46.976	44.610	-	-
November	40.004	40.322	49.475	46.068	38.481	39.304	37.346	35.072	-	-
December	32.403	33.089	37.556	37.755	36.484	36.673	34.386	35.029	-	-
Total MG per Year	599.785	597.560	567.036	540.142	543.633	545.266	519.668	516.901	133.492	139.568
Total (Annual) Acre-Feet	1840.673	1833.844	1740.170	1657.635	1668.348	1673.360	1594.803	1586.311	409.672	428.318
Daily Average (GPD)	1.643	1.637	1.554	1.480	1.489	1.494	1.424	1.416	-	-

Table 2
Water Treatment Plant – Existing and Under-Construction Facilities

System Components	Description	Current Firm Capacity	Capacity Basis	TCEQ Permit Limits
Raw Water Intake	2 pumps at 1,200 GPM each 1 pump at 900 GPM	2,100 GPM/ 3.024 MGD	Firm capacity with largest pump out of service	2,100 GPM[1] (3.024 MGD)
Raw Water Transmission Main	18 inches; approximately 3,450 linear feet	2,100 GPM/ 3.024 MGD	3 FPS velocity; can be increased	2,100 GPM[1,3] (3.024 MGD)
Solids Contact Clarifier No. 1	One 60-foot diameter, 338,215 gallon; 16 foot sidewater depth	1,950 GPM/ 2.800 MGD	Minimum 120-minute detention; 1.0 GPM/SF rise rate in settling zone	2,100 GPM[1] (3.024 MGD)
Solids Contact Clarifier No. 2 (under construction)	One 60-foot diameter, 422,770 gallon; 21-foot sidewater depth	2,425 GPM/ 3.500 MGD	Minimum 120-minute detention; 1.0 GPM/SF rise rate in settling zone	2,100 GPM[1] (3.024 MGD)
Gravity Filter (3) Dual Media	Three 16 feet x 11 feet (528 square feet)	2,460 GPM[2] 3.801 MGD	5 GPM/SF	2,100 GPM[1] (3.024 MGD)
Clearwells	55,200 gallons; 109,500 gallons; 500,000 gallons	664,700 Gallons	CT requirements govern; 5% plant capacity	151,200 Gallons required for 5% of 3.024 MGD
Treated Water Transfer Pumps	2 pumps at 4,404 GPM each	4,404 GPM/ 6.300 MGD	Meets ultimate plant capacity	2,100 GPM[1] (3.024 MGD)
Total Ground Storage	Offsite + Clearwells	1,238,640 Gallons	--	200 Gallons per connection
Total Elevated Storage	Offsite including Flatrock Tank	1,700,000 Gallons	--	100 Gallons per connection

[1] TCEQ limits the Plant's rated capacity to 2,100 GPM based on the Firm Raw Water Pump Capacity, pursuant to TCEQ's Chapter 290.45(b)(2)(A) rule.
[2] The Water Plant Superintendent reports that the filters can only treat 2.9 MGD, due to the inlet piping restrictions on the existing filters. With filter piping upgrades, rate of flow controllers and air scour installation, the filters should be able to comfortably treat 3.3 MGD, assuming the raw water pump station is upgraded.
[3] The existing 18" raw water line will not have to be upgraded at 6.3 MGD pumping rate. The velocity in the 18" pipe at 6.3 MGD is 5 feet per second.

4.7 Other Existing Water Treatment Plant Facilities

- The existing high service pump station consists of five (5) 1,000 GPM vertical turbine pumps located on the roof of the existing concrete rectangular 109,500-gallon clearwell. The firm pumping capacity is 4,000 GPM. Table 4 presents a tabulation of High Service Pumps at each pump station location.
- 130,000-gallon backwash decant and sludge thickener basin. Currently this basin is used to waste filter backwash wastewater and clarifier sludge blowdown to the City sewer.
- Chemical disinfection is accomplished by generation of chlorine dioxide at the raw water intake using two 55-gallon drums of solid sodium chloride and 150-pound cylinders of chlorine gas; and feeding

chloramines at the Water Treatment Plant via multiple 150-pound chlorine gas cylinders, and liquid ammonium sulfate (LAS) via 2,100-gallon storage tank.

- Other chemical systems consist of two 5,000-gallon liquid alum feed tanks for raw water coagulation, polymers feed from a 400-gallon tank, and caustic soda feeds from a 400-gallon tank. The chemical systems are adjusted manually, by operators adjusting feed pumps with varying lake water quality.

- There is a minimal office space along with a lab area and a Motor Control Center that also contains compressors and blower equipment.

4.8 Existing Water Treatment Plant and Water Distribution System Operational Concerns

The Water Treatment Plant Superintendent, Director of Public Works and City Engineer have been developing a list of improvements to various components of the existing Water Treatment Plant High Service Pump Stations, Water Storage Tanks and Water Distribution System. The items recommended are listed as follows:

1. Filter feed pipe sizing is reduced between the filters restricting the flow to the No. 2 and 3 filters. This restriction does not allow for efficient use of No. 2 and 3 filters, as they are starved for water. As a result the No. 1 filter is also overworked. The existing piping needs to be replaced from the No. 1 filter to the No. 3 filter eliminating the reductions in pipe size.

   a) In 2005, the "rate of flow" controllers on the three filters were removed and replaced with a "level control system," which causes the filter valves to constantly be opening and closing, rather than running in a smooth, consistent manner. This anomaly is detrimental to maintaining low turbidities when the plant is operating at high flow rates. The Superintendent recommends that "rate-of-flow" controllers be reinstalled on the filters. An air-scour system is also needed on the three filters in conjunction with the next upgrade of the filters.

   b) Since the filter media is over 15 years old, the Superintendent recommends that a filter media project be initiated. It would be best if all of the filter upgrades be done in one Project. When the media is removed, the underdrain and related steel parts and piping should be inspected, and repaired if defective. A "filter-to-waste" valve and piping system should also be installed on each filter to comply with current TCEQ rules and regulations.

2. The existing three filters were originally constructed with water storage space underlying the filters to provide a token amount of clearwell (CW001) storage for the High Service Pumps and the filter backwash pump. When the next filter expansion is designed, the operation of the plant would be much better, if similarly configured clearwell storage is provided under the two new filters.

3. In order to optimize the use of the new 500,000 gallon clearwell (CW002), the Superintendent recommends that meters be installed on the fill line between Clearwell CW001 and Clearwell CW002 and on the transfer line between Clearwell CW002 and Clearwell CW003 to provide flowrate feedback to improve the automation of flow through the plant. The new meters should have SCADA controls to effect this automation.

4. The raw water and finished water venturi meters should be replaced as they are 33 years old and almost certainly do not give accurate readings. As venturi meters age, the devices interiors develop a build-up of tuberculosis. This restriction can cause them to read higher than actual flows, which is the opposite of residential meters. Just a five percent error would cost the City a fair amount of overpayment to the LCRA. The City's plant personnel are in the process of correcting this deficiency by replacing the two meters.

5. The existing 10" main line between the Via Viejo High Service Pump Station and Mustang Elevated Tank is fed by two – 1,000 GPM pumps. One pump will not keep up with the summer demand of high flows, but the City cannot run 2 pumps as it will blowout in the old existing 10" water line. The existing 16" water line from the Via Viejo Pump Station to the Mustang Elevated Tank needs to be looped to resolve this problem.

6. Both the 500,000 gallon and 200,000 gallon welded steel ground storage tanks at the Via Viejo High Service Pump Station have leakage problems. The City had divers enter the 500,000 gallon welded steel

tank and epoxy 30 small holes in the bottom and put an improvised plug in the 8" drain, but was not able to completely stop the leakage. The City recommends replacing both tanks. The City would like to replace both tanks with a higher, larger capacity prestressed concrete tank in the range of 800,000 gallons.

7. The existing chemical feed system at the existing Water Treatment Plant needs to be equipped with "flow pacing" integrated with the SCADA system. This will insure that the proper amount of chemicals are added to the treatment process, while saving chemical costs by eliminating chemical product waste.

8. The existing Clarifier (No. 1) needs maintenance repairs including:

   - Replace the gear drive and motor assembly
   - Anchor the weir troughs and possibly replace the weir to flow more water.

9. In order to increase the existing Water Treatment Plant capacity, in addition to constructing new filter(s), the three existing raw water pumps need to be upsized. To allow flexibility in varying the raw water flow rate to the Water Treatment Plant, variable frequency drive (VFD) motor controllers should be installed for each pump.

10. When the existing Water Treatment Plant is expanded, the chemical feed system must be evaluated for possible expansion. One required improvement is to replace the injectors on the chlorinators to feed more chlorine.

4.9 Potable Water Storage Facilities

4.9.1 Ground Storage Facilities. The City has six (6) Ground Storage Tanks and one (1) Standpipe in service that provide ground storage. Three (3) Ground Storage Tanks at the City's Water Treatment Plant site are constructed of reinforced concrete. Two (2) Ground Storage Tanks at the Via Viejo site are of the welded steel type. One (1) Welded Steel Standpipe at Gateway Park provides eighty-one (81) feet of ground storage and nineteen (19) feet of elevated storage, a total ground storage capacity of 1,238,640 gallons is provided.

4.9.2 Elevated Storage Facilities. The City has three (3) Elevated Tanks and one (1) Standpipe that provide elevated storage capacity. One (1) Elevated Tank at the Mormon Mill site is a welded steel spheroidal-type with legs. Two (2) Elevated Tanks (one at the Mustang site near the high school and one at the Flatrock site near the hospital) are composite tanks with reinforced concrete cylindrical column and water storage in a welded steel bowl on the top. One (1) Welded Steel Standpipe at the Gateway Park site holds both ground storage and elevated storage as described above. A total elevated storage capacity of 1,747,500 is provided. At TCEQ's minimum criteria of 100 gallons per connection, 17,475 connections (LUE's) can be served with elevated storage. Refer to Table 3 (page 17) – Existing Water Storage Tank Data.

4.10 Existing High Service Pumping Facilities

The City has six (6) High Service Pump Station sites. The purpose of these Pump Stations is to pump water to Standpipe or Elevated Tanks to provide acceptable water pressure to seven (7) pressure planes (zones). The pumps at each pump station are listed in Table 4 – Existing High Service Pump Data, herein. High Service Pumps are sized to meet the peak daily flow requirements in any one or combination of pressure planes.

TABLE 3
EXISTING WATER STORAGE TANK DATA

Description	Type	Capacity (Gals)	Base Operating Elevation (Feet)	Maximum Operating Elevation (Feet)	Ground Elevation at Tank	Dimensions: Dimension (Feet)	Dimensions: Height (Feet)
No. 1 (CW001) Water Treatment Plant	Clearwell/Ground Rectangular Reinforced Concrete	55,200 (771)	771	783	771	33 x 33	% Average
No. 2 (CW002) Water Treatment Plant	Clearwell/Ground Prestressed Concrete	500,000	775	815	775	46 dia.	40
No. 3 (CW003) Water Treatment Plant	Clearwell/Ground Rectangular Reinforced Concrete	107,700	769	779	769	30 x 48	10
No. 1 Via Viejo[1]	Standpipe/Ground Welded Steel	500,000	930	965	930	49 dia.	35
No. 2 Via Viejo[1]	Standpipe/Ground Welded Steel	200,000	930	965	930	31 dia.	35
Mustang	Elevated Composite Concrete & Steel	500,000	1095	1130	1000	49 bowl dia.	35
Mormon Mill	Elevated Welded Steel	200,000	1065	1082.2	990	45 bowl dia.	17
Business & Tech Park[2]	Ground Bolted Steel	76,000	980	1004	980	23 dia.	24
Gateway[2]	Standpipe 3 Elevated/Ground Welded Steel	250,000 (47,500 is Elevated / 202,500 is Ground)	936	1036	936	21 dia.	100
Flatrock	Elevated Composite Concrete & Steel	1,000,000	1256.6	1291.6	1060	70 bowl dia.	35 (Bowl)

Summary of Storage:

Total Ground Storage = 1,643,200 Gallons

Total Elevated Storage = 1,747,500 Gallons

Total Water Storage = 3,390,700 Gallons

[1]Both tanks at Via Viejo have irreparable leaks and should be demolished and replaced with one 750,000 gallon prestressed concrete tank.

[2]The Business & Tech Park pumps and Gateway pumps do not pump to elevated storage. The pumps at both sites are controlled from hydropneumatic tanks located adjacent to the pumps.

TABLE 4
EXISTING HIGH SERVICE PUMP DATA

HSPS Location	Pumps To	Pressure Plane Served	Ground Elevation at Tank	Pump ID No.	GPM	TDH (Feet/PSI)	Notes
Water Treatment Plant	Via Viejo Standpipes (2) Gateway In-Line Pump Station	Via Viejo, Mustang, Mormon Mill, Business & Tech Park, Gateway Park, Flatrock	771	1 2 3 4 5	1000 1000 1000 1000 1000	240/120 240/120 240/120 240/120 240/120	Pump No. 5 Intended for Service to Gateway Standpipe
Via Viejo	Mustang Elevated Tank	Mustang, Mormon Mill	930	1 2	1000 1000	242/105[1] 242/105[1]	
Business and Tech Park	Business and Tech Park Pressure Plane with Hydropneumatic Tank	Business and Tech Park	980	1 2 3	1750 1750 100	158/68 158/68 150/65	
Gateway Circle	Gateway Standpipe	Gateway Park, Flatrock	850	1 2	500 500	185/80	
Gateway Park (at Gateway Standpipe)	Apartment Complex (Ridgemont Village) on Gateway North Street	Ridgemont Village Apartments	936	1 2 3	500 1000 100	101/44 101/44 101/44	80 PSI to Ridgemont Village Pressure Plane
Gateway Park (at Gateway Standpipe)	Flatrock Elevated Tank	Flatrock	936	1 2	750 750	285/123 285/123	

[1]Assumed

4.11 Existing Water Distribution System

The City has old and new water lines throughout the water service area that provide water to customers. Both potable water service and fire flows are provided by this network of pipes.

This Water Master Plan includes the development of a computer-based pipe network analysis to determine the adequacy of the existing water pipe distribution system to deliver desired flow rates and residual pressures to all points in the network.

In addition to evaluating the existing average and peak flow demands in the model, future growth and fire flow demands will be entered into the model.

The software named "WaterCAD" by Bentley was used in the development of the water model.

The water distribution system consists of seven (7) pressure planes or zones identified as Via Viejo, Mustang, Mormon Mill, Industrial and Business Park, Gateway Park, Ridgemont Village and Flatrock pressure planes (refer to Figure 2 – Existing and Proposed Water System Schematic). High service pumps convey the treated water from the water treatment plant through distribution lines to a pair of ground storage tanks on Via Viejo located near the east City limits at F.M. 1431. Water from the 500,000 gallon and 200,000 gallon tanks at the Via Viejo site is booster pumped to the north to a 500,000 gallon composite elevated tank adjacent to Marble Falls High School (Mustang pressure plane). Water from the 200,000 gallon and 500,000 gallon tanks supply a much larger service area via gravity flow to the west and south (Via Viejo pressure plane). Also to the north, near the intersection of Mormon Mill Road and Park Ridge Drive, is a 200,000 gallon elevated storage tank (Mormon Mill pressure plane). Water from the Mustang Elevated Tank flows through pressure reducing valves and water distribution lines into the Mormon Mill Elevated Tank to fill it. This tank supplies the relatively high northeast portion of Marble Falls, including development along Mormon Mill Road, the north segment of U.S. Highway 281 and the ground storage tank at the Business & Technical Park. The pump station at the Business & Technical Park site serves the Marble Falls Business & Technical Park, as well as areas along U.S. Highway 281 north lying north of the Business & Technical Park. S.D. Kallman has plans 95% complete for elevated storage planned for the Business & Technical Park for a 250,000 gallon standpipe, 105 feet in height.

Water is also transported in a southeasterly direction from the treatment plant across the Colorado River (Lake Marble Falls) through a 16" water line on the new Highway 281 Bridge to the "Gateway Park" area, where a pump station boosts water to a 250,000 gallon welded steel standpipe located near the intersection of Gateway Parkway and Steve Hawkins Parkway (Gateway Park pressure plane).

Several things occur at the Gateway standpipe site. The standpipe provides water through gravity flow to most of the development in the Gateway Park development, as well as development on the east side of Highway 281 and south of Lake Marble Falls. Due to the higher ground elevations existing in the Ridgemont Village development, west of the standpipe site, a pump station boosts pressures to this area (Ridgemont Village pressure plane). Then, in order to fill the Flatrock Composite Elevated Tank with water, an additional pump station is located at the Gateway Park standpipe site, which pumps water through a 16" water line to the elevated tank adjacent to the Scott and White Hospital and Medical Clinic (Flatrock pressure plane).

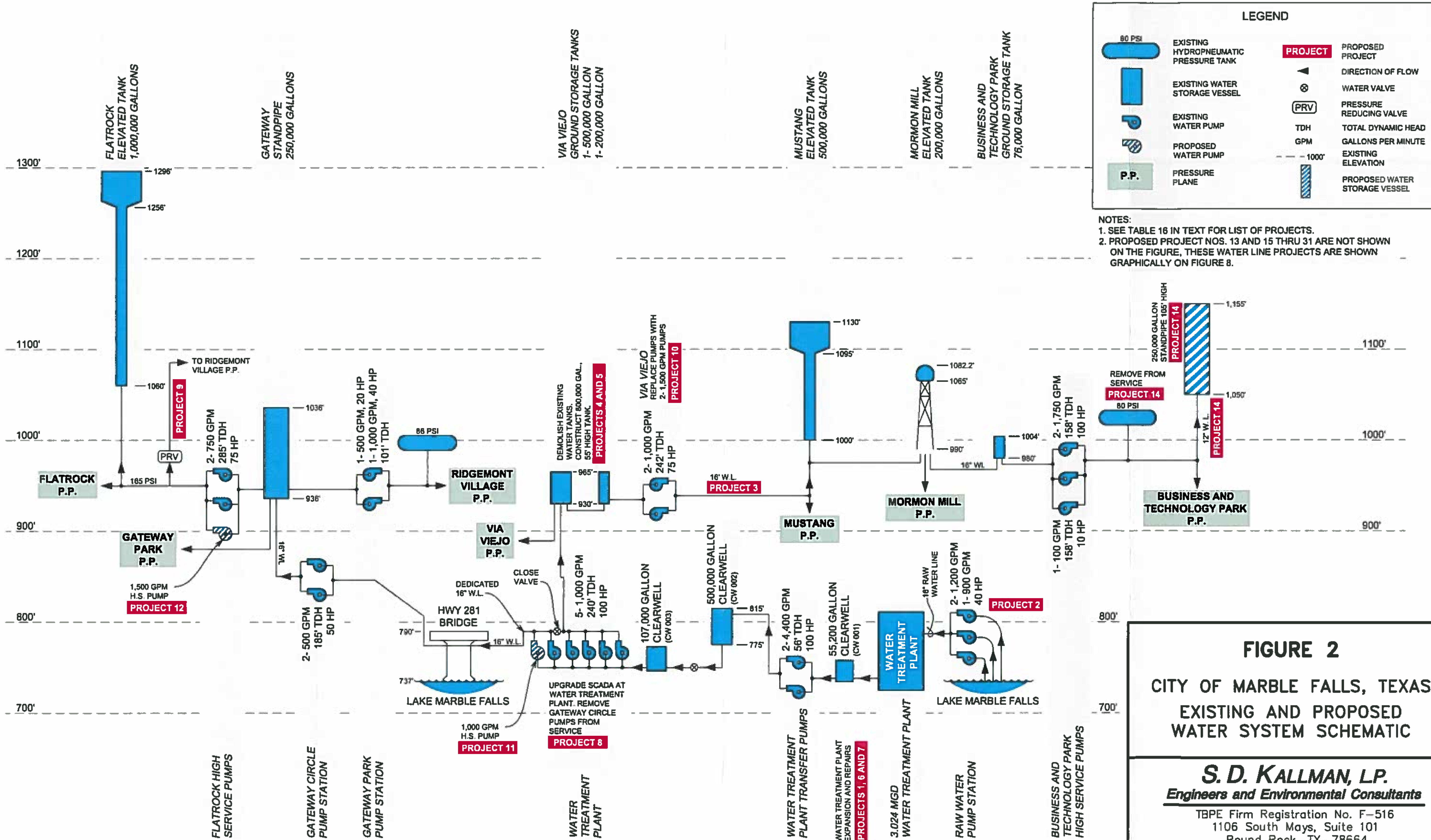

FIGURE 2

CITY OF MARBLE FALLS, TEXAS

EXISTING AND PROPOSED WATER SYSTEM SCHEMATIC

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The preferable ground elevation serviceable for static pressures within a range of 45 PSI to 100 PSI for each pressure plane is shown in Table 5 below.

TABLE 5 - PRESSURE PLANE GROUND ELEVATIONS SERVED		
Pressure Plane Name	**Elevated Storage Overflow Elevation (feet mean sea level)**	**Ground Elevation Range (feet mean sea level)**
Via Viejo	965	734-861
Mustang	1130	899-1026
Mormon Mill	1082.2	851-978
Business & Tech Park	1180[1]	949-1076
Gateway Park	1036	805-932
Ridgemont Village	1136[1]	905-1032
Flatrock	1291.6	1060-1187

[1]Based on maximum pressure setting in Hydropneumatic pressure tank.

4.12 Water System Design Criteria

Rules and Regulations for Public Water Systems as adopted by the Texas Commission on Environmental Quality (TCEQ) establish the minimum water quality requirements for community type water systems. These minimum water quality requirements were established for facilities to ensure their ability to maintain a minimum residual pressure during a fire flow event of 20 psi and a normal operating pressure of 35 psi.

The minimum TCEQ design criteria for community water systems with a surface water supply is presented as follows in Table 6:

TABLE 6 CITY OF MARBLE FALLS MINIMUM TCEQ WATER SYSTEM CAPACITY REQUIREMENTS COMMUNITY WATER SYSTEM WITH SURFACE WATER SUPPLY	
System Component	**Required Capacity**
Raw Water Pump	0.6 GPM per connection with largest pump out of service
Treatment Plant	0.6 GPM per connection under normal rated design flow
Transfer Pumps	0.6 GPM per connection with largest pump out of service
Clearwell Storage	Covered clearwell at treatment plant with capacity of 50 gallons per connection or 5.0 percent of daily plant capacity for systems serving more than 250 connections.
Total Storage	200 gallons per connection
Service Pumps	Two or more pumps with a total rated capacity of 2.0 GPM per connection or with a total capacity of 1,000 GPM and able to meet peak hourly demands with largest pump out of service, whichever is less. Systems meeting elevated storage requirements may provide two pumps with a combined capacity of 2.0 GPM per connection.
Elevated Storage	100 gallons per connection for systems with greater than 2,500 connections. Systems serving less than 2,500 connections can supply pressure tank capacity of 20 gallons per connection; however, pressure tanks are not recommended for systems serving between 1,000 and 2,500 connections.
Auxiliary Power	Required for systems serving more than 250 connections which do not meet elevated storage requirement. Auxiliary power must be provided to deliver a minimum of 0.35 gallons per connection.

TABLE 7					
CITY OF MARBLE FALLS COMPARISON OF THE CAPACITY OF THE WATER SYSTEM TO TCEQ REQUIREMENTS AND MARBLE FALLS MAXIMUM DAY USAGE WITH 4,818 EQUIVALENT CONNECTIONS (LUE'S) IN AUGUST 2015					
System Component	**Existing Number of Connections (LUE's)**	**Capacity Required by TCEQ Rules**	**Capacity Required with Actual 0.41 GPM Maximum Day Per LUE**	**Capacity Currently Provided**	**Status / Recommendation**
Raw Water Pumps	4,818	2,890 GPM (4.16 MGD)	1,976 GPM (2.85 MGD)	2,100 GPM[5] (3.024 MGD)	Required maximum day actual usage is 96% of capacity provided. Expansion of raw water pump station is recommended immediately.
Treatment Plant	4,818	2,890 GPM (4.16 MGD)	1,976 GPM (2.85 MGD)	2,100 GPM (3.024 MGD)	Expansion trigger: 85% x 3.024 MGD = 2.57 MGD/Plant. Expansion of filtration is recommended immediately.
Clearwell Storage	4,818	[1]151,200 gal.	-	664,700 gal.	OK
Total Storage	4,818	963,600 gal.	-	3,390,700 gal.	[2]OK
High Service Pumps at Water Plant	4,818	[3]2,891 GPM	1,976 GPM	[3]4,000 GPM	[3]OK
Elevated Storage	4,818	480,800 gal.	-	1,747,500 gal.	[2]OK
Auxiliary Power	4,818	[4]	[4]	[4]	OK - Auxiliary power is provided at treatment plant and raw water pump station.

Notes: [1] 5% of 3.024 MGD plant capacity.

[2] Elevated storage meets TCEQ requirements. A 250,000 gallon, 105 foot high standpipe was designed (95% complete) by this firm years ago to provide elevated storage at the Business & Tech Park Pressure Plane. To eliminate short-cycling of the 1,750 GPM high service pumps.

[3] There are five existing high service pumps at the City's water treatment plant. Each of the pumps are rated at 1,000 GPM each at 240 feet (TDH). With one pump out of service, the high service pumps are rated for a total flow of 4,000 GPM. The existing hourly flow for 4,818 connections is 2,880 GPM (4,818 connections x .6 GPM per connection (TCEQ) x 1.33 hourly factor = 3,844 GPM). Based on historical peaks @ 0.42 GPM per connection and a 1.33 hourly factor, the booster pump requirements are 2,627 GPM.

[4] Auxiliary power not required since elevated storage requirements in system are met.

[5] TCEQ limits the Plant's rated capacity to 2,100 GPM based on the Firm Raw Water Pump Capacity, pursuant to TCEQ's Chapter 290.45(b)(2)(A) rule.

SECTION 5.

WATER DEMAND FORECASTING AND WATER SYSTEM FACILITY ADEQUACY THROUGH YEAR 2044

5.1 General

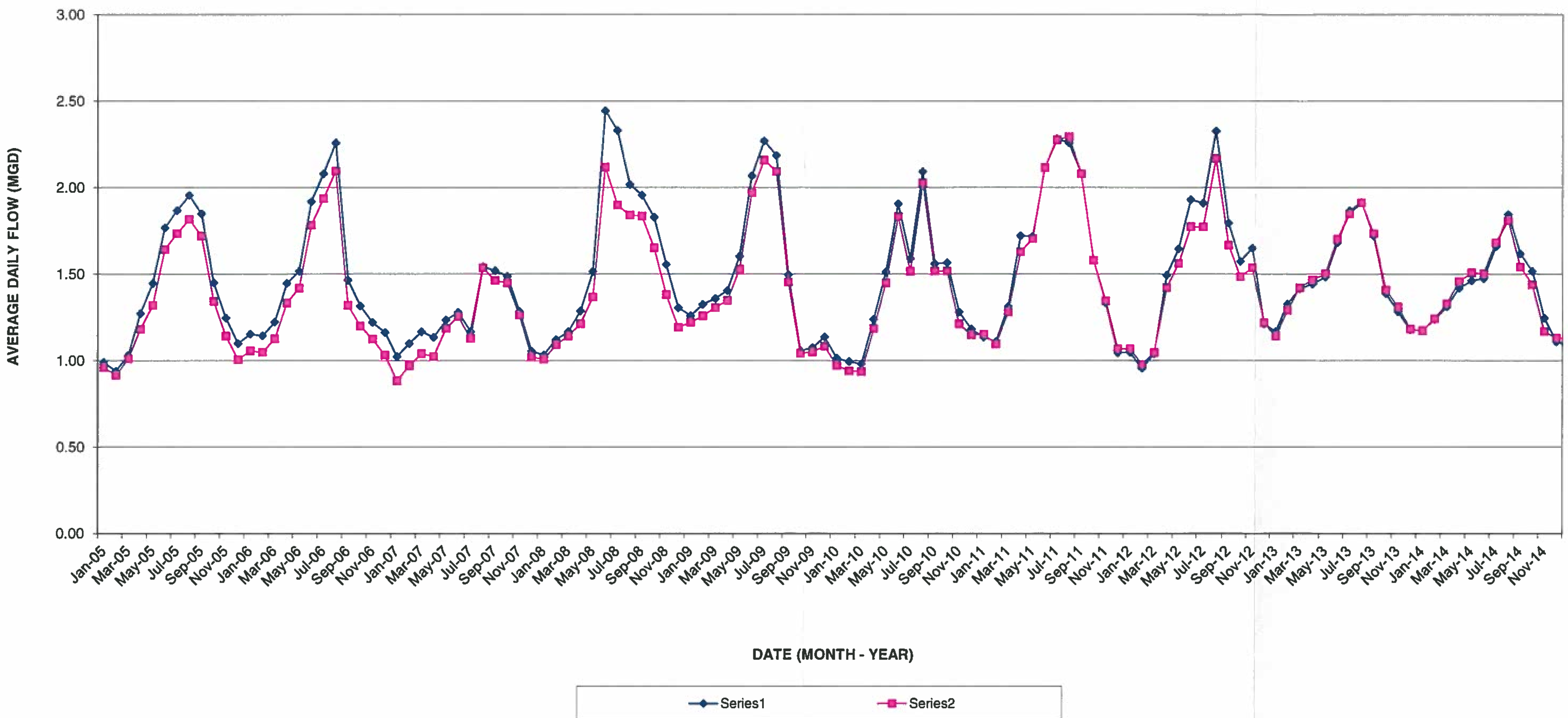
In evaluating the need for future water supply improvements, an estimation of water demands must be made in order to meet TCEQ minimum requirements and to determine the amount of water supply needed to satisfy water demands. Historical water usage records of the City of Marble Falls provide the most reliable source of information to forecast future water demands.

This study will evaluate water facility requirements for four (4) water demand growth scenarios:

- Present / Near Term (based on historical water usage demands)
- Intermediate 1 (year 2024)
- Intermediate 2 (year 2034)
- Ultimate (year 2044)

Figure 3 – Historical Raw Water Usage, following, is a tabulation of the City's monthly raw and treated water flows for the system recorded on a monthly basis for a ten year period from 2005 through 2015. (See yearly reported flows provided to us by the City in Appendix "B". Figure 3 below graphically illustrates water usage for a ten (10) year period from year 2005 through 2014. As would be expected, water usage is greatly affected by the seasons of the year, with maximum demands occurring in the dry summer months.

FIGURE 3
CITY OF MARBLE FALLS
HISTORICAL WATER USAGE
AVERAGE MONTHLY RAW & TREATED WATER PLANT FLOWS
2005 THRU 2014



5.2 Population Forecasting

The City has an updated "Comprehensive Plan" being developed by Halff and Associates. This Master Water and Wastewater Plan shall become an important element of the "Comprehensive Plan." Appendix "A", herein, is "Figure 6.2 – Future Land Use Map," provided to us by the City. This land use map provides guidance to the Master Water and Wastewater Study in defining "demand centers" for water and wastewater use.

Also, provided to us by the City is "Figure 4 - City Population Forecasts vs. Impact Fee Projections," herein, dated January 1, 2015. The graph, which depicts five (5) different growth projections, projects City population growth for a fifteen year period, from year 2010 to year 2025. As requested by City Planning Staff, the "TSDC 1.0 Scenario (Red Line)" population projections will be utilized in this Master Water and Wastewater Plan through the "Intermediate 1 (year 2024)" planning period. Since the graph does not project population from the year 2026 through 2044, which is the culmination year for "Ultimate," in this study, population projections will be developed below for the years 2026 through 2044.

From the City's population projections graph for TSDC 1.0 (Figure 4), the population growth per year averages 143.9 persons per year. This Report will project 144 persons population growth per year in Table 8 below, for years beyond 2025.

TABLE 8		
CITY OF MARBLE FALLS POPULATION PROJECTIONS FOR A 30 YEAR PERIOD (YEAR 2015 TO YEAR 2044)		
YEAR	**POPULATION**	**NOTES**
2010	6,077[1]	Census
2015	6,406[1]	City's Forecast
2020	7,424[1]	City's Forecast
2024	8,011[1]	City's Forecast and Intermediate 1 Demand Scenario
2034	9,451[2]	Intermediate 2 Demand Scenario
2044	10,891[2]	Ultimate Demand Scenario

Footnotes:

[1] Refer to Figure 4 – herein

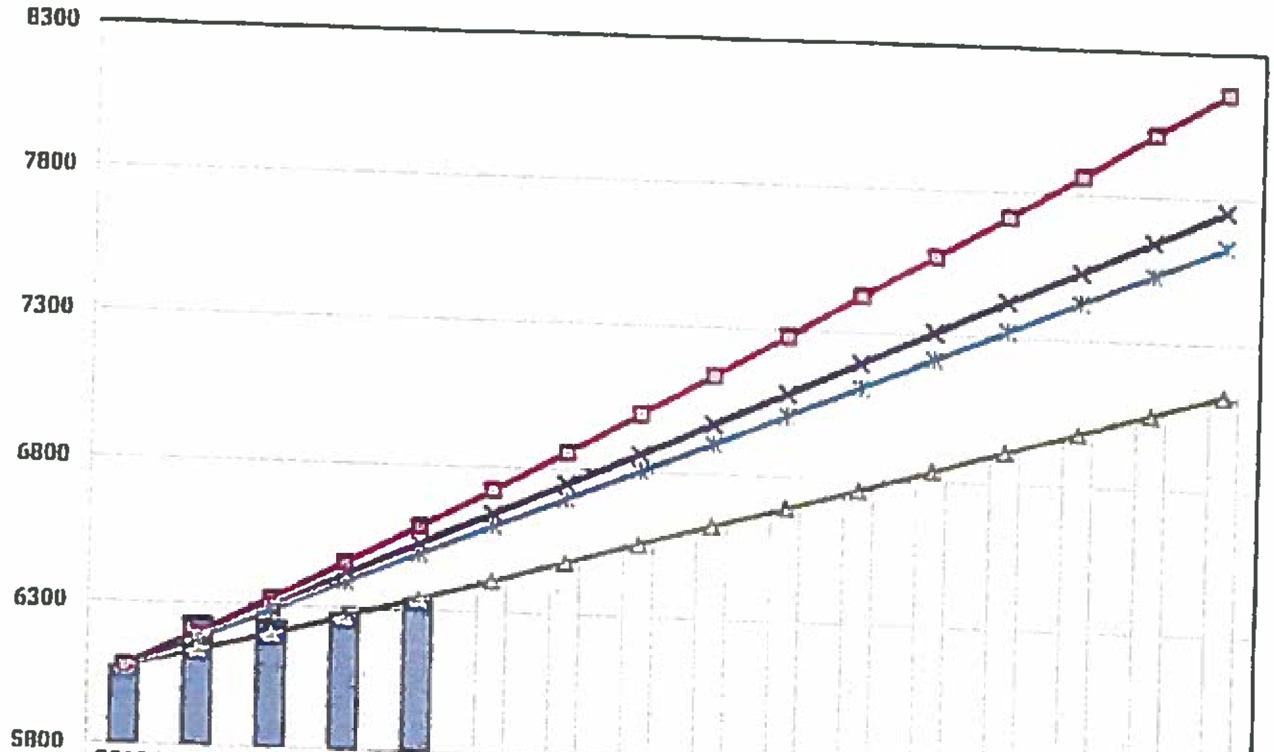
[2] Beginning in Year 2024, Population increases 144 persons per year to year 2044

As shown in Appendix "B" – "City of Marble Falls LUE Calculations", dated August 12, 2015, there are 4,818 LUE's served by the City's water system. The daily average usage is 1.46 MGD and peak day usage is 2.90 MGD. The existing population is 6,406 persons. The Census has determined that there is an average of 2.41 people per equivalent single family residence (LUE). "Equivalent residences" are a composite of single family homes, duplexes, apartments, assisted living and nursing homes.

