Innovative approaches
Practical results
Outstanding service

Water & Wastewater Master Plan

December 2019

Prepared for:

City of Killeen

Prepared by:

FREESE AND NICHOLS, INC.
10431 Morado Circle, Suite 300
Austin, Texas 78759
(512) 617-3100

Water & Wastewater Master Plan
December 2019

FREESE AND NICHOLS, INC.
TEXAS REGISTERED
ENGINEERING FIRM
F-2144

CITY OF KILLEEN
101 N. College Street
Killeen, TX 76541

FREESE AND NICHOLS, INC.
10431 Morado Circle, Suite 300
Austin, Texas 78759
FNI Project Number: KIL17542

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

Appendix A - Water Capital Improvement Plan Cost Tables
Appendix B - Wastewater Capital Improvement Plan Cost Tables
Appendix C - Water Model Calibration Results
Appendix D - Modeled Pumping and Tank Levels
Appendix E - Modeled Pressure and Fire Flow Maps
Appendix F - Risk Based Assessment Maps
Appendix G - Renewal CIP Cost Tables
Appendix H - Facility Site Inspection Sheets

EXECUTIVE SUMMARY

1.0 INTRODUCTION

The City of Killeen is a growing community located in central Texas, within Bell County. The City currently provides water and wastewater service to over 145,000 people. The population within the service area is projected to grow by 50,000 people in the next 20 years. Accommodating this growth in an efficient and cost-effective manner, while also focusing on the maintenance of existing water and wastewater system assets, is the purpose of this 2019 Water and Wastewater Master Plan. This report has been prepared to provide the City of Killeen a planning tool that will serve as a guide for short-term and long-term improvements to the infrastructure within the water and wastewater systems.

2.0 POPULATION

Population and projected land use are important elements in the analysis of water distribution and wastewater collection systems. Water demands and wastewater flows are dependent on the residential population and commercial development served by the systems. This determines the sizing and location of future system infrastructure. A variety of circumstances influence the rate of future development within specific regions or cities so it is important to note that projecting future population is challenging.

The City of Killeen Planning and Development Services Department provided overall City population projections based on the Texas State Data Center's population projection scenarios for Bell County. **Table ES-1** presents the provided population projections used as a control for the Master Plan 5-year, 10-year, and 20-year planning phases.

Table ES-1 City Provided Population Projections

Year	Bell County Population	Killeen Population
2019	365,421	147,630
2024	394,477	159,369
2029	423,462	171,079
2039	485,497	196,141

The City provided a land use shapefile with various designations that each were assigned a specific density (people/acre) to reach the 2019 population shown in **Table ES-1**. Billing meter data was also provided, which FNI used to verify existing development locations throughout the service area. Once the densities

and 2019 population were established, undeveloped parcels were assigned phases to project population for the three planning phases. The resulting population projections by FNI are shown in **Table ES-2**.

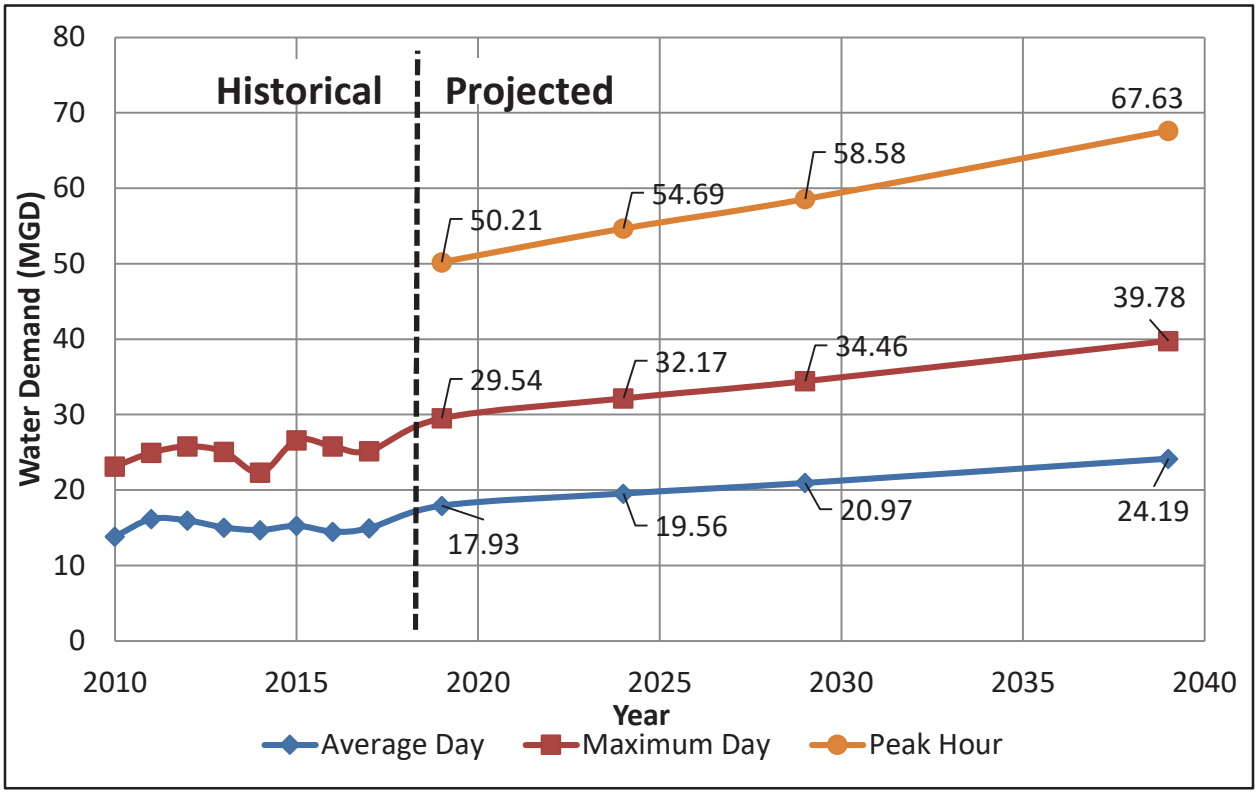
Table ES-2 Population and Land Use Projections

Year	Service Population	Non-Residential Acres
2019	148,088	6,198
2024	160,313	6,867
2029	171,172	7,652
2039	197,019	8,846

3.0 WATER DEMANDS

Reviewing historical water demands provides insight into selecting design criteria used to project future water demands. Annual average day demand, maximum day to average day peaking factors, and per-capita consumption were reviewed by City engineering staff and provided a basis for determining the design criteria used to project water demands. **Figure ES-1** illustrates the historical and projected water demands for the City of Killeen.

Figure ES-1 Historical and Projected Water Demands



4.0 DESCRIPTION OF THE EXISTING WATER SYSTEM

The City of Killeen's distribution system consists of 678 miles of water lines. Pipeline diameters range in size from 0.75-inch to 30-inches. The City acquires water from a wholesale water supplier to provide service to its residents. Currently, the City exclusively purchases treated surface water from Bell County Water Control and Improvement District #1. The surface water is part of 39,000 acre-feet/year of raw water that Killeen has secured in Lake Belton. The existing maximum daily supply of treated water is 32.0 mgd. Killeen's system has four water supply delivery points with associated ground storage tanks and pump stations, two booster pump stations, five elevated storage tanks, two ground storage tanks acting as elevated storage, and two pressure reducing valves.

5.0 WATER SYSTEM ANALYSES AND HYDRAULIC MODELING

Hydraulic analyses were conducted to identify deficiencies in the City of Killeen's existing water distribution system and to establish a capital improvements plan to improve the existing system and meet projected water demands through 2039. Various combinations of improvements and system modifications were investigated to determine the most appropriate approach for meeting projected demands. Parameters considered while developing the capital improvements plan included increasing system reliability, renewing aging infrastructure, simplifying system operations, meeting required fire flows, and maintaining proper residual pressures.

The City of Killeen's existing all pipes water model was converted from the H2OMap Water software package to the InfoWater software package due to H2OMap Water being discontinued by Innovyze. In order to verify that the hydraulic model accurately represented the actual distribution system, a model calibration analysis was performed. The calibration process involved adjusting system operation, demand allocation, and peaking factors to match a known condition. Calibration is an important component of building and using a hydraulic model. Achieving a good calibration to real-world conditions instills confidence that the model elements are reflective of the actual distribution system infrastructure and operation.

The hydraulic model was used to evaluate the existing distribution system to assess current pumping and storage capacity, residual pressures, and fire flow capacity. This analysis is performed to determine if there are any existing system deficiencies and to provide a baseline for the current level of service. The results of the analysis are summarized below:

- The City is currently exceeding TCEQ requirements for storage and pumping capacity in all areas except a minor deficiency in elevated storage for the Upper Pressure Plane.
- A review of existing pressures throughout the system revealed an area of low pressure due to high ground elevations near Park EST.
- The majority of the water system can provide at least 1,000 gpm, which is a typical residential fire flow demand. Available fire flows below 1,000 gpm are due to small diameter lines in isolated areas.

Once the existing system was evaluated, hydraulic analyses were performed on the distribution system under future demand conditions. Water system improvements were developed to accommodate the anticipated residential and non-residential growth over the next 20 years. Challenges facing the water system include providing additional supply and transmission capacity, meeting elevated storage and pumping requirements, providing service to areas of growth, and maintaining aging infrastructure through asset management. Key observations and recommendations resulting from modeling and evaluation of the distribution system are:

- The projected demands exceed the existing treated water rate of 32 mgd in 2024. The WCID #1 water treatment plant currently under design to add 10 mgd will be complete and provide additional supply before 2024 as indicated in future phases of FNI's analysis.
- Several areas were identified that need additional transmission capacity to convey water throughout the distribution system. Transmission lines are larger diameter pipelines, typically greater than 12", primarily used to transfer water from the source to areas of demand.
- Based on the evaluation of existing and future system operations, it is recommended that the City maintain 150 gallons/connection of elevated storage, which is more than the minimum TCEQ requirement.
- As new development occurs within Killeen's water service area, new water lines are needed to extend service to unserved areas. It is recommended that a minimum line size of 12-inches be installed, creating one-mile grids where possible.

6.0 WATER SYSTEM CAPITAL IMPROVEMENTS PLAN

Freese and Nichols, Inc. (FNI) developed a capital improvements plan for the City of Killeen to ensure high quality water service that promotes residential and commercial development. The recommended improvements will provide the required capacity and reliability to meet projected water demands through the year 2039. Utilizing the hydraulic model to analyze the water distribution system, improvements were phased into the three planning periods in which they become hydraulically necessary. It is recommended that these projects be constructed generally in the order listed; however, development patterns may make it necessary to construct some projects sooner or later than anticipated. **Table ES-3** summarizes the costs of the recommended water system capital improvements plan for the City of Killeen.

Table ES-3 Summary of Water Capital Improvements Plan

Phase	Cost
2024	$30,770,600
2029	$19,810,900
2039	$18,584,500
Total	**$69,166,000**

7.0 WASTEWATER FLOWS

FNI reviewed historical data provided by the City from 2010 through 2019 to determine the historical trends in system-wide average daily flow and per-capita flow. Future average daily wastewater flows were calculated by applying the selected per-capita flows to projected residential land use and the selected per-acre flows to projected non-residential land use for the future phases. A peaking factor of 4.0 was used to project peak wet weather flow as flow monitoring and design-storm information were outdated. The City plans to conduct a flow monitoring and I/I reduction study soon after this report is completed. **Table ES-4** lists the wastewater flow projections for the City of Killeen.

Table ES-4 Summary of Wastewater Flow Projections

Year	Killeen Population	Average Day Flow (mgd)	Peak Wet Weather Flow (mgd)
2019	147,630	14.53	58.12
2024	159,369	15.85	63.40
2029	171,079	17.00	68.00
2039	196,141	19.61	78.44

8.0 DESCRIPTION OF THE EXISTING WASTEWATER SYSTEM

The City of Killeen's existing wastewater system consists of 604 miles of wastewater collector mains and interceptors. Pipeline diameters range in size from 4-inches to 42-inches. The wastewater system is served by two wastewater treatment plants that are owned and operated by Bell County Water Control and Improvement District #1. The North WWTP has a total treatment capacity of 18 mgd, while the South WWTP has a treatment capacity of 6 mgd. Lift stations are necessary when wastewater needs to be pumped to a higher elevation where the gravity flow can resume to the outfall of the system. Due to the varying topography citywide, Killeen operates 15 lift stations throughout the service area. The lift stations vary in size from small development addition lift stations near the city limits to the three large lift stations in the center of the City.

9.0 WASTEWATER SYSTEM ANALYSES AND HYDRAULIC MODELING

Hydraulic analyses were conducted to identify deficiencies in the City of Killeen's existing wastewater collection system and to establish a capital improvements plan to improve the existing system and handle projected wastewater flows through 2039. Various combinations of improvements and modifications were investigated to determine the most appropriate approach for conveying projected flows. Parameters used in developing the improvements plan included increasing system reliability, simplifying system operations, handling peak wet weather flows, maintaining proper velocities, and reducing surcharging and sanitary sewer overflows.

FNI imported the previous H2OMap Sewer model into InfoSewer to begin the wastewater system analysis for this report. Killeen had not conducted a recent inflow and infiltration study since the last study in 2010, so FNI decided to use TCEQ's recommended peaking factor of 4 where flow monitoring is not available. This constant factor was applied throughout the system to develop a peak wet weather analysis.

The hydraulic model was used to evaluate the existing collection system's ability to adequately convey wastewater without excessively surcharging or overflowing. This analysis was performed to determine if there are any existing system deficiencies and to provide a baseline for the current level of service. The results of the analysis are summarized below:

- The modeling results showed overflows in the northwestern portion of the Central Subbasin under existing system conditions as several pipe capacities are being exceeded. Projects for upsizing wastewater lines in this area were created to address this issue.

- Minor surcharging occurred throughout the system in the existing model runs, but these results can mostly be attributed to sections of pipe with minimum slopes. These lines did not trigger improvements when creating the CIP.

Once the existing system was evaluated, hydraulic analyses were performed on the collection system under future peak flow conditions. Wastewater system improvements were developed to accommodate the anticipated residential and non-residential growth over the next 20 years. To serve the future growth, the City of Killeen must rehabilitate, replace or upsize existing infrastructure and provide additional service to areas of growth where little or no infrastructure currently exists. Key observations and recommendations resulting from modeling and evaluation of the collection system are:

- Several lift stations require an expansion to maintain flexibility in operations and keep up with future peak wet weather flows. The firm capacities of lift stations #2, #6, #8, #20, and #22 were all exceeded when running future scenarios.

- The development of Turnbo Ranch's wastewater system will need to be closely monitored as a large portion of future growth was in this development. It will be critical to understand how their systems are designed to operate so Killeen can effectively prepare their existing system for the additional flows.

- Model results also indicate that there are existing wastewater mains that do not have capacity to convey future wastewater flows without excessive surcharging or overflowing so several upsizing projects were created.

10.0 WASTEWATER SYSTEM CAPITAL IMPROVEMENTS PLAN

FNI developed a capital improvements plan (CIP) for the City of Killeen to ensure the wastewater collection system will effectively and efficiently continue to convey flow to the wastewater treatment plants. The recommended improvements will provide the required capacity and reliability to meet projected wastewater flows through year 2039. Utilizing the hydraulic model to analyze the wastewater collection system, improvements were phased into the three phases in which they become hydraulically necessary. It is recommended that these projects be constructed generally in the order listed; however, development patterns may make it necessary to construct some projects sooner or later than anticipated. **Table ES-5** summarizes the costs of the recommended wastewater system capital improvements plan for the City of Killeen. The total water and wastewater costs are presented in **Table ES-6**.

Table ES-5 Summary of Wastewater Capital Improvements Plan

Phase	Cost
2024	$25,096,200
2029	$23,529,200
2039	$32,985,400
Total	**$81,610,800**

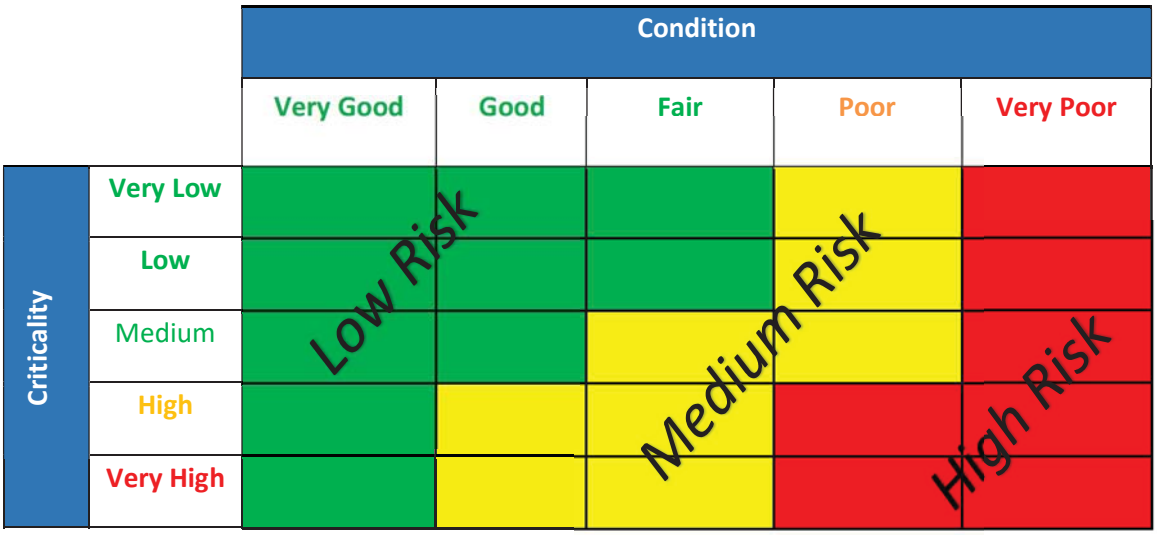
Table ES-6 Summary of Water and Wastewater Costs

Phase	Water Cost	Wastewater Cost	Total Cost
2024	$30,770,600	$25,096,200	$55,866,800
2029	$19,810,900	$23,529,200	$43,340,100
2039	$18,584,500	$32,985,400	$51,569,900
Total	**$69,166,000**	**$81,610,800**	**$150,776,800**

11.0 ASSET MANAGEMENT

As part of the Water and Wastewater Master Plan, FNI performed a water and wastewater pipelines and facilities risk-based assessment (RBA) in order to develop a comprehensive CIP. FNI evaluated the condition and criticality of the pipelines in the City's water distribution and wastewater collection system using the most recent GIS information. Facility condition and criticality scores were assigned through site visits with a team of engineers and utility employees and an understanding of each facility's capacity and location within the system. After assigning condition and criticality scores, FNI determined a risk designation of "High", "Medium", or "Low" for each asset by utilizing matrices similar to the one shown in **Table ES-7**. This allowed FNI to develop a prioritized renewal CIP based on the resulting risk scores that was then integrated with the capacity CIP. The resulting renewal CIP costs for water and wastewater were integrated into the total summary costs in **Tables ES-3, ES-5,** and **ES-6**.

Table ES-7 Example Risk Matrix



1.0 INTRODUCTION

The City of Killeen is a growing community located in central Texas, within Bell County. The City currently provides water and wastewater service to over 145,000 people. The population within the service area is projected to grow by almost 50,000 people in the next 20 years. Accommodating this growth in an efficient and cost-effective manner, while also focusing on the maintenance of existing water and wastewater system assets, is the purpose of this 2019 Water and Wastewater Master Plan. This report has been prepared to provide the City of Killeen a planning tool that will serve as a guide for short-term and long-term improvements to the infrastructure within the water and wastewater systems.

1.1 Scope of Work

Freese and Nichols, Inc. (FNI) was retained by the City of Killeen to prepare a Water and Wastewater Master Plan. The goals of the Water and Wastewater Master Plan were to evaluate the integrity of the existing water and wastewater systems and recommend a phased CIP through the year 2039. The recommended improvements will serve as a basis for the design, construction, and financing of facilities required to meet Killeen's water and wastewater capacity and system renewal needs. The major elements of the scope of this project included:

- Water and Wastewater Model Development
- Population Projections
- Water Demand and Wastewater Flow Projections
- Water and Wastewater Hydraulic Analyses
- Water and Wastewater System Capital Improvements Plan
- Water and Wastewater System Master Plan Report
- Risk Based Assessment of the Water and Wastewater Systems

1.2 List of Abbreviations

Table 1-1 List of Abbreviations

Abbreviation	Full Nomenclature
AD	Average Day Demand
AWWA	American Water Works Association
CCN	Certificate of Convenience and Necessity
CIP	Capital Improvements Plan
EPS	Extended Period Simulation
EST	Elevated Storage Tank
ETJ	Extra-territorial Jurisdiction
FNI	Freese and Nichols, Inc.
gpm	gallons per minute
GST	Ground Storage Tank
HGL	Hydraulic Grade Line
LS	Lift Station
MG	Million Gallons
mgd	million gallons per day
PH	Peak Hour Demand
PRV	Pressure Reducing Valve
PS	Pump Station
psi	pounds per square inch
PZ	Pressure Zone
SCADA	Supervisory Control and Data Acquisition
SSES	Sanitary Sewer Evaluation Survey
SSO	Sanitary Sewer Overflow
TCEQ	Texas Commission on Environmental Quality
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant

2.0 POPULATION

Growth projections are an important component of the water and wastewater master planning process. The magnitude and distribution of the growth in population and non-residential development will dictate where future infrastructure is required. It is important to note that projecting future population is challenging, especially for relatively small geographic areas such as individual cities because it can be difficult to predict how fast or slow development will occur when there are a variety of circumstances that can have an impact. The following sections describe the process used to develop population and non-residential growth projections.

2.1 Service Area

The service area for the Water and Wastewater Master Plan generally consists of the Water Certificate of Convenience and Necessity (CCN). A CCN is a state-regulated agreement in which the CCN holder is required to provide continuous and adequate utility service to all its retail customers and in turn is protected from encroachment by other retail service providers. The current boundary of the City of Killeen's water CCN encompasses the main portion of the City Limits and includes a recently formed Municipal Utility District that extends south of the City Limits. **Figure 2-1** shows the future service area evaluated as part of Killeen's Water and Wastewater Master Plan.

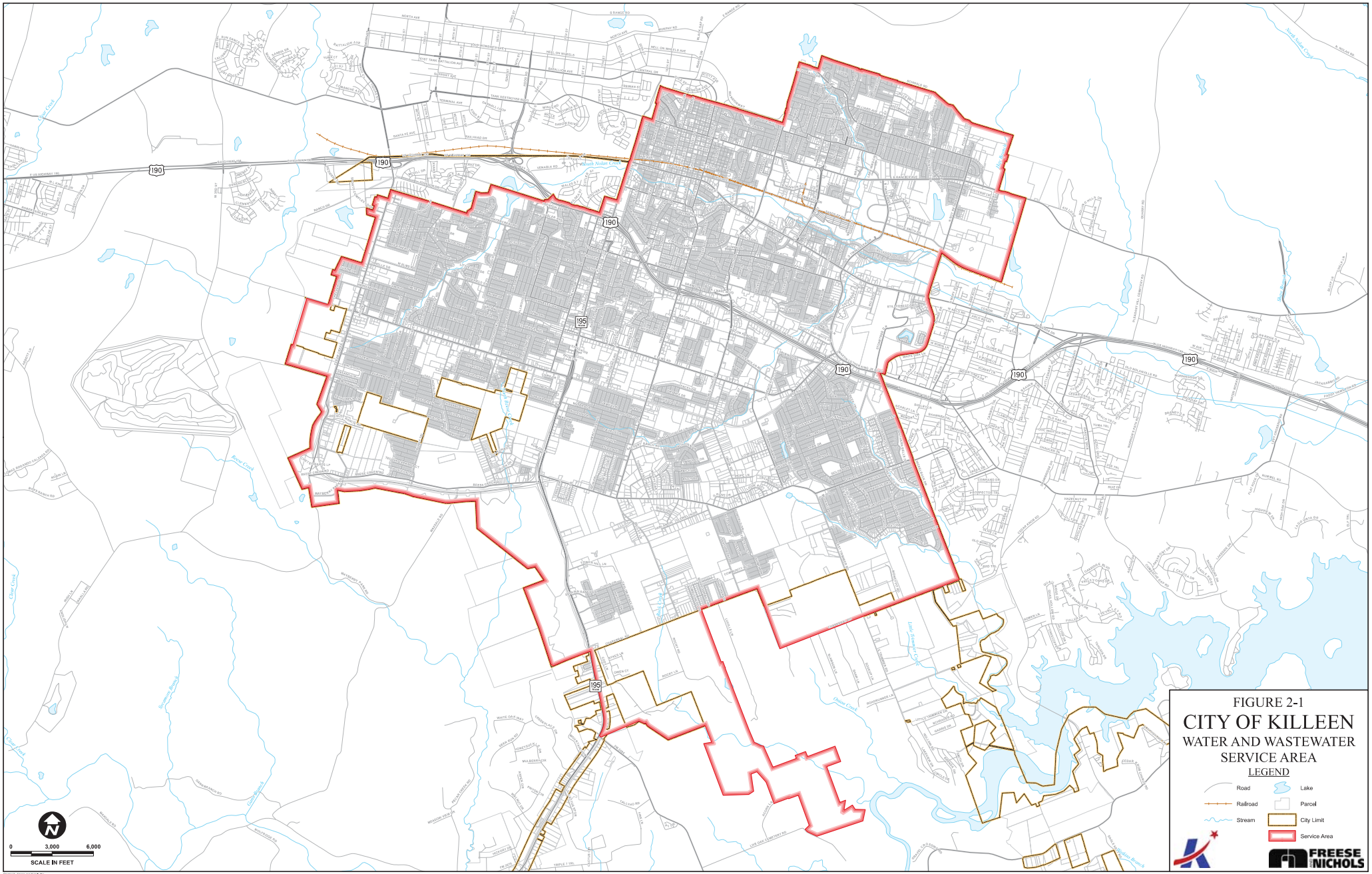


FIGURE 2-1
CITY OF KILLEEN
WATER AND WASTEWATER
SERVICE AREA
LEGEND
Road
Railroad
Stream
Lake
Parcel
City Limit
Service Area
FREESE NICHOLS
0
3,000
6,000
SCALE IN FEET

2.2 Projected Population

The City of Killeen Planning and Development Services Department provided overall City population projections based on the Texas State Data Center's population projection scenarios for Bell County. **Table 2-1** shows the yearly population projections provided by the City. These numbers were used as target control numbers for the Master Plan 5-year, 10-year, and 20-year planning phases.

Table 2-1 City Provided Population Estimates

Year	Bell County Population	Killeen Population
2019	365,421	147,630
2020	371,281	149,998
2021	377,131	152,361
2022	382,937	154,707
2023	388,741	157,051
2024	394,477	159,369
2025	400,259	161,705
2026	405,995	164,022
2027	411,756	166,349
2028	417,593	168,708
2029	423,462	171,079
2030	429,284	173,431
2031	435,316	175,868
2032	441,317	178,292
2033	447,373	180,739
2034	453,555	183,236
2035	459,840	185,775
2036	466,144	188,322
2037	472,469	190,877
2038	479,005	193,518
2039	485,497	196,141

To determine the distribution of the existing and future population, each parcel within the service area was evaluated. The City provided a land use shapefile that was used to categorize each parcel into the following designations:

- Business Park
- Estate
- Four-Plex Residential
- General Commercial
- General Residential
- Industrial
- Multi-Family Residential
- Neighborhood Conservation
- Parks-Recreation
- Planned Development
- Residential Mix
- Residential-Commercial Mix
- Rural
- Suburban Commercial
- Suburban Residential
- Turnbo Ranch
- Urban
- Urban Center

Densities (people/acre) were then developed for each of the land use categories to determine the estimated population associated with the various development types. The City also provided water meter data which was used to determine if a parcel was currently developed or vacant (i.e. if a water meter was located within a parcel, it was considered developed and included in the calculation for existing population). An aerial of the City was also reviewed to ensure developed parcels were captured in the existing population calculation. The next step in the population analysis involved identifying parcels likely to develop in the next 20 years. Parcels were selected using information on impending developments, proximity to major thoroughfares, adjacent development, and input from City staff. Once the parcels were identified and verified by city staff, they were phased into the 5-year, 10-year, and 20-year planning periods to generate the population projections utilized throughout the Master Plan. Once a total population close to the City's 2039 projection was achieved, those parcels were then phased for 5-year and 10-year growth. **Table 2-2** shows the densities for each land use type and **Table 2-3** shows the resulting population projections for each planning year. **Figure 2-2** shows the parcel phasing geographically.

Table 2-2 Land Use Densities

Land Use	People/Acre
Business Park	0
Estate	1
Four-Plex Residential	24
General Commercial	0
General Residential	12
Industrial	0
Multi-Family Residential	30
Neighborhood Conservation	12
Parks-Recreation	0
Planned Development	15
Residential Mix	15
Residential-Commercial Mix	15
Rural	0
Suburban Commercial	0
Suburban Residential	9
Turnbo Ranch	7
Urban	15
Urban Center	15

Table 2-3 Population and Land Use Projections

Year	Service Population	Non-Residential Acres
2019	148,088	6,198
2024	160,313	6,867
2029	171,172	7,652
2039	197,019	8,846

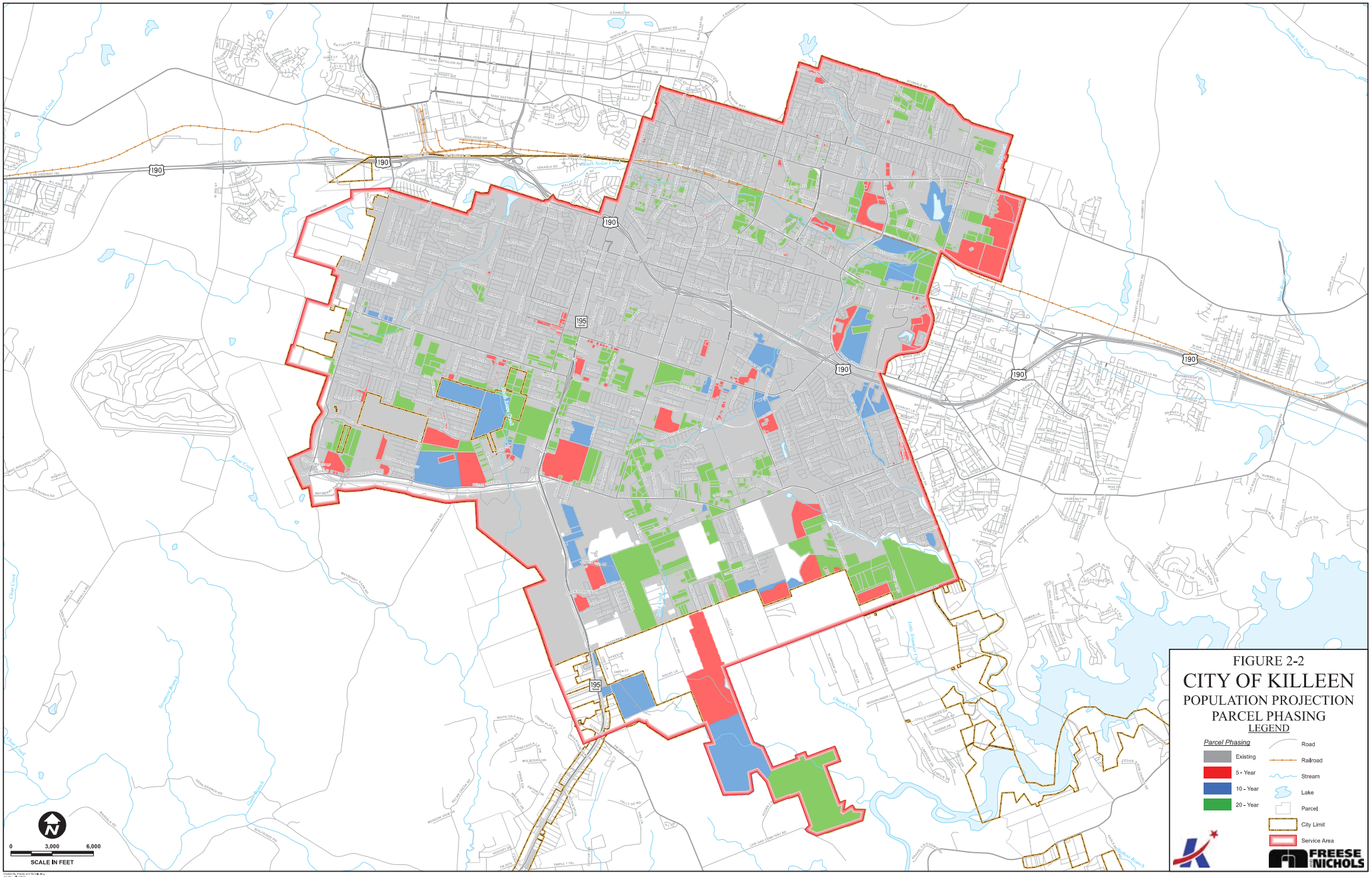


FIGURE 2-2
CITY OF KILLEEN
POPULATION PROJECTION
PARCEL PHASING
LEGEND
Parcel Phasing
Existing
5 - Year
10 - Year
20 - Year
Road
Railroad
Stream
Lake
Parcel
City Limit
Service Area
FREESE NICHOLS
0
3,000
6,000
SCALE IN FEET

3.0 WATER DEMANDS

A water utility must be able to supply water at rates that fluctuate over time. Yearly, monthly, daily, and hourly variations in water use occur, with higher use during dry years and in hot months. Also, water use typically follows a diurnal pattern, being low at night and peaking in the early morning and late afternoon. Flow rates most important to the hydraulic design and operation of a water treatment plant and distribution system are average day (AD), maximum day (MD), and peak hour (PH) demands. Average day use is the total annual water use divided by the number of days in the year and is typically used in water supply planning. The average day demand rate is used as a basis for estimating maximum day and peak hour demands. Maximum day demand is the maximum quantity of water used on any one day of the year. Water supply facilities are typically designed based on the maximum day demand. Peak hour use is the peak rate at which water is required during any one hour of the year. Since minimum distribution pressures are usually experienced during peak hour, the sizes and locations of distribution facilities are generally determined based on this condition.

3.1 Historical Water Demands

Reviewing historical water demands provides insight into selecting design criteria used to project future water demands. The City provided recent water usage data consisting of monthly production and maximum day consumption. Historical annual average day demand, maximum day to average day peaking factors, and per-capita consumption are summarized in **Table 3-1**. The historical water usage shows that the City of Killeen has a relatively low average per-capita consumption ranging from 103 to 126 gpcd with the high value occurring during the 2011 drought. Maximum day demand peaking factors since 2010 vary from a low of 1.52 up to 1.78. These low water demand statistics are likely due to lower irrigation demands from a higher percentage of multi-family homes and lower percentage of homes with automatic sprinkler systems.

Table 3-1 Historical Water Demands

Year	Population	Average Day Demand (MGD)	Average Day Per-Capita (gpcd)	Maximum Day Demand (MGD)	Maximum Day Per-Capita (gpcd)	MD:AD Peaking Factor
2010	127,921	13.87	108	23.17	181	1.67
2011	128,967	16.19	126	24.97	194	1.54
2012	130,389	16.00	123	25.82	198	1.61
2013	132,960	15.06	113	25.10	189	1.67
2014	135,517	14.71	109	22.33	165	1.52
2015	138,031	15.30	111	26.65	193	1.74
2016	140,478	14.51	103	25.81	184	1.78
2017	142,893	14.97	105	25.20	176	1.68
Average	**-**	**-**	**112**	**-**	**185**	**1.65**
Maximum	**-**	**16.19**	**126**	**26.65**	**198**	**1.78**

3.2 Projected Water Demands

Water demands were projected for 2019, 2024, 2029, and 2039 conditions using per-capita and per-acre water usage rates applied to the projected population and future land use presented in Section 2.2. The future water usage rates were selected to align with historical water demands. Since historical data was only available on a system-wide basis, residential and non-residential usage rates were not evaluated for past years. Therefore, system-wide averages were used to identify target ranges for the planning criteria used to project water demands. The historical data shows the overall average day per-capita ranged from 103 gpcd to 126 gpcd with an average of 112 gpcd over the last eight years. Based on the review of this data and the need to plan for low rainfall (dry) years when water demands are typically higher than average, an overall average day per-capita in the 120 gpcd to 125 gpcd range was targeted for the water demand projections. Additionally, a maximum day to average day peaking factor of 1.65 was targeted for the overall peaking factor. The planning criteria selected for each land use type that would allow the overall parameters to fall in the desired ranges is shown in **Table 3-2.** These factors along with a constant peak hour peaking factor of 1.7 were selected using FNI's experience with other municipalities since historical data was unavailable. The resulting water demand projections are shown in **Table 3-3** and graphically on **Figure 3-1**.

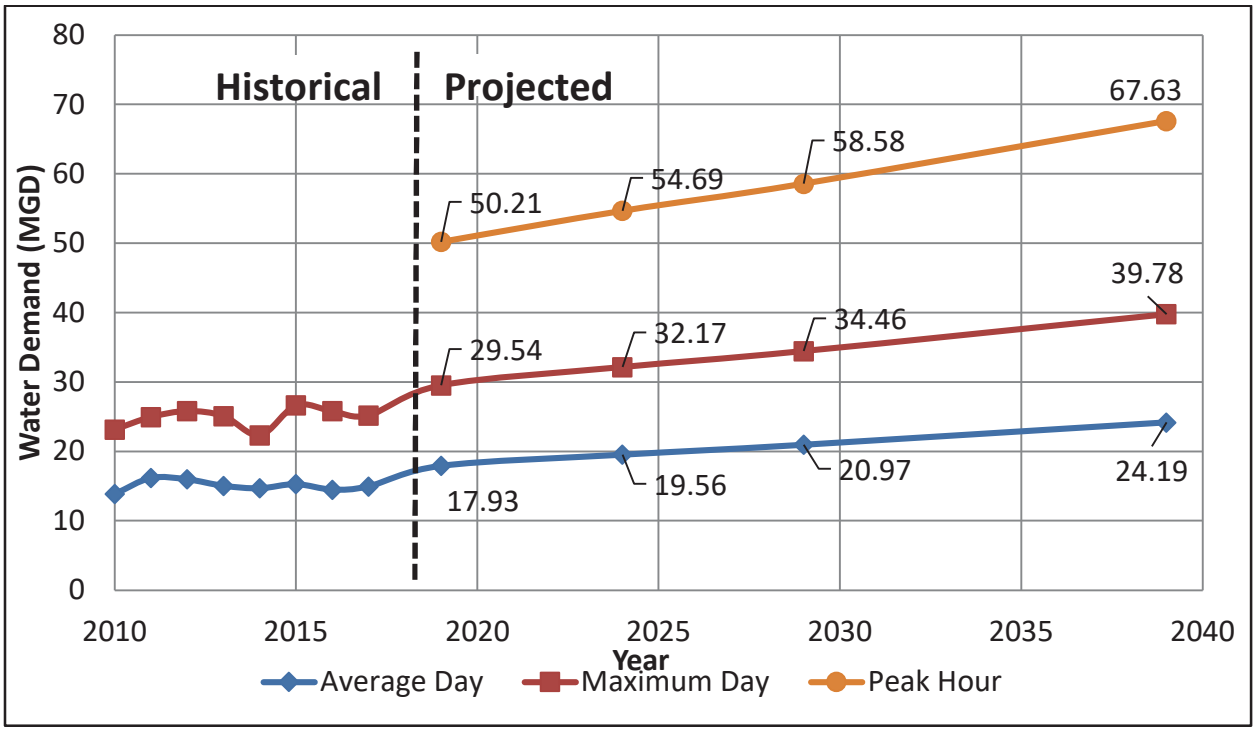
Table 3-2 Water Demand Projection Factors

Land Use	People/acre	Gallons/person (gpcd)	Gallons/acre (gpad)	MD:AD Peaking Factor
Business Park	0	0	700	1.30
Estate	1	100	0	1.75
Four-Plex Residential	24	100	0	1.50
General Commercial	0	0	700	1.30
General Residential	12	100	0	1.75
Industrial	0	0	700	1.30
Multi-Family Residential	30	100	0	1.50
Neighborhood Conservation	12	100	0	1.75
Parks-Recreation	0	0	700	1.30
Planned Development	15	100	350	1.50
Residential Mix	15	100	0	1.75
Residential-Commercial Mix	15	100	350	1.50
Rural	0	0	0	0.00
Suburban Commercial	0	0	700	1.30
Suburban Residential	9	100	0	1.75
Turnbo Ranch	7	100	0	1.75
Urban	15	100	350	1.50
Urban Center	15	100	350	1.50

Table 3-3 Water Demand Projections

Year	Population	Average Day Demand (MGD)	Overall Average Per-Capita (gpcd)	Overall MD:AD Peaking Factor	Maximum Day Demand (MGD)	Overall Maximum Day Per-Capita (gpcd)	PH:MD Peaking Factor	Peak Hour Demand (MGD)
2019	148,088	17.93	121	1.64	29.54	198	1.70	50.22
2024	160,313	19.56	122	1.64	32.17	200	1.70	54.69
2029	171,172	20.97	122	1.64	34.46	200	1.70	58.58
2039	197,019	24.19	122	1.64	39.78	200	1.70	67.63

Figure 3-1 Historical and Projected Water Demands



In order to determine the distribution of the projected water demands by pressure plane, each parcel was classified into one of the existing pressure planes based on the spatial location. The projected demands by pressure plane for each planning year are summarized in **Tables 3-4** through **3-7**. This information is stored in a Microsoft Access database, which can be updated as needed to account for changes in projected growth and the impact it has on the water system.

Table 3-4 2019 Water Demand Projections by Pressure Plane

Pressure Plane	Population	Average Day Demand (MGD)	Maximum Day Demand (MGD)	Peak Hour Demand (MGD)
Airport	5,636	0.65	1.10	1.87
Lower	71,980	9.00	14.68	24.96
Middle	7,207	0.84	1.39	2.37
PRV	1,605	0.21	0.33	0.55
Upper	61,660	7.23	12.04	20.46
2019 Total	**148,088**	**17.93**	**29.54**	**50.21**

Table 3-5 2024 Water Demand Projections by Pressure Plane

Pressure Plane	Population	Average Day Demand (MGD)	Maximum Day Demand (MGD)	Peak Hour Demand (MGD)
Airport	5,994	0.72	1.21	2.05
Lower	80,025	10.03	16.35	27.80
Middle	7,210	0.84	1.40	2.37
PRV	1,605	0.21	0.33	0.55
Upper	65,479	7.76	12.88	21.92
2024 Total	**160,313**	**19.56**	**32.17**	**54.69**

Table 3-6 2029 Water Demand Projections by Pressure Plane

Pressure Plane	Population	Average Day Demand (MGD)	Maximum Day Demand (MGD)	Peak Hour Demand (MGD)
Airport	5,994	0.72	1.21	2.05
Lower	87,992	10.96	17.89	30.41
Middle	7,210	0.84	1.40	2.37
PRV	1,605	0.21	0.33	0.55
Upper	68,371	8.24	13.63	23.20
2029 Total	**171,172**	**20.97**	**34.46**	**58.58**

Table 3-7 2039 Water Demand Projections by Pressure Plane

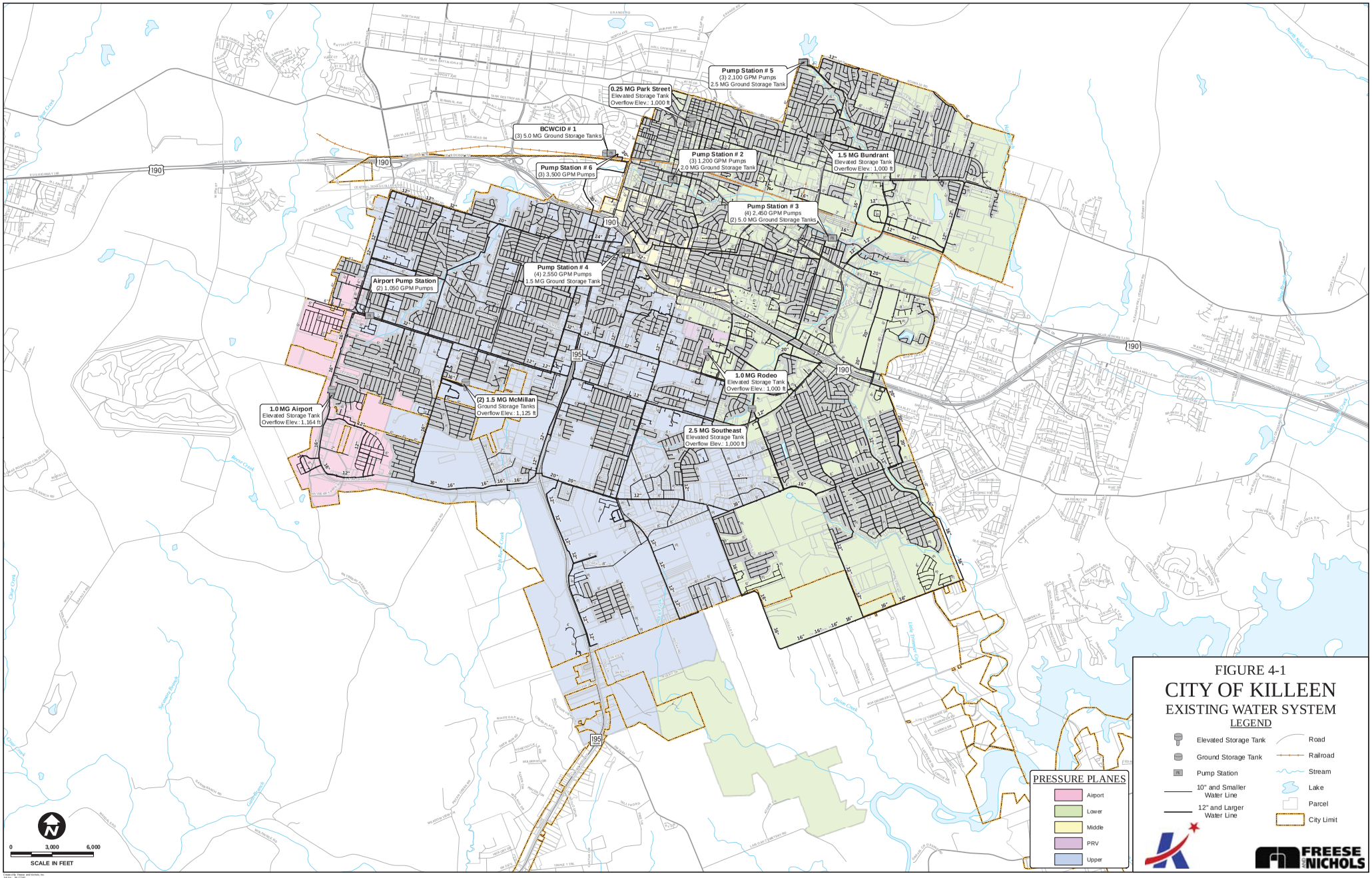
Pressure Plane	Population	Average Day Demand (MGD)	Maximum Day Demand (MGD)	Peak Hour Demand (MGD)
Airport	6,888	0.83	1.39	2.37
Lower	101,620	12.65	20.68	35.15
Middle	7,512	0.87	1.45	2.46
PRV	1,605	0.21	0.33	0.55
Upper	79,394	9.63	15.93	27.10
2039 Total	**197,019**	**24.19**	**39.78**	**67.63**

4.0 DESCRIPTION OF THE EXISTING WATER SYSTEM

The City of Killeen's water distribution system consists of a network of water lines, four water supply delivery points with associated ground storage tanks and pump stations, two booster pump stations, five elevated storage tanks, two ground storage tanks acting as elevated storage, and two pressure reducing valves. **Figure 4-1** shows the existing water distribution system for the City of Killeen.

4.1 Pressure Planes

The distribution system is separated into five pressure planes: Lower, Middle, PRV, Upper, and Airport. The Lower Pressure Plane consists of the northern and eastern portions of the City and is the largest pressure plane, accounting for approximately 50% of the City's total water usage. Ground elevations generally range from 715 feet to 910 feet. The Lower Pressure Plane operates at a static hydraulic gradient of 1,000 feet. The Middle Pressure Plane is a relatively small area between the Upper and Lower Pressure Planes that is supplied by a pressure reducing valve from the Upper Pressure Plane near Pump Station 4. Ground elevations range from 845 feet to 920 feet and are slightly too high to be served from the Lower and slightly too low to be served from the Upper. The PRV is also supplied by a pressure reducing valve from the Upper Pressure Plane near Rodeo EST. Ground elevations range from 855 feet to 920 feet. The Upper Pressure Plane is the City's second largest plane and generally consists of the western portion of the City. Ground elevations range from 860 feet to 1,025 feet. The Upper Pressure Plane is operated at a static hydraulic gradient of 1,125 feet. The Airport Pressure Plane includes the area in the southwestern portion of the City with higher ground elevations ranging from 950 feet to 1,035 feet. A static hydraulic gradient of 1,164.5 feet is established by one elevated storage tank. A schematic profile of the existing water distribution system showing elevations and connectivity is presented on **Figure 4-2**.


Pump Station # 5
(3) 2,100 GPM Pumps
2.5 MG Ground Storage Tank
0.25 MG Park Street
Elevated Storage Tank
Overflow Elev.: 1,000 ft
BCWCID # 1
(3) 5.0 MG Ground Storage Tanks
Pump Station # 6
(3) 3,500 GPM Pumps
Pump Station # 2
(3) 1,200 GPM Pumps
2.0 MG Ground Storage Tank
1.5 MG Bundrant
Elevated Storage Tank
Overflow Elev.: 1,000 ft
Pump Station # 3
(4) 2,450 GPM Pumps
(2) 5.0 MG Ground Storage Tanks
Pump Station # 4
(4) 2,550 GPM Pumps
1.5 MG Ground Storage Tank
Airport Pump Station
(2) 1,050 GPM Pumps
1.0 MG Rodeo
Elevated Storage Tank
Overflow Elev.: 1,000 ft
(2) 1.5 MG McMillan
Ground Storage Tanks
Overflow Elev.: 1,125 ft
1.0 MG Airport
Elevated Storage Tank
Overflow Elev.: 1,164 ft
2.5 MG Southeast
Elevated Storage Tank
Overflow Elev.: 1,000 ft
190
195
0
3,000
6,000
SCALE IN FEET
PRESSURE PLANES
Airport
Lower
Middle
PRV
Upper
FIGURE 4-1
CITY OF KILLEEN
EXISTING WATER SYSTEM
LEGEND
Elevated Storage Tank
Ground Storage Tank
Pump Station
10" and Smaller Water Line
12" and Larger Water Line
Road
Railroad
Stream
Lake
Parcel
City Limit
FREESE NICHOLS

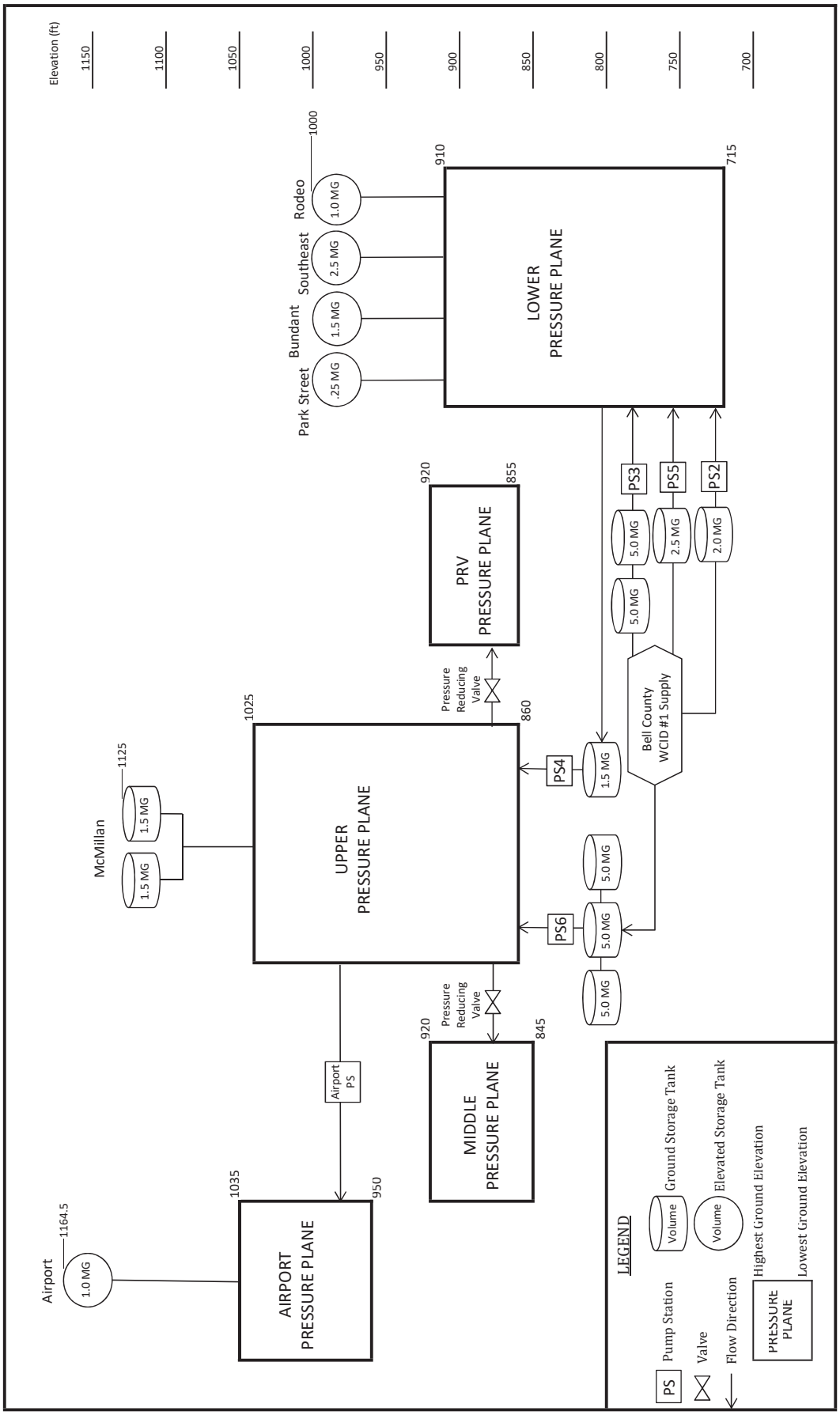


Figure 4-2: Existing Water System Schematic

4.2 Water Lines

The City of Killeen's distribution system consists of 678 miles of water lines. Pipeline diameters range in size from 0.75-inch to 30-inches. **Figure 4-3** illustrates the percentage of pipe length by diameter. Most of the pipes are PVC, asbestos cement, cast iron, or ductile iron. A large portion of the water lines were initially labeled "unknown" in Killeen's GIS information; however, a pipe material was assumed based on their location, age, and neighboring pipe information. **Figure 4-4** shows a summary of the assumed pipe material.

Figure 4-3 Pipeline Diameter by Length

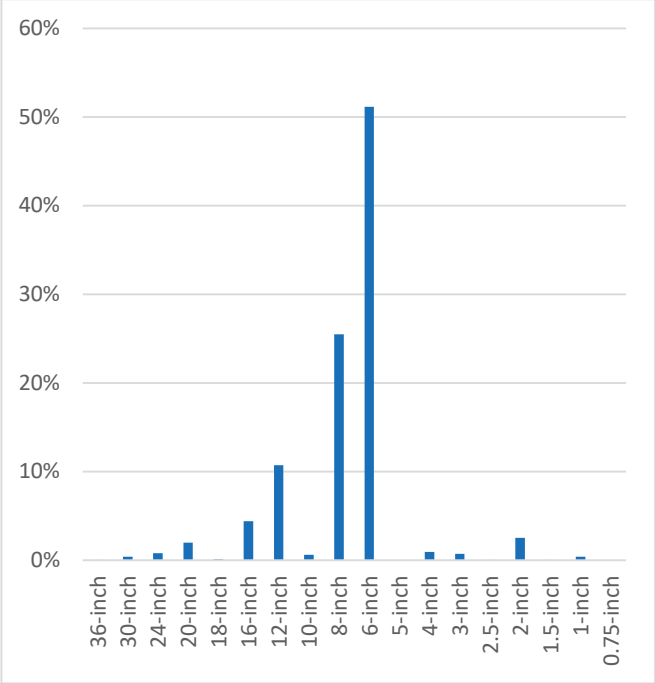
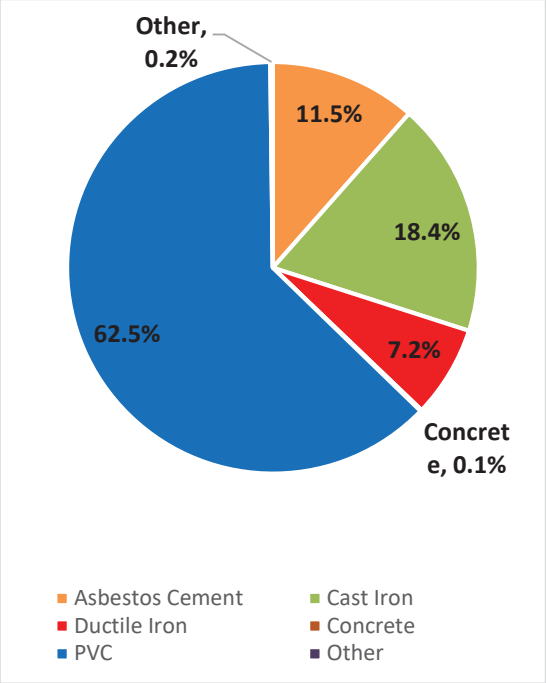


Figure 4-4 Pipeline Material by Length



4.3 Wholesale Water Supply

The City acquires water from a wholesale water supplier to provide service to its residents. The City exclusively purchases treated surface water from Bell County Water Control and Improvement District #1 (BCWCID#1). The surface water that BCWCID#1 treats and then delivers to Killeen is part of the 39,000 acre-feet/year of raw water that Killeen has secured in Lake Belton. The existing maximum daily supply of treated water is 32.0 mgd. Killeen has recently secured an additional 10 mgd from BCWCID#1. That supply will be available when the new WTP at Stillhouse Lake and the 36" supply line are completed.

4.4 Pump Stations

Pump Stations #2, #3, #5, and #6 are wholesale supply facilities. Pump Stations #2, #3, and #5 supply the Lower Pressure Plane, while Pump Station #6 supplies the Upper Pressure Plane. The City also operates two booster pump stations. Pump Station #4 is supplied from the Lower Pressure Plane, primarily from Pump Station #3, and discharges into the Upper Pressure Plane. The Airport Pump Station is the only supply of the Airport Pressure Plane, and it draws water from the Upper Pressure Plane. **Table 4-1** provides a summary of the pumping facilities within Killeen's distribution system.

4.5 Storage Facilities

The City currently utilizes 10 ground storage tanks (GSTs) within the distribution system. Seven GSTs are located at wholesale delivery points and provide supply to the associated pump stations. Three 5.0 MG GSTs at Pump Station #6 are shared with Fort Hood and Copperas Cove. The Pump Station #4 facility also includes a GST that is supplied by the Lower Pressure Plane. The remaining two GSTs are located at higher ground elevations and provide elevated storage for the Upper Pressure Plane.

Additionally, five elevated storage tanks (ESTs) are utilized throughout the distribution system. The Park Street EST, Bundrant EST, Rodeo EST, and Southeast EST serve the Lower Pressure Plane while Airport EST serves the Airport Pressure Plane. **Table 4-2** presents a summary of the City's existing ground storage tanks, and **Table 4-3** shows the elevated storage facilities.

Table 4-1 Summary of Pumping Facilities

Pump Station Name	Pump No.	Rated Capacity (gpm)	Rated Capacity (mgd)	Rated Head	Pressure Plane
Pump Station #2	1	1,200	1.73	190	Lower
	2	1,200	1.73	190	Lower
	3	1,200	1.73	190	Lower
	Total	3,600	5.18	-	-
Pump Station #3	1	2,450	3.53	165	Lower
	2	2,450	3.53	165	Lower
	3	2,450	3.53	165	Lower
	4	2,450	3.53	165	Lower
	Total	9,800	14.11	-	-
Pump Station #5	1	2,100	3.02	175	Lower
	2	2,100	3.02	175	Lower
	3	2,100	3.02	175	Lower
	Total	6,300	9.07	-	-
Lower Total		**19,700**	**28.37**	-	-
Lower Firm		**17,250**	**24.84**	-	-
Pump Station #4	1	2,550	3.672	220	Upper
	2	2,550	3.672	220	Upper
	3	2,550	3.672	220	Upper
	4	2,550	3.672	220	Upper
	Total	10,200	14.69	-	-
Pump Station #6	1	3,500	5.04	270	Upper
	2	3,500	5.04	270	Upper
	3	3,500	5.04	270	Upper
	Total	10,500	15.12	-	-
Upper Total		**20,700**	**29.81**	-	-
Upper Firm		**17,200**	**24.77**	-	-
Airport Pump Station	1	1,050	1.51	260	Airport
	2	1,050	1.51	260	Airport
Airport Total		**2,100**	**3.02**	-	-
Upper Firm		**1,050**	**1.51**	-	-
System Total		**42,500**	**61.20**		

Table 4-2 Existing Ground Storage Tanks

Pressure Plane	Tank Name	Capacity (MG)
Lower	Pump Station #2 GST	2.0
Lower	Pump Station #3 GST #1	5.0
Lower	Pump Station #3 GST #2	5.0
Lower	Pump Station #5 GST	2.5
	Lower Pressure Plane Total	**14.5**
Upper	Pump Station #4 GST	1.5
Upper	Pump Station #6 GST #1	5.0
Upper	Pump Station #6 GST #2	5.0
Upper	Pump Station #6 GST #3	5.0
	Upper Pressure Plane Total	**16.5**
	Total Ground Storage	**31.0**

Table 4-3 Existing Elevated Storage Tanks

Pressure Plane	Tank Name	Capacity (MG)	Overflow Elevation (feet)	Sidewater Depth (feet)
Lower	Park Street EST	0.25	1,000	30
Lower	Bundrant EST	1.50	1,000	40
Lower	Rodeo EST	1.00	1,000	35
Lower	Southeast EST	2.50	1,000	45
Lower Pressure Plane Total		**5.25**		
Upper	McMillan GST #1	1.50	1,125	32
Upper	McMillan GST #2	1.50	1,125	32
Upper Pressure Plane Total		**3.00**		
Airport	Airport EST	1.00	1,164	40
Total Elevated Storage		**9.25**		

5.0 WATER SYSTEM ANALYSES AND HYDRAULIC MODELING

Hydraulic analyses were conducted utilizing a hydraulic water model of the City's water distribution system. The water system was evaluated to identify any deficiencies and to establish a capital improvements plan to meet projected water demands through 2039. Various combinations of improvements and system modifications were investigated to determine the most appropriate approach for meeting projected demands. Parameters used in developing the capital improvements plan included increasing system reliability, renewing aging infrastructure, simplifying system operations, meeting required fire flows, and maintaining proper residual pressures.

5.1 Water Model Development

As part of this study, the City's existing water model was converted from the H2OMap Water software package to the InfoWater software package due to H2OMap Water being discontinued by Innovyze. The existing model was also updated to include recently constructed water lines based on the City's current water system GIS data. The InfoWater model includes approximately 18,000 pipes, ranging in size from 1- to 30-inches.

Temporary pressure testing was conducted to collect data for use in model calibration. Twenty pressure recorders were installed throughout Killeen's service area in the Upper, Middle, Lower, and PRV pressure planes from October 11 – 19, 2017. A summary of the pressure recording data is shown on **Figures 5-1** through **5-3** while the pressure recorder locations are shown on **Figure 5-4**.