Figure 4

City Population Forecasts vs Impact Fee Projections

As of Jan. 1, 2015



*Compiled by the Planning Division of the Development Services Department

City Selected Population Projection for the Impact Fee Study

TSDC = Texas State Data Center

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
City Staff Forecast	6077	6252	6250	6281	6337	6404	6472	6541	6610	6680	6751	6822	6894	6967	7041	7116
TSDC 0.5 Scenario	6,077	6,140	6,203	6,271	6,338	6,406	6,477	6,550	6,620	6,690	6,762	6,836	6,910	6,982	7,053	7,125
TSDC 1.0 Scenario	6,077	6,198	6,322	6,450	6,583	6,719	6,858	6,997	7,137	7,278	7,424	7,569	7,715	7,863	8,011	8,158
US Census Historical 10 Yr Trend	6,077	6,189	6,301	6,412	6,524	6,636	6,748	6,860	6,971	7,083	7,195	7,307	7,419	7,530	7,642	7,754
US Census Historical 20Yr Trend	6,077	6,181	6,284	6,388	6,491	6,595	6,698	6,802	6,905	7,009	7,112	7,216	7,319	7,423	7,526	7,630

5.3 Residential and Commercial LUE Calculations

Based on this data, the number of equivalent single family water connections (LUE's) can be computed:

6,406 persons ÷ 2.41 persons/LUE = 2,658 LUE's (single family equivalents)

The mathematical difference in City-computed 4,818 LUE's (total) and 2,658 LUE's (single family equivalents) is 2,160 LUE's, which are non-residential water customers including commercial, hotels, schools and industrial land uses. These non-residential water users amount to 45% of the total existing LUE customer base (2,160 ÷ 4,818 LUE's x 100% = 45%).

5.4 Residential and Commercial LUE Projections

Utilizing the population projection values from Table 8 and the 55:45 ratio of single family equivalent LUE's to "commercial, hotels, schools and industrial equivalent" LUE's, "Water System LUE Projections" can be developed throughout the planning period.

TABLE 9

CITY OF MARBLE FALLS POPULATION AND WATER LUE PROJECTIONS

Year	Residential Population	Water System LUE's		
		Residential[1]	Commercial Et al[2]	Total
2015	6,406	2,658	2,160	4,818
2024	8,011	3,324	2,720	6,044
2034	9,451	3,922	3,208	7,130
2044	10,891	4,519	3,698	8,217

[1]At 2.41 People per Residential LUE

[2]Commercial, Hotels, Schools and Industrial

5.5 Average LUE

From Table 1, the past 3 years annual historical usage was 534.103 million gallons of treated water for the years 2012, 2013 and 2014. The total average day system usage for this 3 year average can be computed:

534,103,000 gallons ÷ 365 days per year = 1,463,296 gallons per day average; round to 1.46 MGD average

With 4,818 LUE's in year 2015, the average daily usage per connection can be computed as follows:

1,463,296 gallons per day ÷ 4,818 LUE's = 304 gallons per day per LUE average

The historical average daily water usage per capita for the year 2015 can be calculated:

304 gallons per day per LUE ÷ 2.41 persons/LUE = 126 gallons per person per day average

5.6 Peak LUE Calculation

The peak future water demands can be estimated by using the projected population and total water system LUE's figures above and applying a peak water usage factor per person per day to calculate the total peak daily and total peak hourly usage.

The City's water treatment plant experienced a peak day water demand of 2.9 million gallons per day (MGD) in year 2012. Refer to Appendix "B" – City of Marble Falls LUE Calculations. The resulting peak day per LUE calculation for year 2014 is:

2,900,000 gallons ÷ 4,818 LUE's = 602 gallons per day per LUE peak day (0.42 GPM per connection)

The peaking factor for designing water treatment and water pumping facilities for 24-hour per day operation can then be calculated:

Peak usage per LUE ÷ average usage per LUE = 602 gallons per day per connection ÷ 304 gallons per day per connection = 1.98 peak day factor

By applying the peak day factor of 1.98, the historical peak day usage per capita can be determined:

126 gallons per person per day x 1.98 = 250 gallons per person per day peak (0.173 GPM; round to 0.17 GPM per person peak day)

Assuming peak instantaneous or hourly usage for 18 hours of a 24 hour day, the peak hourly usage per person and per LUE for high service pump requirements can be computed:

250 gallons per person per day peak x $\frac{24}{18}$ hours = 334 gallons per person per hour peak (0.23 GPM)

602 gallons per LUE per day peak x $\frac{24}{18}$ hours = 803 gallons per LUE per hour peak (0.56 GPM)

5.7 Water Facility Capacities Based on LUE Projections

Presented in Table 10 – City of Marble Falls water demand requirements, below, are the estimated future raw water pumping and water treatment plant requirements of the City of Marble Falls. These were arrived at by multiplying the LUE projection figures in Table 9 above by 602 gallons per peak day per person.

TABLE 10

CITY OF MARBLE FALLS
WATER DEMAND REQUIREMENTS

Year	Population Projection [1] ①	Equivalent LUE Projection [2] ② (from total LUE's on Table 9)	Peak Daily Demand [3] Raw Water Pumping and Water Treatment Plant Capacity ③ = ② x 602 GPDP LUE (24 Hr. Per Day Operation) (MGD)	(GPM)
2015	6,406	4,818	2.90	2,015
2024	8,011	6,044	3.64	2,527
2034	9,451	7,130	4.30	2,981
2044	10,891	8,217	4.95	3,436

Note: [1] The population projections begin in January of the year shown.
[2] 2010 Census has 2.41 persons per water LUE based on historical data.
[3] The City's historical peak daily water demand equals 602 gallons per day per LUE.

5.8 Water Treatment Plant Expansion Needs

In order to meet peak demands of up to 2.9 MGD the existing water treatment plant is operating for over 23 hours per day. With two shifts of operational staff running the plant, it is difficult to treat and deliver much more than 2.9 MGD to the customers. The recommended expansions of the plant to 4.8 or 6.3 MGD total capacity by adding one or two more filter cells at 1.5 MGD each will improve the automatic operation of the plant. From Table 10, if a water treatment plant expansion to a capacity of 4.8 MGD was completed, the plant would be able to meet peak demands until year 2030, when the demand on the plant could reach its TCEQ 85% capacity of 4.08 MGD. Through the "Ultimate" planning year of 2044, with all filters operating with two 1.5 MGD filters added, the plant could treat 5.2 MGD with one of the three existing 1.1 MGD filters out of service for maintenance.

Should the City decide to not expand the existing water treatment plant greater than 4.8 MGD, the City has an existing site on the south side of the lake on which to construct a new water treatment plant.

However, should TCEQ decide to enforce their requirement for water treatment plants to provide 0.6 GPM per connection (LUE – TCEQ Chapter 290.45(b)(2)(B) rules), the 4.8 MGD expanded plant capacity with the addition of a 1.5 MGD filter cell, will only serve 5,555 LUE's:

(4,800,000 ÷ 1440 minutes/day x 0.6 GPM/LUE = 5,555 LUE's)

This LUE value is projected to occur in year 2020 (Table 10 Interpolation).

5.9 Water System Capacities for Intermediate 1, Intermediate 2 and Ultimate Design Scenarios

Table 7 provided a comparison of the capacity of the existing water system to minimum TCEQ water system capacity requirements and actual City of Marble Falls peak daily demand of 0.42 GPM/LUE, and whether any facility improvements were needed. Tables 11, 12 and 13 provide the same comparison for the years 2024, 2034 and 2044.

Table 11

CITY OF MARBLE FALLS
INTERMEDIATE 1 DEMAND SCENARIO (YEAR 2024)
COMPARISON OF THE CAPACITY OF THE WATER SYSTEM TO TCEQ REQUIREMENTS AND MARBLE FALLS MAXIMUM DAY USAGE WITH 6,044 EQUIVALENT CONNECTIONS (LUE'S)

System Component	Existing Number of Connections (LUE's)	Capacity Required by TCEQ Rules	Capacity Required with Actual 0.42 GPM Maximum Day per LUE	Capacity Currently Provided	Status / Recommendation
Raw Water Pumps	6,044	3,627GPM (5.23 MGD)	2,539 GPM (3.66 MGD)	2,100 GPM[5] (3.024 MGD)	Required maximum day exceeds capacity provided. Expansion of raw water pump station is recommended for year 2024 water demands.
Treatment Plant	6,044	3,627 GPM (5.23 MGD)	2,539 GPM (3.66 MGD)	2,100 GPM (3.024 MGD)	Required maximum day exceeds capacity provided. Expansion of treatment plant is recommended for year 2024 water demands.
Clearwell Storage	6,044	[1] 261,500 gal.	-	664,700 gal.	OK
Total Storage	6,044	1,208,800 gal.	-	3,390,700 gal.	[2] OK
High Service Pumps at Water Plant	6,044	3,627 GPM (5.23 MGD)	2,539 GPM	[3] 4,000 GPM (5.76 MGD)	OK
Elevated Storage	6,044	604,400 gal.	-	1,747,500 gal.	[2] OK
Auxiliary Power	6,044	[4]	[4]	[4]	OK - Auxiliary power is provided at treatment plant and raw water pump station

Notes:
[1] 5% of 5.23 MGD plant capacity.
[2] Elevated storage meets TCEQ requirements. A 250,000 gallon, 105 foot high standpipe was designed (95% complete) by this firm years ago to provide elevated storage at the Business & Tech Park Pressure Plane to eliminate short-cycling of the 1,750 GPM high service pumps.
[3] There are five existing high service pumps at the City's water treatment plant. Each of the pumps are rated at 1,000 GPM each at 240 feet (TDH). With one pump out of service, the high service pumps are rated for a total flow of 4,000 GPM.
[4] Auxiliary power not required since TCEQ elevated storage requirements in system are met.
[5] TCEQ limits the Plant's rated capacity to 2,100 GPM based on the Firm Raw Water Pump Capacity, pursuant to TCEQ's Chapter 290.45(b)(2)(A) rule.

Table 12 CITY OF MARBLE FALLS INTERMEDIATE 2 DEMAND SCENARIO (YEAR 2034) COMPARISON OF THE CAPACITY OF THE WATER SYSTEM TO TCEQ REQUIREMENTS AND MARBLE FALLS MAXIMUM DAY USAGE WITH 7,130 EQUIVALENT CONNECTIONS (LUE'S)					
System Component	**Existing Number of Connections (LUE's)**	**Capacity Required by TCEQ Rules**	**Capacity Required with Actual 0.42 GPM Maximum Day per LUE**	**Capacity Currently Provided**	**Status / Recommendation**
Raw Water Pumps	7,130	4,278 GPM (6.16 MGD)	2,995 GPM (4.32 MGD)	2,100 GPM[5] (3.024 MGD)	Required maximum day exceeds capacity provided. Expansion of raw water pump station is recommended for year 2034 water demands.
Treatment Plant	7,130	4,278 GPM (6.16 MGD)	2,995 GPM (4.32 MGD)	2,100 GPM[5] (3.024 MGD)	Required maximum day exceeds capacity provided. Expansion of treatment plant is recommended for year 2034 water demands.
Clearwell Storage	7,130	[1] 308,000 gal.	-	664,700 gal.	OK
Total Storage	7,130	1,426,000 gal.	-	3,390,700 gal.	[2] OK
High Service Pumps at Water Plant	7,130	4,278 GPM (6.16 MGD)	2,995 GPM (4.32 MGD)	[3] 4,000 GPM (5.76 MGD)	OK
Elevated Storage	7,130	713,000 gal.	-	1,747,500 gal.	[2] OK
Auxiliary Power	7,130	[4]	[4]	[4]	OK - Auxiliary power is provided at treatment plant and raw water pump station

Notes:

[1] 5% of 6.13 MGD plant capacity.

[2] Elevated storage meets TCEQ requirements. A 250,000 gallon, 105 foot high standpipe was designed (95% complete) by this firm years ago to provide elevated storage at the Business & Tech Park Pressure Plane to eliminate short-cycling of the 1,750 GPM high service pumps.

[3] There are five existing high service pumps at the City's water treatment plant. Each of the pumps are rated at 1,000 GPM each at 240 feet (TDH). With one pump out of service, the high service pumps are rated for a total flow of 4,000 GPM.

[4] Auxiliary power not required since TCEQ elevated storage requirements in system are met.

[5] TCEQ limits the Plant's rated capacity to 2,100 GPM based on the Firm Raw Water Pump Capacity, pursuant to TCEQ's Chapter 290.45(b)(2)(A) rule.

Table 13

CITY OF MARBLE FALLS
ULTIMATE DEMAND SCENARIO (YEAR 2044)
COMPARISON OF THE CAPACITY OF THE WATER SYSTEM TO TCEQ REQUIREMENTS AND MARBLE FALLS
MAXIMUM DAY USAGE WITH 8,217 EQUIVALENT CONNECTIONS (LUE'S)

System Component	Existing Number of Connections (LUE's)	Capacity Required by TCEQ Rules	Capacity Required with Actual 0.42 GPM Maximum Day per LUE	Capacity Currently Provided	Status / Recommendation
Raw Water Pumps	8,217	4,931 GPM (7.10 MGD)	3,452 GPM (4.97 MGD)	2,100 GPM (3.024 MGD)	Required maximum day exceeds capacity provided. Expansion of raw water pump station is recommended for year 2044 water demands.
Treatment Plant	8,217	4,931 GPM (7.10 MGD)	3,452 GPM (4.97 MGD)	2,100 GPM (3.024 MGD)	Required maximum day exceeds capacity provided. Expansion of treatment plant is recommended for year 2044 water demands.
Clearwell Storage	8,217	[1] 355,000 gal.	-	664,700 gal.	OK
Total Storage	8,217	1,643,400 gal.	-	3,390,700 gal.	[2] OK
High Service Pumps at Water Plant	8,217	4,931 GPM (7.10 MGD)	3,452 GPM (4.97 MGD)	[3] 4,000 GPM (5.76 MGD)	OK @ 0.42 GPM/LUE Add 1 – 1,000 GPM pump to fill gateway standpipe @ 0.6 GPM/LUE
Elevated Storage	8,217	821,700 gal.	-	1,747,500 gal.	[2] OK
Auxiliary Power	8,217	[4]	[4]	[4]	OK - Auxiliary power is provided at treatment plant and raw water pump station

Notes:

[1] 5% of 7.03 MGD plant capacity.

[2] Elevated storage meets TCEQ requirements. A 250,000 gallon, 105 foot high standpipe was designed (95% complete) by this firm years ago to provide elevated storage at the Business & Tech Park Pressure Plane to eliminate short-cycling of the 1,750 GPM high service pumps.

[3] There are five existing high service pumps at the City's water treatment plant. Each of the pumps are rated at 1,000 GPM each at 240 feet (TDH). With one pump out of service, the high service pumps are rated for a total flow of 4,000 GPM.

[4] Auxiliary power not required since TCEQ elevated storage requirements in system are met.

5.10 Allocation of LUE Projections for each Pressure Plane and Corresponding Peak Daily Demands

TABLE 14 CITY OF MARBLE FALLS WATER CONNECTION (LUE) GROWTH ALLOCATION WITHIN PRESSURE PLANES				
Pressure Plane	Existing LUE's/GPM	Intermediate 1 Demand Scenario Year 2024 Proposed LUE's/GPM[1]	Intermediate 2 Demand Scenario Year 2034 Proposed LUE's/GPM[1]	Ultimate Demand Scenario Year 2044 Proposed LUE's/GPM[1]
Via Viejo	2499 / 1050	2582 / 1085	2666 / 1120	2749 / 1155
Mustang	757 / 318	790 / 332	823 / 346	857 / 360
Mormon Mill	894 / 375	1077 / 452	1110 / 466	1144 / 480
Business & Tech Park	31 / 13	87 / 37	143 / 61	200 / 84
Gateway Park	383 / 161	474 / 199	568 / 238	653 / 274
Ridgemont Village	86 / 36	86 / 36	86 / 36	86 / 36
Flatrock	168 / 71	948 / 398	1736 / 729	2528 / 1062
Total LUE's	4818 / 2024	6044 / 2539	7132 / 2996	8217 / 3451

Note: [1] "GPM" equates to "Peak Day Demand" at 0.42 GPM/LUE

From "Table 9 – City of Marble Falls Population and Water Line Projections", the year 2044 "residual population" is projected to be 10,891 persons or 4,519 LUE's (10,891 persons divided by 2.41 persons per LUE). Also projected for year 2044 are 3,698 LUE's for commercial, hotels, schools and industrial land uses. The total LUE's projected for year 2044 in Table 9 are 8,217 LUE's, which can be seen in Table 14, above. The peak day water demand computes to 3,451 GPM (8,217 LUE's multiplied by 0.42 GPM peak day rate per LUE = 3,451 GPM). The water treatment plant capacity required in year 2044 is projected at 3,451 GPM or 4,969,440 gallons per day. The City's existing water treatment plant can produce good quality water at a maximum rate of around 2,900,000 gallons per day, resulting in a shortfall of 2,069,440 gallons per day.

In development of the total LUE's and their placement in the seven pressure planes in Table 14, above, not all of the "LUE's" for the following complete build-out of known proposed projects were included in the year 2044 projection of 8,217 LUE's, as by doing so, would project considerably more than 8,217 LUE's, which would conflict with the population projections in "Table 8 – City of Marble Falls Population Projections for a 30 Year Period".

The proposed medium to large size projects currently in the planning phase are Panther Hollow (220 LUE's), Homestead Apartments behind Home Depot (150 LUE's), Gregg Ranch (1,246 LUE's), Live Oak Ranch (350 LUE's) and Flatrock (2,691 LUE's). By year 2044, Panther Hollow, Homestead Apartments behind Home Depot and Live Oak Ranch are assumed to be "built-out". By year 2044, projects assumed to be only "partially built-out" are Gregg Ranch (976 of 1,276 LUE's) and Flatrock (902 of 2,691 LUE's), leaving 2,059 LUE's in Gregg Ranch and Flatrock to build-out beyond year 2044.

5.11 Adequacy of Existing Storage and High Service Pumping Facilities within each Pressure Plane

From the allocation of water system connections (LUE's) within each pressure plane, an analysis of adequacy of storage and high service pumps can be provided. Table 15 compares the City's existing storage and pumping facilities to the capacities required for each pressure plane over a 30 year period. The status of each facility for adequacy is noted and where insufficient capacity exists, a recommendation for upgrade is given. TCEQ Chapter 290.45(b)(2)(G) states that elevated storage capacity of 100 gallons per connection (LUE) is required for systems with more than 2,500 connections (LUE's). Refer to Section 8 for a summary of proposed water system improvements and their associated estimates of probable cost.

TABLE 15

CITY OF MARBLE FALLS
ANALYSIS OF ELEVATED STORAGE AND HIGH SERVICE PUMPS IN EACH PRESSURE PLANE FOR EXISTING AND ULTIMATE DESIGN SCENARIO

PRESSURE PLANE IDENTIFICATION		YEAR 2014 4,818 LUE's Total in City		YEAR 2044 8,217 LUE's Total in City	
VIA VIEJO	REQUIRED	Elevated Storage 2,499 x 100 = 249,900 gallons	High Service Pumps Existing Peak Day: 2,499 LUE's 2,499 x 0.42 GPM/LUE = 1,050 GPM TCEQ Rule: 2,499 LUE's x 0.6 GPM/LUE = 1,500 GPM	Elevated Storage 2,749 LUE's x 100 gallons/LUE = 274,900 gallons	High Service Pumps Existing Peak Day: 2,749 LUE's x 0.42 GPM/LUE = 1,155 GPM TCEQ Rule: 2,749 LUE's x 0.6 GPM/LUE = 1,650 GPM
	EXISTING	Top 10 feet in two 35 feet high ground storage tanks. 1 - 500,000 gallon tank 1 - 200,000 gallon tank 10/35 x 700,000 gallons = 200,000 gallons existing elevated storage	5 - 1000 GPM pumps at water treatment plant 4,000 GPM firm capacity	Top 10 feet in two 35 feet high ground storage tanks. 1 - 500,000 gallon tank 1 - 200,000 gallon tank 10/35 x 700,000 gallons = 200,000 gallons existing elevated storage	5 - 1000 GPM pumps at water treatment plant 4,000 GPM firm capacity
	STATUS	Need additional 49,900 gallons in top 10 feet of tank. Existing two tanks leak. Replace with one-20 foot higher tank with top 20 feet as elevated storage. Select 55 foot high, 750,000 gallon tank. Elevated storage = 800,000 x 20/55 = 290,900 gallons. Ok - exceeds 249,900 required	OK	Need additional 74,900 gallons in top 10 feet of tank. Select 55 foot high, 750,000 gallon tank. Elevated storage = 800,000 x 20/55 - 290,900 gallons. Ok - exceeds 274,900 gallons required	OK
MUSTANG RIDGE	REQUIRED	Elevated Storage 757 LUE's x 100 gallons/LUE = 75,700 gallons	High Service Pumps Existing Peak Day: 757 LUE's (Mustang) + 894 LUE's (Mormon Mill) + 150 LUE's (Business & Tech Park = 1,801 LUE's x 0.42 GPM/LUE = 756 GPM TCEQ Rule: 1,801 LUE's x 0.6 GPM/LUE = 1,081 GPM	Elevated Storage 857 LUE's x 100 gallons/LUE = 5,700 gallons	High Service Pumps Existing Peak Day: 857 LUE's (Mustang) + 994 LUE's (Mormon Mill) + 200 LUE's (Business & Tech Park) = 2,051 LUE's x 0.42 GPM/LUE = 862 GPM TCEQ Rule: 2,051 LUE's x 0.6 GPM/LUE = 1,231 GPM
	EXISTING	500,000 gallons ÷ 100 gallons/LUE = 5,000 LUE's can be served	Two - 1,000 GPM pumps at Via Viejo tank site. Firm capacity = 1,000 GPM	500,000 gallons ÷ 100 gallons/LUE = 5,000 LUE's can be served	Two - 1,000 GPM pumps at Via Viejo tank site. Firm capacity = 1,000 GPM
	STATUS	OK	Replace Via Viejo pumps with two - 1,500 GPM high service pumps firm capacity = 1,500 GPM	OK	Replace Via Viejo pumps with two - 1,500 GPM high service pumps for firm capacity = 1,500 GPM

TABLE 15 (Continued)

CITY OF MARBLE FALLS

ANALYSIS OF ELEVATED STORAGE AND HIGH SERVICE PUMPS IN EACH PRESSURE PLANE FOR EXISTING AND ULTIMATE DESIGN SCENARIO

PRESSURE PLANE IDENTIFICATION		YEAR 2014 4,818 LUE's Total in City		YEAR 2044 8,217 LUE's Total in City	
MORMON MILL	REQUIRED	Elevated Storage 894 LUE's x 100 GPM/LUE = 89,400 gallons	High Service Pumps Existing Peak Day: 894 LUE's (Mormon Mill) + 150 LUE's (Business & Tech Park) = 1,044 LUE's x 0.42 GPM/LUE = 439 GPM TCEQ Rule: 1,044 LUE's x 0.6 GPM/LUE = 627 GPM	Elevated Storage 1,144 LUE's x 100 gallons/LUE = 114,400 gallons	High Service Pumps Existing Peak Day: 1,144 LUE's (Mormon Mill) + 200 LUE's (Business & Tech Park) = 1,344 LUE's x 0.42 GPM/LUE = 565 GPM TCEQ Rule: 1,344 LUE's x 0.6 GPM/LUE = 806 GPM
	EXISTING	200,000 gallons ÷ 100 GPM/LUE = 2,000 LUE's can be served	See "Mustang Pressure Plane" which feeds Mormon Mill elevated tank via pressure reducing valves	200,000 gallons ÷ 100 GPM/LUE = 2,000 LUE's can be served	See "Mustang Pressure Plane"
	STATUS	OK	See "Mustang Pressure Plane"	OK	See "Mustang Pressure Plane"
BUSINESS & TECH PARK	REQUIRED	Elevated Storage 31 LUE's x 100 gallons/LUE = 3,100 gallons	High Service Pumps Existing Peak Day: 31 LUE's x 0.42 GPM/LUE = 13 GPM TCEQ Rule: 31 LUE's x 0.6 GPM/LUE = 19 GPM	Elevated Storage 200 LUE's x 100 gallons/LUE - 20,000 gallons	High Service Pumps Existing Peak Day: 200 LUE's x 0.42 GPM/LUE = 84 GPM TCEQ Rule: 200 LUE's x 0.6 GPM/LUE = 120 GPM
	EXISTING	None - 5,000 gallon Hydropneumatic pressure tank	Two - 1,750 GPM pumps sized for industrial fire	None - 5,000 gallon Hydropneumatic pressure tank	Two - 1,750 GPM pumps sized for industrial fire
	STATUS	95% design plans complete by S.D. Kallman, L.P. for a 250,000 gallon 105 foot standpipe. Constructing this elevated storage tank will provide 20/105 x 250,000 = 47,600 gallons of elevated storage and eliminate short-cycling of the 1,750 GPM pumps.	OK	95% design plans complete by S.D. Kallman, L.P. for a 250,000 gallon 105 foot standpipe. Constructing this elevated storage tank will provide 20/105 x 250,000 = 47,600 gallons of elevated storage and eliminate short-cycling of the 1,750 pumps.	OK

TABLE 15 (Continued)

CITY OF MARBLE FALLS

ANALYSIS OF ELEVATED STORAGE AND HIGH SERVICE PUMPS IN EACH PRESSURE PLANE FOR EXISTING AND ULTIMATE DESIGN SCENARIO

PRESSURE PLANE IDENTIFICATION		YEAR 2014 4,818 LUE's Total in City		YEAR 2044 8,217 LUE's Total in City	
GATEWAY PARK	REQUIRED	**Elevated Storage** 383 LUE's x 100 gallons/LUE = 38,300 gallons	**High Service Pumps** Existing Peak Day: 383 LUE's (Gateway Park) + 86 LUE's (Ridgemont Village) + 168 LUE's (Flatrock) = 637 LUE's x 0.42 GPM/LUE = 268 GPM TCEQ Rule: 637 LUE's x 0.6 GPM/LUE = 383 GPM	**Elevated Storage** 433 LUE's x 100 gallons/LUE = 43,300 gallons	**High Service Pumps** Existing Peak Day: 653 LUE's (Gateway Park) + 86 LUE's (Ridgemont Village) + 2,528 LUE's (Flatrock) = 3,267 LUE's x 0.42 GPM/LUE = 1,372 GPM TCEQ Rule: 3,267 LUE's x 0.6 GPM/LUE = 1,960 GPM
	EXISTING	Top 20 feet in 100 feet high 250,000 gallon standpipe 20/100 x 250,000 gallons = 50,000 gallons existing elevated storage.	One - 1,000 GPM high service pump at water treatment plant is dedicated to filling Gateway standpipe. However, the SCADA between the water treatment plant and the Gateway standpipe site needs to be installed. At this time, there is an in-line pump station (Gateway Circle) with two - 500 GPM pumps that boost Via Viejo pressure plane water to the Gateway standpipe.	Top 20 feet in 100 feet high 250,000 gallon standpipe 20/100 x 250,000 gallons = 50,000 gallons existing elevated storage.	One - 1,000 GPM high service pump at water treatment plant is dedicated to filling Gateway standpipe. However, the SCADA between the water treatment plant and the Gateway standpipe site needs to be installed. At this time, there is an in-line pump station (Gateway Circle) with two - 500 GPM pumps that boost Via Viejo pressure plane water to the Gateway standpipe.
	STATUS	OK	SCADA controls should be intsalled and the Gateway Circle pump station should be taken out of service. The 16" water line from the water treatment plant to the Gateway standpipe should be disconnected from the Via Viejo pressure plane by shutting certain valves, so that flow from the 1,000 GPM pump at the water treatment plant can fill the Gateway standpipe as a dedicated 16" water line.	OK	In addition to the "status" recommendations for year 2014 (this Table), one - 1,000 GPM high service pump should be added at the water treatment plant to allow two - 1,000 GPM pumps to be dedicated to the Gateway standpipe filling. Also, a third pump of 1,500 GPM capacity should be added to the two existing 750 GPM pumps located at the Gateway standpipe site that are dedicated for filling the Flatrock standpipe. These two proposed pumps described above, should be added when the flow demands increase in the Gateway Park pressure plane and Flatrock pressure plane in future years.

TABLE 15 (Continued)

CITY OF MARBLE FALLS

ANALYSIS OF ELEVATED STORAGE AND HIGH SERVICE PUMPS IN EACH PRESSURE PLANE FOR EXISTING AND ULTIMATE DESIGN SCENARIO

PRESSURE PLANE IDENTIFICATION		YEAR 2014 4,818 LUE's Total in City		YEAR 2044 8,217 LUE's Total in City	
RIDGEMONT VILLAGE	REQUIRED	Elevated Storage 86 LUE's x 100 Gallons/LUE = 8,600 gallons	High Service Pumps Refer to Gateway Park Pressure Plane	Elevated Storage 86 LUE's x 100 gallons/LUE = 8,600 gallons	High Service Pumps Refer to Gateway Park Pressure Plane
	EXISTING	None - 5,000 gallon Hydropneumatic pressure tank	Refer to Gateway Park Pressure Plane	None - 5,000 gallon Hydropneumatic pressure tank	Refer to Gateway Park Pressure Plane
	STATUS	OK	Ridgemont Village pressure plane should be switched over to Flatrock pressure plane with the installation of a pressure reducing valve. The 500 GPM and 1,000 GPM pumps and Hydropneumatic pressure tank could then be taken out of service	OK	Ridgemont Village pressure plane should be switched over to Flatrock pressure plane with the installation of a pressure reducing valve. The 500 GPM and 1,000 GPM pumps and Hydropneumatic pressure tank could then be taken out of service
FLATROCK	REQUIRED	Elevated Storage 168 LUE's x 100 gallons/LUE = 168,000 gallons	High Service Pumps Refer to Gateway Park Pressure Plane	Elevated Storage 2,898 LUE's x 100 gallons/LUE - 289,800 gallons	High Service Pumps Refer to Gateway Park Pressure Plane
	EXISTING	1 million composite elevated storage tank adjacent to hospital	Refer to Gateway Park Pressure Plane	1 million composite elevated storage tank adjacent to hospital	Refer to Gateway Park Pressure Plane
	STATUS	OK	Refer to Gateway Park Pressure Plane	OK	Refer to Gateway Park Pressure Plane

SECTION 6.

WATER DISTRIBUTION SYSTEM COMPUTER MODELING

6.1 General

The City has old and new water lines throughout the water service area that provide water to customers. Both potable water service and fire flows are provided by this network of pipes. The software named "WaterCAD" by Bentley was used in the development of the water distribution network analysis.

This Water Master Plan includes the development of a computer-based pipe network analysis to determine the adequacy of the existing water pipe distribution system to deliver desired flow rates and residual pressures to all points in the network.

The following simulations, with detailed output reports are provided to the City in a separate document.

6.8.1 "Base Model" of existing water distribution system at 1 GPM/LUE.
6.8.2 Near-term average day simulation for routine operations at 0.21 GPM per LUE.
6.8.3 Near-term peak (maximum) day simulation for identifying distribution system pressures lower than 35 PSI at 0.42 GPM per LUE.
6.8.4 Near-term peak hour simulation for identifying distribution system issues and verifying the capability to refill system tanks at 0.56 GPM per LUE.
6.8.5 Near-term peak day simulations with fire flows, one at a time, in various pressure planes (no output data included – see results in Section 6, Figures 1-A through 1-M.
6.8.6 Simulation for "Intermediate 1" design scenario (year 2024) at peak day.
6.8.7 Simulation for "Intermediate 2" design scenario (year 2034) at peak day.
6.8.8 Simulation for "Ultimate" design scenario (year 2044) at peak day

6.2 Pressure Planes South of Lake Marble Falls

Several things occur at the Gateway standpipe site. The standpipe provides water through gravity flow to most of the customers in the Gateway Park development, as well as customers on the east side of Highway 281 and south of Lake Marble Falls. Due to the higher ground elevations existing in the Ridgemont Village development, west of the standpipe site, a pump station boosts pressures to this area (Ridgemont Village pressure plane). Then, in order to fill the Flatrock Elevated Tank with water, an additional pump station is located at the Gateway Park standpipe site, which pumps water through a 16" water line to this elevated tank adjacent to the Scott and White Hospital and Medical Clinic (Flatrock pressure plane).

6.3 Ground Elevations Preferable for each Pressure Plane

The preferable ground elevation serviceable for static pressures within a range of 45 PSI to 100 PSI for each pressure plane is shown in Table 5 below. (Table 5 is shown herein in Section 4.11, but repeated in this section for convenience to the reader).

TABLE 5 - PRESSURE PLANE GROUND ELEVATIONS SERVED

Pressure Plane Name	Elevated Storage Overflow Elevation (feet mean sea level)	Ground Elevation Range (feet mean sea level)
Via Viejo	965	734-861
Mustang	1130	899-1026
Mormon Mill	1082.2	851-978
Business & Tech Park	1180[1]	949-1076
Gateway Park	1036	805-932
Ridgemont Village	1136[1]	905-1032
Flatrock	1291.6	1060-1187

[1]Based on maximum pressure setting in Hydropneumatic pressure tank

6.4 Water System Design Criteria

Rules and Regulations for Public Water Systems as adopted by the Texas Commission on Environmental Quality (TCEQ) establish the minimum water quality requirements for community type water systems. These minimum water quality requirements were established for facilities to ensure their ability to maintain a minimum residual pressure during a fire flow event of 20 psi and a normal operating pressure of 35 psi.

6.5 Existing Pressure Planes

The water distribution system consists of seven (7) pressure planes or zones identified as Via Viejo, Mustang, Mormon Mill, Industrial and Business Park, Gateway Park, Ridgemont Village and Flatrock pressure planes (refer to Figure 2 – Existing and Proposed Water System Schematic). High service pumps convey the treated water from the water treatment plant through distribution lines to a pair of ground storage tanks on Via Viejo located near the east City limits at F.M. 1431. Water from the 500,000 gallon and 200,000 gallon tanks at the Via Viejo site is booster pumped to the north to a 500,000 gallon composite elevated tank adjacent to Marble Falls High School (Mustang pressure plane). Water from the 200,000 gallon and 500,000 gallon tanks supply a much larger service area via gravity flow to the west and south (Via Viejo pressure plane). Also to the north, near the intersection of Mormon Mill Road and Park Ridge Drive, is a 200,000 gallon elevated storage tank (Mormon Mill pressure plane). Water from the Mustang Elevated Tank flows through pressure reducing valves and water distribution lines into the Mormon Mill Elevated Tank to fill it. This tank supplies the relatively high northeast portion of Marble Falls, including development along Mormon Mill Road, the north segment of U.S. Highway 281 and the ground storage tank at the Business & Technical Park. The pump station at the Business & Technical Park site serves the Marble Falls Business & Technical Park, as well as areas along U.S. Highway 281 lying north of the Business & Technical Park. S.D. Kallman has plans 95% complete for elevated storage planned for the Business & Technical Park for a 250,000 gallon standpipe, 105 feet in height.

Water is also transported in a southeasterly direction from the treatment plant across the Colorado River (Lake Marble Falls) through a 16" water line on the new Highway 281 Bridge to the "Gateway Park" area, where a pump station boosts water to a 250,000 gallon welded steel standpipe located near the intersection of Gateway Parkway and Steve Hawkins Parkway (Gateway Park pressure plane).

6.6 Development of the WaterCAD Model for the City's Existing Water Distribution System

To set up the data for the WaterCAD simulation, the following elements had to be established for the existing (near-term) simulation:

- Water line geometric layout with data input of pipe size (diameter), pipe length, pipe age (c-factor) and pipe name.
- Intersections or dead-ends of water lines called junctions or nodes. Data input consisted of node elevation (mean sea level), water demand (in LUE's) at node and node name. The "Command" global demand factor changes the "LUE's" to 0.42 GPM/LUE for peak day nodal demands, etc.
- Pump stations increase pressure to move water through the distribution system to satisfy meter demands and fill elevated water storage tanks. "Table 4 – Existing High Service Pump Data" was developed to provide a list of data to enter into the simulation (Table 4, repeated here). Pump curve data is entered for each pump.
- Water storage tanks that provide pressure and water storage for each pressure plane (see Table 5, repeated here from Section 4.11), in the water distribution system. Table 3, (repeated here from Section 4.9), lists all water storage tank data required for the model set-up.
- Pressure reducing valves which reduce water line pressures that exceed 100 PSI to a lower pressure to maintain a desirable pressure range in the lower pressure plane.

TABLE 3
EXISTING WATER STORAGE TANK DATA

Description	Type	Capacity (Gals)	Base Operating Elevation (Feet)	Maximum Operating Elevation (Feet)	Ground Elevation at Tank	Dimensions	
						Dimension (Feet)	Height (Feet)
No. 1 (CW001) Water Treatment Plant	Clearwell/Ground Rectangular Reinforced Concrete	55,200 (771)	771	783	771	33 x 33	% Average
No. 2 (CW002) Water Treatment Plant	Clearwell/Ground Prestressed Concrete	500,000	775	815	775	46 dia.	40
No. 3 (CW003) Water Treatment Plant	Clearwell/Ground Rectangular Reinforced Concrete	107,700	769	779	769	30 x 48	10
No. 1 Via Viejo[1]	Standpipe/Ground Welded Steel	500,000	930	965	930	49 dia.	35
No. 2 Via Viejo[1]	Standpipe/Ground Welded Steel	200,000	930	965	930	31 dia.	35
Mustang	Elevated Composite Concrete & Steel	500,000	1095	1130	1000	49 bowl dia.	35
Mormon Mill	Elevated Welded Steel	200,000	1065	1082.2	990	45 bowl dia.	17
Business & Tech Park[2]	Ground Bolted Steel	76,000	980	1004	980	23 dia.	24
Gateway[2]	Standpipe 3 Elevated/Ground Welded Steel	250,000 (47,500 is Elevated / 202,500 is Ground)	936	1036	936	21 dia.	100
Flatrock	Elevated Composite Concrete & Steel	1,000,000	1256.6	1291.6	1060	70 bowl dia.	35 (Bowl)

Summary of Storage:

Total Ground Storage =	1,643,200 Gallons
Total Elevated Storage =	1,747,500 Gallons
Total Water Storage =	3,390,700 Gallons

[1]Both tanks at Via Viejo have irreparable leaks and should be demolished and replaced with one 750,000 gallon prestressed concrete tank.

[2]The Business & Tech Park pumps and Gateway pumps do not pump to elevated storage. The pumps at both sites are controlled from hydropneumatic tanks located adjacent to the pumps.

TABLE 4
EXISTING HIGH SERVICE PUMP DATA

HSPS Location	Pumps To	Pressure Plane Served	Ground Elevation at Tank	Pump ID No.	GPM	TDH (Feet/PSI)	Notes
Water Treatment Plant	Via Viejo Standpipes (2) Gateway In-Line Pump Station	Via Viejo, Mustang, Mormon Mill, Business & Tech Park, Gateway Park, Flatrock	771	1 2 3 4 5	1000 1000 1000 1000 1000	240/120 240/120 240/120 240/120 240/120	Pump No. 5 Intended for Service to Gateway Standpipe
Via Viejo	Mustang Elevated Tank	Mustang, Mormon Mill	930	1 2	1000 1000	242/105[1] 242/105[1]	
Business and Tech Park	Business and Tech Park Pressure Plane with Hydropneumatic Tank	Business and Tech Park	980	1 2 3	1750 1750 100	158/68 158/68 150/65	
Gateway Circle	Gateway Standpipe	Gateway Park, Flatrock	850	1 2	500 500	185/80	
Gateway Park (at Gateway Standpipe)	Apartment Complex (Ridgemont Village) on Gateway North Street	Ridgemont Village Apartments	936	1 2 3	500 1000 100	101/44 101/44 101/44	80 PSI to Ridgemont Village Pressure Plane
Gateway Park (at Gateway Standpipe)	Flatrock Elevated Tank	Flatrock	936	1 2	750 750	285/123 285/123	

[1]Assumed

6.7 WaterCAD Modeling Scenarios

The WaterCAD model is based on existing infrastructure in which mainly water lines greater than 6-inch were included. In the absence of 6" and larger water lines in some areas, water lines smaller than 6-inch were used as water mains in the model. The WaterCAD model determines flow rates and velocities in distribution lines as well as pressures throughout the system based on input system geometry and water demands. The computer model can be used to analyze distribution lines, pump stations or elevated storage tank operations on a city-wide scale. The simulations used in these analyses were both steady state and extended period simulation (EPS) models with multiple scenarios, such as peak (maximum) day, peak hour, minimum hour and fire flow being evaluated. The "Ultimate" design scenario (year 2044) distribution system was analyzed by WaterCAD to assure that the proposed system improvements provide adequate volumes and pressures throughout the system.

The proposed water system for year 2044 is designed to accommodate the development of the City based on current development trends. The recommended water system improvements in Table 16 have been identified and phased into Immediate, Near-Term, and Intermediate 1, for project completions by end of year 2016, end of year 2020 and end of year 2024, respectively. Design scenarios for Intermediate 2 (2034) and Ultimate (2044) have recommended projects associated with them, that should be reviewed for adequacy in subsequent Master Water Plan updates.

6.8 Evaluation of Distribution System Utilizing WaterCAD Computer Network Modeling Output Data

The following simulations will summarize the output results with deficiencies, if any, described and recommendations to resolve them.

6.8.1 "Base" Model Development at 1 GPM per LUE

The "Base" Model was developed with 6" and larger existing water lines. In the absence of 6" and larger water lines, existing water lines smaller than 6" were used in the model. The whole existing water distribution system is represented in the "Base" Model. Each of the seven pressure planes are depicted in different colors in Figure 7 – Pressure Plane Map and Figure 8 – Capital Improvements Program for Water System.

The existing pipe data, nodal data, storage tank data, pump data and pressure reducing valve (PRV) for the "Base Model" is provided in a separate document to the City. See Section F-1.

6.8.2 Near-Term Average Day Simulation for Routine Operations

The "Base" Model was run with "average day" flow per LUE. This equated to 0.21 GPM per LUE, which is 50% of the City's peak day usage of 0.42 GPM per LUE. Since the "Base" model has 1 GPM per LUE at demand nodes, the Global Demand Factor (GDF) for "average day" flow is computed as follows:

1 GPM/LUE x 0.42 GPM/LUE (peak day) x 50% = 0.21 GPM/LUE

Thus, a GDF of 0.21 was input into the "Base" Model. See the Pipe Table and Junction (Nodal) Table in Section F-2 provided in a separate document to the City.

Summary:

There were no residual pressures in the seven pressure planes lower than 35 PSI.

Recommendations:

No distribution system improvements are recommended for average day flows.

6.8.3 Near-Term Peak (Maximum) Day Simulation for Identifying Distribution System Pressures Lower than 35 PSI

The "Base" Model was run with "peak day" flow per LUE, this equated to 0.42 GPM per LUE, which is the City's historical value for usage on a "peak day". The GDF is computed as follows:

1 GPM/LUE x 0.42 GPM/LUE (peak day) = 0.42 GPM per LUE

Thus, a GDF of 0.42 was input into the "Base" Model. See the Pipe Table and Junction (Nodal) Table in Section F-3 provided in a separate document to the City.

Summary:

Pressure at or below required 35 PSI threshold along entire length of existing 8" PVC water line on Hamilton Creek Road. Beginning at existing 2" PVC connection (J593, -38.97 PSI) heading east to 8" PVC connection on Hamilton Creek Road corner (J595, 7.21 PSI) pressure slowly increases as 8" PVC heads north to end of line (J594, 33.51 PSI).

Recommendations:

Tie into existing 16" ductile iron water line on Manzano Mile (J733) with a new 12" PVC water line and run southeast 2,366 l.f. to connect to existing 8" PVC x 2" PVC (J593). Existing PRV on existing 8" PVC water line at Hamilton Creek Road is set at 30 PSI. With recommended 12" PVC water line added, new pressures are: (J593, 59.65 PSI) (J595, 43.40 PSI) (J594, 69.70 PSI). When the PRV is set at pressures higher than 30 PSI, some homes exceed 100 PSI static pressure.

6.8.4 Near-Term Peak Hour Simulation for Identifying Distribution System Issues and Verifying the Capability to Refill System Tanks

The "Base" Model was run with "peak hour" flow per LUE. This equated to 0.56 GPM per LUE, which his 33% higher than the City's historical value for usage on a "peak day". The GDF is computed as follows:

1 GPM/LUE x 0.42 GPM/LUE (peak day) x 1.33 = 0.56 GPM per LUE

Thus, a GDF of 0.56 was input into the "Base" Model. See the Pipe Table and Junction (Nodal) Table in Section F-4 provided in a separate document to the City.

Summary:

Pressure at or below required 35 PSI threshold along entire length of existing 8" PVC water line on Hamilton Creek Road. Beginning at existing 2" PVC connection (J593, -38.97 PSI) heading east to 8" PVC connection on Hamilton Creek Road corner (J595, 7.21 PSI) pressure slowly increases as 8" PVC heads north to end of line (J594, 33.51 PSI).

Recommendations:

Tie into existing 16" ductile iron water line on Manzano Mile (J733) with a new 12" PVC water line and run southeast 2,366 l.f. to connect to existing 8" PVC x 2" PVC (J593). Existing PRV on existing 8" PVC water line at Hamilton Creek Road is set at 30 PSI. With recommended 12" PVC water line added, new pressures are: (J593, 59.55 PSI) (J595, 43.49 PSI) (J594, 69.68 PSI).

6.8.5 Near-Term Peak Day Simulations with Fire Flows, One at a Time, in Various Pressure Planes

The "Base" Model was run with "peak day" flow per LUE plus one single 1,500 GPM 750 GPM (residential) or (commercial, schools, apartments and industrial) fire flow at selected node locations only. This equated to 0.42 GPM per LUE, which is the City's historical value for usage on a "peak day" plus 750 GPM or 1,500 GPM for the fire.

The "Base" Model was modified by adding 3,571 GPM at the selected fire node. When the 0.42 GDF is applied in the model, the resulting value at the selected fire node is 1,500 GPM (3,571 x 0.42 = 1,500).

The fire flow analyses for each of the seven existing pressure planes resulted in numerous nodes falling below the threshold pressure of 20 PSI. The following Figures 1-A through 1-M provide the location of the fire flow at a given junction (node), residual pressures at the junction for "peak day flow" and "peak day flow plus one-750 GPM fire or one-1,500 GPM fire" for the existing distribution system. Also shown are residual pressures at the same junction for "peak day flow plus one-750 GPM or one-1,500 GPM fire". After the recommended water line(s) are installed, which results in residual pressure rising above 20 PSI at the junction, the fourth residual pressure shown is with the new water line(s) installed at "peak day flow" without the fire flow.

Estimated costs for water line improvements to upgrade the fire protection capabilities in the water distribution system, as shown in Figure 1-A through 1-M are scheduled in Table 16 – City of Marble Falls – Project List, Schedule and Probable Estimate of Cost for Recommended Water System Improvements.

6.8.6 Simulation for "Intermediate 1" Design Scenario (Year 2024) at Peak Day for 6,044 Projected LUE's

The Model developed in 6.8.6 including recommended water lines for fire flows run with "peak day" flow per LUE, with projected LUE growth for the "Intermediate 1" design scenario, shown in Table 14, added to selected nodes in each pressure plane, as applicable from Table 14. Additional high service pump flows were increased accordingly. The GDF is computed as follows:

1 GPM/LUE x 0.42 GPM/LUE (Peak Day) = 0.42 GPM/LUE

Thus, a GDF of 0.42 was input into the "Base" Model. See the Pipe Table and Junction (Nodal) Table in Section F-5 provided in a separate document to the City.

Summary:

The Model experienced no flows less than 35 PSI at the nodes.

Recommendations:

No new water lines other than the new water lines to satisfy fire flow conditions, as shown in Figures 1-A through 1-M, are needed.

6.8.7 Simulation for "Intermediate 2" Design Scenario (Year 2034) at Peak Day for 7,132 Projected LUE's

The Model developed in 6.8.6 including recommended water lines for fire flows run with "peak day" flow per LUE, with projected LUE growth for the Intermediate 2 design scenario, shown in Table 14, added to selected nodes in each pressure plane, as applicable from Table 14. Additional high service pump flows were increased accordingly. The GDF is computed as follows:

1 GPM/LUE x 0.42 GPM/LUE (Peak Day) = 0.42 GPM/LUE

Thus, a GDF of 0.42 was input into the "Base" Model. See the Pipe Table and Junction (Nodal) Table in Section F-6 provided in a separate document to the City.

Summary:

The Model experienced no flows less than 35 PSI at the nodes.

Recommendations:

No new water lines other than the new water lines to satisfy fire flow conditions, as shown in Figures 1-A through 1-M, are needed.

6.8.8 Simulation for "Ultimate" Design Scenario (Year 2044) at Peak Day with Fire Figures for 8,217 Projected LUE's

The Model developed in 6.8.6 including recommended water lines for fire flows run with "peak day" flow per LUE, with projected LUE growth for the "Ultimate" design scenario, shown in Table 14, added to selected nodes in each pressure plane, as applicable from Table 14. Additional high service pump flows were increased accordingly. The GDF is computed as follows:

1 GPM/LUE x 0.42 GPM/LUE (Peak Day) = 0.42 GPM/LUE

Thus, a GDF of 0.42 was input into the "Base" Model. See the Pipe Table and Junction (Nodal) Table in Section F-8 provided in a separate document to the City.

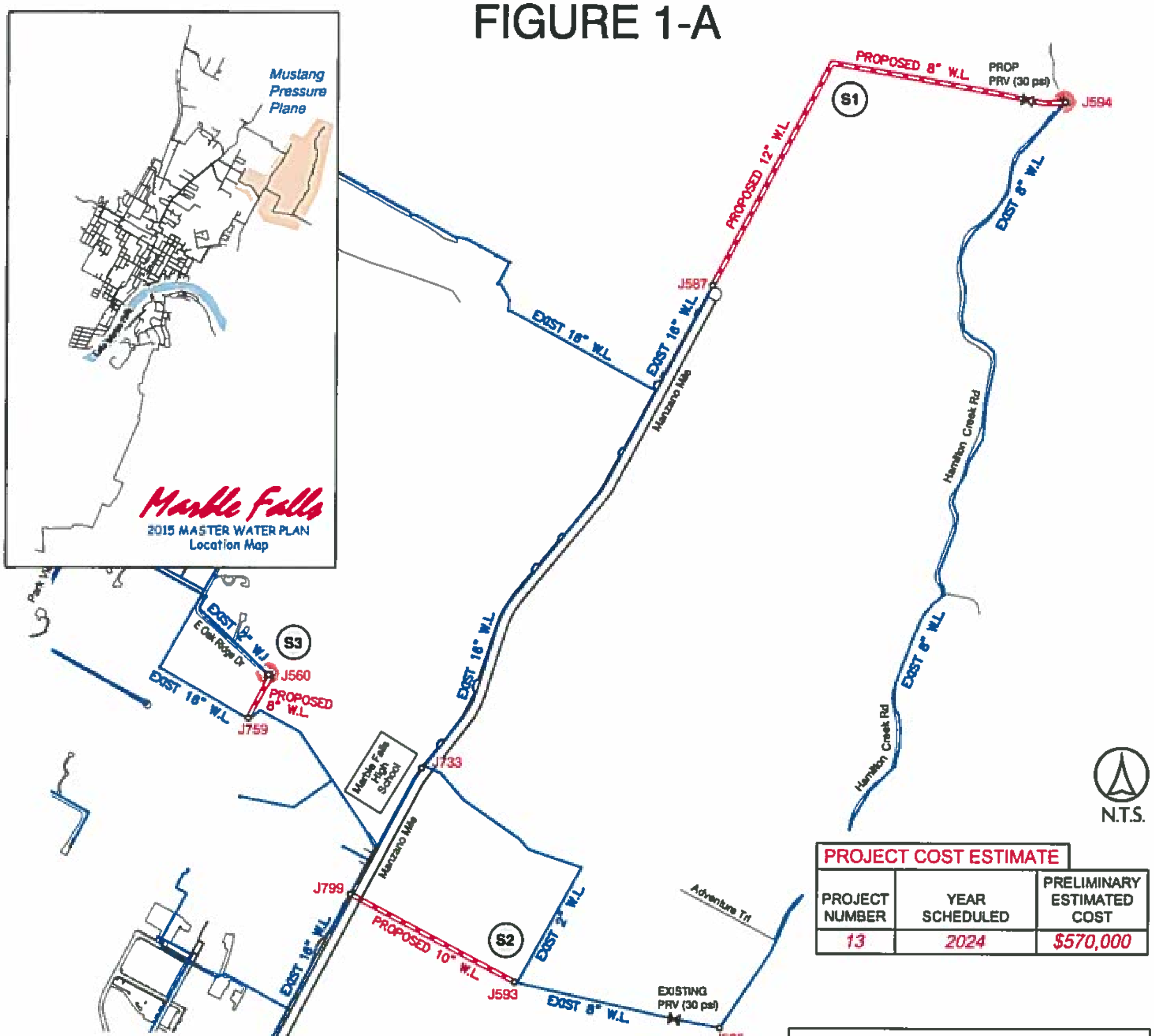
Summary:

The Model experienced no flows less than 35 PSI at the nodes.

Recommendations:

No new water lines other than the new water lines to satisfy fire flow conditions, as shown in Figures 1-A through 1-M, are needed.

FIGURE 1-A



PROJECT COST ESTIMATE

PROJECT NUMBER	YEAR SCHEDULED	PRELIMINARY ESTIMATED COST
13	2024	$570,000

FIRE EVENT RESULTS

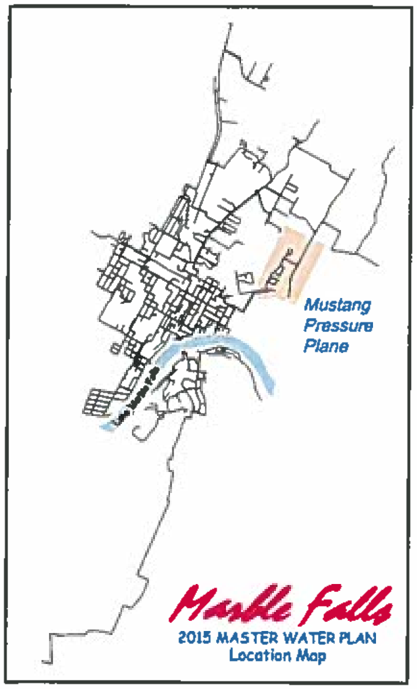
STUDY AREA	JUNCTION	EXISTING PEAK DAY FLOW PRESSURE (PSI)	PRESSURE WITH 750 GPM FIRE EVENT (PSI)	PRESSURE WITH SOLUTION APPLIED (PSI)	NEW PRESSURE WITHOUT FIRE DEMAND (PSI)
S1	J594	-54	-9,100	30.00	69.60
S2	J593	-126		59.57	
	J595	-80		43.38	
S3	J560	60.90	-20,333	59.65	66.72

LEGEND

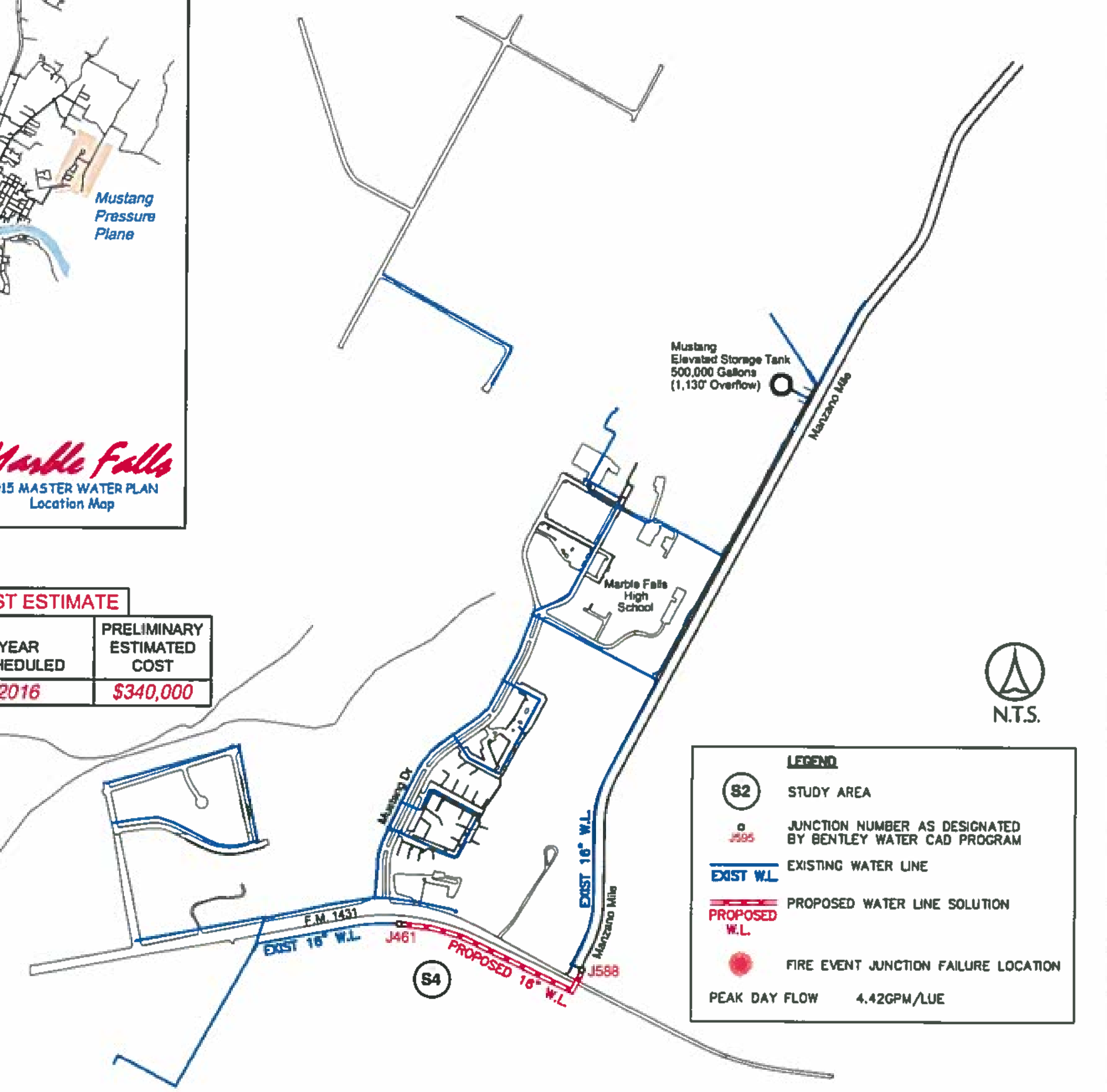
(S2)	STUDY AREA
J595	JUNCTION NUMBER AS DESIGNATED BY BENTLEY WATER CAD PROGRAM
EXIST W.L.	EXISTING WATER LINE
PROPOSED W.L.	PROPOSED WATER LINE SOLUTION
●	FIRE EVENT JUNCTION FAILURE LOCATION
PEAK DAY FLOW	4.42GPM/LUE

STUDY AREA	DESCRIPTION OF FAILURE AND SOLUTION
S1	*FIRE EVENT FAIL AT END OF EXISTING 8" W.L. ON NORTH END HAMILTON CREEK ROAD. (J594) —SOLUTION— LOOP NEW W.L. FROM END OF EXISTING 16" D.I. W.L. AT NORTH END OF MANZANO MILE (J587) HEAD NORTH 1,900 L.F. WITH 12" PVC W.L. THEN EAST 1,600 WITH 8" PVC W.L. TO HAMILTON CREEK ROAD (J594). (TOTAL PIPE LENGTH= 3,500 LF) *(INSTALL PRV @ 30psi)*
S2	*LOW JUNCTION PRESSURES ON SOUTH END OF EXISTING 8" PVC WATER LINE ON HAMILTON CREEK ROAD (J593 AND J595) —SOLUTION— REPLACE EXISTING 2" PVC WATER LINE WITH NEW 10" PVC WATER LINE CONNECTING AT EXISTING 16" D.I. W.L. ON MANZANO MILE (J799) HEADING EAST TO CONNECT TO EXISTING 8" PVC W.L. (J593) (TOTAL PIPE LENGTH= 1,394 LF)
S3	*FIRE EVENT FAIL AT END OF EXISTING 2" PVC WATER LINE ON EAST OAK RIDGE DR. (J560) —SOLUTION— CONNECT NEW 8" PVC W.L. AT END OF EXISTING 2" W.L. (J560) AND HEAD SOUTH TO CONNECT AT EXISTING 16" D.I. W.L. BEHIND MARBLE FALLS HIGH SCHOOL (J759) (TOTAL PIPE LENGTH= 375 LF)

FIGURE 1-B



PROJECT COST ESTIMATE		
PROJECT NUMBER	YEAR SCHEDULED	PRELIMINARY ESTIMATED COST
2	2016	$340,000



STUDY AREA	DESCRIPTION OF FAILURE AND SOLUTION
S4	*FAILURE OF EXISTING 10" W.L. TO CARRY FLOW FROM BOTH PUMPS RUNNING AT VIA VIEJO PUMP STATION, AS EXISTING 10" W.L. BLOWS OUT. –SOLUTION– CONNECT NEW 16" PVC W.L. AT END OF EXISTING 16" PVC W.L. ON F.M. 1431 (J461), CROSS F.M. 1431 TO CONNECT TO EXISTING 16" D.I. W.L. (J588) ON MANZANO MILE. (TOTAL PIPE LENGTH= 1,476 LF)

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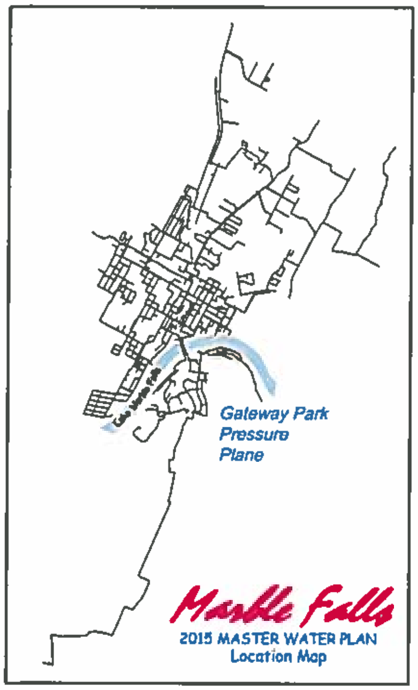
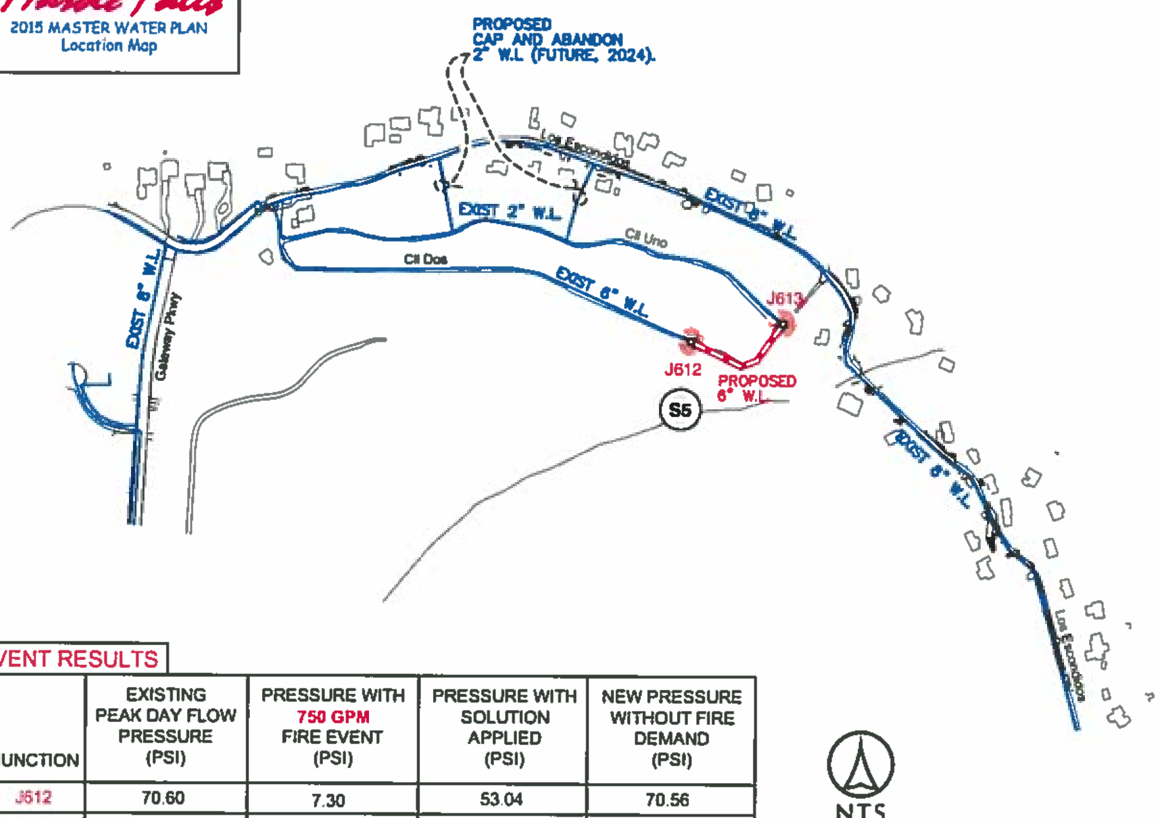
FIGURE 1-C



PROJECT COST ESTIMATE		
PROJECT NUMBER	YEAR SCHEDULED	PRELIMINARY ESTIMATED COST
14	2024	$58,000

LEGEND

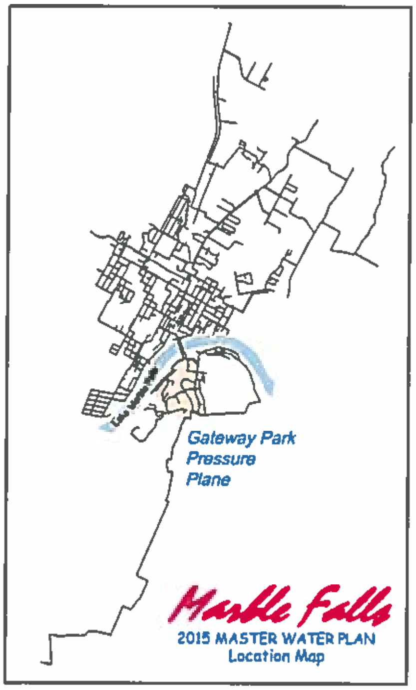
- (S2) STUDY AREA
- J595 JUNCTION NUMBER AS DESIGNATED BY BENTLEY WATER CAD PROGRAM
- EXIST W.L. EXISTING WATER LINE
- PROPOSED W.L. PROPOSED WATER LINE SOLUTION
- FIRE EVENT JUNCTION FAILURE LOCATION
- PEAK DAY FLOW 4.42GPM/LUE



FIRE EVENT RESULTS					
STUDY AREA	JUNCTION	EXISTING PEAK DAY FLOW PRESSURE (PSI)	PRESSURE WITH 750 GPM FIRE EVENT (PSI)	PRESSURE WITH SOLUTION APPLIED (PSI)	NEW PRESSURE WITHOUT FIRE DEMAND (PSI)
S5	J612	70.60	7.30	53.04	70.56
	J613	85.40	-5,783	24.29	86.15

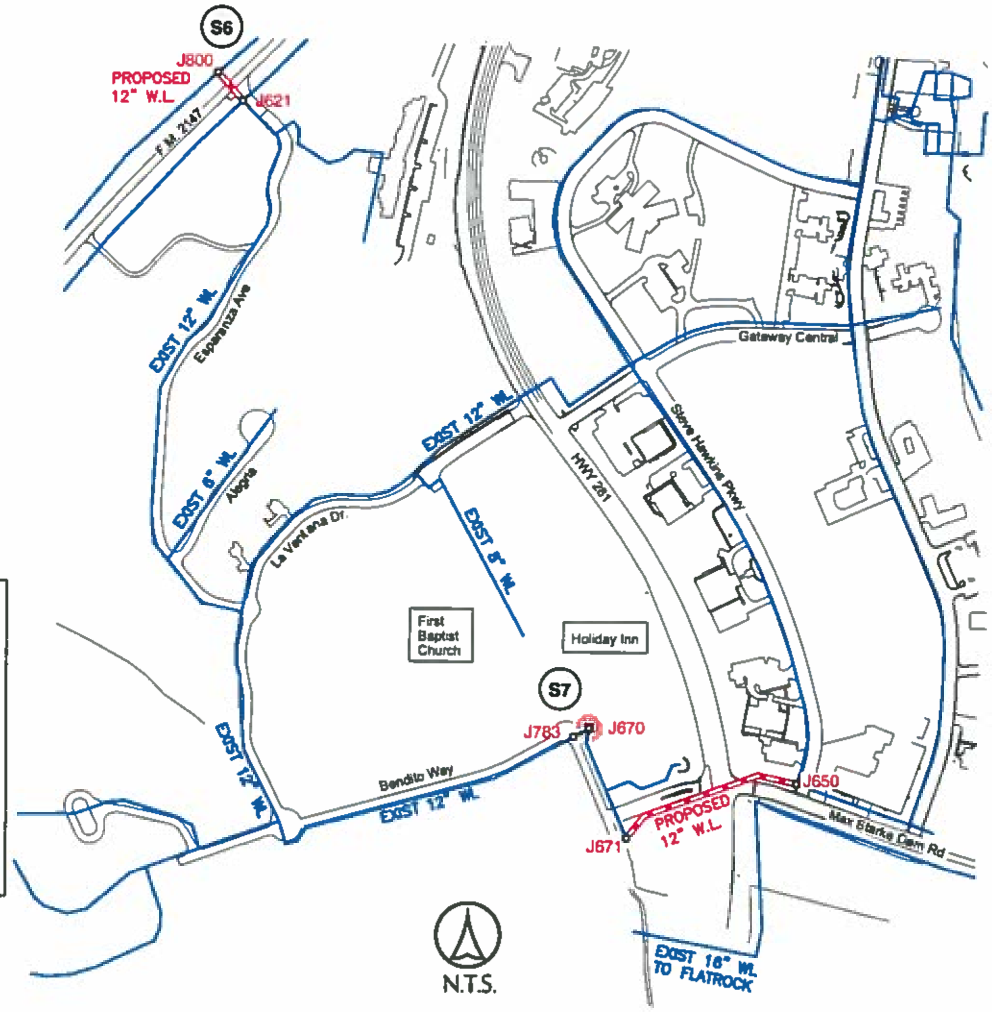
STUDY AREA	DESCRIPTION OF FAILURE AND SOLUTION
S5	*FIRE EVENT FAIL AT END OF EXISTING 6" PVC W.L. ON AT SOUTHEAST CORNER OF CII DOS ST. (J612) *FIRE EVENT FAIL AT (J613) ON EXISTING 2" PVC W.L. AT END OF CII UNO ST. —SOLUTION— TIE TO EXISTING 6" PVC W.L. ON CII DOS ST. (J612) WITH NEW 6" PVC W.L. AND RUN NORTH TO CII DOS ST. AND CONNECT TO EXISTING 2" PVC W.L. (J613), (TOTAL PIPE LENGTH= 422 LF)

FIGURE 1-D



LEGEND

S2	STUDY AREA
J595	JUNCTION NUMBER AS DESIGNATED BY BENTLEY WATER CAD PROGRAM
EXIST W.L.	EXISTING WATER LINE
PROPOSED W.L.	PROPOSED WATER LINE SOLUTION
	FIRE EVENT JUNCTION FAILURE LOCATION
PEAK DAY FLOW	4.42GPM/LUE



FIRE EVENT RESULTS

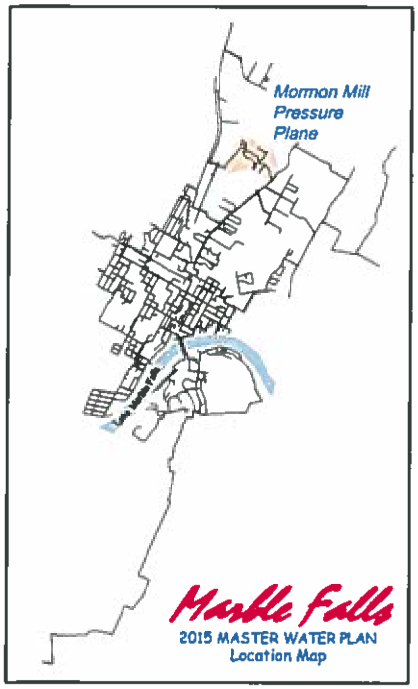
STUDY AREA	JUNCTION	EXISTING PEAK DAY FLOW PRESSURE (PSI)	PRESSURE WITH 1,500 GPM FIRE EVENT (PSI)	PRESSURE WITH SOLUTION APPLIED (PSI)	NEW PRESSURE WITHOUT FIRE DEMAND (PSI)
S7	J670	37.40	8.01	20.06	33.55

PROJECT COST ESTIMATE

PROJECT NUMBER	YEAR SCHEDULED	PRELIMINARY ESTIMATED COST
15	2024	$120,000

STUDY AREA	DESCRIPTION OF FAILURE AND SOLUTION
S6	CREATE LOOP: ADD 12" PVC W.L. FROM (J621) ON SOUTH SIDE OF FM 2147 AND CROSS TO NORTH SIDE OF FM 2147 AND CONNECT TO EXISTING 8" PVC W.L. (J800) (TOTAL PIPE LENGTH= 115 LF)
S7	*FIRE EVENT FAIL AT (J670) ON BENDITO WAY IN FRONT OF HOLIDAY INN. —SOLUTION— TIE INTO EXISTING 12" PVC W.L. AT CORNER OF BENDITO WAY AND MAX STARKE DAMN RD. (J671) WITH NEW 12" PVC W.L. AND RUN WEST ACROSS HWY 281 AND TIE INTO EXISTING 8" PVC W.L. AT CORNER OF STEVE HAWKINS PKWY AND MAX STARKE DAMN RD. (J650) (TOTAL PIPE LENGTH= 587 LF) (IN ADDITION: PROPOSED 6TH PUMP AT EXISTING WATER TREATMENT PLANT MUST BE IN OPERATION.)