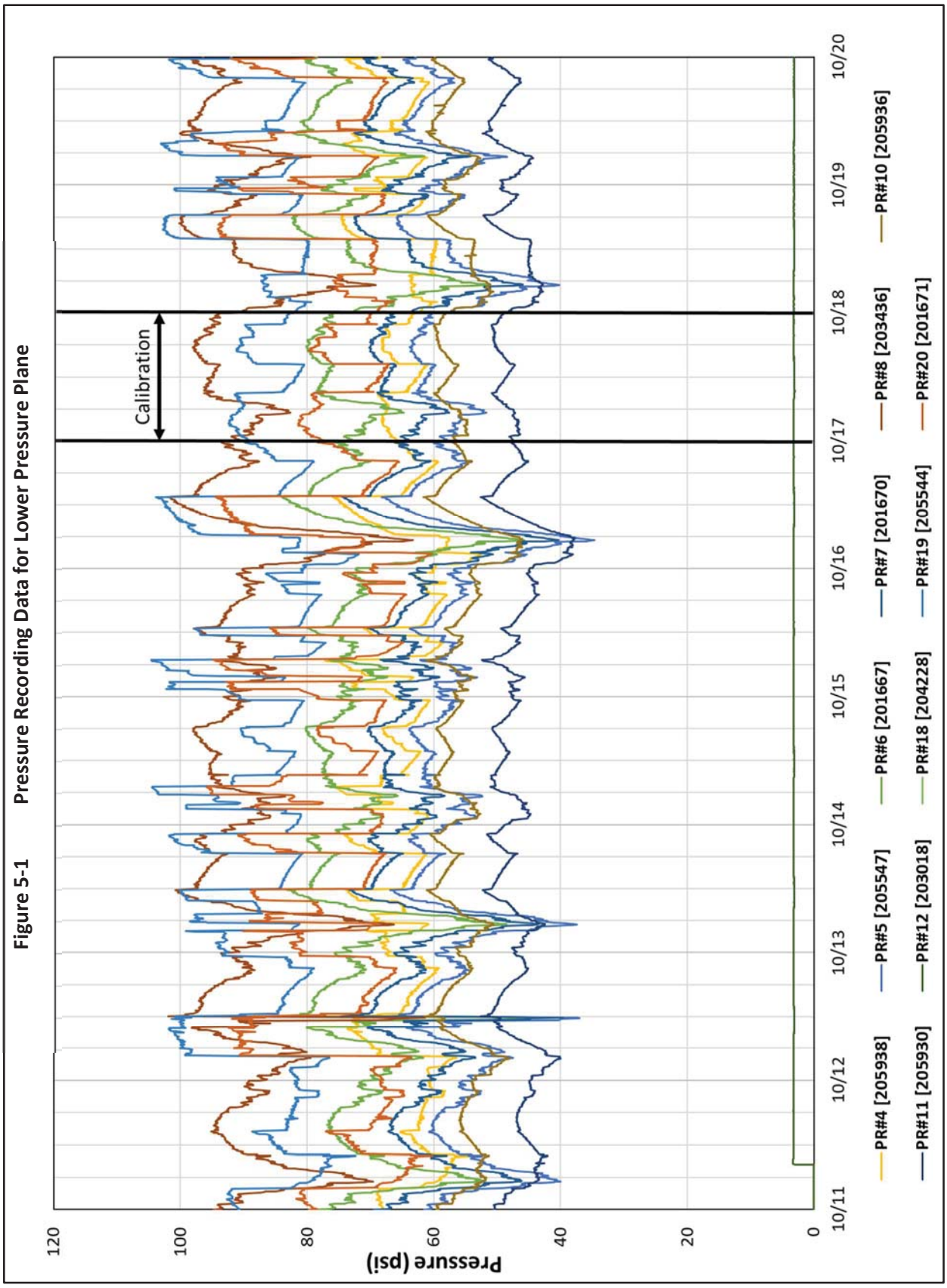


Figure 5-1 Pressure Recording Data for Lower Pressure Plane

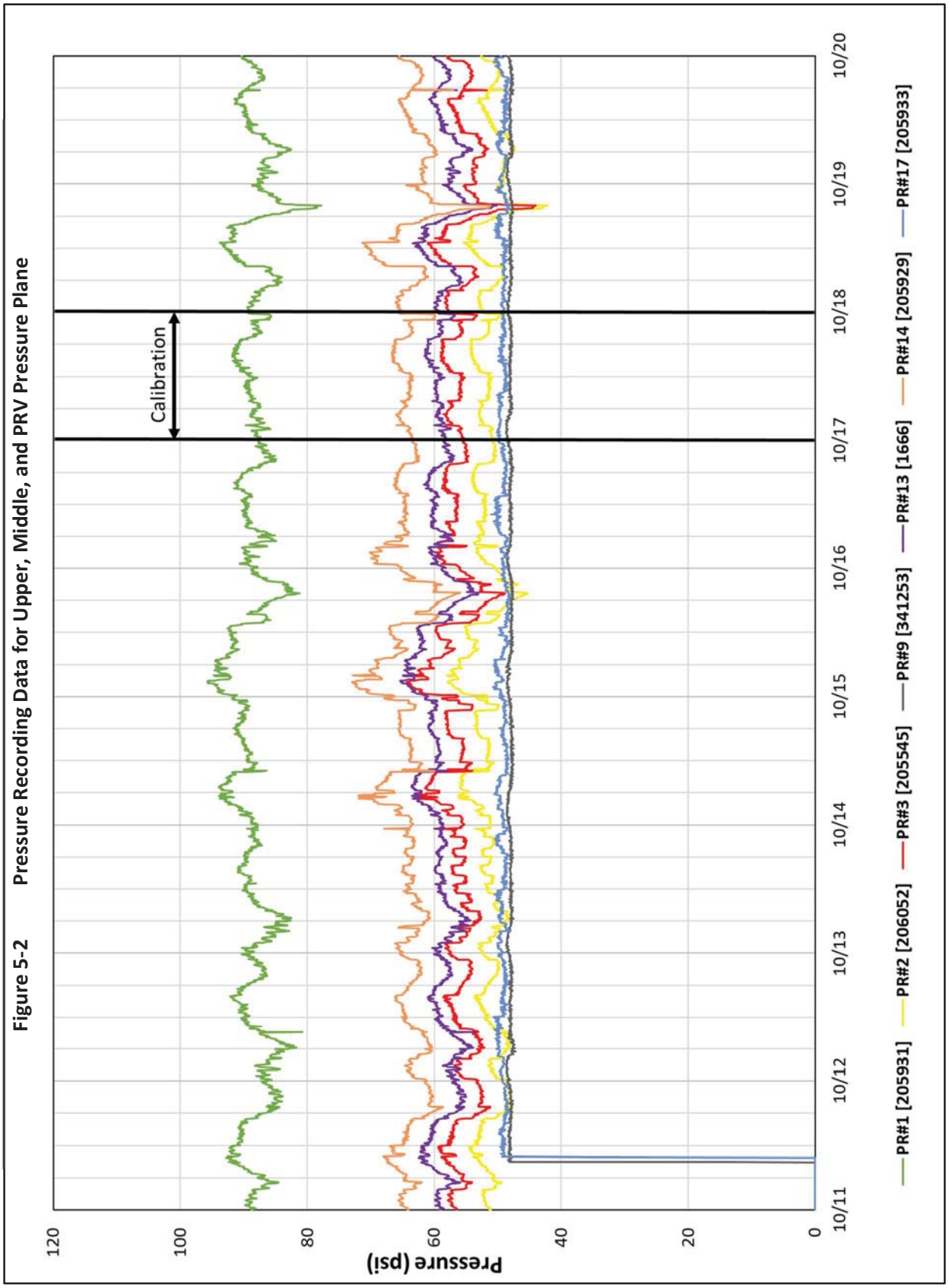


Figure 5-2 Pressure Recording Data for Upper, Middle, and PRV Pressure Plane

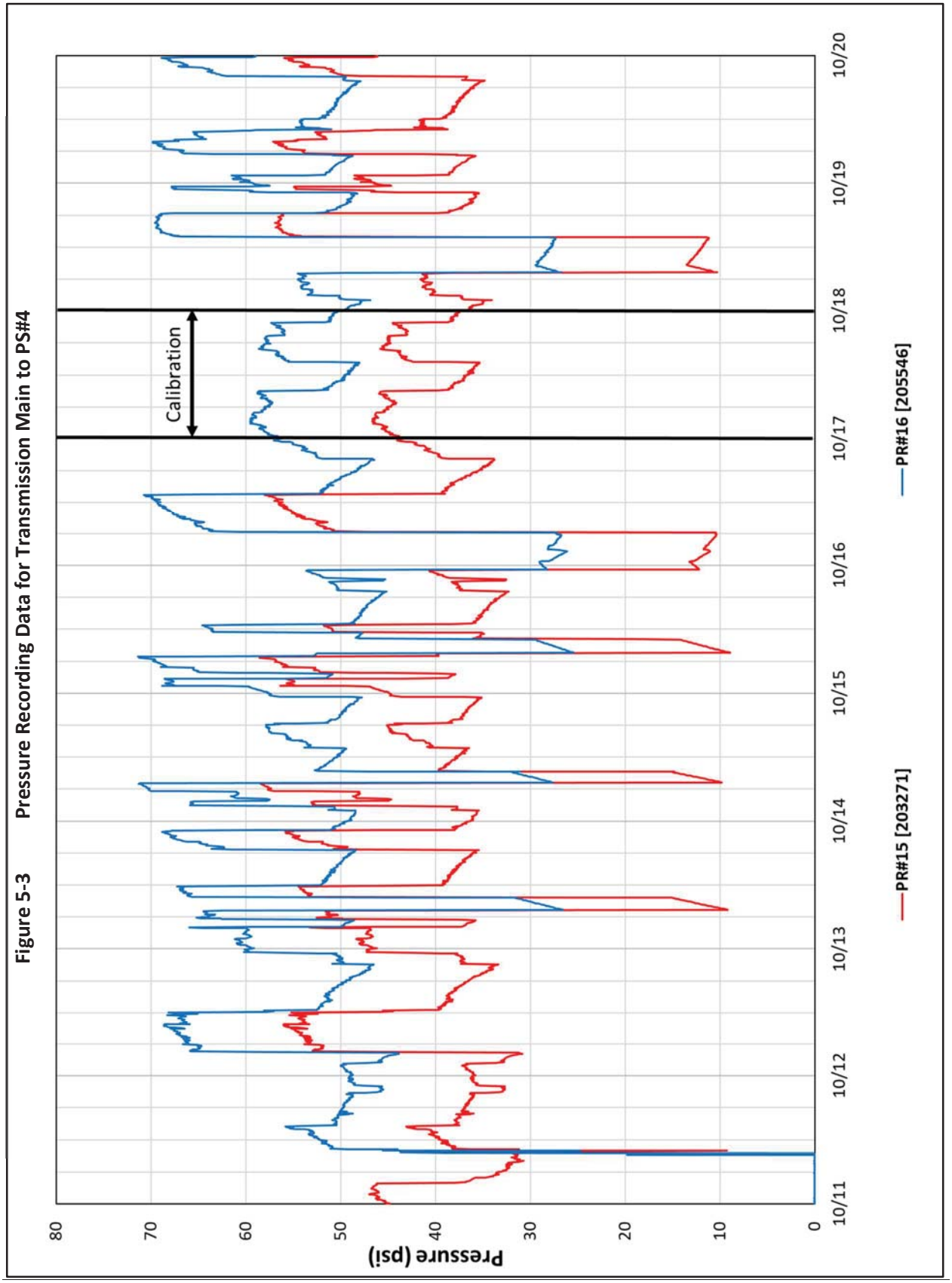
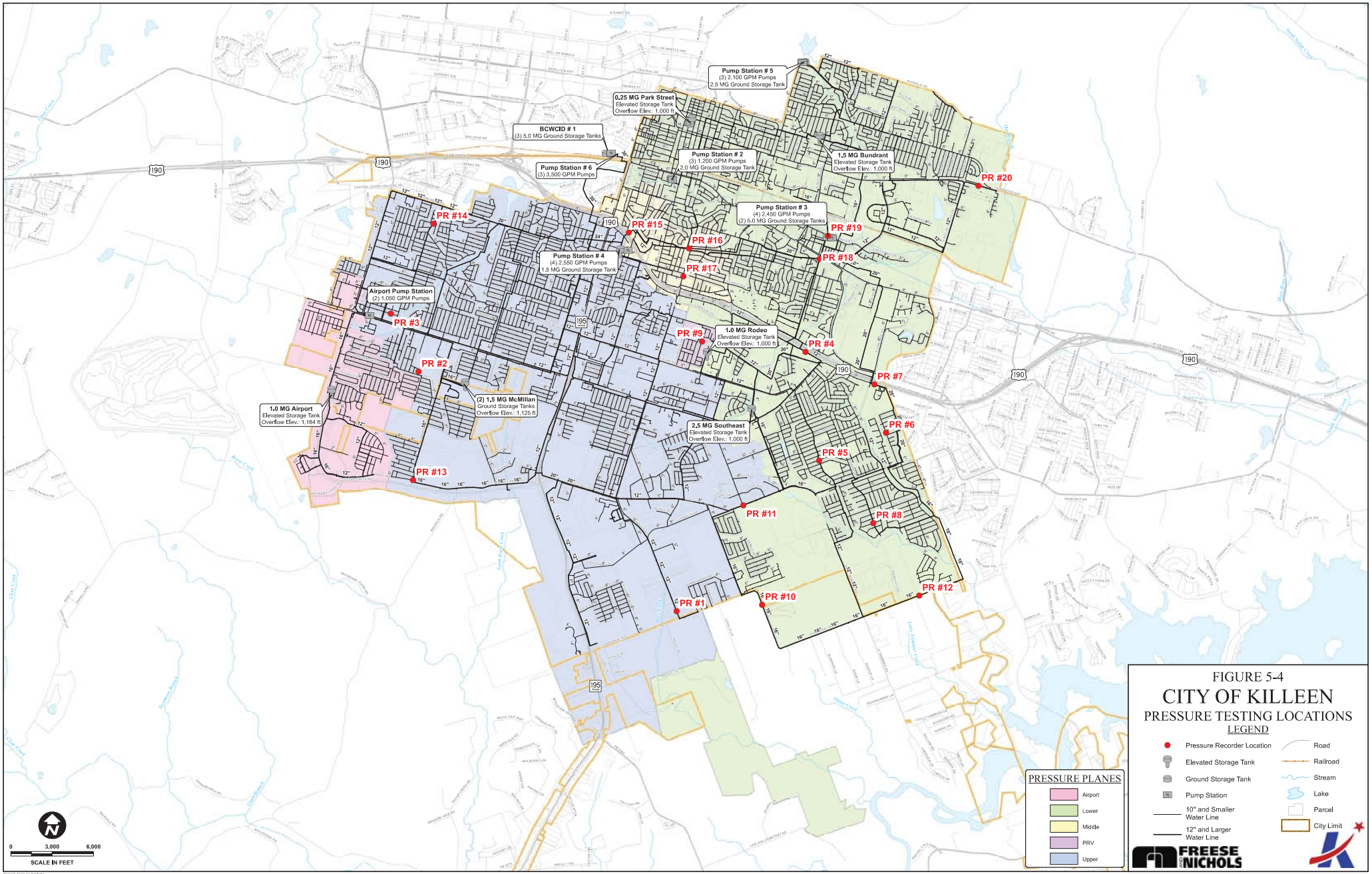


Figure 5-3 Pressure Recording Data for Transmission Main to PS#4


Pump Station # 5
(3) 2,100 GPM Pumps
2.5 MG Ground Storage Tank
0.25 MG Park Street
Elevated Storage Tank
Overflow Elev.: 1,000 ft
BCWCID # 1
(3) 5.0 MG Ground Storage Tanks
Pump Station # 6
(3) 3,500 GPM Pumps
Pump Station # 2
(3) 1,200 GPM Pumps
2.0 MG Ground Storage Tank
1.5 MG Bundrant
Elevated Storage Tank
Overflow Elev.: 1,000 ft
Pump Station # 3
(4) 2,450 GPM Pumps
(2) 5.0 MG Ground Storage Tanks
Pump Station # 4
(4) 2,550 GPM Pumps
1.5 MG Ground Storage Tank
Airport Pump Station
(2) 1,050 GPM Pumps
1.0 MG Rodeo
Elevated Storage Tank
Overflow Elev.: 1,000 ft
(2) 1.5 MG McMillan
Ground Storage Tanks
Overflow Elev.: 1,125 ft
1.0 MG Airport
Elevated Storage Tank
Overflow Elev.: 1,164 ft
2.5 MG Southeast
Elevated Storage Tank
Overflow Elev.: 1,000 ft
PR #1
PR #2
PR #3
PR #4
PR #5
PR #6
PR #7
PR #8
PR #9
PR #10
PR #11
PR #12
PR #13
PR #14
PR #15
PR #16
PR #17
PR #18
PR #19
PR #20
190
195
0
3,000
6,000
SCALE IN FEET
PRESSURE PLANES
Airport
Lower
Middle
PRV
Upper
FIGURE 5-4
CITY OF KILLEEN
PRESSURE TESTING LOCATIONS
LEGEND
Pressure Recorder Location
Elevated Storage Tank
Ground Storage Tank
Pump Station
10" and Smaller Water Line
12" and Larger Water Line
Road
Railroad
Stream
Lake
Parcel
City Limit
FREESE NICHOLS

In order to verify that the hydraulic model accurately represented the actual distribution system, a model calibration analysis was performed. The calibration process involves adjusting system operation, C-values, demand allocation, and peaking factors to match a known condition. Calibration is an important component of building and using a hydraulic model. Achieving a good calibration to real-world conditions instills confidence that the model elements are reflective of the distribution system infrastructure. The calibration process also identifies discrepancies in the recorded data versus the modeled data that may require further investigation, such as closed valves that are intended to be open and deterioration of pumps.

The City provided available SCADA records during the pressure testing period with hourly readings of flow, pump status, and tank levels recorded for all monitored points in the system. Some discrepancies were found in the original data pulled from the SCADA system so City staff manually entered flow and tank level information into a spreadsheet for use in developing diurnal demand curves. The flow and tank level data was utilized to calculate a diurnal curve by examining water going into (supply) and out of (demand) the distribution system. Diurnal demand curves were calculated for the Lower, Upper, and Airport Pressure Planes. The Middle and PRV Pressure Planes are supplied through Upper Pressure Plane pump stations, so diurnal curves could not be calculated and were therefore grouped with the Upper Pressure Plane. Additionally, flow is not measured going into the Pump Station #4 ground storage tank so accurate diurnal curves could only be developed when Pump Station #4 was not being used. Therefore, the 24-hour period occurring on October 17, 2017, from 12:00 am to 11:00 pm was selected for calibration. This day was selected because Pump Station #4 was not in use and no other data anomalies were observed.

During the extended period simulation (EPS) calibration, adjustments were made to the model in order to match the known conditions of October 17, 2017. FNI utilized EPS modeling to evaluate the range of pressures, the turnover of tanks, and cycling of pumps over a 24-hour period. An important finding that resulted from the model calibration was the discovery of a closed valve along the 20-inch line in the eastern portion of the Lower Pressure Plane near Highway 190. FNI identified a potential closed valve based on the calibration results so City staff conducted a field investigation to check valve status in the area. A valve that should normally be open was found in the closed position. City staff opened the valve and subsequently reported improved pressure and water quality in the area.

Full calibration results, found in **Appendix C**, include graphs showing the relationship between modeled data points versus SCADA or pressure recorder data points. The results demonstrate a good correlation between recorded and modeled values and provide confidence in the accuracy of the model.

5.2 Existing Water System Analysis

The existing distribution system was evaluated to assess current pumping and storage capacity, residual pressures, and fire flow capacity. This analysis is performed to determine if there are any existing system deficiencies and to provide a baseline for the current level of service. The parameters that were evaluated are discussed in the following sections.

Pumping and Storage Capacities

As a public water utility, the City of Killeen must comply with the rules and regulations for public water systems set forth by the Texas Commission on Environmental Quality (TCEQ) in Chapter 290. The City is required to meet the TCEQ elevated storage capacity requirement of 100 gallons per connection and total storage capacity requirement of 200 gallons per connection. The City provided the number of active connections as of February 2019. A comparison of the City's existing storage by pressure plane to TCEQ requirements is shown in **Table 5-1**.

Table 5-1 Existing TCEQ Storage Requirements

Pressure Plane	Population	Connections	Total Storage (MG)		Required Elevated Storage	Existing Elevated Storage
			Required	Existing		
Lower	71,980	29,328	5.87	19.75	2.93	5.25
Upper, Middle, & PRV	70,472	28,713	5.74	19.50	2.87	3.00
Airport	5,636	2,296	0.46	1.00	0.23	1.00
Total	**148,088**	**60,337**	**12.07**	**40.25**	**6.03**	**9.25**

In addition to storage requirements, the City is also required to meet the pumping capacity requirements presented in **Table 5-2**. Existing pumping capacity was evaluated and is summarized in **Table 5-3**. The Lower Pressure Plane is supplied through Pump Stations #2, #3, and #5. Since the elevated storage capacity in the Lower Pressure Plane is less than 200 gallons per connection, criterion 2(b) from **Table 5-2** applies for pumping capacity. The combined capacity of Pump Stations #2, #3, and #5 minus the capacity of the largest pump is 24.84 mgd, which is slightly below the estimated peak hour demand 24.96 mgd as shown in **Table 5-3**. Additional pumping capacity is currently under design at the new WCID #1 WTP that

provides 10 mgd to the Lower Pressure Plane. The Upper Pressure Plane is supplied by Pump Stations #4 and #6. The Middle and PRV Pressure Planes are supplied from the Upper Pressure Plane, so the pumping capacity is evaluated for all three pressure planes combined. The combined elevated storage capacity for the three pressure planes is less than 200 gallons per connection, so criterion 2(b) also applies to the Upper, Middle, and PRV Pressure Planes. The combined capacity of Pump Stations #4 and #6 minus the capacity of the largest pump is 24.77 mgd, which is greater than the minimum required capacity as shown in **Table 5-3**. The Airport Pressure Plane has more than 200 gallons per connection of elevated storage, so Condition 1 in **Table 5-2** is satisfied. Therefore, the criterion of 0.6 gpm per connection of pumping capacity applies to the Airport Pressure Plane. The capacity of the Airport Pump Station is 3.02 mgd, which is greater than the minimum required capacity as shown in **Table 5-3**.

Table 5-2 TCEQ Service Pumping Requirements

Condition		Service Pumping Capacity Requirement
1	If providing at least 200 gallons per connection of elevated storage	Two service pumps with a minimum combined capacity of 0.6 gpm per connection at each pressure plane
2	If providing less than 200 gallons per connection of elevated storage	**The lesser of (a) or (b):**
		(a) Total pumping capacity of 2.0 gpm per connection
		(b) Total capacity of at least 1,000 gpm and the ability to meet peak hourly demands with the largest pump out of service

Note: Capacity requirement from 30 TAC 260.45 (b)(2)(F)

Table 5-3 Existing System TCEQ Pumping Requirements

Pressure Plane	2019 Population	February 2019 Connections	Gallons/Conn of Elevated Storage	Controlling Criteria	Required Pumping Capacity	Existing Pumping Capacity
Lower	71,980	29,328	179	Peak Hour Demand	24.96	24.84*
Upper, Middle, & PRV	70,472	28,713	104	Peak Hour Demand	23.38	24.77
Airport	5,636	2,296	436	0.6 gpm/conn	1.98	3.02
Total	**148,088**	**60,337**			**50.32**	**52.63**

*Note: WCID's 10 mgd WTP Pump Station is currently under design, which will increase pumping capacity

System Pressures

A hydraulic analysis was performed under existing demand conditions to evaluate residual pressure throughout the distribution system. A 24-hour extended period simulation (EPS) was performed with 2019 maximum day demands. EPS modeling provides a means to evaluate the system over time to assess response to hourly changes in demand, pump cycling, and tanks filling or draining. During a maximum day EPS analysis, the peak hour demand is also simulated using hourly peaking factors based on the typical diurnal demand pattern. Peak hour demand represents the single hour of the year with the highest system demand. Peak hour simulations are used to assess the ability of the distribution system to maintain residual pressures because the highest demand period typically induces the lowest pressure due to increased headloss throughout the system. The TCEQ minimum required pressure within a distribution system is 35 psi specifically under peak hour demand conditions; however, the 35 psi requirement applies to all demand conditions.

After reviewing the existing pressures throughout the system, the model was showing low pressure in the area surrounding Park EST. This area has the highest ground elevations within the Lower Pressure Plane so the low pressures are a result high service elevations. **Figure 5-5** shows the minimum pressures observed in the model under existing demand conditions. It is recommended that a new pressure plane be created to serve this area after the Park EST is decommissioned. Two alternatives and their costs for creating an additional pressure plane in this area were presented to Killeen staff and are shown in **Figures 5-6** and **5-7**. Alternative 1 utilizes a new 0.72 mgd pump station, a 5,000 gallon hydropneumatic tank, two new valves, and a 50,000 gallon GST to isolate the area and maintain higher pressures. Alternative 2 was created to utilize existing infrastructure in the Lower Pressure Plane. It utilizes a new pump station that draws from the existing GST at Pump Station #2 and a hydropneumatic tank to maintain higher pressures. A distribution line must be isolated from the Pump Station #2 to the new pressure plane so multiple locations require valves and additional pipe installation. Despite using existing infrastructure, the cost to isolate the distribution line proved to be more costly than Alternative 1, and it created some operational issues by removing the distribution line from the LPP. Project 5W within **Section 6.0** and the cost analysis shown in **Appendix A** reflects Alternative 1, but Killeen staff could also utilize Alternative 2 to address the low pressures seen near the Park EST.

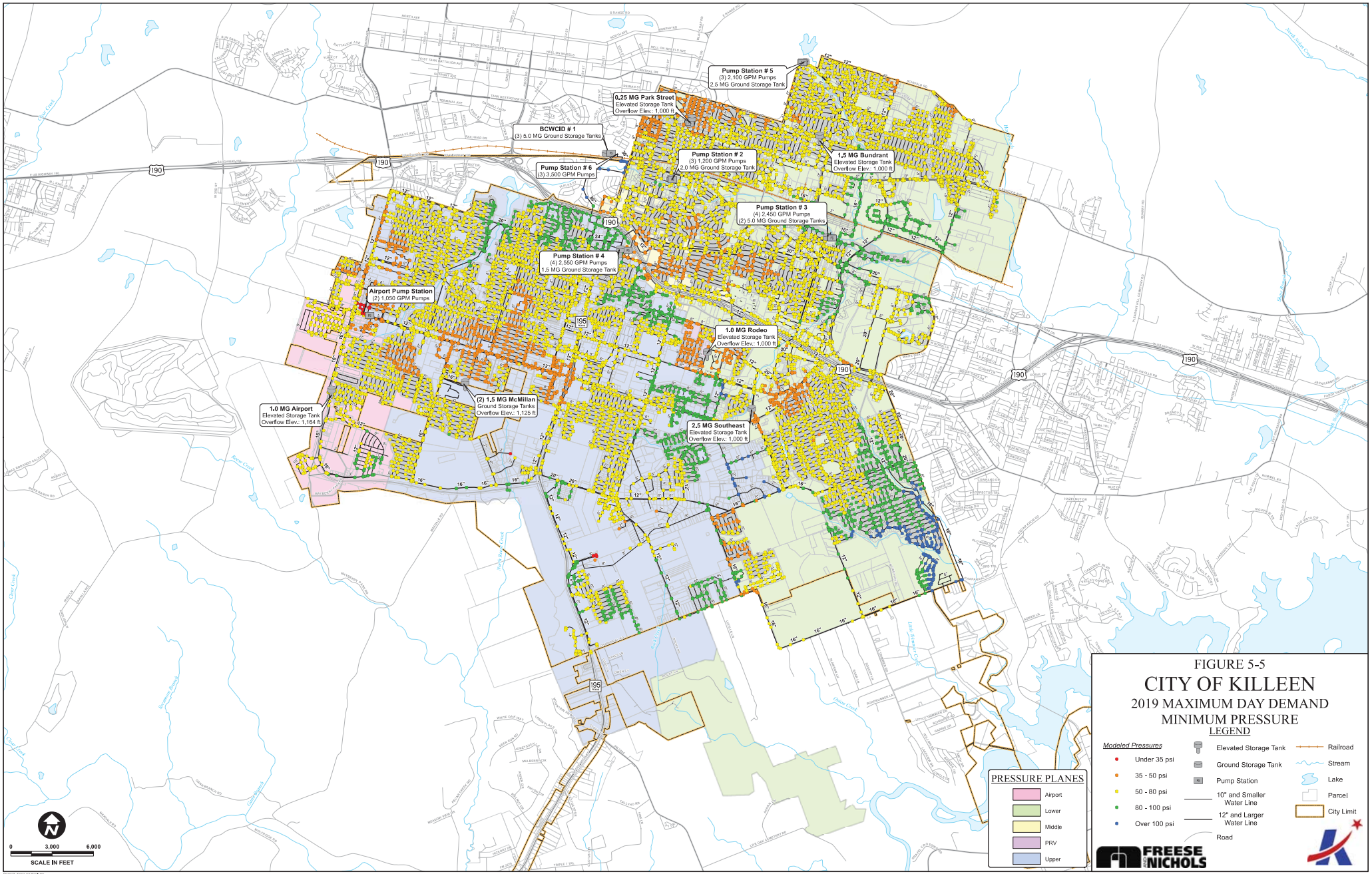

Pump Station # 5
(3) 2,100 GPM Pumps
2.5 MG Ground Storage Tank
0.25 MG Park Street
Elevated Storage Tank
Overflow Elev.: 1,000 ft
BCWCID # 1
(3) 5.0 MG Ground Storage Tanks
Pump Station # 6
(3) 3,500 GPM Pumps
Pump Station # 2
(3) 1,200 GPM Pumps
2.0 MG Ground Storage Tank
1.5 MG Bundrant
Elevated Storage Tank
Overflow Elev.: 1,000 ft
Pump Station # 3
(4) 2,450 GPM Pumps
(2) 5.0 MG Ground Storage Tanks
Pump Station # 4
(4) 2,550 GPM Pumps
1.5 MG Ground Storage Tank
Airport Pump Station
(2) 1,050 GPM Pumps
1.0 MG Rodeo
Elevated Storage Tank
Overflow Elev.: 1,000 ft
1.0 MG Airport
Elevated Storage Tank
Overflow Elev.: 1,164 ft
(2) 1.5 MG McMillan
Ground Storage Tanks
Overflow Elev.: 1,125 ft
2.5 MG Southeast
Elevated Storage Tank
Overflow Elev.: 1,000 ft
190
195
0
3,000
6,000
SCALE IN FEET
PRESSURE PLANES
Airport
Lower
Middle
PRV
Upper
FIGURE 5-5
CITY OF KILLEEN
2019 MAXIMUM DAY DEMAND
MINIMUM PRESSURE
LEGEND
Modeled Pressures
Under 35 psi
35 - 50 psi
50 - 80 psi
80 - 100 psi
Over 100 psi
Elevated Storage Tank
Ground Storage Tank
Pump Station
10" and Smaller Water Line
12" and Larger Water Line
Road
Railroad
Stream
Lake
Parcel
City Limit
FREESE NICHOLS

FIGURE 5-6

CITY OF KILLEEN

PROPOSED PRESSURE PLANE ALTERNATIVE 1

LEGEND

- Water Line
- Pump Station (PS)
- Ground Storage Tank
- Lower Pressure Plane
- Proposed Park Pressure Plane
- Proposed Valve for Isolation
- Existing Valve to be Closed

FREESE AND NICHOLS

Created By Freese and Nichols, Inc.
Job No.: KIL17542
Location: H:\W_WW_PLANNING\Deliverables\18-Final_Report_Figures\(Figure-5-6)-ParkPP_Alternative1.mxd
Updated: Thursday, August 15, 2019 8:52:48 AM

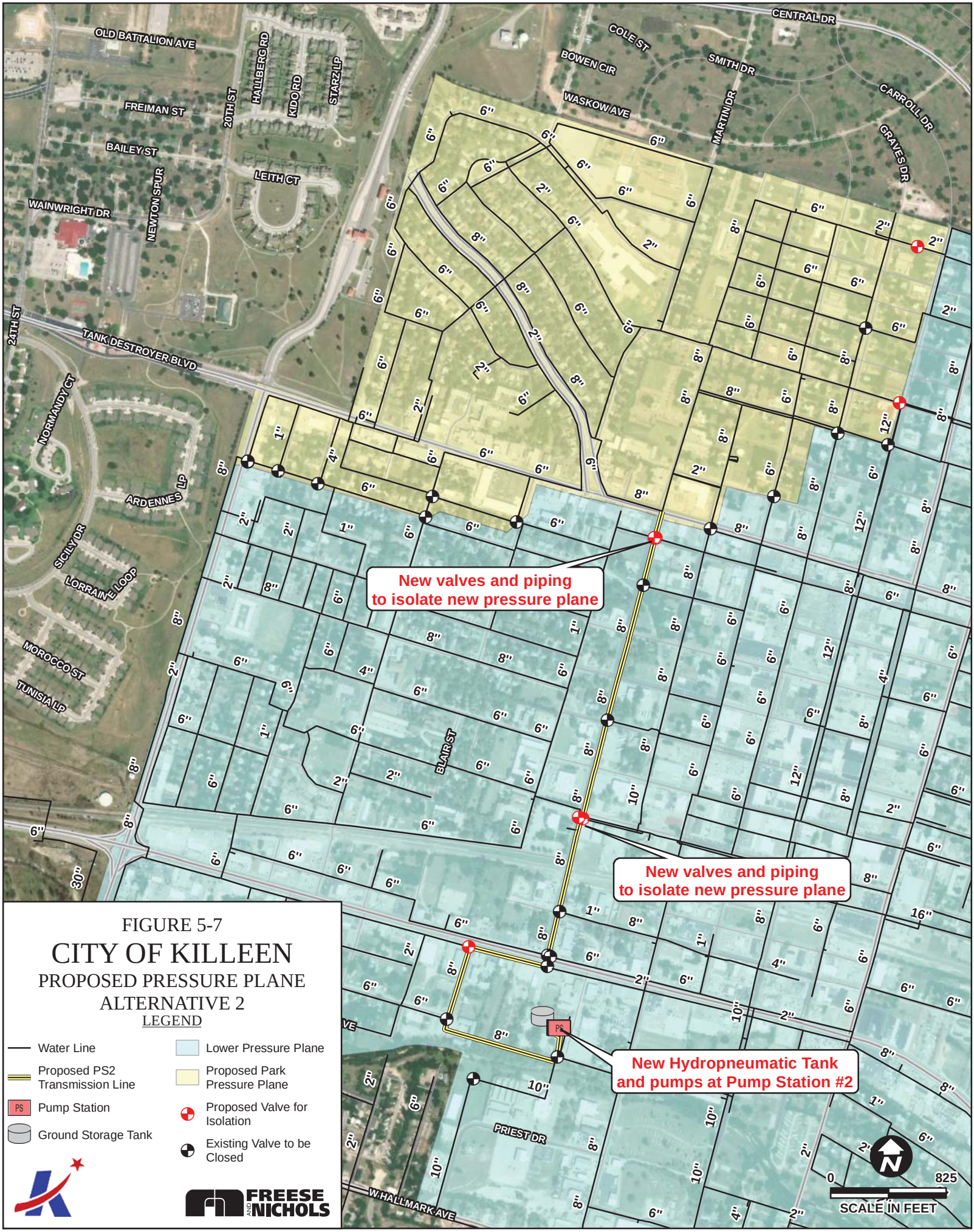


FIGURE 5-7

CITY OF KILLEEN

PROPOSED PRESSURE PLANE ALTERNATIVE 2

LEGEND

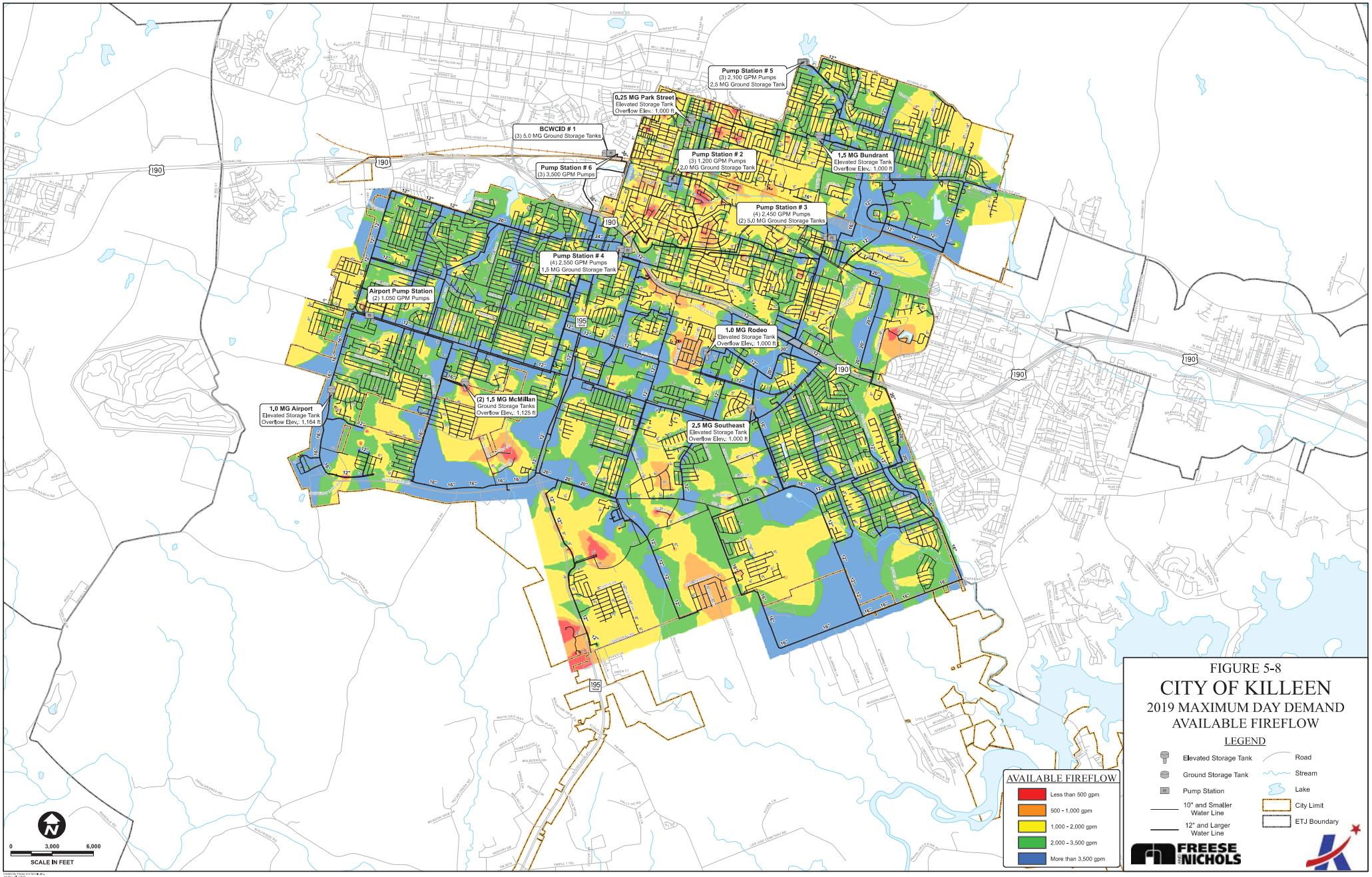
- Water Line
- Proposed PS2 Transmission Line
- PS Pump Station
- Ground Storage Tank
- Lower Pressure Plane
- Proposed Park Pressure Plane
- Proposed Valve for Isolation
- Existing Valve to be Closed

FREESE AND NICHOLS

Created By Freese and Nichols, Inc.
Job No.: KIL17542
Location: H:\W_WW_PLANNING\Deliverables\18-Final_Report_Figures\(Figure-5-7)-ParkPP_Alternative2.mxd
Updated: Thursday, August 15, 2019 8:51:16 AM

Fire Flow Capacity

To evaluate the fire suppression capabilities of the system, a fire flow analysis was conducted under existing maximum day demand conditions. TCEQ requires a minimum residual pressure of 20 psi be maintained while delivering the fire flow demand. For this analysis, a steady-state model run was utilized to calculate the available fire flow at each node in the system with a pressure of 20 psi. **Figure 5-8** shows the results of the fire flow simulation. The majority of the water system can provide at least 1,000 gpm, which is a typical residential fire flow demand. Available fire flows below 1,000 gpm are due to small diameter lines in isolated areas. Upsizing of smaller lines and looping are two methods to improve low fire flow. Available fire flow for commercial, multi-family, and industrial land uses should be evaluated on a case by case basis.


Pump Station # 5
(3) 2,100 GPM Pumps
2.5 MG Ground Storage Tank
0.25 MG Park Street
Elevated Storage Tank
Overflow Elev.: 1,000 ft
BCWCID # 1
(3) 5.0 MG Ground Storage Tanks
Pump Station # 6
(3) 3,500 GPM Pumps
Pump Station # 2
(3) 1,200 GPM Pumps
2.0 MG Ground Storage Tank
1.5 MG Bundrant
Elevated Storage Tank
Overflow Elev.: 1,000 ft
Pump Station # 3
(4) 2,450 GPM Pumps
(2) 5.0 MG Ground Storage Tanks
Pump Station # 4
(4) 2,550 GPM Pumps
1.5 MG Ground Storage Tank
Airport Pump Station
(2) 1,050 GPM Pumps
1.0 MG Rodeo
Elevated Storage Tank
Overflow Elev.: 1,000 ft
1.0 MG Airport
Elevated Storage Tank
Overflow Elev.: 1,164 ft
(2) 1.5 MG McMillan
Ground Storage Tanks
Overflow Elev.: 1,125 ft
2.5 MG Southeast
Elevated Storage Tank
Overflow Elev.: 1,000 ft
190
195
0
3,000
6,000
SCALE IN FEET
AVAILABLE FIREFLOW
Less than 500 gpm
500 - 1,000 gpm
1,000 - 2,000 gpm
2,000 - 3,500 gpm
More than 3,500 gpm
FIGURE 5-8
CITY OF KILLEEN
2019 MAXIMUM DAY DEMAND
AVAILABLE FIREFLOW
LEGEND
Elevated Storage Tank
Ground Storage Tank
Pump Station
10" and Smaller Water Line
12" and Larger Water Line
Road
Stream
Lake
City Limit
ETJ Boundary
FREESE NICHOLS

5.3 Future Water System Analysis

Hydraulic analyses were performed on the distribution system under future demand conditions. A 24-hour extended period simulation (EPS) was performed under maximum day demand conditions for each planning period. In order to document system operations, graphs showing modeled pumping and tank levels for each planning period can be found in **Appendix D**.

Color-coded pressure maps were prepared to illustrate the minimum residual pressure calculated at model junctions under maximum day demands for the future system conditions. The maps help identify potential problem areas in the system and indicate improvements CIP projects have had on system pressure and fireflow. Minimum pressures shown on the maps represent the lowest value of the pressures experienced during the 48-hour simulation., usually occurring during the peak hour demand. Fire flow contour maps were also prepared for future system conditions to show the available fire flow throughout the distribution system. The pressure maps and fire flow maps for 2024, 2029, and 2039 system conditions can be found in **Appendix E**.

Water system improvements were developed to accommodate the anticipated residential and non-residential growth over the next 20 years. Challenges facing the water system include providing additional supply and transmission capacity, meeting elevated storage and pumping requirements, and providing service to areas of growth south of the existing City limits where little or no infrastructure currently exists. Key observations and recommendations resulting from modeling and evaluation of the distribution system are discussed in the following sections.

Transmission Capacity

Several areas were identified as needing additional transmission capacity to convey water throughout the distribution system. In order to utilize the full capacity of Pump Station #5, a new 24-inch transmission line discharging from the pump station is recommended. A 24-inch transmission line is also recommended along Chaparral Road and Highway 195 to convey water from the new water supply deliver point. More information about the specific projects are discussed in Section 6 on this report.

Pumping and Storage

The review of the historical water usage presented in Section 3.1 shows that the City of Killeen has relatively low peaking factors for maximum day and peak hour demand conditions, which warrants atypical pumping and storage needs. Based on the evaluation of existing and future system operations, it

is recommended that the City maintain 150 gallons per connection of elevated storage. This is above the TCEQ minimum of 100 gallons per connection, which allows for more reliability during emergency situations. Projected elevated storage volumes for each planning phase using 150 gallons per connection for the LPP and UPP are listed in **Table 5-4**. Future connection counts for each pressure plane estimated assuming 2.45 people per connection. This is the ratio of current connections to 2019 population, and it is assumed to remain constant for future projections. The Airport Pressure Plane shows no deficiencies in elevated storage volume and even exceeds 200 gallons per connection through 2039. The Lower and Upper Pressure Plane both show deficiencies based on projected growth. Additional elevated storage is recommended in both pressure planes with the specific projects discussed in Section 6.0.

Table 5-4 Future Elevated Storage Volume Required

Pressure Plane (Criterion)	Existing Elevated Storage (MG)	Elevated Storage Volume Required (MG)			
		2019	2024	2029	2039
Lower (150 gal/conn)	5.25	4.40	4.90	**5.49**	**6.22**
Upper, Middle, & PRV (150 gal/conn)	3.00	**4.31**	**4.55**	**4.73**	**5.42**
Airport (200 gal/conn)	1.00	0.46	0.49	0.49	0.56

The recommendation of 150 gallons per connection for the LPP and UPP is below the threshold of 200 gallons per connection that TCEQ stipulates for reducing the pumping capacity requirement to 0.6 gpm per connection. For both the LPP and the UPP, it is recommended that Killeen maintain enough pumping capacity to meet peak hour demands as criterion 2(b) from **Table 5-2** stipulates. Peak hour demand projections for the LPP and UPP were compared to existing firm capacities and is summarized in **Table 5-5**. Peak hour demands exceed the firm pumping capacity of both the LPP and UPP, and CIP projects were developed to address these deficiencies, which is discussed in Section 6.0. The Airport Pressure Plane pumping requirements shown are based on 0.6 gpm per connection and the full capacity of the current pump station as criterion 1 from **Table 5-2** stipulates. The existing capacity exceeds projected pumping required, however, there is a CIP project for the Airport Pressure Plane pump station. This is to mitigate pumping directly from the UPP distribution line into the Airport Pressure Plane by constructing a new ground storage tank at the pump station site. More information regarding this project is found in Section 6.0.

Table 5-5 Future Pumping Capacity Requirements

Pressure Plane (Criterion)	Existing Pumping Capacity (MGD)	Pumping Required (MGD)			
		2019	2024	2029	2039
Lower (Peak Hour Demand)	24.84	**24.96**	**27.80**	**30.93**	**35.15**
Upper, Middle, & PRV (Peak Hour Demand)	24.77	23.38	**24.84**	**26.12**	**30.10**
Airport (0.6 gpm/connection)	3.02	1.98	2.11	2.11	2.43

New Development

As new development occurs within Killeen's water service area, new water lines are needed to extend service to areas that are not currently served. It is recommended that a minimum of 12-inch lines be installed creating one-mile gridding where possible. It is also recommended to minimize dead-end lines to avoid water quality issues and excessive flushing. Specific projects to provide new water service are discussed in Section 6.

Water Supply Capacity

Securing future water supply is essential to support continued growth within the City. The water supply capacity must be sufficient to replenish the water consumed daily within the service area. The maximum day demand is expected to grow from 29 mgd to almost 40 mgd in 2039. The projected demands exceed the 32 mgd that is currently supplied at the existing BCWCID #1 deliver points by 2024. Killeen has secured an additional 10 mgd from BCWCID #1 that will be available at the District's new water treatment plant near Stillhouse Hollow Lake. BCWCID #1 is currently designing the new water treatment plant and high service pump station along with a 36-inch transmission line to supply Killeen's Lower Pressure Plane. The delivery point will be near Chaparral Road between Trimmier Road and Featherline Road.

Focused modeling was performed to assess how the new water delivery point could be implemented in Killeen's system. Ultimately a new elevated storage tank will be constructed at the delivery point site where the 36-inch transmission line connects to Killeen's system. A booster pump station is also planned to be constructed at the site that will transfer water from the Lower Pressure Plane to the Upper Pressure Plane. However, it is anticipated that the new water treatment plant and transmission line will be completed prior to the City's new elevated tank. An interim model scenario was developed to evaluate this configuration and document any changes required to receive the new supply at the expected

contractual amounts. The modeling was conducted for average day and maximum day demand conditions. The results of the analysis showed that the high service pump station at the BCWCID #1 water treatment plant can be controlled based on the water level of the City's Southeast EST. To utilize more water from the new south supply, Pump Station #3 should be used less frequently while Pump Station #4 should be used more frequently. Under average day demand conditions, approximately 4.7 mgd could be utilized from the new south supply. Under maximum day demand conditions, that flow rate increases to approximately 7.0 mgd. Once the elevated tank, booster pump station, and Upper Pressure Plane transmission line is constructed, the full 10.0 mgd supply can be utilized.

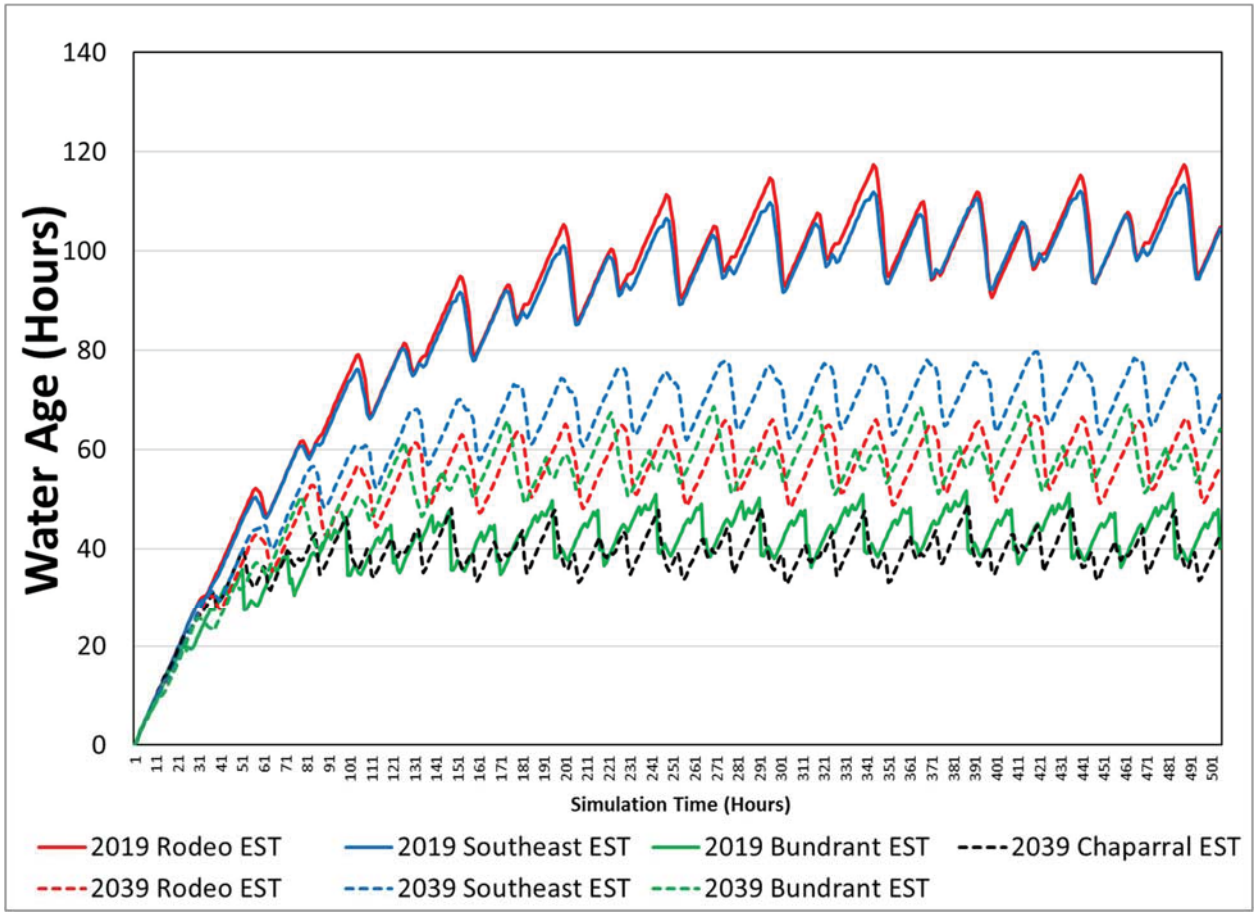
5.4 Water Quality Analysis

The City requested that FNI create advanced modeling scenarios to better understand its distribution system's water quality. Water age model runs for existing and future average day demand conditions were created along with a source trace analysis of the future south supply for average and maximum day demand conditions. The results are discussed in the following sections.

Water Age

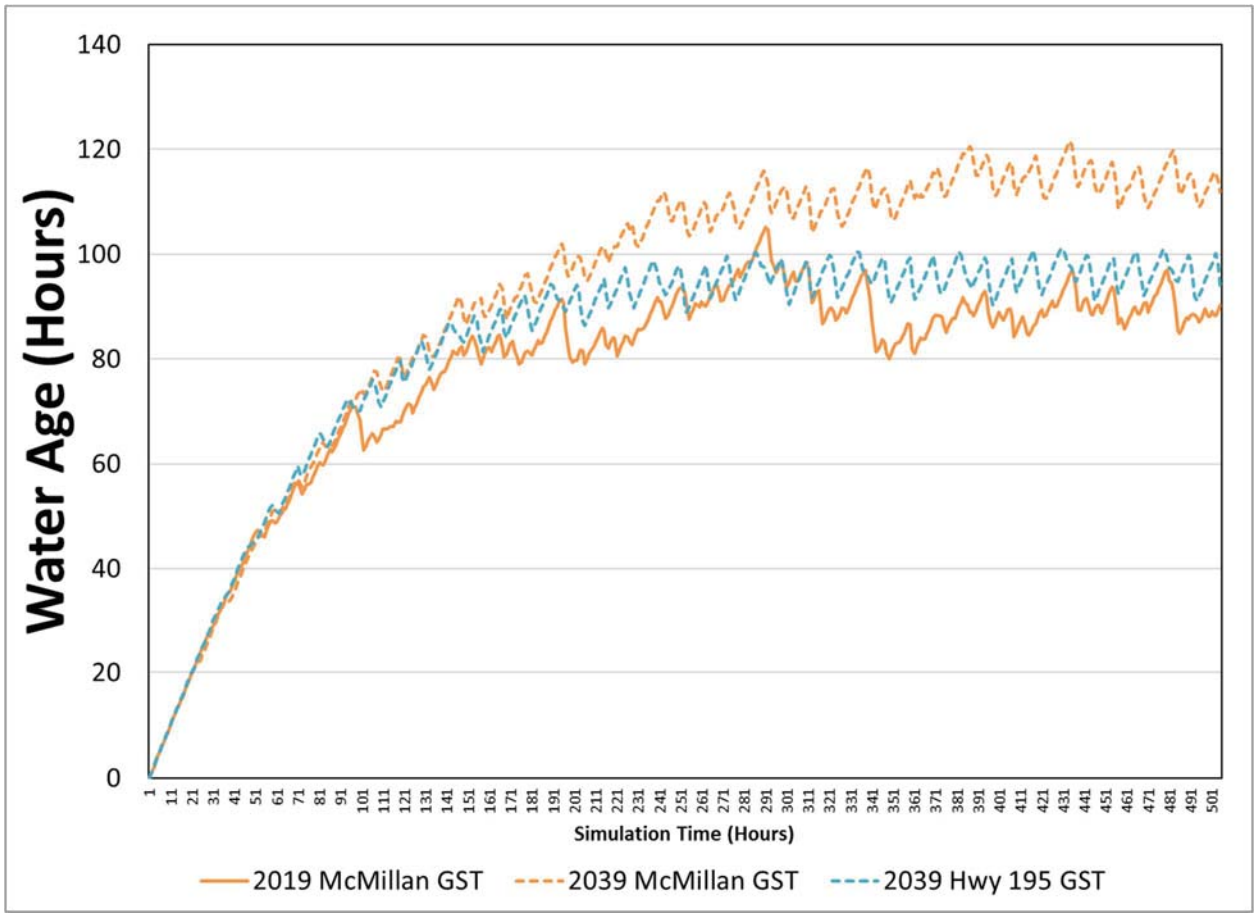
Existing and 2039 system conditions were analyzed to determine the impact of increased demands and system improvements on water age. While water age does not directly cause poor water quality, it is known that disinfectant residual degrades over time and disinfection byproduct levels increase over time. Therefore, decreasing water age can reduce the loss of chlorine residual and the formation of disinfection byproducts. Average day demand conditions typically yield higher water age than maximum day conditions, which makes it the preferred scenario to identify water age issues the system might experience. Water age analysis also requires a longer simulation time than the typical 24-hour extended period simulation. Pump station and valve controls were adjusted to ensure a consistent pattern across the system over a 3-week simulation. During the run, the system's water age increases over the first few days until an equilibrium with demand patterns is met and the tank water age begins to cycle. These tank results help indicate a consistent water age been determined. The resulting tank cycling pattern is shown in **Figures 5-9** through **5-11**. They show existing and future EST water age during a 21-day period for the Lower Pressure Plane, Upper Pressure Plane, and the Airport Pressure Plane.

Figure 5-9 Elevated Storage Tank Water Age for Lower Pressure Plane



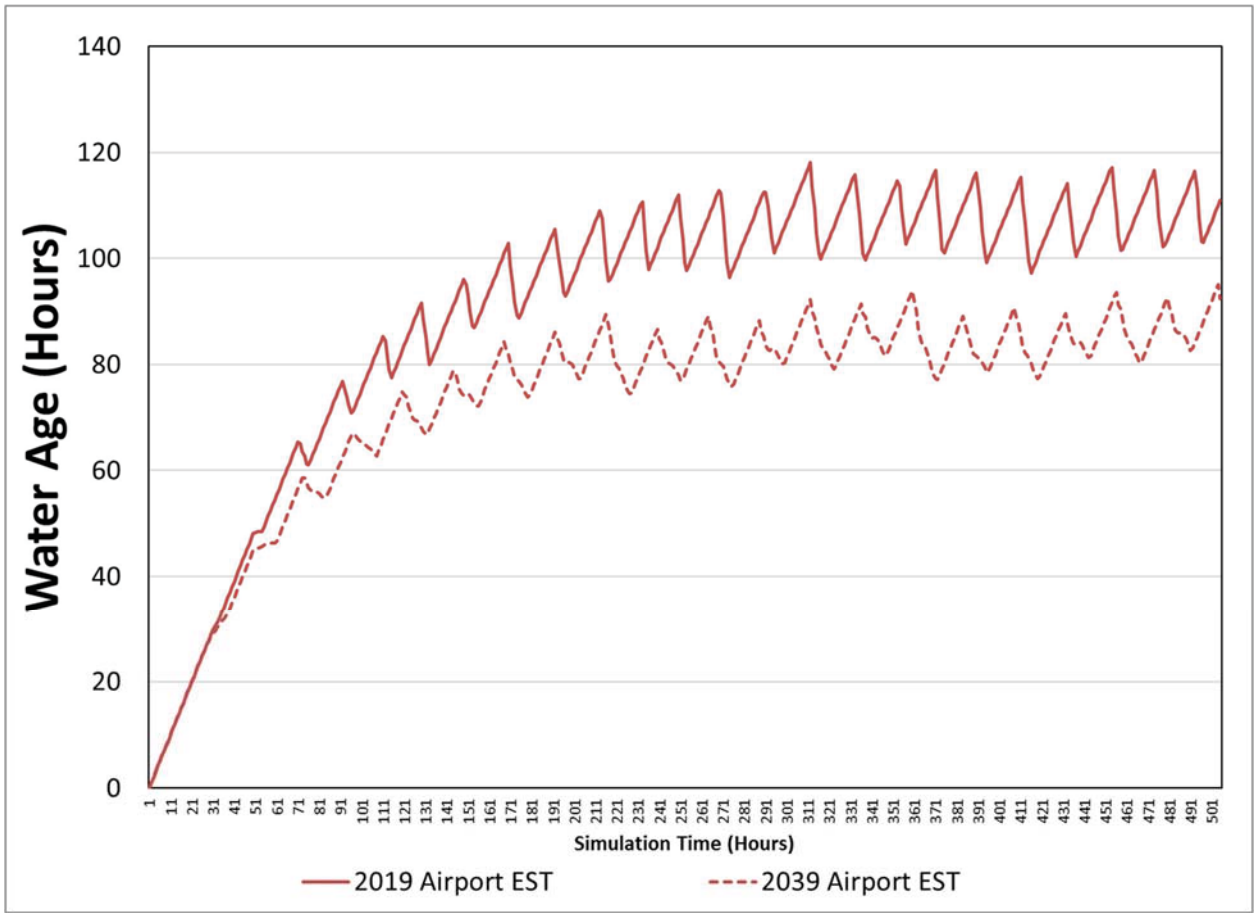
As shown on Figure 5-9, the existing water age of the elevated tanks in the Lower Pressure Plane vary significantly between the Bundrant EST, located in the northern portion of the pressure plane, and the Rodeo EST and Southeast EST, which are both more southernly located. This is due to the existing supply for the Lower Pressure Plane being located in the north, which causes the Bundrant EST to receive water more quickly and therefore reduce travel time which causes lower water age. However, in the 2039 simulation, the new WTP is online and supplies the Lower Pressure Plane from the south. This results in more consistent water age in all of the elevated storage tanks because supply sources are better balanced from a hydraulic distance standpoint. The Chaparral EST receives water directly from the new WTP, so its average age is approximately 20 hours lower than the tanks located within the LPP distribution system.

Figure 5-10 Elevated Storage Tank Water Age for Upper Pressure Plane



The two ground storage tanks at McMillan are simulated as one equivalent sized tank for modeling purposes. This assumes both tanks fill and drain at the same rate and therefore have the same water age. **Figure 5-10** shows the water age in the tanks increases in the future when the proposed Highway 195 tanks are online. Two new ground storage tanks are recommended by 2039, which doubles the existing storage capacity in the Upper Pressure Plane. This additional volume causes an increase in the water age of approximately 25 hours. However, the overall water age is still within acceptable ranges.

Figure 5-11 Elevated Storage Tank Water Age for Airport Pressure Plane

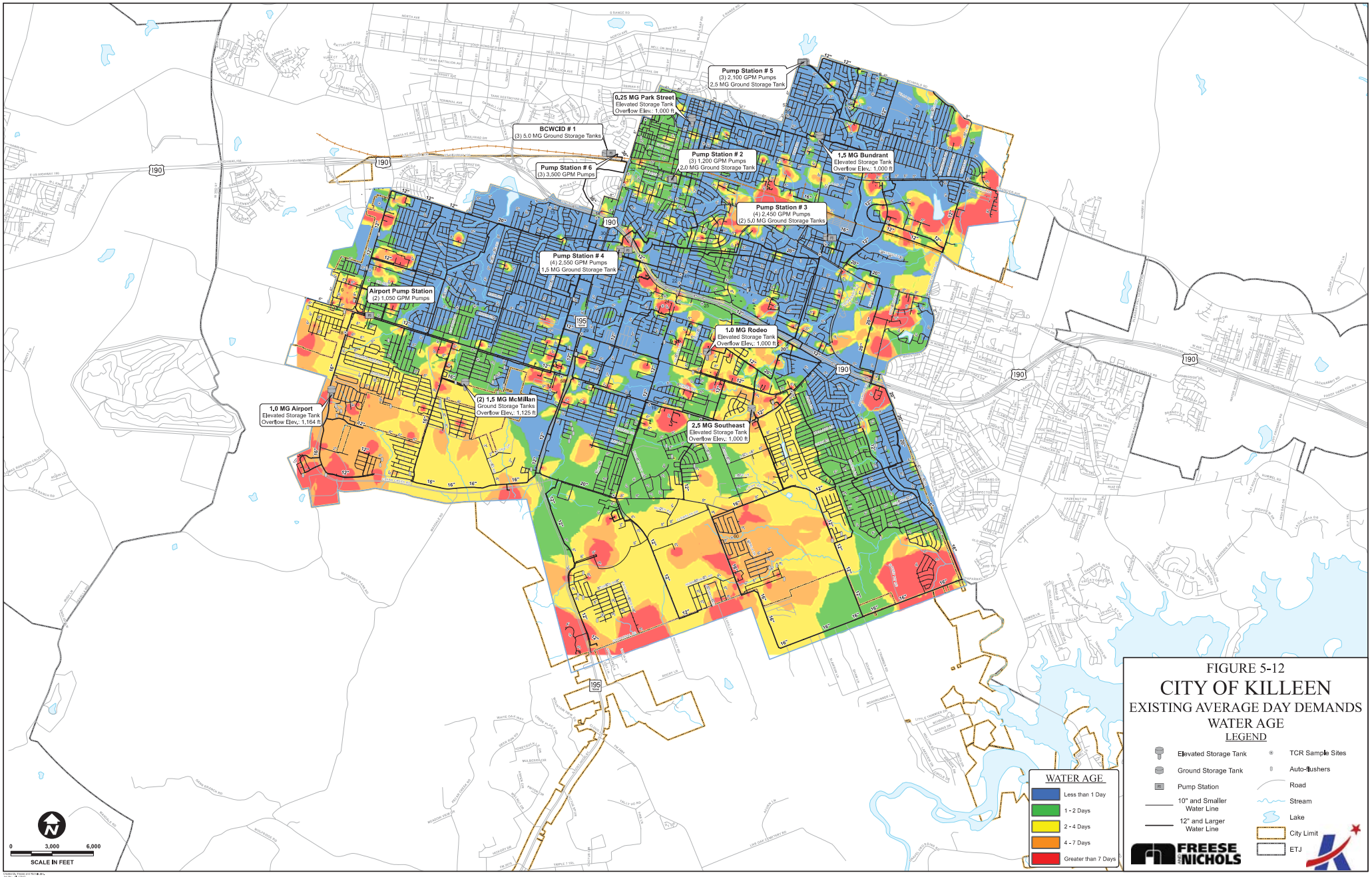


Airport EST has the highest existing water age of all elevated tanks in the system. This is due to its proximity to existing supply sources and lower water demands within the Airport Pressure Plane. As demands increase into the future the water age decreases because the water is consumed faster and does not stay in the tank as long. **Figure 5-11** shows the water age decreases by approximately 30 hours in 2039 compared to the existing modeled water age.

Mapping was developed to illustrate system-wide water age results. **Figures 5-12** and **5-13** show existing and future water age, respectively. The maps also show the City's 67 auto-flushing locations. Auto-flushers can be installed and programmed to automatically open and close at specified days/times to flush a water line. The City utilizes auto-flushers to help move stagnant water through dead-end and low flow water lines. The auto-flushers were simulated in the model by determining the flushing pattern and flowrate associated with each of the auto-flushers and input as an additional demand at the specified flushing locations.

The results of the existing water age analysis indicate that water age is generally lower in the north and increases as water moves south away from the existing water supply delivery points. Isolated pockets of poor water age can be seen in each pressure plane at dead-end lines where little to no water use occurs. The Airport Pressure Plane shows the highest water age overall, as expected, since it does not have a direct supply source and receives water via the Upper Pressure Plane. The Upper Pressure Plane has areas in the south along Chaparral Road that exceed seven days in age, which is due to the distance the water must travel from the supply at Pump Station #6. Overall, the existing system does not show any unexpected areas with poor water age. The City could improve water age by looping dead-end lines and/or limiting long sections of water line with low water usage.

The future system water age was calculated with 2039 projected demands and the proposed system improvements. Most notably, BCWCID #1's new water treatment plant that will deliver water to the southern portion of the Lower Pressure Plane makes a significant impact to the system's water age. Areas in the south that experienced high water age during the existing system analysis are reduced by up to four days with the addition of the south supply and the booster pump station. The area within the proposed Park Pressure Plane shows to have a slightly higher water age due the addition of a ground storage tank needed to implement a pump station for the new pressure plane. Future operations should be set up to maximize water turnover and tank cycling to avoid potential water quality issues. In general, the future system water age results indicate that the system-wide water age will decrease into the future as water demands increase.