FIGURE 1-E

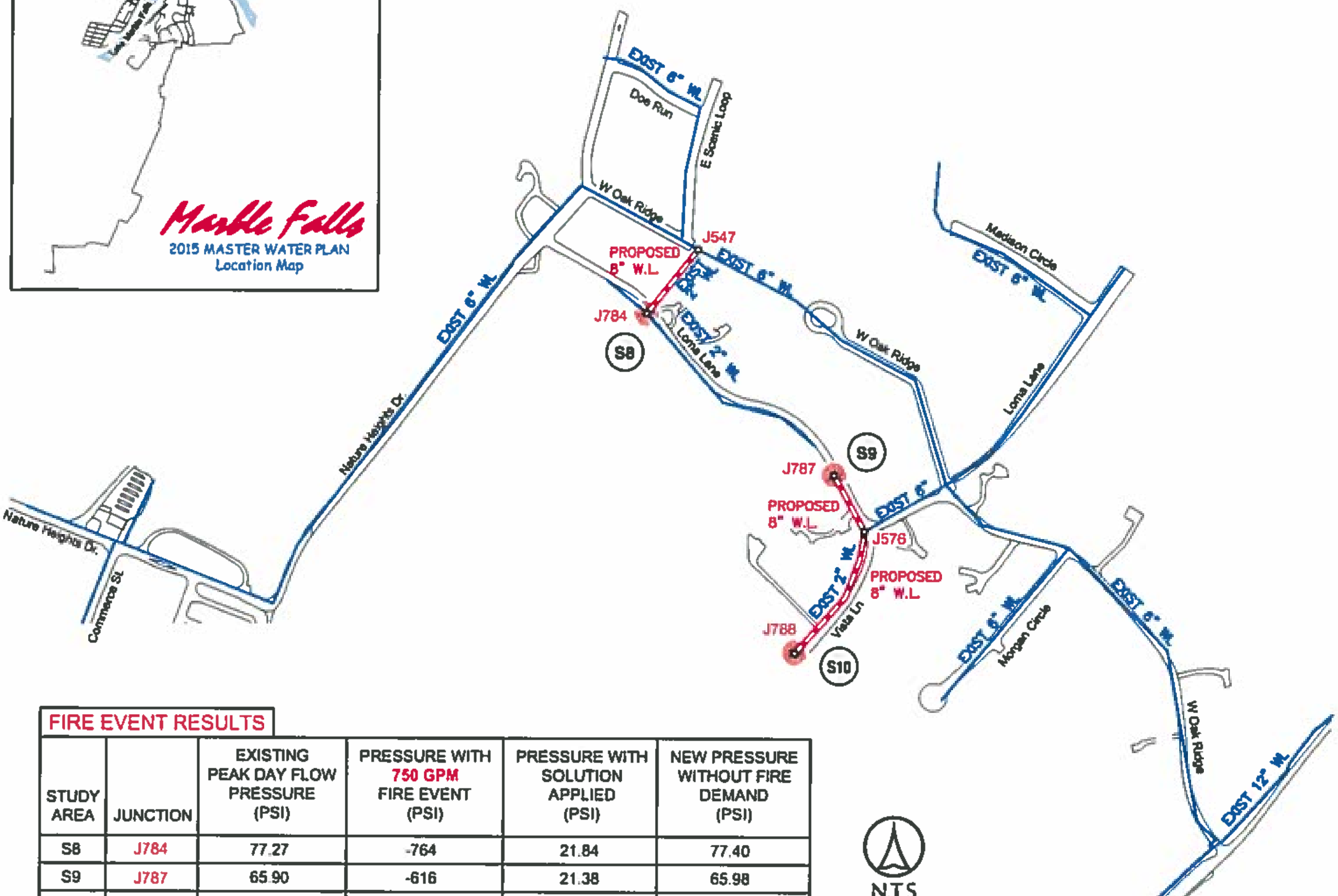


PROJECT COST ESTIMATE

PROJECT NUMBER	YEAR SCHEDULED	PRELIMINARY ESTIMATED COST
16	2024	$103,000

LEGEND

S2	STUDY AREA
J595	JUNCTION NUMBER AS DESIGNATED BY BENTLEY WATER CAD PROGRAM
EXIST W.L.	EXISTING WATER LINE
PROPOSED W.L.	PROPOSED WATER LINE SOLUTION
	FIRE EVENT JUNCTION FAILURE LOCATION
PEAK DAY FLOW	4.42GPM/LUE



FIRE EVENT RESULTS

STUDY AREA	JUNCTION	EXISTING PEAK DAY FLOW PRESSURE (PSI)	PRESSURE WITH 750 GPM FIRE EVENT (PSI)	PRESSURE WITH SOLUTION APPLIED (PSI)	NEW PRESSURE WITHOUT FIRE DEMAND (PSI)
S8	J784	77.27	-764	21.84	77.40
S9	J787	65.90	-616	21.38	65.98
S10	J788	68.83	-1,390	21.26	69.01

STUDY AREA	DESCRIPTION OF FAILURE AND SOLUTION
S8	*FIRE EVENT FAIL ON EXISTING 2" PVC W.L. ON LOMA LANE (J784) —SOLUTION— UPGRADE EXISTING 2" PVC W.L. FROM LOMA LANE (J784) HEADING NORTH TO WEST OAK RIDGE (J547) WITH NEW 8" PVC W.L. (TOTAL PIPE LENGTH= 261 LF)
S9	*FIRE EVENT FAIL AT END OF EXISTING 2" PVC W.L. ON LOMA LANE (J787) —SOLUTION— UPGRADE EXISTING 2" PVC W.L. ON LOMA LANE FROM (J576) WEST TO (J787) WITH NEW 8" PVC W.L. (TOTAL PIPE LENGTH= 210 LF)
S10	*FIRE EVENT FAIL AT END OF EXISTING 2" PVC W.L. ON LOMA LANE (J787) —SOLUTION— UPGRADE EXISTING 2" PVC W.L. ON VISTA LANE FROM (J576) SOUTH TO (J788) WITH NEW 8" PVC W.L. (TOTAL PIPE LENGTH= 460 LF)

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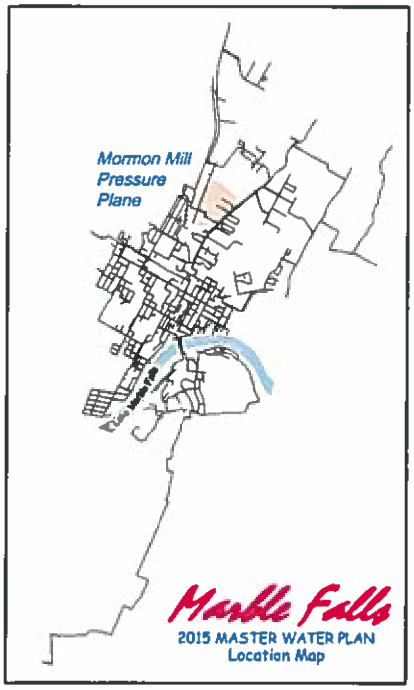
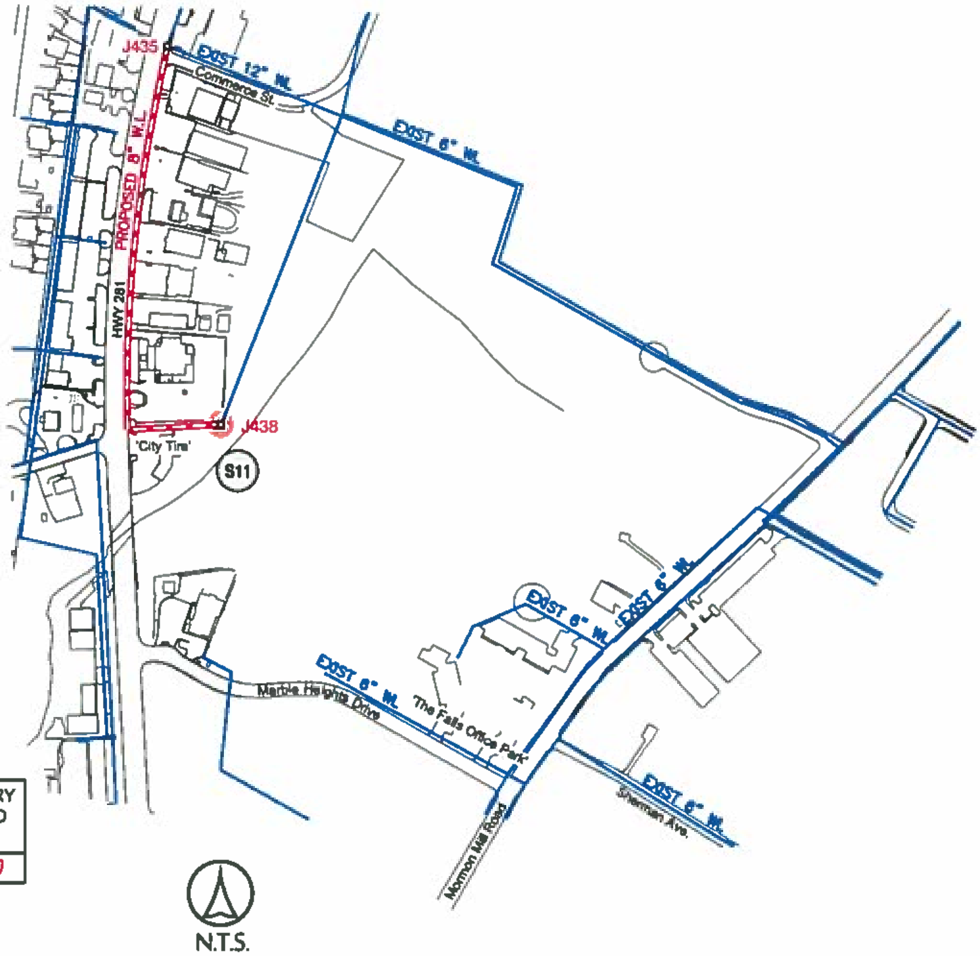
FIGURE 1-F





PROJECT COST ESTIMATE

PROJECT NUMBER	YEAR SCHEDULED	PRELIMINARY ESTIMATED COST
18	2024	$158,000

FIRE EVENT RESULTS

STUDY AREA	JUNCTION	EXISTING PEAK DAY FLOW PRESSURE (PSI)	PRESSURE WITH 1,500 GPM FIRE EVENT (PSI)	PRESSURE WITH SOLUTION APPLIED (PSI)	NEW PRESSURE WITHOUT FIRE DEMAND (PSI)
S11	J438	120.65	-75.47	90.88	121.11

LEGEND

- (S2) STUDY AREA
- J585 JUNCTION NUMBER AS DESIGNATED BY BENTLEY WATER CAD PROGRAM
- EXIST W.L. EXISTING WATER LINE
- PROPOSED W.L. PROPOSED WATER LINE SOLUTION
- FIRE EVENT JUNCTION FAILURE LOCATION

PEAK DAY FLOW 4.42GPM/LUE

STUDY AREA

(S11)

DESCRIPTION OF FAILURE AND SOLUTION

*FIRE EVENT FAIL AT END OF EXISTING 6" AC W.L. BEHIND RETAIL BUSINESS 'CITY TIRE' (J438)

—SOLUTION—

ADD NEW 8" PVC W.L. BEGINNING AT (J435) ON CORNER OF HWY 281 AND COMMERCE STREET RUNNING DOWN THE EAST SIDE OF HWY 281 DOWN TO R.O.W. ON NORTH SIDE OF PARKING LOT OF "CITY TIRE" AND THEN HEAD EAST TO CONNECT TO EXISTING 6" A.C. W.L. (J438) (TOTAL PIPE LENGTH= 1,310 LF)

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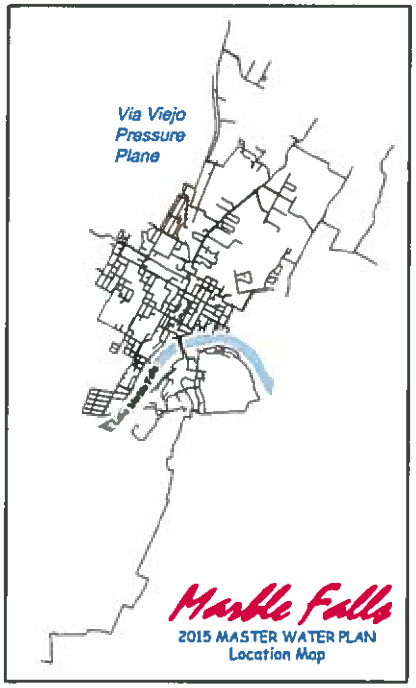
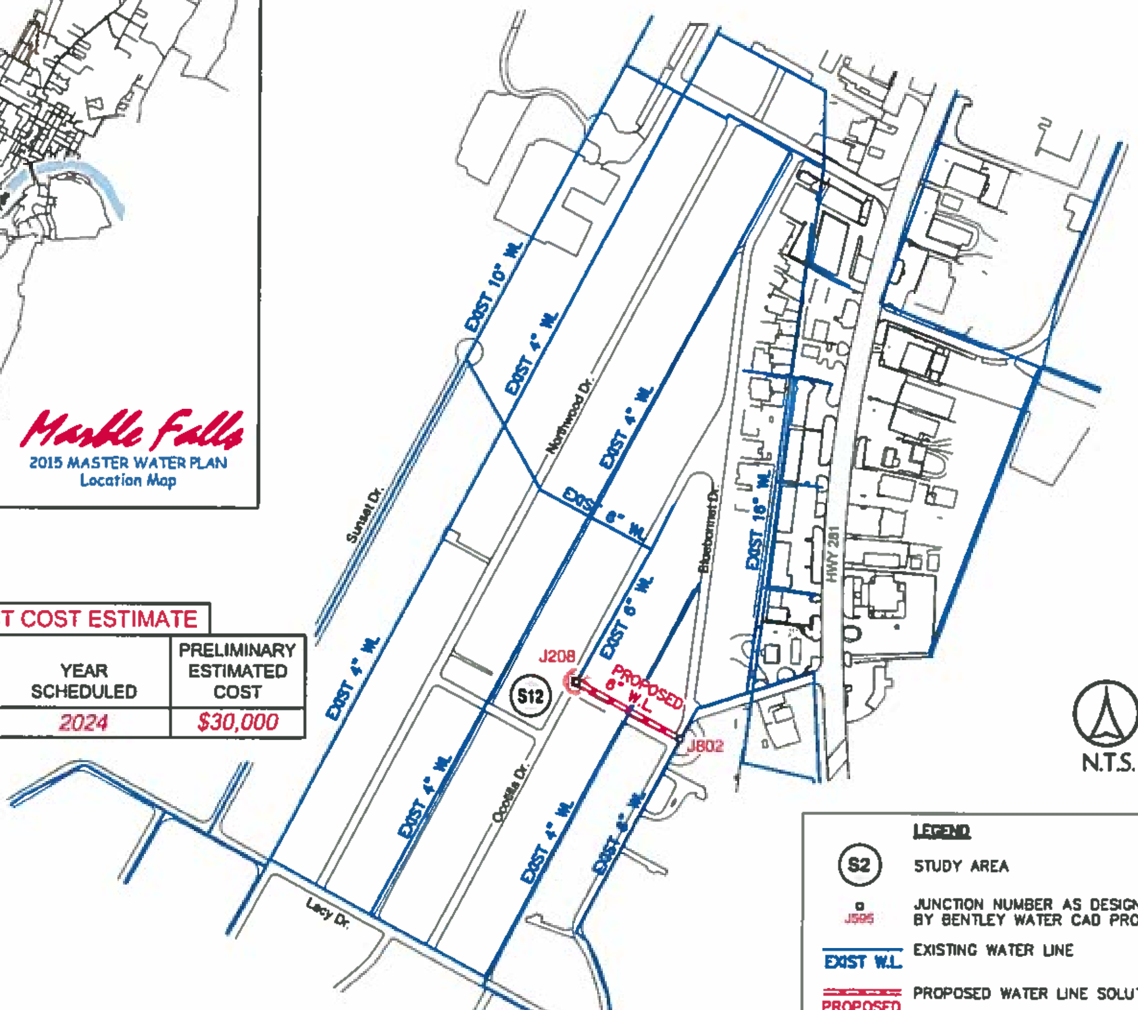
FIGURE 1-G





PROJECT COST ESTIMATE

PROJECT NUMBER	YEAR SCHEDULED	PRELIMINARY ESTIMATED COST
19	2024	$30,000

LEGEND

S2 STUDY AREA

J595 JUNCTION NUMBER AS DESIGNATED BY BENTLEY WATER CAD PROGRAM

EXIST W.L. EXISTING WATER LINE

PROPOSED W.L. PROPOSED WATER LINE SOLUTION

FIRE EVENT JUNCTION FAILURE LOCATION

PEAK DAY FLOW 4.42GPM/LUE

FIRE EVENT RESULTS

STUDY AREA	JUNCTION	EXISTING PEAK DAY FLOW PRESSURE (PSI)	PRESSURE WITH 750 GPM FIRE EVENT (PSI)	PRESSURE WITH SOLUTION APPLIED (PSI)	NEW PRESSURE WITHOUT FIRE DEMAND (PSI)
S12	J208	59.78	-1.26	38.36	61.81

STUDY AREA	DESCRIPTION OF FAILURE AND SOLUTION
S12	*FIRE EVENT FAIL AT END OF EXISTING 6" A.C. W.L. ON OCOTILLA DR. (J208) -SOLUTION- CONNECT TO END OF EXISTING 6" A.C. W.L. ON OCOTILLA DR (J208) WITH NEW 6" PVC W.L. AND RUN EAST TO CONNECT TO EXISTING 6" A.C. W.L. ON BLUEBONNET DR. (J802) (TOTAL PIPE LENGTH= 350 LF)

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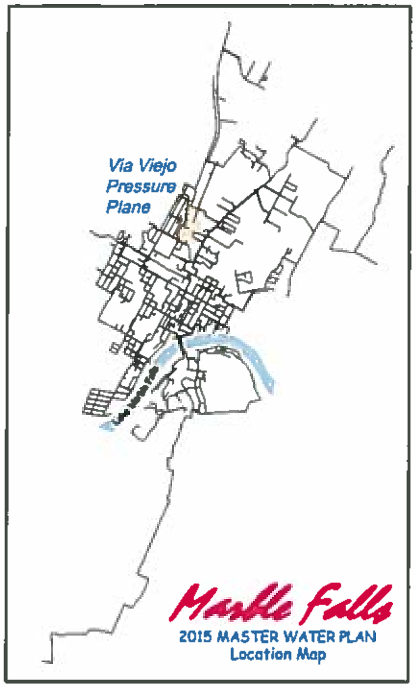
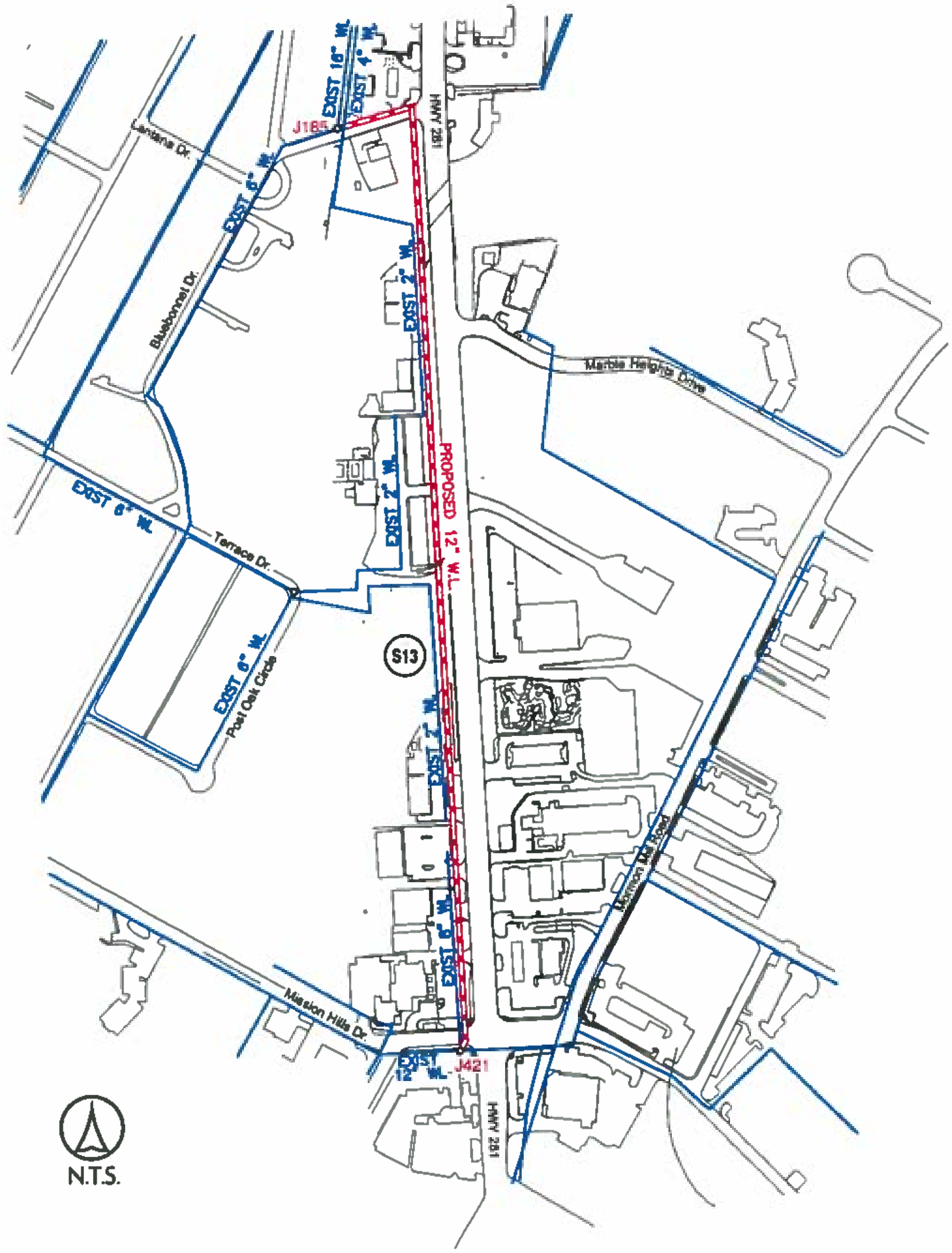
FIGURE 1-H



LEGEND

- (S2) STUDY AREA
- J595 JUNCTION NUMBER AS DESIGNATED BY BENTLEY WATER CAD PROGRAM
- EXIST W.L. EXISTING WATER LINE
- PROPOSED W.L. PROPOSED WATER LINE SOLUTION
- FIRE EVENT JUNCTION FAILURE LOCATION

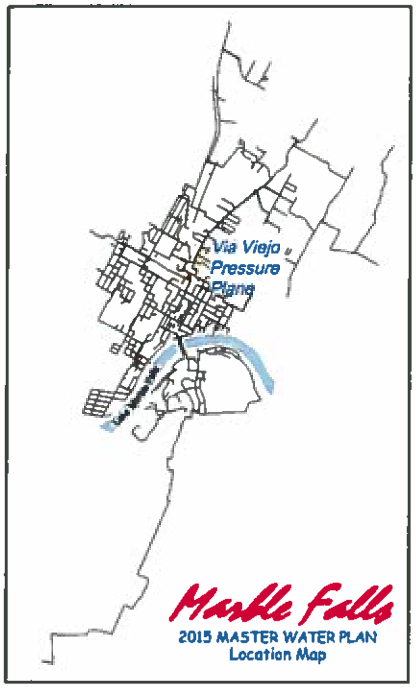
PEAK DAY FLOW 4.42GPM/LUE



PROJECT COST ESTIMATE		
PROJECT NUMBER	YEAR SCHEDULED	PRELIMINARY ESTIMATED COST
20	2024	$324,000

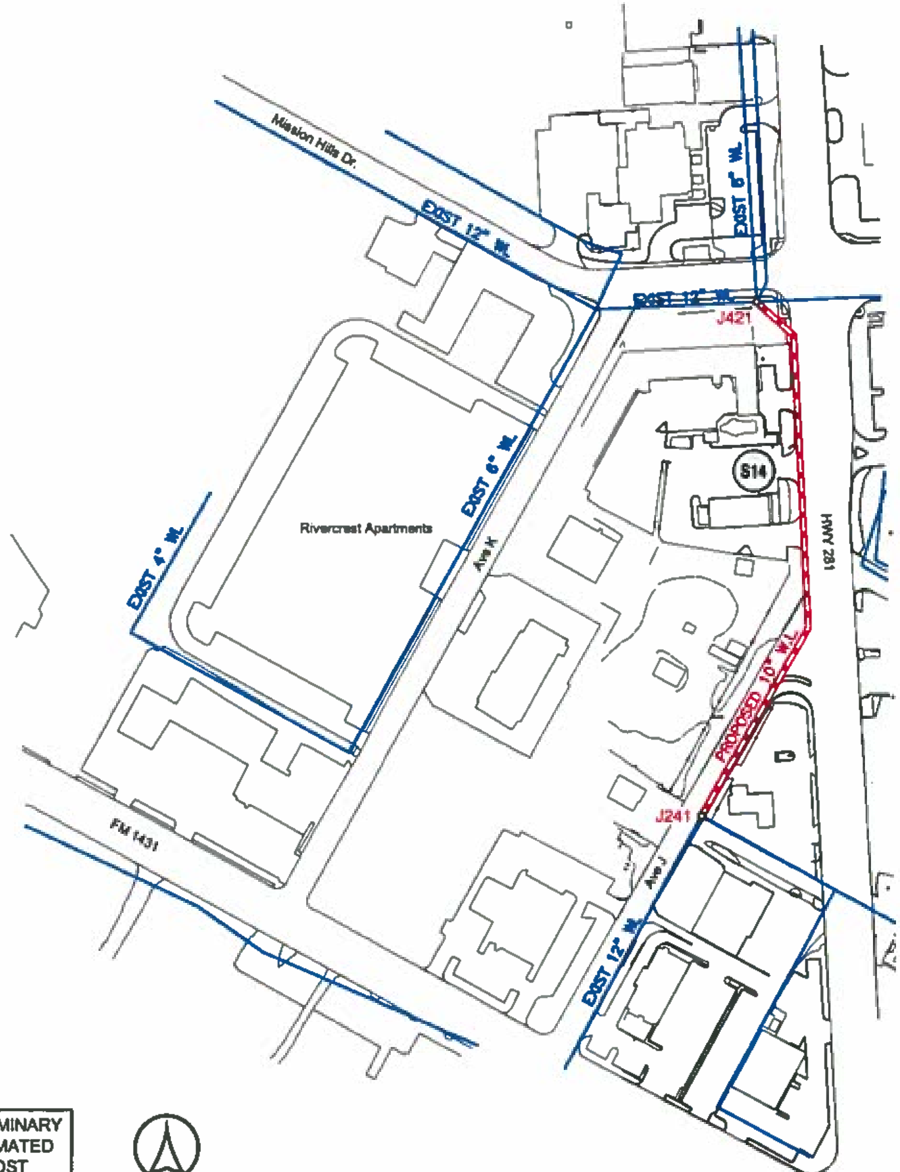
STUDY AREA	DESCRIPTION OF FAILURE AND SOLUTION
S13	ADD NEW 12" PVC W.L. STARTING AT (J185) ON LANTANA DR., HEAD EAST TO HWY 281 THEN SOUTH ALONG WEST SIDE OF HWY 281 DOWN TO CONNECT TO EXISTING 12" PVC W.L. ON MISSION HILLS DR. TO CREATE LOOP FOR FIRE PROTECTION FOR RETAIL BUSINESSES ALONG WEST SIDE OF HWY 281 (TOTAL PIPE LENGTH= 2,700 LF)

FIGURE 1-I



LEGEND

S2	STUDY AREA
J595	JUNCTION NUMBER AS DESIGNATED BY BENTLEY WATER CAD PROGRAM
EXIST W.L.	EXISTING WATER LINE
PROPOSED W.L.	PROPOSED WATER LINE SOLUTION
	FIRE EVENT JUNCTION FAILURE LOCATION
PEAK DAY FLOW	4.42GPM/LUE



PROJECT COST ESTIMATE

PROJECT NUMBER	YEAR SCHEDULED	PRELIMINARY ESTIMATED COST
21	2024	$98,000

N.T.S.

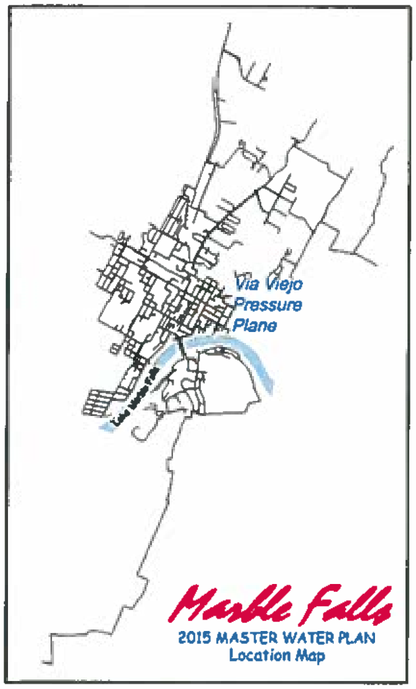
STUDY AREA

S14

DESCRIPTION OF FAILURE AND SOLUTION

ADD NEW 10" PVC W.L. TO CREATE LOOP FOR FIRE PROTECTION BEGINNING AT (J421) AT CORNER OF HWY 281 AND MISSION HILLS DR. HEADING SOUTH ALONG WEST SIDE OF HWY 281 DOWN TO EXISTING 12" PVC W.L. (J241) ON AVE. J AT USED CAR DEALERSHIP (TOTAL PIPE LENGTH= 730 LF)

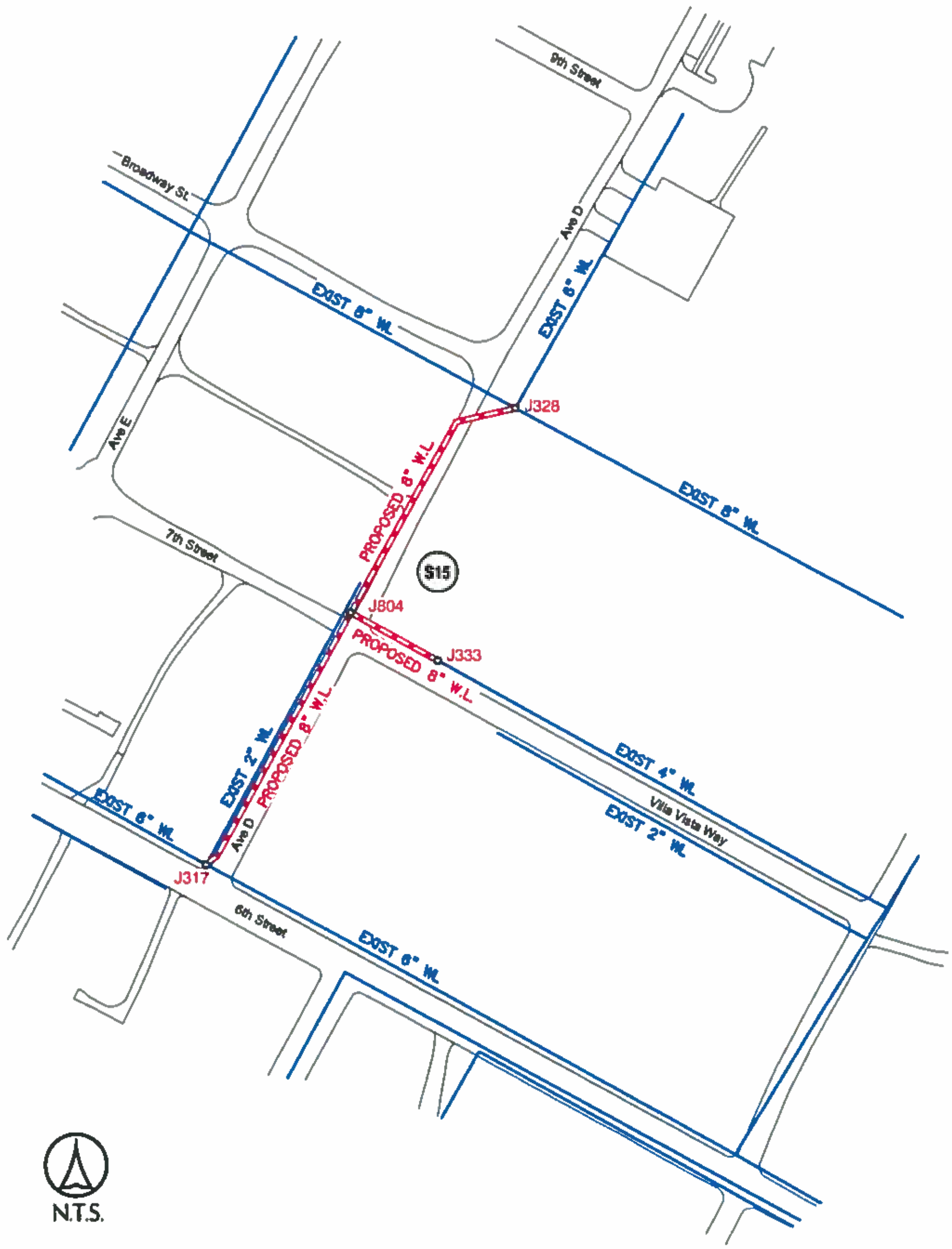
FIGURE 1-J



LEGEND

S2	STUDY AREA
J595	JUNCTION NUMBER AS DESIGNATED BY BENTLEY WATER CAD PROGRAM
EXIST W.L.	EXISTING WATER LINE
PROPOSED W.L.	PROPOSED WATER LINE SOLUTION
	FIRE EVENT JUNCTION FAILURE LOCATION

PEAK DAY FLOW 4.42GPM/LUE



PROJECT COST ESTIMATE		
PROJECT NUMBER	YEAR SCHEDULED	PRELIMINARY ESTIMATED COST
22	2024	$96,000

N.T.S.

STUDY AREA	DESCRIPTION OF FAILURE AND SOLUTION
S15	PROVIDE FIRE PROTECTION AT THE CORNER OF AVE. D AND VILLA VISTA WAY, ADD NEW 8" PVC W.L. BEGINNING AT EXISTING 6" A.C. W.L. (J317) AT CORNER OF 6TH ST. AND AVE. D AND HEAD NORTH ON AVE. D TO CONNECT TO EXISTING 8" D.I. W.L. ON BROADWAY ST. (J328). CONNECT NEW 8" PVC W.L. TO END OF EXISTING 4" A.C. W.L. (J333) AT WEST END OF VILLA VISTA WAY AND HEAD WEST TO TEE INTO PROPOSED NEW 8" PVC W.L. (J804) (TOTAL PIPE LENGTH= 875 LF)

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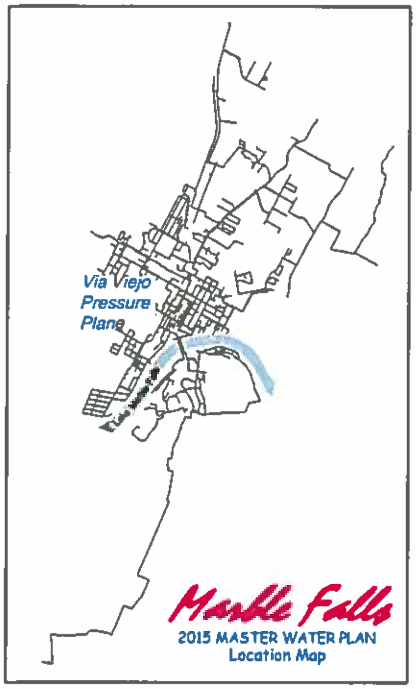
FIGURE 1-K



LEGEND

S2	STUDY AREA
J595	JUNCTION NUMBER AS DESIGNATED BY BENTLEY WATER CAD PROGRAM
EXIST W.L.	EXISTING WATER LINE
PROPOSED W.L.	PROPOSED WATER LINE SOLUTION
	FIRE EVENT JUNCTION FAILURE LOCATION

PEAK DAY FLOW 4.42GPM/LUE

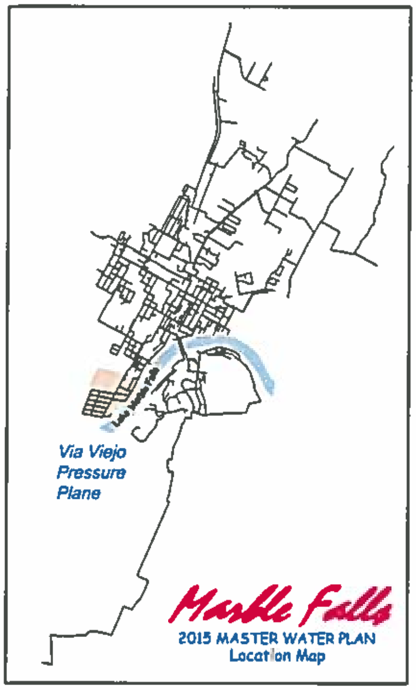
PROJECT COST ESTIMATE

PROJECT NUMBER	YEAR SCHEDULED	PRELIMINARY ESTIMATED COST
23	2024	$56,000

N.T.S.

STUDY AREA	DESCRIPTION OF FAILURE AND SOLUTION
S16	CLOSE LOOP TO PROVIDE FIRE PROTECTION ON 6TH ST. BETWEEN MAIN ST. AND HWY 281. ADD NEW 8" PVC W.L. BEGINNING AT EXISTING 8" D.I. W.L. (J770) ON MAIN ST. AND HEAD EAST TO CONNECT TO EXISTING 4" PVC W.L. ON 6TH ST. AT ALLEY WAY BEHIND "SALEM" RETAIL CENTER (TOTAL PIPE LENGTH= 180 LF)
S17	CLOSE LOOP TO PROVIDE FIRE PROTECTION ON MAIN ST. BETWEEN 3RD ST. AND 4TH ST. ADD NEW 8" PVC W.L. BEGINNING AT EXISTING 8" PVC W.L. (J142) ON CORNER OF MAIN ST. AND 3RD ST. THEN HEAD NORTH TO CONNECT TO EXISTING 6" PVC W.L. ON CORNER MAIN ST. AND 4TH ST. (TOTAL PIPE LENGTH= 408 LF)

FIGURE 1-L



LEGEND

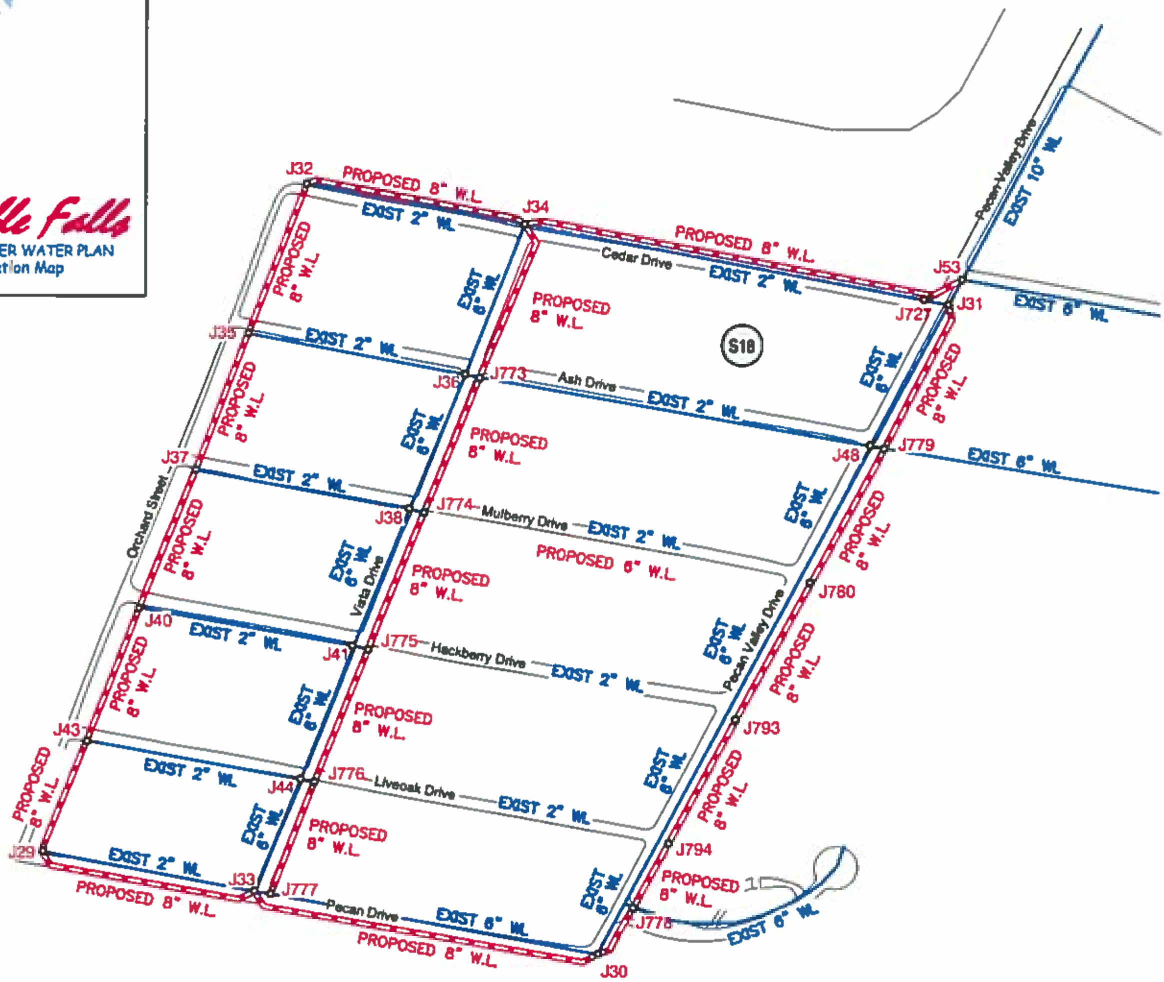
- (S2) STUDY AREA
- J595 JUNCTION NUMBER AS DESIGNATED BY BENTLEY WATER CAD PROGRAM
- EXIST W.L. — EXISTING WATER LINE
- PROPOSED W.L. — PROPOSED WATER LINE SOLUTION
- FIRE EVENT JUNCTION FAILURE LOCATION

PEAK DAY FLOW 4.42GPM/LUE

PROJECT COST ESTIMATE

PROJECT NUMBER	YEAR SCHEDULED	PRELIMINARY ESTIMATED COST
24	2024	$728,000

N.T.S.



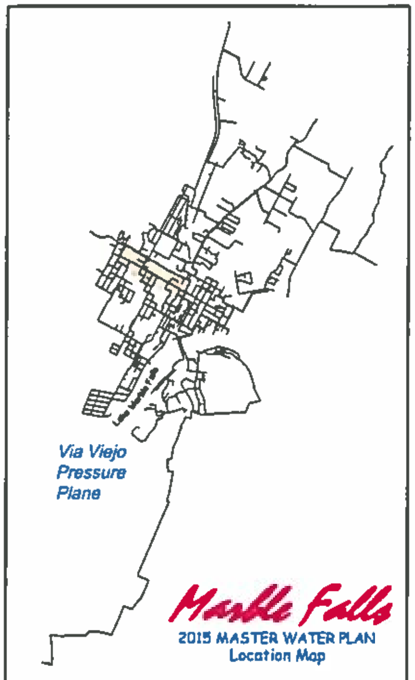
STUDY AREA

(S18)

DESCRIPTION OF FAILURE AND SOLUTION

FAILURES AT MULTIPLE LOCATIONS IN THIS SECTION AT 750 GPM FIRE TEST.
ADD NEW 8" PVC W.L. AT PERIMETER (CEDAR DR., ORCHARD ST., PECAN DR., PECAN VALLEY DR.) CONNECTING BACK TO EXISTING 10" D.I. W.L. ON PECAN VALLEY DR. (J53)
ADD NEW 8" PVC W.L. AT FULL LENGTH OF VISTA DR. THESE UPDATES SATISFY ALL FIRE DEMANDS ON EACH CROSS STREET (CEDAR DR., ASH DR., MULBERRY DR., HACKBERRY DR., LIVEOAK DR., PECAN DR.)
(TOTAL OF ALL 8" PVC W.L. PIPE = 7,657 LF)

FIGURE 1-M



LEGEND

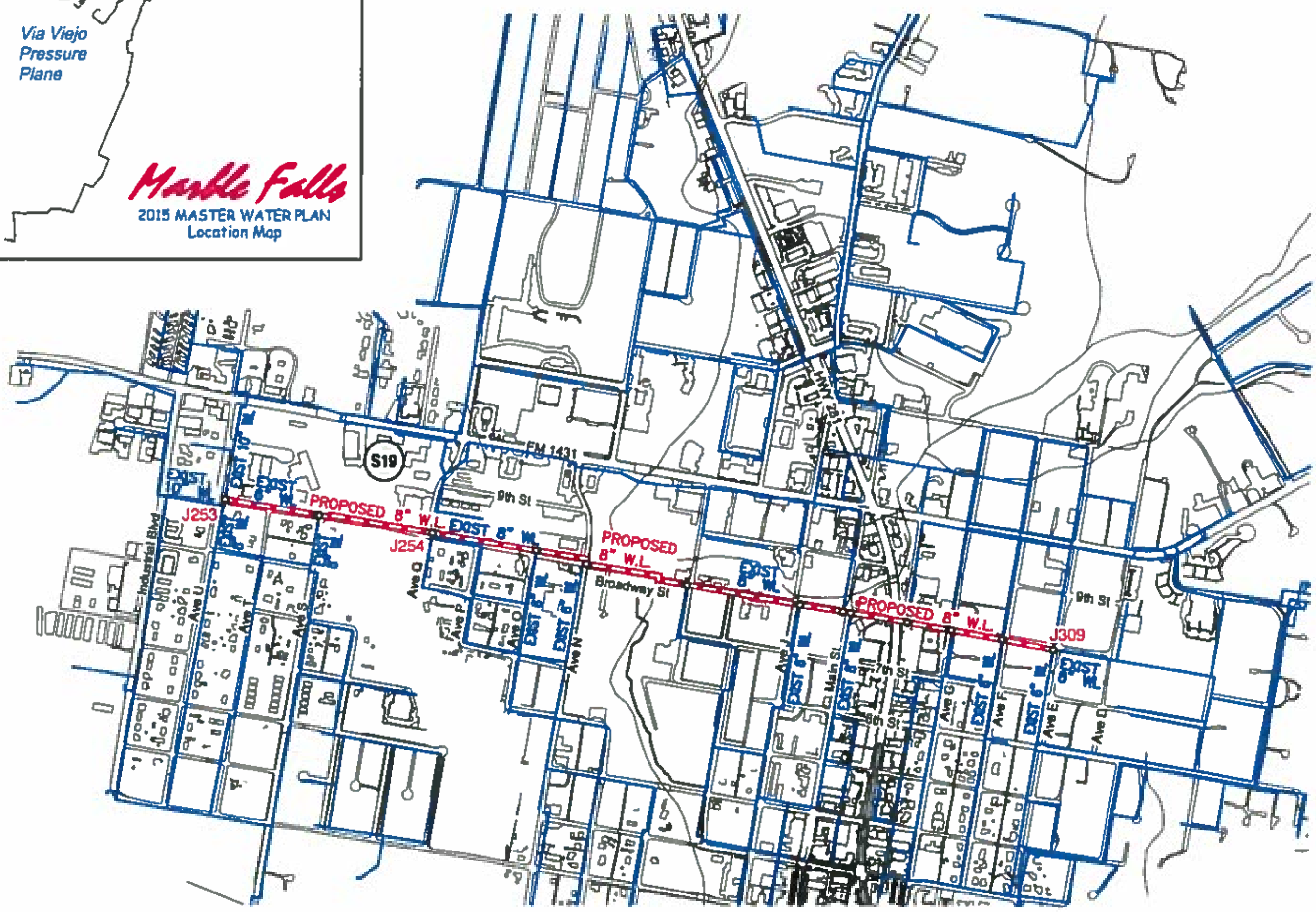
- (S2) STUDY AREA
- J595 JUNCTION NUMBER AS DESIGNATED BY BENTLEY WATER CAD PROGRAM
- EXIST W.L. EXISTING WATER LINE
- PROPOSED W.L. PROPOSED WATER LINE SOLUTION
- FIRE EVENT JUNCTION FAILURE LOCATION

PEAK DAY FLOW 4.42GPM/LUE

PROJECT COST ESTIMATE

PROJECT NUMBER	YEAR SCHEDULED	PRELIMINARY ESTIMATED COST
12	2024	$930,000

N.T.S.



STUDY AREA (S19)

DESCRIPTION OF FAILURE AND SOLUTION

DEGRADED CONDITIONS REQUIRING FREQUENT MAINTENANCE NECESSITATES REPLACEMENT OF EXISTING 6" PVC W.L. AND 8" D.I. W.L. ALONG BROADWAY STREET.
BEGINNING AT (J253) ON BROADWAY ST. AND AVE. J REPLACE EXISTING 1,604 L.F. OF 6" PVC W.L. TO (J254) ON AVE Q. WITH NEW 8" PVC W.L.
CONTINUE ON BROADWAY ST. AT (J254) WITH REPLACEMENT OF EXISTING 8" D.I. W.L. HEADING EAST 5,246 L.F. TO (J309) ON AVE E WITH NEW 8" PVC W.L.
(TOTAL 8" PVC W.L. PIPE= 6,450 LF)

SECTION 7.

LCRA RAW WATER SUPPLY CONTRACT

As mentioned previously, the City's potable water is provided from a surface water treatment plant treating raw water from Lake Marble Falls on the Colorado River. To serve the projected 30-year water needs through year 2044 of 8,217 projected equivalent connections (see Table 9), the required treated water supply capacity based upon the City of Marble Falls historical demands of 0.42 GPM/LUE, is 4.97 million gallons per day (MGD) for 24-hour pumping and treatment (3.452 GPM).

The City has recently been implementing increases in certain components of the water treatment plant. A 500,000 gallon precast concrete clearwell has been added in year 2014. A 3.5 MGD concrete clarifier is currently under construction (November 2015). The next components of the water treatment plant that will need expanding are:

1. The raw water pump station, and

2. The gravity filters.

The expansion of the raw water pumps should bring the pump stations firm capacity up to 6.3 MGD. The City has physical space on the water treatment plant site to add only two more filter cells, with the option of adding one additional filter cell to raise the treatment plant capacity to 4.8 MGD or constructing two filter basins to max the plant out at 6.3 MGD.

The construction of both filters in one phase will certainly save the City in the long run versus building only one filter at a time. Of course, the City must be sensitive to dedicating its available funds to the highest priority water projects.

The existing water supply contract with the Lower Colorado River Authority (LCRA) stipulates a maximum raw water supply rate of 2,000 acre-feet per year, which equates to an average of 1.79 MGD. The contract stipulations and costs for this raw water are detailed in the LCRA Raw Water Sale Contract. Based upon the year 2000 water consumption and service connection data, the current average water use is approximately 304 gallons per day per living unit equivalent (LUE).

For 4,818 existing LUE's and an average water demand of 304 gallons per day per LUE in the City, 1,641 acre-feet per year of surface water would be consumed out of the 2,000 ac-ft. per year contractual allocations from LCRA. This usage represents 82% of the City's contracted amount. Based on the Population and LUE Projections shown in Table 9, the current LCRA surface water allocation should last until year 2022, when 5,888 LUE's should be active (1,790,000 GPD ÷ 304 gallons per day per connection average = 5,888 LUE's. Applying this usage to the projected 30-year service need of 8,217 LUE's yields an average daily water flow in the year 2044 of about 2.50 MGD. The associated raw water supply, calculated on an annual basis, will be approximately 2,798 acre-feet per year. It is therefore recommended that the City continue to monitor its water usage amounts and when appropriate initiate an increase in its raw water supply contract with LCRA to at least 2,800 acre-feet per year. These raw water supply needs could escalate, if the "Water usage per LUE" increases to year 2000 usage levels.

SECTION 8.

RECOMMENDED WATER SYSTEM IMPROVEMENTS AND PROBABLE ESTIMATED COSTS FOR IMMEDIATE, NEAR-TERM, INTERMEDIATE 1, INTERMEDIATE 2 AND ULTIMATE DESIGN SCENARIO PROJECTS FOR THE RECOMMENDED CAPITAL IMPROVEMENTS PROGRAM (CIP)

Estimates of probable cost are provided for a thirty (30) year period from year 2015 to 2044. From Table 10 – Water Demand Requirements, projections for growth show that equivalent water connections (LUE's) will grow from 4,818 existing connections in 2014 to 8,217 connections by year 2044, or an increase of 3,399 LUE's. To stay ahead of TCEQ's 85% capacity rule for water treatment plant and high service pumping capacity and to improve the reliability of the City's water system, this Water System Master Plan includes recommendations for major water system improvements and probable estimates of cost for those facilities identified in Table 16, herein, for Immediate projects (year 2016 completion), Near-term projects (year 2020 completion), Intermediate 1 projects (year 2024 completion), Intermediate 2 projects (year 2034 completion) and Ultimate (year 2044 completion).

Figure 5 is an existing site plan of the City's water treatment plant on Circle Drive. Figure 6 depicts a proposed site plan of the same water treatment plant facility with "Under Construction and Recommended) facilities shown.

The preliminary estimated costs herein have been developed based on area historical construction costs for projects of similar scope and nature. A 25% factor has been added into the estimates for engineering, surveying and contingencies. No costs have been included for land and easement acquisition, legal or fiscal expenses. The recommended improvements, schedules and probable estimates of cost are presented in Table 16. Detailed estimates of probable cost for adding additional gravity filtration for expanding the water treatment plant to 4.8 or 6.3 MGD are included in Appendix C.

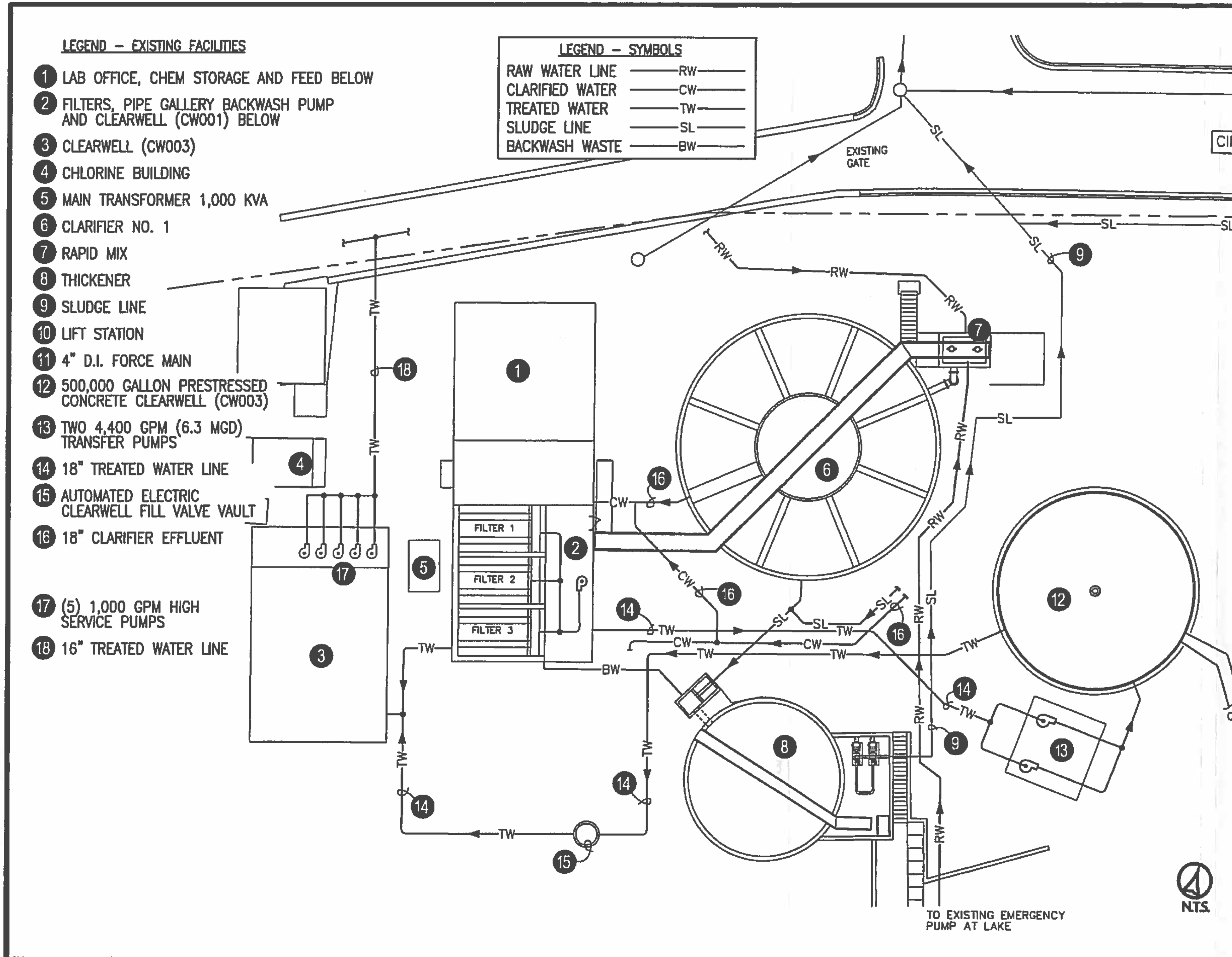


FIGURE 5

CITY OF MARBLE FALLS, TEXAS
EXISTING WATER TREATMENT PLANT SITE PLAN

S. D. KALLMAN, LP.
Engineers and Environmental Consultants
TBPE Firm Registration No. F-516
1106 South Mays, Suite 101
Round Rock, TX. 78664
Phone: (512) 218-4404
Fax: (512) 218-1668
www.sdkallman.com

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LEGEND – EXISTING FACILITIES

1. LAB OFFICE, CHEM STORAGE AND FEED BELOW
2. FILTERS, PIPE GALLERY BACKWASH PUMP AND CLEARWELL (CW001) BELOW
3. CLEARWELL (CW003)
4. CHLORINE BUILDING
5. MAIN TRANSFORMER 1,000 KVA
6. CLARIFIER NO. 1
7. RAPID MIX
8. THICKENER
9. SLUDGE LINE
10. LIFT STATION
11. 4" D.I. FORCE MAIN
12. 500,000 GALLON PRESTRESSED CONCRETE CLEARWELL (CW003)
13. TWO 4,400 GPM (6.3 MGD) TRANSFER PUMPS
14. 18" TREATED WATER LINE
15. AUTOMATED ELECTRIC CLEARWELL FILL VALVE VAULT
16. 18" CLARIFIER EFFLUENT
16. 18" CLARIFIER EFFLUENT (UNDER CONSTRUCTION)
17. (5) 1,000 GPM HIGH SERVICE PUMPS
18. 16" TREATED WATER LINE
19. 3.5 MGD CLARIFIER NO. 2 (UNDER CONSTRUCTION)
20. IMMEDIATE PROJECT: TWO 1.5 MGD GRAVITY FILTERS (ONE FILTER– 4.8 MGD TOTAL PLANT CAPACITY. TWO FILTERS– 6.3 MGD TOTAL PLANT CAPACITY)
21. INTERMEDIATE PROJECT: ONE– 1,000 GPM HIGH SERVICE PUMP FOR GATEWAY STANDPIPE

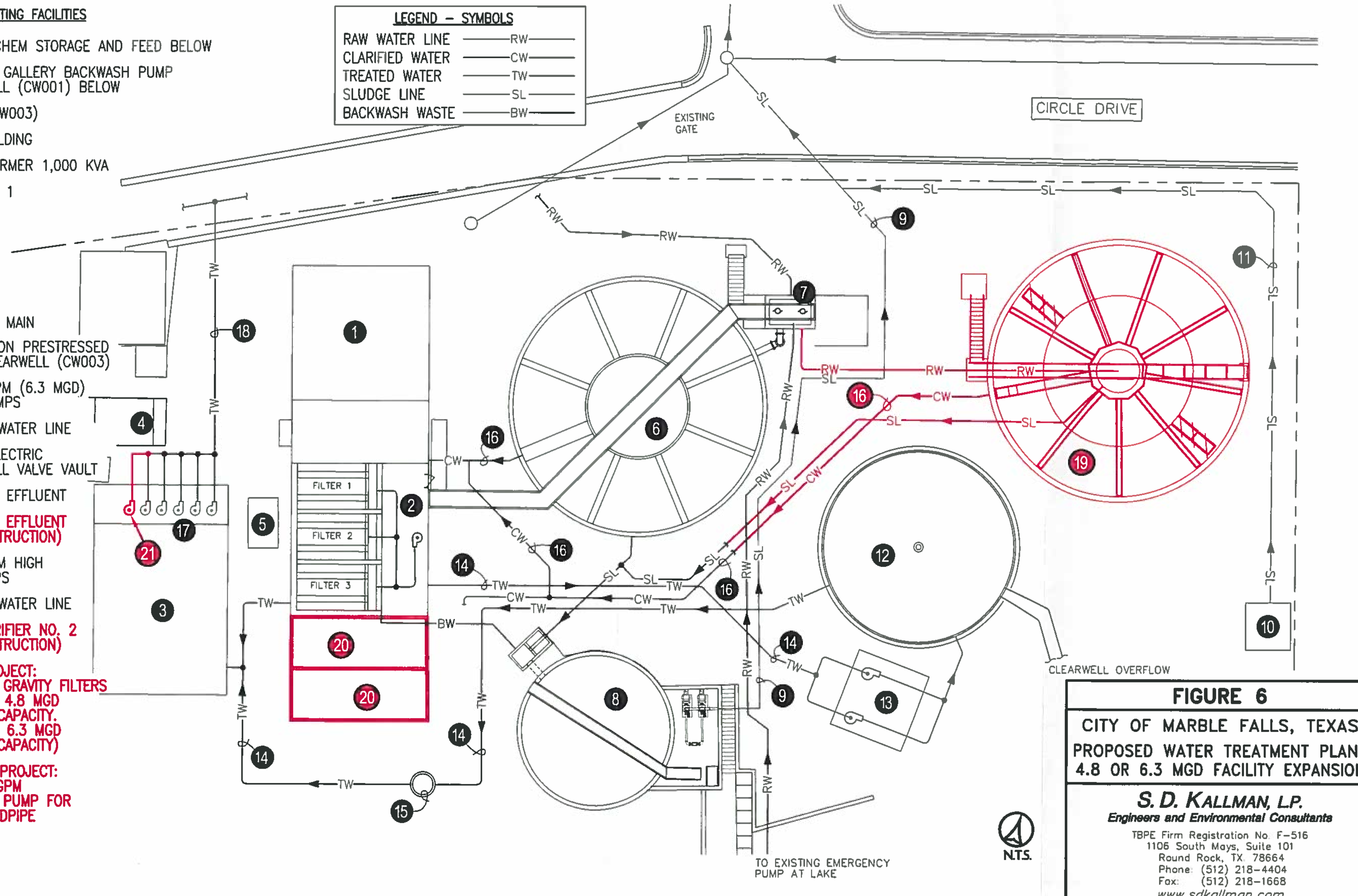

FIGURE 6

CITY OF MARBLE FALLS, TEXAS

PROPOSED WATER TREATMENT PLANT 4.8 OR 6.3 MGD FACILITY EXPANSION

S. D. KALLMAN, L.P.
Engineers and Environmental Consultants
TBPE Firm Registration No. F-516
1106 South Mays, Suite 101
Round Rock, TX 78664
Phone: (512) 218-4404
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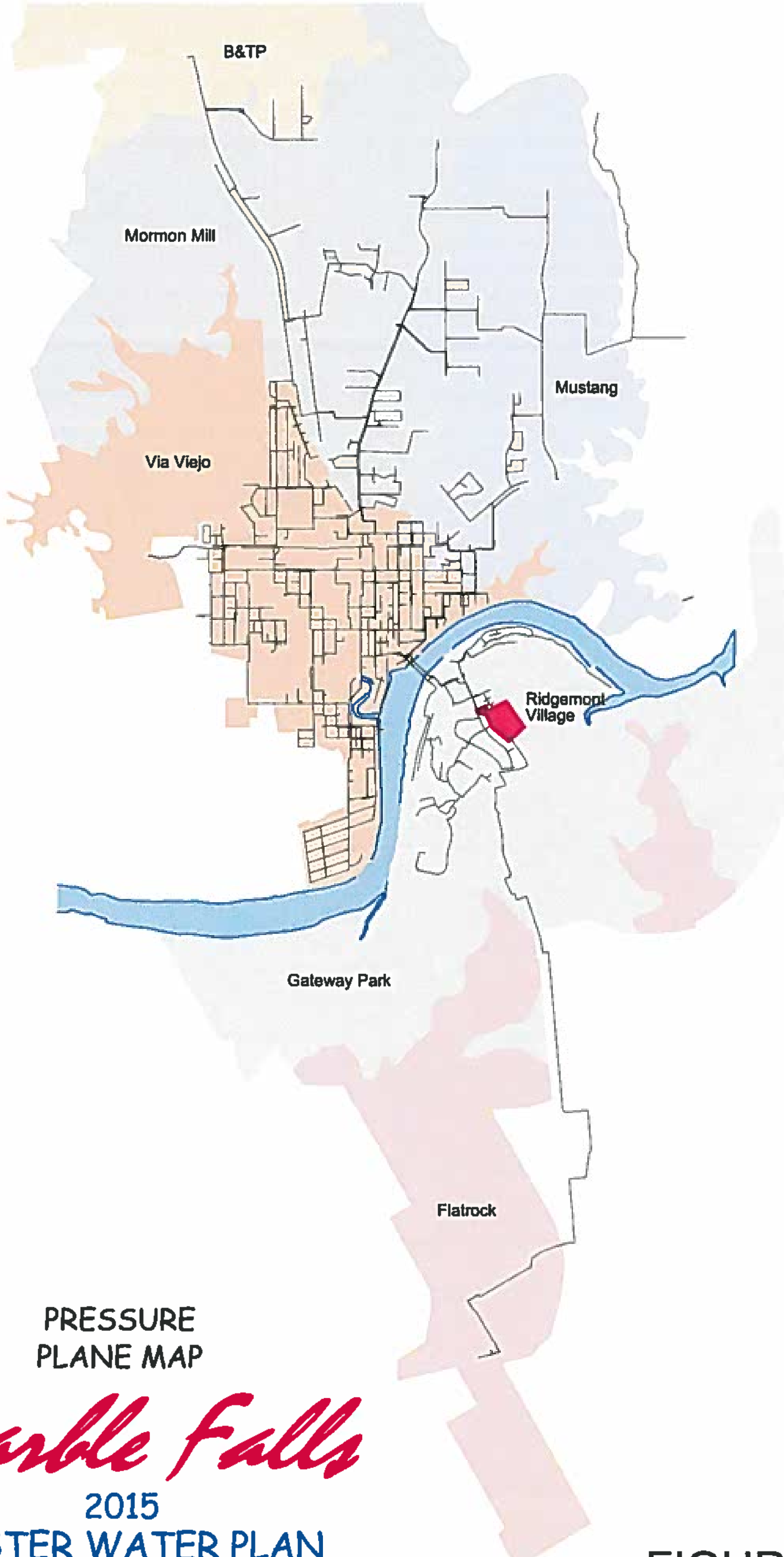
www.sdkallman.com