Pump Station # 5
(3) 2,100 GPM Pumps
2.5 MG Ground Storage Tank
0.25 MG Park Street
Elevated Storage Tank
Overflow Elev.: 1,000 ft
BCWCID # 1
(3) 5.0 MG Ground Storage Tanks
Pump Station # 6
(3) 3,500 GPM Pumps
Pump Station # 2
(3) 1,200 GPM Pumps
2.0 MG Ground Storage Tank
1.5 MG Bundrant
Elevated Storage Tank
Overflow Elev.: 1,000 ft
Pump Station # 3
(4) 2,450 GPM Pumps
(2) 5.0 MG Ground Storage Tanks
Pump Station # 4
(4) 2,550 GPM Pumps
1.5 MG Ground Storage Tank
Airport Pump Station
(2) 1,050 GPM Pumps
1.0 MG Rodeo
Elevated Storage Tank
Overflow Elev.: 1,000 ft
1.0 MG Airport
Elevated Storage Tank
Overflow Elev.: 1,164 ft
(2) 1.5 MG McMillan
Ground Storage Tanks
Overflow Elev.: 1,125 ft
2.5 MG Southeast
Elevated Storage Tank
Overflow Elev.: 1,000 ft
190
195
0
3,000
6,000
SCALE IN FEET
WATER AGE
Less than 1 Day
1 - 2 Days
2 - 4 Days
4 - 7 Days
Greater than 7 Days
FIGURE 5-12
CITY OF KILLEEN
EXISTING AVERAGE DAY DEMANDS
WATER AGE
LEGEND
Elevated Storage Tank
Ground Storage Tank
Pump Station
10" and Smaller Water Line
12" and Larger Water Line
TCR Sample Sites
Auto-flushers
Road
Stream
Lake
City Limit
ETJ
FREESE NICHOLS

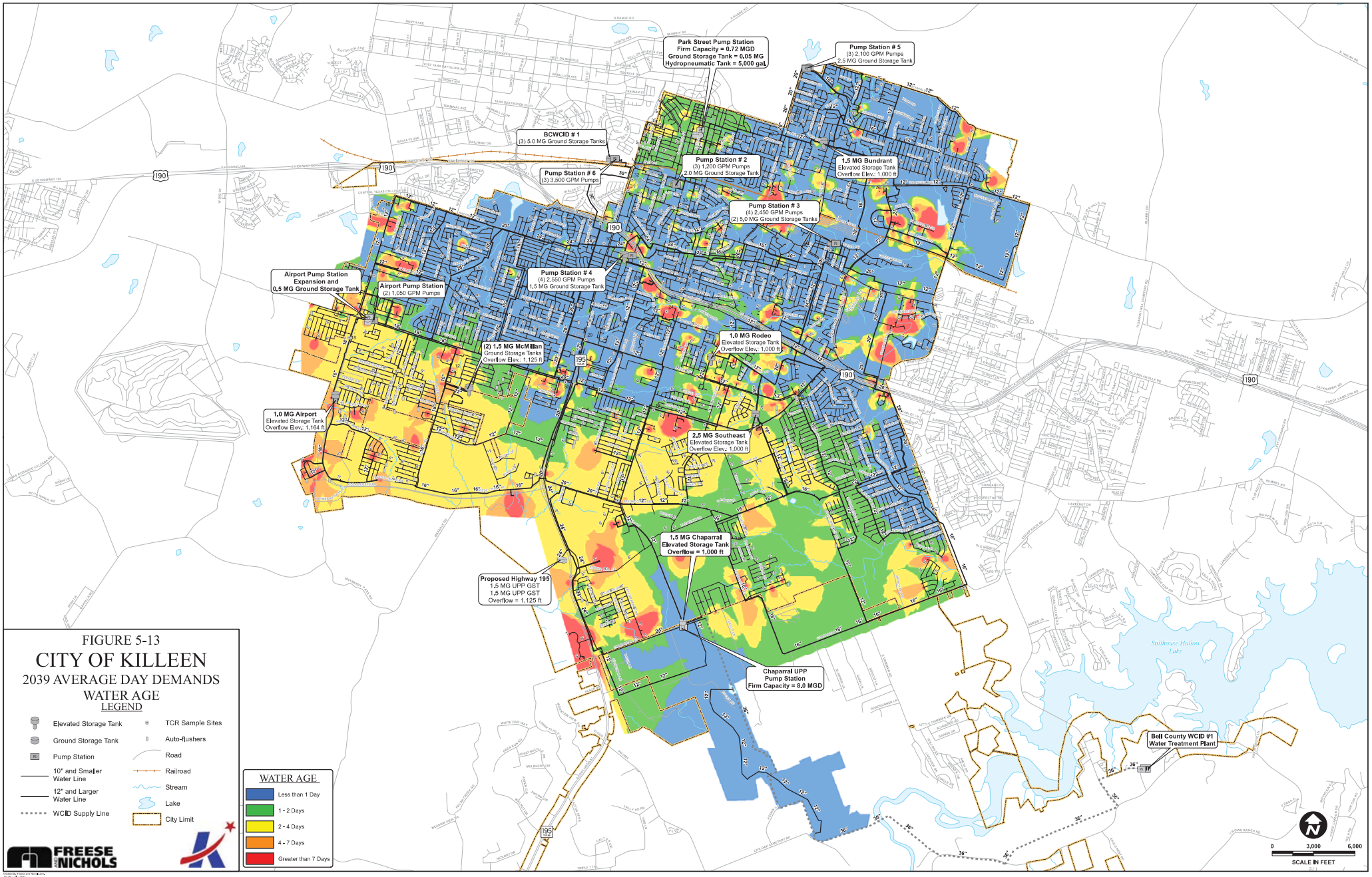


FIGURE 5-13

CITY OF KILLEEN

2039 AVERAGE DAY DEMANDS WATER AGE

LEGEND

- Elevated Storage Tank
- Ground Storage Tank
- Pump Station
- 10" and Smaller Water Line
- 12" and Larger Water Line
- WCID Supply Line
- TCR Sample Sites
- Auto-flushers
- Road
- Railroad
- Stream
- Lake
- City Limit

FREESE NICHOLS

Source Trace

A source trace analysis was performed to evaluate the changes in source water throughout the distribution system once BCWCID #1's new water treatment plant is in-service and supplying the City from the southern delivery point. A source trace simulation was developed considering the 5-year projected demands and the associated proposed improvements. Source tracing tracks the percentage of water that reaches each node in the network from a particular source. Source tracing is a useful tool for analyzing distribution systems drawing water from two or more water supplies. It can show to what degree water from a given source blends with that from other sources, and how the spatial pattern of this blending changes over time. Modeling results show a percentage of water from the south supply at every model node in the system. **Figure 5-14** and **5-15** illustrate the influence area of the south supply under average day and maximum day demand conditions, respectively. The City has expressed the desire to "baseload" off the south supply to maximize the water delivered from the new water treatment plant. Therefore, the amount of water being utilized from the south supply for average day and maximum day demand conditions remains relatively consistent. This causes the limits of the south supply's influence area to change based on the system demands. During 2024 average day conditions of 19.56 mgd, water from the south supply spreads throughout the Lower, Upper, and Airport Pressure Planes to cover approximately half the water system. The south supply's area of influence decreases during maximum day demand conditions, as more of the existing northern supplies are required to meet the projected 32.47 mgd demand.

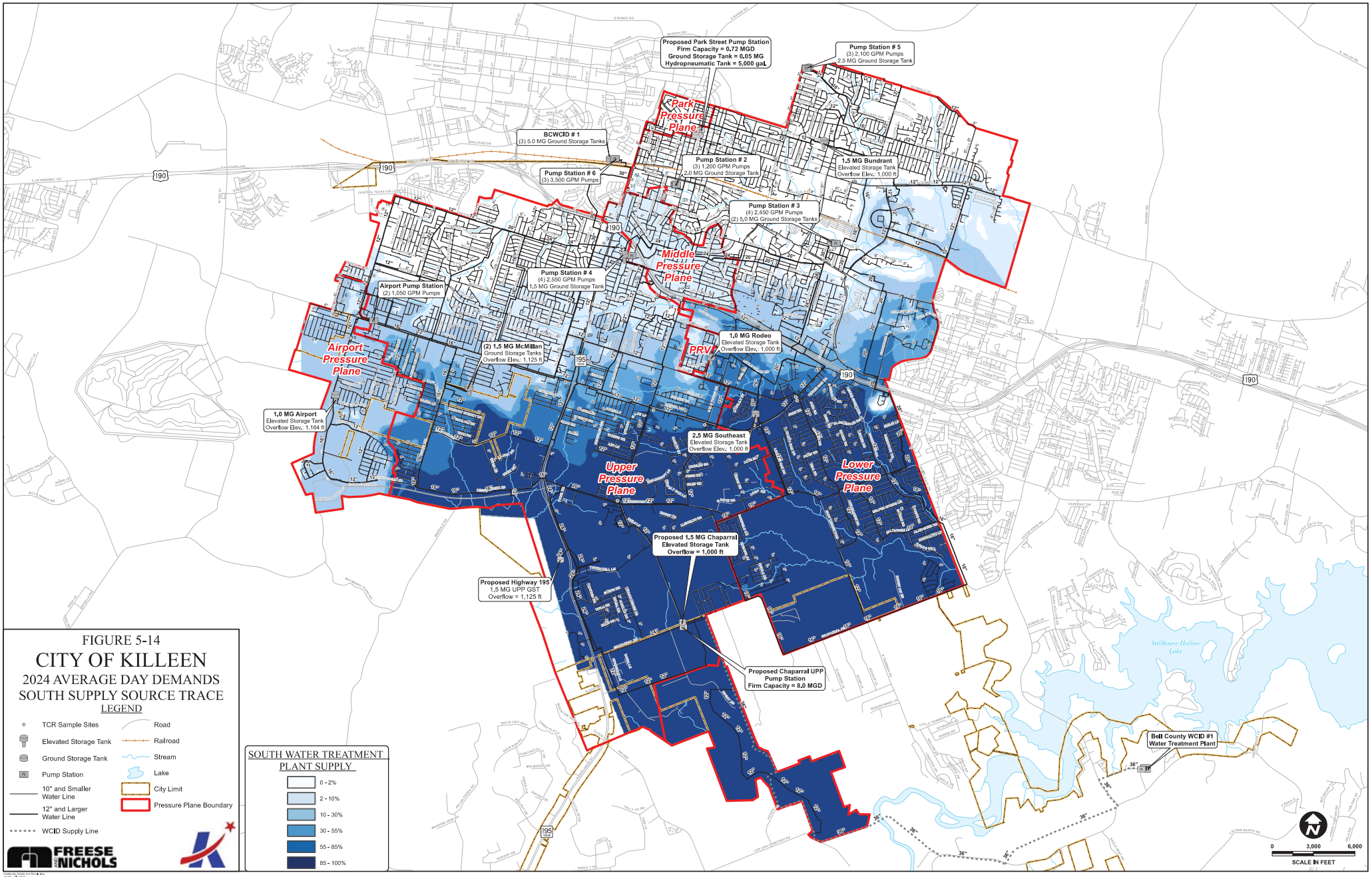


FIGURE 5-14

CITY OF KILLEEN

2024 AVERAGE DAY DEMANDS SOUTH SUPPLY SOURCE TRACE

LEGEND

- TCR Sample Sites
- Elevated Storage Tank
- Ground Storage Tank
- Pump Station
- 10" and Smaller Water Line
- 12" and Larger Water Line
- WCID Supply Line
- Road
- Railroad
- Stream
- Lake
- City Limit
- Pressure Plane Boundary

FREESE AND NICHOLS

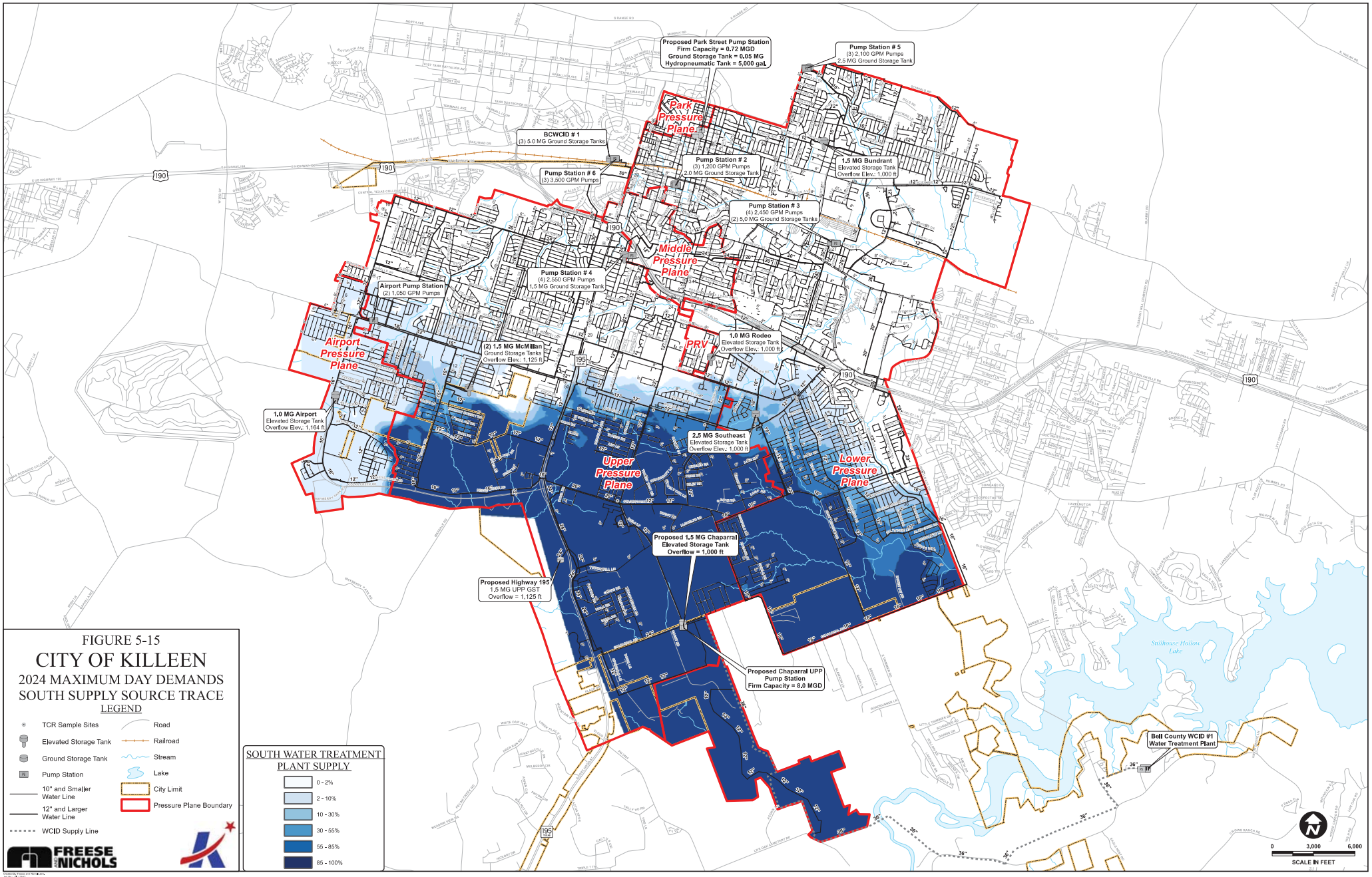


FIGURE 5-15

CITY OF KILLEEN

2024 MAXIMUM DAY DEMANDS SOUTH SUPPLY SOURCE TRACE

LEGEND

- TCR Sample Sites
- Elevated Storage Tank
- Ground Storage Tank
- Pump Station
- 10" and Smaller Water Line
- 12" and Larger Water Line
- WCID Supply Line
- Road
- Railroad
- Stream
- Lake
- City Limit
- Pressure Plane Boundary

FREESE AND NICHOLS

6.0 WATER SYSTEM CAPITAL IMPROVEMENTS PLAN

A capital improvements plan (CIP) was developed for the City of Killeen to ensure high quality water service that promotes residential and commercial development. The recommended improvements will provide the required capacity and reliability to meet projected water demands through year 2039. The recommended projects for the water system are presented on **Figure 6-1**. Locations shown for new mains and other recommended improvements were generalized for hydraulic analyses. Specific alignments and sites will be determined as part of the design process.

Capital costs were calculated for the major water facilities and do not include individual service connections or subdivision lines. The costs are in 2019 dollars and include an allowance for engineering, surveying, and contingencies. **Table 6-1** summarizes the costs of the water system capital improvements plan for the City of Killeen. Detailed descriptions of the projects and associated costs are included in **Appendix A**.

Utilizing the hydraulic model to analyze the water distribution system, improvements were phased into the three planning periods in which they become hydraulically necessary. It is recommended that these projects be constructed generally in the order listed; however, development patterns may make it necessary to construct some projects sooner or later than anticipated. The following sections list the projects by phase and provide a description and driver for each project.

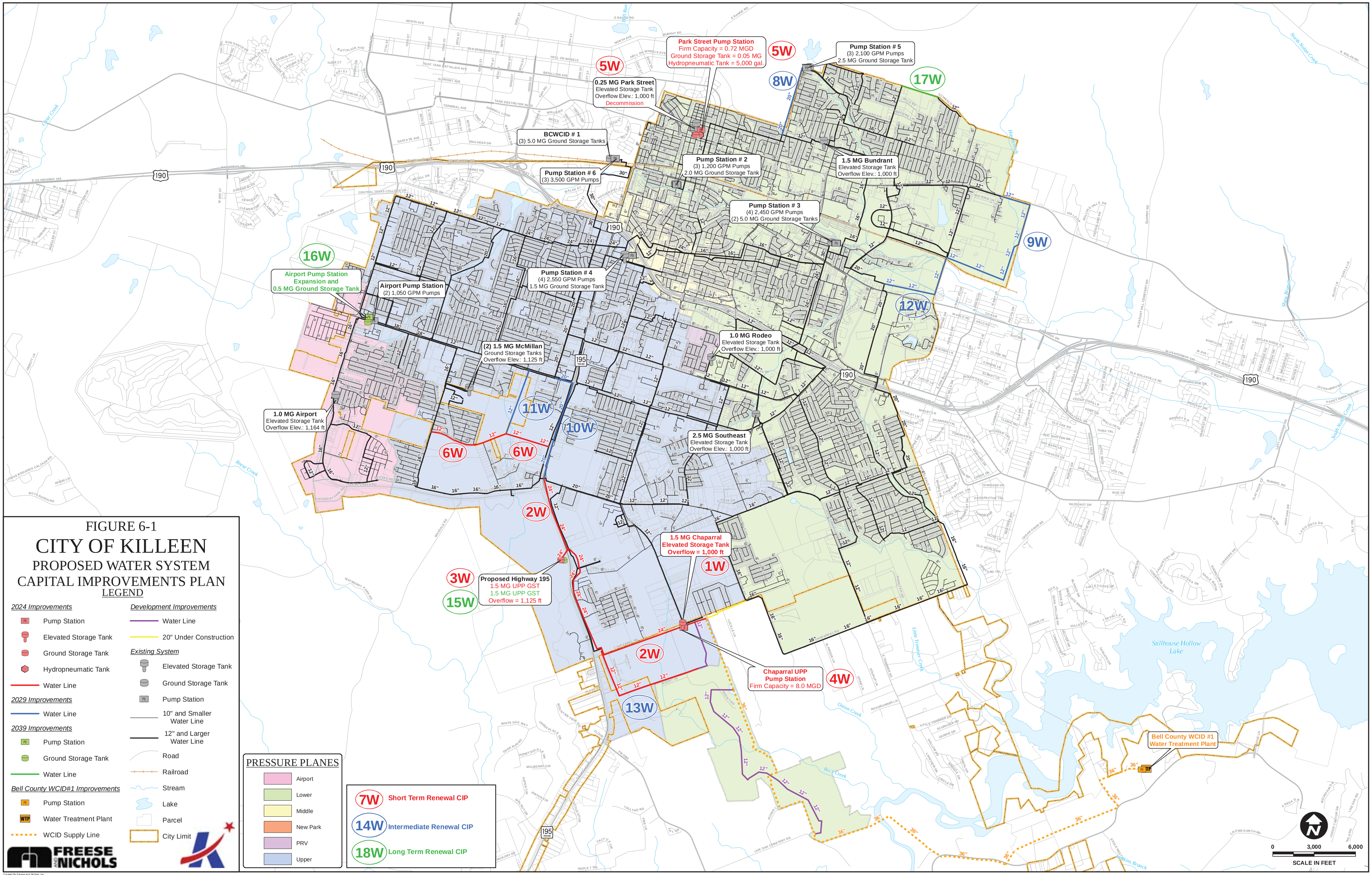


FIGURE 6-1
CITY OF KILLEEN
PROPOSED WATER SYSTEM
CAPITAL IMPROVEMENTS PLAN
LEGEND
2024 Improvements
Pump Station
Elevated Storage Tank
Ground Storage Tank
Hydropneumatic Tank
Water Line
2029 Improvements
Water Line
2039 Improvements
Pump Station
Ground Storage Tank
Water Line
Bell County WCID#1 Improvements
Pump Station
Water Treatment Plant
WCID Supply Line
Development Improvements
Water Line
20" Under Construction
Existing System
Elevated Storage Tank
Ground Storage Tank
Pump Station
10" and Smaller Water Line
12" and Larger Water Line
Road
Railroad
Stream
Lake
Parcel
City Limit
PRESSURE PLANES
Airport
Lower
Middle
New Park
PRV
Upper
7W Short Term Renewal CIP
14W Intermediate Renewal CIP
18W Long Term Renewal CIP
FREESE NICHOLS
0 3,000 6,000
SCALE IN FEET
Park Street Pump Station
Firm Capacity = 0.72 MGD
Ground Storage Tank = 0.05 MG
Hydropneumatic Tank = 5,000 gal.
0.25 MG Park Street
Elevated Storage Tank
Overflow Elev.: 1,000 ft
Decommission
BCWCID # 1
(3) 5.0 MG Ground Storage Tanks
Pump Station # 6
(3) 3,500 GPM Pumps
Pump Station # 5
(3) 2,100 GPM Pumps
2.5 MG Ground Storage Tank
Pump Station # 2
(3) 1,200 GPM Pumps
2.0 MG Ground Storage Tank
1.5 MG Bundrant
Elevated Storage Tank
Overflow Elev.: 1,000 ft
Pump Station # 3
(4) 2,450 GPM Pumps
(2) 5.0 MG Ground Storage Tanks
Pump Station # 4
(4) 2,550 GPM Pumps
1.5 MG Ground Storage Tank
Airport Pump Station
Expansion and
0.5 MG Ground Storage Tank
Airport Pump Station
(2) 1,050 GPM Pumps
(2) 1.5 MG McMillan
Ground Storage Tanks
Overflow Elev.: 1,125 ft
1.0 MG Rodeo
Elevated Storage Tank
Overflow Elev.: 1,000 ft
1.0 MG Airport
Elevated Storage Tank
Overflow Elev.: 1,164 ft
2.5 MG Southeast
Elevated Storage Tank
Overflow Elev.: 1,000 ft
1.5 MG Chaparral
Elevated Storage Tank
Overflow = 1,000 ft
Proposed Highway 195
1.5 MG UPP GST
1.5 MG UPP GST
Overflow = 1,125 ft
Chaparral UPP
Pump Station
Firm Capacity = 8.0 MGD
Bell County WCID #1
Water Treatment Plant
Stillhouse Hollow Lake
1W
2W
3W
4W
5W
6W
8W
9W
10W
11W
12W
13W
15W
16W
17W

Table 6-1 Water Capital Improvement Plan Summary

Project Number	Project Name	Cost
1W	Chaparral Elevated Storage Tank	$4,830,000
2W	24-inch Highway 195 Water Line	$8,545,000
3W	Highway 195 Ground Storage Tank #1	$2,415,000
4W	Chaparral Pump Station	$5,244,000
5W	Park Street Booster Pump Station	$1,011,800
6W	12-inch Mohawk Road Water Line	$1,808,400
7W	Short Term Water Renewal CIP	$6,916,400
	Short Term (2019 – 2024) Total	**$30,770,600**
8W	24-inch Westcliff Road Water Line	$1,788,500
9W	12-inch E Rancier Avenue Line	$2,484,000
10W	20-inch Highway 195 Water Line	$2,905,400
11W	12-inch Water Line from Mohawk Road to Stan Schlueter Loop	$973,900
12W	12-inch N Roy Reynolds Drive Water Line	$1,311,600
13W	12-inch Water Line Loop South of Chaparral Rd	$3,431,100
14W	Intermediate Water Renewal CIP	$6,916,400
	Intermediate (2025 – 2029) Total	**$19,810,900**
15W	Highway 195 Ground Storage Tank #2	$2,070,000
16W	Airport Pump Station Expansion and New Ground Storage Tank	$2,125,200
17W	12-inch Schwald Road Water Line	$556,500
18W	Long Term Water Renewal CIP	$13,832,800
	Long Term (2030 – 2039) Total	$18,584,500
	Water Capital Improvement Plan Total	**$69,166,000**

6.1 Water Projects from 2019 to 2024

Projects recommended within the first 5-year phase are the most critical to the system. These projects resolve existing deficiencies or accommodate near-term projected growth. A detailed description of each project is provided below.

Project 1W: Chaparral Elevated Storage Tank

This project includes a 1.5 MG elevated storage tank located near Chaparral Road and Trimmier Road. The new tank provides additional elevated storage in the LPP. It will also serve as storage for the suction side of the future UPP pump station.

Project 2W: 24-inch Highway 195 Water Line

This project includes a transmission line along Highway 195 between the proposed Chaparral Road Pump Station and Stagecoach Road. This pipeline is needed to convey water from the proposed Chaparral Pump Station into the UPP. It also provides transmission capacity to and from the proposed Highway 195 tank.

Project 3W: Highway 195 Ground Storage Tank #1

This project includes a 1.5 MG ground storage tank serving as an elevated tank located on a hill near Highway 195 and Tower Hill Lane. The projected growth in the UPP requires additional elevated storage to meet TCEQ requirements.

Project 4W: Chaparral Pump Station

This project includes an 8.0 MGD Pump Station on the same site as the Chaparral EST. Additional pumping capacity is needed to meet projected maximum day demands in the UPP. This pump station allows the City to better utilize water supply from the new BCWCID #1 South Water Treatment Plant.

Project 5W: Park Street Booster Pump Station

This project includes a new 50,000 gallon ground storage tank, 0.72 mgd pump station, 5,000 gallon hydropneumatic tank, and two isolation valves at the existing Park EST site. This project creates a new pressure plane to increase pressure for a small area of high elevation near the existing Park EST. Currently, during high demand periods, this area experiences pressures below the TCEQ minimum required pressure of 35 psi.

Project 6W: 12-inch Mohawk Road Water Line

This project involves a 12-inch distribution line between Bunny Trail and Highway 195. This pipeline is needed to distribute water to an area projected for future growth.

Project 7W: Short Term Water Renewal CIP

This project involves the replacement or rehabilitation of water lines and facilities identified in FNI's Renewal CIP. As water lines, pump stations, and storage tanks age, assets need to be replaced or rehabbed to maintain functionality. FNI conducted facility condition assessments and a risk-based assessment for linear assets to identify projects in the renewal CIP. Half of the total cost of the renewal projects is included in the 5-year CIP.

6.2 Water Projects from 2024 to 2029

Projects in the second phase generally include projects that facilitate expected growth and create reliability within the system. A detailed description of each project in the 2024 to 2029 phase is provided below.

Project 8W: 20-inch W.S. Young Drive Water Line

This project involves a 20-inch transmission line from Pump Station #5 to Poage Road. This pipeline provides additional transmission capacity from Pump Station #5. The existing 16-inch line experiences high velocities and headloss when the full capacity of pump station #5 is utilized. The additional 20-inch line will allow the pumps to operate more efficiently.

Project 9W: 12-inch E Rancier Avenue Line

This project involves a 12-inch loop in the northeastern portion of the LPP, generally between Rancier Avenue and the railroad. This pipeline is needed to extend water service to an area projected for future growth.

Project 10W: 20-inch Highway 195 Water Line

This project involves a 20-inch transmission line from Stagecoach Road to Elms Road. This pipeline provides additional transmission capacity in the UPP.

Project 11W: 12-inch Water Line from Mohawk Road to Stan Schlueter Loop

This project involves a 12-inch distribution line between Stan Schlueter Loop and the proposed 12-inch along Mohawk Road. This pipeline is needed to distribute water to an area projected for future growth.

Project 12W: 12-inch N Roy Reynolds Drive Water Line

This project involves a 12-inch distribution line along Business Highway 190 from S Twin Creek Drive to Roy Reynolds Drive, and north from Business Highway 190 to the railroad. This pipeline extends water service to an area projected for future growth.

Project 13W: 12-inch Water Line Loop South of Chaparral Rd

This project will finish looping a 12-inch distribution line by developer south of Chaparral Road in the UPP. This pipeline completes looping for future growth.

Project 14W: Intermediate Water Renewal CIP

This project involves the replacement or rehabilitation of water lines and facilities identified in FNI's Renewal CIP. As water lines, pump stations, and storage tanks age, assets need to be replaced or rehabbed to maintain functionality. FNI conducted facility condition assessments and a risk-based assessment for linear assets to identify projects in the renewal CIP. Half of the total cost of the renewal projects is included in the 10-year CIP.

6.3 Water Projects from 2029 to 2039

The CIP projects included in the final planning phase from 2029 to 2039 continue to facilitate anticipated growth within the service area. A detailed description of each project in this phase is provided below.

Project 15W: Highway 195 Ground Storage Tank #2

This project includes a second 1.5 MG ground storage tank serving as an elevated tank located on a hill near Highway 195 and Tower Hill Lane. The projected growth in the UPP requires additional elevated storage to meet TCEQ requirements.

Project 16W: Airport Pump Station Expansion and New Ground Storage Tank

This project involves a 2.0 MGD pump station and a new 0.5 MG Ground Storage Tank to replace the existing Airport Pump Station. The proposed pump station expansion will provide pumping capacity to meet demands in the Airport Pressure Plane. The new GST provides storage on the suction side of the pump station, which is required by TCEQ.

Project 17W: 12-inch Schwald Road Water Line

This project involves a 12-inch distribution line along Schwald Road from 60th Street to Ridge Haven Drive. This pipeline completes looping for future growth in the area.

Project 18W: Long Term Water Renewal CIP

This project involves the replacement or rehabilitation of water lines and facilities identified in FNI's Renewal CIP. As water lines, pump stations, and storage tanks age, assets need to be replaced or rehabbed to maintain functionality. FNI conducted facility condition assessments and a risk-based assessment for linear assets to identify projects in the renewal CIP for the next 10 years. Assets should be re-evaluated every 5 to 10 years to assess condition and need for rehabilitation.

7.0 WASTEWATER FLOWS

Wastewater flows in a municipal collection system vary by time of day, wastewater discharge source and weather conditions. Average daily flow is defined as the total wastewater flow over a one-year period divided by the number of days in that year. Wastewater treatment plants are typically sized in terms of average daily flow. The collection system is sized to convey peak wastewater flows. Peak wastewater flow is comprised of three components: the peak dry weather flow, infiltration, and inflow. Infiltration is the seepage of groundwater into the sewer pipe and appurtenances. It is estimated as the difference between the minimum nighttime flow during dry weather, low groundwater periods and the maximum nighttime flow during high groundwater periods, which occur immediately after a storm event. Inflow is the measurement of storm water runoff from paved and non-paved areas from both public and private sector sources. The collection system must be able to convey the peak flow that results from design level storm events.

7.1 Historical Wastewater Flows

FNI analyzed yearly flow data provided by the City from 2010 to 2017 to determine the historical trends in system-wide average daily flow and per-capita flow. The citywide per-capita flow rate ranged from a low of 77 gpcd in 2011 to a high of 102 gpcd in 2010 with an average of 87 gpcd. **Table 7-1** is a summary of Killeen's historical wastewater flows.

Table 7-1 Historical Wastewater Flows

Year	Population	Average Day Flow (MGD)	Average Day Per-Capita (gpcd)
2010	127,921	12.99	102
2011	128,967	9.88	77
2012	130,389	10.58	81
2013	132,960	10.80	81
2014	135,517	11.41	84
2015	138,031	13.76	100
2016	140,478	13.11	93
2017	142,893	11.35	79
Average	-	-	**87**
Maximum	-	**13.76**	**102**

7.2 Projected Wastewater Flows

Wastewater flows were projected for 2019, 2024, 2029, and 2039 conditions using per-capita and per-acre flows applied to the projected population and future land use presented in Section 2.2. The future wastewater flow rates were selected to align with historical wastewater flows. Therefore, an overall average day per-capita flow rate of approximately 100 gpcd was targeted for the wastewater flow projections. The planning criteria selected for each land use type that would allow the overall per-capita to fall within the desired range is shown in **Table 7-2**. The resulting wastewater flow projections are shown in **Table 7-3**.

Table 7-2 Wastewater Flow Projection Factors

Land Use	People/acre	Gallons/person (gpcd)	Gallons/acre (gpad)
Business Park	0	0	600
Estate	1	80	0
Four-Plex Residential	24	80	0
General Commercial	0	0	600
General Residential	12	80	0
Industrial	0	0	600
Multi-Family Residential	30	80	0
Neighborhood Conservation	12	80	0
Parks-Recreation	0	0	600
Planned Development	15	80	300
Residential Mix	15	80	0
Residential-Commercial Mix	15	80	300
Rural	0	0	0
Suburban Commercial	0	0	300
Suburban Residential	9	80	0
Turnbo Ranch	7	80	0
Urban	15	80	300
Urban Center	15	80	300

Table 7-3 Wastewater Phased Flow Projections

Year	Population	Residential Flow (MGD)	Non-Residential Flow (MGD)	Average Day Flow (MGD)	Average Day Per-Capita (gpcd)
2019	148,088	11.85	2.68	14.53	98
2024	160,313	12.83	3.02	15.85	99
2029	171,172	13.69	3.31	17.00	99
2039	197,019	15.76	3.85	19.61	100

8.0 DESCRIPTION OF THE EXISTING WASTEWATER SYSTEM

The City of Killeen's wastewater collection system consists of a network of gravity lines, 15 lift stations and associated force mains, and 2 wastewater treatment plants. **Figure 8-1** shows the existing wastewater collection system for the City of Killeen.

8.1 Major Basins

Wastewater basin boundaries are identified by determining the flow paths in the wastewater collection system and grouping areas that have the same outfall location. Killeen's collection system is separated into five major wastewater basins: WWTP, Long Branch, Central, South Nolan Creek, and Trimmier Creek. The WWTP, Long Branch, and South Nolan Creek Basins flow to the North Wastewater Treatment Plant, while Trimmier Creek and Central Basins flow to the South Wastewater Treatment Plant.

8.2 Wastewater Lines

The City of Killeen's existing wastewater system consists of 604 miles of wastewater collector mains and interceptors. Pipeline diameters range in size from 4-inches to 42-inches. **Figure 8-2** illustrates the percentage of pipe length by diameter. **Figure 8-3** shows a summary of the pipe material based on the City's GIS data. The City has done significant research and surveying of wastewater lines, so the GIS data includes other useful information, such as upstream and downstream manhole ID, year of installation, and type of pipe (gravity or force main).

8.3 Wastewater Treatment Plants

The wastewater system is served by two wastewater treatment plants (WWTPs) that are owned and operated by BCWCID #1. The North WWTP is located along 38th Street in the north central portion of the city. Killeen and Fort Hood convey flow to this plant, which has a total treatment capacity of 18 mgd. The South WWTP, located in the southeastern portion of the City, only receives flow from Killeen and has a treatment capacity of 6 mgd.

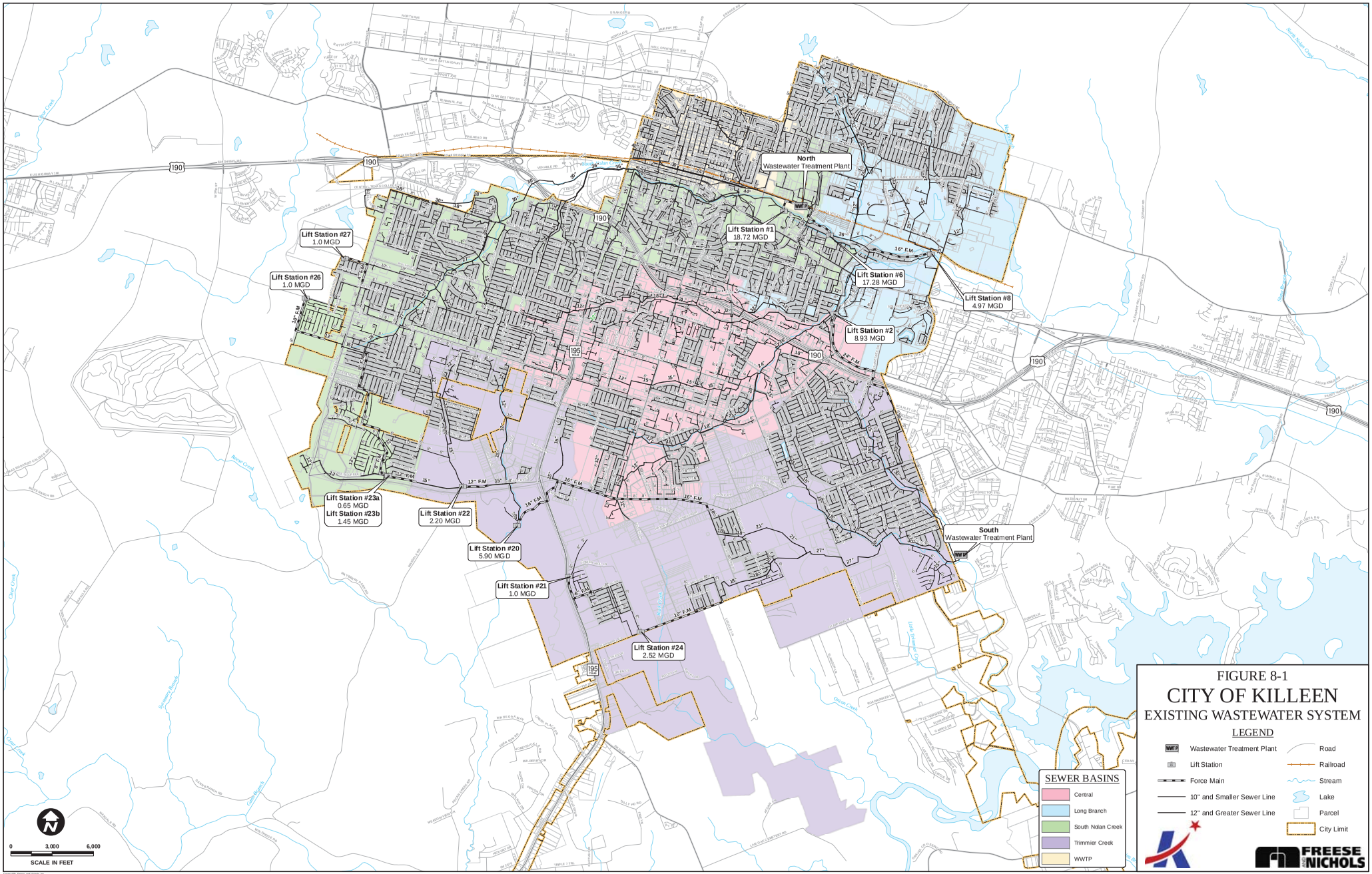


FIGURE 8-1

CITY OF KILLEEN

EXISTING WASTEWATER SYSTEM

LEGEND

- Wastewater Treatment Plant
- Lift Station
- Force Main
- 10" and Smaller Sewer Line
- 12" and Greater Sewer Line
- Road
- Railroad
- Stream
- Lake
- Parcel
- City Limit

FREESE NICHOLS

Figure 8-2 Pipeline Diameter by Length

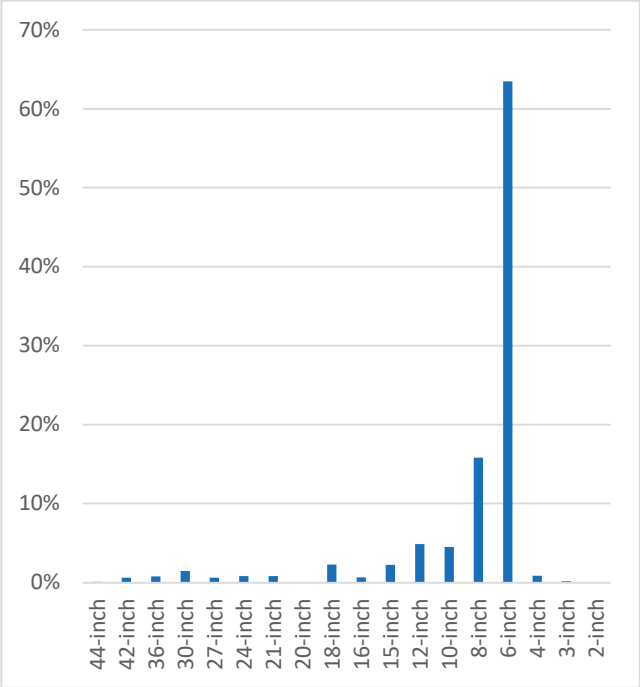
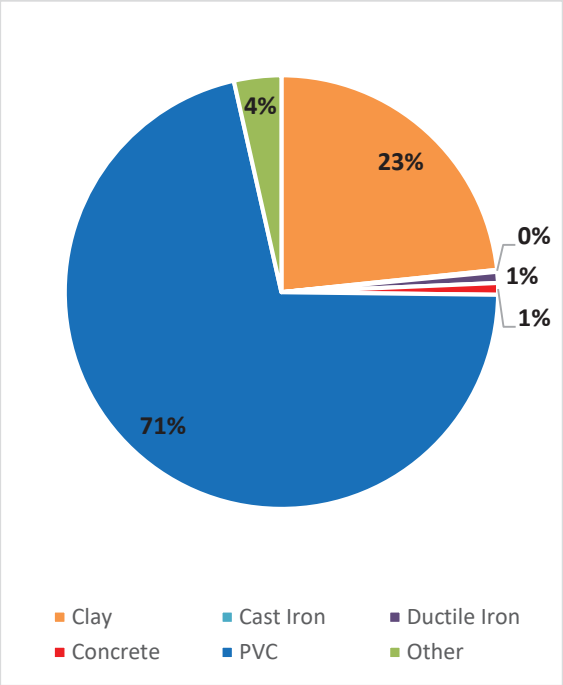


Figure 8-3 Pipeline Material by Length



8.4 Lift Stations

Lift stations are necessary when wastewater needs to be pumped to a higher elevation where the flow can resume to be conveyed by gravity to the outfall of the system. Due to the varying topography, Killeen operates 15 lift stations throughout the service area. The lift stations vary in size from small development lift stations near the city limits to the three large lift stations in the center of the City. Lift Stations #1, #2, and #6 pump roughly 70% of the total daily flow to the North and South WWTPs and are crucial facilities in the wastewater system. Currently Lift Station #2 pumps flow to the South WWTP; however, there is a diversion structure that allows wastewater to bypass Lift Station #2 and flow to the North WWTP. This provides flexibility and some degree of backup during brief times when maintenance is needed or an unexpected failure occurs at either Lift Station #2 or the South WWTP. **Table 8-1** is a list of the lift stations in the City of Killeen along with the corresponding existing firm pumping capacity.

Table 8-1 Existing Lift Station Capacity

Lift Station No.	Existing Firm Capacity (mgd)
1	18.72
2	8.93
6	17.28
8	4.97
20	5.90
21	1.00
22	2.20
23a	0.65
23b	1.45
24	2.52
26	1.00
27	1.00

Note: Lift Stations #9, #24a, Wassay and S.T.E 1 were not evaluated due to the small area being served and low capacity of the pumps.

9.0 WASTEWATER SYSTEM ANALYSIS AND HYDRAULIC MODELING

Hydraulic analyses were conducted to identify deficiencies in the City of Killeen's existing wastewater collection system and to establish a capital improvements plan to improve the existing system and handle projected wastewater flows through 2039. Various combinations of improvements and modifications were investigated to determine the most appropriate approach for conveying projected flows. Parameters used in developing the improvements plan included increasing system reliability, simplifying system operations, handling peak wet weather flows, maintaining proper velocities, and reducing surcharging and sanitary sewer overflows.

9.1 Wastewater Hydraulic Model Development

FNI imported the previous wastewater system hydraulic model into InfoSewer from H2OMap Sewer to begin the model update process. The model includes all 10-inch and larger gravity sewer mains, key 8-inch mains, lift stations, and force mains. It is typical in wastewater models to exclude smaller gravity mains and lift stations due to the availability of the information required in the model, such as invert elevations. Issues with small collector lines are typically due to blockages or poor pipe condition, which would not be identified in the model, rather than hydraulic restrictions. Therefore, the effort it would take to acquire the needed information outweighs the benefit of including all pipes.

The model was updated to include recently constructed lines and lift stations. The City's GIS database and as-built plans were used to input the new information. A verification run was conducted to compare the modeled flow to measured flow at the City's permanent flow meters. The modeled flow generally fell within the observed range of flows.

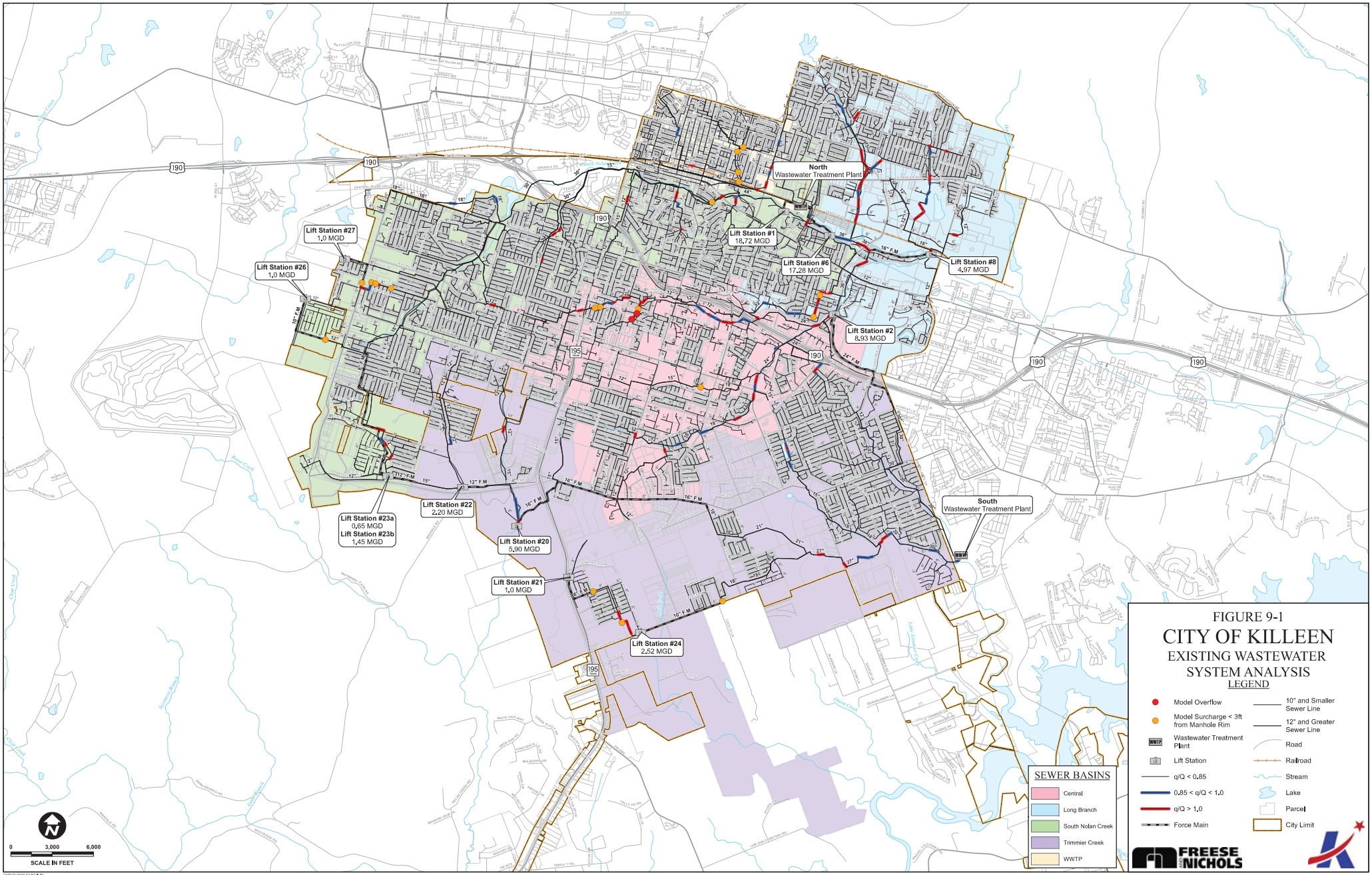
9.2 Existing Wastewater System Analysis

The existing collection system was evaluated to assess the ability of the system to adequately convey wastewater to the WWTPs without excessively surcharging or overflowing. This analysis was performed to determine if there are any existing system deficiencies and to provide a baseline for the current level of service.

The critical flow condition for analyzing a wastewater collection system is peak wet weather. For this study, steady-state modeling was utilized, so a diurnal curve and storm hydrograph were not developed. Comprehensive system-wide flow monitoring data was not available for this study so a peaking factor of 4.0 was used to estimate peak wet weather flows. TCEQ recommends using a 4.0 peaking factor in the absence of flow monitoring data. The City plans to conduct temporary flow monitoring in the next 1-2 years as an update to the 2010 SSES Basin Prioritization Study, which will provide data that can be used to refine the projected peak wet weather flows by basin if necessary.

Flow, depth, and velocity are important factors when analyzing the peak wet weather flow simulations. Design criteria vary, but for this wastewater system study, it was determined that the hydraulic grade line should not exceed three feet below the manhole rim elevation. The flow in the line divided by the maximum capacity of the line, or q/Q, is also analyzed when looking at model results. A q/Q greater than 1.0 indicates that the wastewater main is exceeding capacity. **Figure 9-1** is a color-coded map that illustrates the surcharge state of modeled manholes, as well as the q/Q value for each wastewater main for the existing system analysis. Overall the collection system conveys the peak flow without overflows under existing system conditions. However, the following areas of concern were identified:

- The 15-inch and 12-inch line in the Central basin, south of Highway 190 experiences surcharging and two model predicted overflows occur.
- The interceptors in the Long Branch basin show capacity constraints but no surcharging or overflows occur.
- Isolated hydraulic bottlenecks and surcharging occur throughout the system under peak wet weather flows.


North
Wastewater Treatment Plant
South
Wastewater Treatment Plant
Lift Station #27
1.0 MGD
Lift Station #26
1.0 MGD
Lift Station #1
18.72 MGD
Lift Station #6
17.28 MGD
Lift Station #8
4.97 MGD
Lift Station #2
8.93 MGD
Lift Station #22
2.20 MGD
Lift Station #23a
0.65 MGD
Lift Station #23b
1.45 MGD
Lift Station #20
5.90 MGD
Lift Station #21
1.0 MGD
Lift Station #24
2.52 MGD
190
195
0
3,000
6,000
SCALE IN FEET
SEWER BASINS
Central
Long Branch
South Nolan Creek
Trimmier Creek
WWTP
FIGURE 9-1
CITY OF KILLEEN
EXISTING WASTEWATER SYSTEM ANALYSIS
LEGEND
Model Overflow
Model Surcharge < 3ft from Manhole Rim
Wastewater Treatment Plant
Lift Station
q/Q < 0.85
0.85 < q/Q < 1.0
q/Q > 1.0
Force Main
10" and Smaller Sewer Line
12" and Greater Sewer Line
Road
Railroad
Stream
Lake
Parcel
City Limit
FREESE NICHOLS

9.3 Future Wastewater System Analysis

Wastewater system improvements were developed to accommodate the anticipated residential and non-residential growth over the next 20 years. To serve the future growth, the City of Killeen must rehabilitate, replace, or upsize existing infrastructure and provide additional service to areas of growth where little or no infrastructure currently exists.

When determining the size of proposed wastewater lines, TCEQ design criteria (217.53 (I) (1)) dictate that gravity sewer lines shall be sized to maintain a minimum velocity of 2 feet per second. Maintaining these velocities discourages settling of solids. TCEQ design criteria (217.67 (a)) also state that force mains shall be sized to convey the lift station pumping capacity at a minimum velocity of 3 feet per second for duplex lift stations and 2 feet per second with one pump operating at a lift station with three or more pumps. When sizing lines for future wastewater loading, it is specifically stated in TCEQ Chapter 217 217.53 (j) (3) that "A collection system must be designed to prevent a surcharge in any pipe at the expected peak flow." Therefore, all proposed lines are sized to prevent surcharging. TCEQ slope requirements, as shown in **Table 9-1**, were utilized for new lines in undeveloped areas. If proposed lines are constructed at a greater slope than the minimum slopes listed in **Table 9-1**, then the proposed line size should be evaluated based on the updated capacity.

Table 9-1 TCEQ Slope Requirements

Pipe Size (in)	Minimum Slope (ft/ft)	Maximum Slope (ft/ft)
6	0.00500	12.35
8	0.00330	8.40
10	0.00250	6.23
12	0.00200	4.88
15	0.00150	3.62
18	0.00110	2.83
21	0.00090	2.30
24	0.00080	1.93
27	0.00060	1.65
30	0.00055	1.43

Lift Station Capacity

Lift station capacity was analyzed under peak wet weather flow conditions. FNI recommends new lift station sizing or lift station expansion sizing to meet TCEQ requirements. TCEQ Chapter 217 217.61 (c) states that "the firm pumping capacity of a lift station must handle the expected peak flow." Firm pumping capacity at a lift station is defined as the maximum pumping capacity with the largest pumping unit out of service. **Table 9-2** shows the existing capacity of each lift station as well as the future peak wet weather flow that the lift station is projected to convey. Based on the projected flows, Lift Stations #6, #8, #20, #22, and #24 will need expansion projects, which are discussed in more detail in Section 10.0.

Additional analysis was conducted to evaluate the interaction of Lift Station #2 and Lift Station #6. Current system operations allow flow from the Central Basin to be pumped to the South WWTP via Lift Station #2 or it can bypass Lift Station #2 and flow to Lift Station #6 where it is pumped to the North WWTP. For the following loading projections, it was assumed that Lift Station #2 would be able to pump its firm capacity, while the excess peak wet weather flow would continue downstream to Lift Station #6. The lift station expansion capacities were determined using the 2039 loading values.

Table 9-2 Projected Lift Station Loading

Lift Station	Existing Capacity (MGD)	2019 Loading (MGD)	2024 Loading (MGD)	2029 Loading (MGD)	2039 Loading (MGD)
1	18.72	16.05	16.15	16.20	17.60
2	8.93	8.93	8.93	8.93	8.93
6	17.28	15.21	17.61	19.3	22.23
8	4.97	3.57	4.89	5.28	6.21
20	5.90	3.89	4.83	5.69	7.05
21	1.00	0.53	0.53	0.68	0.68
22	2.20	2.24	2.64	3.13	3.76
23a	0.65	0.48	0.55	0.55	0.67
23b	1.45	1.12	1.29	1.29	1.56
24	2.52	1.33	1.59	2.18	3.32
26	1.00	0.12	0.12	0.12	0.15
27	1.00	0.15	0.15	0.15	0.15

Note: Text is red once the loading exceeds the existing capacity. This indicates when the lift station expansion is needed.

Wastewater Treatment Plant Capacity

The North and South wastewater treatment plants are owned and operated by BCWCID #1. Therefore, treatment plant expansions are not considered in Killeen's Capital Improvement Plant. However, the City will likely need to secure additional wholesale treatment capacity. **Table 9-3** shows the results of future average daily flow scenarios at each treatment plant. This does not include flows from other BCWCID #1 customers.

Table 9-3 Projected Average Daily Flow by WWTP

Year	North WWTP Average Flow (MGD)	South WWTP Average Flow (MGD)
2019	7.87	6.58
2024	8.31	7.46
2029	8.42	8.65
2039	9.17	10.34

New Development

New growth and capacity improvement lines were a focus of the capital improvements program. The City will continue to grow to the south and will require new infrastructure to provide service to new customers. The topography of the southern portion of the City drains towards the Lampasas River and Stillhouse Hollow Lake. City staff provided the preliminary layouts of Turnbo Ranch's proposed lift stations, which collect flow within the development and pump it to gravity lines that flow to the South WWTP. These projects are expected to be constructed by the developer and therefore are not included in the City's CIP. must pump flow to locations where it can be conveyed to the South WWTP.

10.0 WASTEWATER SYSTEM CAPITAL IMPROVEMENTS PLAN

A capital improvements plan (CIP) was developed for the City of Killeen to ensure the wastewater system will effectively and efficiently continue to convey flow to the wastewater treatment plants. The recommended improvements will provide the required capacity and reliability to meet projected wastewater flows through year 2039. The recommended projects for the wastewater system are presented on **Figure 10-1**. Locations shown for new mains and other recommended improvements were generalized for hydraulic analyses. Specific alignments and sites will be determined as part of the design process.

Capital costs were calculated for the major wastewater facilities and do not include individual service connections or subdivision lines. The costs are in 2019 dollars and include an allowance for engineering, surveying, and contingencies. **Table 10-1** summarizes the costs of the wastewater system capital improvements plan for the City of Killeen. Detailed descriptions of the projects and associated costs are included in **Appendix B**. Lift Station expansion costs take into consideration the installation of pumps, piping, miscellaneous valves/appurtenances, site work, wet well expansion/repair, and by-pass pumping. Unit prices shown in the cost summaries are assumed to include direct project costs, overhead, and profit for the contractors.

Utilizing the hydraulic model to analyze the water distribution system, improvements were phased into the three planning periods in which they become hydraulically necessary. It is recommended that these projects be constructed generally in the order listed; however, development patterns may make it necessary to construct some projects sooner or later than anticipated. The following sections list the projects by phase and provide a description and driver for each project.

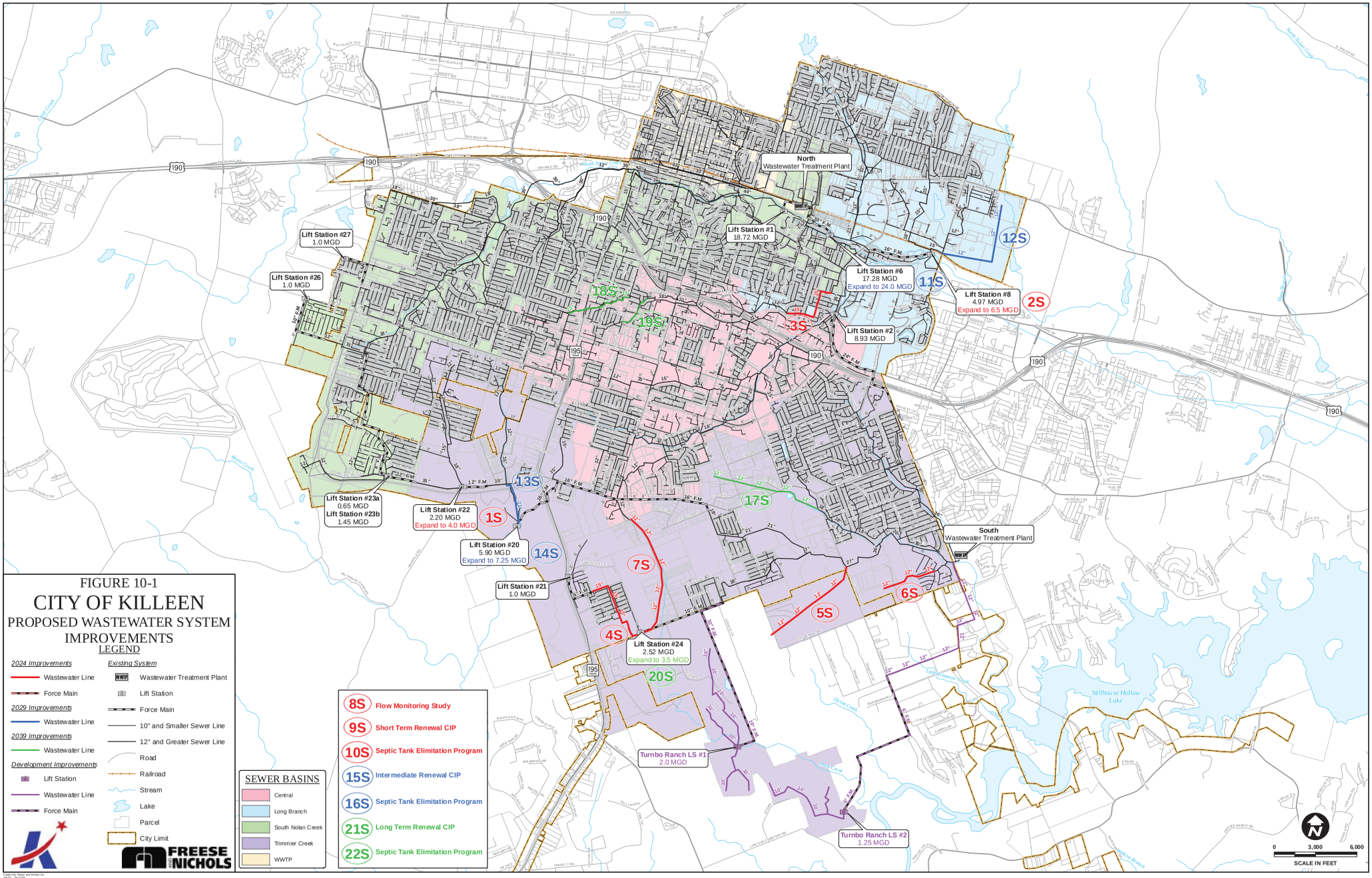


FIGURE 10-1

CITY OF KILLEEN

PROPOSED WASTEWATER SYSTEM IMPROVEMENTS

LEGEND

2024 Improvements
- Wastewater Line
- Force Main

2029 Improvements
- Wastewater Line

2039 Improvements
- Wastewater Line

Development Improvements
- Lift Station
- Wastewater Line
- Force Main

Existing System
- Wastewater Treatment Plant
- Lift Station
- Force Main
- 10" and Smaller Sewer Line
- 12" and Greater Sewer Line
- Road
- Railroad
- Stream
- Lake
- Parcel
- City Limit

SEWER BASINS
- Central
- Long Branch
- South Nolan Creek
- Trimmier Creek
- WWTP

- 8S Flow Monitoring Study
- 9S Short Term Renewal CIP
- 10S Septic Tank Elimitation Program
- 15S Intermediate Renewal CIP
- 16S Septic Tank Elimitation Program
- 21S Long Term Renewal CIP
- 22S Septic Tank Elimitation Program

FREESE NICHOLS

Table 10-1 Wastewater Capital Improvements Plan Summary

Project Number	Project Name	Cost
1S	Lift Station #22 Expansion	$1,587,000
2S	Lift Station #8 Expansion	$1,587,000
3S	15-inch Wastewater Main Replacement in the Long Branch Subbasin	$1,668,500
4S	12/15-inch Main Replacement Upstream of Lift Station #24	$1,959,200
5S	12-inch Wastewater Main in Trimmier Creek Basin	$1,620,700
6S	12-inch Wastewater Main near Money Pit Road	$850,100
7S	12-inch Wastewater Main along Trimmier Road in Southern Trimmier Creek Basin	$1,796,200
8S	Flow Monitoring & I/I Reduction Study	$240,000
9S	Short Term Wastewater Renewal CIP	$8,787,500
10S	Septic Tank Elimination Program	$5,000,000
	Short Term (2019 - 2024) Total	**$25,096,200**
11S	Lift Station #6 Expansion	$4,209,000
12S	12-inch Wastewater Main in Long Branch Basin	$1,640,600
13S	18/21-inch Wastewater Main Replacement in the Trimmier Creek Subbasin	$1,546,100
14S	Lift Station #20 Expansion	$2,346,000
15S	Intermediate Term Wastewater Renewal CIP	$8,787,500
16S	Septic Tank Elimination Program	$5,000,000
	Intermediate (2025 - 2029) Total	**$23,529,200**
17S	12-inch Wastewater Main in Trimmier Creek Basin	$1,746,900
18S	15-inch Wastewater Main Replacement in Central Basin	$1,565,000
19S	12-inch Wastewater Main Replacement in Central Basin	$511,600
20S	Lift Station #24 Expansion	$1,587,000
21S	Long Term Wastewater Renewal CIP	$17,574,900
22S	Septic Tank Elimination Program	$10,000,000
	Long Term (2030 - 2039) Total	**$32,985,400**
	Wastewater Capital Improvement Plan Total	**$81,610,800**

10.1 Wastewater Projects from 2019 to 2024

Projects recommended within the first 5-year phase are the most critical to the system. These projects resolve existing deficiencies or accommodate projected growth. A detailed description of each project is provided below.

Project 1S: Lift Station #22 Expansion

This project involves expanding Lift Station #22 from its current field-tested capacity of 2.2 MGD (total capacity) to a firm capacity of 4.0 MGD to meet projected flows in the area. Components of the project include replacing the existing pumps, upsizing 8-inch connections, and electrical improvements. It is assumed that temporary by-pass pumping will be needed to replace the piping and elbows. Structural changes may also be required within the wet well to meet Hydraulic Institute standards.

Project 2S: Lift Station #8 Expansion

This project involves expanding Lift Station #8 from its current capacity of 4.97 mgd to a firm capacity of 6.5 mgd. It is anticipated that the three existing pumps would be replaced along with electrical upgrades and piping connections. Structural changes may also be required within the wet well to meet Hydraulic Institute standards.

Project 3S: 15-inch Wastewater Main Replacement in the Long Branch Basin

This project involves replacing an existing 12-inch line with a 15-inch line from Scottsdale Drive to Flynn Street. The existing 12-inch line shows model predicted overflows during peak wet weather flows. The proposed 15-inch wastewater main will provide capacity to convey future peak wet weather flows.

Project 4S: 12/15-inch Main Replacement Upstream of Lift Station #24

This project involves replacing an existing 10/12/15-inch main downstream of the force main from Lift Station #21 with a 12/15-inch wastewater line. Population projections indicate that there will be growth in the areas upstream of Lift Station #24. The existing wastewater main does not have the capacity to serve the population growth and must be upsized to convey future flows.

Project 5S: 12-inch Wastewater Main in Trimmier Creek Basin

This project involves a new 12-inch wastewater main north of Chaparral Road and west of Trimmier Road, which connects to the existing 27-inch line in the Trimmier Creek Basin. The new line will provide wastewater service to new customers north of Chaparral Road in the Trimmier Creek Basin.

Project 6S: 12-inch Wastewater Main near Money Pit Road

This project involves a proposed 12-inch wastewater main extending west from an existing 15-inch main south of Pyrite Drive in the Trimmier Creek subbasin. The proposed line will provide service to future customers west of the existing 15-inch line.

Project 7S: 12-inch Wastewater Main along Trimmier Road in Southern Trimmier Creek Basin

This project involves a new 12-inch wastewater main along the creek near Trimmier Road between Stagecoach Road and Lift Station #24. This project will provide service to existing and new customers along Trimmier Road and is currently under design.

Project 8S: Flow Monitoring & I/I Reduction Study

This project is for conducting system-wide temporary flow monitoring and an analysis to reduce inflow and infiltration (I/I). This study will provide updated information on the amount of I/I being conveyed in the wastewater system. Effective management of I/I reduces infrastructure and treatment costs.

Project 9S: Short Term Wastewater Renewal CIP

This project involves the replacement or rehabilitation of wastewater lines and facilities identified in FNI's Renewal CIP. As wastewater lines and lift stations age, assets need to be replaced or rehabbed to maintain functionality. FNI conducted facility condition assessments and a risk-based assessment for linear assets to identify projects in the renewal CIP. Half of the total cost of the renewal projects is included in the 5-year CIP.

Project 10S: Septic Tank Elimination Program

Infrastructure associated with the City's Septic Tank Elimination Program. The Septic Tank Elimination Program installs the needed infrastructure to extend wastewater service to existing City residents with septic tanks.

10.2 Wastewater Projects from 2024 to 2029

Projects in the second phase generally include projects that facilitate expected growth and create reliability within the system. A detailed description of each project in the 2024 to 2029 phase is provided below.