PRESSURE
PLANE MAP

Marble Falls
2015
MASTER WATER PLAN

FIGURE 7

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TABLE 16

CITY OF MARBLE FALLS

PROJECT LIST, SCHEDULE AND PROBABLE ESTIMATES OF COST FOR RECOMMENDED WATER SYSTEM IMPROVEMENTS

YEAR SCHEDULED	PROJECT NO.	TYPE OF FACILITY	RECOMMENDED IMPROVEMENTS	PRELIMINARY ESTIMATED COST INCLUDING 25% ENGINEERING AND CONTINGENCY
8.1 "Immediate" Project Recommendations for Water System Improvements that should be online by End of Year 2016				
Immediate (Year 2016)	1	Water Treatment Plant	Add 1 - 1.5 MGD Gravity Filter to Expand Plant to 4.8 MGD, Replace 2 Existing Raw Water Pumps with 2 - 2,400 GPM Pumps and VFD's and Construct Existing Water Treatment Plant Upgrades	$3,924,500
Immediate (Year 2016)	1A	Water Treatment Plant Alternate	Add 2 - 1.5 MGD Gravity Filters to Expand Existing Plant to 6.3 MGD, Replace 3 Existing Raw Water Pumps with 3 - 2,400 GPM Pumps and VFD's and Construct Existing Water Treatment Plant Upgrades	($5,107,500)
Immediate (Year 2016)	2	Water Distribution Line	<u>Mustang Pressure Plane</u> Install 16" Water Line from Via Viejo High Service Pump Station to Existing 16" Water Line at F.M. 1431 and Manzano Mile From Figure 1-B. S4 - 1476 L.F. of 16" Water Line plus F.M. 1431 Highway Bore = $340,000	$340,000
Immediate (Year 2016)	3	Water Storage Tank	<u>Via Viejo Pressure Plane</u> Demolish Existing 200,000 Gallon and 500,000 Gallon Ground Storage Tank at Via Viejo. Construct One - 800,000 Gallon Prestressed Concrete Tank at Via Viejo (55 feet high)	$1,100,000
Immediate (Year 2016)	4	Water Well	<u>Flatrock Pressure Plane</u> Install Pump, Piping and Controls in Existing 10" Diameter Water Well	$265,000
8.1 Total Probable Estimate of Cost for "Immediate" Improvements (Project Nos. 1-4)				$5,629,500
(Project Nos. 1A, 2, 3 and 4)				($6,812,500)

TABLE 16 (Cont'd)

CITY OF MARBLE FALLS
PROJECT LIST, SCHEDULE AND PROBABLE ESTIMATES OF COST
FOR RECOMMENDED WATER SYSTEM IMPROVEMENTS

YEAR SCHEDULED	PROJECT NO.	TYPE OF FACILITY	RECOMMENDED IMPROVEMENTS	PRELIMINARY ESTIMATED COST INCLUDING 25% ENGINEERING AND CONTINGENCY
8.2 "Near-Term" Project Recommendations for Water System Improvements that should be online by End of Year 2020				
Near Term (Year 2020)	5	Water Treatment Plant	Remove and Dispose (Off-Site) Existing Clarifier Equipment at Clarifier No. 1. Furnish and Install New Clarifier Equipment	$870,000
Near Term (Year 2020)	6	Water Distribution Line	Gateway Park Pressure Plane Install SCADA Controls at the Water Treatment Plant Site and Gateway Standpipe Site to allow 1 - 1,000 GPM High Service Pump at the Water Treatment Plant High Service Pump Station to be solely dedicated to filling the Gateway Standpipe - Close Valves Branching off of the Existing 16" Water Line from the Water Treatment Plant to the Gateway Standpipe to eliminate water flow into the Gateway Park Pressure Plane from the Existing 16" Dedicated Water Line	$50,000
Near Term (Year 2020)	7	Water Distribution Line	Flatrock Pressure Plane Install a Main-Line PRV on the 16" Flatrock Pressure Plane Water Distribution Line leaving the Gateway Standpipe Site and Connect to the Ridgemont Village Pressure Plane Water Line on the same Site. This will allow the Flatrock Pressure Plane to serve the Ridgemont Village Pressure Plane and take the 2 - High Service Pumps and Hydropneumatic Pressure Tank at Gateway Park out of service	$50,000
Near Term (Year 2020)	8	High Service Pumps	Mustang Pressure Plane Replace the 2 - 1,000 GPM High Service Pumps with 2 - 1,500 GPM Pumps at the Via Viejo Pump Station to satisfy growing water demands in the Mustang, Mormon Mill and Business & Tech Park Pressure Planes, all of which are served by the Via Viejo Pumps. Upsize the Yard Piping from the new recommended Via Viejo 800,000 Gallon Tank to the Pumps' Suction Header.	$500,000
8.2 Total Probable Estimate of Cost for "Near Term" Improvements (Project Nos. 5-8)				**$1,470,000**

TABLE 16 (Cont'd)

CITY OF MARBLE FALLS
PROJECT LIST, SCHEDULE AND PROBABLE ESTIMATES OF COST FOR RECOMMENDED WATER SYSTEM IMPROVEMENTS

YEAR SCHEDULED	PROJECT NO.	TYPE OF FACILITY	RECOMMENDED IMPROVEMENTS	PRELIMINARY ESTIMATED COST INCLUDING 25% ENGINEERING AND CONTINGENCY
8.3 "Intermediate 1" Project Recommendations for Water System Improvements that should be online by End of Year 2024				
Intermediate 1 (Year 2024)	9	High Service Pumps	Gateway Park Pressure Plane Install the sixth 1,000 GPM High Service Pump at the Water Treatment Plant High Service Pump Station to dedicate 2 - 1000 GPM High Service Pumps to filling the Gateway Standpipe as water	$175,000
Intermediate 1 (Year 2024)	10	High Service Pumps	Flatrock Pressure Plane Expand the Flatrock High Service Pump Station at the Gateway Standpipe Site by adding 1 - 1500 GPM High Service Pump to meet growing water demands in the Flatrock Pressure Plane (related to Project No. 15, above)	$175,000
Intermediate 1 (Year 2024)	11	Water Storage	Business & Industrial Park Pressure Plane 250,000 Gallon, 105 Foot High Standpipe and 12" Water Line from Street to Standpipe	$400,000
Intermediate 1 (Year 2024)	12	Water Distribution Line	Via Viejo Pressure Plane Install Replacement 8" Water Line on Broadway Street from Industrial Blvd. East to Avenue "E" from Figure 1-M: S19 - 6450 L.F. of 8" Water Line Replacement plus U.S. Hwy. 81 Bore = $930,000	$930,000
8.3 Total Probable Estimate of Cost for "Intermediate 1" Improvements (Project Nos. 9-12)				$1,680,000

TABLE 16 (Cont'd)

CITY OF MARBLE FALLS
PROJECT LIST, SCHEDULE AND PROBABLE ESTIMATES OF COST
FOR RECOMMENDED WATER SYSTEM IMPROVEMENTS

YEAR SCHEDULED	PROJECT NO.	TYPE OF FACILITY	RECOMMENDED IMPROVEMENTS	PRELIMINARY ESTIMATED COST INCLUDING 25% ENGINEERING AND CONTINGENCY
8.4 "Intermediate 1" Project Recommendations for "Current Fire Flow Needs" that should be online by End of Year 2024				
Intermediate 1 (Year 2024)	13	Water Distribution Line	Mustang Pressure Plane From Figure 1-A to Upgrade Fire Protection: S1 - 1900 L.F. of 12" Water Line = $228,000 S1 - 1600 L.F. of 8" Water Line = $144,000 S1 - Install 8" PRV = $10,000 S2 - 1394 L.F. of 10" Water Line = $154,000 S3 - 375 L.F. of 8" Water Line = $34,000 Total = $570,000	$570,000
Intermediate 1 (Year 2024)	14	Water Distribution Line	Gateway Park Pressure Plane From Figure 1-C to Upgrade Fire Protection: S5 - 422 L.F. of 6" Water Line = $55,000 Cap Two - 2" Water Lines = $3,000 Total = $58,000	$58,000
Intermediate 1 (Year 2024)	15	Water Distribution Line	Gateway Park Pressure Plane From Figure 1-D to Upgrade Fire Protection: S6 - 115 L.F. of 12" Water Line = $20,000 S7 - 587 L.F. of 12" Water Line = $100,000 Total = $120,000	$120,000
Intermediate 1 (Year 2024)	16	Water Distribution Line	Mormon Mill Pressure Plane From Figure 1-E to Upgrade Fire Protection: S8 - 261 L.F. of 8" Water Line = $29,000 S9 - 210 L.F. of 8" Water Line = $23,000 S10 - 460 L.F. of 8" Water Line = $51,000 Total = $103,000	$103,000

TABLE 16 (Cont'd)

CITY OF MARBLE FALLS

PROJECT LIST, SCHEDULE AND PROBABLE ESTIMATES OF COST FOR RECOMMENDED WATER SYSTEM IMPROVEMENTS

YEAR SCHEDULED	PROJECT NO.	TYPE OF FACILITY	RECOMMENDED IMPROVEMENTS	PRELIMINARY ESTIMATED COST INCLUDING 25% ENGINEERING AND CONTINGENCY
Intermediate 1 (Year 2024)	17	Water Distribution Line	<u>Mormon Mill Pressure Plane</u> Nature Heights Water Line 2900 L.F. of 12" Water Line = $406,000	$406,000
Intermediate 1 (Year 2024)	18	Water Distribution Line	<u>Mormon Mill Pressure Plane</u> From Figure 1-F to Upgrade Fire Protection: S11 - 1310 L.F. of 12" Water Line = $158,000	$158,000
Intermediate 1 (Year 2024)	19	Water Distribution Line	<u>Via Viejo Pressure Plane</u> From Figure 1-G to Upgrade Fire Protection: S12 - 350 L.F. of 6" Water Line = $30,000	$30,000
Intermediate 1 (Year 2024)	20	Water Distribution Line	<u>Mormon Mill Pressure Plane</u> From Figure 1-H to Upgrade Fire Protection S13 - 2700 L.F. of 12" Water Line = $324,000	$324,000
Intermediate 1 (Year 2024)	21	Water Distribution Line	<u>Via Viejo Pressure Plane</u> From Figure 1-I to Upgrade Fire Protection: S14 - 730 L.F. of 10" Water Line = $98,000	$98,000
Intermediate 1 (Year 2024)	22	Water Distribution Line	<u>Via Viejo Pressure Plane</u> From Figure 1-J to Upgrade Fire Protection: S15 - 875 L.F. of 8" Water Line = $96,000	$96,000
Intermediate 1 (Year 2024)	23	Water Distribution Line	<u>Via Viejo Pressure Plane</u> From Figure 1-K to Upgrade Fire Protection: S16 - 180 L.F. of 8" Water Line = $17,000 S17 - 408 L.F. of 8" Water Line = $39,000 Total = $56,000	$56,000
Intermediate 1 (Year 2024)	24	Water Distribution Line	<u>Via Viejo Pressure Plane</u> From Figure 1-L to Upgrade Fire Protection: S18 - 7657 L.F. of 8" Water Line = $728,000	$728,000
8.4 Total Probable Estimate of Cost for "Intermediate 1" Improvements (Project Nos. 13-24)				$2,747,000

TABLE 16 (Cont'd)

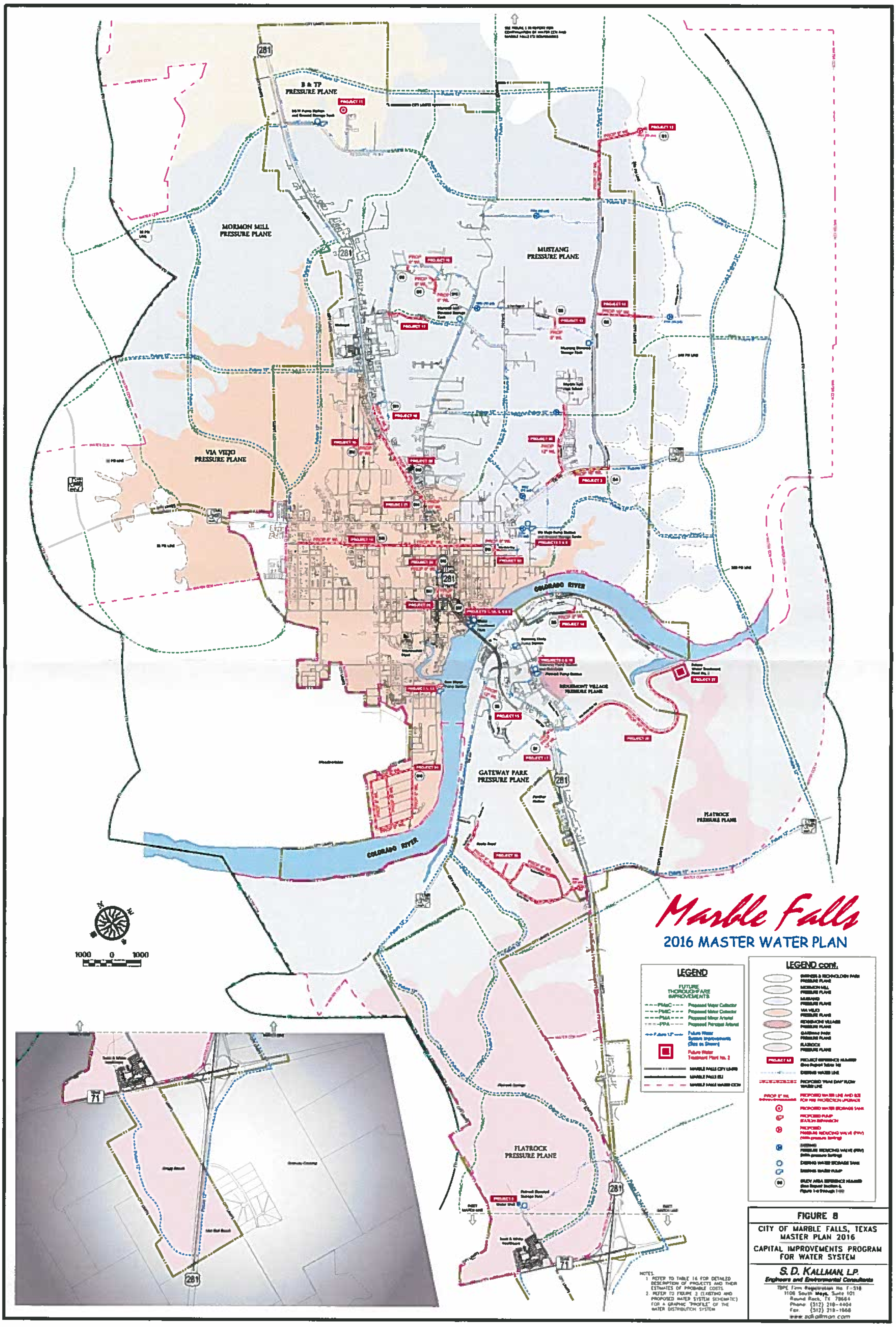
CITY OF MARBLE FALLS
PROJECT LIST, SCHEDULE AND PROBABLE ESTIMATES OF COST
FOR RECOMMENDED WATER SYSTEM IMPROVEMENTS

YEAR SCHEDULED	PROJECT NO.	TYPE OF FACILITY	RECOMMENDED IMPROVEMENTS	PRELIMINARY ESTIMATED COST INCLUDING 25% ENGINEERING AND CONTINGENCY
8.5 "Intermediate 2" Project Recommendations for Water System Improvements that should be online by End of Year 2034				
Intermediate 2 (Year 2034)	25	Water Distribution Line	Gateway Park Pressure Plane 14,500 L.F. of 8" Water Lines and Fire Hydrants through the Lake Marble Falls Subdivision (Rocky Road Water Line) Total = $2,170,000	$2,170,000
Intermediate 2 (Year 2034)	26	Water Distribution Line	Replace 2,500 L.F. of Existing 10" Water Line with 12" Water Line along the West side of Mustang Drive	$300,000
Intermediate 2 (Year 2034)	27	Water Treatment Plant	3 MGD Water Treatment Plant on South Side of Lake including Raw Water Intake, Storage Tanks, High Service Pumps	$16,000,000
Intermediate 2 (Year 2034)	28	Water Distribution Line	6600 L.F. of 16" Water Line from South Water Treatment Plant to Gateway Park	$3,000,000
8.5 Total Probable Estimate of Cost for "Intermediate 2" Improvements (Project Nos. 25-28				$21,470,000
8.6 "Ultimate" Project Recommendations for Water System Improvements that should be online by End of Year 2044				
Ultimate (Year 2044)	-	-	Recommended Water System Improvements to be determined in next Master Water Plan update	$0
8.6 Total Probable Estimate of Cost for "Ultimate" Improvements				$0

TABLE 16 (Cont'd)

CITY OF MARBLE FALLS
PROJECT LIST, SCHEDULE AND PROBABLE ESTIMATES OF COST
FOR RECOMMENDED WATER SYSTEM IMPROVEMENTS
SUMMARY

YEAR SCHEDULED	PROJECT NOS.	DESIGN SCENARIO	PRELIMINARY ESTIMATED COST INCLUDING 25% ENGINEERING AND CONTINGENCY
Immediate	1 - 4 (1A, 2, 3 and 4)	Water System Improvements that are recommended to be online by end of year 2016	\$5,629,500 (\$6,812,500)
Near Term	5 - 8	Water System Improvements that are recommended to be online by end of year 2020	\$1,470,000
Intermediate 1	9 - 12	Water System Improvements that are recommended to be online by end of year 2024	\$1,680,000
Intermediate 1	13 - 14	Water System Improvements to meet "Current Fire Flow Needs" that are recommended to be online by end of year 2024	\$2,747,000
Intermediate 2	25 - 28	Water System Improvements that are recommended to be online by end of year 2034	\$21,470,000
Ultimate	-	Water System Improvements for the "Ultimate" Design Scenario shall be determined with future updates to the Master Water Plan	-
		Summary Total - Years 2016 Through 2044	\$32,996,500 (\$34,179,500)



B & TP PRESSURE PLANE
MORMON MILL PRESSURE PLANE
MUSTANG PRESSURE PLANE
VIA VIEJO PRESSURE PLANE
COLORADO RIVER
REDEMPTION VILLAGE PRESSURE PLANE
GATEWAY PARK PRESSURE PLANE
FLATROCK PRESSURE PLANE
281
71
1000 0 1000
Marble Falls
2016 MASTER WATER PLAN
LEGEND
FUTURE THOROUGHFARE IMPROVEMENTS
PMaC
PMC
PMA
PPA
LEGEND cont.
FIGURE 8
CITY OF MARBLE FALLS, TEXAS
MASTER PLAN 2016
CAPITAL IMPROVEMENTS PROGRAM
FOR WATER SYSTEM
S. D. KALLMAN, L.P.
Engineers and Environmental Consultants
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NOTES:
1. REFER TO TABLE 16 FOR DETAILED DESCRIPTION OF PROJECTS AND THEIR ESTIMATES OF PROBABLE COSTS.
2. REFER TO FIGURE 2 (EXISTING AND PROPOSED WATER SYSTEM SCHEMATIC) FOR A GRAPHIC "PROFILE" OF THE WATER DISTRIBUTION SYSTEM

NOTES:
1. REFER TO TABLE 16 FOR DETAILED DESCRIPTION OF PROJECTS AND THEIR ESTIMATES OF PROBABLE COSTS.
2. REFER TO FIGURE 2 (EXISTING AND PROPOSED WATER SYSTEM SCHEMATIC) FOR A GRAPHIC "PROFILE" OF THE WATER DISTRIBUTION SYSTEM.

FIGURE 8

CITY OF MARBLE FALLS, TEXAS
MASTER PLAN 2016

CAPITAL IMPROVEMENTS PROGRAM
FOR WATER SYSTEM

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MASTER

WASTEWATER PLAN

SECTION 9.

SCOPE OF WORK – WASTEWATER SYSTEM

The Master Wastewater Plan will evaluate the wastewater collection system with respect to existing facilities, proposed current projects and specific recommended projects in a Capital Improvements Program (CIP) for year 2016 (Existing Scenario), year 2021 (a 5 year growth period), and year 2026 (a 10 year growth period). This effort will determine how wastewater collection demands are met at this time, and how increased demands should be contended within the next 5 years from known proposed development projects, as well as for the next 10 years. The study is limited to the City's wastewater service area south of Lake Marble Falls.

Future wastewater improvements south of the lake to serve the wastewater drainage basin for the Ultimate Growth Scenario for year 2044 will also be shown on Figure 11.

The scope of work for this Plan is detailed as follows:

- To evaluate key components of the City's existing wastewater collection infrastructure on the south side of Lake Marble Falls to include:
    - Gravity Wastewater Collection Systems
    - Pressure Sewer Systems
    - Wastewater Lift Stations
    - Wastewater Force Mains
    - Future Wastewater Treatment Plant
- To determine current LUE wastewater usage requirements for average and peak day demands utilizing the City's historical wastewater usage reports.
- To develop a wastewater hydraulic model utilizing Bentley's "SewerCAD" software for identifying possible excessive flow rates in existing gravity wastewater pipes, pressure sewer pipes, force mains and lift station pumps. Also, to analyze adequate storage capacity in wetwells. Wastewater demand projections for the existing wastewater collection system will be developed in the Model. Then the Model can be used by the City as a tool to model new development project wastewater flows.
- To determine wastewater service population and number of connections (Living Unit Equivalents – LUE's) for existing condition, 5 year growth period, 10 year growth period and ultimate "build-out" projection for the south side of the lake.
- To make recommendations for specific wastewater facilities and estimated costs for 5 year and 10 year wastewater collection system improvements on the south side of the lake.
- To make determination of site and easement requirements for the proposed wastewater collection and treatment system improvements.
- To prepare preliminary estimates of probable cost for specific recommended immediate projects and Capital Improvements Program (CIP) projects for a 5 and 10 year period. Proposed wastewater collection facilities shown on Figure 11 will be identified for specific development projects. No costs are developed for these projects, as the developers will construct and pay for those facilities.

SECTION 10

CONCLUSIONS AND RECOMMENDATIONS WASTEWATER MASTER PLAN

Based on the 2014 average annual wastewater flow of approximately 0.89 MGD, the expanded wastewater treatment plant will have about 235,000 GPD of additional capacity before it reaches the 75 percent flow of 1.125 MGD, which triggers planning efforts for additional wastewater treatment capacity.

The previous studies prepared by HDR recommend future construction of a new wastewater treatment plant south of Lake Marble Falls to provide additional capacity beyond the permitted final phase of the existing wastewater treatment plant located on the north side of the lake west of downtown Marble Falls. HDR's recommendation in a Technical Memorandum hinges on three primary drivers:

1. Expected growth patterns in the City
2. Land area limitations for the existing land disposal system
3. Site constraints at the existing wastewater treatment plant.

While future growth in Marble Falls currently appears to be the strongest on the south side of the lake, land disposal limitations and site constraints are major hurdles for expansion of the existing wastewater treatment plant beyond 1.5 MGD on the existing plant site located on the north side of the lake. The recommended future wastewater plant site on the south side of the lake is shown on the Flatrock Springs Property on Figure 11.

From the Model of the existing wastewater collection system on the south side of the lake, there are no existing capacity deficiencies at the present time. However, due to known development projects that have been presented to the City, on the south side of the lake, wastewater collection facilities currently are being planned to be constructed by these development projects in the near term.

As the developments bring on new wastewater service customers, the City will need to begin permitting and preparing construction plans for the new wastewater plant to be sited on the 21 acre Flatrock Springs Property within the next 3 to 5 years.

Paragraph 12.3 – "Wastewater Recommendations for Additions and Modifications", herein, details the recommended Capital Improvements Plan.

Section 14 – "Recommended Wastewater System Improvements and Probable Estimated Costs for 5 Year and 10 Year Growth Period Projects on the South Side of Lake Marble Falls for the Recommended Capital Improvements Program (CIP)" provides estimates of probable cost for the 5 year growth period from year 2016 to 2021. There are no recommended Capital Wastewater Improvements for the 10 year growth period.

SECTION 11

EXISTING WASTEWATER SYSTEM SOUTH OF LAKE MARBLE FALLS

11.1 General

The City of Marble Falls is served by an existing 0.98 million gallons per day (MGD) activated sludge wastewater treatment plant. The plant is located on the north side of Lake Marble Falls, south of Yett Street, west of downtown and the U.S. Highway 281 bridge.

There are numerous gravity wastewater lines, pressure sewer systems, five (5) lift stations and five (5) pressure force mains that comprise the wastewater collection system located south of Lake Marble Falls.

11.2 Certified Service Area

The City of Marble Falls holds a Certificate of Convenience and Necessity (CCN No. 20426) for wastewater service to areas generally within the City limits. Refer to Figure 9 – CCN Map of Wastewater Service Area, herein for a map of the wastewater CCN boundaries.

11.3 Existing Wastewater Treatment Plant

The wastewater treatment plant located on the north side of Lake Marble Falls is permitted for an interim phase daily average flow of 0.98 million gallons per day (MGD) and a final phase daily average flow of 1.5 MGD. The plant currently operates in the interim phase. Continued growth in the Marble Falls service area demonstrates that the wastewater system requires additional treatment capacity in the near future. As a result, the City has elected to expand the existing wastewater treatment plant to its final phase permitted flow of 1.5 MGD. The permit requires additional aeration and final clarification for the final phase.

The wastewater treatment plant currently treats municipal wastewater in a conventional activated sludge process. The plant consists of an influent lift station with four submersible pumps, a screen structure with two manual bar screens, a concrete oxidation ditch with wall-mounted brush aerators, three final clarifiers, tertiary disk filters, a chlorine disinfection basin, an emergency raw sewage holding basin, a low service final effluent pump station with three pumps, and a reclaimed water system with a high service pump station with three pumps and a 200,000 gallon ground storage tank. The oxidation ditch was constructed in the 1980s with two rotors. Modifications to the ditch in the 1990s included additional of a third rotor, which allows the system to operate at higher BOD loadings than a standard oxidation ditch and thus, enabled an increase in permitted capacity to 0.98 MGD within the same aeration volume.

Solids handling consists of a waste sludge holding tank, a belt filter press for sludge dewatering, and sludge drying beds for emergency use. Dewatered sludge is currently disposed of at a TCEQ permitted landfill. The permit also authorizes disposal of sludge at a TCEQ authorized land application site or co-disposal landfill. The permit does not authorize land application of Class A or Class B sewage sludge. Figure 10 below shows the process flow diagram at the existing wastewater treatment plant.

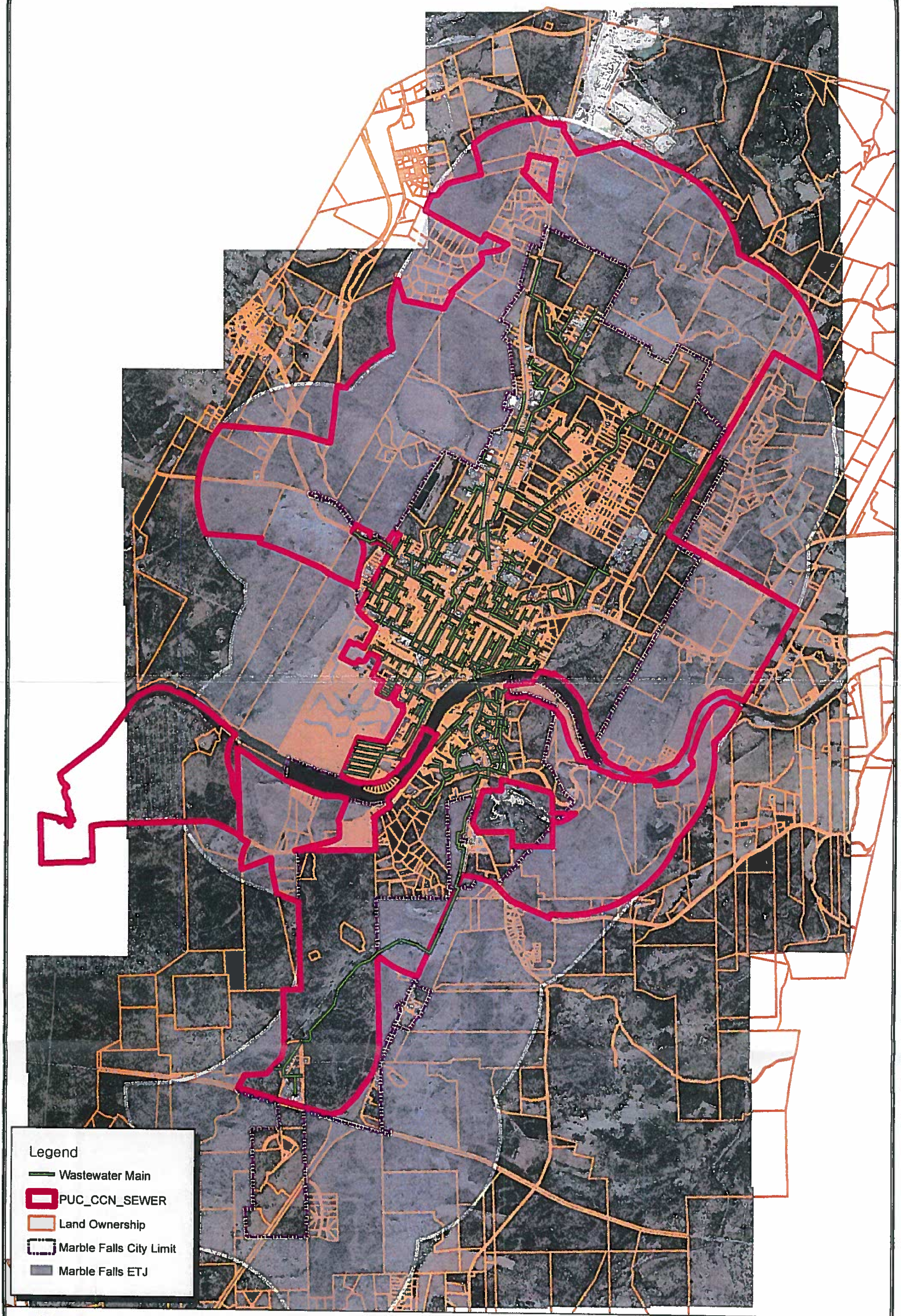

FIGURE 9 SEWER CCN MAP

This product is for informational purposes and may not have been prepared for or be suitable for legal, engineering, or surveying purposes. It does not represent an on the ground survey and represents only the approximate relative location of boundary properties. Map by D. ..., GIS Planner, Development Services.

0 1,500 3,000
Feet
1 inch = 4,078 Feet

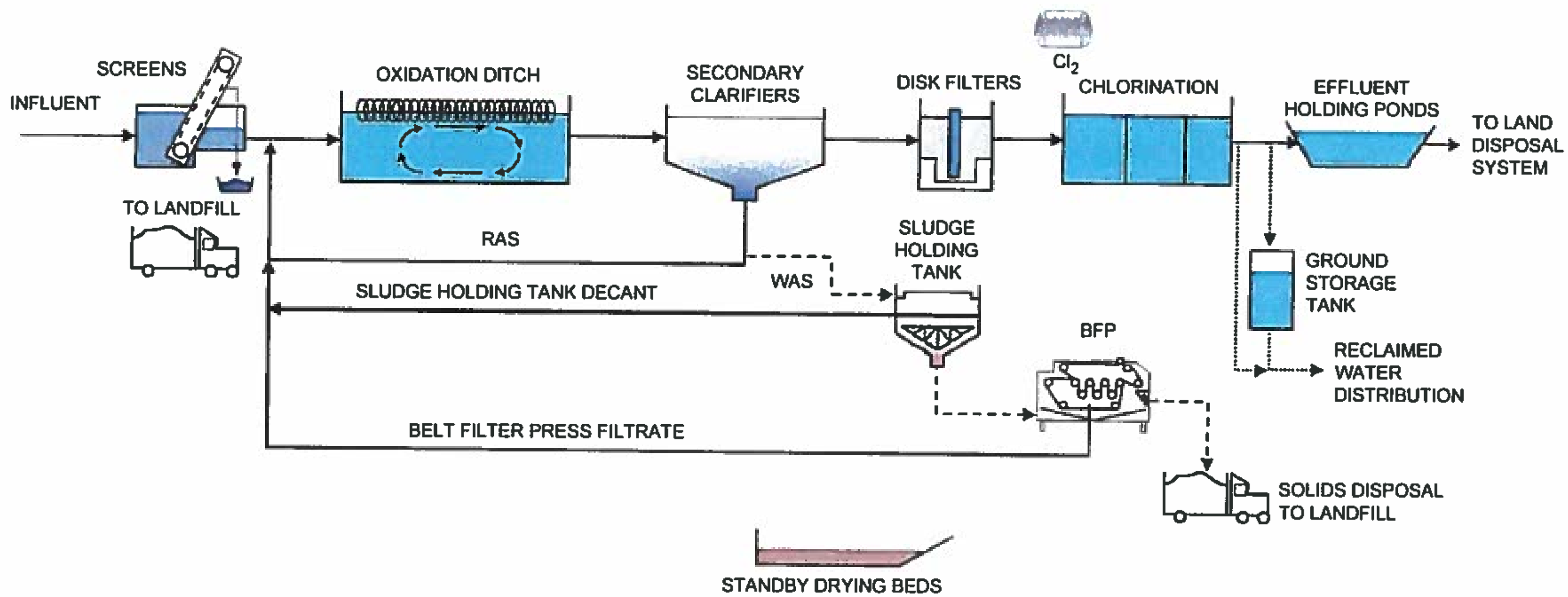

FIGURE 10

CITY OF MARBLE FALLS, TEXAS
EXISTING WASTEWATER TREATMENT PLANT
PROCESS FLOW DIAGRAM

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The City's current Texas Land Application Permit (TLAP) authorizes the City to dispose of treated effluent via surface irrigation on 234 acres of non-public access agricultural land located on the north end of the City by the west site of U.S. Highway 281. The existing permit authorizes an interim phase with an annual average flow of 0.98 MGD and a final phase with an annual average flow of 1.5 MGD. The final phase two-hour peak flow is 4.5 MGD.

Most effluent from the Marble Falls wastewater treatment plant is currently pumped to the irrigation farm for land application, but some effluent is also pumped into the reclaimed water distribution system for landscape irrigation. The current reuse authorization for the Marble Falls wastewater treatment plant effluent is for Type I effluent. Based on the 2014 average annual wastewater flow of approximately 0.89 MGD, the expanded wastewater treatment plant will have about 235,000 GPD of additional capacity before it reaches the 75 percent flow trigger of 1.125 MGD, which requires planning to begin on providing additional wastewater treatment plant capacity.

The City has received bids and awarded a construction contract for the expansion of the wastewater treatment plant to an average treatment capacity of 1.5 MGD. Following this expansion, the congested site will be at its limit for treatment facilities. When flows exceed 75% of the 1.5 MGD upgraded wastewater treatment plant capacity, planning to locate a second wastewater treatment plant on the south side of Lake Marble Falls must begin.

11.4 Existing Wastewater Collection System

The existing wastewater collection system south of Lake Marble Falls consists of five (5) lift stations and miscellaneous sizes of wastewater collection lines, force mains and pressure sewer systems to convey wastewater flows from one point to another. Refer to Figure 11 – Wastewater Facilities South of Lake Marble Falls, herein. The locations, flow capacities and related information pertinent to each of the five (5) lift stations is shown in "Table 17 – Existing Lift Station Data", below.

The City has old and new wastewater lines throughout the wastewater service area that provides wastewater collection service to developed areas south of Lake Marble Falls.

This Wastewater Master Plan includes the development of a computer-based pipe model based on existing flow demands. Both wastewater collection pipes, pressure sewer pipes and lift stations will be included in the model.

The software named "SewerCAD" by Bentley was used in the development of the wastewater model.

The same approximate number of wastewater connections (LUE's) exists in the City's water and wastewater service area, on the south side of Lake Marble Falls, as there are in the number of water connections. From Table 14 in the water system section of this study, there are approximately 637 existing LUE's served by the City in the Gateway Park, Ridgemont Village and Flatrock Pressure Planes and other areas on the south side of the lake. Therefore, the City has approximately 637 existing LUE's served by the existing wastewater collection system on the south side of Lake Marble Falls.

TABLE 17

EXISTING LIFT STATION DATA

Lift Station Name	Ground Elevation at Lift Station Site	Pump ID No.	GPM	TDH (Feet)	Motor Hp	Wetwell Inner Diameter (Ft.)	Wetwell Depth (Ft.)	Operating Elevation Pump 1 On/Off	Notes
SH- 281	772.75	1	1205.9	57	70	16	25.37	754.38/748.38	
	772.75	2	1205.9	57	70	16	-	754.38/748.38	
Los Esconditos	794.55	1	80	54	3	5	14.55	783/781	
	794.55	2	80	54	3	5	14.55	785/781	
Gateway	910.23	1	150	48	5	5	12.18	906/900	
	910.23	2	150	48	5	5	12.18	907/900	
La Ventana	821	1	197	248	53	9	15	809/807	
	821	2	197	248	53	9	15	809.4/807	
Flatrock	930.9	1	700	62.5	20	10	21.9	914.5/911.5	
	930.9	2	700	62.5	20	10	21.9	915/911.5	

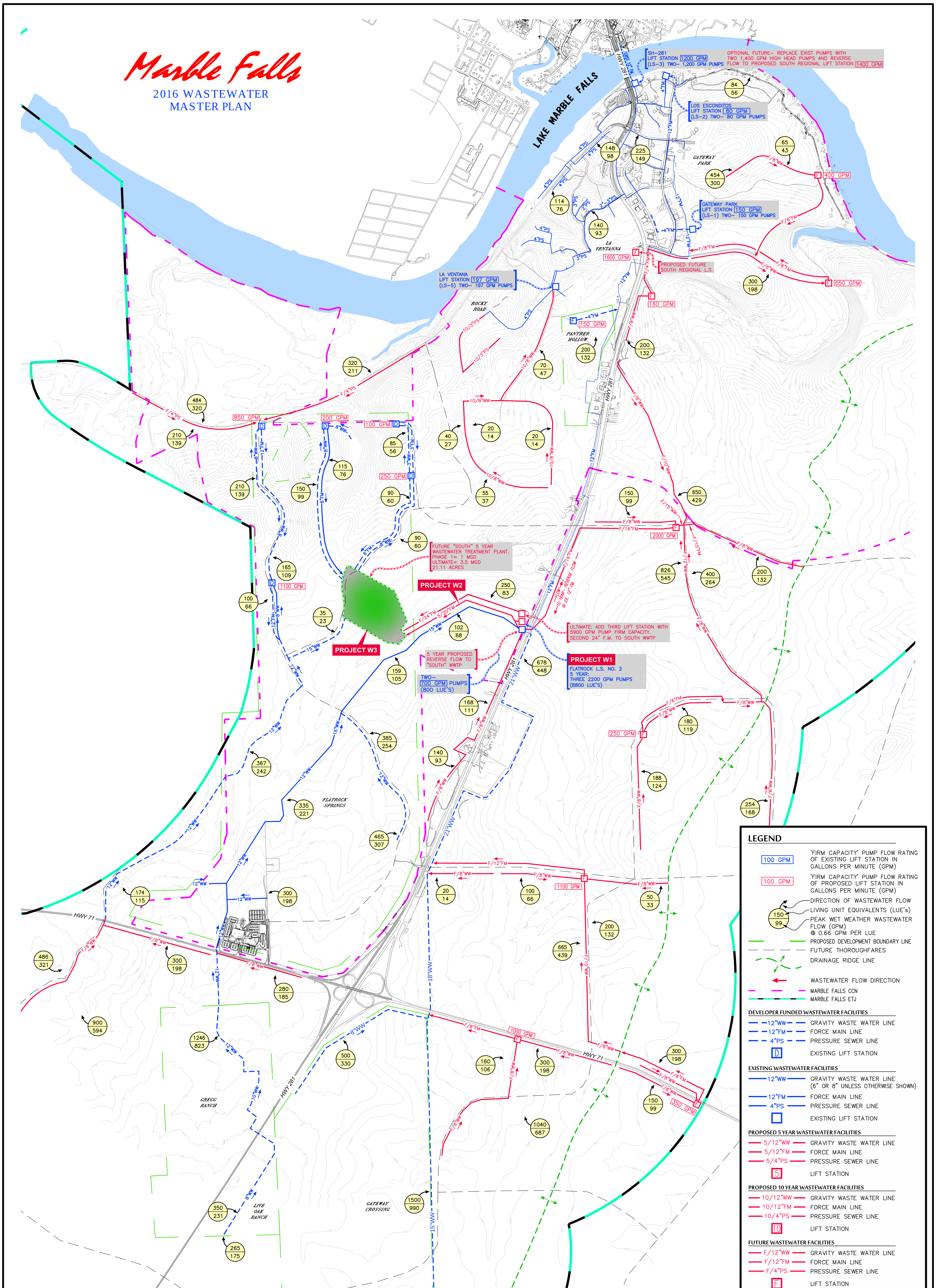

FIGURE 11

CITY OF MARBLE FALLS, TEXAS
MASTER PLAN 2016

CAPITAL IMPROVEMENTS PROGRAM
FOR WASTEWATER SYSTEM

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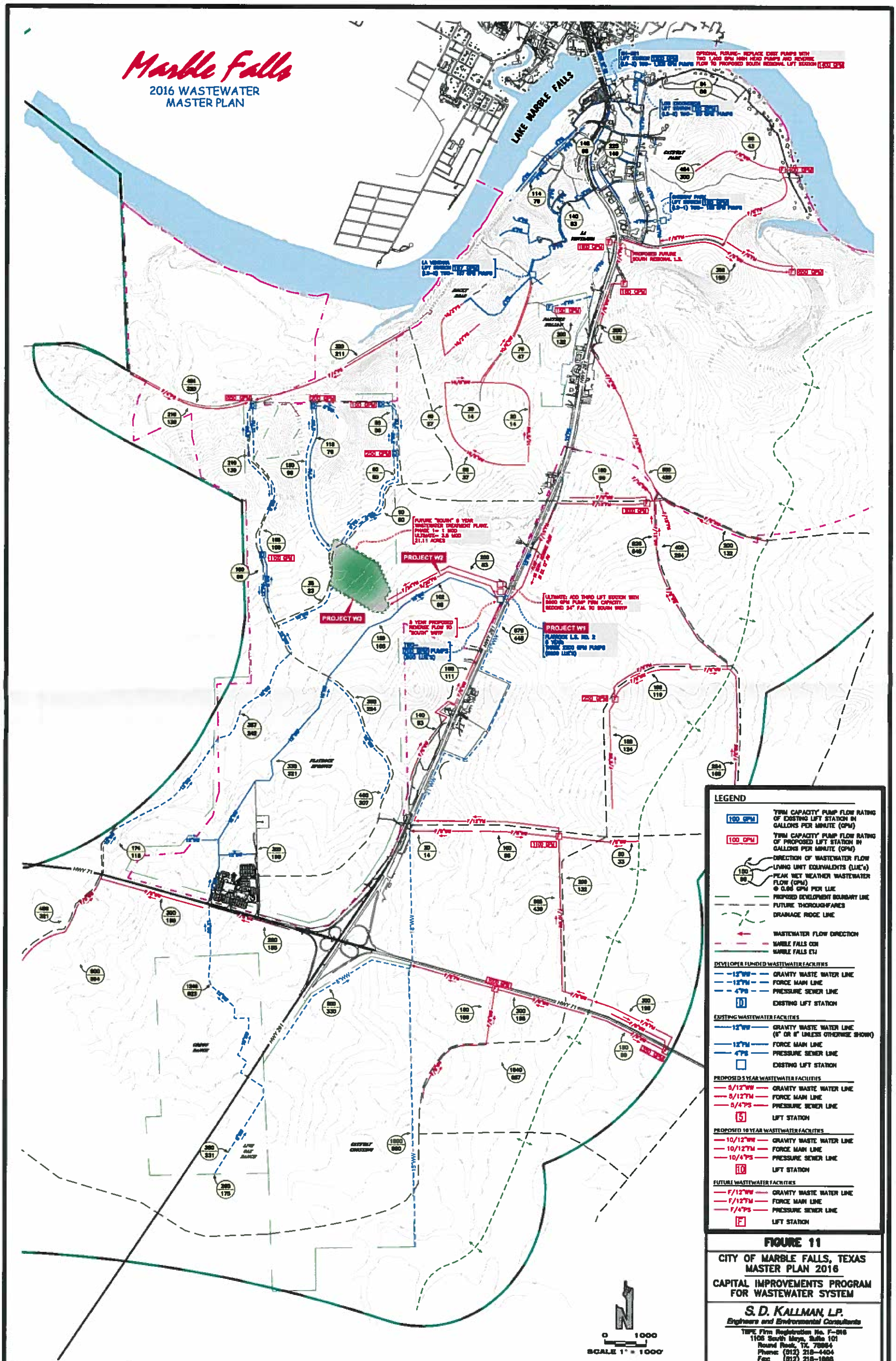

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11.5 Drainage Basins

Natural topography of drainage basins is important in wastewater collection and trunk lines, since sewers are most economically constructed as gravity flow conduits. Sewage is carried out of a drainage basin much in the same way as rainfall runoff. In areas where the terrain is flat as compared with sloping topography, a gravity conduit following natural ground slope will transport sewage at a slower rate. To keep pipe size to a minimum, the slope of the pipe can be increased, requiring the conduit to be buried deeper as the line progresses down the slope.

There is a practical limit to depth, due primarily to costs involved in excavation and working conditions. When the practical limit is reached, pipe diameter can be increased, or the sewage can be lifted by pumps where the process of pipe size and depth of excavation can again be evaluated, as described above.

It is often necessary to transport sewage from one drainage basin to another, either by pumping or sometimes by deep cuts through natural divides. Each case must be evaluated based on the areas that can be served, operation and maintenance costs to the City, and treatment plant location.

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It is often necessary to transport sewage from one drainage basin to another, either by pumping or sometimes by deep cuts through natural divides. Each case must be evaluated based on the areas that can be served, operation and maintenance costs to the City and treatment plant location.

11.6 Wastewater Flows

Wastewater flows were determined for each drainage basin in the service area south of Lake Marble Falls, by utilizing projected land use and flows related to land use. Many of the proposed wastewater lines will not be constructed for several years, if not decades, in the future. The projected land uses and unit flows should be reviewed periodically to determine if the design criteria are changing.

Wastewater is discharged from residential, commercial and industrial establishments. Water also infiltrates the system through manhole covers, broken pipe, and faulty pipe joints, particularly at house connections. The wastewater flow is collected in laterals, then in trunk mains where it is carried to a plant for treatment and disposal.

Prior to design of pipelines, lift stations or treatment plants, it is necessary to determine the magnitude of wastewater flows. In the City of Marble Falls, where influent flow records are maintained, per capita flow and other parameters can be calculated based on current population data.

Wastewater is not contributed to the trunk lines at a uniform rate throughout the day. Peak flows occur at mid-morning and early evening, much the same as is experienced in the City's water distribution system. These peak flows must be considered in designing pipelines.

Infiltration of rainfall and ground water into the sewer lines must also be considered in calculating pipe sizes and plant hydraulics. Extremes in pipeline infiltration can be controlled by making every effort during design and construction of lateral and trunk sewers to utilize improved sewer jointing materials and maintain careful and workmanlike installation practices. Special attention should be given to small sewers since they normally constitute the largest percentage of pipeline length in a system.

Although these current design and construction practices minimize infiltration, a common problem is aging infrastructure. Cracking and joint separation in old pipes can lead to problems with tree root penetration contributing heavily to the amount of inflow and infiltration seen within a wastewater collection system.

SECTION 12

WASTEWATER DEMAND FORECASTING
SOUTH OF THE LAKE

12.1 General

To evaluate the need for wastewater treatment plant capacity, the total wastewater service area of the City of Marble Falls must be considered; on both the north side and south side of the lake. The wastewater flows currently generated on the south side of the lake are pumped by the SH-281 Lift Station through a force main installed on the new Highway 81 Bridge crossing Lake Marble Falls to the existing gravity wastewater collection system on the north side of the lake; thence flowing to the existing wastewater treatment plant.

When planning at 75% plant utilization begins for additional wastewater treatment capacity, the total flows for the City must be considered.

Historical wastewater usage records of the City of Marble Falls provide the most reliable source of information to forecast future wastewater demands.

This wastewater study for the City's wastewater service area south of Lake Marble falls will evaluate wastewater collection and treatment. Requirements for four wastewater demand growth scenarios:

- Present (based on historical wastewater usage demands)
- 5 year (year 2021)
- 10 year (year 2026)
- Ultimate (year 2044)

Historical wastewater demands can be found in Appendix B, which details City record data for past wastewater usage.

12.2 Population and Wastewater Demand Forecasting

From Appendix B, the City's Table for "Marble Falls LUE Calculations" has a daily average wastewater flow at its wastewater treatment plant of 950,000 gallons per day (GPD) in year 2014, which is the most recent year of recorded data. The "LUE Input Data" Table shows a total of 4,135 LUE's.

An average wastewater usage of 230 GPD per LUE can be computed (950,000 GPD ÷ 4,135 LUE's = 230 GPD/LUE). At 2.41 persons per LUE, the per capita average wastewater usage is 95 GPD per person (230 GPD/LUE ÷ 2.41 persons = 95 GPD per LUE per person). The peak day wastewater flow in year 2013, which is the highest peak day for the three years of recorded data is 1,990,000 GPD. The peak day usage per LUE can be calculated as 480 GPD per LUE (1,990,000 GPD ÷ 4,135 LUE's = 481; round to 480 GPD per LUE). This recorded peak flow for a 24 hour period of 480 GPD per LUE can also be expressed as 0.33 GPM per LUE (480 GPD per LUE ÷ 1,440 minutes per day = 0.33 GPM per LUE).

Another widely used method of estimating peak wet weather (PWW) flows in wastewater collection systems is shown below:

Design Loading = 2.41 people per LUE
At 2 LUE's per acre = 4.82 people per acre

Though land development projects with many different land uses generates higher than 2 LUE's per acre, a typical value of 2 LUE's per acre is reasonable when evaluating the whole ETJ land area of approximately 10,400 acres. In Figure 11, "LUE" and "GPM" PWW flow data is higher when specific "LUE's" are known for proposed land development projects.

Wastewater flow = 4.82 people per acre x 96 gallons per day (Marble Falls average wastewater flow per person) = 463 GPD per acre

(230 GPD average per LUE ÷ 2.41 persons per LUE= 95.4; round to 96 GPD average per person)
Convert to GPM = 463 GPD per acre ÷ 1,440 minutes per day = 0.32 GPM per acre

Peak day weather flow = 0.32 GPM per acre x 2.5 peaking factor for ETJ area = 0.8 GPM per acre peak dry weather flow

Add infiltration/inflow into the wastewater collection system:

750 GPD per acre ÷ 1,440 minutes per day = 0.52 GPM per acre

Total peak wet weather flow = 0.8 GPM per acre + 0.52 GPM per acre = 1.32 GPM per acre

Compute wastewater flow in "GPM per LUE"

Peak wet weather flow = 1.32 GPM per acre ÷ 2 LUE's per acre = 0.66 GPM/LUE

Thus, the City has recorded a peak flow of 0.33 GPM per LUE, during a 24 hour period, but actual peak flows vary throughout the day. The 2.5 peaking factor used above is applicable to instantaneous periods during the day when wastewater flows are higher than the peak based on a total days usage. The wastewater lines have to be sized to be able to carry these instantaneous peak flows, so that no spills occur.

Based on the above reasoning, 0.66 GPM per Lue will be used as the design criteria for computer modeling and for sizing future wastewater collection lines for the whole ETJ south of the lake.

Design criteria for lift stations result in higher "peak factors", than 2.5 when they are serving a wastewater drainage basin smaller than the whole ETJ. Lift stations of this size usually have "peak wet weather" flows ranging from 0.7 GPM per Lue for large drainage basins to 1.0 GPM per LUE for much smaller drainage basins.

"Table 8 - City of Marble Falls – Population Projections for a 34 Year Period" (year 2015 to year 2044) in Section 5.2 of the Master Water Plan projects population growth for a 30 year period. Table 8 is repeated here for the convenience of the reader of this Report.

TABLE 8		
CITY OF MARBLE FALLS POPULATION PROJECTIONS FOR A 30 YEAR PERIOD (YEAR 2015 TO YEAR 2044)		
YEAR	POPULATION	NOTES
2010	6,077[1]	Census
2015	6,406[1]	City's Forecast
2020	7,424[1]	City's Forecast
2024	8,011[1]	City's Forecast and Intermediate 1 Demand Scenario
2034	9,451[2]	Intermediate 2 Demand Scenario
2044	10,891[2]	Ultimate Demand Scenario

Footnotes:

[1] Refer to Figure 3 – herein

[2] Beginning in Year 2024, Population increases 144 persons per year to year 2044

"Table 9 - City of Marble Falls – Population and Water LUE Projections" in Section 5.4 of the Master Water Plan projects water system LUE's for the whole City.

Table 18 below projects wastewater LUE growth over a 30 year period for the whole city assuming that all new LUE's are connected to the wastewater system.

TABLE 18		
CITY OF MARBLE FALLS POPULATION AND WATER AND WASTEWATER PROJECTIONS		
Year	Water System LUE's Total	Wastewater System LUE's Total
2016	4,818	4,135
2024	6,044	5,361
2034	7,130	6,447
2044	8,217	7,534

For the wastewater service area south of the lake, the following LUE projections have been developed in Table 19 for a 30 year period and beyond (Future Complete Basin Build-Out).

TABLE 19	
CITY OF MARBLE FALLS WASTEWATER LUE PROJECTIONS SOUTH OF LAKE MARBLE FALLS	
Year	Wastewater System LUE's South of Lake Marble Falls
2016	637
2024	1,608
2034	2,990
2044	4,069
Future Basin Build-Out for 10,400 acres	18,818

12.3 Wastewater Recommendations for Additions and Modifications

As previously mentioned in Section 11.C, herein, planning will need to begin on a second wastewater treatment plant on the south side of Lake Marble Falls when wastewater treatment plant flows reach 1.125 MGD. At an average wastewater flow demand of 230 GPD per LUE, this capacity can serve 4,891 LUE's. At 136 LUE's of City-wide growth per year, existing 4,135 Lue's of wastewater customers will grow to 4,891 LUE's in 5 years [(4,891 – 4,135) ÷ 136 LUE's per year = 5.5 years] or year 2021. Therefore, costs will be incurred for permitting and engineering for the new south wastewater treatment plant within a 5 year window. The new wastewater treatment plant site has been shown on the Land Use Plan for the Flatrock Springs Development (see Appendix E) as a 21.1 acre parcel. This site is also shown on Figure 11, herein. To make sure the City has treatment capacity to serve the growth, the construction for the new plant should be initiated at the end of the 5 year window. Of course, "Actual Growth" versus "Projected Growth" should be monitored annually to assure that the new south plant is online by the time the existing plant is at 90% capacity (1.35 MGD).

When the new south wastewater treatment plant comes online, several modifications and additions to the wastewater collection system on the south side of Lake Marble Falls will need to be completed. Because of the excessive head conditions that would be encountered by trying to pump from the SH-281 Lift Station uphill back to the existing Flatrock Lift Station (LS-4) or even higher to the proposed south wastewater treatment plant, a new "South Regional" Lift Station is recommended to be constructed and be in-service when the new south wastewater treatment plant comes online. The location of this South Regional Lift Station is on the west side of Highway 281 near Max Starke Dam Road, just to the south of the La Ventana Development, as shown on Figure 11. This new lift station will pump through the existing 12" force main in a southerly direction to the Flatrock Lift Station location. At the Flatrock Lift Station site, a larger lift station will be required, as the Flatrock Lift Station is only rated at 700 GPM (1 MGD). Also, a new 20" force main will have to be installed to carry the wastewater flows from this larger lift station (Flatrock No. 2) at the Flatrock Lift Station site up to the new south wastewater treatment plant. The flow from the existing 700 GPM Flatrock Lift Station will be reversed and pumped through the proposed 20" force main to the new south wastewater treatment plant.

A future lift station (South Regional Lift Station) is shown in Figure 11 on the west side of Highway 281, across from Max Starke Dam Road's intersection with Highway 281. This lift station, if built, would pick up the wastewater flows from the "reverse flow" from the SH-281 Lift Station, if converted to pump to the south. The major benefit of the proposed South Regional Lift Station would be to reduce the "high total dynamic head" that the SH-281 Lift Station replacement pumps would have overcome to pump over the hill in Gateway Park and south to the existing Flatrock Lift Station. High head submersible lift station pumps have very low operating efficiencies, which result in high costs of electricity.

The City may elect to never modify the SH-281 Lift Station to reverse the wastewater flow to the new South Regional Lift Station, due to the cost savings of replacing the pumps with high head pumps. There should be enough diversion of flows on the south side of the lake with the Flatrock 700 GPM lift station and new Flatrock No. 2 lift station, handling the majority of the growth.

Due to the pending development potential of Flatrock Springs, Gregg Ranch, Live Oak Ranch, Gateway Crossing and Panther Hollow, all on the south side of the lake, the cost of expanding lift stations and force mains make the timing of constructing the new south wastewater treatment plant sooner than later more desirable.

SECTION 13

WASTEWATER COLLECTION SYSTEM COMPUTER MODELING

13.1 General

The City has old and new wastewater lines throughout the wastewater service area that collects the wastewater generated by its customers. The software named "SewerCAD" by Bentley was used in the development of the wastewater collection network analysis.

This Wastewater Master Plan includes the development of a computer-based pipe network analysis to determine the adequacy of the existing wastewater collection system on the south side of Lake Marble Falls to convey assumed flow rates from all points in the network to the wastewater treatment plant located on the north side of Lake Marble Falls and west of downtown.

The following simulations, with detailed output reports are provided to the City in a separate document.

13.1.1 "Base Model" of the existing wastewater collection system at a peak wet weather flow of 0.66 GPM/LUE.

13.2 Existing Wastewater Collection System South of Lake Marble Falls

The existing wastewater collection system south of Lake Marble Falls consists of five (5) lift stations and miscellaneous sizes of wastewater collection lines, force mains and pressure sewer systems to convey wastewater flows from one point to another. Refer to Figure 11 – Wastewater Facilities South of Lake Marble falls, herein. The locations, flow capacities and related information pertinent to each of the five (5) lift stations is shown in "Table 17 – Existing Lift Station Data," herein.

The same approximate number of wastewater connections (LUE's) exists in the City's water and wastewater service area, on the south side of Lake Marble Falls, as there are in the number of water connections. From Table 14 in the water system section of this study, there are approximately 637 existing LUE's served by the City in the Gateway Park, Ridgemont Village and Flatrock Pressure Planes and other areas on the south side of the lake. Therefore, the City has approximately 637 existing LUE's served by the existing wastewater collection system on the south side of Lake Marble Falls.

13.3 Wastewater Collection System Design Criteria

Design criteria for sewage systems as adopted by the Texas Commission on Environmental Quality (TCEQ) establishes the minimum guidelines to be used for the comprehensive consideration of domestic sewage collection, treatment, or disposal systems and establish the minimum design criteria pursuant to existing state statutes pertaining to effluent quality necessary to meet state water quality standards. These criteria are intended to promote the design of facilities in accordance with good public health and water quality engineering practices.

13.4 Existing Wastewater Drainage Basins

The existing wastewater collection system on the south side of Lake Marble Falls must serve an area in the ETJ of approximately 10,400 acres that is very hilly with vast changes in topography. Because of these frequent elevation variations, seven (7) lift stations are required. Many more lift stations will also be constructed as the ETJ builds out over the years to come. Lift stations become necessary when 1.) Gravity wastewater collection lines get too deep to be economically feasible to build and 2.) When the gravity wastewater pipes reach a low ground point in a drainage basin, where there is nowhere to flow and must be pumped up in elevation to another gravity line that can convey the wastewater flow to eventually arrive at a wastewater treatment plant for treatment.

The existing SH-281 (LS-3) Lift Station located on the south bank of Lake Marble Falls adjacent to the new Highway 281 bridge currently pumps all wastewater flows generated on the south side of the lake across the bridge through a 12 inch force main to the north side of the lake. From there, the wastewater flows through a series of pipe so the existing wastewater treatment plant.

The other six (6) lift stations pump wastewater flows through force mains that eventually arrive at the SH-281 Lift Station. These seven (7) lift stations and existing gravity wastewater lines have been modeled for this report.

13.5 Development of the SewerCAD Model for the City's Existing Wastewater Collection System on the South Side of Lake Marble Falls

To set up the data for the SewerCAD simulation, the following elements had to be established for the existing simulation:

- Water line geometric layout with data input of pipe size (diameter), pipe length, pipe age and type (m-factor) and pipe name.
- Intersections or dead-ends of wastewater lines called junctions or nodes at manholes and lift stations. Data input consisted of node elevation (mean sea level), wastewater demand (in LUE's) at node and node name.
- Lift stations were input into the Model with data including pump "GPM" and total dynamic head (TDH) and pump "on" and "off" elevations.
- Pressure sewer pipes were input into the Model.

13.6 Evaluation of Wastewater Collection System Utilizing SewerCAD Computer Network Modeling Output Data

The following simulation will summarize the output results with deficiencies, if any, described and recommendations to resolve them.

13.6.1 "Base" Model Development at 0.66 GPM per LUE

The "Base" Model was developed with existing gravity wastewater lines, pressure sewer lines, lift stations and force mains. The whole existing wastewater collection system is represented in the "Base" Model. Each of the seven lift stations are depicted in Figure 11 – Wastewater Facilities South of Lake Marble Falls".

The existing pipe data, nodal data, and pump data for the "Base Model" is provided in a separate document to the City.

Summary:

There were no pipe or pump deficiencies resulting from the Model of the existing wastewater collection system peak flow demands on the south side of Lake Marble Falls.

Recommendations:

If there were no new wastewater customers added on the south side of the lake, then no wastewater improvements would be required. However, due to all of the known development projects in the planning phase along the Highway 281 corridor south from the lake to Highway 71, many improvements will be necessary to handle the wastewater flows that will be created.

Many wastewater collection facilities will be installed and paid for by the developers in order to serve their projects. There are three (3) projects recommended in Section 14 of this report within the next 5 year period that the City may finance. This does not preclude the City's required cost participation by the developers who are creating these additional wastewater flows on the south side of the lake.

There are no new projects identified in Section 14 that are recommended to be constructed within a 10 year period. The City should perform an update of this Master Wastewater Plan within a 5 year period to determine if any project needs have arisen.

SECTION 14

RECOMMENDED WASTEWATER SYSTEM IMPROVEMENTS AND PROBABLE ESTIMATED COSTS FOR 5 YEAR AND 10 YEAR GROWTH PERIOD PROJECTS ON THE SOUTH SIDE OF LAKE MARBLE FALLS FOR THE RECOMMENDED CAPITAL IMPROVEMENTS PROGRAM (CIP)

Estimates of probable cost are provided for 5 year and 10 year growth periods from year 2016 to 2026. From Table 18 – "City of Marble Falls Population and Water and Wastewater Projections", projections for growth show that equivalent wastewater connections (LUE's) will grow from 4,135 existing connections in 2016 to 7,534 connections by year 2044, or an increase of 3,399 LUE's. To stay ahead of TCEQ's 75% capacity rule for wastewater treatment plant capacity and to improve the reliability of the City's wastewater system on the south side of Lake Marble Falls, this Wastewater System Master Plan includes recommendations for major wastewater system improvements and probable estimates of cost for those facilities identified in Table 20, herein, for projects needed from now through 2020 (5 year growth period) and from 2020 through 2025 (10 year growth period).

The preliminary estimated costs herein have been developed based on area historical construction costs for projects of similar scope and nature. A 25% factor has been added into the estimates for engineering, surveying and contingencies. No costs have been included for land and easement acquisition, legal or fiscal expenses. The recommended improvements, schedules and probable estimates of cost are presented in Table 20.

TABLE 20

CITY OF MARBLE FALLS
PROJECT LIST, SCHEDULE AND PROBABLE ESTIMATES OF COST
FOR RECOMMENDED WASTEWATER SYSTEM IMPROVEMENTS

YEAR SCHEDULED	PROJECT NO.	TYPE OF FACILITY	RECOMMENDED IMPROVEMENTS	PRELIMINARY ESTIMATED COST INCLUDING 25% ENGINEERING AND CONTINGENCY
14.1 Project Recommendations for Wastewater System Improvements that should be online within 5 years by End of Year 2021				
5 Year (Year 2021)	W1	Lift Station	Existing Flatrock Lift Station - 700 GPM capacity. Construct a 2nd Flatrock Lift Station Adjacent to Existing Lift Station within 5 years - Design to Reverse Flow to "New South Wastewater Treatment Plant." 5 year - 4,400 GPM (3 - 2,200 pumps). Existing 700 GPM Lift Station still in service but Reverse Flow to New South Wastewater Treatment Plant.	$2,500,000
5 Year (Year 2021)	W2	Force Main	4,600 L.F. 20" Force main from Flatrock Lift Station to New South Wastewater Treatment Plant to carry flows from the Existing Flatrock Lift Station and Proposed Flatrock Lift Station No. 2	$1,150,000
5 Year (Year 2021)	W3	Wastewater Treatment Plant	1 MGD "South" Wastewater Treatment Plant to be Constructed on 21.1 Acre Site located within the Flatrock Springs Development. Land for Effluent Irrigation not yet identified nor budgeted for.	$12,500,000
14.1 Total Probable Estimate of Cost for 5 Year Improvements (Project Nos. W1-W3)				$16,150,000
14.2 Project Recommendations for Wastewater System Improvements that should be online within 10 years by End of Year 2026				
10 Year (Year 2026)	-	-	No 10 year project needs have been identified.	$0
14.2 Total Probable Estimate of Cost for 10 Year Improvements				$0

TABLE 20 (Cont'd)

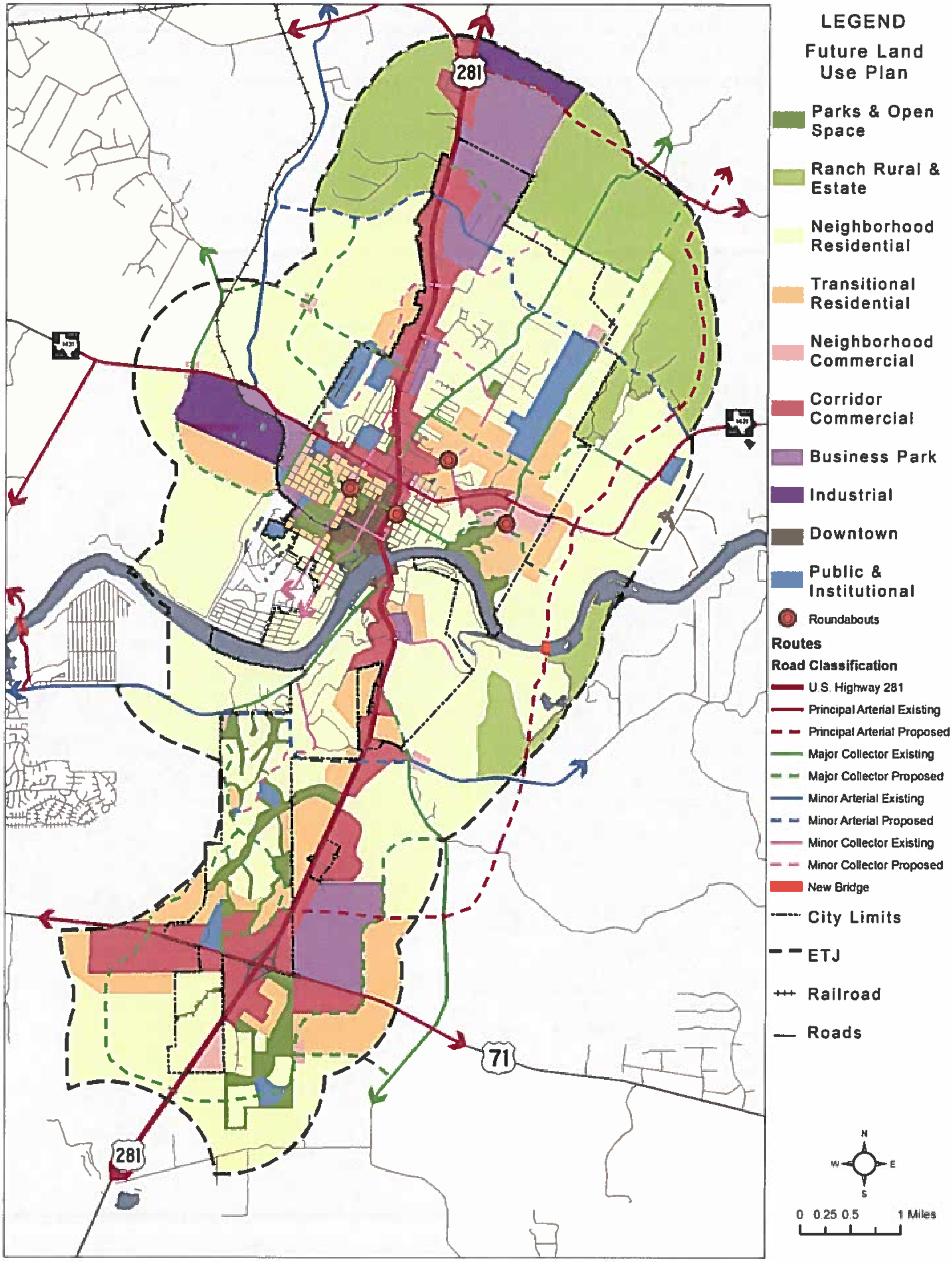
CITY OF MARBLE FALLS
PROJECT LIST, SCHEDULE AND PROBABLE ESTIMATES OF COST
FOR RECOMMENDED WASTEWATER SYSTEM IMPROVEMENTS

YEAR SCHEDULED	PROJECT NOS.	DESIGN SCENARIO	PRELIMINARY ESTIMATED COST INCLUDING 25% ENGINEERING AND CONTINGENCY
5 Year	W1, W2, W3	Wastewater System Improvements that are recommended to be online by end of year 2021	$16,150,000
10 Year	-	No Wastewater System Improvements are recommended between years 2021 and 2026	$0
Ultimate	-	Wastewater System Improvements for the "Ultimate" Design Scenario shall be determined with future updates to the Master Wastewater Plant	-
		Summary Total - Years 2016 Through 2026	$16,150,000

APPENDIX A

MAP 5.1
FUTURE LAND USE MAP FROM COMPREHENSIVE PLAN

Map 5.1, Future Land Use Plan



APPENDIX B

CITY OF MARBLE FALLS
LUE CALCULATIONS

CITY OF MARBLE FALLS, TX

CLIENT: CITY OF MARBLE FALLS
PROJECT: Marble Falls LUE Calcs
DATE: 8/12/2015

WATER			
METER SIZE	MULTIPLIER	NO. METERS	LUE EQUIVALENT
3/4" Meter	1.00	2,519	2,511
1" Meter	2.78	296	823
1-1/2" Meter	5.68	47	267
2" Meter	8.84	89	787
3" Meter	10.67	6	64
4" Meter	18.48	9	166
6" Meter	33.33	6	200
	TOTAL	2,972	4,818

WASTEWATER			
METER SIZE	MULTIPLIER	NO. SERVICES	LUE EQUIVALENT
3/4" Meter	1.00	2185	2186
1" Meter	2.70	256	689
1-1/2" Meter	5.48	40	220
2" Meter	7.74	80	621
3" Meter	10.67	5	56
4" Meter	16.67	6	102
6" Meter	33.33	8	262
	TOTAL	2580	4,135

Assumption is made based on Water meter Size. All gravity WW laterals are 4" or larger.