Project 11S: Lift Station #6 Expansion

This project involves expanding Lift Station #6 from its current capacity of 17.28 mgd to a firm capacity of 24.0 mgd. Piping and supports may need to be replaced which would require temporary by-pass pumping. Structural changes may also be required within the wet well, such as baffling or enlarged hatches. Lift Station #6 was also identified for needed rehabilitation. Project R4S (approximately $1.2M in **Appendix G**) can either be completed before or in conjunction with the expansion. This project provides operational flexibility to allow wastewater to be diverted from Lift Station #2 to Lift Station #6 and pumped to the North WWTP.

Project 12S: 12-inch Wastewater Main in Long Branch Basin

This project involves a new 12-inch wastewater main upstream of an existing 15-inch main east of Roy Reynolds Drive. The new lines will provide wastewater service to new customers east of Roy Reynolds Drive in the Long Branch Basin.

Project 13S: 18/21-inch Wastewater Main Replacement in the Trimmier Creek Subbasin

This project involves replacing existing 15/18-inch wastewater lines with new 18/21-inch lines south of Stagecoach Road. Replacing the existing line with a 18/21-inch wastewater main will provide capacity to convey future peak wet weather flows.

Project 14S: Lift Station #20 Expansion

This project involves expanding Lift Station #20 from its current capacity of 5.9 mgd to a firm capacity of 7.25 mgd. It is anticipated that the expansion would consist of replacing the existing two pumps and adding a third pump. Additional improvements may also be required such as upsized piping connections, electrical upgrades, and structural modifications to the wet well.

Project 15S: Intermediate Term Wastewater Renewal CIP

This project involves the replacement or rehabilitation of wastewater lines and facilities identified in FNI's Renewal CIP. As wastewater lines and lift stations age, assets need to be replaced or rehabbed to maintain functionality. FNI conducted facility condition assessments and a risk-based assessment for linear assets to identify projects in the renewal CIP. Half of the total cost of the renewal projects is included in the 10-year CIP.

Project 16S: Septic Tank Elimination Program

Infrastructure associated with the City's Septic Tank Elimination Program. The Septic Tank Elimination Program installs the needed infrastructure to extend wastewater service to existing City residents with septic tanks.

10.3 Wastewater Projects from 2029 to 2039

The CIP projects included in the final planning phase from 2029 to 2039 continue to facilitate anticipated growth within the service area. A detailed description of each project in this phase is provided below.

Project 17S: 12-inch Wastewater Main in Trimmier Creek Basin

This project involves a new 12-inch wastewater main along the creek west of East Trimmier Road. It will provide wastewater service to new and existing customers in the Trimmier Creek basin near Onion Road, Stagecoach Road, and East Trimmier Road.

Project 18S: 15-inch Wastewater Main Replacement in Central Basin

This project involves replacing an existing 12-inch line with a 15-inch line between Old FM 440 and Florence Road. The project provides additional capacity to convey future peak wet weather flows.

Project 19S: 12-inch Wastewater Main Replacement in Central Basin

This project involves replacing an existing 8-inch line with a 12-inch line between Florence Road and Broadway Drive in the Central Basin. The project provides additional capacity to convey future peak wet weather flows.

Project 20S: Lift Station #24 Expansion

This project involves expanding Lift Station #24 from its current capacity of 2.52 mgd to a firm capacity of 3.5 mgd. It is anticipated that the existing pumps would be replaced along with electrical upgrades and piping connections. Structural changes may also be required within the wet well to meet Hydraulic Institute standards.

Project 21S: Long Term Wastewater Renewal CIP

This project involves the replacement or rehabilitation of wastewater lines and facilities identified in FNI's Renewal CIP. As wastewater lines and lift stations age, assets need to be replaced or rehabbed to maintain functionality. FNI conducted facility condition assessments and a risk-based assessment for linear assets to identify projects in the renewal CIP for the next 10 years. Assets should be re-evaluated every 5 to 10 years to assess condition and need for rehabilitation.

Project 22S: Septic Tank Elimination Program

Infrastructure associated with the City's Septic Tank Elimination Program. The Septic Tank Elimination Program installs the needed infrastructure to extend wastewater service to existing City residents with septic tanks.

11.0 ASSET MANAGEMENT

As part of the Water and Wastewater Master Plan, FNI developed risk-based assessments (RBA) of water and wastewater infrastructure in order to develop a comprehensive CIP that includes both growth related improvements and renewal improvements.

For pipelines, the first step in the RBA process involved a water and wastewater data assessment. After receiving GIS data from December 2018, a large portion of the water and wastewater pipelines were missing material and age values. For both systems, assumptions were made with the help of City staff to fill in the missing GIS information. This was done with an understanding of when regions within Killeen's systems were constructed and the materials commonly used for construction during those time periods. For example, an unknown water line material in the northwest portion of Killeen's service area was assumed to be cast iron as it was the most common material used during the time this portion of the city was developed.

FNI then evaluated the condition and criticality of the pipelines using various parameters discussed in sections 11.1 and 11.2. Once each pipeline was assigned a condition and criticality score, FNI determined a risk rating for each asset by utilizing matrices developed to combine the condition and criticality scores.

For facilities, the first step in the RBA process involved site visits and condition assessments of each of the water and wastewater facilities. The site visit team was composed of master planning engineers, facility design engineers, electrical engineers, and utility staff. The team took photos of each site and collectively decided scores for each of the condition parameters before leaving the site. Criticality scores were then assigned through a desktop analysis that took into consideration its capacity or size of the facility, its proximity to critical customers or environmentally sensitive areas, and its location within the system. These condition and criticality scores were then multiplied to generate the final risk score assigned to each facility.

These risk scores allowed FNI to develop a prioritized renewal CIP that was then integrated with the capacity CIP for a comprehensive Master Plan. A workshop was held with City staff to discuss the results of the RBA and the prioritized renewal CIP. The parameters used for the RBA analysis for both water and wastewater systems are documented in the following sections.

11.1 Condition Assessment

In a RBA, an asset's condition score is used to represent its likelihood of failure. Condition parameters and scoring are based on a combination of physical data (e.g., material, age, field condition assessment, etc.), and operational data (maintenance history), which are used to develop a best estimate of the assumed condition of each line. A summary of condition scores and their definitions are below in **Table 11-1**.

Table 11-1 Condition Assessment Scoring

Condition Rating	Scoring Guidelines
1	Very good condition; no improvements recommended to maintain function
2	Good condition; minor improvements recommended to maintain function
3	Fair condition; improvements recommended to improve performance or efficiency
4	Poor condition; improvements recommended to maintain reliability
5	Very Poor condition; rehabilitation or replacement required

11.1.1 Water Facility Condition Parameters

FNI conducted pump station and storage tank site visits with Killeen staff on January 29 and 30, 2019, at the six pump stations and nine storage tanks. Facilities that were evaluated include:

- Pump Station #2 and Ground Storage Tank
- Pump Station #3
- Pump Station #4 and Ground Storage Tank
- Pump Station #5 and Ground Storage Tank
- Pump Station #6
- Pump Station #7 (Airport)
- Bundrant Elevated Storage Tank
- Rodeo Elevated Storage Tank
- Southeast Elevated Storage Tank
- McMillan Ground Storage Tanks (2)
- Airport Elevated Storage Tank

Parameters that were evaluated at each facility are shown in **Tables 11-2** and **11-3**. The site visit team included city staff, electrical engineers, pump station and storage tank design engineers, and master planning engineers. During the site visit, the team took pictures and assigned a condition score to each parameter before moving on to the next facility. Facility components that received a condition score of a 4 or 5 were included in the renewal CIP outlined in Section 11.3.3. An example pump station inspection sheet is shown in **Figure 11-1**. Completed inspection sheets can be found in **Appendix H**.

Table 11-2 Pump Station Condition Parameters

Parameter	Weight (%)
MCC/Switch Gear	15
Alternate Power (dual power feed or backup generator)	10
HVAC	5
Piping	5
Valves	5
Meters	5
Pumps	15
Motors	15
Walls	5
Roof	5
Foundation	5
Instrumentation	5
SCADA	5

Table 11-3 Storage Tank Condition Parameters

Parameter	Weight (%)
Structure – Internal	25
Structure – External	20
Mechanical - Hatches, Valves, Vents	20
Electrical & Instrumentation	15
Roof Slope	10
Overflow	10

Figure 11-1 Water Facility Example Sheet

Pump Station 3

Inspection Date: 1/30

Facility Information	
Address:	304 S 48th St
Year in Service:	1999
Type of Facility:	
Number of Pumps:	4
Capacity:	4-2,000 gpm pumps
Horsepower:	150 min
Monitoring:	
Generator:	

CONDITION ASSESSMENT

	Component Group	Component Condition Rating	Weight Factor	Weighted Component Rating	Comments
Electircal	MCC, Switch Gear	3	15%	0.45	Soft starter for Pump 2 caught fire 3 years ago. Repairs were made to the starter unit, but not all parts/wiring were replaced. Currently Pump 4 Soft Starter is out of service (capacitance fail). Reported that main breaker on the ATS trips on when 2 pumps are called to start at the same time causing the generator to start. Pump Station is run in manual. Recommend a coordination study of the power system be done.
	Alternate Power (dual power feed or back up generator)	1	10%	0.10	Site currently has a generator- it is regularly excercised and maintenanced.
Mechanical	HVAC	4	5%	0.20	Heaters don't work. It was reported that all pumps at this pump station can be running at the same time. The pump station does not have air conditioning and can warm inside. It appears there are aftermarket A/C units on the back of the MCC. Recommend an evaluation of the heat loss of the equipment in the pump station.
	Piping	2	5%	0.10	Inside piping looks good. Outside piping has a bare spot.
	Valves	1	5%	0.05	systems have been replaced in last 2 years. Pump 1 clay valve was just rebuilt.
	Meters	1	5%	0.05	Steve mentioned meter does not have enough distance from discharge to operate accurately
	Pumps	5	15%	0.75	Pumps 3 & 4 had impellers replaced. Pumps 1 & 2 need replacing as well. Pump 4 is down because soft starter is out.
	Motors	1	15%	0.15	No reported issues
Structure	Walls	1	5%	0.05	
	Roof	1	5%	0.05	
	Foundation	1	5%	0.05	
	Instrumentation	1	5%	0.05	No reported issues
	SCADA	2	5%	0.10	It was noted that a HIM screen was needed on the SCADA cabinet for remote control of the pump station and tank status. Also, as reported above, the main breaker on the ATS trips on when 2 pumps are called to start at the same time causing the generator to start. Recommend to modify programming or implement a programmed time delay between 2 pumps starting.
	Condition Rating			**2.15**	Possibly installing new crane

The water facility condition scores were calculated based on the scores assigned by the site visit team and their corresponding weights. The final scores are summarized below in **Tables 11-4** and **11-5**. All facilities fall within fair to good condition.

Table 11-4 Pump Station Condition Scores

Pump Station	Condition Scores
Pump Station 4	2.20
Pump Station 3	2.15
Pump Station 5	2.15
Pump Station 2	1.80
Pump Station 7	1.80
Pump Station 6	1.60

Table 11-5 Storage Tank Condition Scores

Storage Tank	Condition Score
Pump Station 2 GST	2.50
Pump Station 4 GST	2.45
Pump Station 5 GST	2.40
Southeast EST	2.20
McMillan GST #2	1.55
Rodeo EST	1.35
Bundrant EST	1.35
McMillan GST #1	1.25
Airport EST	1.20

11.1.2 Wastewater Facility Condition Parameters

FNI conducted lift station site visits with Killeen staff on January 18 and 19, 2019. The facilities that were evaluated included:

- Lift Station #1
- Lift Station #2
- Lift Station #6
- Lift Station #8
- Lift Station #9
- Lift Station #20
- Lift Station #21
- Lift Station #22
- Lift Station #23a
- Lift Station #23b
- Lift Station #24
- Lift Station #24b
- Lift Station #26
- Lift Station #27
- Wassay

Parameter that were evaluated at each lift station are shown in **Tables 11-6.** The site visit team included utility staff, electrical engineers, lift station design engineers, and master planning engineers. During the site visit, the team took pictures and assigned a condition score to each parameter before moving on to the next facility. Lift station components that received a condition score of a 4 or 5 were included in the renewal CIP outlined in Section 11.3.3. An example Lift Station inspection sheet is shown in **Figure 11-2**. Completed inspection sheets can be found in **Appendix H**.

Table 11-6 Lift Station Parameters

Parameter	Weight (%)
Electrical & Instrumentation – MCC, Back-up Power, Cables, SCADA, alarms	25
Pumps & Motors	20
Structure - Hatches, Corrosion, Cracks, Leaking	20
Piping and Valves	15
Mechanical - Ventilation, Odor Control, Crane, Mixers, Meters	10
Site - Drainage, Access Drive, Security, Fencing	10

Figure 11-2 Lift Station Example Sheet

Lift Station #8

Inspection Date:

Facility Information

Address:	100 N Roy Reynolds Dr
Year in Service:	1975 (Plans)
Type of Facility:	Submersible
Number of Pumps:	3
Design Point:	1.944 MGD @ 70'
Horsepower:	40.0
Capacity:	3.9 MGD
Monitoring:	SCADA
Generator:	Generac 180 kW

CONDITION ASSESSMENT

Component Group	Component Condition Rating	Weight Factor	Weighted Component Rating	Comments
Electrical & Instrumentation – MCC, Back-up Power, Cables, SCADA, alarms	1	25%	0.25	
Pumps and Motors	1	20%	0.20	
Structure - Hatches, Corrosion, Cracks, Leaking	2	20%	0.40	Corrosion on hateches & minor cracking on concrete
Piping and Valves	2	15%	0.30	Corrosion on piping
Mechanical - Ventilation, Odor Control, Crane, Mixers, Meters	2	10%	0.20	Chain on catch basket is attached to light (support broken)
Site - Drainage, Access Drive, Security, Fencing	1	10%	0.10	Back gate has large gap someone could fit through
Condition Rating	-	-	**1.45**	

The wastewater facility condition scores were calculated based on the scores assigned by the site visit team and their corresponding weights. The final scores are summarized in **Table 11-7**. All lift stations fall within fair to good condition.

Table 11-7 Lift Station Condition Scores

Lift Station	Condition Scores
Wassay	3
LS9	2.8
LS1	2.5
LS22	2.4
LS6	2.2
LS20	2.05
LS21	2
LS26	2
LS27	1.85
LS24	1.8
LS2	1.45
LS8	1.45
LS23b	1.45
LS23a	1.3
LS24b	1.2

11.1.3 Water Pipeline Condition Parameters

The condition of the City's water pipelines was assessed based on each line's material, age and maintenance history.

- Material: based on supplied GIS data and assumed where data was unknown
- Age: based on supplied GIS data and assumed where data was unknown
- Maintenance History: sum of non-routine maintenance or emergency repair work orders from 1/2013 - 12/2018

Weighting, criteria, and scoring for each parameter used in the water pipeline condition assessment is presented in **Table 11-8**. FNI developed a series of charts summarizing the pipeline condition assessment parameters. Water pipeline material score by length is summarized in **Figure 11-3**. Water line age score by length is summarized in **Figure 11-4**. Pipeline maintenance history score by length is summarized in **Figure 11-5**.

Table 11-8 Water Pipeline Condition Assessment Parameters

Weighting	Parameter	Criteria	Points
40%	Material	AC – Asbestos Cement	5
		Cast Iron	4
		Ductile Iron	3
		Concrete	2
		Steel, PVC, Copper	1
40%	Age	Older than 50 Years	5
		Between 41 and 50 Years	4
		Between 31 and 40 Years	3
		Between 21 and 30 Years	2
		Between 1 and 20 Years	1
20%	Maintenance History	More than 5 Maintenance Issues	5
		3 to 5 Maintenance Issues	3
		1 to 2 Maintenance Issues	2
		No Maintenance History	1

Figure 11-3 Water Pipeline Length vs. Material Score

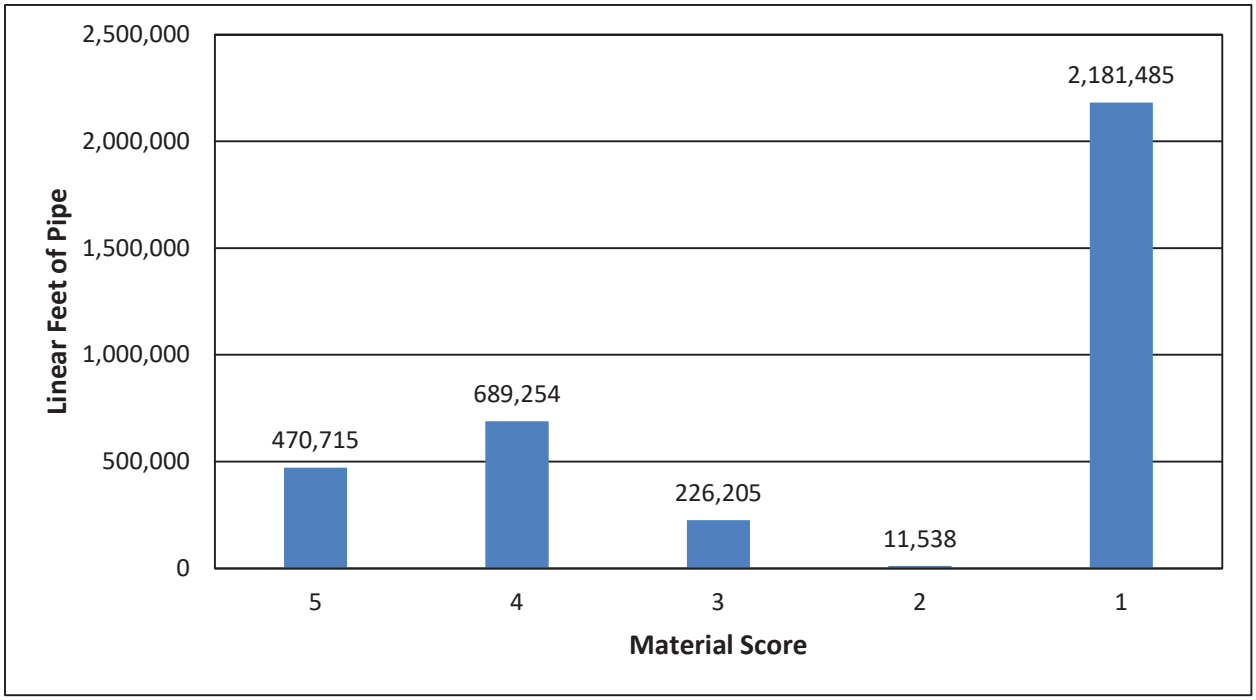


Figure 11-4 Water Pipeline Length vs. Age Score

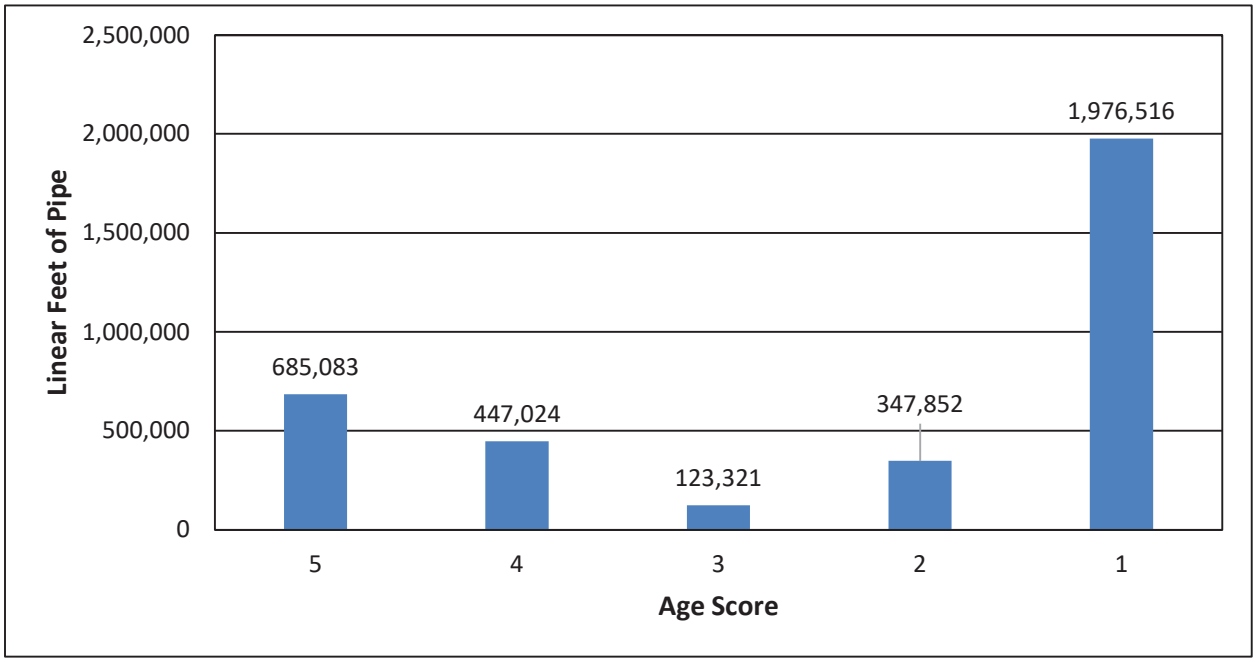
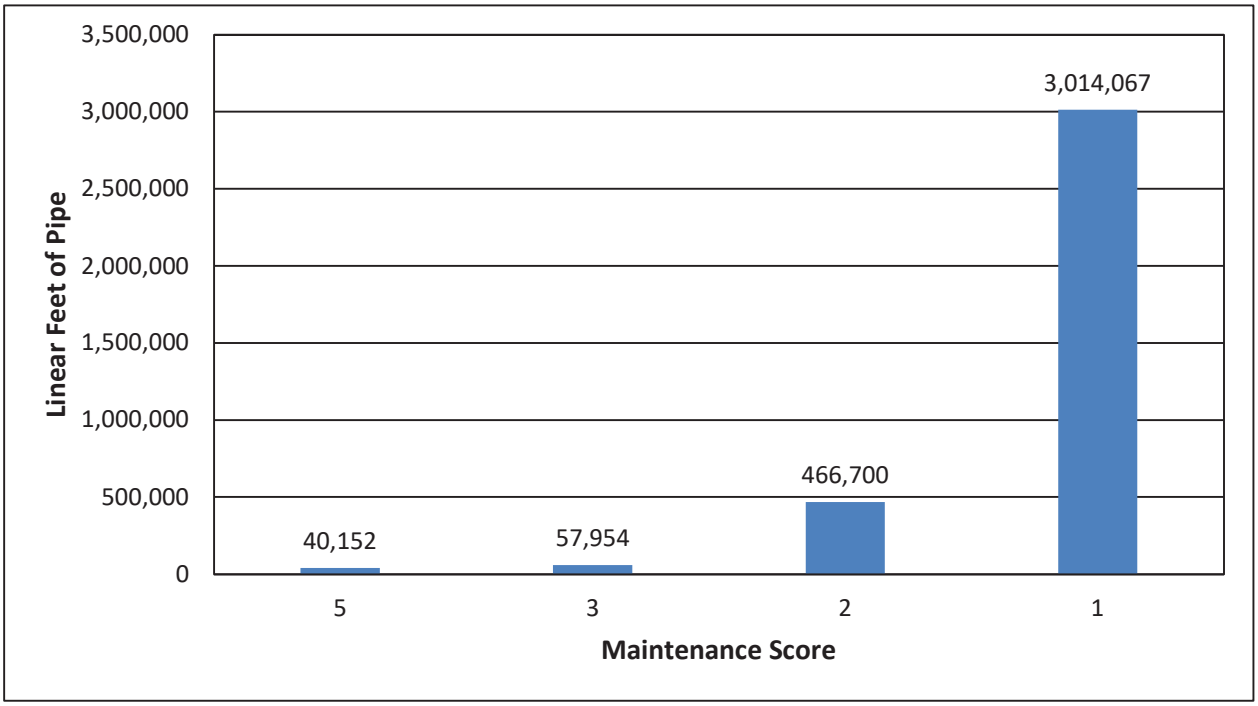


Figure 11-5 Water Pipeline Length vs. Maintenance Score



Results of the condition assessment for the water lines are shown in **Table 11-9**. The final water line condition scores were grouped into ranges and qualitative scores of "Very Good" to "Very Poor" condition were assigned to each asset. Maps are included in **Appendix F** that display Killeen's water system with each asset's material, age, and final condition rating.

Table 11-9 Water Pipeline Condition Assessment Results

Condition	1	2	3	4	5
Grade	Very Good	Good	Fair	Poor	Very Poor
Score Range	0 to 1.0	1.1 to 2.0	2.1 to 3.0	3.1 to 4.0	4.1 to 5.0
Total Length (ft)	1,597,307	655,570	227,502	225,441	461,355
Total Length (%)	50	21	7	7	15

11.1.4 Wastewater Pipeline Condition Parameters

The condition of the City's wastewater pipelines was assessed based on each line's material, age, and maintenance history.

- Material: based on supplied GIS data and assumed where data was unknown
- Age: based on supplied GIS data and assumed where data was unknown
- Maintenance History: sum of non-routine maintenance or emergency repair work orders from 1/2013 - 12/2018

Weighting, criteria, and scoring for each parameter used in the wastewater pipeline condition assessment is presented in **Table 11-10**. FNI developed a series of charts summarizing the pipeline assessment parameters. Wastewater pipeline material score by length is summarized in **Figure 11-6**. Wastewater line age score by length is summarized in **Figure 11-7**. Pipeline maintenance history score by length is summarized in **Figure 11-8**. Sewer rehabilitation and replacement data from the past five years were used to update both pipe material and age to develop an accurate condition score.

Table 11-10 Wastewater Pipeline Condition Assessment Parameters

Weighting	Parameter	Criteria	Points
40%	Material	Clay	5
		Cast Iron	4
		Ductile Iron	3
		Concrete	2
		PVC, Hobas, HDPE, Fiberglass, CIPP	1
40%	Age	Older than 50 Years	5
		Between 41 and 50 Years	4
		Between 31 and 40 Years	3
		Between 21 and 30 Years	2
		Between 1 and 20 Years	1
20%	Maintenance History	More than 3 Maintenance Issues	5
		3 Maintenance Issues	4
		2 Maintenance Issues	3
		1 Maintenance Issues	2
		No Maintenance History	1

Figure 11-6 Wastewater Pipeline Length vs. Material Score

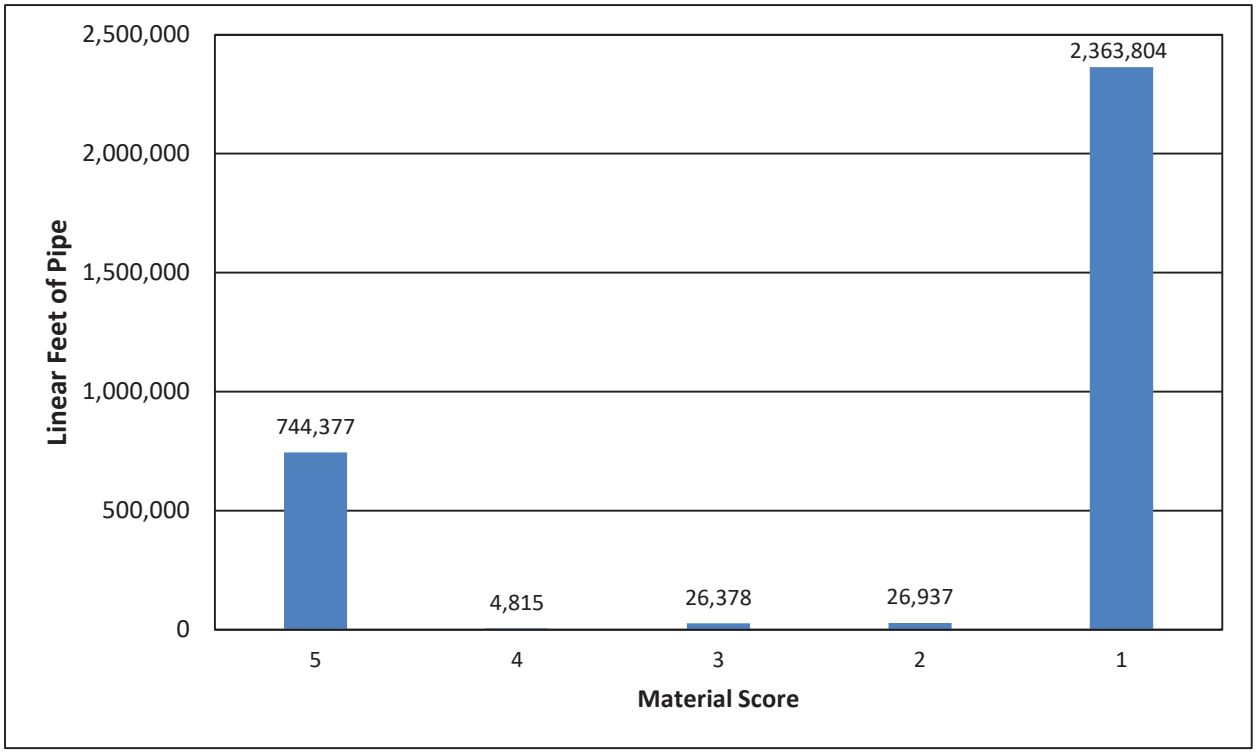


Figure 11-7 Wastewater Pipeline Length vs. Age Score

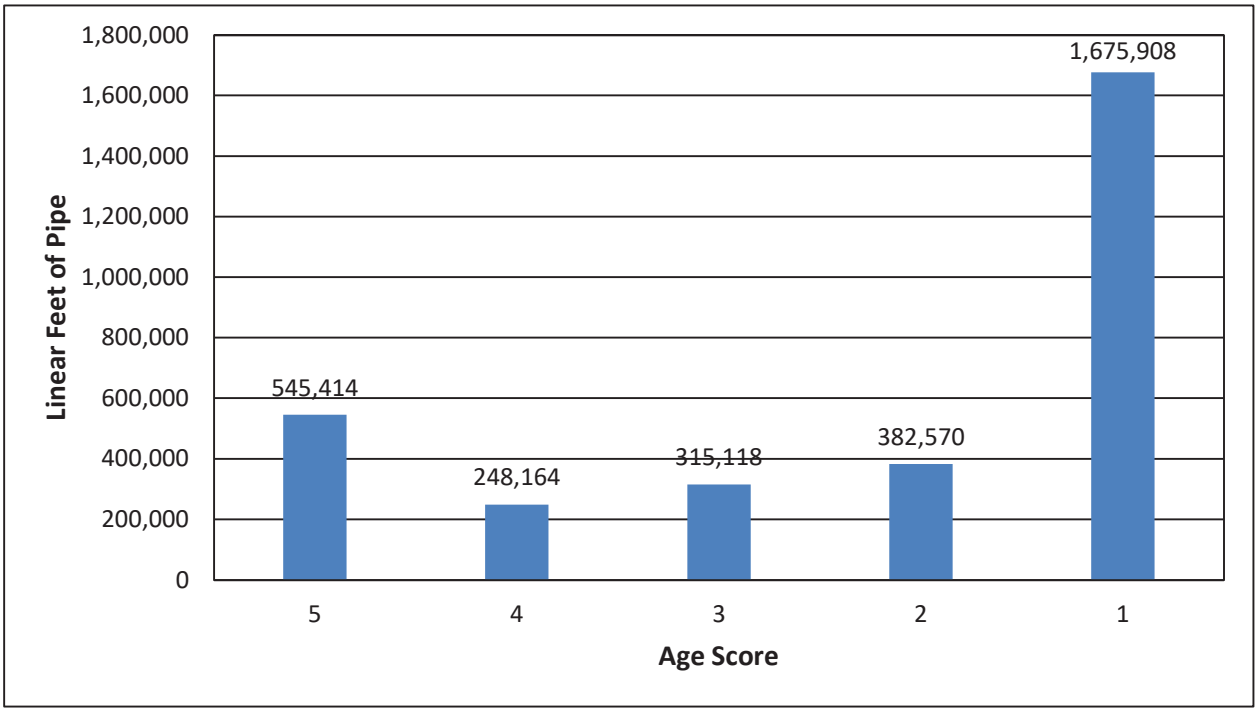
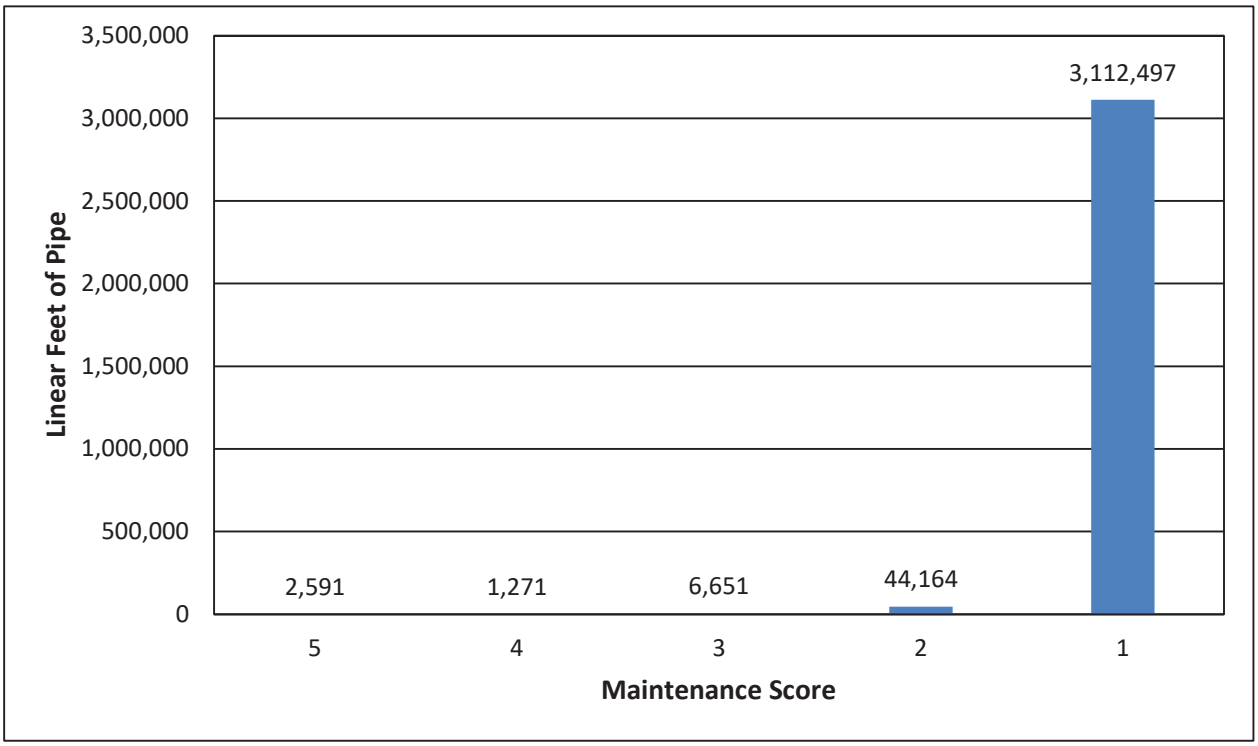


Figure 11-8 Wastewater Pipeline Length vs. Maintenance Score



Results of the condition assessment for the wastewater lines are shown in **Table 11-11**. The wastewater condition scores were grouped into ranges and qualitative scores of "Very Good" to "Very Poor" condition were assigned to each asset. Maps are included in **Appendix F** that display Killeen's wastewater system with each asset's material, age, and final condition rating.

Table 11-11 Wastewater Pipeline Condition Assessment Results

Condition	1	2	3	4	5
Grade	Very Good	Good	Fair	Medium	Very Poor
Score Range	0.0 to 1.0	1.1 to 2.0	2.1 to 3.0	3.1 to 4.0	4.1 to 5.0
Total Length (ft)	1,787,046	414,937	230,497	1,056,305	90,012
Total Length (%)	50	12	6	30	3

11.2 Criticality Assessment

In a RBA, the criticality of a line or facility can be defined as the consequence of asset failure. Consequences of failure can be social, environmental, and economic. As a result, social, environmental, and economic parameters were created to assign each asset a criticality score, and the results of this analysis are summarized in the following sections. **Appendix F** includes the final criticality rating for both the water and wastewater assets.

11.2.1 Water Facility Criticality Parameters

The criticality of the City's water facilities was assessed based on the capacity served by each facility, its public image or regulatory impact, and the length of a facility outage. Scores from **Table 11-12** were assigned using the facility's capacity, its impact on water system performance, and its pressure plane demands. For example, Airport EST is the only storage facility in its pressure plane, and its volume is approximately 80% of the maximum day demand. This resulted in the FNI team assigning Airport EST a "Capacity Affected" score of 5. The criticality scores for pump stations and storage tanks are summarized in **Tables 11-13** and **11-14**, respectively. **Figure 11-9** shows an example calculation using the parameters.

Table 11-12 Pump Station and Storage Tank Criticality Parameters

Criticality Parameter	Weight
Capacity Affected	50%
Public Image/Regulatory Impact	20%
Outage Duration	30%

Figure 11-9 Pump Station Criticality Example – Pump Station #6

CRITICALITY ASSESSMENT					
Component Group	**Percent of PP Capacity**	**Criticality Rating**	**Weight Factor**	**Weighted Component Rating**	**Comments**
Capacity Affected	68%	5	50%	2.50	Pumping capacity with largest pump out of service equates to approximately 68% of Upper Pressure Plane Max Day Demand
Public Image/Regulatory Impact	[redacted]	5	20%	1.00	
Outage Duration	[redacted]	5	30%	1.50	
Criticality Rating	[redacted]	-	100%	**5.00**	

Table 11-13 Pump Station Criticality Scores

Pump Station	Criticality Scores
Pump Station 6	5
Pump Station 3	4.8
Pump Station 4	4.4
Pump Station 7	4.4
Pump Station 2	3.8
Pump Station 5	3.8

Table 11-14 Storage Tank Criticality Scores

Storage Tank	Criticality Score
Airport EST	4.5
Southeast EST	3.8
Pump Station 5 GST	3.3
McMillan GST #2	3.2
McMillan GST #1	3.2
Pump Station 2 GST	2.9
Pump Station 4 GST	2.9
Rodeo EST	2.8
Bundrant EST	2.8

11.2.1 Wastewater Facility Criticality Parameters

The criticality of the City's wastewater facilities was assessed based on a lift station's proximity to an environmentally sensitive area (streams, floodplains, parks), population served, and distance from a residential unit. Scores from **Table 11-15** were assigned using knowledge of the facility's size, its impact on wastewater system performance, and the demands of the pressure plane of each facility. For example, Lift Station #23b is within 500' of a residential dwelling and received a "High Impact Area" score of 3. According to the wastewater projections, it currently serves approximately 3,000 people, which received a score of 3. The criticality scores are summarized in **Tables 11-16**. **Figure 11-10** displays an example criticality calculation.

Table 11-15 Lift Station Criticality Parameters

Criticality Parameter	Weight
Proximity to Environmentally Sensitive Area	40%
Population Served	30%
High Impact Areas	30%

Figure 11-10 Lift Station Criticality Example – Lift Station #23b

CRITICALITY ASSESSMENT				
Component Group	**Component Criticality Rating**	**Weight Factor**	**Weighted Component Rating**	**Comments**
Environmentally Sensitive Areas	5	40%	2.00	
Population Served	3	30%	0.90	Served population of approximately 3,000
High Impact Areas	3	30%	0.90	Within 500' of residential structures
Criticality Rating	-	100%	**3.80**	

Table 11-16 Lift Station Criticality Scores

Lift Station	Condition Scores
LS1	5
LS2	5
LS6	5
LS8	4.1
LS23a	3.8
LS23b	3.8
LS24	3.8
LS22	3.5
LS27	3.2
LS26	2.6
LS20	2.2
LS21	1.9
LS9	1.6
LS24b	1.6
Wassay	1.3

11.2.2 Water Pipeline Criticality Parameters

The criticality of the City's water pipelines was assessed based on diameter, proximity to critical customers, accessibility, and redundancy. Pipe diameter is an estimation of the number of customers served and capacity, with large transmission lines receiving the highest scores and small distribution lines receiving low scores. A matrix for assigning a score according to a line's proximity to critical customers was developed for four different radius lengths and is shown in **Table 11-17**. This parameter identifies pipes that would most impact hospitals, schools, and any government buildings within Killeen's service area.

Table 11-17 Water Pipeline Proximity Scoring Matrix

Proximity and Density Score		Count of High Profile/Critical Customers			
		0	2	4	5
Radial Distance From Pipe (mi)	1/4	1	3	4	5
	1/2	1	1	3	4
	3/4	1	1	1	3
	1	1	1	1	1

An accessibility score was assigned to each line depending on whether the line crosses rivers, railroads, highways, or arterial roads. The redundancy parameter was determined by assigning a score of 3 to all lines that are dead-ends and areas of pipeline that have only one supply point. The four parameters with their weights and associated scoring criteria are summarized below in **Table 11-18**. FNI developed a series of charts summarizing the pipeline condition assessment parameters. Water pipeline diameter score by length is summarized in **Figure 11-11**. Water line proximity to critical customers score by length is summarized in **Figure 11-12**. Pipeline accessibility score by length is summarized in **Figure 11-13**, and the redundancy score by length is summarized in **Figure 11-14**.

Table 11-18 Water Pipeline Criticality Assessment Parameters

Weighting	Parameter	Criteria	Points
40%	Diameter	Greater than 20 inches	5
		Between 16 and 20 inches	4
		Between 8 and 12 inches	3
		Less than 8 inches	1
30%	Proximity	Maximum score from **Table 11-5**	1, 3, 4, or 5
10%	Accessibility	River, Stream, or Railroad Crossing	5
		Interstate or State Highway Crossing	3
		Major Collector or Arterial Crossing	2
		No Crossing	1
20%	Redundancy	Non-redundant Pipe	3
		Redundant Pipe	1

Figure 11-11 Water Pipeline Length vs. Diameter Score

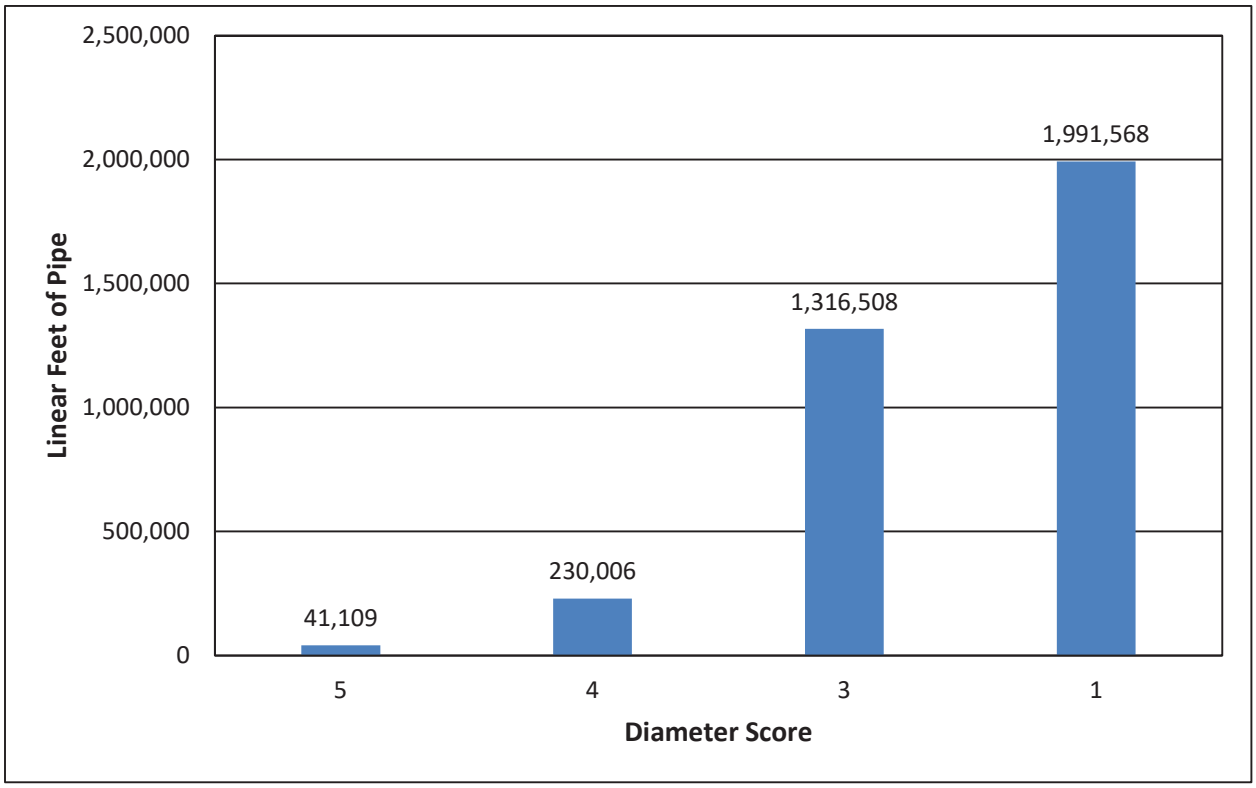


Figure 11-12 Water Pipeline Length vs. Proximity Score

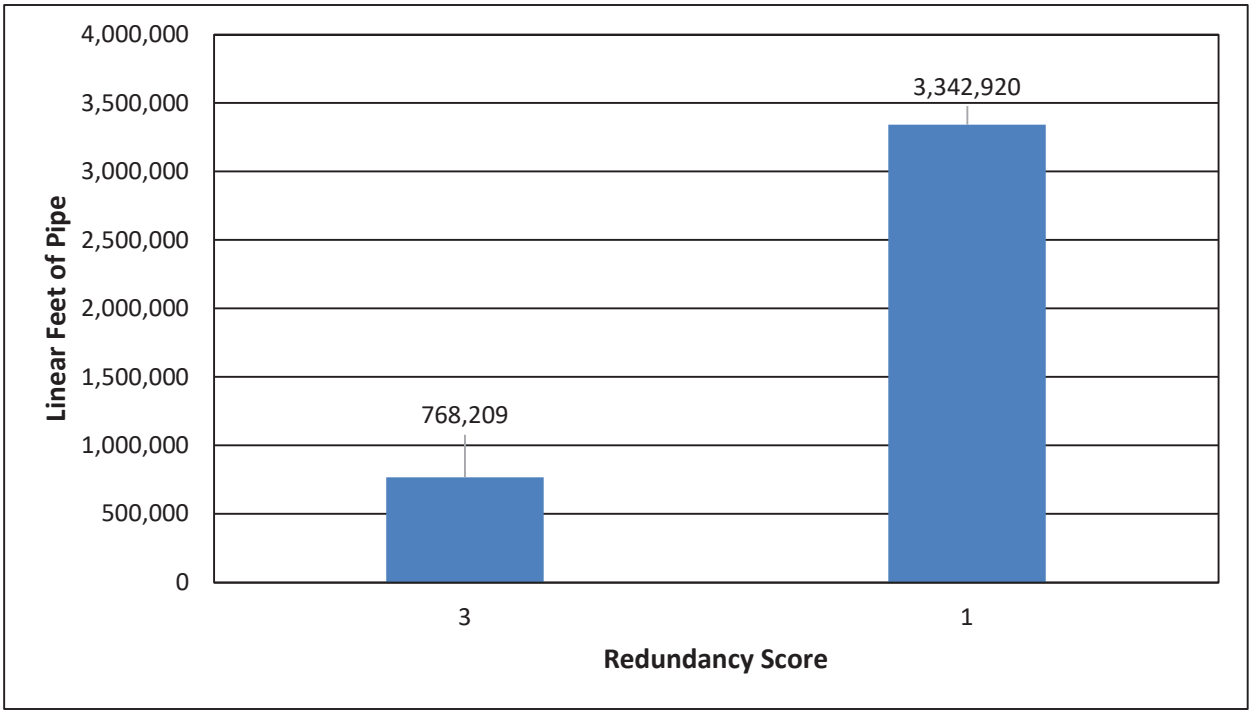


Figure 11-13 Water Pipeline Length vs. Accessibility Score

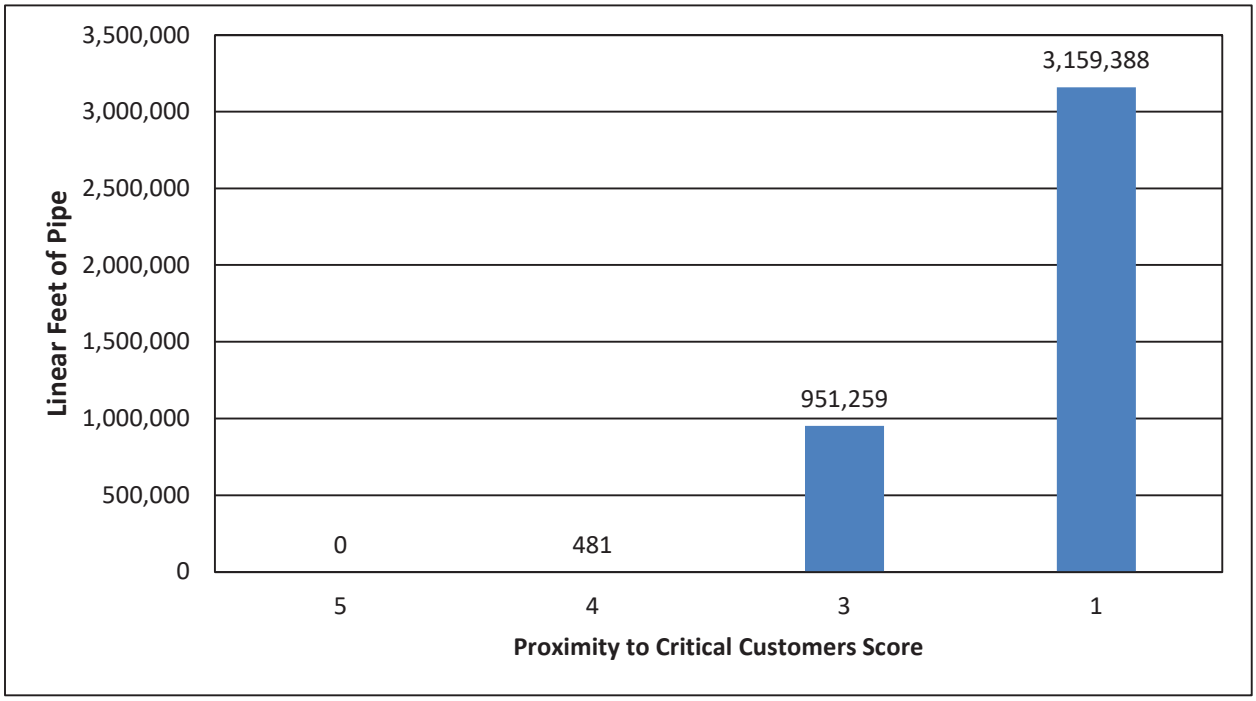
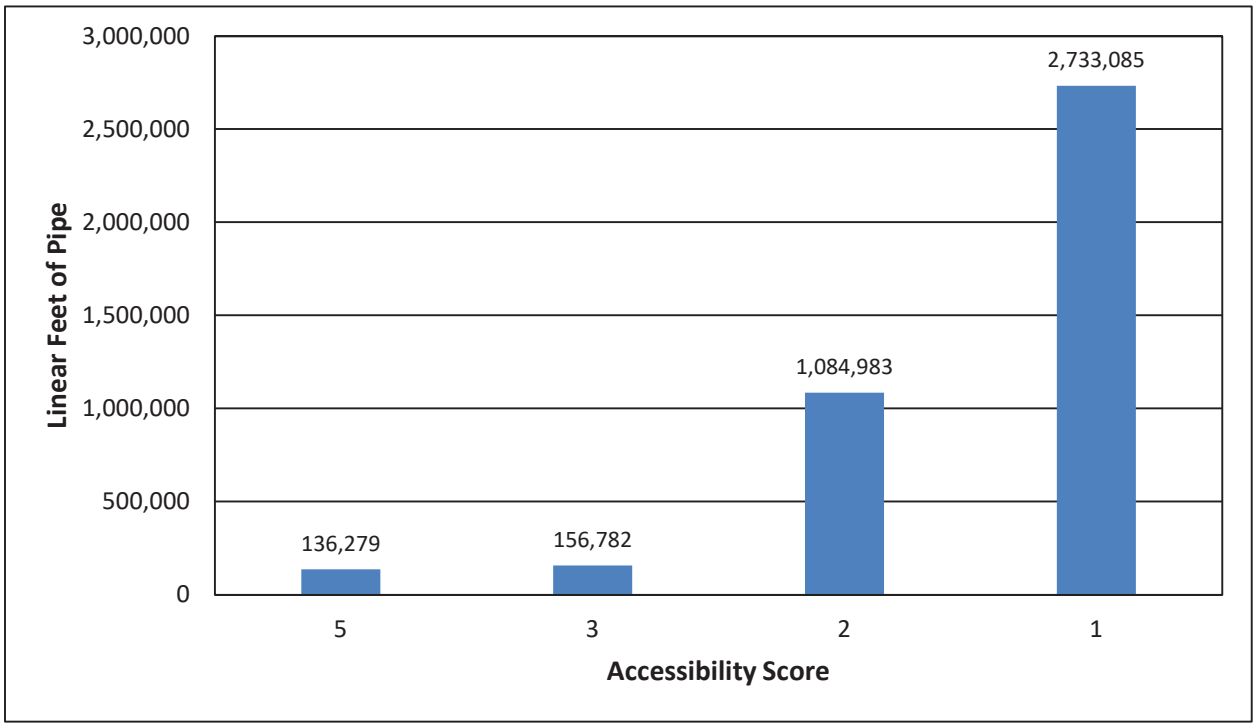


Figure 11-14 Water Pipeline Length vs. Redundancy Score



Results of the criticality assessment for water pipelines are shown in **Table 11-19**. The water pipeline criticality scores were then grouped into ranges, and qualitative scores of "Very Low" to "Very High" criticality were assigned to each asset.

Table 11-19 Water Pipeline Criticality Assessment Results

Criticality	1	2	3	4	5
Grade	Very Low	Low	Medium	High	Very High
Score Range	0.0 to 1.0	1.1 to 2.0	2.1 to 3.0	3.1 to 4.0	4.1 to 5.0
Total Length (feet)	841,390	2,238,529	481,253	17,696	-
Total Length (%)	24	63	13	0	0

11.2.3 Wastewater Pipeline Criticality Parameters

The criticality of the City's wastewater pipelines was assessed based on diameter, accessibility, and proximity to environmentally sensitive areas. The diameter is an estimation of the number of customers served and capacity with large interceptor lines receiving the highest scores and small collector lines receiving low scores. An accessibility score was assigned to each line if it crossed any rivers, railroads, highways, or arterial roads. An environmental sensitivity score was assigned to each wastewater line according to its distance from water bodies, floodplains, and parks. The three parameters with their weights and associated scoring criteria are summarized below in **Table 11-20**. FNI developed a series of charts summarizing the pipeline criticality parameters. Wastewater pipeline diameter score by length is summarized in **Figure 11-15**. Wastewater line accessibility score by length is summarized in **Figure 11-16**. Pipeline environmental sensitivity score by length is summarized in **Figure 11-17**.

Table 11-20 Wastewater Pipeline Criticality Assessment Parameters

Weighting	Parameter	Criteria	Points
40%	Diameter	Greater than 21 inches	5
		Between 15 and 21 inches	4
		Between 8 and 12 inches	3
		Less than 8 inches	1
20%	Accessibility	River, Stream, or Railroad Crossing	5
		Interstate or State Highway Crossing	3
		Major Collector or Arterial Crossing	2
		No Crossing	1
40%	Environmental Sensitivity	Within 500 ft of Water Body	5
		Within Floodplain	3
		Within Park, Open Space, or Natural Area	2
		None	1

Figure 11-15 Wastewater Pipeline Length vs. Diameter Score

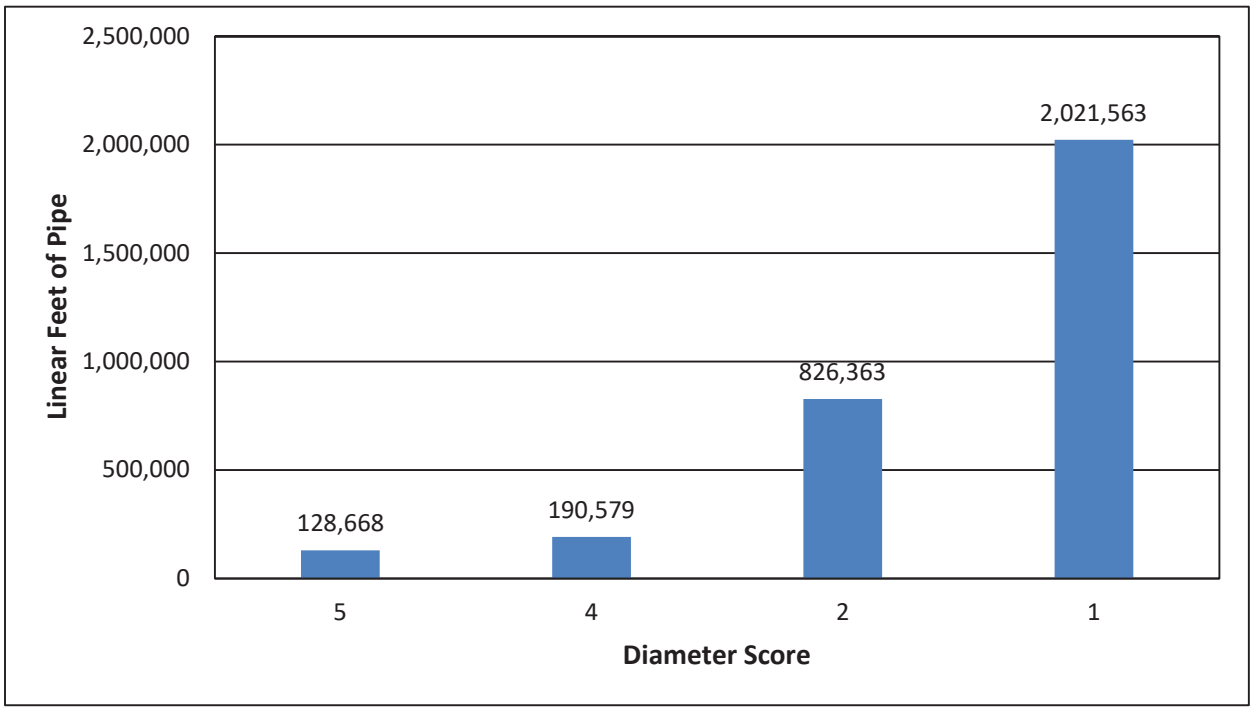


Figure 11-16 Wastewater Pipeline Length vs. Accessibility Score

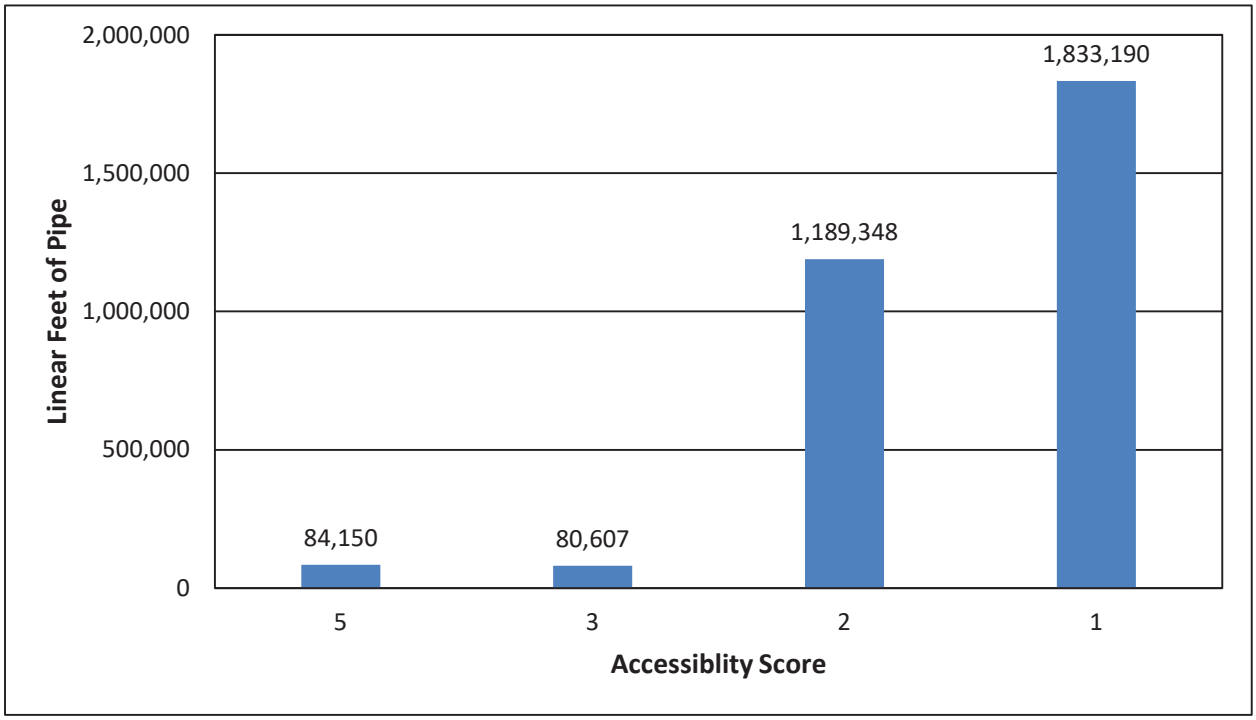
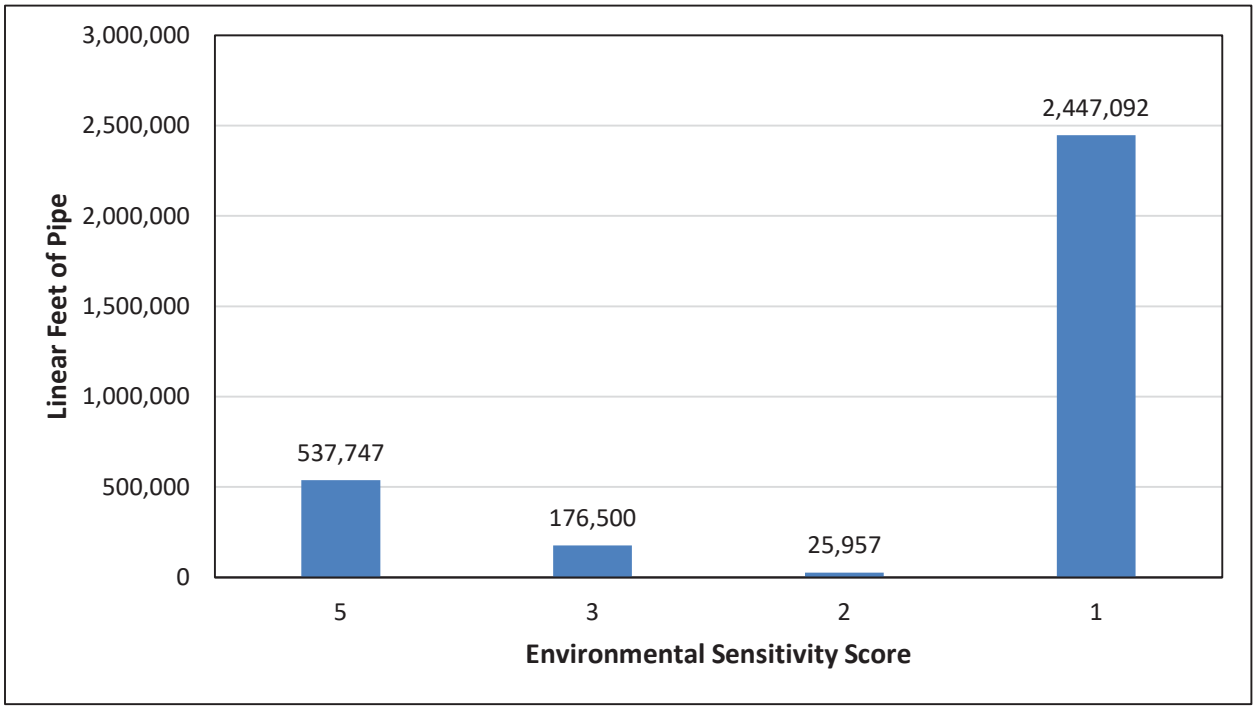


Figure 11-17 Wastewater Pipeline Length vs. Environmental Sensitivity Score



Results of the criticality assessment for wastewater pipelines are shown in **Table 11-21**. The wastewater pipeline criticality scores were then grouped into ranges, and qualitative scores of "Very Low" to "Very High" criticality were assigned to each asset.

Table 11-21 Wastewater Pipeline Criticality Assessment Results

Criticality	1	2	3	4	5
Grade	Very Low	Low	Medium	High	Very High
Score Range	0 to 1.0	1.1 to 2.0	2.1 to 3.0	3.1 to 4.0	4.1 to 5.0
Total Length (ft)	966,106	1,437,035	503,318	140,033	120,682
Total Length (%)	31	45	16	4	4

11.3 Risk Assessment

After assigning condition and criticality scores, the risk of asset failure is determined by plotting the condition and criticality scores as (x, y) coordinates in a risk matrix. A sample risk matrix can be seen below in **Table 11-22**. **Figures 11-18** and **11-19** display water and wastewater lines with the "Low", "Medium", and "High" risk designations. A prioritized water and wastewater system renewal CIP was developed from these risk maps and discussed in detail in 11.3.4.

Table 11-22 Example Risk Matrix

		Condition				
		Very Good	Good	Fair	Poor	Very Poor
Criticality	Very Low	Low Risk			Medium Risk	
	Low					High Risk
	Medium			Medium Risk		
	High					
	Very High					

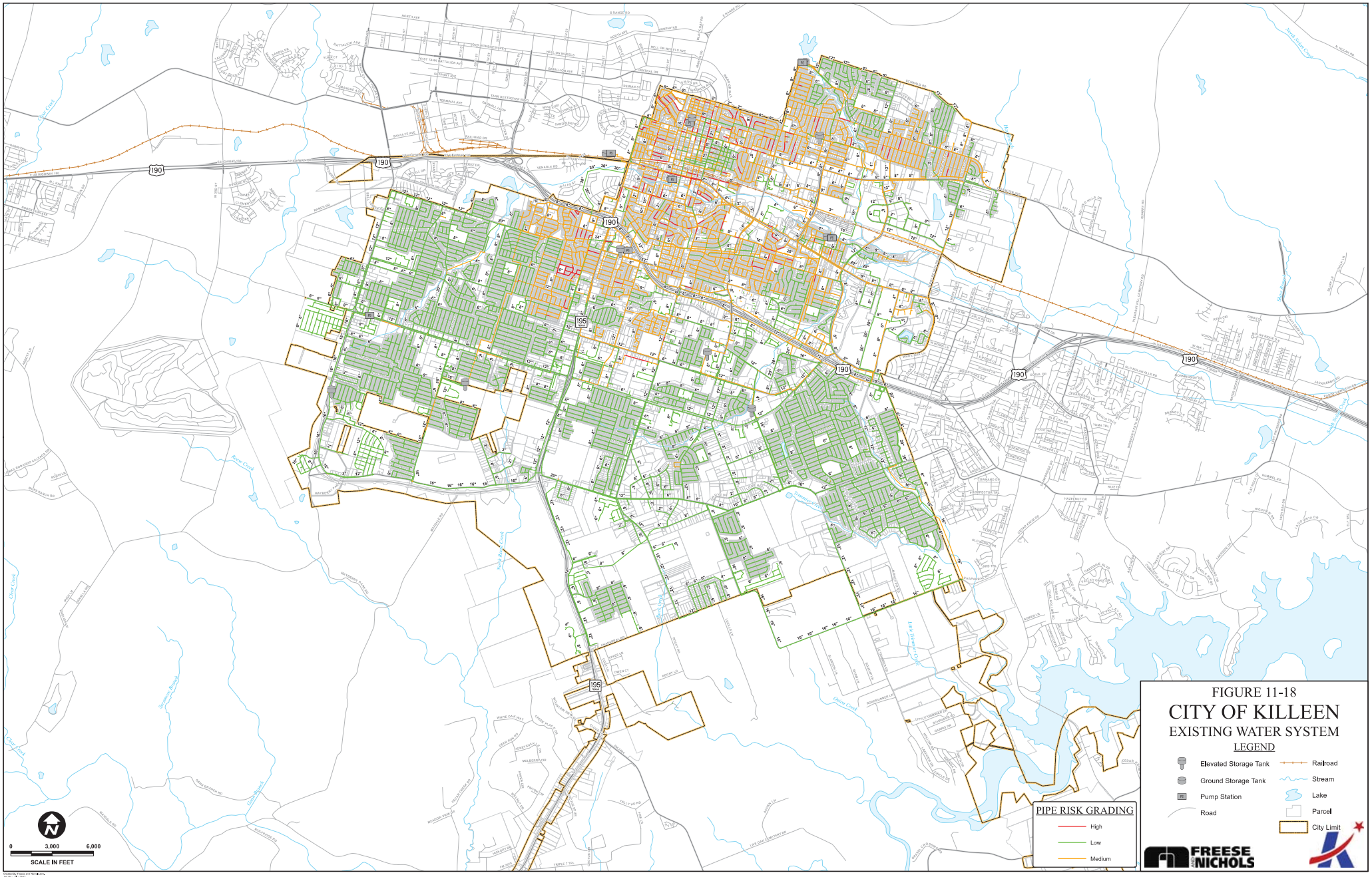


FIGURE 11-18
CITY OF KILLEEN
EXISTING WATER SYSTEM
LEGEND
Elevated Storage Tank
Ground Storage Tank
Pump Station
Road
Railroad
Stream
Lake
Parcel
City Limit
PIPE RISK GRADING
High
Low
Medium
0
3,000
6,000
SCALE IN FEET
FREESE NICHOLS

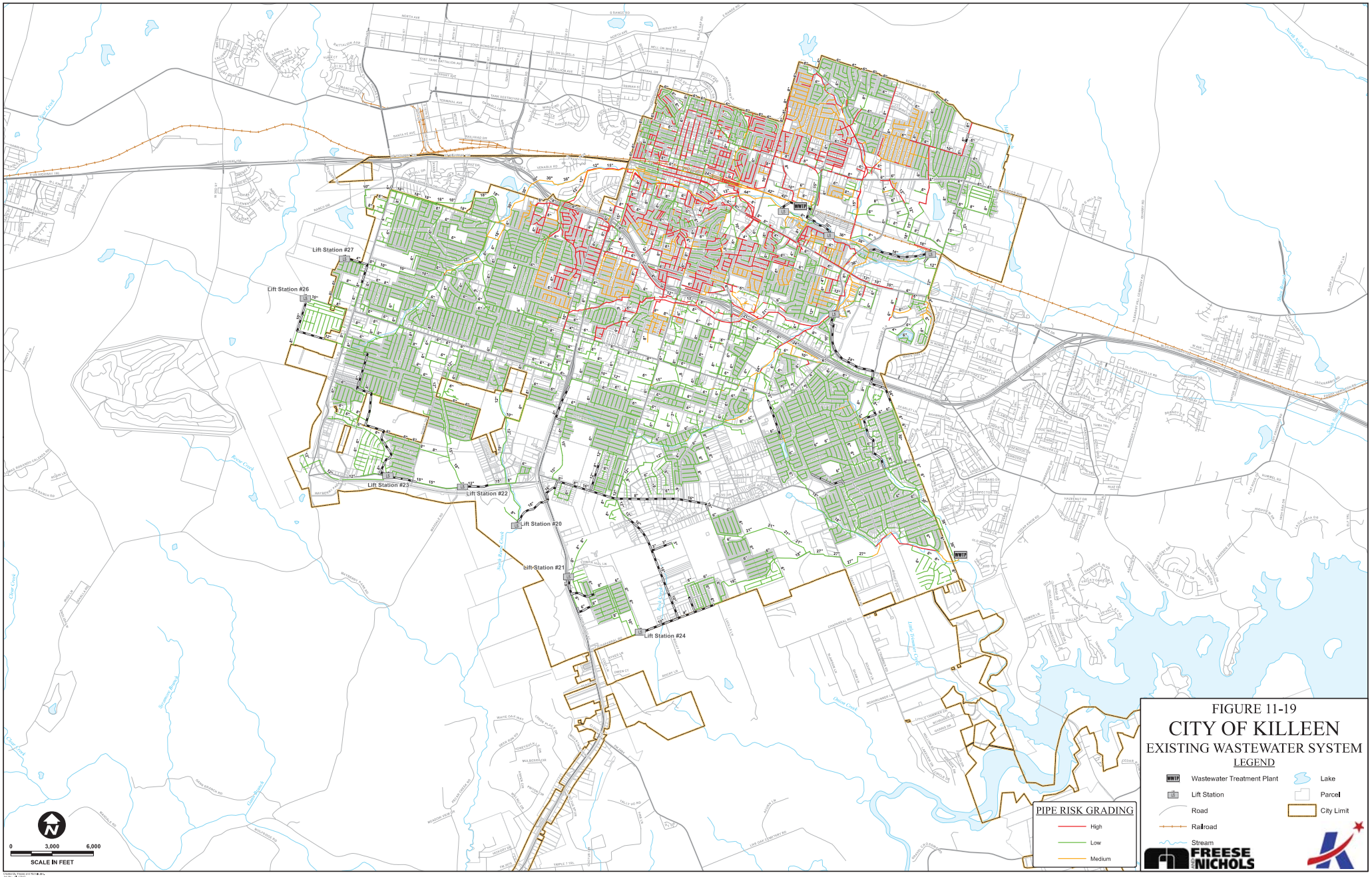


FIGURE 11-19

CITY OF KILLEEN

EXISTING WASTEWATER SYSTEM

LEGEND

- Wastewater Treatment Plant
- Lift Station
- Road
- Railroad
- Stream
- Lake
- Parcel
- City Limit

FREESE NICHOLS

11.3.1 Water Facility Risk Assessment

Water facility risk scores for pump stations and storage tanks are summarized in **Tables 11-23** and **11-24**, respectively. No facilities received "Poor" or "Very Poor" condition scores which resulted in no "High Risk" water facilities for the RBA. Due to this result, renewal projects shown in 11.3.4 were focused on individual condition parameters that received a score of 4 or 5.

Table 11-23 Pump Station Risk Results

	Condition				
Criticality	**Very Good**	**Good**	**Fair**	**Poor**	**Very Poor**
Very Low					
Low					
Medium					
High		PS2	PS5		
Very High		PS7 & PS8	PS4 & PS3		

Table 11-24 Storage Tank Risk Results

	Condition				
Criticality	**Very Good**	**Good**	**Fair**	**Poor**	**Very Poor**
Very Low					
Low					
Medium		Rodeo & Bundrant	PS4 & PS2 GST		
High		McMillan 1 & 2	Southeast & PS5 GST		
Very High		Airport			

11.3.1 Wastewater Facility Risk Assessment

Wastewater facility risk scores for lift stations are summarized in **Table 11-25**. Again, no lift stations received "Poor" or "Very Poor" overall condition scores for the RBA. Due to this result, renewal projects shown in 11.3.4 were focused on individual condition parameters that received a score of 4 or 5.

Table 11-25 Lift Station Risk Results

	Condition				
Criticality	**Very Good**	**Good**	**Fair**	**Poor**	**Very Poor**
Very Low					
Low		24b, 21	9, Wassay		
Medium		26	20		
High		23a, 23b, 24, 27	22		
Very High		2, 8	1, 6		

11.3.2 Water Pipeline Risk Assessment

The water pipeline risk scores are summarized in **Table 11-26.** A very small percentage of lines received the "High-Risk" designation, which were utilized to develop the renewal CIP in section 11.3.4. Approximately 34% of lines were "Medium-Risk" and the other 66% of lines received a "Low-Risk" designation.

Table 11-26 Water Risk Scoring Summary

		Condition				
		Very Good	**Good**	**Fair**	**Poor**	**Very Poor**
Criticality	**Very Low**	482,812	133,185	6,999	201,907	16,487
	Low	1,105,472	236,978	153,605	679,906	62,497
	Medium	197,099	38,129	62,015	172,982	11,028
	High	1,663	6,645	7,878	1,509	-
	Very High	-	-	-	-	-

11.3.3 Wastewater Pipeline Risk Assessment

The wastewater pipeline risk scores are summarized in **Table 11-27.** Approximately 4% of lines received the "High-Risk" designation, which were utilized to develop the renewal CIP in section 11.3.4. Approximately 22% of lines were "Medium-Risk" and the other 74% of lines received a "Low-Risk" designation.

Table 11-27 Wastewater Risk Scoring Summary

		Condition				
		Very Good	Good	Fair	Poor	Very Poor
Criticality	Very Low	586,648	180,291	54,214	63,587	81,366
	Low	587,690	332,573	104,244	147,059	265,469
	Medium	307,031	85,808	34,197	8,710	66,649
	High	75,062	17,154	10,995	2,444	34,378
	Very High	39,953	39,744	23,852	3,641	13,493

11.3.4 Renewal CIP Development

FNI developed a cost estimate for "High-Risk" water pipeline replacement and wastewater pipeline rehab while also identifying specific renewal projects for facilities that had component condition scores of 4 or 5. These projects are shown for the water and wastewater systems in **Figures 11-20** and **11-21**, respectively. All "High-Risk" water lines were included in the Renewal CIP project R1W, however, some "High-Risk" wastewater lines were excluded from project R1S's cost estimate. The pipelines removed from the wastewater cost analysis were located in basins where Killeen had recently completed rehabilitation projects. The unit costs shown in **Table 11-28** for water and wastewater lines were the basis for both linear asset cost estimates. The unit cost for wastewater is much less due to the likely spot repair or lining of pipe utilized instead of full pipe replacement. Facility renewal costs varied based on the size of each facility and the component in need of repair. Detailed cost sheets for renewal projects are found in **Appendix G**. A contingency cost of 20% was included as well as a 15% engineering and surveying cost. **Table 11-29** and **Table 11-30** summarize the results of the water and wastewater renewal CIP. Placeholder

projects in the overall CIP were used to designate costs associated with the renewal projects. Half of the total cost was included in the 5-year CIP while remaining half was included in the 10-year CIP.

Table 11-28 Water and Wastewater Renewal CIP Unit Costs

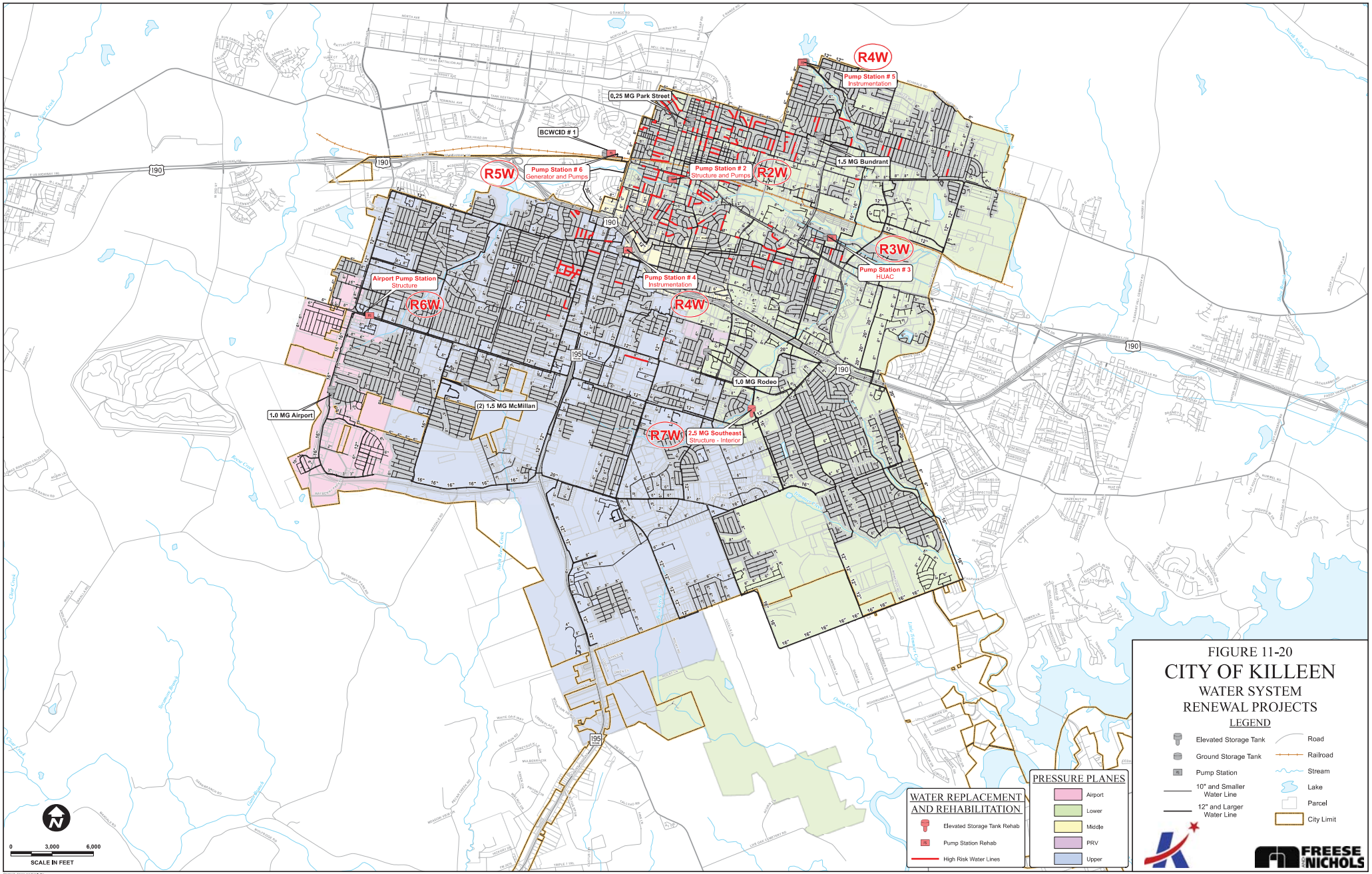
Item	Unit Cost
Water Line	$12/diameter-inch/linear foot
Wastewater Line	$6/diameter-inch/linear foot
Wastewater 4' Diameter Manhole	$4,000/MH

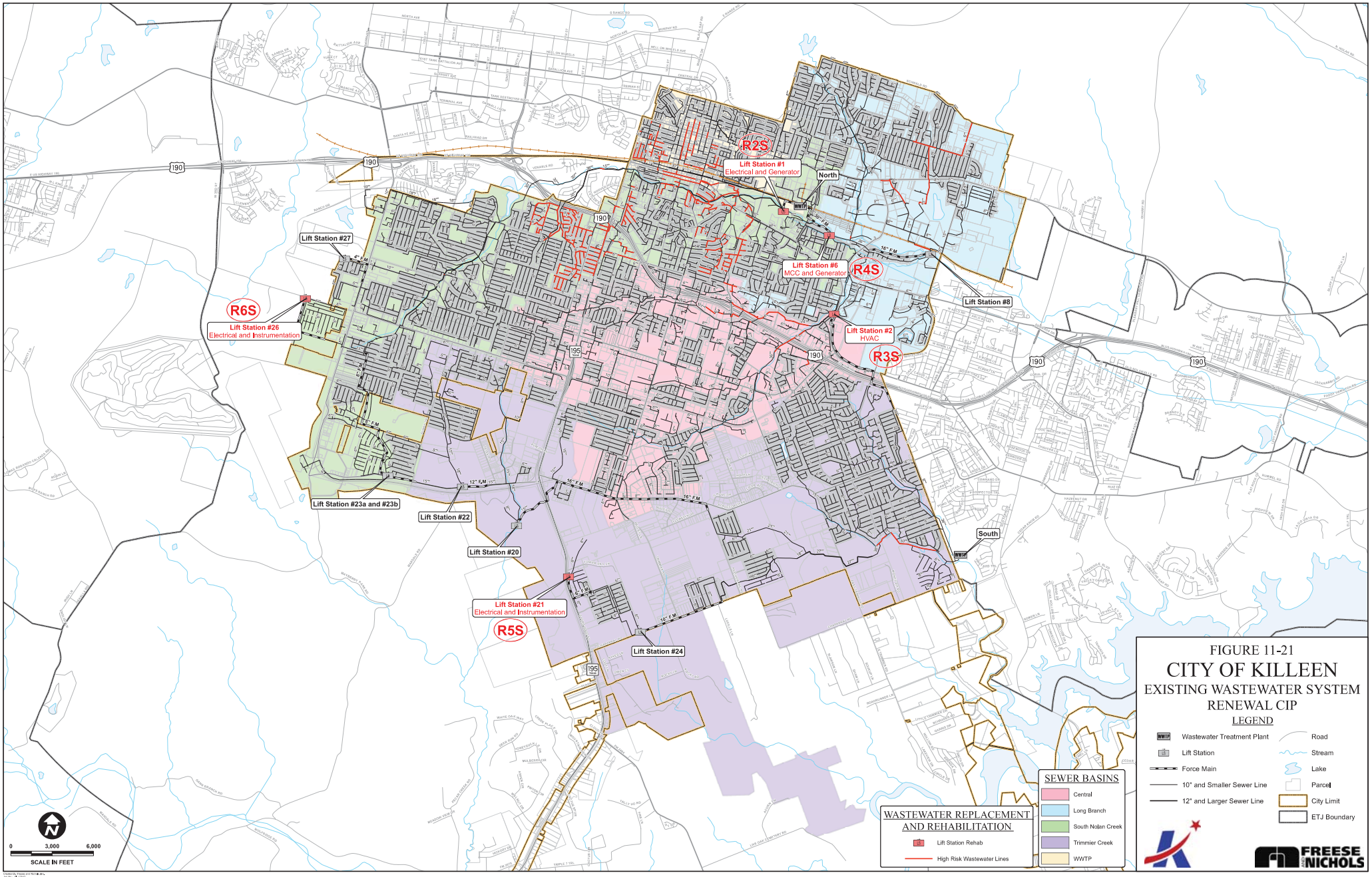
Table 11-29 Water Renewal CIP Cost Summary

Project Number	Project Name	Cost
R1W	Water Line Replacement or Rehabilitation Area #1	$10,274,400
R2W	Pump Station #2 Rehabilitation	$1,695,400
R3W	Pump Station #3 Rehabilitation	$621,000
R4W	Pump Station #4 & #5 Rehabilitation	$138,000
R5W	Pump Station #6 Rehabilitation	$690,000
R6W	Airport Pump Station Rehabilitation	$138,000
R7W	Southeast EST Rehabilitation	$276,000
	Water Renewal CIP Total	**$13,832,800**

Table 11-30 Wastewater Renewal CIP Cost Summary

Project Number	Project Name	Cost
R1S	Wastewater Line Replacement and Rehabilitation Area #1	$14,676,900
R2S	Lift Station #1 Rehabilitation	$690,000
R3S	Lift Station #2 Rehabilitation	$138,000
R4S	Lift Station #6 Rehabilitation	$1,242,000
R5S	Lift Station #21 Rehabilitation	$ 414,000
R6S	Lift Station #26 Rehabilitation	$414,000
	Wastewater Renewal CIP Total	**$17,574,900**


R4W
Pump Station # 5
Instrumentation
0.25 MG Park Street
BCWCID # 1
R5W
Pump Station # 6
Generator and Pumps
Pump Station # 2
Structure and Pumps
R2W
1.5 MG Bundrant
R3W
Pump Station # 3
HVAC
Airport Pump Station
Structure
R6W
Pump Station # 4
Instrumentation
R4W
1.0 MG Rodeo
1.0 MG Airport
(2) 1.5 MG McMillan
R7W
2.5 MG Southeast
Structure - Interior
190
195
0
3,000
6,000
SCALE IN FEET
WATER REPLACEMENT AND REHABILITATION
Elevated Storage Tank Rehab
Pump Station Rehab
High Risk Water Lines
PRESSURE PLANES
Airport
Lower
Middle
PRV
Upper
FIGURE 11-20
CITY OF KILLEEN
WATER SYSTEM
RENEWAL PROJECTS
LEGEND
Elevated Storage Tank
Ground Storage Tank
Pump Station
10" and Smaller Water Line
12" and Larger Water Line
Road
Railroad
Stream
Lake
Parcel
City Limit
FREESE AND NICHOLS


R2S
Lift Station #1
Electrical and Generator
North
Lift Station #27
Lift Station #6
MCC and Generator
R4S
Lift Station #8
R6S
Lift Station #26
Electrical and Instrumentation
Lift Station #2
HVAC
R3S
Lift Station #23a and #23b
Lift Station #22
Lift Station #20
South
Lift Station #21
Electrical and Instrumentation
R5S
Lift Station #24
190
195
SCALE IN FEET
0
3,000
6,000
SEWER BASINS
Central
Long Branch
South Nolan Creek
Trimmier Creek
WWTP
WASTEWATER REPLACEMENT AND REHABILITATION
Lift Station Rehab
High Risk Wastewater Lines
FIGURE 11-21
CITY OF KILLEEN
EXISTING WASTEWATER SYSTEM
RENEWAL CIP
LEGEND
Wastewater Treatment Plant
Lift Station
Force Main
10" and Smaller Sewer Line
12" and Larger Sewer Line
Road
Stream
Lake
Parcel
City Limit
ETJ Boundary
FREESE NICHOLS

Appendix A

Water Capital Improvement Plan

Cost Tables

City of Killeen

Water Capital Improvement Cost Estimate — **October, 2019**

Construction Project Number: 1W — **Phase: 2024**

Project Name: **Chaparral Elevated Storage Tank**

Project Description:

1.5 MG elevated storage tank located near Chaparral Road and Rocky Creek Ranch Road.

Vicinity Map

Project Drivers:

The new tank provides additional elevated storage in the LPP. It will also serve as storage for the suction side of the future UPP pump station.

Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	1.5 MG Elevated Storage Tank	1	LS	$ 3,500,000	$ 3,500,000
		SUBTOTAL:			**$ 3,500,000**
		CONTINGENCY		20%	$ 700,000
		SUBTOTAL:			**$ 4,200,000**
		ENG/SURVEY		15%	$ 630,000
		SUBTOTAL:			**$ 4,830,000**
		Estimated Project Total:			**$ 4,830,000**

City of Killeen

Water Capital Improvement Cost Estimate — **October, 2019**

Construction Project Number: 2W — **Phase:** 2024

Project Name: 24-inch Highway 195 Water Line

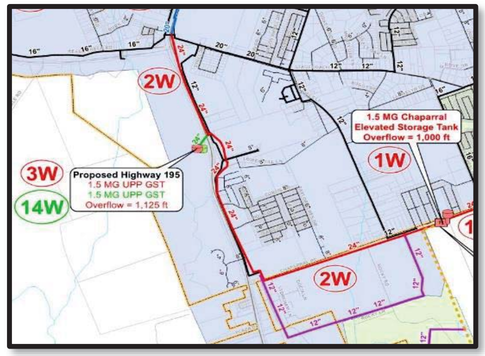
Project Description:

Transmission line along Highway 195 between the proposed Chaparral Road Pump Station and Stagecoach Road.

Project Drivers:

This pipeline is needed to convey water from the proposed Chaparral Pump Station into the UPP. It also provides transmission capacity to and from the proposed Highway 195 tank

Vicinity Map



Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	24" WL & Appurtenances	21,500	LF	$ 288	$ 6,192,000
				SUBTOTAL:	**$ 6,192,000**
		CONTINGENCY		20%	$ 1,238,400
				SUBTOTAL:	**$ 7,430,400**
		ENG/SURVEY		15%	$ 1,114,600
				SUBTOTAL:	**$ 8,545,000**
				Estimated Project Total:	**$ 8,545,000**

City of Killeen

Water Capital Improvement Cost Estimate		October, 2019
Construction Project Number:	3W	Phase: 2024
Project Name:	Highway 195 Ground Storage Tank #1	

Project Description:

1.5 MG ground storage tank serving as an elevated tank located on a hill near Highway 195 and Tower Hill Lane.

Project Drivers:

Projected growth in the UPP requires additional elevated storage to meet TCEQ requirements.

Vicinity Map

Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	1.5 MG Ground Storage Tank	1	LS	$ 1,500,000	$ 1,500,000
2	Site Improvements	1	LS	$ 250,000	$ 250,000
				SUBTOTAL:	**$ 1,750,000**
		CONTINGENCY		20%	$ 350,000
				SUBTOTAL:	**$ 2,100,000**
		ENG/SURVEY		15%	$ 315,000
				SUBTOTAL:	**$ 2,415,000**
				Estimated Project Total:	**$ 2,415,000**

City of Killeen

FREESE AND NICHOLS | KILLEEN TEXAS

Water Capital Improvement Cost Estimate		October, 2019
Construction Project Number:	4W	Phase: 2024
Project Name:	Chaparral Pump Station	

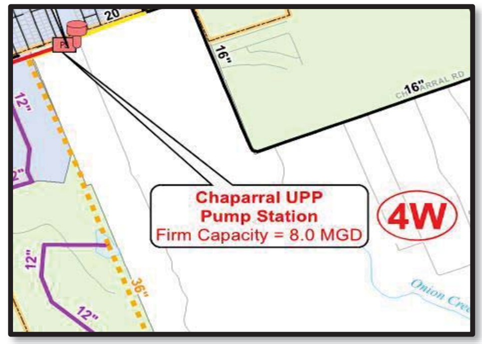
Project Description:

8.0 MGD Pump Station on the same site as the Chaparral EST.

Project Drivers:

Additional pumping capacity is needed to meet projected maximum day demands in the UPP. This pump station allows the City to better utilize water supply from the new BCWCID #1 South Water Treatment Plant.

Vicinity Map



Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Pump Station - New 8.0 MGD	1	LS	$ 3,800,000	$ 3,800,000
			SUBTOTAL:		$ 3,800,000
		CONTINGENCY		20%	$ 760,000
			SUBTOTAL:		$ 4,560,000
		ENG/SURVEY		15%	$ 684,000
			SUBTOTAL:		$ 5,244,000
			Estimated Project Total:		$ 5,244,000

City of Killeen

Water Capital Improvement Cost Estimate		**October, 2019**	
Construction Project Number:	**5W**	**Phase:**	**2024**
Project Name:	**Park Street Booster Pump Station**		

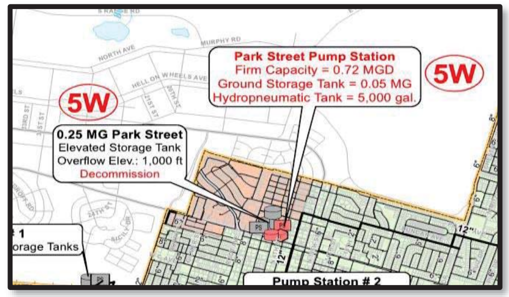
Project Description:

New 50,000 gallon ground storage tank, 0.72 mgd pump station, 5,000 gallon hydropneumatic tank, and two isolation valves at the existing Park EST site.

Project Drivers:

This project creates a new pressure plane to increase pressure for a small area of high elevation near the existing Park EST. Currently, during high demand periods, this area experiences pressures below the TCEQ minimum required pressure of 35 psi.

Vicinity Map



Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Hydropneumatic Tank	1	LS	$ 140,000	$ 140,000
2	8" Gate Valve	2	LS	$ 1,540	$ 3,080
3	0.05 MG Ground Storage Tank	1	LS	$ 215,000	$ 215,000
4	Pump Station - New 0.72 MGD	1	LS	$ 375,000	$ 375,000
				SUBTOTAL:	**$ 733,100**
		CONTINGENCY		20%	$ 146,700
				SUBTOTAL:	**$ 879,800**
		ENG/SURVEY		15%	$ 132,000
				SUBTOTAL:	**$ 1,011,800**
				Estimated Project Total:	**$ 1,011,800**

City of Killeen

FREESE AND NICHOLS — KILLEEN TEXAS

Water Capital Improvement Cost Estimate	**October, 2019**
Construction Project Number: 6W	**Phase:** 2024
Project Name:	**12-inch Mohawk Road Water Line**

Project Description:

12-inch distribution line between Bunny Trail and Highway 195.

Project Drivers:

This pipeline is needed to distribute water to an area projected for future growth.

Vicinity Map

Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	12" WL & Appurtenances	9,100	LF	$ 144	$ 1,310,400
			SUBTOTAL:	**$ 1,310,400**
		CONTINGENCY		20%	$ 262,100
				SUBTOTAL:	**$ 1,572,500**
		ENG/SURVEY		15%	$ 235,900
				SUBTOTAL:	**$ 1,808,400**
				Estimated Project Total:	**$ 1,808,400**

City of Killeen

Water Capital Improvement Cost Estimate		October, 2019
Construction Project Number:	7W	Phase: 2024
Project Name:	Short Term Water Renewal CIP	

Project Description:

Replacement or rehabilitation of water lines and facilities identified in FNI's Renewal CIP.

Project Drivers:

As water lines, pump stations, and storage tanks age, assets need to be replaced or rehabbed to maintain functionality. FNI conducted facility condition assessments and a risk-based assessment for linear assets to identify projects in the renewal CIP. Half of the total cost of the renewal projects is included in the 5-year CIP.

Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Water Renewal CIP	1	LS	$ 6,916,400	$ 6,916,400
				SUBTOTAL:	$ 6,916,400
		CONTINGENCY		0%	$ -
				SUBTOTAL:	$ 6,916,400
		ENG/SURVEY		0%	$ -
				SUBTOTAL:	$ 6,916,400
				Estimated Project Total:	$ 6,916,400

City of Killeen

FREESE AND NICHOLS | KILLEEN TEXAS

Water Capital Improvement Cost Estimate	October, 2019
Construction Project Number: 8W	Phase: 2029

Project Name: 20-inch W.S. Young Drive Water Line

Project Description:

20-inch transmission line from Pump Station #5 to Poage Road.

Project Drivers:

This pipeline provides additional transmission capacity from Pump Station #5. The existing 16-inch line experiences high velocities and headloss when the full capacity of pump station #5 is utilized. The additional 20-inch line will allow the pumps to operate more efficiently.

Vicinity Map

Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	20" WL & Appurtenances	5,400	LF	$ 240	$ 1,296,000
				SUBTOTAL:	**$ 1,296,000**
		CONTINGENCY		20%	$ 259,200
				SUBTOTAL:	**$ 1,555,200**
		ENG/SURVEY		15%	$ 233,300
				SUBTOTAL:	**$ 1,788,500**
				Estimated Project Total:	**$ 1,788,500**

City of Killeen

Water Capital Improvement Cost Estimate	**October, 2019**
Construction Project Number: **9W**	**Phase: 2029**
Project Name:	**12-inch E Rancier Avenue Line**

Project Description:

12-inch loop in the northeastern portion of the LPP, generally between Rancier Avenue and the railroad.

Project Drivers:

This pipeline is needed to extend water service to an area projected for future growth.

Vicinity Map

Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	12" WL & Appurtenances	12,500	LF	$ 144	$ 1,800,000
				SUBTOTAL:	**$ 1,800,000**
		CONTINGENCY		20%	$ 360,000
				SUBTOTAL:	**$ 2,160,000**
		ENG/SURVEY		15%	$ 324,000
				SUBTOTAL:	**$ 2,484,000**
				Estimated Project Total:	**$ 2,484,000**

City of Killeen

Water Capital Improvement Cost Estimate	October, 2019
Construction Project Number: 10W	Phase: 2029
Project Name:	20-inch Highway 195 Water Line

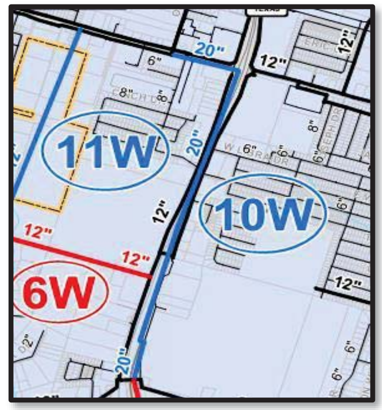
Project Description:

20-inch transmission line from Stagecoach Road to Elms Road.

Project Drivers:

This pipeline provides additional transmission capacity in the UPP.

Vicinity Map



Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	20" WL & Appurtenances	8,000	LF	$ 240	$ 1,920,000
2	32" Boring and Casing	150	LF	$ 560	$ 84,000
3	Water Pavement Repair	1,350	LF	$ 75	$ 101,250
				SUBTOTAL:	**$ 2,105,300**
		CONTINGENCY		20%	$ 421,100
				SUBTOTAL:	**$ 2,526,400**
		ENG/SURVEY		15%	$ 379,000
				SUBTOTAL:	**$ 2,905,400**
				Estimated Project Total:	**$ 2,905,400**

City of Killeen

Water Capital Improvement Cost Estimate — **October, 2019**

Construction Project Number: 11W — **Phase:** 2029

Project Name: 12-inch Water Line from Mohawk Road to Stan Schlueter Loop

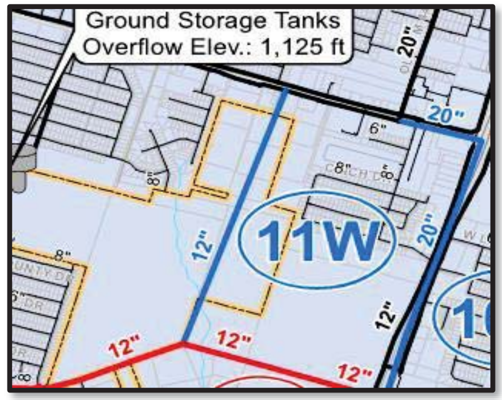
Project Description:

12-inch distribution line between Stan Schlueter Loop and the proposed 12-inch along Mohawk Road.

Project Drivers:

This pipeline is needed to distribute water to an area projected for future growth.

Vicinity Map



Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	12" WL & Appurtenances	4,900	LF	$ 144	$ 705,600
				SUBTOTAL:	**$ 705,600**
		CONTINGENCY		20%	$ 141,200
				SUBTOTAL:	**$ 846,800**
		ENG/SURVEY		15%	$ 127,100
				SUBTOTAL:	**$ 973,900**
				Estimated Project Total:	**$ 973,900**

City of Killeen

FREESE AND NICHOLS | KILLEEN TEXAS

Water Capital Improvement Cost Estimate	**October, 2019**
Construction Project Number: 12W	**Phase: 2029**
Project Name:	**12-inch N Roy Reynolds Drive Water Line**

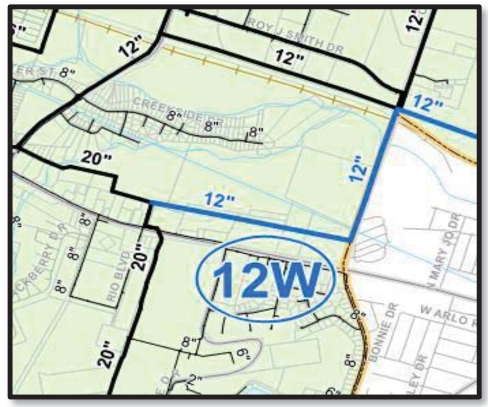
Project Description:

12-inch distribution line along Business Highway 190 from S Twin Creek Drive to Roy Reynolds Drive, and north from Business Highway 190 to the railroad.

Project Drivers:

This pipeline extends water service to an area projected for future growth.

Vicinity Map



Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	12" WL & Appurtenances	6,600	LF	$ 144	$ 950,400
				SUBTOTAL:	**$ 950,400**
		CONTINGENCY		20%	$ 190,100
				SUBTOTAL:	**$ 1,140,500**
		ENG/SURVEY		15%	$ 171,100
				SUBTOTAL:	**$ 1,311,600**
				Estimated Project Total:	**$ 1,311,600**

City of Killeen

Water Capital Improvement Cost Estimate		October, 2019
Construction Project Number:	13W	Phase: 2029
Project Name:	12-inch Water Line Loop South of Chaparral Rd	

Project Description:

12-inch distribution line connected to a developer distribution line south of Chaparral Road in the UPP.

Project Drivers:

This pipeline completes looping for future growth.

Vicinity Map

Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	12" WL & Appurtenances	17,265	LF	$ 144	$ 2,486,160
				SUBTOTAL:	**$ 2,486,200**
		CONTINGENCY		20%	$ 497,300
				SUBTOTAL:	**$ 2,983,500**
		ENG/SURVEY		15%	$ 447,600
				SUBTOTAL:	**$ 3,431,100**
				Estimated Project Total:	**$ 3,431,100**

City of Killeen

Water Capital Improvement Cost Estimate		October, 2019
Construction Project Number:	14W	Phase: 2029
Project Name:	Intermediate Water Renewal CIP	

Project Description:

Replacement or rehabilitation of water lines and facilities identified in FNI's Renewal CIP.

Project Drivers:

As water lines, pump stations, and storage tanks age, assets need to be replaced or rehabbed to maintain functionality. FNI conducted facility condition assessments and a risk-based assessment for linear assets to identify projects in the renewal CIP. Half of the total cost of the renewal projects is included in the 10-year CIP.

Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Water Renewal CIP	1	LS	$ 6,916,400	$ 6,916,400
		SUBTOTAL:			$ 6,916,400
		CONTINGENCY		0%	$ -
		SUBTOTAL:			$ 6,916,400
		ENG/SURVEY		0%	$ -
		SUBTOTAL:			$ 6,916,400
		Estimated Project Total:			$ 6,916,400

City of Killeen

Water Capital Improvement Cost Estimate | **October, 2019**

Construction Project Number: 15W | **Phase: 2039**

Project Name: **Highway 195 Ground Storage Tank #2**

Project Description:

Second 1.5 MG ground storage tank serving as an elevated tank located on a hill near Highway 195 and Tower Hill Lane.

Project Drivers:

Projected growth in the UPP requires additional elevated storage to meet TCEQ requirements.

Vicinity Map

Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	1.5 MG Ground Storage Tank	1	LS	$ 1,500,000	$ 1,500,000
				SUBTOTAL:	**$ 1,500,000**
		CONTINGENCY		20%	$ 300,000
				SUBTOTAL:	**$ 1,800,000**
		ENG/SURVEY		15%	$ 270,000
				SUBTOTAL:	**$ 2,070,000**
				Estimated Project Total:	**$ 2,070,000**

City of Killeen

FREESE AND NICHOLS | KILLEEN TEXAS

Water Capital Improvement Cost Estimate		October, 2019
Construction Project Number:	16W	Phase: 2039
Project Name:	Airport Pump Station Expansion and New Ground Storage Tank	

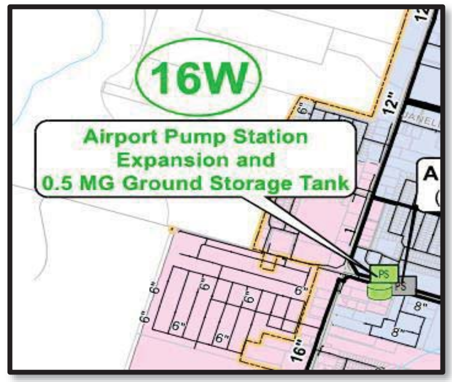
Project Description:

2.0 MGD pump station and a new 0.5 MG Ground Storage Tank to replace the existing Airport Pump Station.

Project Drivers:

The proposed pump station expansion will provide pumping capacity to meet demands in the Airport Pressure Plane. The new GST provides storage on the suction side of the pump station, which is required by TCEQ.

Vicinity Map



Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Pump Station - New 2.0 MGD	1	LS	$ 1,040,000	$ 1,040,000
2	0.5 MG Ground Storage Tank	1	LS	$ 500,000	$ 500,000
				SUBTOTAL:	**$ 1,540,000**
		CONTINGENCY		20%	$ 308,000
				SUBTOTAL:	**$ 1,848,000**
		ENG/SURVEY		15%	$ 277,200
				SUBTOTAL:	**$ 2,125,200**
				Estimated Project Total:	**$ 2,125,200**

City of Killeen

Water Capital Improvement Cost Estimate — **October, 2019**

Construction Project Number: 17W — **Phase:** 2039

Project Name: 12-inch Schwald Road Water Line

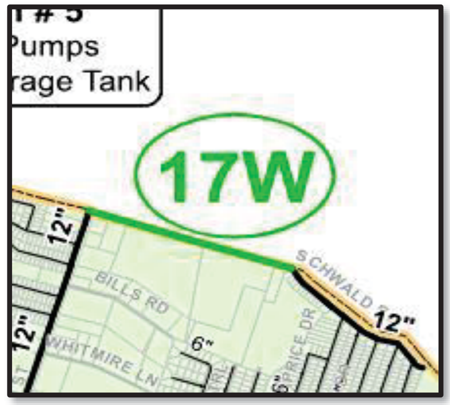
Project Description:

12-inch distribution line along Schwald Road from 60th Street to Ridge Haven Drive.

Project Drivers:

This pipeline completes looping for future growth.

Vicinity Map



Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	12" WL & Appurtenances	2,800	LF	$ 144	$ 403,200
				SUBTOTAL:	**$ 403,200**
		CONTINGENCY		20%	$ 80,700
				SUBTOTAL:	**$ 483,900**
		ENG/SURVEY		15%	$ 72,600
				SUBTOTAL:	**$ 556,500**
				Estimated Project Total:	**$ 556,500**

City of Killeen

Water Capital Improvement Cost Estimate		October, 2019
Construction Project Number:	18W	Phase: 2039
Project Name:	Long Term Water Renewal CIP	

Project Description:

Replacement or rehabilitation of water lines and facilities identified in FNI's Renewal CIP.

Project Drivers:

As water lines, pump stations, and storage tanks age, assets need to be replaced or rehabbed to maintain functionality. FNI conducted facility condition assessments and a risk-based assessment for linear assets to identify projects in the renewal CIP for the next 10 years. Assets should be re-evaluated every 5-10 years to assess condition and need for rehabilitation.

Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Long Term Renewal CIP	1	LS	#########	$ 13,832,800
				SUBTOTAL:	**$ 13,832,800**
		CONTINGENCY		0%	$ -
				SUBTOTAL:	**$ 13,832,800**
		ENG/SURVEY		0%	$ -
				SUBTOTAL:	**$ 13,832,800**
				Estimated Project Total:	**$ 13,832,800**

Appendix B

Wastewater Capital Improvement Plan

Cost Tables

City of Killeen

Capital Improvement Cost Estimate — **October, 2019**

Construction Project Number: 1S — **Phase:** 2024

Project Name: Lift Station #22 Expansion

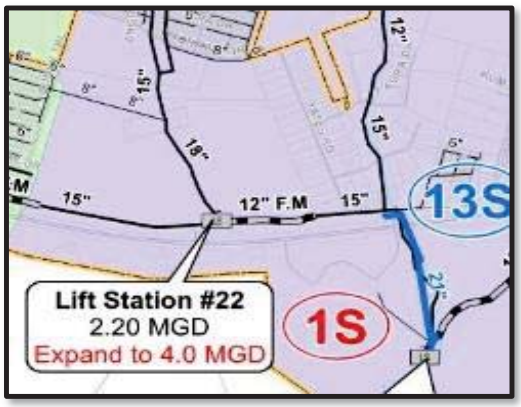
Project Description:

Expand Lift Station #22 from its current tested capacity of 2.2 MGD (both pumps on) to a firm capacity of 4.0 MGD. Lift Station expansion costs take into consideration the installation of pumps, piping, miscellaneous valves/appurtenances, site work, wet well expansion/repair, and by-pass pumping. Unit prices shown in the cost summaries are assumed to include direct project costs, overhead, and profit for the contractors.

Project Drivers:

Growth in Lift Station #22's subbasin requires a 1.8 MGD expansion to handle future peak wet weather flow.

Vicinity Map



Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Replace Pump with 4 MGD Pump	2	EA	$ 200,000	$ 400,000
2	Misc. Electrical	1	LS	$ 300,000	$ 300,000
3	By-pass Pumping	1	LS	$ 250,000	$ 250,000
4	Structural Modifications	1	LS	$ 100,000	$ 100,000
5	Misc. Piping	1	LS	$ 100,000	$ 100,000
				SUBTOTAL:	**$ 1,150,000**
				CONTINGENCY 20%	$ 230,000
				SUBTOTAL:	**$ 1,380,000**
				ENG/SURVEY 15%	$ 207,000
				SUBTOTAL:	**$ 1,587,000**
				Estimated Project Total:	**$ 1,587,000**

City of Killeen

FREESE AND NICHOLS | KILLEEN TEXAS

Capital Improvement Cost Estimate — **October, 2019**

Construction Project Number: 2S — **Phase:** 2024

Project Name: Lift Station #8 Expansion

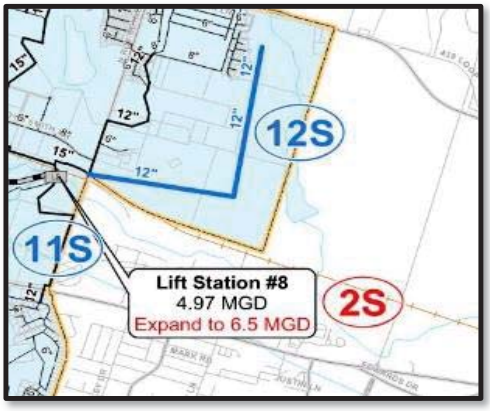
Project Description:

Expand Lift Station #8 from its current capacity of 4.97 MGD to a firm capacity of 6.5 MGD. Lift Station expansion costs take into consideration the installation of pumps, piping, miscellaneous valves/appurtenances, site work, wet well expansion/repair, and by-pass pumping. Unit prices shown in the cost summaries are assumed to include direct project costs, overhead, and profit for the contractors.

Project Drivers:

Growth in Lift Station #8's subbasin requires a 2.6 MGD expansion to handle future peak wet weather flow.

Vicinity Map



Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Replace Pump with 3.25 MGD Pump	3	EA	$ 200,000	$ 600,000
2	Misc. Electrical	1	LS	$ 300,000	$ 300,000
3	By-pass Pumping	1	LS	$ 250,000	$ 250,000
4	Structural Modifications	1	LS	$ 100,000	$ 100,000
5	Misc. Piping	1	LS	$ 100,000	$ 100,000
				SUBTOTAL:	**$ 1,350,000**
			CONTINGENCY	20%	$ 270,000
				SUBTOTAL:	**$ 1,620,000**
			ENG/SURVEY	15%	$ 243,000
				SUBTOTAL:	**$ 1,863,000**
				Estimated Project Total:	**$ 1,863,000**

City of Killeen

FREESE AND NICHOLS | KILLEEN TEXAS

Capital Improvement Cost Estimate		**October, 2019**
Construction Project Number:	**3S**	**Phase: 2024**
Project Name:	**15-inch Wastewater Main Replacement in the Long Branch Subbasin**	

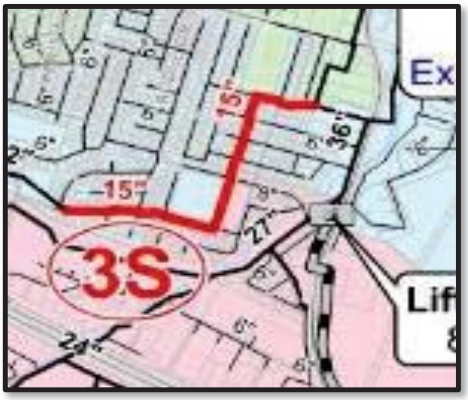
Project Description:

Replace existing 12-inch line with a 15-inch line from Scottsdale Drive to Flynn Street.

Project Drivers:

Existing 12-inch line shows model predicted overflows during peak wet weather flows. The proposed 15-inch wastewater main will provide capacity to convey future peak wet weather flows.

Vicinity Map



Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	15" Pipe < 8 feet deep	4,800	LF	$ 180	$ 864,000
2	60" Diameter Manhole	10	EA	$ 6,000	$ 60,000
3	Sewer Pavement Repair	3,800	LF	$ 75	$ 285,000
				SUBTOTAL:	**$ 1,209,000**
				CONTINGENCY 20%	$ 241,800
				SUBTOTAL:	**$ 1,450,800**
				ENG/SURVEY 15%	$ 217,700
				SUBTOTAL:	**$ 1,668,500**
				Estimated Project Total:	**$ 1,668,500**

City of Killeen

Capital Improvement Cost Estimate — **October, 2019**

Construction Project Number: 4S — **Phase:** 2024

Project Name: 12/15-inch Main Replacement Upstream of Lift Station #24

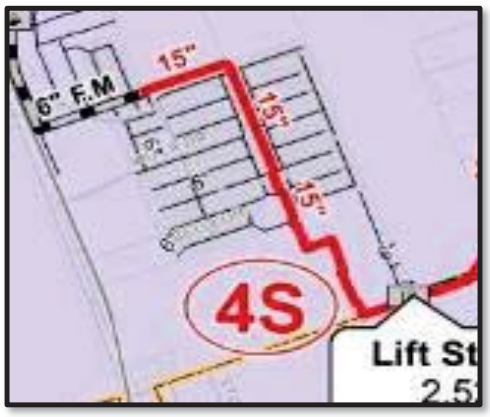
Project Description:

The proposed 12/15-inch wastewater line will replace the existing 10/12/15-inch main downstream of the force main from Lift Station #21.

Project Drivers:

Population projections indicate that there will be growth in the areas upstream of Lift Station #24. The existing wastewater main does not have the capacity to serve the population growth and must be upsized to convey future flows.

Vicinity Map



Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	12" Pipe < 8 feet deep	2,900	LF	$ 144	$ 417,600
2	15" Pipe < 8 feet deep	3,500	LF	$ 180	$ 630,000
3	60" Diameter Manhole	7	EA	$ 6,000	$ 42,000
4	48" Diameter Manhole	6	EA	$ 5,000	$ 30,000
5	Sewer Pavement Repair	4,000	LF	$ 75	$ 300,000

		SUBTOTAL:	**$ 1,419,600**
	CONTINGENCY 20%		$ 284,000
		SUBTOTAL:	**$ 1,703,600**
	ENG/SURVEY 15%		$ 255,600
		SUBTOTAL:	**$ 1,959,200**
		Estimated Project Total:	**$ 1,959,200**

City of Killeen

Capital Improvement Cost Estimate — **October, 2019**

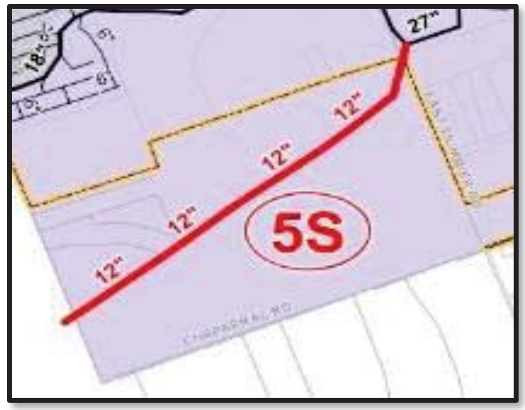
Construction Project Number: **5S** — **Phase: 2024**

Project Name: **12-inch Wastewater Main in Trimmier Creek Basin**

Project Description:

New 12-inch wastewater main north of Chaparral Road and west of Trimmier Road connecting to the existing 27-inch line in the Trimmier Creek Basin.

Vicinity Map



Project Drivers:

The new line will provide wastewater service to new customers north of Chaparral Road in the Trimmier Creek Basin.

Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	12" Pipe < 8 feet deep	7,600	LF	$ 144	$ 1,094,400
2	48" Diameter Manhole	16	EA	$ 5,000	$ 80,000
				SUBTOTAL:	**$ 1,174,400**
		CONTINGENCY		20%	$ 234,900
				SUBTOTAL:	**$ 1,409,300**
		ENG/SURVEY		15%	$ 211,400
				SUBTOTAL:	**$ 1,620,700**
				Estimated Project Total:	**$ 1,620,700**

City of Killeen

Capital Improvement Cost Estimate — **October, 2019**

Construction Project Number: **6S** — **Phase: 2024**

Project Name: **12-inch Wastewater Main near Money Pit Road**

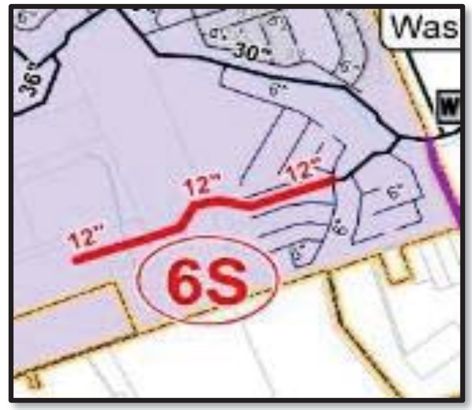
Project Description:

Proposed 12-inch wastewater main extending west from an existing 15-inch main south of Pyrite Drive in the Trimmier Creek subbasin.

Project Drivers:

The proposed line will provide service to future customers west of the existing 15-inch line.

Vicinity Map



Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	12" Pipe < 8 feet deep	4,000	LF	$ 144	$ 576,000
2	48" Diameter Manhole	8	EA	$ 5,000	$ 40,000
				SUBTOTAL:	**$ 616,000**
		CONTINGENCY		20%	$ 123,200
				SUBTOTAL:	**$ 739,200**
		ENG/SURVEY		15%	$ 110,900
				SUBTOTAL:	**$ 850,100**
				Estimated Project Total:	**$ 850,100**

City of Killeen

FREESE AND NICHOLS | KILLEEN TEXAS

Capital Improvement Cost Estimate	October, 2019
Construction Project Number: 7S	Phase: 2024
Project Name:	12-inch Wastewater Main along Trimmier Road in Southern Trimmier Creek Basin

Project Description:

New 12-inch wastewater main along the creek near Trimmier Road between Stagecoach Road and Lift Station #24.

Project Drivers:

This project will provide service to existing and new customers along Trimmier Road.

Vicinity Map

Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	12" Pipe < 8 feet deep	9,700	LF	$ 144	$ 1,396,800
2	48" Diameter Manhole	20	EA	$ 5,000	$ 100,000
				SUBTOTAL:	**$ 1,496,800**
		CONTINGENCY		20%	$ 299,400
				SUBTOTAL:	**$ 1,796,200**
		ENG/SURVEY		0%	$ -
				SUBTOTAL:	**$ 1,796,200**
				Estimated Project Total:	**$ 1,796,200**

City of Killeen

FREESE AND NICHOLS — KILLEEN TEXAS

Capital Improvement Cost Estimate — **October, 2019**

Construction Project Number: **8S** — **Phase: 2024**

Project Name: **Flow Monitoring & I/I Reduction Study**

Project Description:

Conduct system-wide temporary flow monitoring and analysis to reduce inflow and infiltration (I/I).

Project Drivers:

This study will provide updated information on the amount of I/I being conveyed in the wastewater system. Effective management of I/I reduces infrastructure and treatment costs.

Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	I/I Reduction Study	1	LS	$ 200,000	$ 200,000
				SUBTOTAL:	**$ 200,000**
		CONTINGENCY		20%	$ 40,000
				SUBTOTAL:	**$ 240,000**
		ENG/SURVEY		0%	$ -
				SUBTOTAL:	**$ 240,000**
				Estimated Project Total:	**$ 240,000**

City of Killeen

Capital Improvement Cost Estimate		October, 2019
Construction Project Number:	9S	Phase: 2024
Project Name:	Short Term Wastewater Renewal CIP	

Project Description:

Replacement or rehabilitation of wastewater lines and facilities identified in FNI's Renewal CIP.

Project Drivers:

As wastewater lines and lift stations age, assets need to be replaced or rehabbed to maintain functionality. FNI conducted facility condition assessments and a risk-based assessment for linear assets to identify projects in the renewal CIP. Half of the total cost of the renewal projects is included in the 5-year CIP.

Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Wastewater Renewal CIP	1	LS	$ 8,787,450	$ 8,787,450
				SUBTOTAL:	$ 8,787,500
		CONTINGENCY		0%	$ -
				SUBTOTAL:	$ 8,787,500
		ENG/SURVEY		0%	$ -
				SUBTOTAL:	$ 8,787,500
				Estimated Project Total:	$ 8,787,500

City of Killeen

Capital Improvement Cost Estimate — October, 2019

Construction Project Number: 10S — Phase: 2024

Project Name: **Septic Tank Elimination Program**

Project Description:

Infrastructure associated with the City's Septic Tank Elimination Program.

Project Drivers:

The Septic Tank Elimination Program installs the needed infrastructure to extend wastewater service to existing City residents with septic tanks.

Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Sewer Improvements (5-years)	1	LS	$ 5,000,000	$ 5,000,000
				SUBTOTAL:	**$ 5,000,000**
		CONTINGENCY		0%	$ -
				SUBTOTAL:	**$ 5,000,000**
		ENG/SURVEY		0%	$ -
				SUBTOTAL:	**$ 5,000,000**
				Estimated Project Total:	**$ 5,000,000**

City of Killeen

FREESE AND NICHOLS | KILLEEN TEXAS

Capital Improvement Cost Estimate — **October, 2019**

Construction Project Number: 11S — **Phase:** 2029

Project Name: Lift Station #6 Expansion

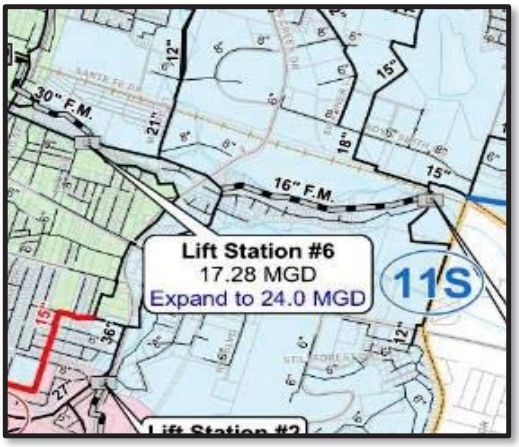
Project Description:

Expand Lift Station #6 from its current capacity of 17.28 MGD to a firm capacity of 24.0 MGD. Rehab project R4S (approximately $1.2M) can either be completed before or in conjunction with the expansion. Lift Station expansion costs take into consideration the installation of pumps, piping, miscellaneous valves/appurtenances, site work, wet well expansion/repair, and by-pass pumping. Unit prices shown in the cost summaries are assumed to include direct project costs, overhead, and profit for the contractors.

Project Drivers:

This project provides operational flexibility to allow wastewater to be diverted from Lift Station #2 to Lift Station #6 and pumped to the North WWTP.

Vicinity Map



Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Replace Pump with 12 MGD Pump	3	EA	$ 600,000	$ 1,800,000
2	Misc. Electrical	1	LS	$ 300,000	$ 300,000
3	By-pass Pumping	1	LS	$ 750,000	$ 750,000
4	Structural Modifications	1	LS	$ 100,000	$ 100,000
5	Misc. Piping	1	LS	$ 100,000	$ 100,000
				SUBTOTAL:	$ 3,050,000
				CONTINGENCY 20%	$ 610,000
				SUBTOTAL:	$ 3,660,000
				ENG/SURVEY 15%	$ 549,000
				SUBTOTAL:	$ 4,209,000
				Estimated Project Total:	$ 4,209,000

City of Killeen

Capital Improvement Cost Estimate — **October, 2019**

Construction Project Number: 12S — **Phase:** 2029

Project Name: 12-inch Wastewater Main in Long Branch Basin

Project Description:

The proposed 12-inch wastewater main is upstream of an existing 15-inch main east of Roy Reynolds Drive.

Project Drivers:

The new lines will provide wastewater service to new customers east of Roy Reynolds Drive in the Long Branch Basin.

Vicinity Map

Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	12" Pipe < 8 feet deep	7,700	LF	$ 144	$ 1,108,800
2	48" Diameter Manhole	16	EA	$ 5,000	$ 80,000
				SUBTOTAL:	**$ 1,188,800**
		CONTINGENCY		20%	$ 237,800
				SUBTOTAL:	**$ 1,426,600**
		ENG/SURVEY		15%	$ 214,000
				SUBTOTAL:	**$ 1,640,600**
				Estimated Project Total:	**$ 1,640,600**

City of Killeen

Capital Improvement Cost Estimate — **October, 2019**

Construction Project Number: 13S — **Phase:** 2029

Project Name: 18/21-inch Wastewater Main Replacement in the Trimmier Creek Subbasin

Project Description:

New 18/21-inch wastewater line replacing existing 15/18-inch south of Stagecoach Road.

Project Drivers:

Replacing the existing line with a 18/21-inch wastewater main will provide capacity to convey future peak wet weather flows.

Vicinity Map

Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	21" Pipe < 8 feet deep	3,300	LF	$ 252	$ 831,600
2	18" Pipe < 8 feet deep	290	LF	$ 216	$ 62,640
3	60" Diameter Manhole	5	EA	$ 6,000	$ 30,000
4	32" Boring and Casing	350	LF	$ 560	$ 196,000
				SUBTOTAL:	**$ 1,120,300**
		CONTINGENCY		20%	$ 224,100
				SUBTOTAL:	**$ 1,344,400**
		ENG/SURVEY		15%	$ 201,700
				SUBTOTAL:	**$ 1,546,100**
				Estimated Project Total:	**$ 1,546,100**

City of Killeen

FREESE AND NICHOLS | KILLEEN TEXAS

Capital Improvement Cost Estimate — **October, 2019**

Construction Project Number: 14S — **Phase:** 2029

Project Name: Lift Station #20 Expansion

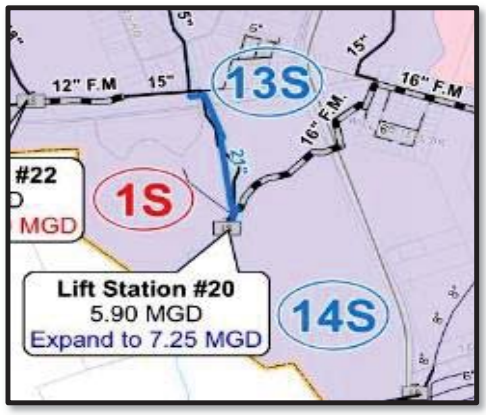
Project Description:

Expand Lift Station #20 from its current capacity of 5.9 MGD to a firm capacity of 7.25 MGD. Lift Station expansion costs take into consideration the installation of pumps, piping, miscellaneous valves/appurtenances, site work, wet well expansion/repair, and by-pass pumping. Unit prices shown in the cost summaries are assumed to include direct project costs, overhead, and profit for the contractors.

Project Drivers:

Growth in Lift Station #20's subbasin requires a 1.4 MGD expansion to handle future peak wet weather flow.

Vicinity Map



Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Replace Pump with 3.75 MGD Pump	3	EA	$ 200,000	$ 600,000
2	Misc. Electrical	1	LS	$ 300,000	$ 300,000
3	Electrical Building	1	LS	$ 350,000	$ 350,000
4	By-pass Pumping	1	LS	$ 250,000	$ 250,000
5	Structural Modifications	1	LS	$ 100,000	$ 100,000
6	Misc. Piping	1	LS	$ 100,000	$ 100,000
				SUBTOTAL:	**$ 1,700,000**
				CONTINGENCY 20%	$ 340,000
				SUBTOTAL:	**$ 2,040,000**
				ENG/SURVEY 15%	$ 306,000
				SUBTOTAL:	**$ 2,346,000**
				Estimated Project Total:	**$ 2,346,000**

City of Killeen

Capital Improvement Cost Estimate		**October, 2019**
Construction Project Number:	**15S**	**Phase: 2029**
Project Name:	**Intermediate Term Wastewater Renewal CIP**	

Project Description:

Replacement or rehabilitation of wastewater lines and facilities identified in FNI's Renewal CIP.

Project Drivers:

As wastewater lines and lift stations age, assets need to be replaced or rehabbed to maintain functionality. FNI conducted facility condition assessments and a risk-based assessment for linear assets to identify projects in the renewal CIP. Half of the total cost of the renewal projects is included in the 10-year CIP.

Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Wastewater Renewal CIP	1	LS	$ 8,787,450	$ 8,787,450
		SUBTOTAL:			**$ 8,787,500**
		CONTINGENCY		0%	$ -
		SUBTOTAL:			**$ 8,787,500**
		ENG/SURVEY		0%	$ -
		SUBTOTAL:			**$ 8,787,500**
		Estimated Project Total:			**$ 8,787,500**

City of Killeen

Capital Improvement Cost Estimate		**October, 2019**
Construction Project Number:	**16S**	**Phase: 2029**
Project Name:	**Septic Tank Elimination Program**	

Project Description:

Infrastructure associated with the City's Septic Tank Elimination Program.

Project Drivers:

The Septic Tank Elimination Program installs the needed infrastructure to extend wastewater service to existing City residents with septic tanks.

Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Sewer Improvements (5-years)	1	LS	$ 5,000,000	$ 5,000,000
		SUBTOTAL:			**$ 5,000,000**
		CONTINGENCY		0%	$ -
		SUBTOTAL:			**$ 5,000,000**
		ENG/SURVEY		0%	$ -
		SUBTOTAL:			**$ 5,000,000**
		Estimated Project Total:			**$ 5,000,000**

City of Killeen

Capital Improvement Cost Estimate — **October, 2019**

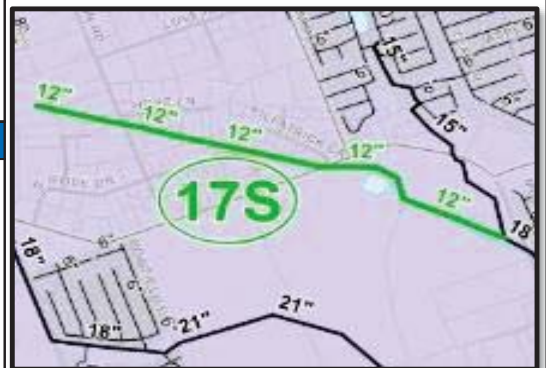
Construction Project Number: 17S — **Phase: 2039**

Project Name: **12-inch Wastewater Main in Trimmier Creek Basin**

Project Description:

New 12-inch wastewater main along the creek west of East Trimmier Road.