CURRENT WATER SYSTEM USAGE (MGD)

WATER	Year 2012	Year 2013	Year 2014
Peak Month	2.17	1.91	1.81
Peak Day	2.90	2.45	2.20
Daily Avg	1.48	1.49	1.47
Winter Month Avg	1.10	1.20	1.20

CURRENT WASTEWATER SYSTEM FLOWS (MGD)

WASTEWATER	Year 2012	Year 2013	Year 2014
Peak Month	0.88	0.95	1.02
Peak Day	1.70	1.99	1.79
Daily Avg	0.73	0.82	0.95

LUE INPUT DATA

	Total LUEs	Daily Avg Usage (MGD)	Peak Day Usage (MGD)
WATER	4,818	1.48	2.90
WASTEWATER	4,135	0.82	1.99

LUE USAGE PER CONNECTION

	Planning LUE Usage (Gal/day) (Avg Day)	Design LUE Usage (Gal/day) (Peak Day)	Adopted LUE Usage (Gal/day)	Peak Day Usage (gpm)
WATER	304	602	602	0.42
WASTEWATER	196	477	477	0.33

POPULATION USAGE

	PPL per LUE	Daily Avg Usage (gpd)	Peak Day Usage (gpd)
WATER	2.41	126.14	249.74
WASTEWATER	2.41	81.33	197.93

CONSUMPTION SUMMARY
January 16th to Feb 16th 2015

YEAR: 2015 Total Sewer Accounts = 2580

		TOTAL ADDRE	Total Usage per 1000	Total Usage	Total Accounts	Average Usage per 1000	Average Billed per 1000	Calculated LUE Multiplier
				COMMERCIAL METERS				
CI1	COM 3/4"	406	2,006	2,006,000	410	5	5	1.00
CI2	COM 1"	105	1,603	1,603,000	106	15	15	3.00
CI3	COM 1 1/2"	10	352	352,000	10	35	35	7.00
CI4	COM 2"	87	3,266	3,266,000	87	38	38	7.60
CI5	COM 3"	3	106	106,000	3	35	35	7.00
CI6	COM 4"	6	321	321,000	6	54	54	10.80
CI7	COM 6"	4	2	2,000	4	1	1	0.20
CO1	COM OUTSIDE 3/4"	1	3	3,000	1	3	3	Not Needed
MF	1 1/2" WATER USED E	30	721	721,000	30	24	24	4.80
PP		2	17	17,000	2	9	9	Not Needed
				RESIDENTIAL METERS				
RI1	RES 3/4"	2,099	7,077	7,077,000	2,119	3	3	1.00
RI2	RES 1"	188	1,351	1,351,000	189	7	7	2.33
RI3	RES 1 1/2"	6	92	92,000	6	15	15	5.00
RI4	RES 2"	5	158	158,000	5	32	32	10.67
RI5	RES 3"	3	190	190,000	3	63	63	21.00
RI6	RES 4"	1	15	15,000	1	15	15	5.00
RO1	RES OUTSIDE 3/4"	5	18	18,000	5	4	4	1.33
RO2	RES OUTSIDE 1"	1	2	2,000	1	2	2	0.67
				Residential SPRINKLER METERS				
SP1		5	3	3,000	5	1	1	Not Needed
SP2		3	47	47,000	3	16	16	Not Needed
SP3		5	0		5	0	0	Not Needed
SP4		12	271	271,000	12	23	23	Not Needed
SP6		2	81	81,000	2	41	41	Not Needed
				COMMERCIAL SPRINKLERS				
A01		42	87	87,000	42	2	2	Not Needed
A02		64	474	474,000	65	7	7	Not Needed
A03		9	82	82,000	9	9	9	Not Needed
A05		10	109	109,000	10	11	11	Not Needed
		TOTAL ADDRE	TOT-CONS		BILLS	CONS/ADDR	CONS/BILL	
-------	----	---------	-------------		----------	--------------	--------------	
RANGE:	0							
APT		257	1,621		258	6	6	
COM		733	8,225		739	11	11	
CTY		40	830		40	21	21	
NC		13	70		14	5	5	
RES		2,071	7,708		2,090	4	4	
			18,454					
		TOTAL ADDRE	TOT-CONS		BILLS	CONS/ADDR	CONS/BILL	
-------	----	---------	-------------		----------	--------------	--------------	
YEAR: 2015								
RANGE:	0							
		3,114	18,454		3,141	6	6	
GRAND T OTAL		3,114	18,454		3,141	6	6	

Average LUE Calculation

Meter Size	Total Monthly Usage	Total Daily Usage	Impact Fee Multiplier	Calculated LUE Multiplier	Adopted LUE Multiplier	Total Connections	Total LUEs	Avg Day LUE Usage
3/4"	9,083,000	302,767	1	1.00	1.00	2505	2,186	139
1"	2,954,000	98,467	1.67	2.70	2.70	293	689	143
1.5"	1,165,000	38,833	3.33	5.48	5.48	46	220	177
2"	3,424,000	114,133	5.33	7.74	7.74	92	621	184
3"	296,000	9,867	10.67	15.99	10.67	6	56	177
4"	336,000	11,200	16.67	10.54	16.67	7	102	110
6"	2,000	67	33.33	12.20	33.33	9	262	0
TOTAL Used In Calcs	17,260,000	575,333				2958	4,135	
				677.19				

08-04- 2015
SERVICE COD CONSTUMPTION SU CONSTUMPTION SUMMARY 6/16-7/16

YEAR: 2015

	DESCRIPTION	TOTAL ADDRESSES	Total Usage per 1000	Total Usage	Total Accounts	Average Usage per 1000	Average Billed per 1000	Calculated LUE Multiplier
			COMMERCIAL METERS					
CI1	COM 3/4"	404	2,670	2,670,000	405	7	7	1.00
CI2	COM 1"	106	1,986	1,986,000	107	19	19	2.71
CI3	COM 1 1/2"	11	482	482,000	11	44	44	6.29
CI4	COM 2"	84	4,860	4,860,000	84	58	58	8.29
CI5	COM 3"	3	62	62,000	3	21	21	3.00
CI6	COM 4"	8	695	695,000	8	87	87	12.43
CI7	COM 6"	6	25	25,000	6	4	4	0.57
CO1	COM OUTSIDE 3/4"	1	0	0	1	0	0	0.00
MF	1 1/2" WATER USED BY CITY	30	1,249	1,249,000	30	42	42	6.00
~~PP~~	~~PURPLE PIPE~~	~~2~~	~~184~~	~~184000~~	~~2~~	~~92~~	~~92~~	~~13.14285714~~
			RESIDENTIAL METERS					
RI1	RES 3/4"	2,115	13,569	13,569,000	2,139	6	6	1.00
RI2	RES 1"	190	2,977	2,977,000	195	16	15	2.67
RI3	RES 1 1/2"	6	102	102,000	6	17	17	2.83
RI4	RES 2"	5	265	265,000	5	53	53	8.83
RI5	RES 3"	3	289	289,000	3	96	96	16.00
RI6	RES 4"	1	20	20,000	1	20	20	3.33
RO1	RES OUTSIDE 3/4"	5	50	50,000	5	10	10	1.67
RO2	RES OUTSIDE 1"	1	0	0	1	0	0	0.00
			Residential SPRINKLER METERS					
SP1	SPK 3/4"	5	24	24,000	5	5	5	1.00
SP2	SPK 1"	3	52	52,000	3	17	17	3.40
SP3	SPK 1 1/2"	5	435	435,000	5	87	87	17.40
SP4	SPK 2"	12	713	713,000	12	59	59	11.80
SP6	SPK 4"	2	324	324,000	2	162	162	32.40
			COMMERCIAL SPRINKLERS					
A01	SPK 3/4"	43	416	416,000	43	10	10	1.00
A05	3/4" WATER USED BY CITY	12	67	67,000	12	6	6	0.60
A02	SPK 1"	66	1,957	1,957,000	66	30	30	3.00
A03	SPK 2"	11	1,033	1,033,000	11	94	94	9.40
A06	SPK 3"	1	1,060	1,060,000	1	1,060	1,060	106.00
			4533					
		GRAND TOTAL	35,566					
RANGE:		0						
Appartments		255	2,278	2,278	260	9	9	
Commercial		739	16,159	16,159	741	22	22	
City		42	1,316	1,316	42	31	31	
Neighborhood Commercial		14	76	76	14	5	5	
Residential		2,091	15,737	15,737	2115	8	7	
		GRAND TOTAL	35,566	35,566				
YEAR:		2015						
GRAND TOTAL		3,141	35,566	35,566	3172	11	11	

Average LUE Calculation

Meter Size	Total Monthly Usage	Total Daily Usage	Impact Fee Multiplier	Calculated LUE Multiplier	Total LUEs	Avg Day LUE Usage
3/4"	16,729,000	557,633	1	1.00	2,519.00	221
1"	6,972,000	232,400	1.67	2.78	822.66	282
1.5"	584,000	19,467	3.33	5.68	267.09	73
2"	6,871,000	229,033	5.33	8.84	786.67	291
3"	1,411,000	47,033	10.67	10.67	64.02	735
4"	1,039,000	34,633	16.67	18.48	166.33	208
6"	25,000	833	33.33	33.33	199.98	4
TOTAL Used In Calcs	33,631,000				4,826	
				580.22		

APPENDIX C

PROBABLE ESTIMATE OF COST FOR PHASE 4 IMPROVEMENTS, GRAVITY FILTERS AND RAW WATER PUMP IMPROVEMENTS FOR 4.8 MGD AND 6.3 MGD CAPACITY AND EXISTING WATER TREATMENT PLANT UPGRADES

APPENDIX C.1
PROJECT NO. 1

CITY OF MARBLE FALLS WATER TREATMENT PLANT

PROBABLE ESTIMATE OF COST FOR PHASE 4 IMPROVEMENTS GRAVITY FILTERS AND RAW WATER PUMP IMPROVEMENTS FOR 4.8 MGD TOTAL PLANT CAPACITY AND ALTERNATE COSTS FOR EXISTING PLANT UPGRADES

__ Conceptual __X Preliminary _ Final

Prepared by: Steven D. Kallman, P.E., R.P.L.S. Date: March 21, 2016

PROJECT: Marble Falls Water Treatment Plant Improvements Phase 4
LOCATION: Installation of One Gravity Filter and Two Raw Water Pumps
CLIENT NAME: City of Marble Falls
CLIENT ADDRESS: 800 3rd Street, Marble Falls, Texas 78654
CLIENT PHONE: (830) 798-6265 for Eric Belaj, P.E.

No.	Item/Description	Unit	Unit Price	Quantity	Amount
GRAVITY FILTERS - ONE EACH					
1	Mobilization, Bonds and Insurance	L.S.	$ 93,000.00	1	$ 93,000.00
2	Excavations and Compacted Fill at Filters Foundation	L.S.	$ 132,000.00	1	$ 132,000.00
3	33'-4" X 14'-8" X 21'-11" Tall Reinforced Concrete Single Filter Cell and Pipe Gallery	L.S.	$ 276,000.00	1	$ 276,000.00
4	Masonry Work at New Filter Building	L.S.	$ 60,000.00	1	$ 60,000.00
5	Metal Roofing at New Filter Building	L.S.	$ 39,000.00	1	$ 39,000.00
6	Filter Face Piping, Valves and Piping Supports	L.S.	$ 180,000.00	1	$ 180,000.00
7	Yard Piping and Connections	L.S.	$ 20,000.00	1	$ 20,000.00
8	Gravity Filter Equipment for Two Filter Cells, Including Underdrain Systems, Media Retainer Plate, Air Header Piping, Wash Troughs, Filter Media, Filter Control Systems, Automatic Valves and Startup Services - **1.5 MGD Capacity**	L.S.	$ 276,000.00	1	$ 276,000.00
9	Installation of Gravity Filter Equipment	L.S.	$ 100,500.00	1	$ 100,500.00
10	Backwash Pump for New Gravity Filters	L.S.	$ 80,000.00	1	$ 80,000.00
11	Electrical and VFD for Backwash Pump	L.S.	$ 100,000.00	1	$ 100,000.00
12	Erosion Control	L.S.	$ 5,000.00	1	$ 5,000.00
13	Stabilize Construction Entrance	L.S.	$ 4,000.00	1	$ 4,000.00
14	Restoration and Revegetation	L.S.	$ 7,500.00	1	$ 7,500.00
15	Construction Staking	L.S.	$ 4,000.00	1	$ 4,000.00
16	Plant Startup	L.S.	$ 15,000.00	1	$ 15,000.00
17	Painting and Coatings at Piping	L.S.	$ 39,000.00	1	$ 39,000.00
	SUBTOTAL ESTIMATED GRAVITY FILTER CONSTRUCTION COST				**$ 1,431,000.00**
RAW WATER INTAKE PUMP IMPROVEMENTS - 2 EACH					
1	Remove Two Existing Raw Water Pumps	L.S.	$ 32,000.00	1	$ 32,000.00
2	Install 2 Each 2,400 GPM Pumps	L.S.	$ 325,000.00	1	$ 325,000.00
3	Install SS Anti-Vortex Plates	L.S.	$ 65,000.00	1	$ 65,000.00
4	Remove and Replace Existing Piping and Valves at Two Pumps	L.S.	$ 52,000.00	1	$ 52,000.00
5	Electrical & 2 Each VFD's	L.S.	$ 225,000.00	1	$ 225,000.00
6	Painting and Coatings at Pumps and Piping	L.S.	$ 20,000.00	1	$ 20,000.00
	SUBTOTAL ESTIMATED RAW WATER PUMP CONSTRUCTION COST				**$ 719,000.00**
	TOTAL ESTIMATED GRAVITY FILTER & RAW WATER PUMP CONSTRUCTION COST				**$ 2,150,000.00**
	BASIC ENGINEERING SERVICES				**$ 258,000.00**
	INSPECTION SERVICES				**$ 15,000.00**
	O&M MANUALS				**$ 8,500.00**
	TOTAL ESTIMATED PROJECT COST - GRAVITY FILTER AND RAW WATER PUMPS				**$ 2,431,500.00**

APPENDIX C.1
PROJECT NO. 1

CITY OF MARBLE FALLS WATER TREATMENT PLANT

PROBABLE ESTIMATE OF COST FOR PHASE 4 IMPROVEMENTS GRAVITY FILTERS AND RAW WATER PUMP IMPROVEMENTS FOR 4.8 MGD TOTAL PLANT CAPACITY AND ALTERNATE COSTS FOR EXISTING PLANT UPGRADES

__ Conceptual   __X Preliminary   _ Final

Prepared by: Steven D. Kallman, P.E., R.P.L.S.   Date: March 21, 2016

PROJECT:	Marble Falls Water Treatment Plant Improvements Phase 4
LOCATION:	Installation of One Gravity Filter and Two Raw Water Pumps
CLIENT NAME:	City of Marble Falls
CLIENT ADDRESS:	800 3rd Street, Marble Falls, Texas 78654
CLIENT PHONE:	(830) 798-6265 for Eric Belaj, P.E.

No.	Item/Description	Unit	Unit Price	Quantity	Amount
BELOW ARE ESTIMATED COSTS FOR EXISTING WATER TREATMENT PLANT UPGRADES:					
A.1	Upgrade Chlorine Injectors and Feed Pumps	L.S.	$ 73,000.00	1	$ 73,000.00
A.2	Install Ultrasonic Meters in Yard Piping in 2 Locations to Improve Treatment Operations, Install Wiring and SCADA	L.S.	$ 90,000.00	1	$ 90,000.00
A.3	Install "Flow Pacing" Equipment on Chemical Feed System. Install Wiring and SCADA	L.S.	$ 202,000.00	1	$ 202,000.00
A.4	Install Upsized Chemical Feed System Pumps, Tanks and Spare Pumps and Tubes	L.S.	$ 238,000.00	1	$ 238,000.00
A.5	Furnish and Install Equipment to Replace Filter Media and Underdrain System, to Include Filter Control System, Level Transmitters, Loss-of-Head Transmitters, Mag Effluent Flow Meters, Mag B/W Flow Meter and Turbidimeters, Air Scrub System for the 3 Existing Filters, Repair Miscellaneous Related Parts on Existing Underdrain, Grouting and Installation of Underdrain Securement Hardware. Furnish and Install Required Filter Influent Valves, Filter-to-Waste Valves, Rate-of-Flow Control Valves, including all Filter Face Piping and Fittings and Coatings. Install all Electrical Conduits and Wiring from the Filter Control Console to all Valve Actuators	L.S.	$ 890,000.00	1	$ 890,000.00
SUBTOTAL ESTIMATED WATER TREATMENT PLANT UPGRADES					$ 1,493,000.00
TOTAL ESTIMATED PROJECT COST = GRAVITY FILTER, RAW WATER PUMPS AND EXISTING WATER TREATMENT PLANT UPGRADES					$ 3,924,500.00
NOTE: Dollar Amounts in the "Amount" Column Include Engineering Costs for Items A.1 through A.5 Only					

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STATE OF TEXAS
STEVEN D. KALLMAN
40762
REGISTERED
PROFESSIONAL ENGINEER

03-21-16

APPENDIX C.2
PROJECT NO. 1A

CITY OF MARBLE FALLS WATER TREATMENT PLANT

PROBABLE ESTIMATE OF COST FOR
PHASE 4 IMPROVEMENTS
GRAVITY FILTERS AND RAW WATER PUMP IMPROVEMENTS FOR
6.3 MGD TOTAL PLANT CAPACITY AND
ALTERNATE COSTS FOR EXISTING PLANT UPGRADES

__ Conceptual   __X Preliminary   _ Final

Prepared by: Steven D. Kallman, P.E., R.P.L.S.   Date: March 21, 2016

PROJECT:	Marble Falls Water Treatment Plant Improvements Phase 4
LOCATION:	Installation of Two Gravity Filters and Three Raw Water Pumps
CLIENT NAME:	City of Marble Falls
CLIENT ADDRESS:	800 3rd Street, Marble Falls, Texas 78654
CLIENT PHONE:	(830) 798-6265 for Eric Belaj, P.E.

No.	Item/Description	Unit	Unit Price	Quantity	Amount
GRAVITY FILTERS - ONE EACH					
1	Mobilization, Bonds and Insurance	L.S.	$ 155,000.00	1	$ 155,000.00
2	Excavations and Compacted Fill at Filters Foundation	L.S.	$ 189,000.00	1	$ 189,000.00
3	33'-4" X 29'-9" X 21'-11" Tall Reinforced Concrete Dual Filter Cells and Pipe Gallery	L.S.	$ 420,000.00	1	$ 420,000.00
4	Masonry Work at New Filter Building	L.S.	$ 94,500.00	1	$ 94,500.00
5	Metal Roofing at New Filter Building	L.S.	$ 63,000.00	1	$ 63,000.00
6	Filter Face Piping, Valves and Piping Supports	L.S.	$ 295,000.00	1	$ 295,000.00
7	Yard Piping and Connections	L.S.	$ 20,000.00	1	$ 20,000.00
8	Gravity Filter Equipment for Two Filter Cells, Including Underdrain Systems, Media Retainer Plate, Air Header Piping, Air Compressor, Wash Troughs, Filter Media, Filter Control Systems, Automatic Valves and Startup Services - 3 MGD Capacity	L.S.	$ 460,000.00	1	$ 460,000.00
9	Installation of Gravity Filter Equipment	L.S.	$ 170,000.00	1	$ 170,000.00
10	Backwash Pump for New Gravity Filters	L.S.	$ 80,000.00	1	$ 80,000.00
11	Electrical and VFD for Backwash Pump	L.S.	$ 100,000.00	1	$ 100,000.00
12	Erosion Control	L.S.	$ 5,000.00	1	$ 5,000.00
13	Stabilized Construction Entrance	L.S.	$ 4,000.00	1	$ 4,000.00
14	Restoration and Revegetation	L.S.	$ 7,500.00	1	$ 7,500.00
15	Construction Staking	L.S.	$ 4,000.00	1	$ 4,000.00
16	Plant Startup	L.S.	$ 15,000.00	1	$ 15,000.00
17	Painting and Coatings at Piping	L.S.	$ 64,000.00	1	$ 64,000.00
SUBTOTAL ESTIMATED GRAVITY FILTER CONSTRUCTION COST					**$ 2,146,000.00**
RAW WATER INTAKE PUMP IMPROVEMENTS - 2 EACH					
1	Remove Existing Raw Water Pumps	L.S.	$ 45,000.00	1	$ 45,000.00
2	Install 3 Each 2,400 GPM Pumps	L.S.	$ 475,000.00	1	$ 475,000.00
3	Install SS Anti-Vortex Plates	L.S.	$ 75,000.00	1	$ 75,000.00
4	Remove and Replace Existing Piping and Valves at Two Pumps	L.S.	$ 85,000.00	1	$ 85,000.00
5	Electrical & 3 Each VFD's	L.S.	$ 350,000.00	1	$ 350,000.00
6	Painting and Coatings at Pumps and Piping	L.S.	$ 26,000.00	1	$ 26,000.00
SUBTOTAL ESTIMATED RAW WATER PUMP CONSTRUCTION COST					**$ 1,056,000.00**
TOTAL ESTIMATED GRAVITY FILTER & RAW WATER PUMP CONSTRUCTION COST					**$ 3,202,000.00**
BASIC ENGINEERING SERVICES					**$ 384,000.00**
INSPECTION SERVICES					**$ 20,000.00**
O&M MANUALS					**$ 8,500.00**
TOTAL ESTIMATED PROJECT COST - GRAVITY FILTER AND RAW WATER PUMPS					**$ 3,614,500.00**

APPENDIX C.2
PROJECT NO. 1A

CITY OF MARBLE FALLS WATER TREATMENT PLANT

PROBABLE ESTIMATE OF COST FOR
PHASE 4 IMPROVEMENTS
GRAVITY FILTERS AND RAW WATER PUMP IMPROVEMENTS FOR
6.3 MGD TOTAL PLANT CAPACITY AND
ALTERNATE COSTS FOR EXISTING PLANT UPGRADES

__ Conceptual   __X Preliminary   _ Final

Prepared by: Steven D. Kallman, P.E., R.P.L.S.   Date: March 21, 2016

PROJECT:	Marble Falls Water Treatment Plant Improvements Phase 4
LOCATION:	Installation of Two Gravity Filters and Three Raw Water Pumps
CLIENT NAME:	City of Marble Falls
CLIENT ADDRESS:	800 3rd Street, Marble Falls, Texas 78654
CLIENT PHONE:	(830) 798-6265 for Eric Belaj, P.E.

No.	Item/Description	Unit	Unit Price	Quantity	Amount
BELOW ARE ESTIMATED COSTS FOR EXISTING WATER TREATMENT PLANT UPGRADES:					
A.1	Upgrade Chlorine Injectors and Feed Pumps	L.S.	$ 73,000.00	1	$ 73,000.00
A.2	Install Ultrasonic Meters in Yard Piping in 2 Locations to Improve Treatment Operations. Install Wiring and SCADA	L.S.	$ 90,000.00	1	$ 90,000.00
A.3	Install "Flow Pacing" Equipment on Chemical Feed System. Install Wiring and SCADA	L.S.	$ 202,000.00	1	$ 202,000.00
A.4	Install Upsized Chemical Feed System Pumps, Tanks and Spare Pumps and Tubes	L.S.	$ 238,000.00	1	$ 238,000.00
A.5	Furnish and Install Equipment to Replace Filter Media and Underdrain System, to Include Filter Control System, Level Transmitters, Loss-of-Head Transmitters, Mag Effluent Flow Meters, Mag B/W Flow Meter and Turbidimeters, Air Scrub System for the 3 Existing Filters, Repair Miscellaneous Related Parts on Existing Underdrain, Grouting and Installation of Underdrain Securement Hardware. Furnish and Install Required Filter Influent Valves, Filter-to-Waste Valves, Rate-of-Flow Control Valves, Including all Filter Face Piping and Fittings and Coatings. Install all Electrical Conduits and Wiring from the Filter Control Console to all Valve Actuators	L.S.	$ 890,000.00	1	$ 890,000.00
SUBTOTAL ESTIMATED WATER TREATMENT PLANT UPGRADES					$ 1,493,000.00
TOTAL ESTIMATED PROJECT COST = GRAVITY FILTER, RAW WATER PUMPS AND EXISTING WATER TREATMENT PLANT UPGRADES					$ 5,107,500.00
NOTE: Dollar Amounts in the "Amount" Column Include Engineering Costs for Items A.1 through A.5 Only					

S.D. KALLMAN, L.P.

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03-21-16

APPENDIX D

NEW WATER TREATMENT PLANT
AND WATER LINE SOUTH OF LAKE MARBLE FALLS
PROJECT SHEETS FROM THE CITY'S CIP
AND 2015 – 2019 CIP UPDATE MAPS

City of Marble Falls Texas

CAPITAL IMPROVEMENT PROGRAM

FISCAL YEAR 2019 - 2029

PROJECT NAME: SOUTH WATER PLANT

PROJECT DESCRIPTION	PROJECT JUSTIFICATION
PR5 - This project consists of constructing a new water plant adjacent to Max Starke Dam and install new raw water intake.	The continuing development on the south side of the lake will in the future require the need for a second water treatment plant. The City has the option to purchase a 5-acre site from LCRA for the new plant.

PROJECT COST ALLOCATIONS	FY PROJECTED APPROPRIATIONS									
	GL ACCOUNT NUMBER	TOTAL BUDGET	FUNDED BUDGET	EXPENSES THRU 2013-2014	2020-2021	2021-2022	2022-2023	2023-2024	FUTURE	PROJECT TOTAL
Prelim. Engineering										
Survey										$ -
Right of Way										$ -
Geotechnical										$ -
Final Engineering Design		$ 1,500,000.00							$ 1,500,000.00	$ 1,500,000.00
Bidding Phase										$ -
Const. Administration										$ -
Construction		$ 14,500,000.00							$ 14,500,000.00	$ 14,500,000.00
TOTAL COSTS		$ 16,000,000.00	$ -	$ -	$ -	$ -	$ -	$ -	$ 16,000,000.00	$ 16,000,000.00

FUNDING SOURCES	GL ACCOUNT NUMBER	TOTAL BUDGET	FUNDED BUDGET	FUNDED THRU 2013-2014	2020-2021	2021-2022	2022-2023	2023-2024	FUTURE	PROJECT TOTAL
General Revenue										$ -
Certificates of Obligation										$ -
Grants										$ -
TIRZ										$ -
Other										$ -
Unfunded		$ 16,000,000.00							$ 16,000,000.00	$ 16,000,000.00
TOTAL SOURCES		$ 16,000,000.00	$ -	$ -	$ -	$ -	$ -	$ -	$ 16,000,000.00	$ 16,000,000.00

CITY OF Marble Falls TEXAS

CAPITAL IMPROVEMENT PROGRAM

FISCAL YEAR 2019 - 2029

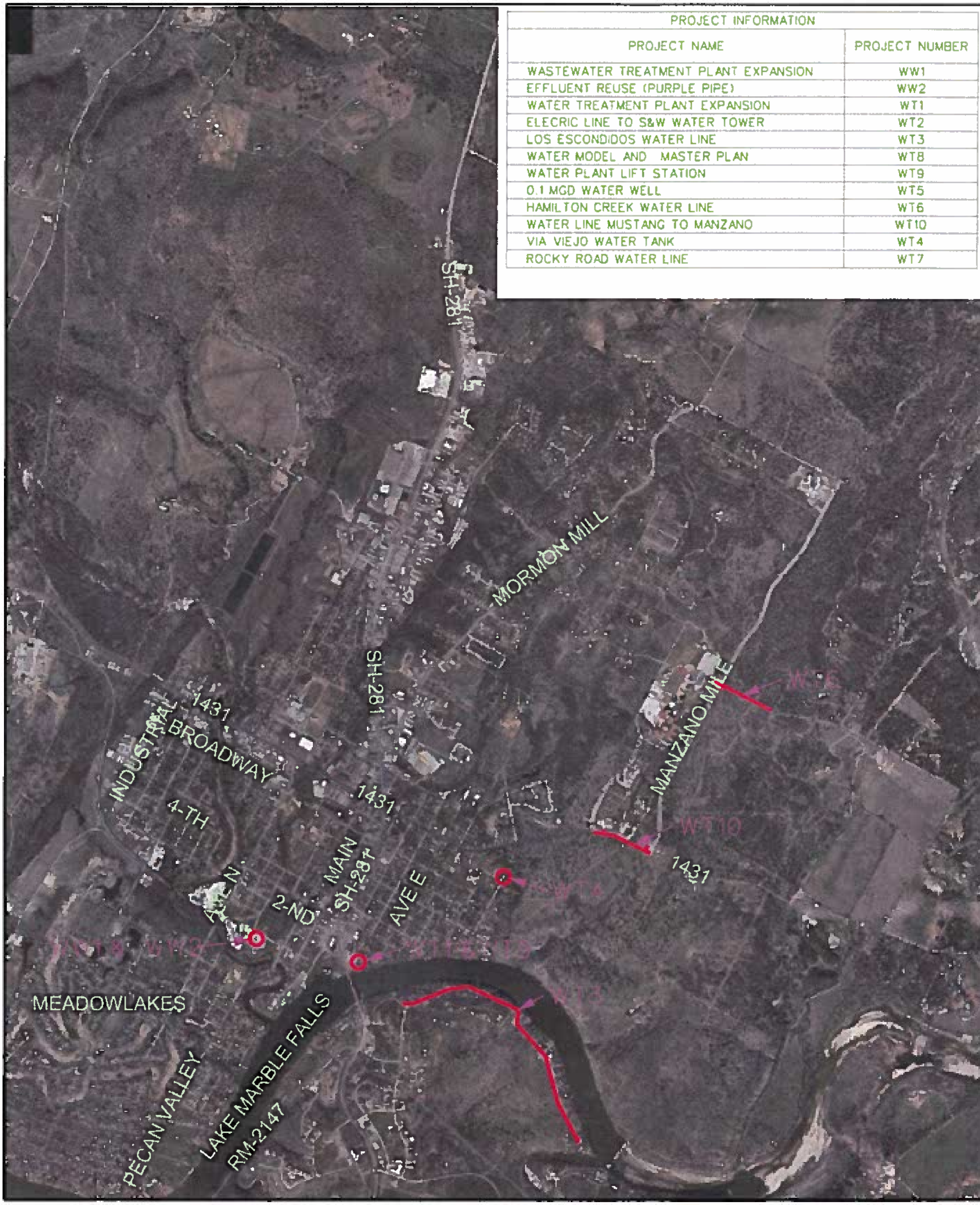
PROJECT NAME: WATER LINE FROM S PLANT TO GATEWAY

PROJECT DESCRIPTION	PROJECT JUSTIFICATION
PR6 - This project consists of constructing a new water transmission water line from the future water plant, adjacent to Max Starke Dam, to connect to existing system at Gateway. Pipe size is yet to be determined.	The planned second water treatment plant south of the lake will require a transmission line to connect to existing system. The City has the option to purchase a 5-acre site from LCRA for the new plant, but the plant location is approx. one mile from the existing water system.

PROJECT COST ALLOCATIONS	FY PROJECTED APPROPRIATIONS									
	GL ACCOUNT NUMBER	TOTAL BUDGET	FUNDED BUDGET	EXPENSES THRU 2013-2014	2020-2021	2021-2022	2022-2023	2023-2024	FUTURE	PROJECT TOTAL
Prelim. Engineering										$ -
Survey										$ -
Right of Way										$ -
Geotechnical										$ -
Final Engineering Design		$ 300,000.00							$ 300,000.00	$ 300,000.00
Bidding Phase										$ -
Const. Administration										$ -
Construction		$ 2,700,000.00							$ 2,700,000.00	$ 2,700,000.00
TOTAL COSTS		$ 3,000,000.00	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,000,000.00	$ 3,000,000.00

FUNDING SOURCES	GL ACCOUNT NUMBER	TOTAL BUDGET	FUNDED BUDGET	FUNDED THRU 2013-2014	2020-2021	2021-2022	2022-2023	2023-2024	FUTURE	PROJECT TOTAL
General Revenue										$ -
Certificates of Obligation										$ -
Grants										$ -
TIRZ										$ -
Other										$ -
Unfunded		$ 3,000,000.00							$ 3,000,000.00	$ 3,000,000.00
TOTAL SOURCES		$ 3,000,000.00	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,000,000.00	$ 3,000,000.00

PROJECT INFORMATION	
PROJECT NAME	PROJECT NUMBER
WASTEWATER TREATMENT PLANT EXPANSION	WW1
EFFLUENT REUSE (PURPLE PIPE)	WW2
WATER TREATMENT PLANT EXPANSION	WT1
ELECRIC LINE TO S&W WATER TOWER	WT2
LOS ESCONDIDOS WATER LINE	WT3
WATER MODEL AND MASTER PLAN	WT8
WATER PLANT LIFT STATION	WT9
0.1 MGD WATER WELL	WT5
HAMILTON CREEK WATER LINE	WT6
WATER LINE MUSTANG TO MANZANO	WT10
VIA VIEJO WATER TANK	WT4
ROCKY ROAD WATER LINE	WT7



Marble Falls
TEXAS

2015–2019 CIP UPDATE

UTILITIES

NORTH

SHEET 1 OF 2

MARCH 2015

0 1500 3000
SCALE IN FEET

PROJECT INFORMATION	
PROJECT NAME	PROJECT NUMBER
WASTEWATER TREATMENT PLANT EXPANSION	WW1
EFFLUENT REUSE (PURPLE PIPE)	WW2
WATER TREATMENT PLANT EXPANSION	WT1
ELECRIC LINE TO S&W WATER TOWER	WT2
LOS ESCONDIDOS WATER LINE	WT3
WATER MODEL AND MASTER PLAN	WT8
WATER PLANT LIFT STATION	WT9
0.1 MGD WATER WELL	WT5
HAMILTON CREEK WATER LINE	WT6
WATER LINE MUSTANG TO MANZANO	WT10
VIA VIEJO WATER TANK	WT4
ROCKY ROAD WATER LINE	WT7

Marble Falls
TEXAS

2015–2019 CIP UPDATE

UTILITIES

NORTH

SHEET 2 OF 2

MARCH 2015

0 1500 3000

SCALE IN FEET

APPENDIX E

FLATROCK SPRINGS
MASTER PLAN

Exhibit "B-1" (1 of 3) – Master Plan