Vicinity Map



Project Drivers:

This project will provide wastewater service to new and existing customers in the Trimmier Creek basin near Onion Road, Stagecoach Road, and East Trimmier Road.

Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	12" Pipe < 8 feet deep	8,200	LF	$ 144	$ 1,180,800
2	48" Diameter Manhole	17	EA	$ 5,000	$ 85,000

	SUBTOTAL:	**$ 1,265,800**
CONTINGENCY	20%	$ 253,200
	SUBTOTAL:	**$ 1,519,000**
ENG/SURVEY	15%	$ 227,900
	SUBTOTAL:	**$ 1,746,900**
	Estimated Project Total:	**$ 1,746,900**

City of Killeen

Capital Improvement Cost Estimate — **October, 2019**

Construction Project Number: 18S — **Phase:** 2039

Project Name: 15-inch Wastewater Main Replacement in Central Basin

Project Description:

Replace existing 12-inch line with a 15-inch line between Old FM 440 and Florence Road.

Project Drivers:

The project provides additional capacity to convey future peak wet weather flows.

Vicinity Map

Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	15" Pipe < 8 feet deep	5,900	LF	$ 180	$ 1,062,000
2	60" Diameter Manhole	12	EA	$ 6,000	$ 72,000
				SUBTOTAL:	**$ 1,134,000**
				CONTINGENCY 20%	$ 226,800
				SUBTOTAL:	**$ 1,360,800**
				ENG/SURVEY 15%	$ 204,200
				SUBTOTAL:	**$ 1,565,000**
				Estimated Project Total:	**$ 1,565,000**

City of Killeen

FREESE AND NICHOLS | KILLEEN TEXAS

Capital Improvement Cost Estimate		October, 2019
Construction Project Number:	**19S**	**Phase: 2039**
Project Name:	**12-inch Wastewater Main Replacement in Central Basin**	

Project Description:

Replace existing 8-inch line with a 12-inch line between Florence Road and Broadway Drive in the Central Basin.

Project Drivers:

The project provides additional capacity to convey future peak wet weather flows.

Vicinity Map

Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	12" Pipe < 8 feet deep	2,400	LF	$ 144	$ 345,600
2	48" Diameter Manhole	5	EA	$ 5,000	$ 25,000

	SUBTOTAL:	**$ 370,600**
CONTINGENCY	20%	$ 74,200
	SUBTOTAL:	**$ 444,800**
ENG/SURVEY	15%	$ 66,800
	SUBTOTAL:	**$ 511,600**
	Estimated Project Total:	**$ 511,600**

City of Killeen

FREESE AND NICHOLS | KILLEEN TEXAS

Capital Improvement Cost Estimate	**October, 2019**
Construction Project Number: 20S	**Phase: 2039**
Project Name:	**Lift Station #24 Expansion**

Project Description:

Expand Lift Station #24 from its current capacity of 2.52 MGD to a firm capacity of 3.5 MGD. Lift Station expansion costs take into consideration the installation of pumps, piping, miscellaneous valves/appurtenances, site work, wet well expansion/repair, and by-pass pumping. Unit prices shown in the cost summaries are assumed to include direct project costs, overhead, and profit for the contractors.

Project Drivers:

Growth in Lift Station #24's subbasin requires a 1.0 MGD expansion to handle future peak wet weather flow.

Vicinity Map

Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Replace Pump with 3.5 MGD Pump	2	EA	$ 200,000	$ 400,000
2	Misc. Electrical	1	LS	$ 300,000	$ 300,000
3	By-pass Pumping	1	LS	$ 250,000	$ 250,000
4	Structural Modifications	1	LS	$ 100,000	$ 100,000
5	Misc. Piping	1	LS	$ 100,000	$ 100,000
				SUBTOTAL:	**$ 1,150,000**
				CONTINGENCY 20%	$ 230,000
				SUBTOTAL:	**$ 1,380,000**
				ENG/SURVEY 15%	$ 207,000
				SUBTOTAL:	**$ 1,587,000**
				Estimated Project Total:	**$ 1,587,000**

City of Killeen

Capital Improvement Cost Estimate | **October, 2019**

Construction Project Number: **21S** | **Phase: 2039**

Project Name: **Long Term Wastewater Renewal CIP**

Project Description:

Replacement and/or rehabilitation of wastewater lines and facilities identified in FNI's Renewal CIP.

Project Drivers:

As wastewater lines and lift stations age, assets need to be replaced or rehabbed to maintain functionality. FNI conducted facility condition assessments and a risk-based assessment for linear assets to identify projects in the renewal CIP for the next 10 years. Assets should be re-evaluated every 5-10 years to assess condition and need for rehabilitation.

Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Long Term Wastewater Renewal CIP	1	LS	$ 17,574,900	$ 17,574,900
				SUBTOTAL:	**$ 17,574,900**
		CONTINGENCY		0%	$ -
				SUBTOTAL:	**$ 17,574,900**
		ENG/SURVEY		0%	$ -
				SUBTOTAL:	**$ 17,574,900**
				Estimated Project Total:	**$ 17,574,900**

City of Killeen

Capital Improvement Cost Estimate	**October, 2019**
Construction Project Number: 22S	**Phase: 2039**
Project Name:	**Septic Tank Elimination Program**

Project Description:

Infrastructure associated with the City's Septic Tank Elimination Program.

Project Drivers:

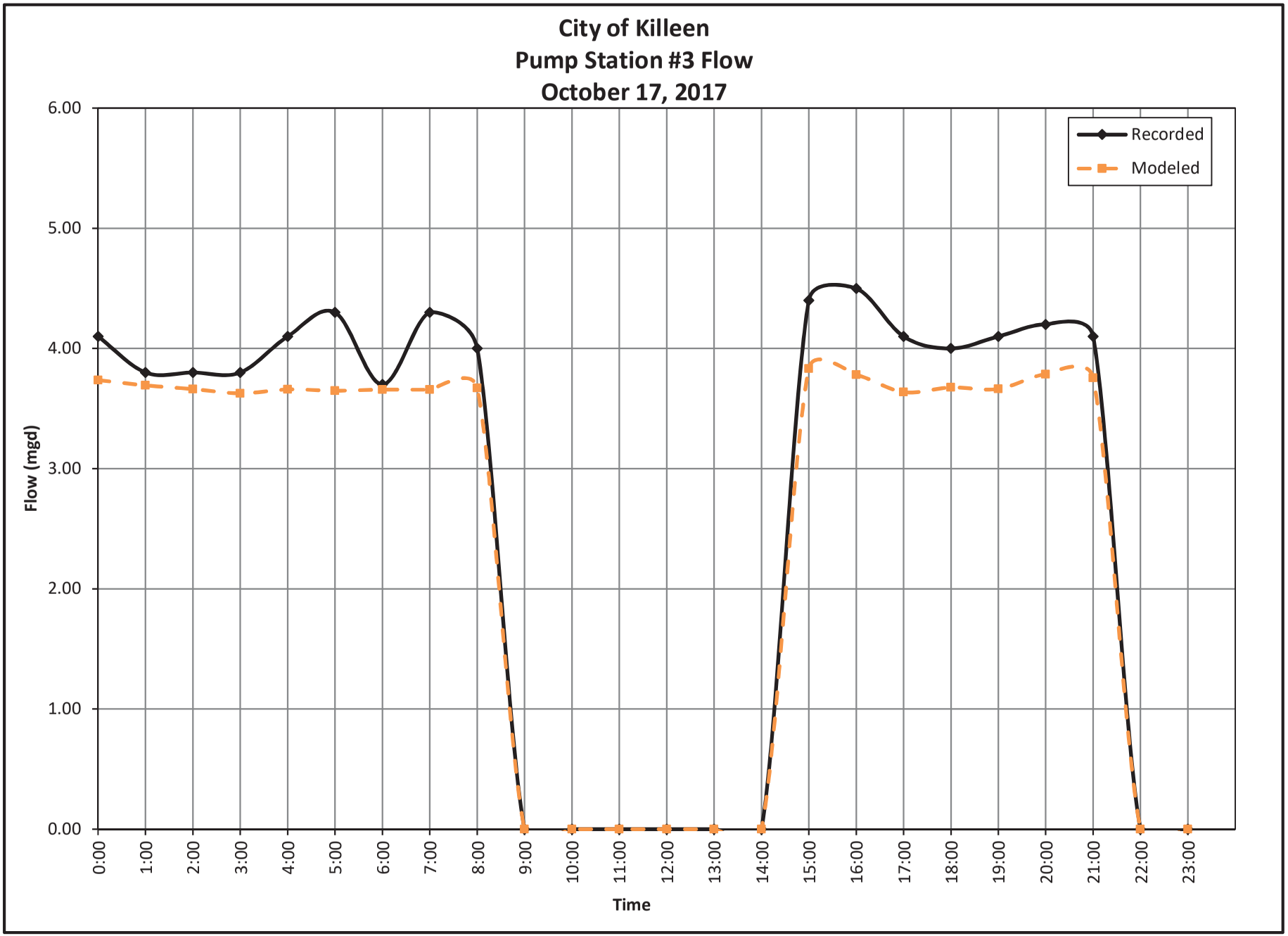
The Septic Tank Elimination Program installs the needed infrastructure to extend wastewater service to existing City residents with septic tanks.

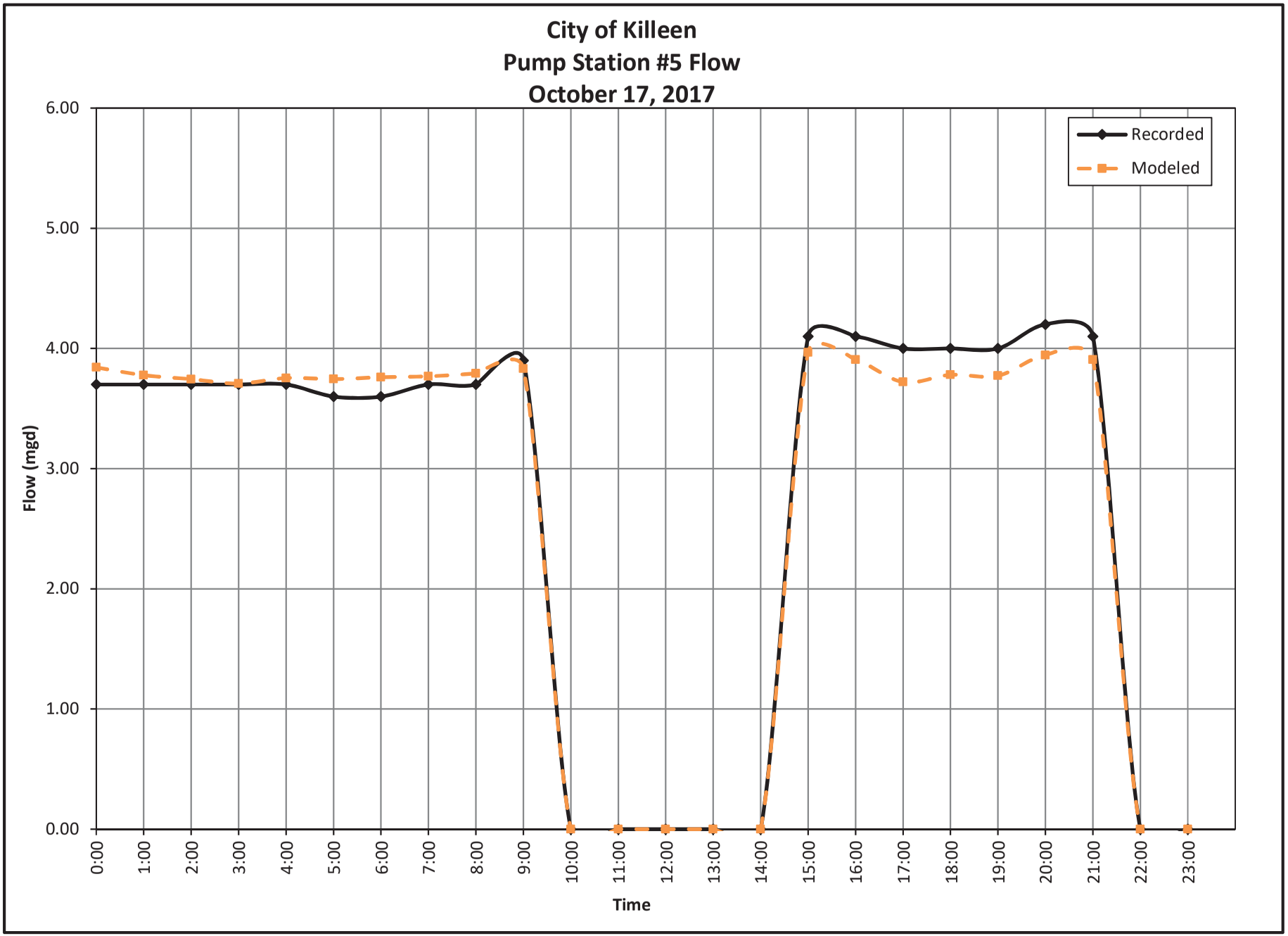
Opinion of Probable Construction Cost

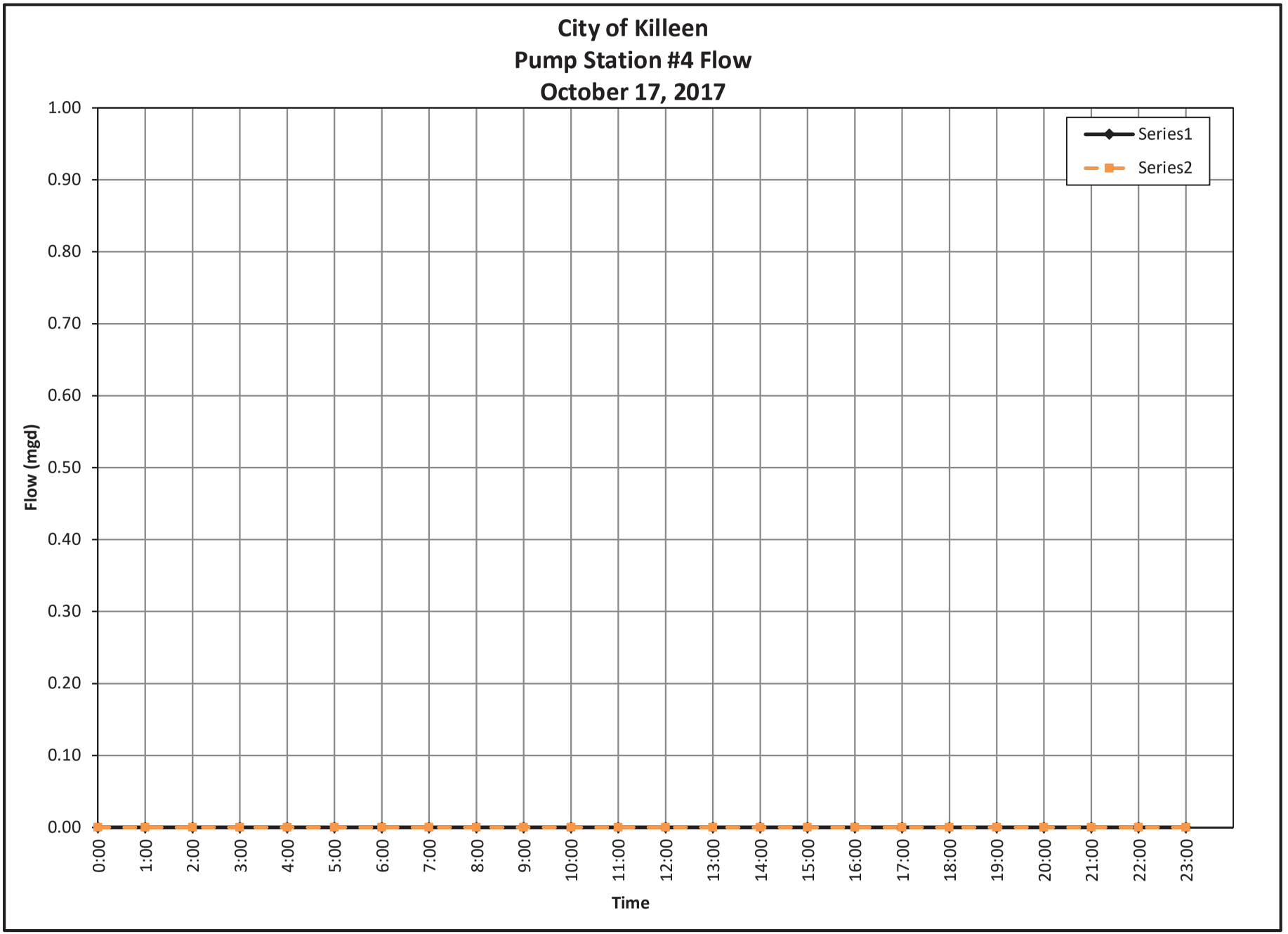
ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Sewer Improvements (10-years)	1	LS	$ 10,000,000	$ 10,000,000
				SUBTOTAL:	**$ 10,000,000**
		CONTINGENCY		0%	$ -
				SUBTOTAL:	**$ 10,000,000**
		ENG/SURVEY		0%	$ -
				SUBTOTAL:	**$ 10,000,000**
				Estimated Project Total:	**$ 10,000,000**

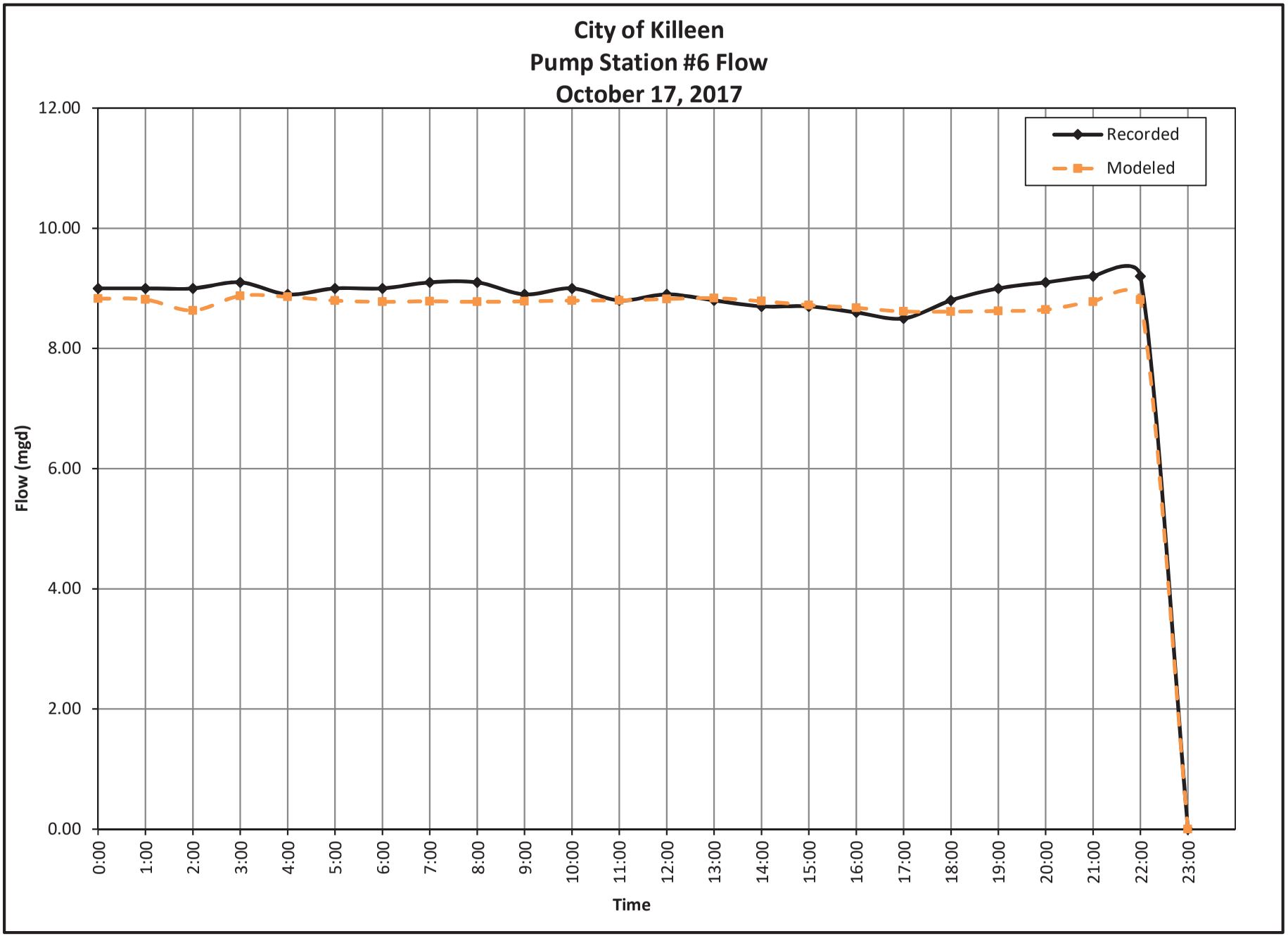
Appendix C

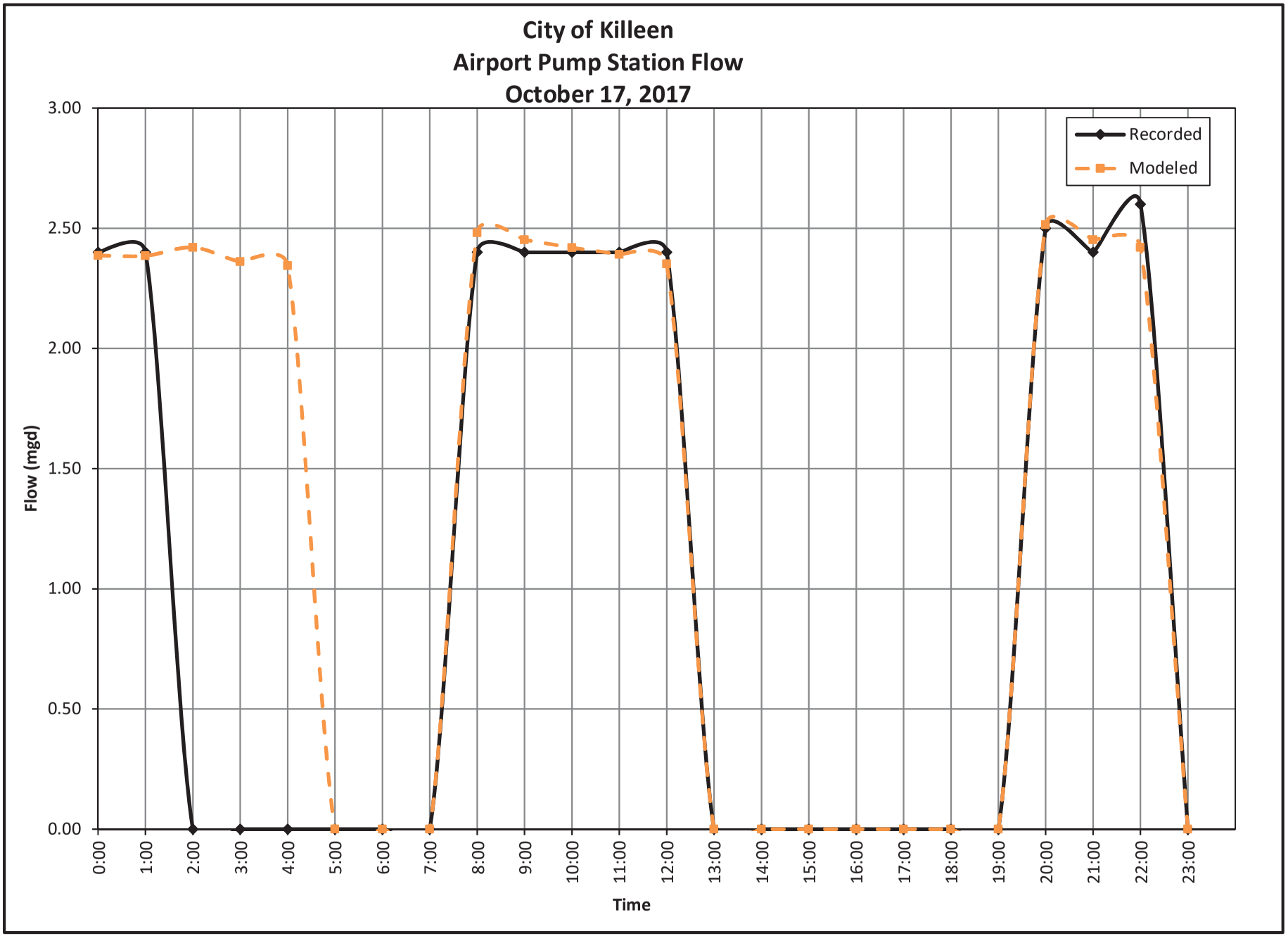
Water Model Calibration Results

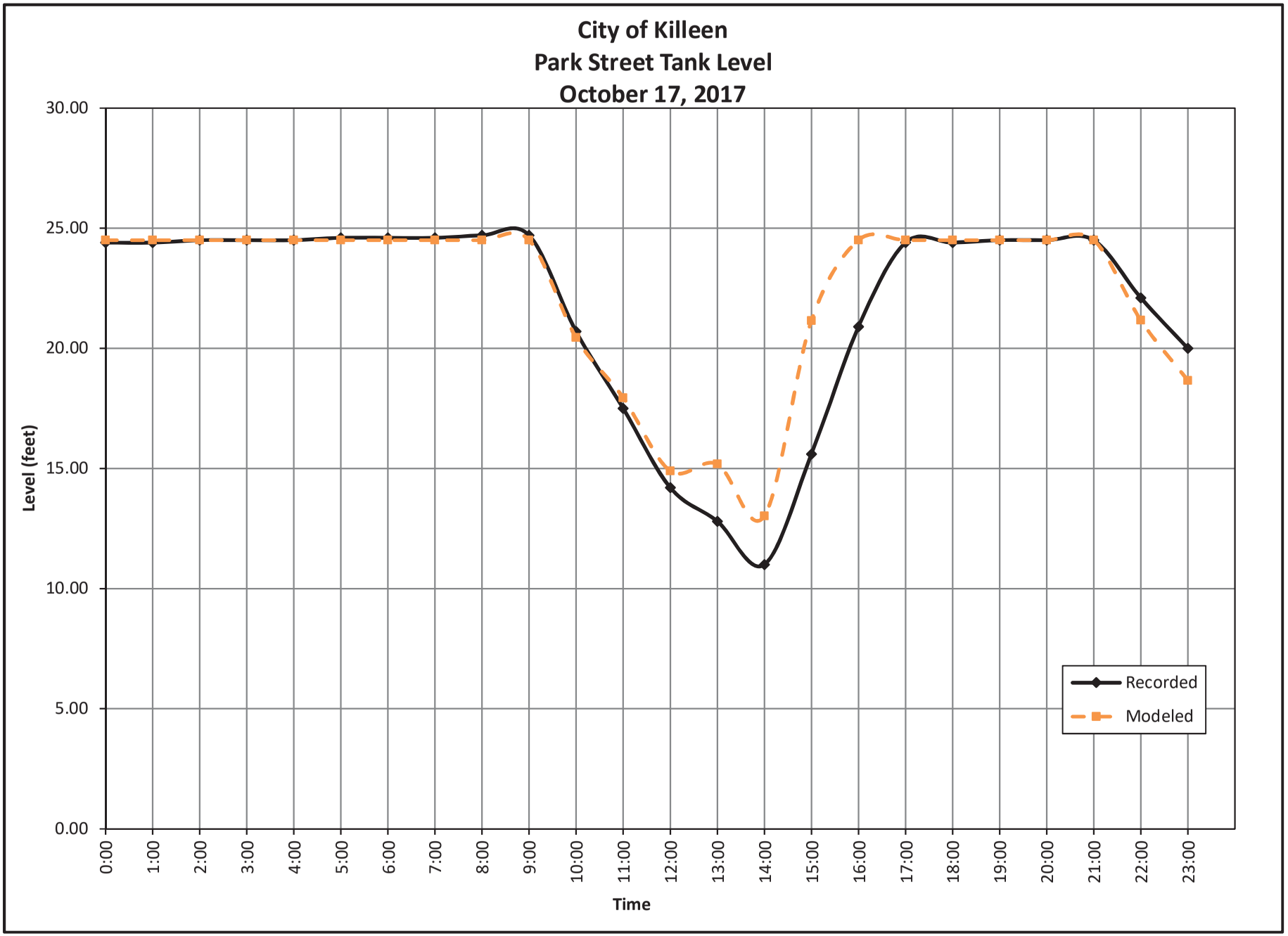

City of Killeen
Pump Station #3 Flow
October 17, 2017
Recorded
Modeled
Flow (mgd)
6.00
5.00
4.00
3.00
2.00
1.00
0.00
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
Time

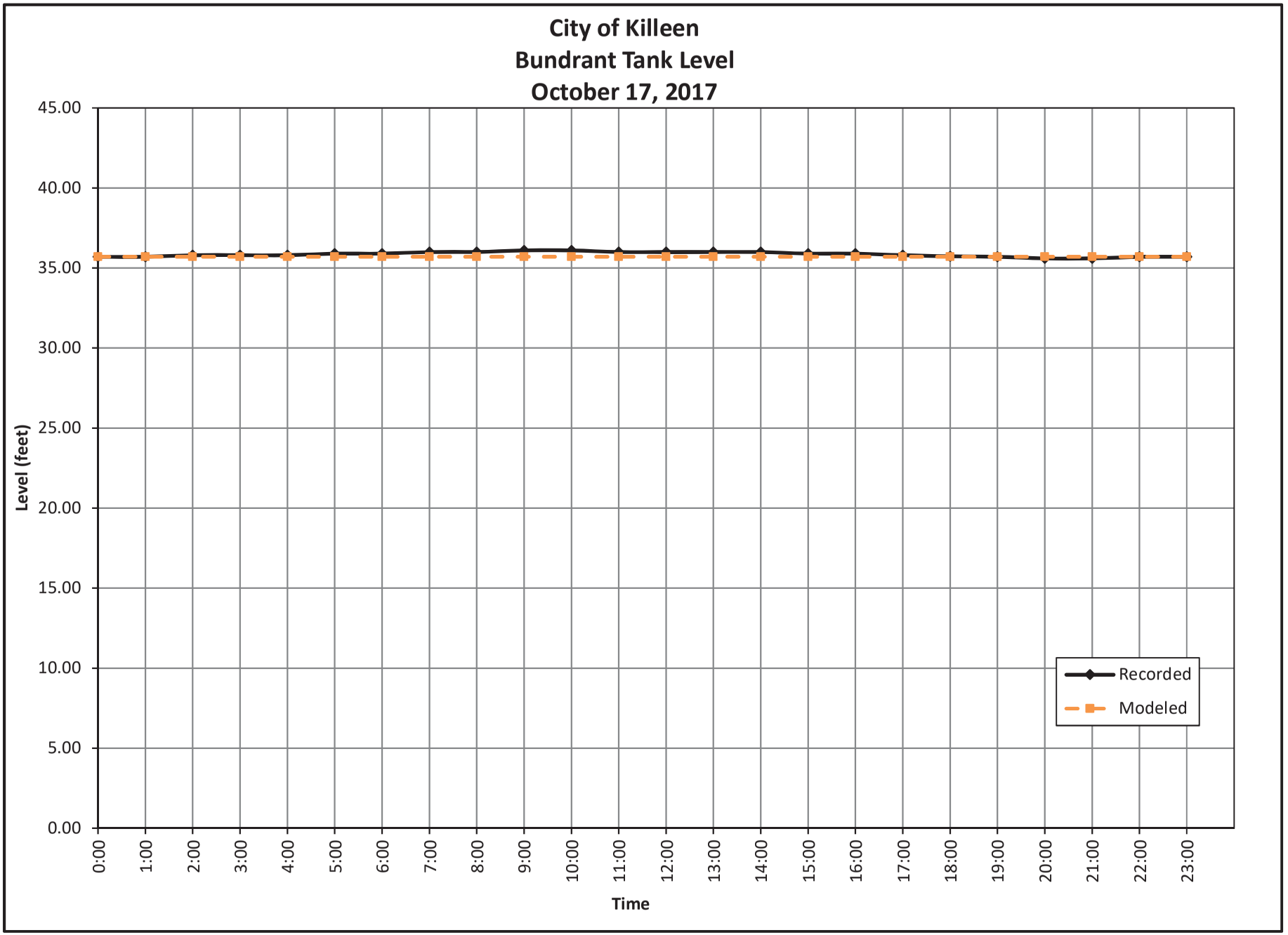

City of Killeen
Pump Station #5 Flow
October 17, 2017
Recorded
Modeled
Flow (mgd)
6.00
5.00
4.00
3.00
2.00
1.00
0.00
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
Time

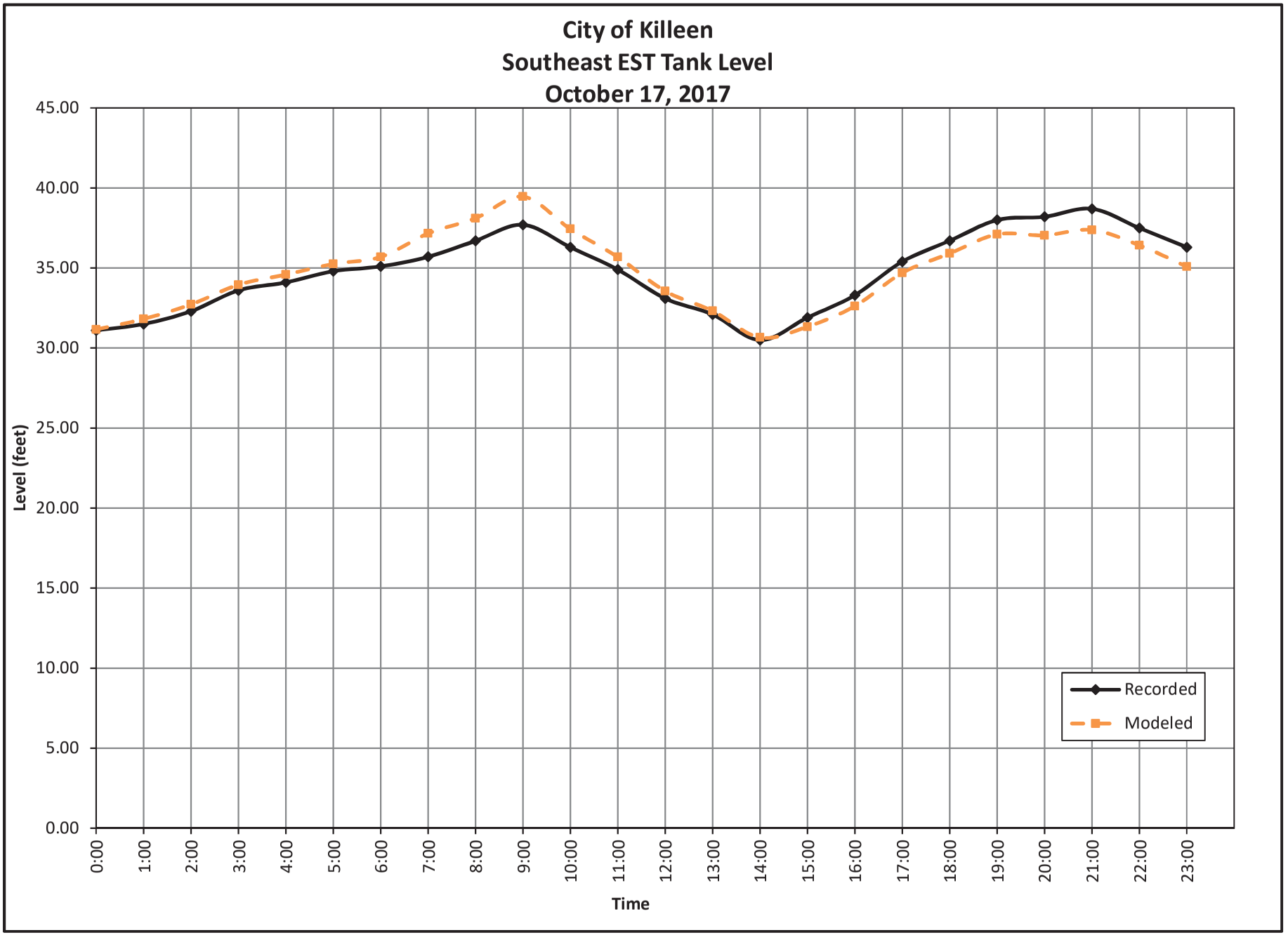

City of Killeen
Pump Station #4 Flow
October 17, 2017
Flow (mgd)
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
Time
Series1
Series2

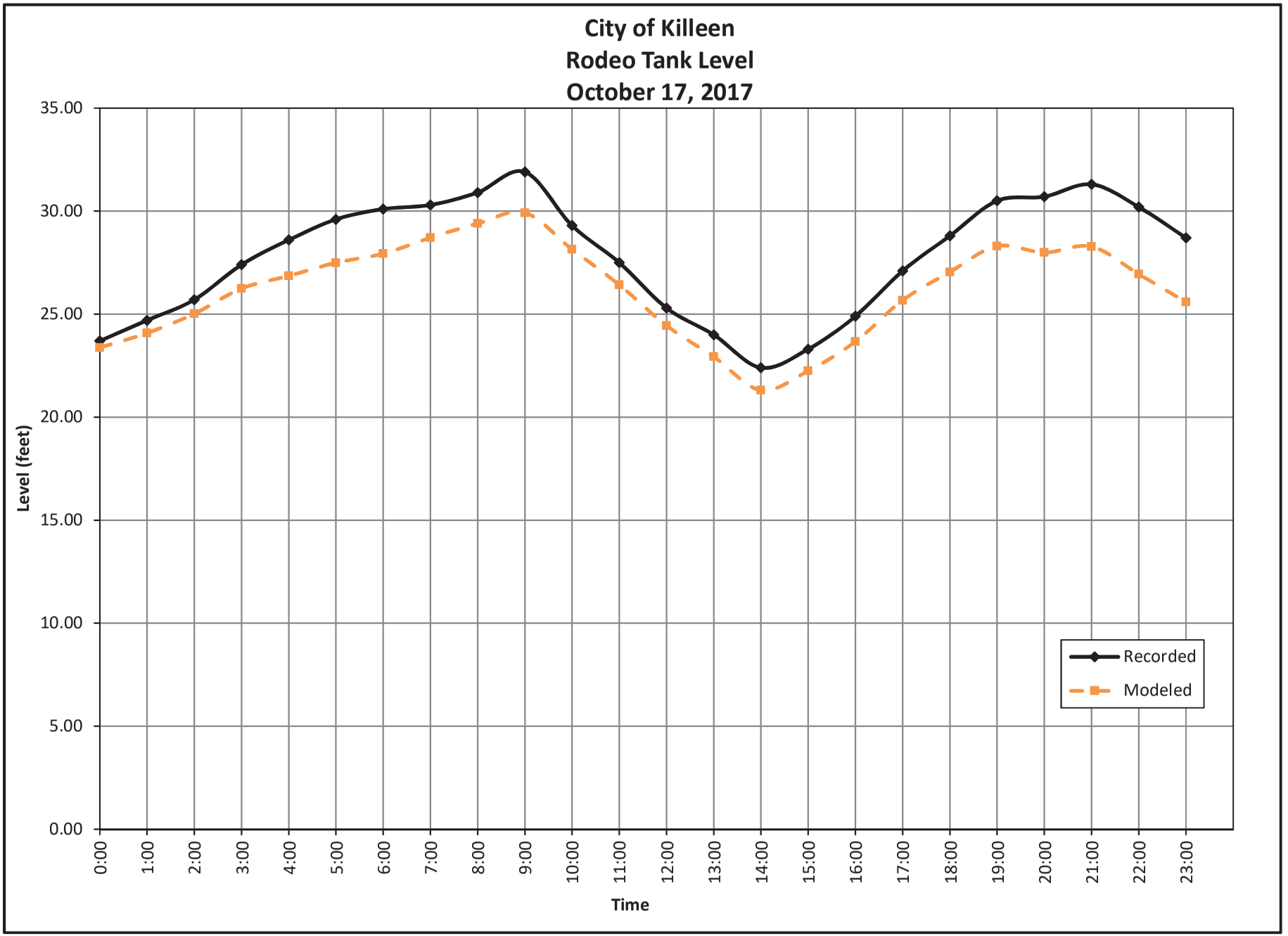

City of Killeen
Pump Station #6 Flow
October 17, 2017
Recorded
Modeled
Flow (mgd)
12.00
10.00
8.00
6.00
4.00
2.00
0.00
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
Time

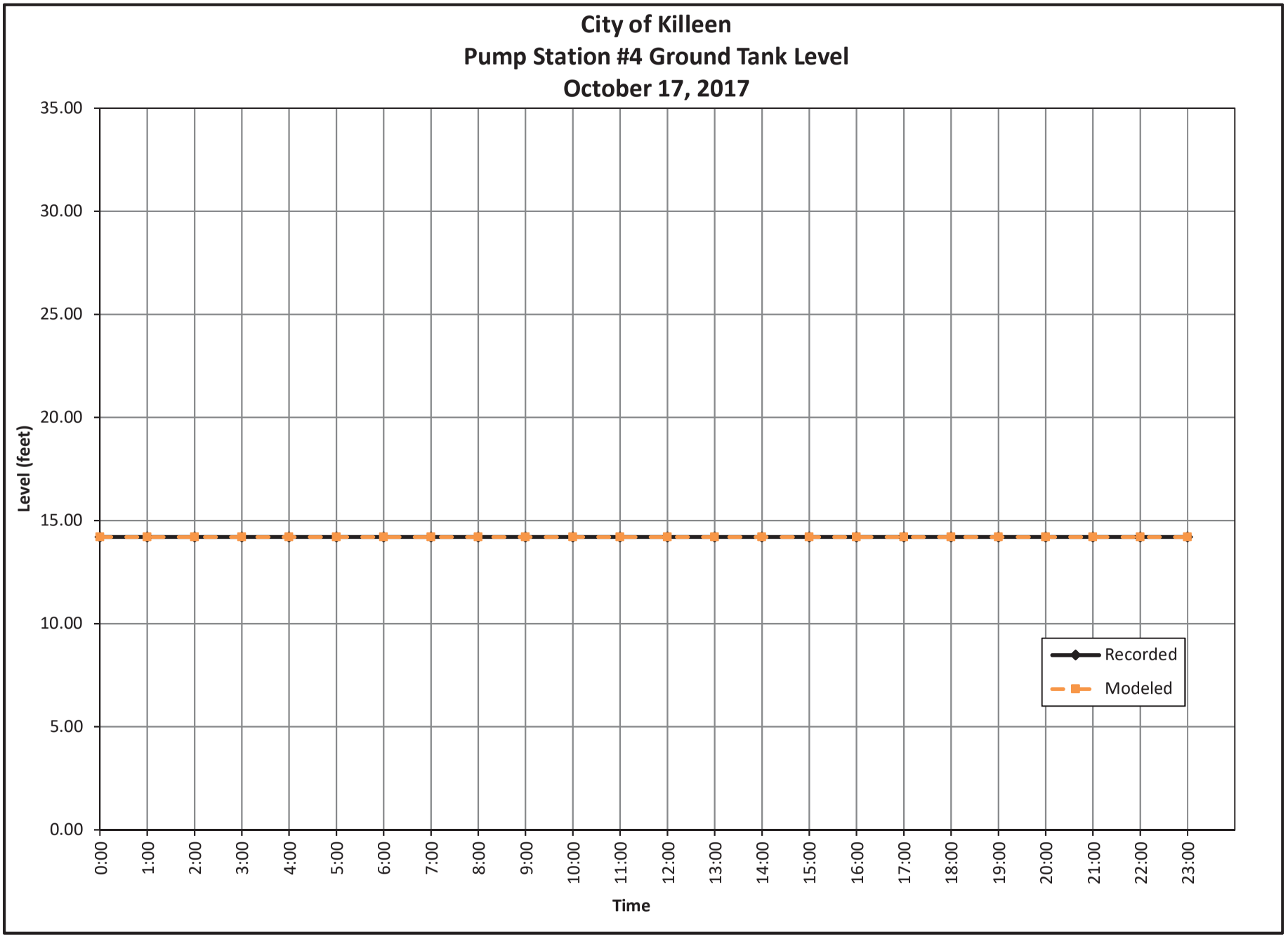

City of Killeen
Airport Pump Station Flow
October 17, 2017
Recorded
Modeled
Flow (mgd)
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
Time

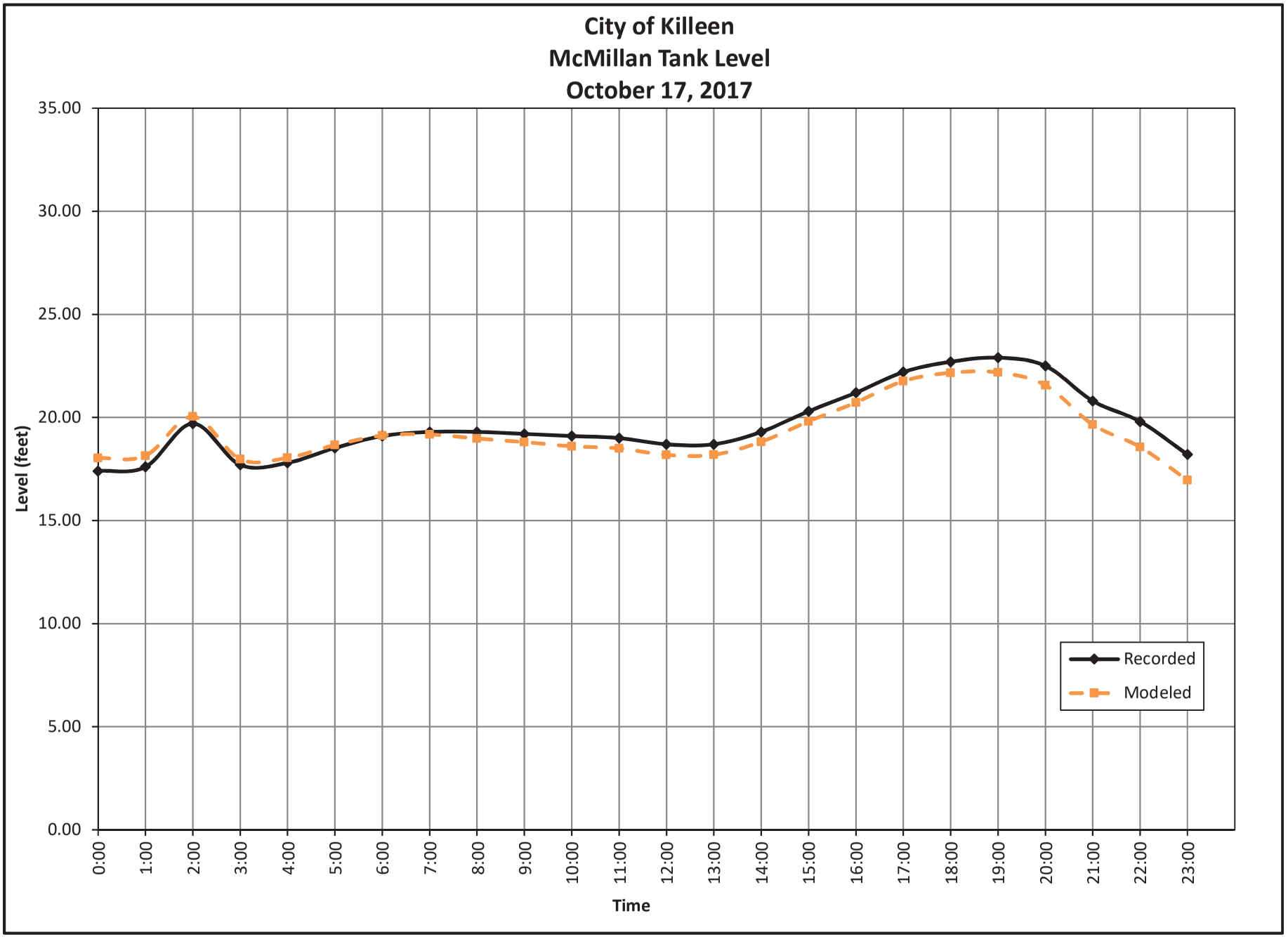

City of Killeen
Park Street Tank Level
October 17, 2017
30.00
25.00
20.00
15.00
10.00
5.00
0.00
Level (feet)
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
Time
Recorded
Modeled

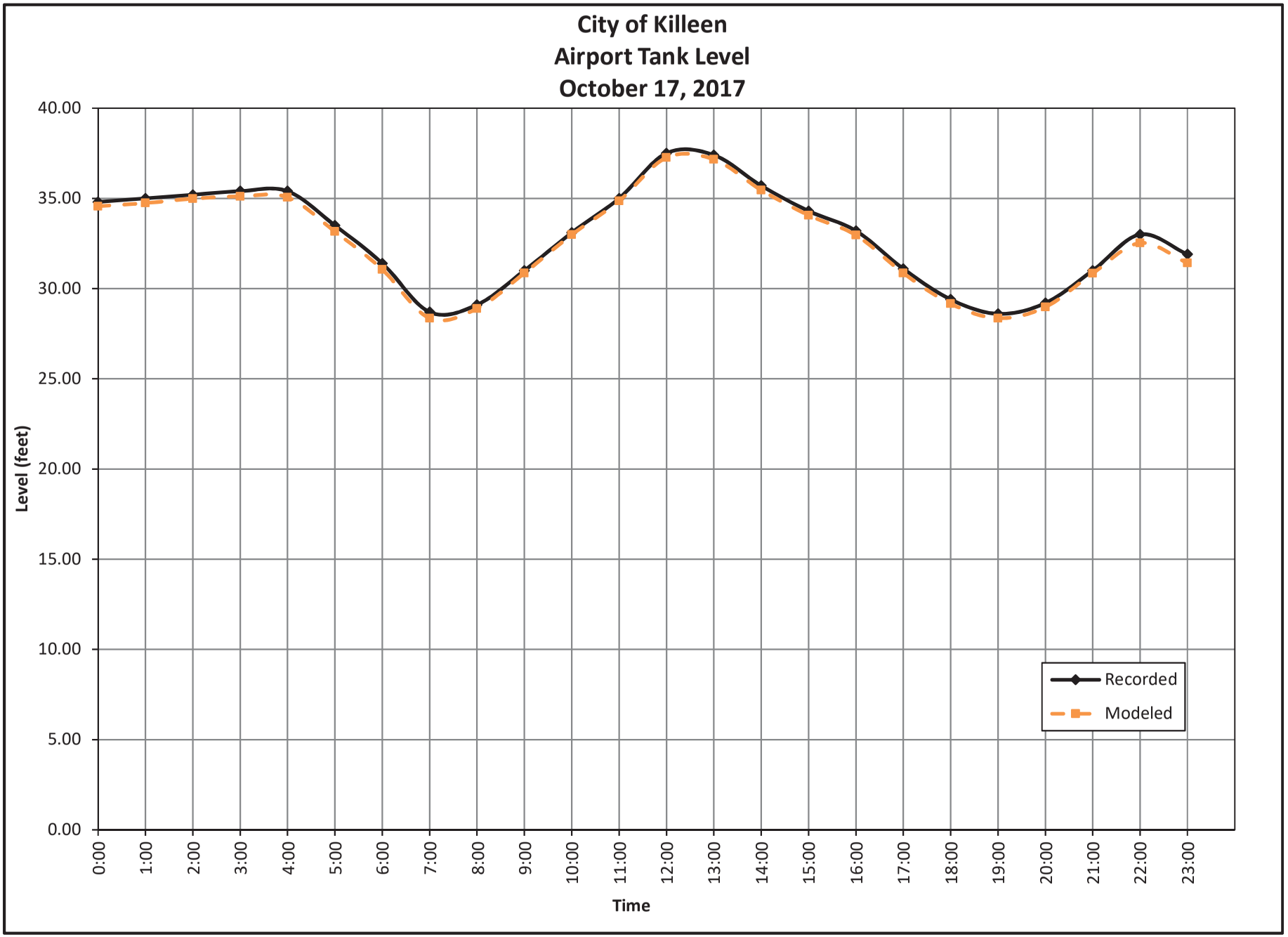

City of Killeen
Bundrant Tank Level
October 17, 2017
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
Level (feet)
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
Time
Recorded
Modeled

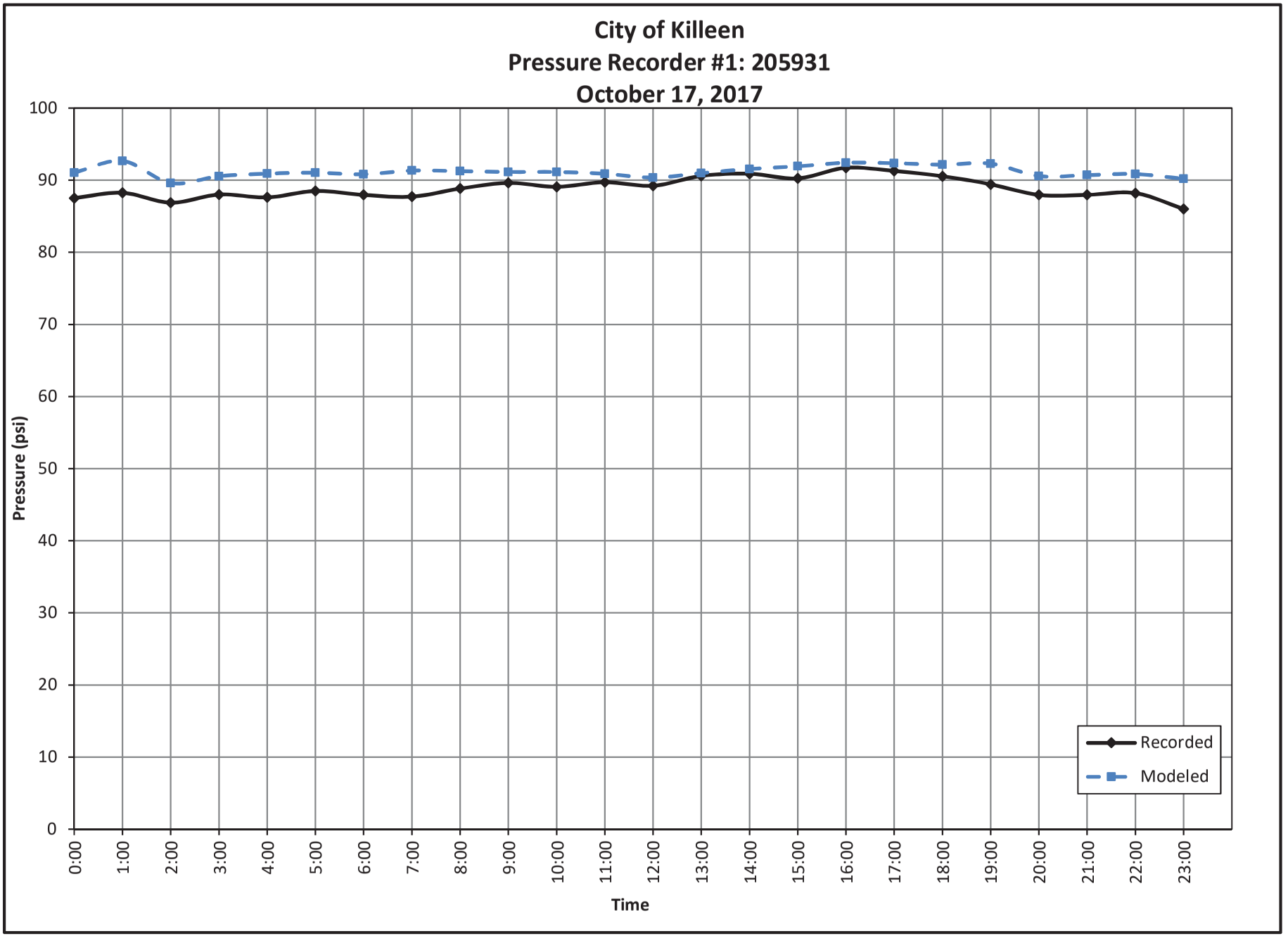

City of Killeen
Southeast EST Tank Level
October 17, 2017
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
Level (feet)
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
Time
Recorded
Modeled

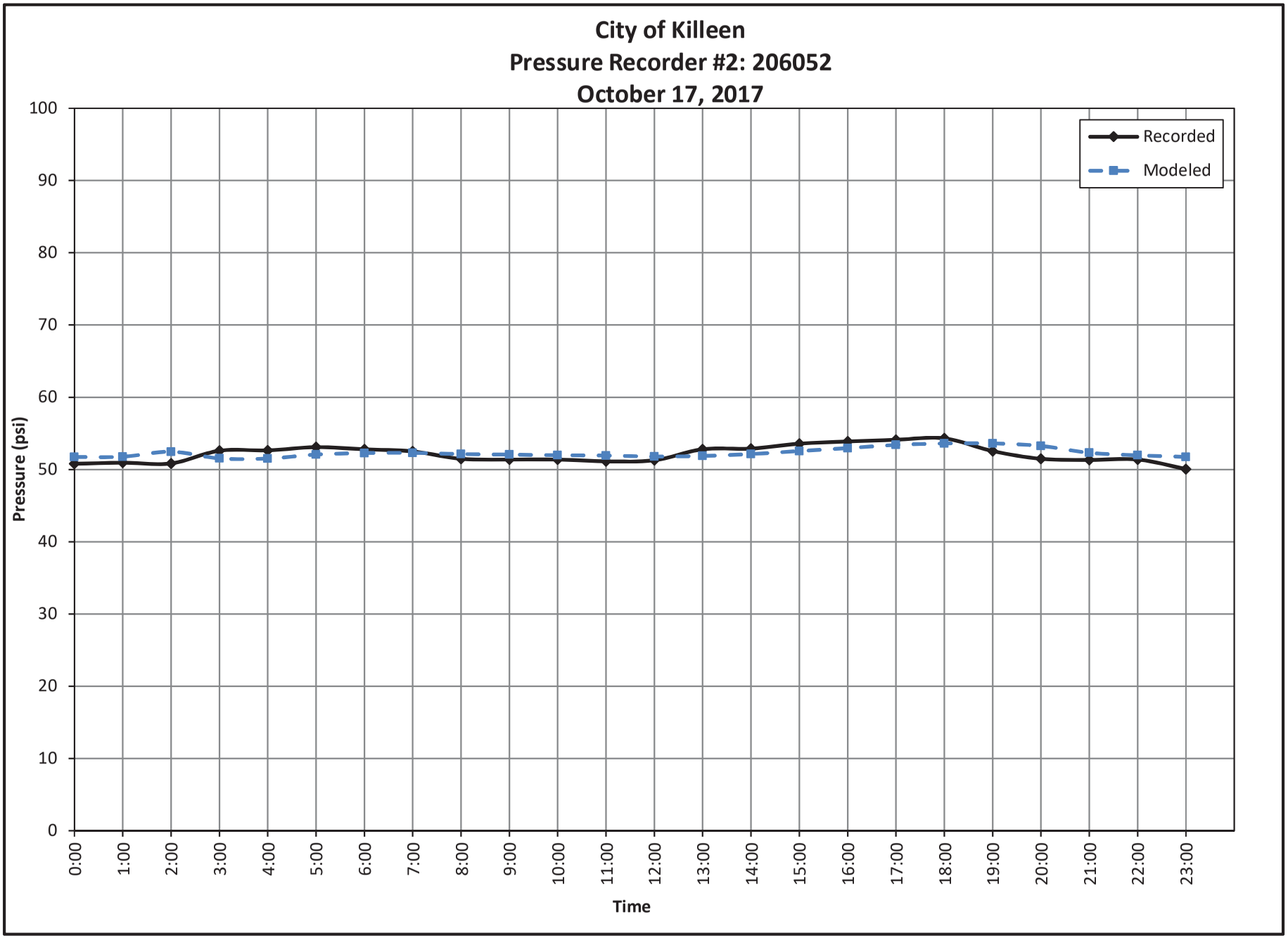

City of Killeen
Rodeo Tank Level
October 17, 2017
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
Level (feet)
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
Time
Recorded
Modeled

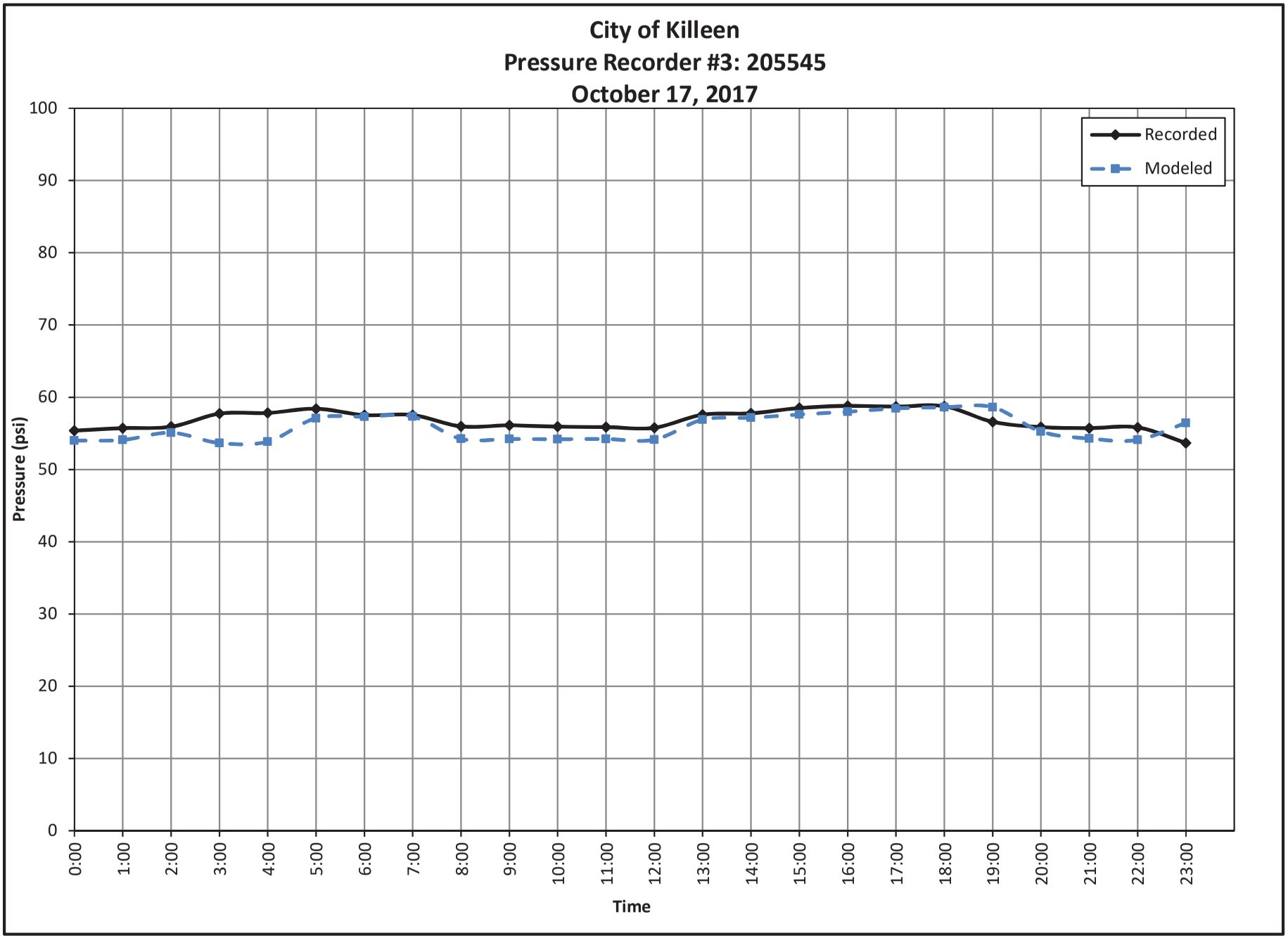

City of Killeen
Pump Station #4 Ground Tank Level
October 17, 2017
Level (feet)
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
Time
Recorded
Modeled

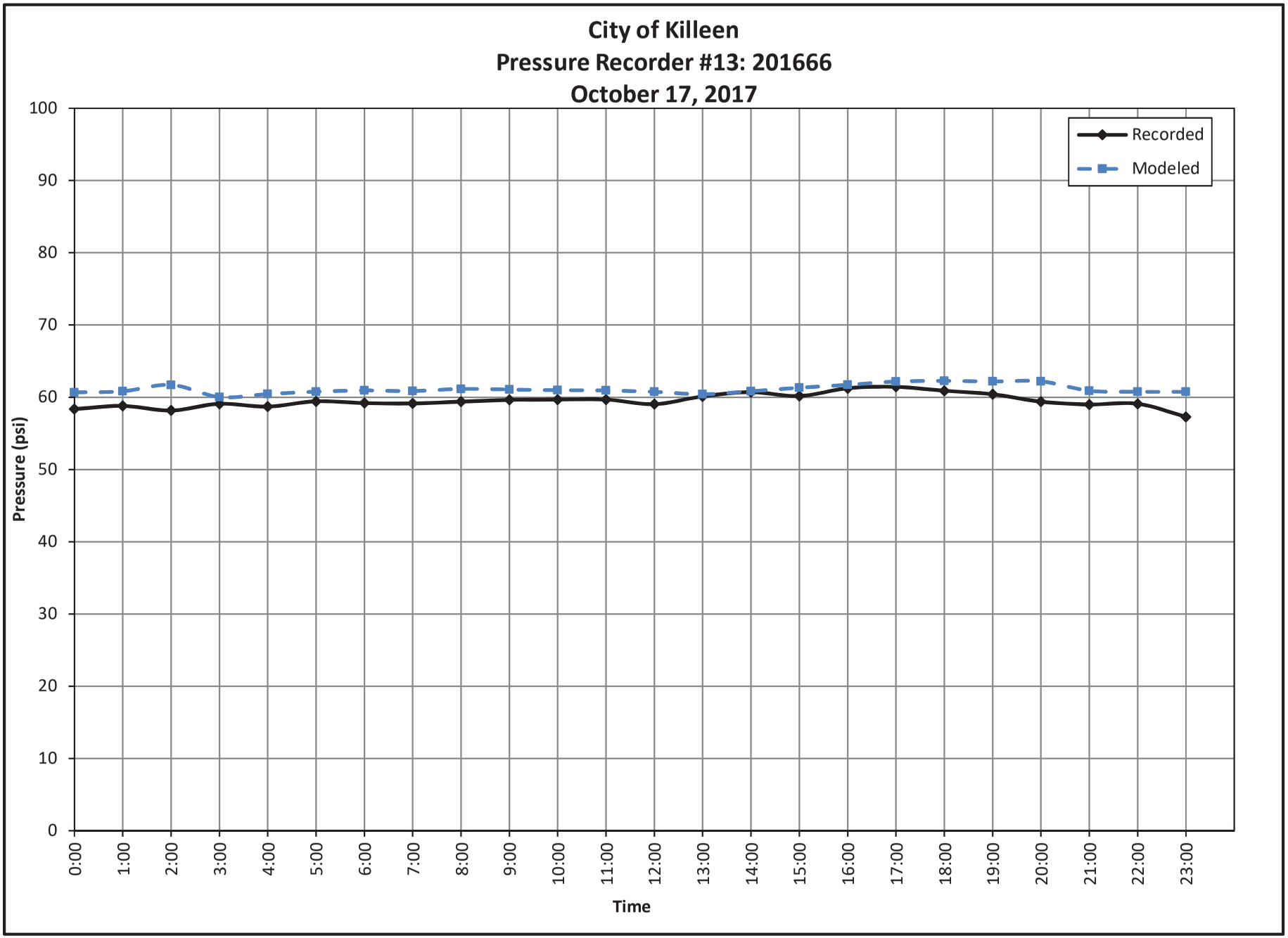

City of Killeen
McMillan Tank Level
October 17, 2017
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
Level (feet)
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
Time
Recorded
Modeled

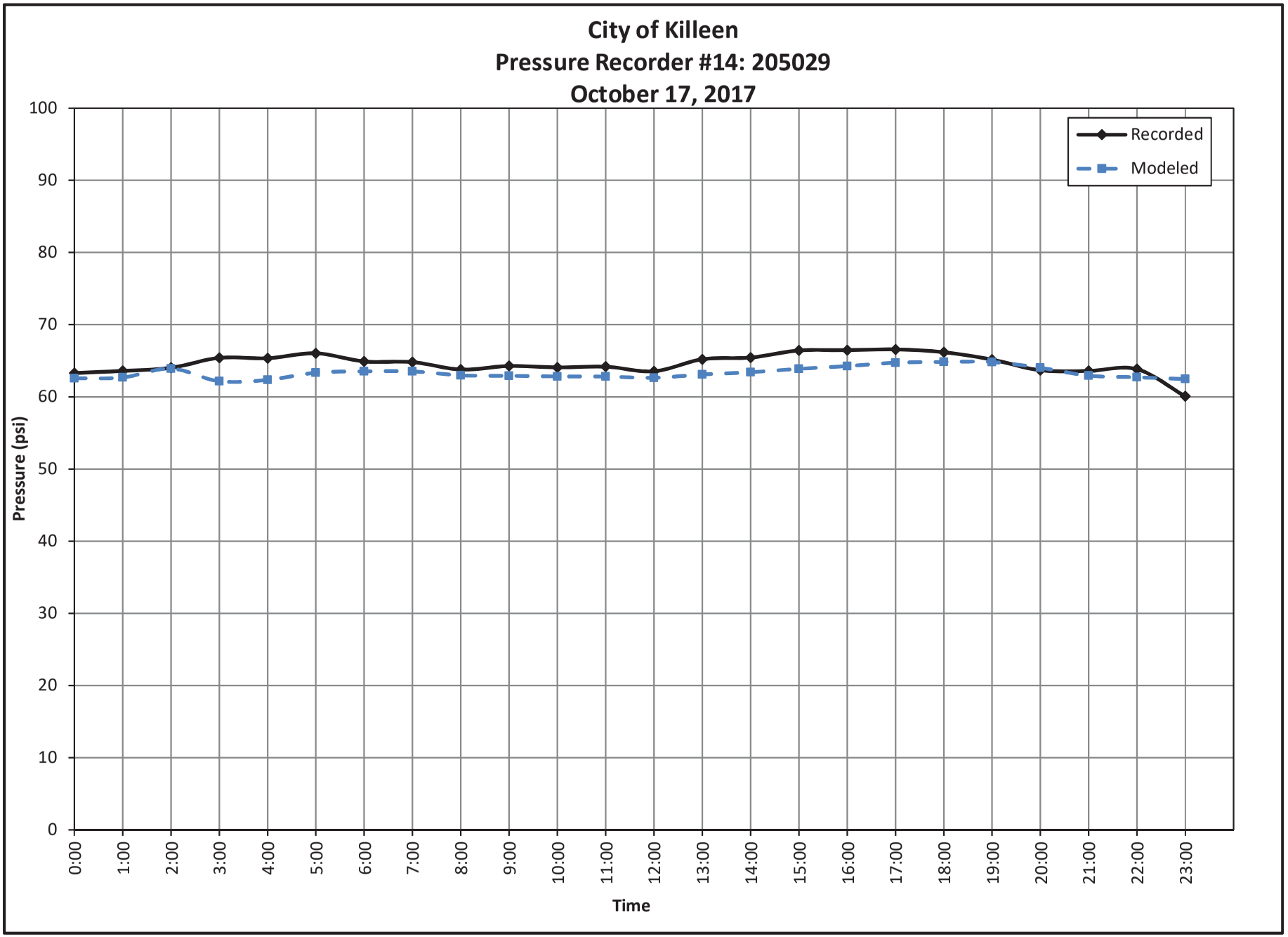

City of Killeen
Airport Tank Level
October 17, 2017
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
Level (feet)
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
Time
Recorded
Modeled

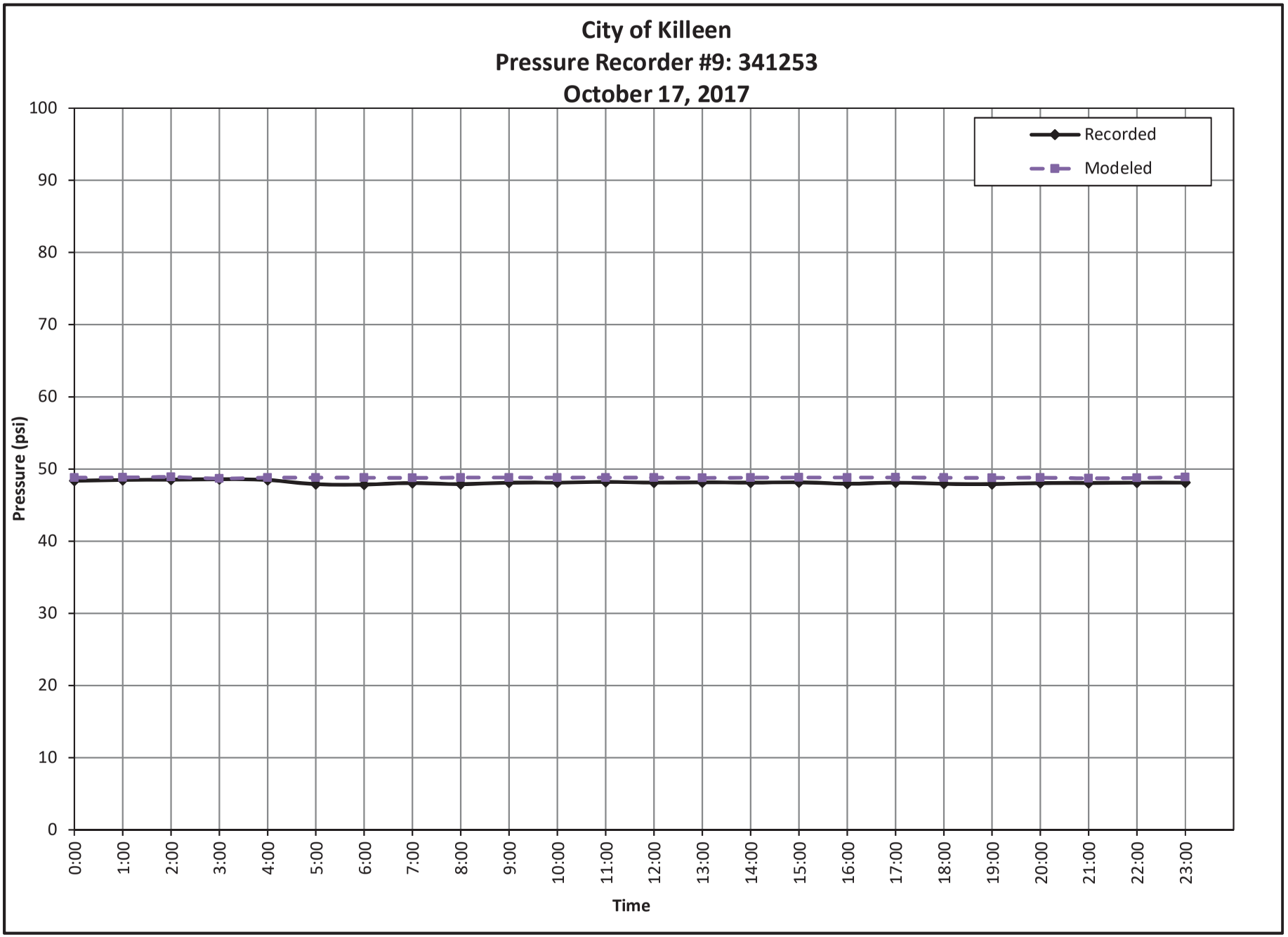

City of Killeen
Pressure Recorder #1: 205931
October 17, 2017
Pressure (psi)
100
90
80
70
60
50
40
30
20
10
0
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
Time
Recorded
Modeled

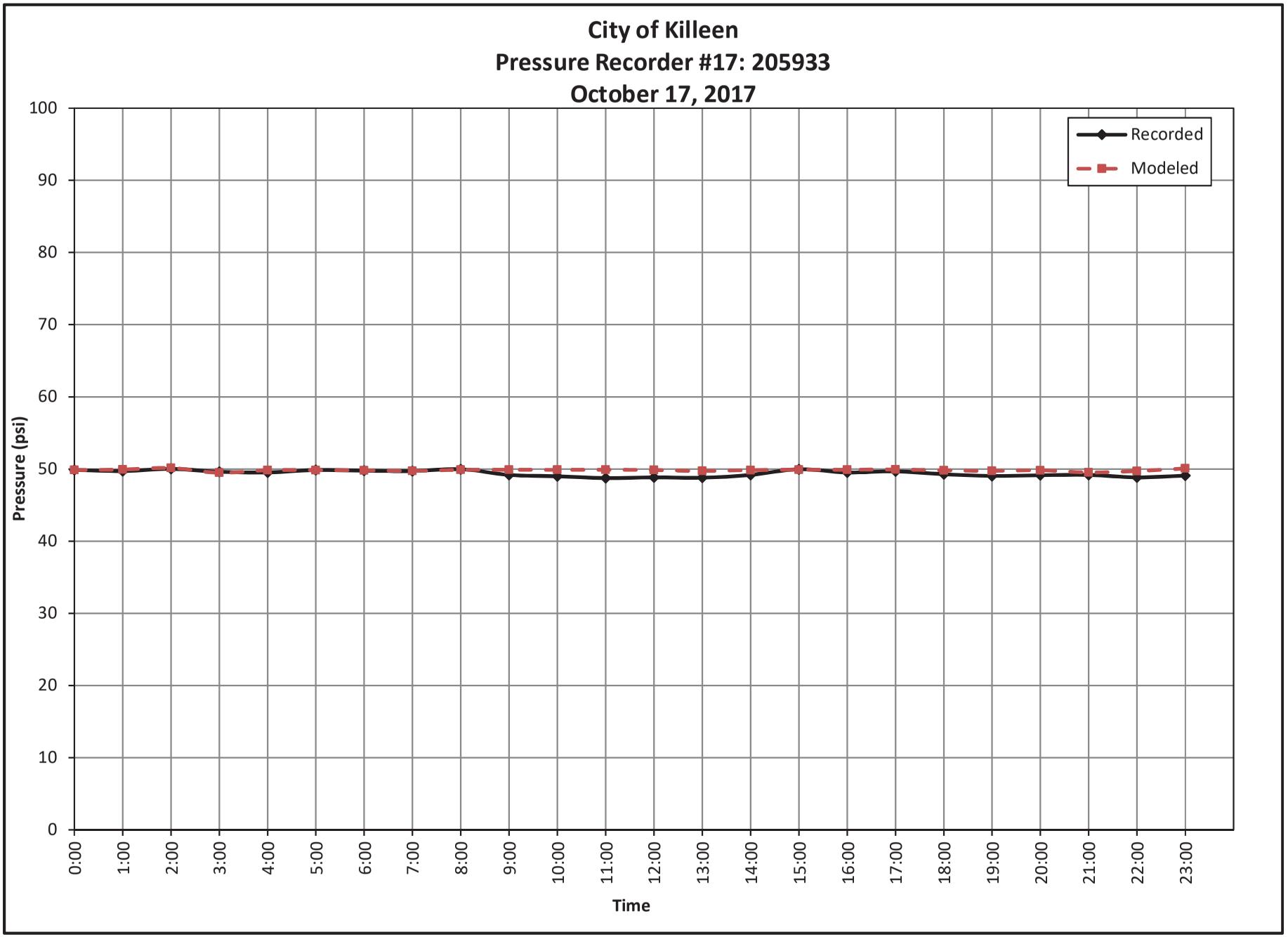

City of Killeen
Pressure Recorder #2: 206052
October 17, 2017
Recorded
Modeled
Pressure (psi)
100
90
80
70
60
50
40
30
20
10
0
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
Time

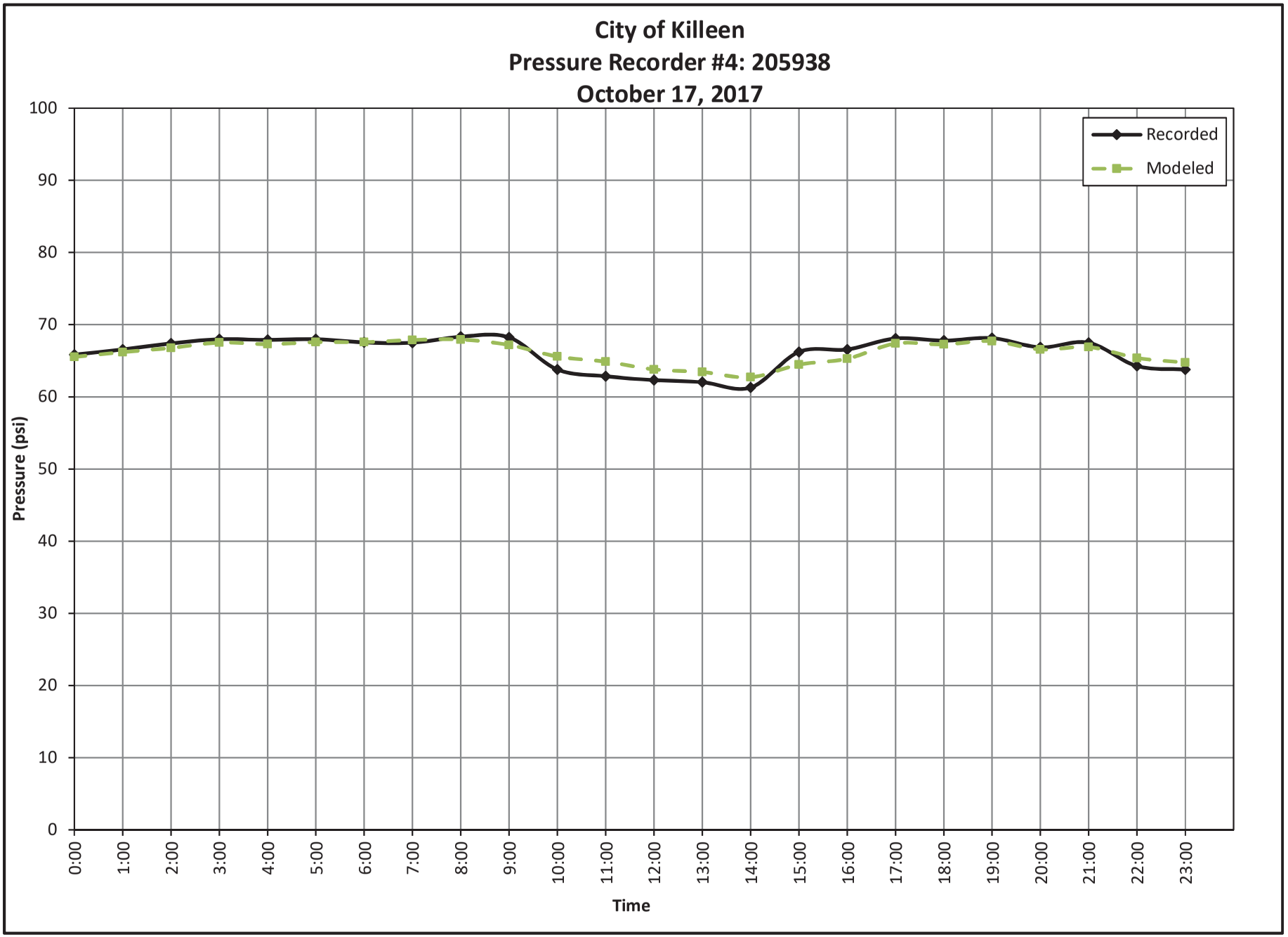

City of Killeen
Pressure Recorder #3: 205545
October 17, 2017
Recorded
Modeled
Pressure (psi)
100
90
80
70
60
50
40
30
20
10
0
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
Time

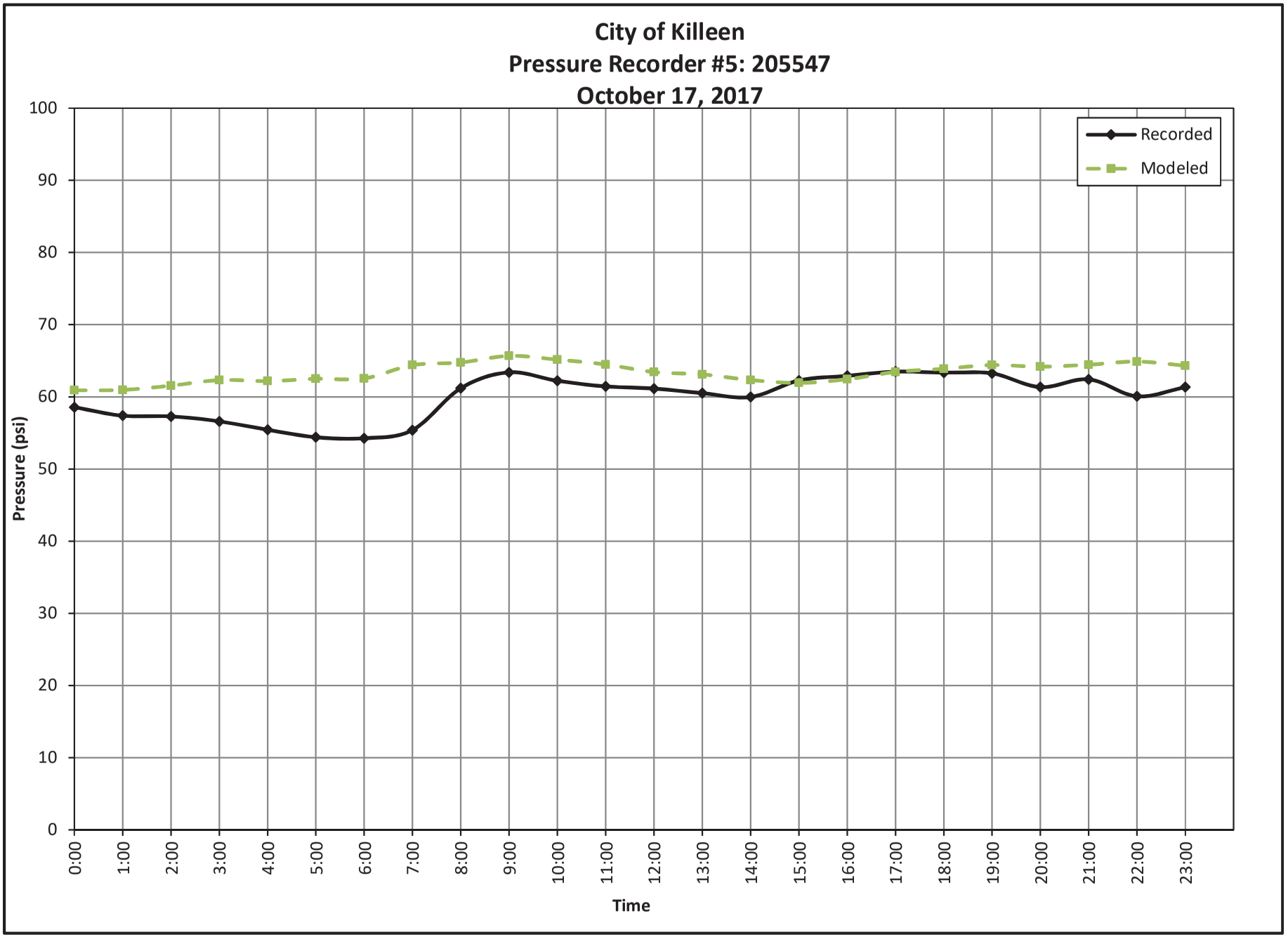

City of Killeen
Pressure Recorder #13: 201666
October 17, 2017
Recorded
Modeled
Pressure (psi)
100
90
80
70
60
50
40
30
20
10
0
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
Time

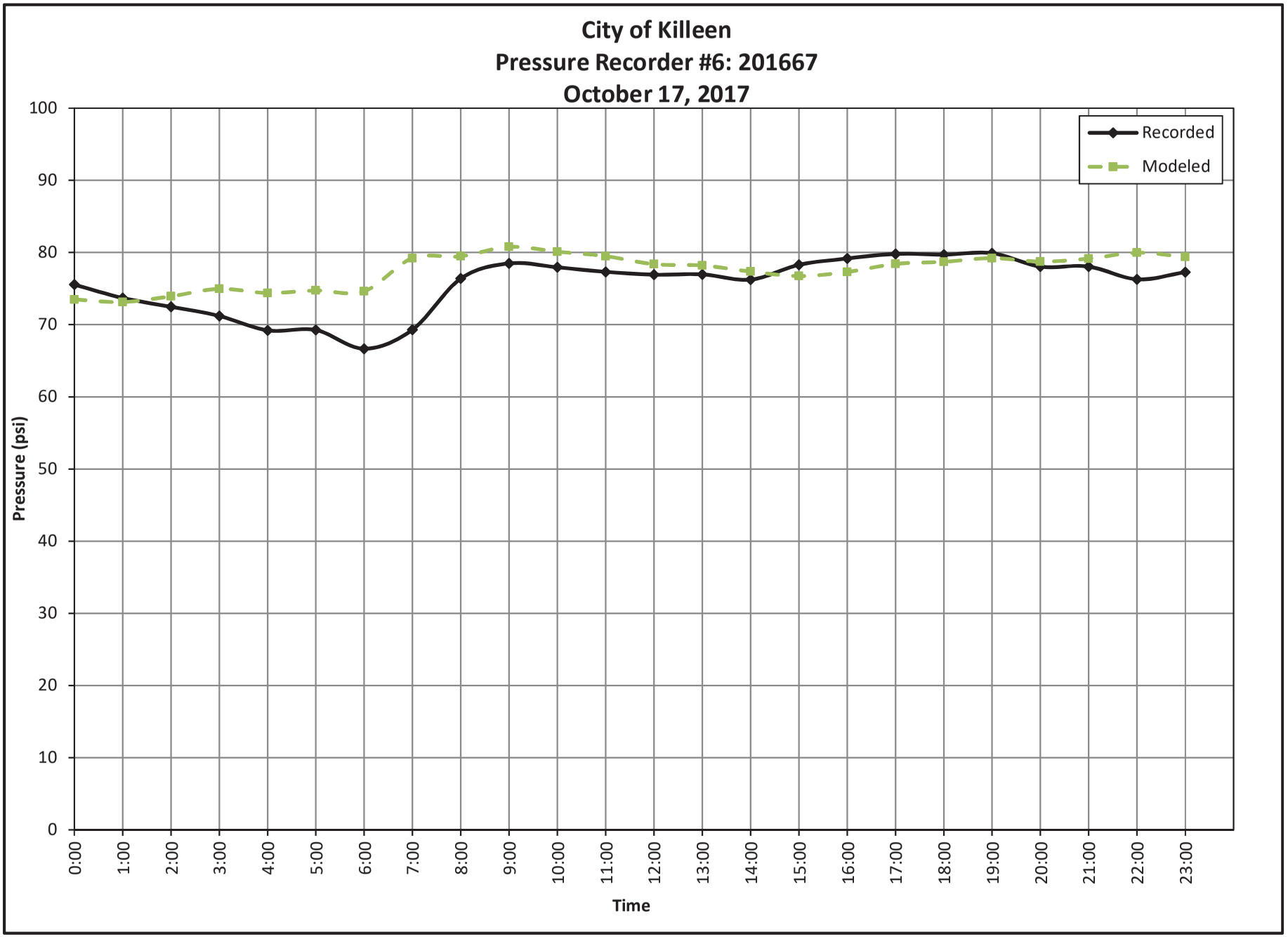

City of Killeen
Pressure Recorder #14: 205029
October 17, 2017
Recorded
Modeled
Pressure (psi)
100
90
80
70
60
50
40
30
20
10
0
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
Time

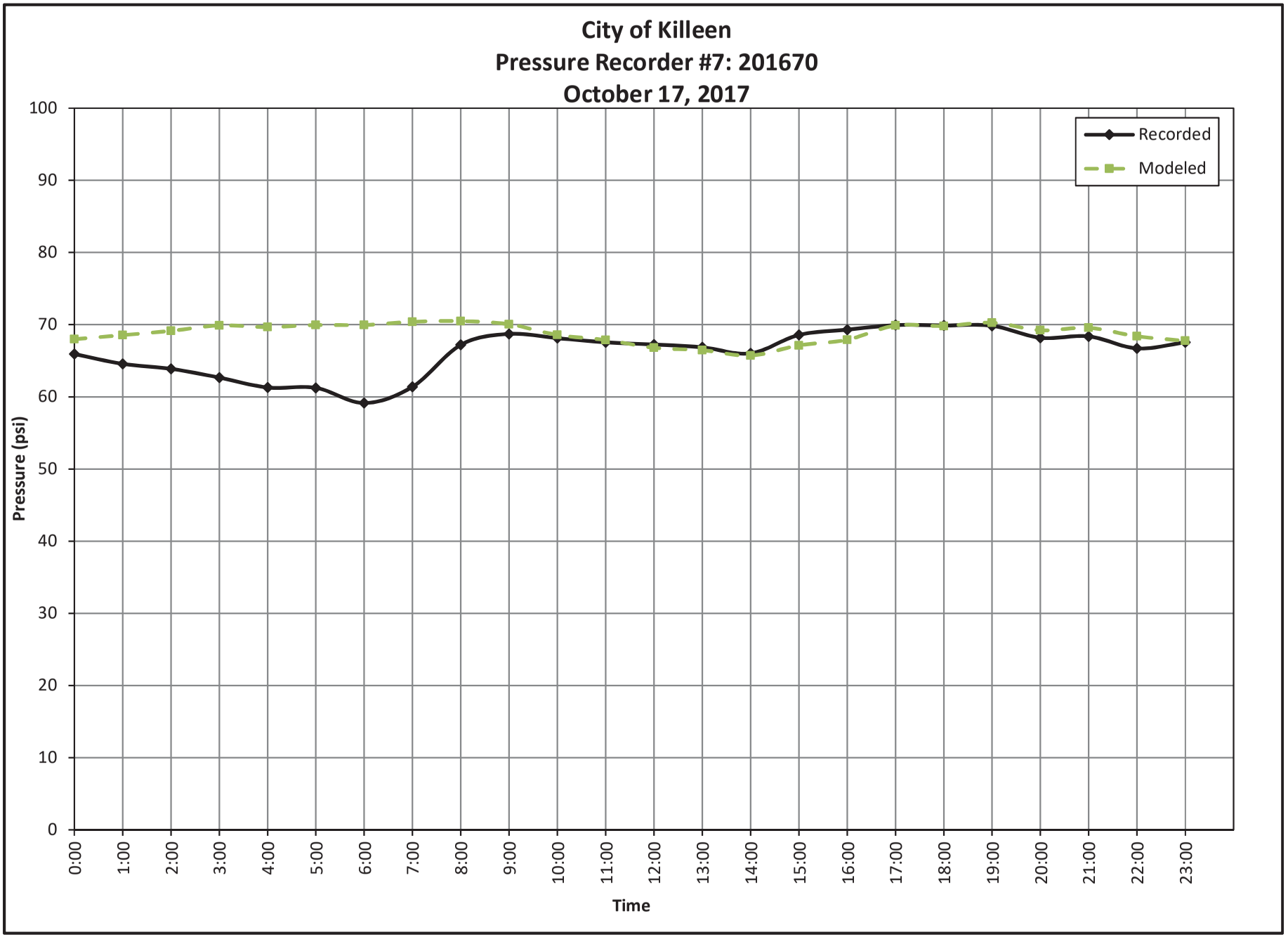

City of Killeen
Pressure Recorder #9: 341253
October 17, 2017
Recorded
Modeled
Pressure (psi)
100
90
80
70
60
50
40
30
20
10
0
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
Time

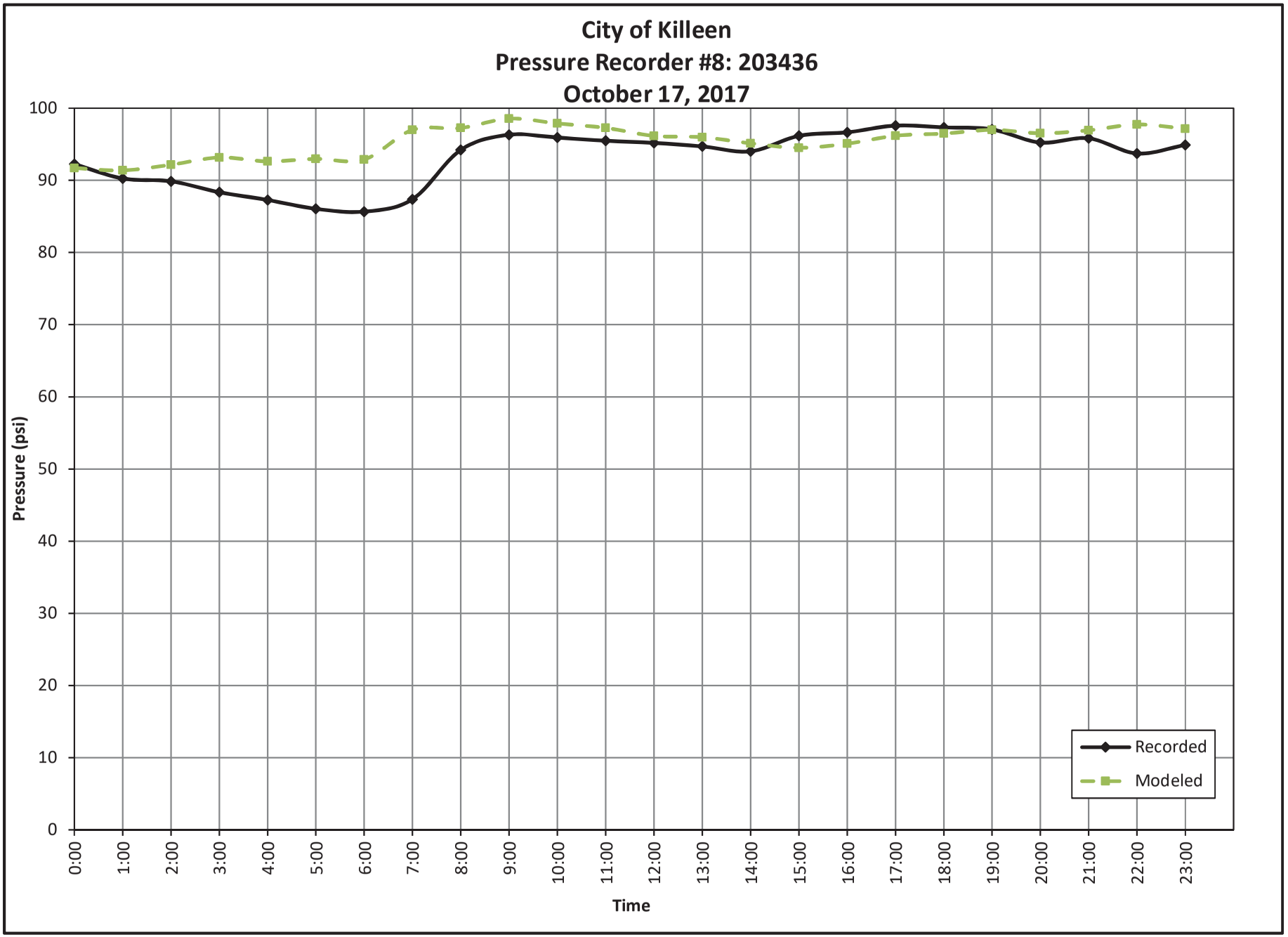

City of Killeen
Pressure Recorder #17: 205933
October 17, 2017
Recorded
Modeled
Pressure (psi)
100
90
80
70
60
50
40
30
20
10
0
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
Time

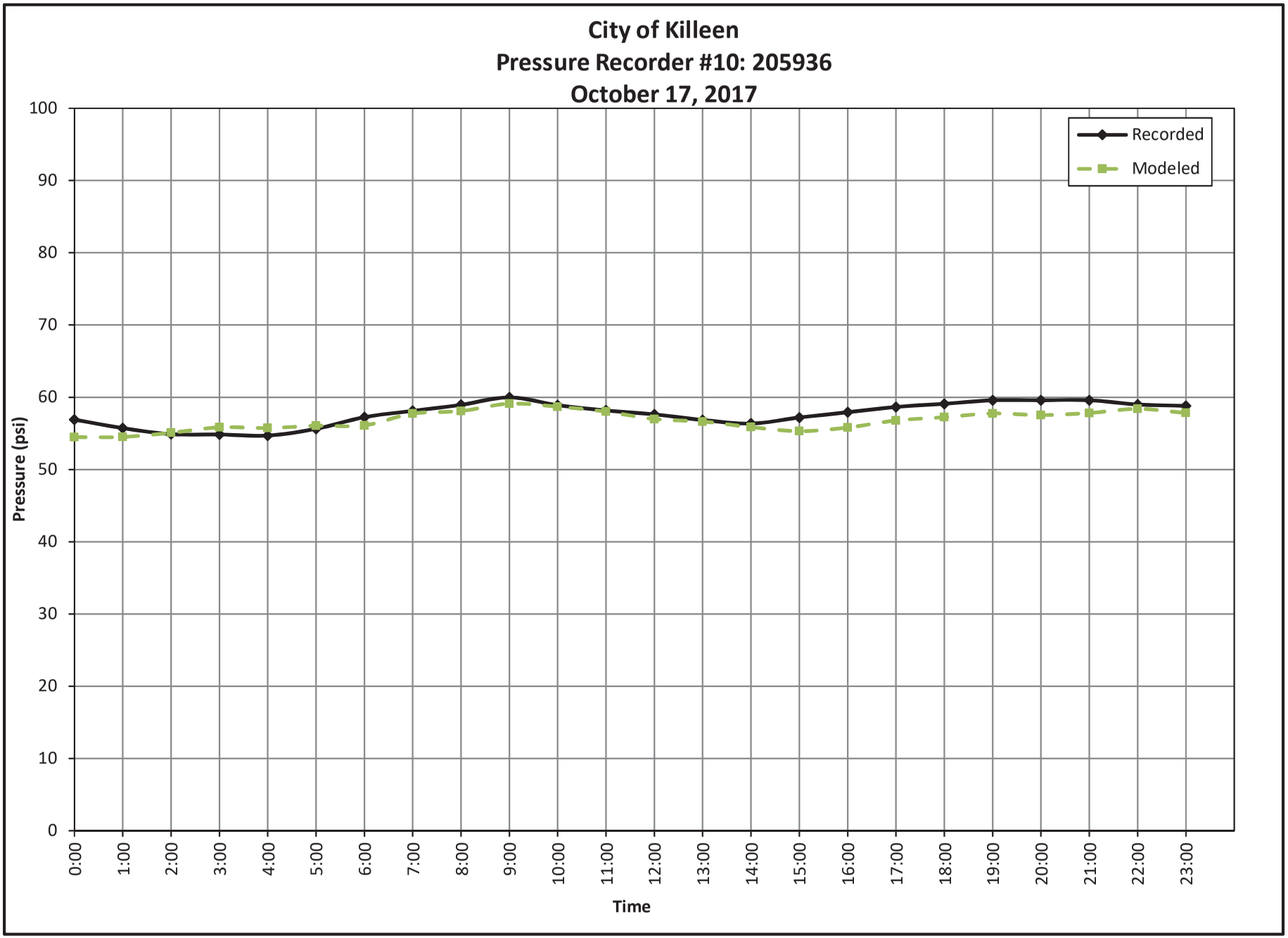

City of Killeen
Pressure Recorder #4: 205938
October 17, 2017
Recorded
Modeled
Pressure (psi)
100
90
80
70
60
50
40
30
20
10
0
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
Time

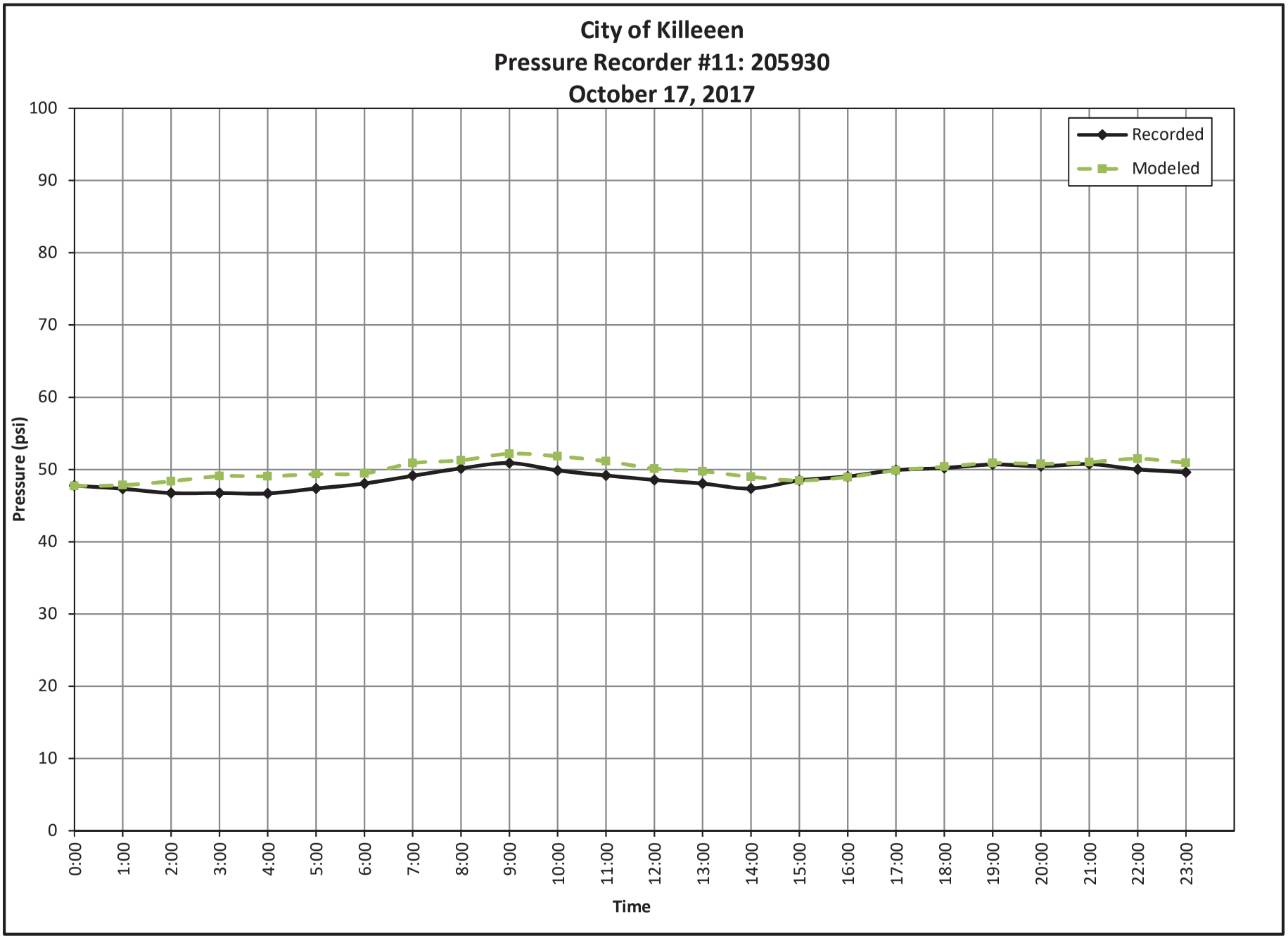

City of Killeen
Pressure Recorder #5: 205547
October 17, 2017
Recorded
Modeled
Pressure (psi)
100
90
80
70
60
50
40
30
20
10
0
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
Time

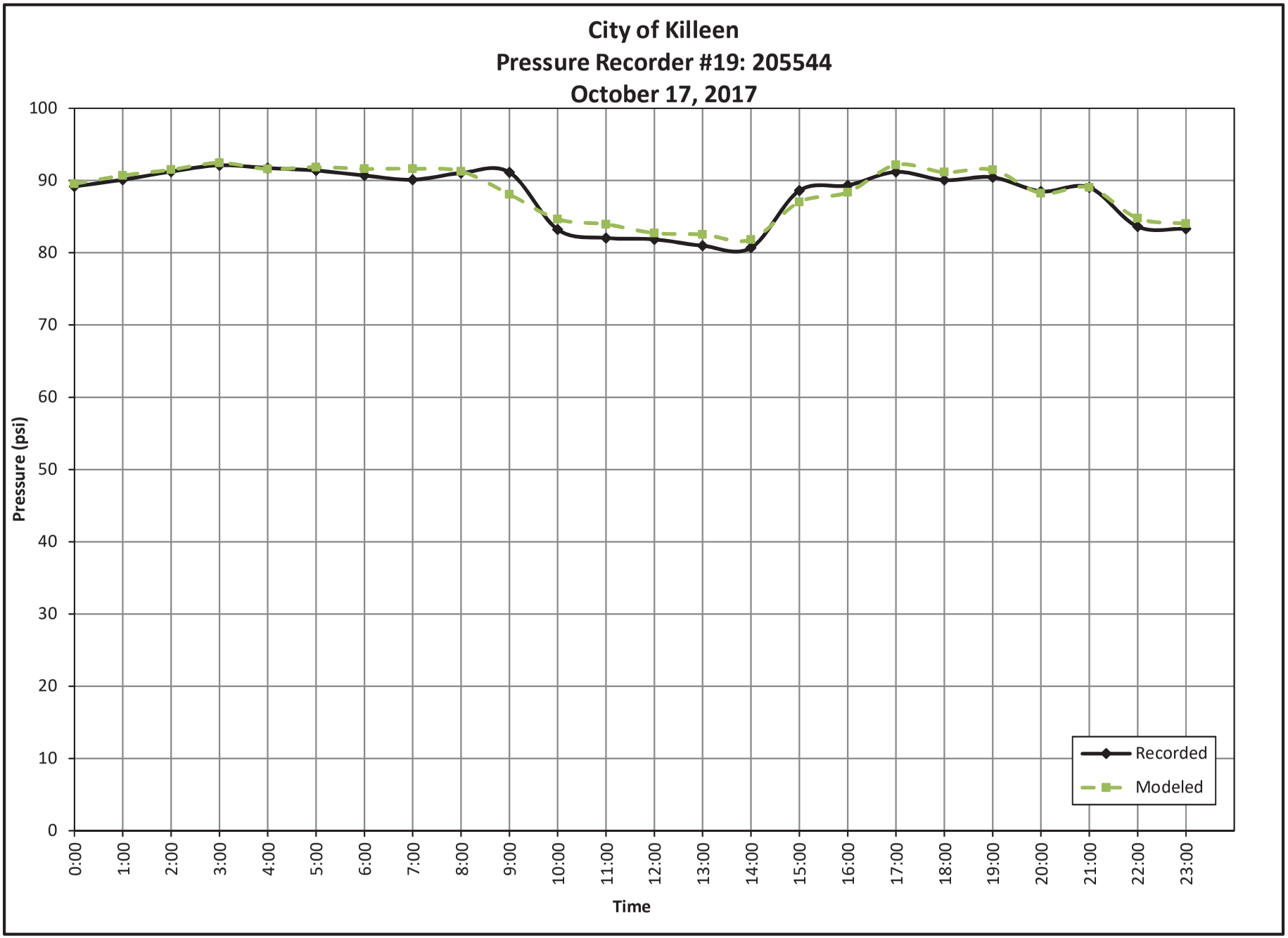

City of Killeen
Pressure Recorder #6: 201667
October 17, 2017
Recorded
Modeled
Pressure (psi)
100
90
80
70
60
50
40
30
20
10
0
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
Time

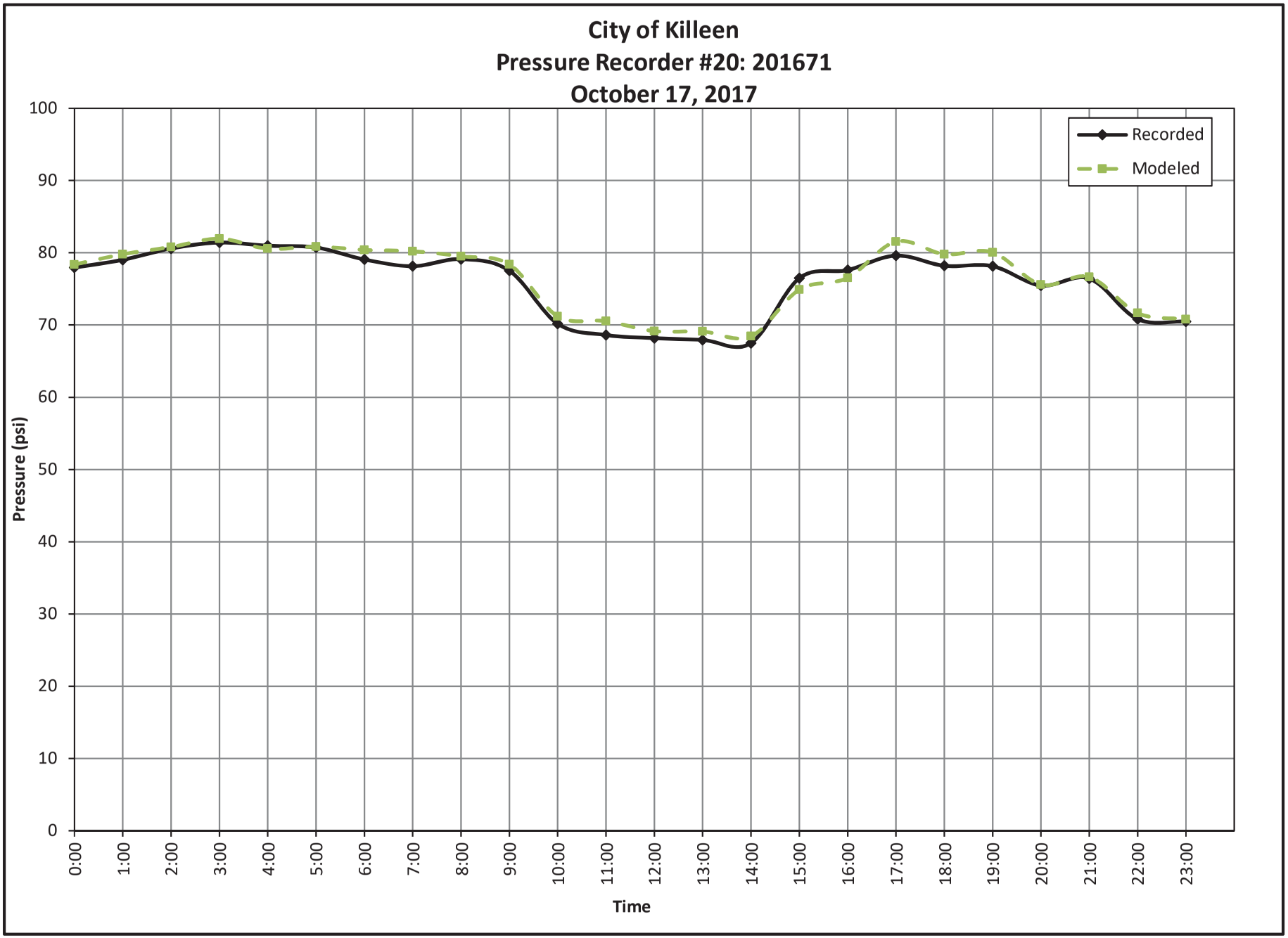

City of Killeen
Pressure Recorder #7: 201670
October 17, 2017
Recorded
Modeled
Pressure (psi)
100
90
80
70
60
50
40
30
20
10
0
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
Time

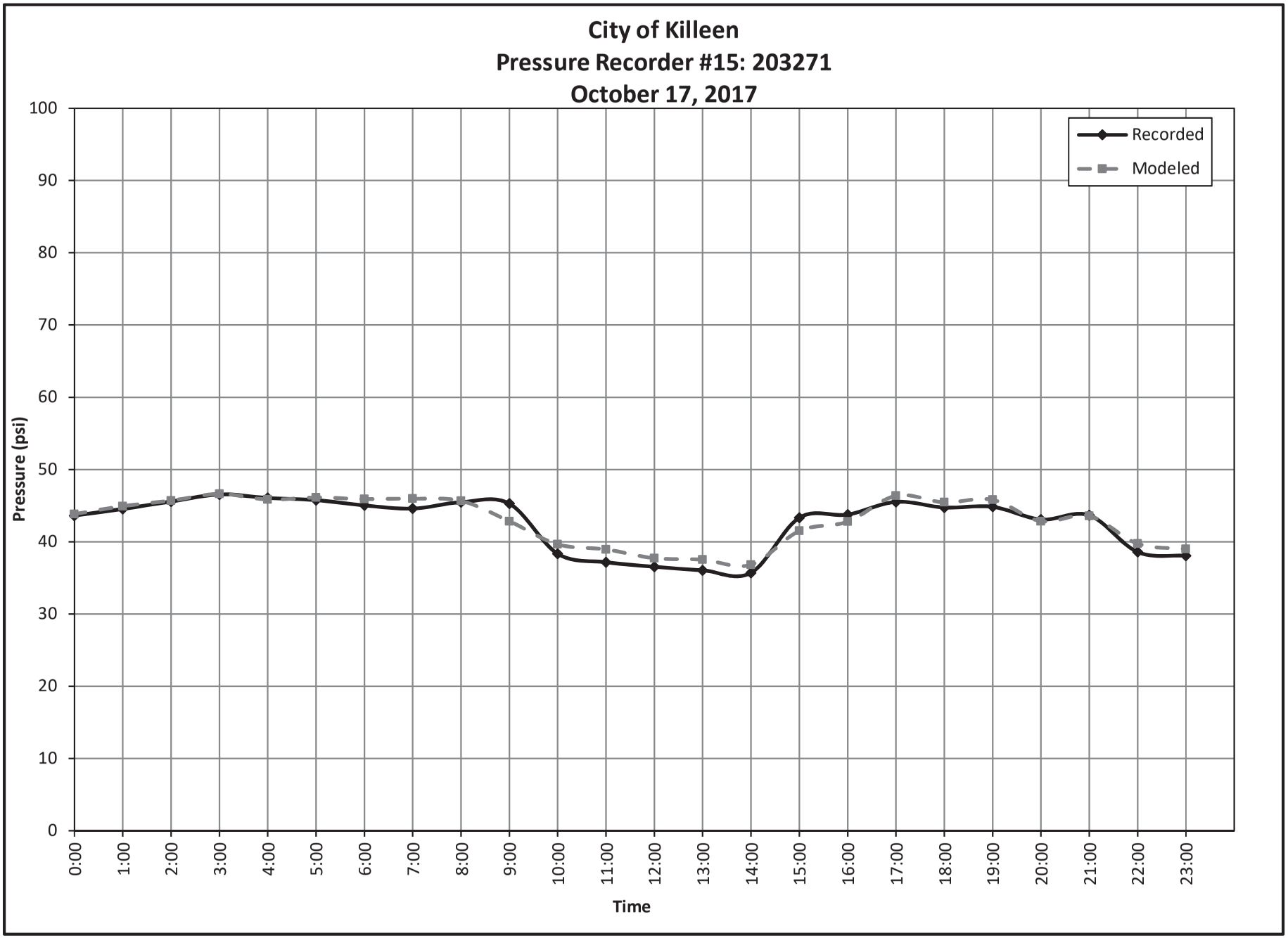

City of Killeen
Pressure Recorder #8: 203436
October 17, 2017
Pressure (psi)
100
90
80
70
60
50
40
30
20
10
0
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
Time
Recorded
Modeled

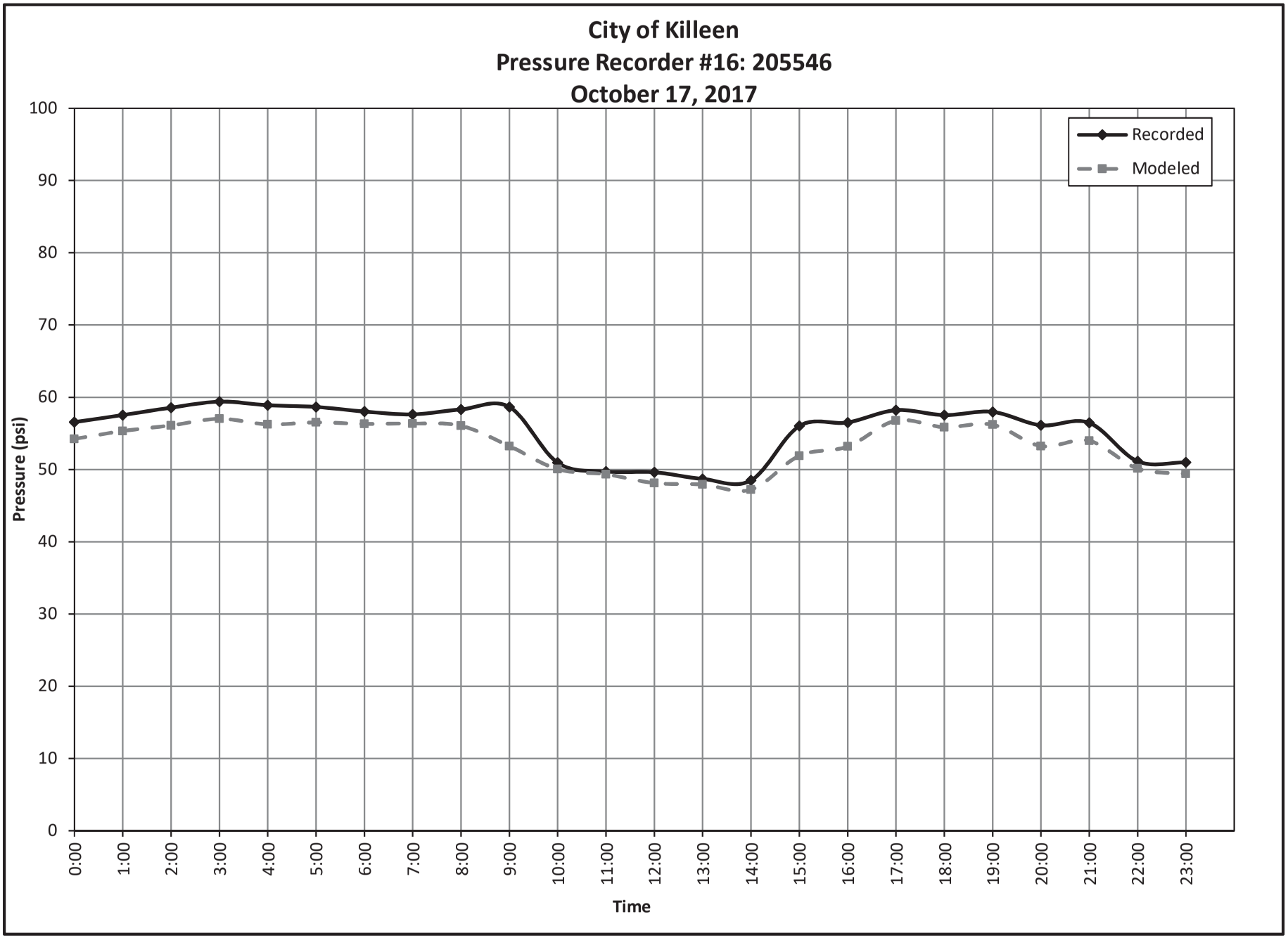

City of Killeen
Pressure Recorder #10: 205936
October 17, 2017
Recorded
Modeled
Pressure (psi)
100
90
80
70
60
50
40
30
20
10
0
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
Time

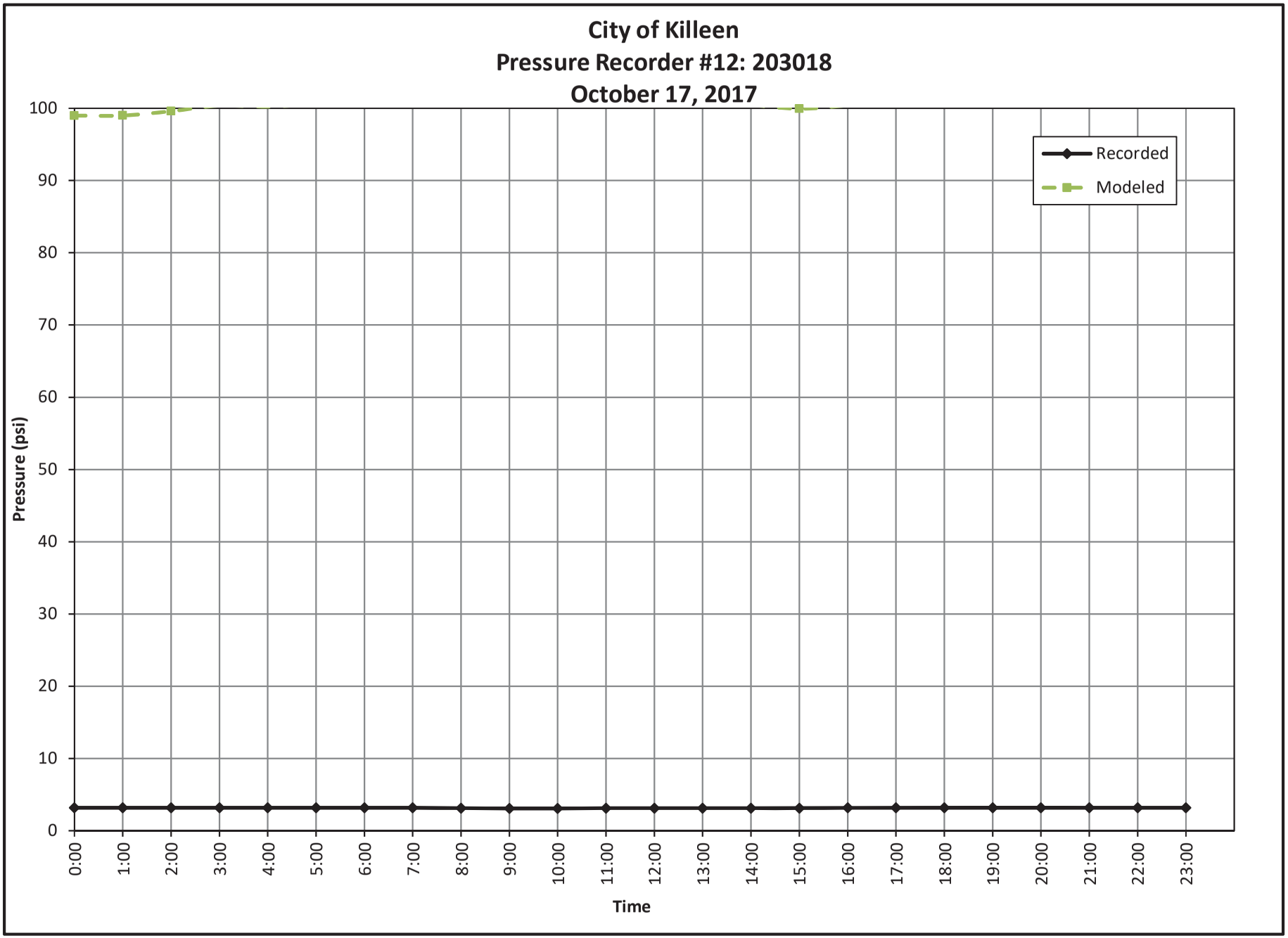

City of Killeeen
Pressure Recorder #11: 205930
October 17, 2017
Recorded
Modeled
Pressure (psi)
100
90
80
70
60
50
40
30
20
10
0
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
Time

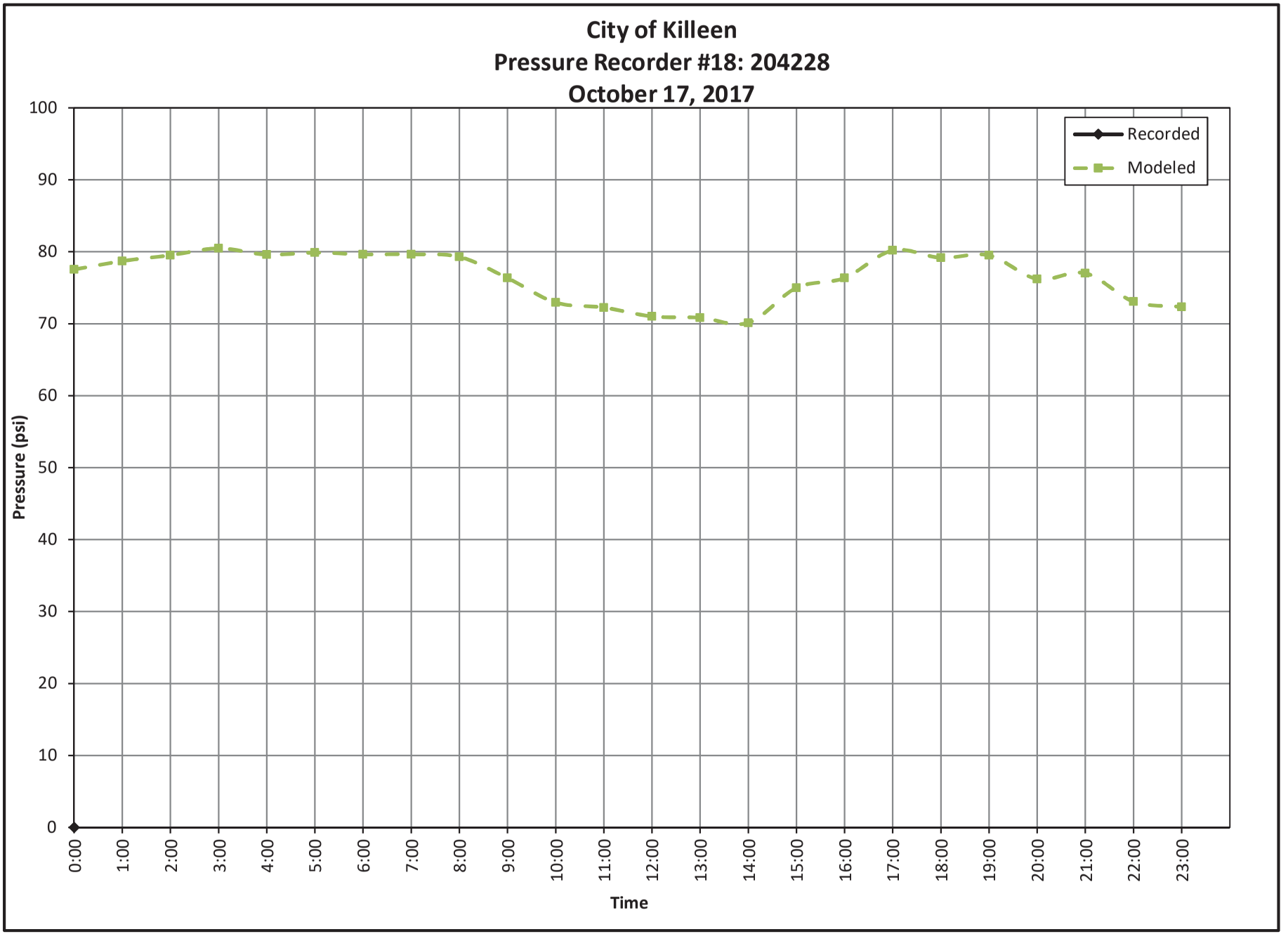

City of Killeen
Pressure Recorder #19: 205544
October 17, 2017
Pressure (psi)
100
90
80
70
60
50
40
30
20
10
0
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
Time
Recorded
Modeled


City of Killeen
Pressure Recorder #20: 201671
October 17, 2017
Recorded
Modeled
Pressure (psi)
100
90
80
70
60
50
40
30
20
10
0
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
Time


City of Killeen
Pressure Recorder #15: 203271
October 17, 2017
Recorded
Modeled
Pressure (psi)
100
90
80
70
60
50
40
30
20
10
0
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
Time

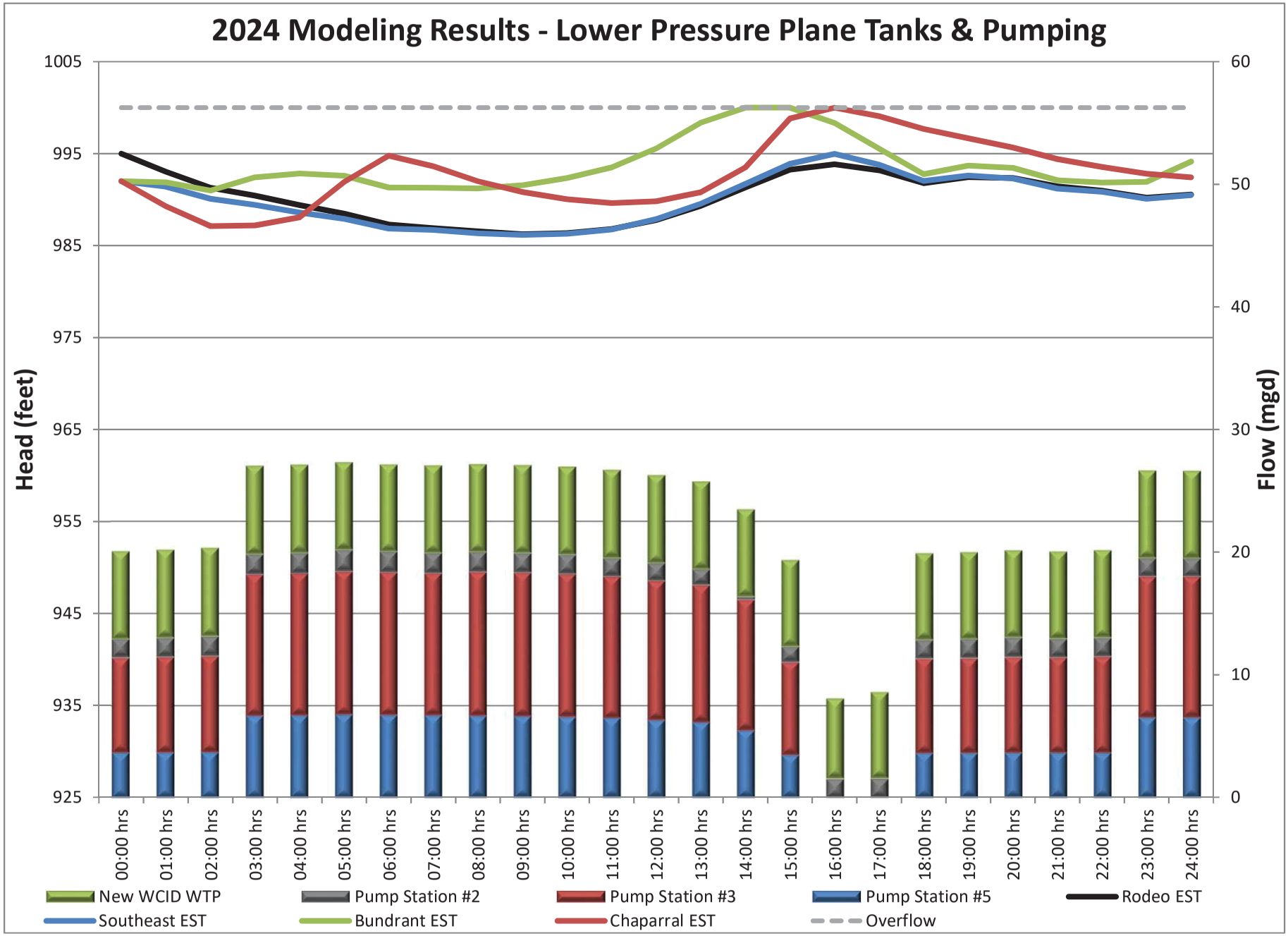

City of Killeen
Pressure Recorder #16: 205546
October 17, 2017
Recorded
Modeled
Pressure (psi)
100
90
80
70
60
50
40
30
20
10
0
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
Time

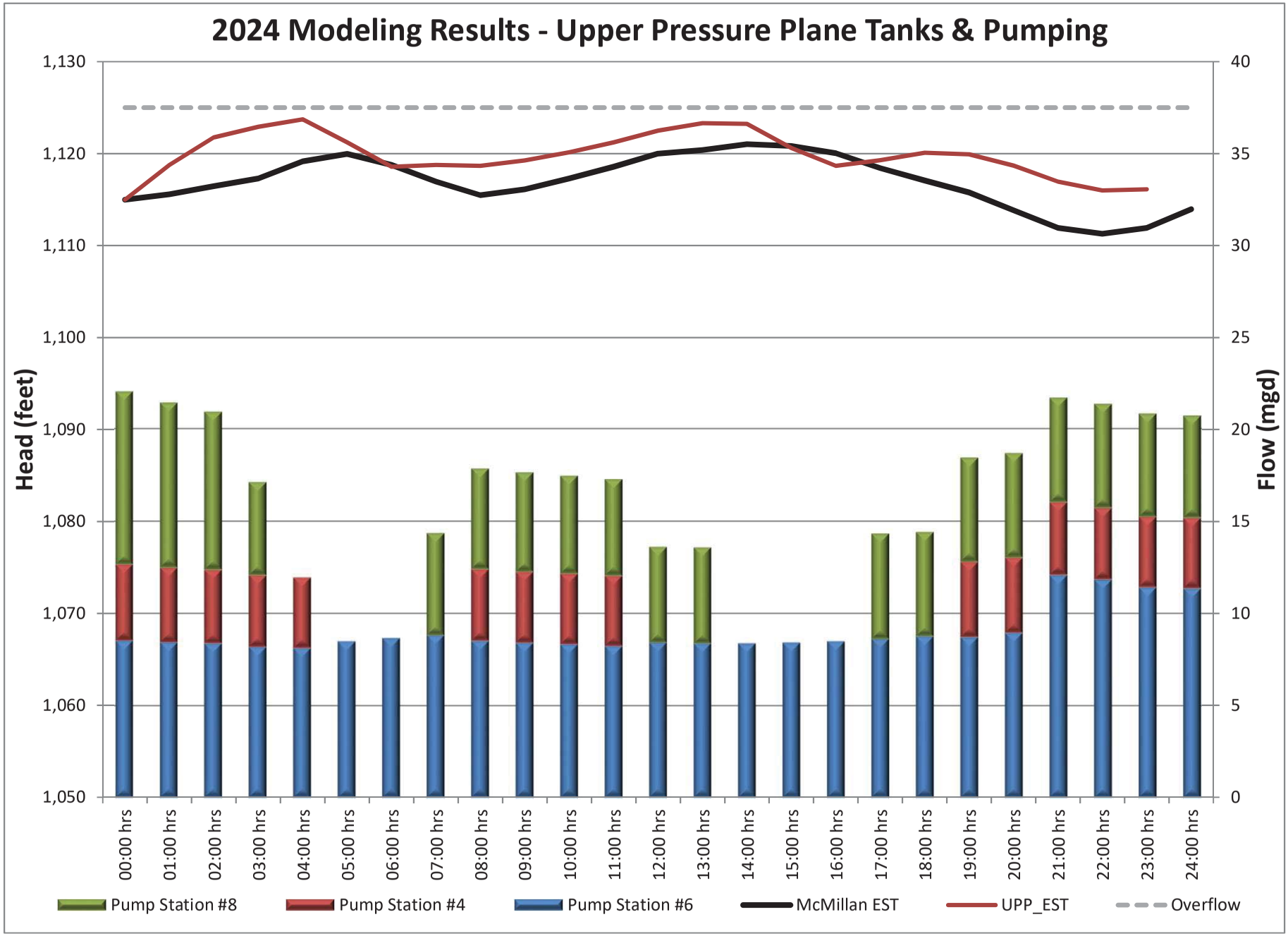

City of Killeen
Pressure Recorder #12: 203018
October 17, 2017
Recorded
Modeled
Pressure (psi)
100
90
80
70
60
50
40
30
20
10
0
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
Time

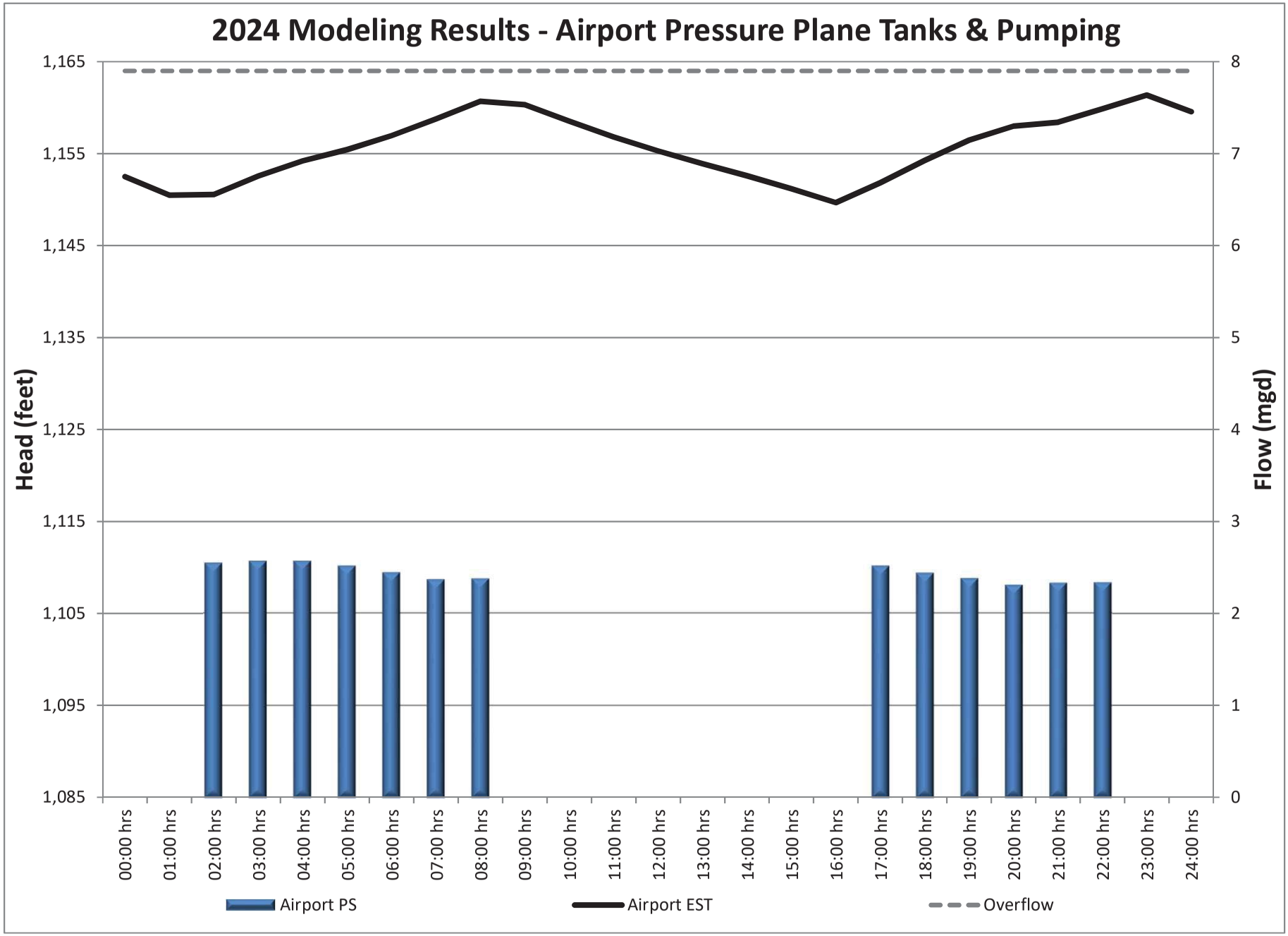

City of Killeen
Pressure Recorder #18: 204228
October 17, 2017
Recorded
Modeled
Pressure (psi)
100
90
80
70
60
50
40
30
20
10
0
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
Time

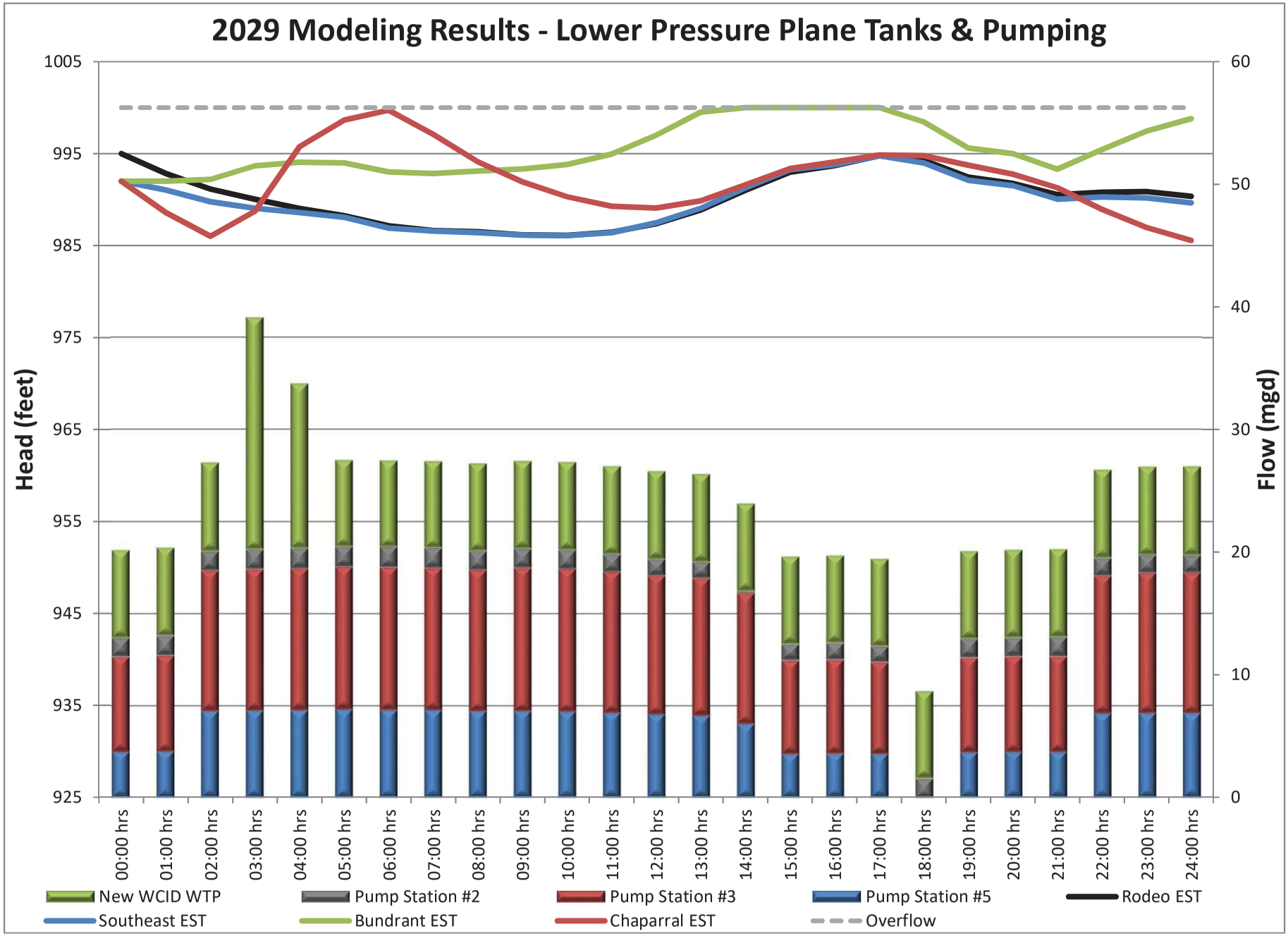
Appendix D

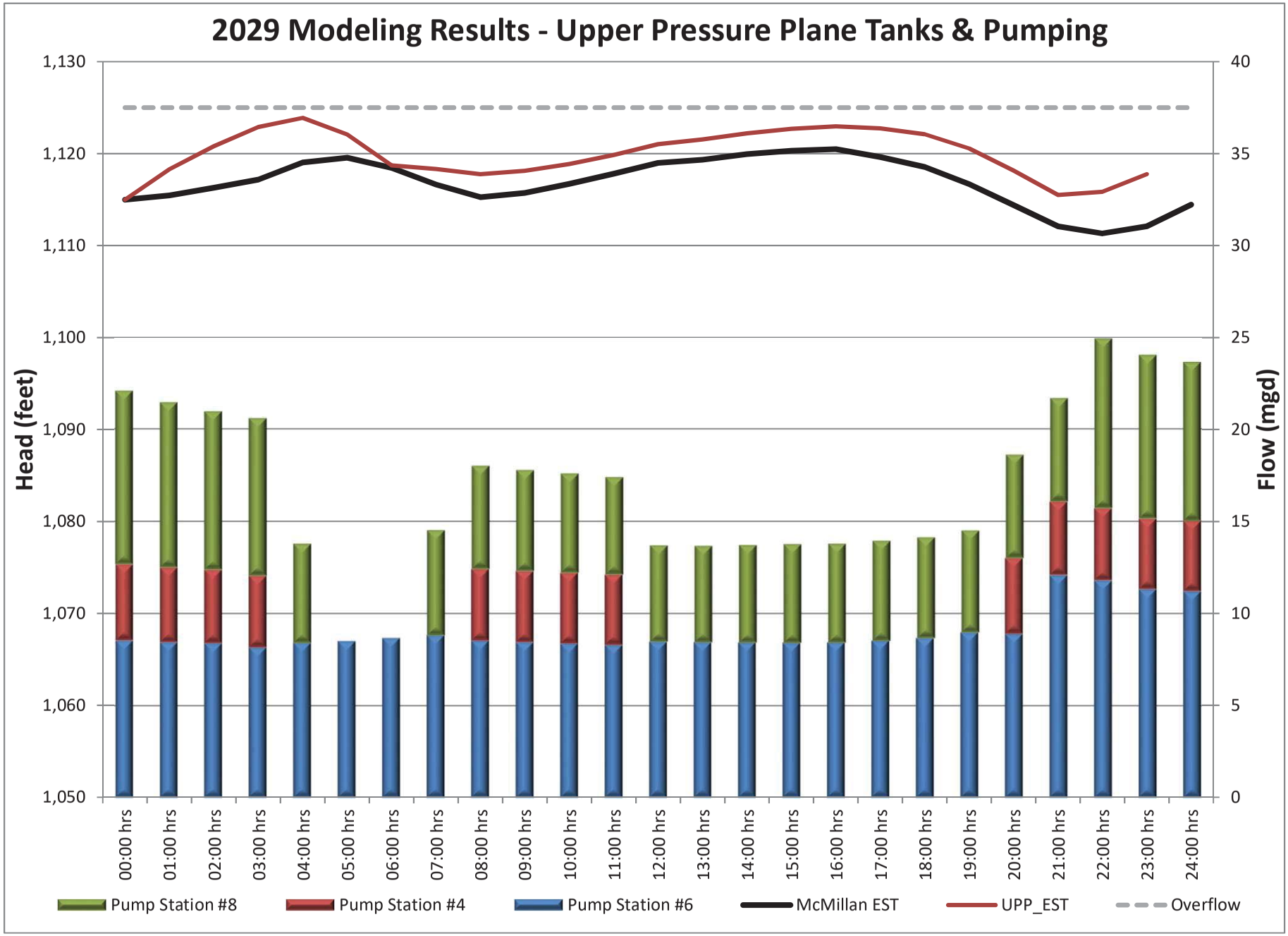
Modeled Pumping and Tank Levels

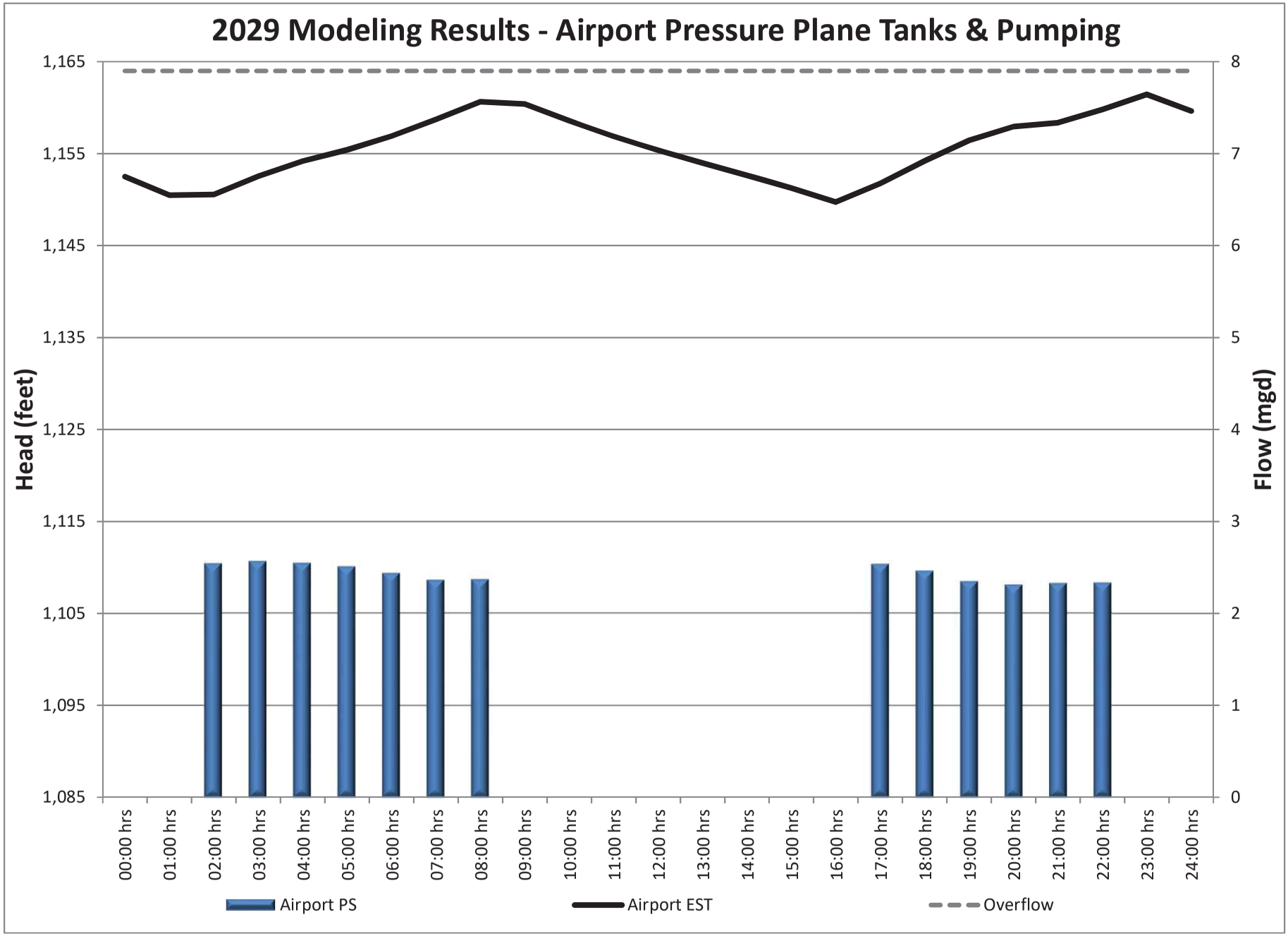

2024 Modeling Results - Lower Pressure Plane Tanks & Pumping
Head (feet)
Flow (mgd)
1005
995
985
975
965
955
945
935
925
60
50
40
30
20
10
0
00:00 hrs
01:00 hrs
02:00 hrs
03:00 hrs
04:00 hrs
05:00 hrs
06:00 hrs
07:00 hrs
08:00 hrs
09:00 hrs
10:00 hrs
11:00 hrs
12:00 hrs
13:00 hrs
14:00 hrs
15:00 hrs
16:00 hrs
17:00 hrs
18:00 hrs
19:00 hrs
20:00 hrs
21:00 hrs
22:00 hrs
23:00 hrs
24:00 hrs
New WCID WTP
Pump Station #2
Pump Station #3
Pump Station #5
Rodeo EST
Southeast EST
Bundrant EST
Chaparral EST
Overflow

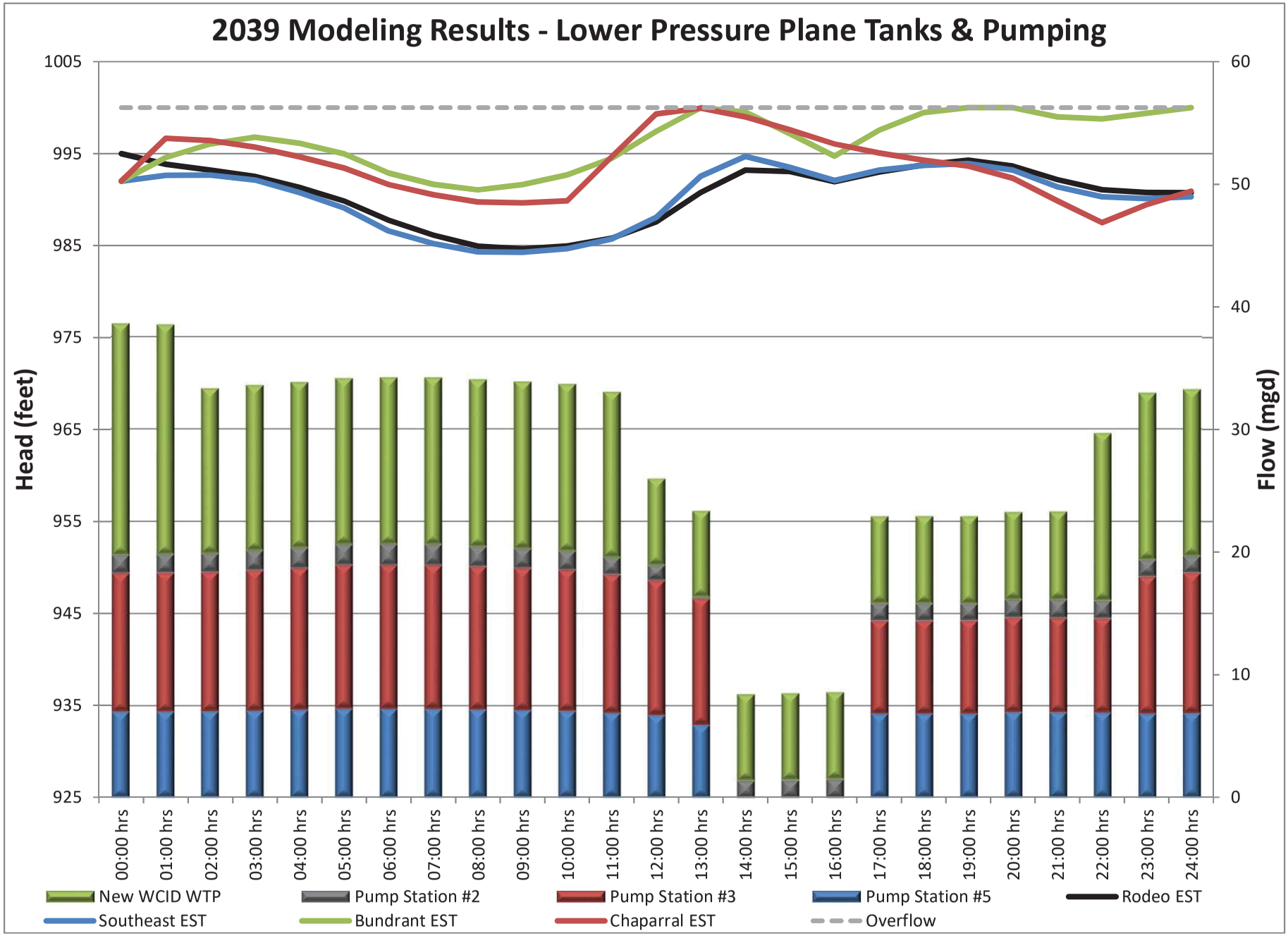

2024 Modeling Results - Upper Pressure Plane Tanks & Pumping
Head (feet)
Flow (mgd)
1,130
1,120
1,110
1,100
1,090
1,080
1,070
1,060
1,050
40
35
30
25
20
15
10
5
0
00:00 hrs
01:00 hrs
02:00 hrs
03:00 hrs
04:00 hrs
05:00 hrs
06:00 hrs
07:00 hrs
08:00 hrs
09:00 hrs
10:00 hrs
11:00 hrs
12:00 hrs
13:00 hrs
14:00 hrs
15:00 hrs
16:00 hrs
17:00 hrs
18:00 hrs
19:00 hrs
20:00 hrs
21:00 hrs
22:00 hrs
23:00 hrs
24:00 hrs
Pump Station #8
Pump Station #4
Pump Station #6
McMillan EST
UPP_EST
Overflow

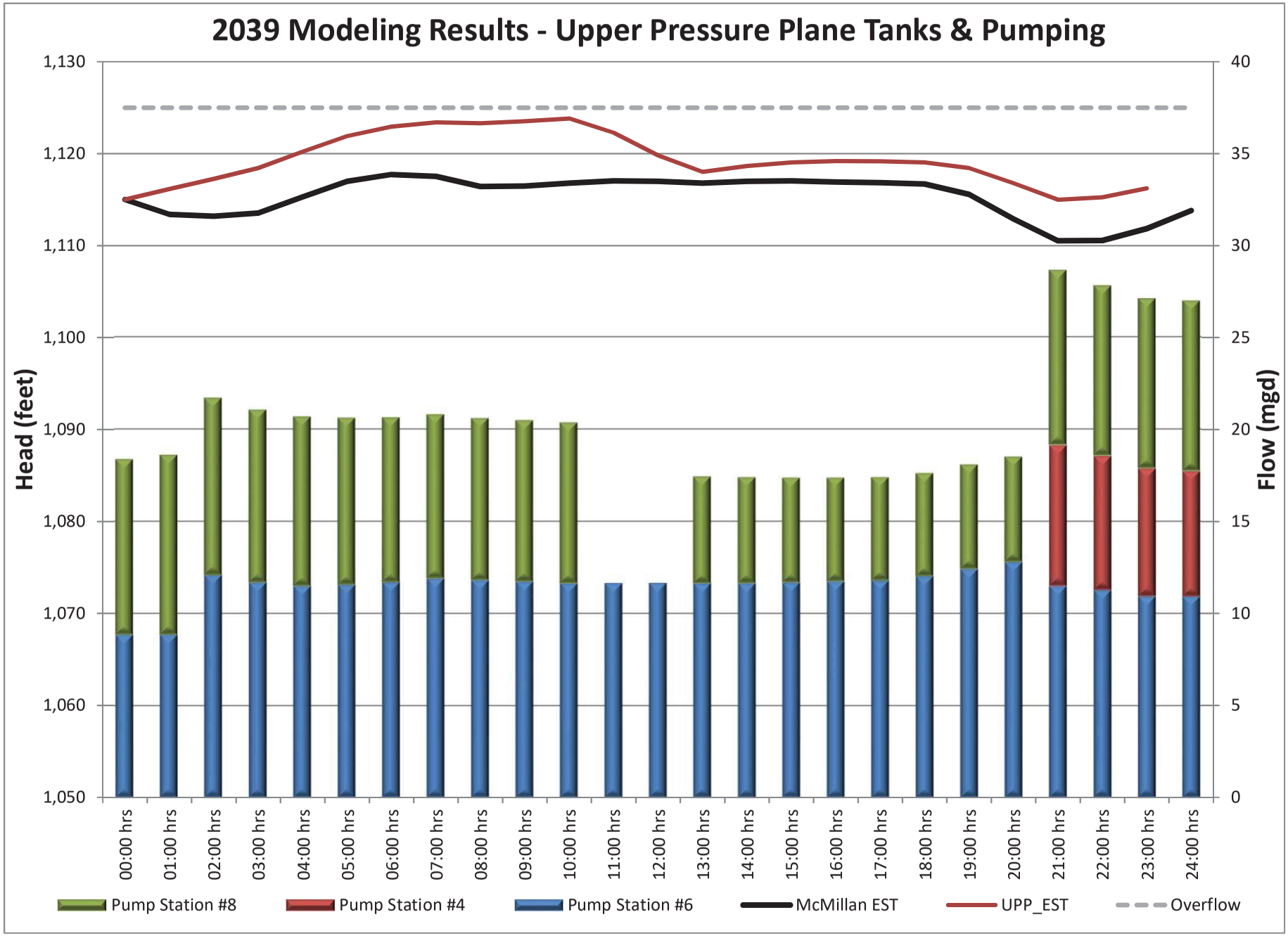

2024 Modeling Results - Airport Pressure Plane Tanks & Pumping
Head (feet)
Flow (mgd)
1,165
1,155
1,145
1,135
1,125
1,115
1,105
1,095
1,085
8
7
6
5
4
3
2
1
0
00:00 hrs
01:00 hrs
02:00 hrs
03:00 hrs
04:00 hrs
05:00 hrs
06:00 hrs
07:00 hrs
08:00 hrs
09:00 hrs
10:00 hrs
11:00 hrs
12:00 hrs
13:00 hrs
14:00 hrs
15:00 hrs
16:00 hrs
17:00 hrs
18:00 hrs
19:00 hrs
20:00 hrs
21:00 hrs
22:00 hrs
23:00 hrs
24:00 hrs
Airport PS
Airport EST
Overflow

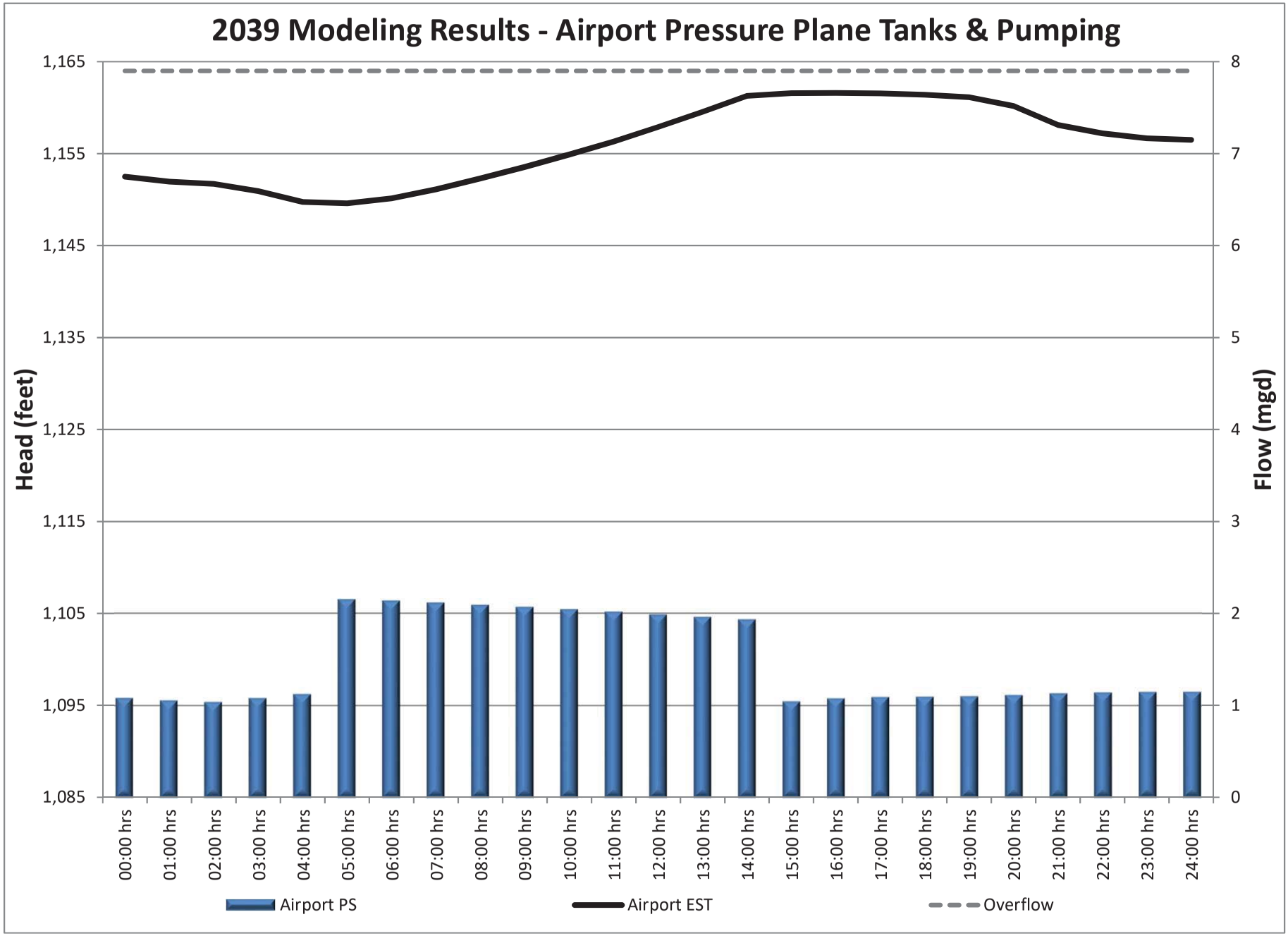

2029 Modeling Results - Lower Pressure Plane Tanks & Pumping
Head (feet)
Flow (mgd)
1005
995
985
975
965
955
945
935
925
60
50
40
30
20
10
0
00:00 hrs
01:00 hrs
02:00 hrs
03:00 hrs
04:00 hrs
05:00 hrs
06:00 hrs
07:00 hrs
08:00 hrs
09:00 hrs
10:00 hrs
11:00 hrs
12:00 hrs
13:00 hrs
14:00 hrs
15:00 hrs
16:00 hrs
17:00 hrs
18:00 hrs
19:00 hrs
20:00 hrs
21:00 hrs
22:00 hrs
23:00 hrs
24:00 hrs
New WCID WTP
Pump Station #2
Pump Station #3
Pump Station #5
Rodeo EST
Southeast EST
Bundrant EST
Chaparral EST
Overflow


2029 Modeling Results - Upper Pressure Plane Tanks & Pumping
Head (feet)
Flow (mgd)
1,130
1,120
1,110
1,100
1,090
1,080
1,070
1,060
1,050
40
35
30
25
20
15
10
5
0
00:00 hrs
01:00 hrs
02:00 hrs
03:00 hrs
04:00 hrs
05:00 hrs
06:00 hrs
07:00 hrs
08:00 hrs
09:00 hrs
10:00 hrs
11:00 hrs
12:00 hrs
13:00 hrs
14:00 hrs
15:00 hrs
16:00 hrs
17:00 hrs
18:00 hrs
19:00 hrs
20:00 hrs
21:00 hrs
22:00 hrs
23:00 hrs
24:00 hrs
Pump Station #8
Pump Station #4
Pump Station #6
McMillan EST
UPP_EST
Overflow


2029 Modeling Results - Airport Pressure Plane Tanks & Pumping
Head (feet)
Flow (mgd)
1,165
1,155
1,145
1,135
1,125
1,115
1,105
1,095
1,085
8
7
6
5
4
3
2
1
0
00:00 hrs
01:00 hrs
02:00 hrs
03:00 hrs
04:00 hrs
05:00 hrs
06:00 hrs
07:00 hrs
08:00 hrs
09:00 hrs
10:00 hrs
11:00 hrs
12:00 hrs
13:00 hrs
14:00 hrs
15:00 hrs
16:00 hrs
17:00 hrs
18:00 hrs
19:00 hrs
20:00 hrs
21:00 hrs
22:00 hrs
23:00 hrs
24:00 hrs
Airport PS
Airport EST
Overflow

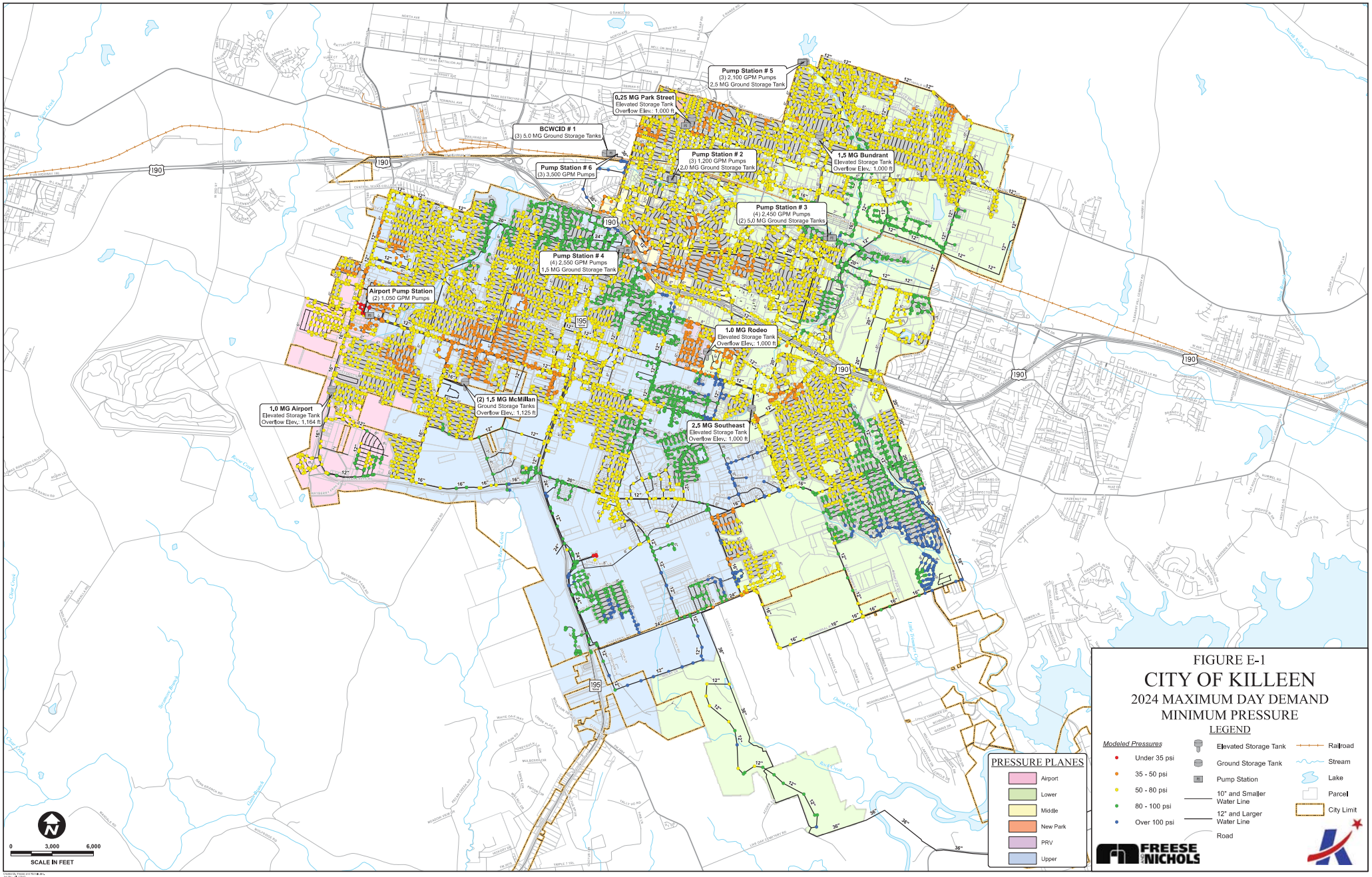

2039 Modeling Results - Lower Pressure Plane Tanks & Pumping
Head (feet)
Flow (mgd)
1005
995
985
975
965
955
945
935
925
60
50
40
30
20
10
0
00:00 hrs
01:00 hrs
02:00 hrs
03:00 hrs
04:00 hrs
05:00 hrs
06:00 hrs
07:00 hrs
08:00 hrs
09:00 hrs
10:00 hrs
11:00 hrs
12:00 hrs
13:00 hrs
14:00 hrs
15:00 hrs
16:00 hrs
17:00 hrs
18:00 hrs
19:00 hrs
20:00 hrs
21:00 hrs
22:00 hrs
23:00 hrs
24:00 hrs
New WCID WTP
Pump Station #2
Pump Station #3
Pump Station #5
Rodeo EST
Southeast EST
Bundrant EST
Chaparral EST
Overflow

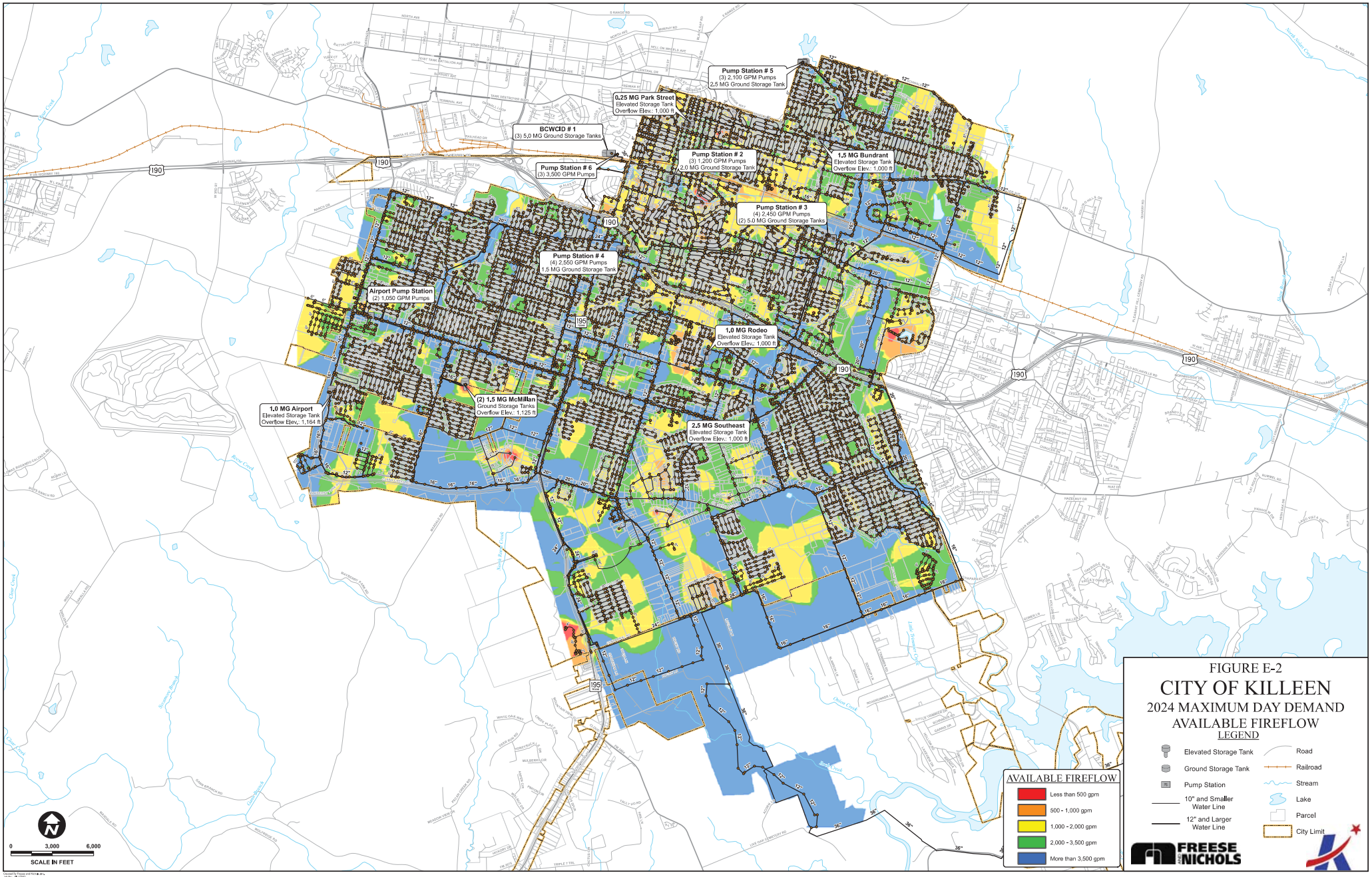

2039 Modeling Results - Upper Pressure Plane Tanks & Pumping
Head (feet)
Flow (mgd)
1,130
1,120
1,110
1,100
1,090
1,080
1,070
1,060
1,050
40
35
30
25
20
15
10
5
0
00:00 hrs
01:00 hrs
02:00 hrs
03:00 hrs
04:00 hrs
05:00 hrs
06:00 hrs
07:00 hrs
08:00 hrs
09:00 hrs
10:00 hrs
11:00 hrs
12:00 hrs
13:00 hrs
14:00 hrs
15:00 hrs
16:00 hrs
17:00 hrs
18:00 hrs
19:00 hrs
20:00 hrs
21:00 hrs
22:00 hrs
23:00 hrs
24:00 hrs
Pump Station #8
Pump Station #4
Pump Station #6
McMillan EST
UPP_EST
Overflow

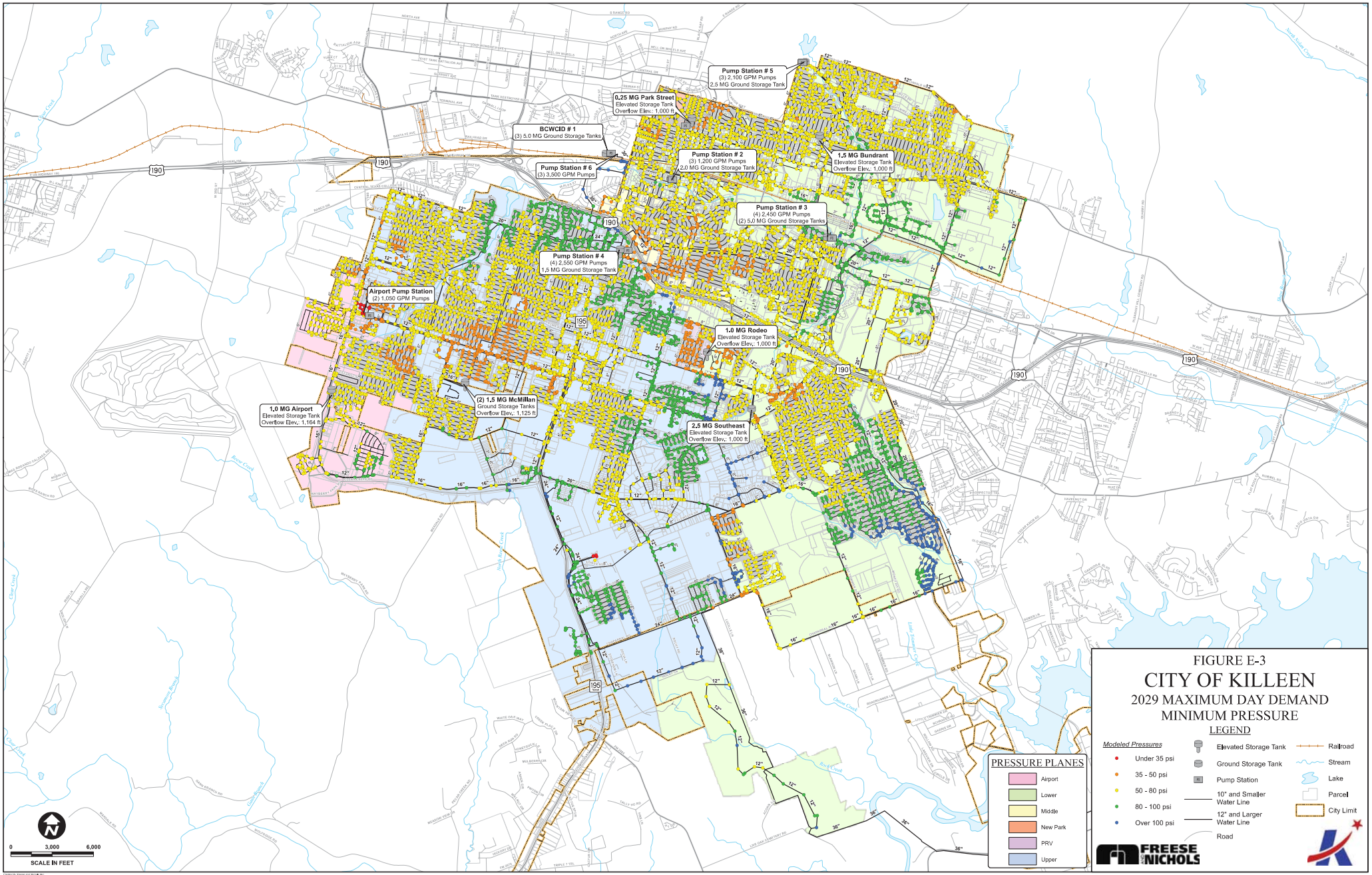

2039 Modeling Results - Airport Pressure Plane Tanks & Pumping
Head (feet)
Flow (mgd)
1,165
1,155
1,145
1,135
1,125
1,115
1,105
1,095
1,085
8
7
6
5
4
3
2
1
0
00:00 hrs
01:00 hrs
02:00 hrs
03:00 hrs
04:00 hrs
05:00 hrs
06:00 hrs
07:00 hrs
08:00 hrs
09:00 hrs
10:00 hrs
11:00 hrs
12:00 hrs
13:00 hrs
14:00 hrs
15:00 hrs
16:00 hrs
17:00 hrs
18:00 hrs
19:00 hrs
20:00 hrs
21:00 hrs
22:00 hrs
23:00 hrs
24:00 hrs
Airport PS
Airport EST
Overflow

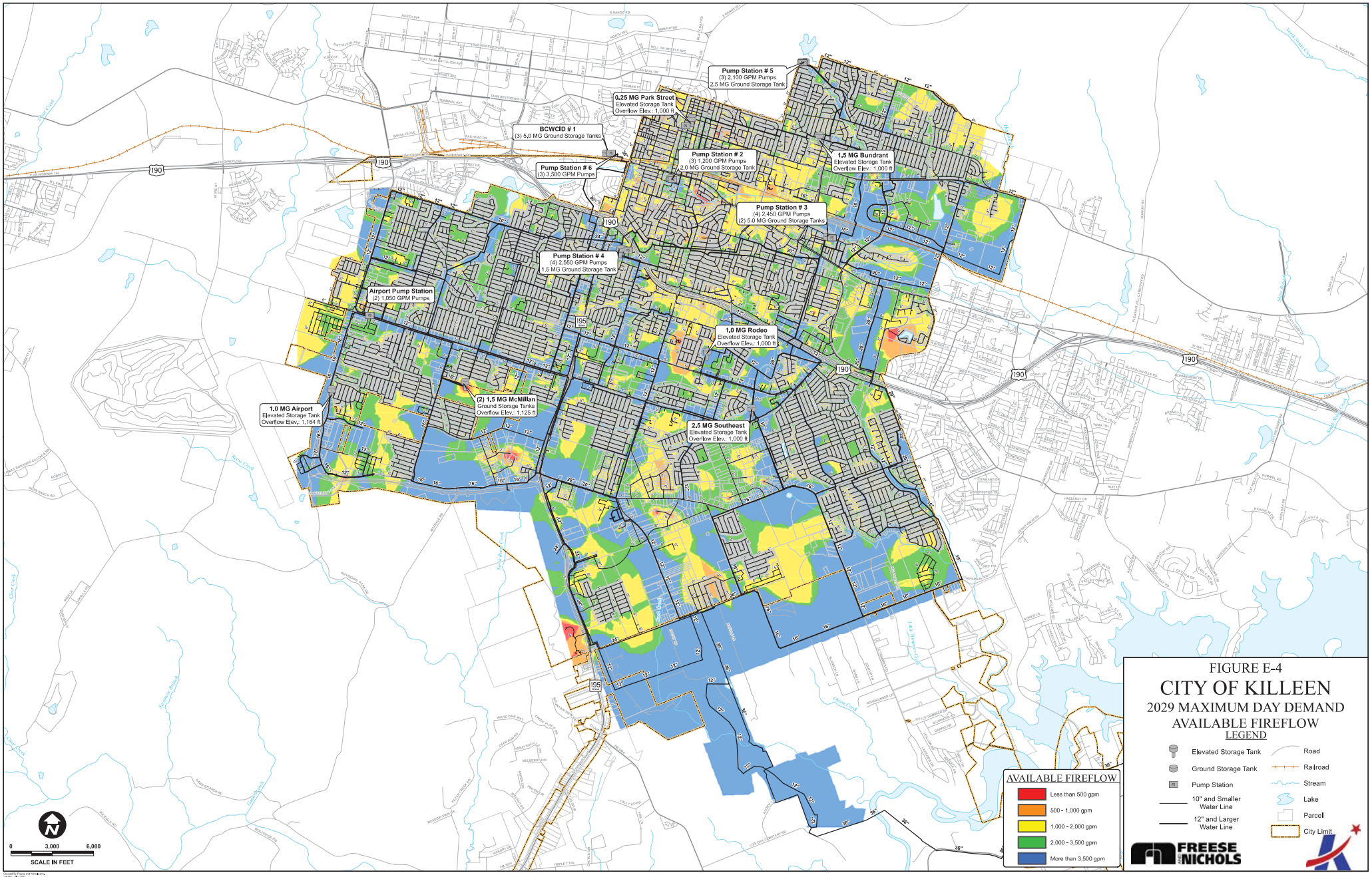
Appendix E

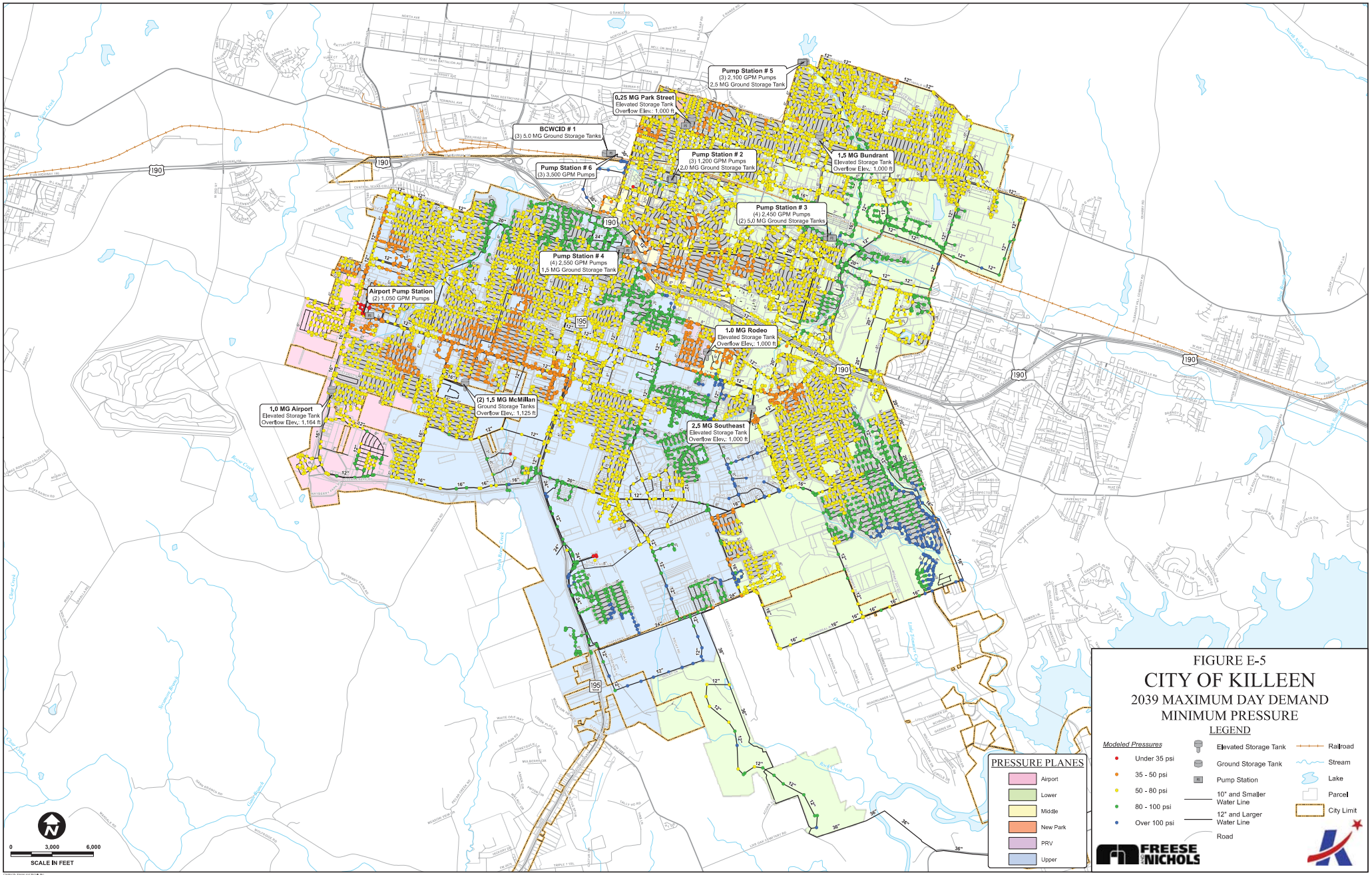
Pressure and Fire Flow Maps

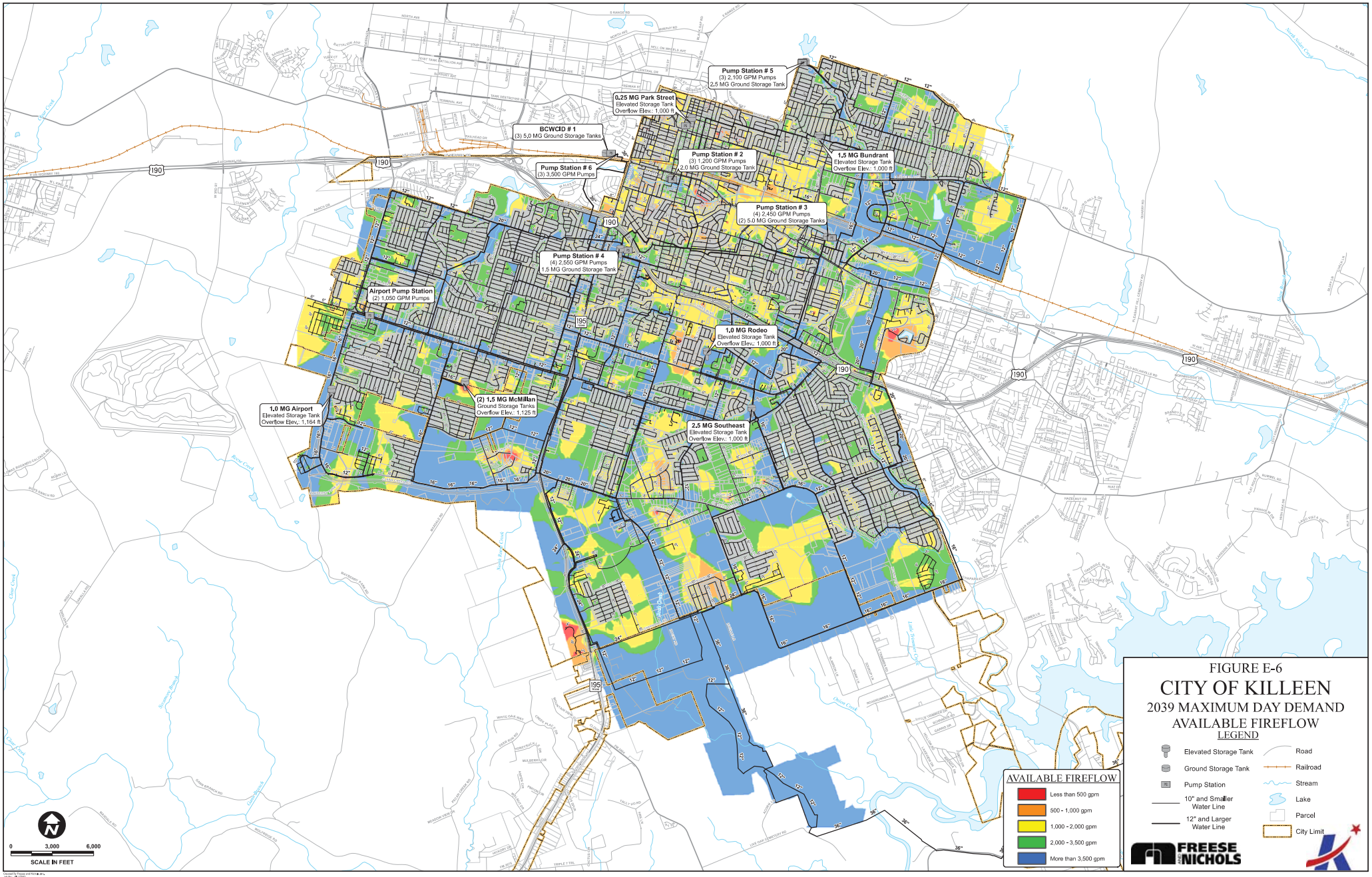

Pump Station # 5
(3) 2,100 GPM Pumps
2.5 MG Ground Storage Tank
0.25 MG Park Street
Elevated Storage Tank
Overflow Elev.: 1,000 ft
BCWCID # 1
(3) 5.0 MG Ground Storage Tanks
Pump Station # 6
(3) 3,500 GPM Pumps
Pump Station # 2
(3) 1,200 GPM Pumps
2.0 MG Ground Storage Tank
1.5 MG Bundrant
Elevated Storage Tank
Overflow Elev.: 1,000 ft
Pump Station # 3
(4) 2,450 GPM Pumps
(2) 5.0 MG Ground Storage Tanks
Pump Station # 4
(4) 2,550 GPM Pumps
1.5 MG Ground Storage Tank
Airport Pump Station
(2) 1,050 GPM Pumps
1.0 MG Rodeo
Elevated Storage Tank
Overflow Elev.: 1,000 ft
1.0 MG Airport
Elevated Storage Tank
Overflow Elev.: 1,164 ft
(2) 1.5 MG McMillan
Ground Storage Tanks
Overflow Elev.: 1,125 ft
2.5 MG Southeast
Elevated Storage Tank
Overflow Elev.: 1,000 ft
190
195
0
3,000
6,000
SCALE IN FEET
PRESSURE PLANES
Airport
Lower
Middle
New Park
PRV
Upper
FIGURE E-1
CITY OF KILLEEN
2024 MAXIMUM DAY DEMAND
MINIMUM PRESSURE
LEGEND
Modeled Pressures
Under 35 psi
35 - 50 psi
50 - 80 psi
80 - 100 psi
Over 100 psi
Elevated Storage Tank
Ground Storage Tank
Pump Station
10" and Smaller Water Line
12" and Larger Water Line
Road
Railroad
Stream
Lake
Parcel
City Limit
FREESE NICHOLS


Pump Station # 5
(3) 2,100 GPM Pumps
2.5 MG Ground Storage Tank
0.25 MG Park Street
Elevated Storage Tank
Overflow Elev.: 1,000 ft
BCWCID # 1
(3) 5.0 MG Ground Storage Tanks
Pump Station # 6
(3) 3,500 GPM Pumps
Pump Station # 2
(3) 1,200 GPM Pumps
2.0 MG Ground Storage Tank
1.5 MG Bundrant
Elevated Storage Tank
Overflow Elev.: 1,000 ft
Pump Station # 3
(4) 2,450 GPM Pumps
(2) 5.0 MG Ground Storage Tanks
Pump Station # 4
(4) 2,550 GPM Pumps
1.5 MG Ground Storage Tank
Airport Pump Station
(2) 1,050 GPM Pumps
1.0 MG Rodeo
Elevated Storage Tank
Overflow Elev.: 1,000 ft
1.0 MG Airport
Elevated Storage Tank
Overflow Elev.: 1,164 ft
(2) 1.5 MG McMillan
Ground Storage Tanks
Overflow Elev.: 1,125 ft
2.5 MG Southeast
Elevated Storage Tank
Overflow Elev.: 1,000 ft
190
195
0
3,000
6,000
SCALE IN FEET
AVAILABLE FIREFLOW
Less than 500 gpm
500 - 1,000 gpm
1,000 - 2,000 gpm
2,000 - 3,500 gpm
More than 3,500 gpm
FIGURE E-2
CITY OF KILLEEN
2024 MAXIMUM DAY DEMAND
AVAILABLE FIREFLOW
LEGEND
Elevated Storage Tank
Ground Storage Tank
Pump Station
10" and Smaller Water Line
12" and Larger Water Line
Road
Railroad
Stream
Lake
Parcel
City Limit
FREESE NICHOLS


Pump Station # 5
(3) 2,100 GPM Pumps
2.5 MG Ground Storage Tank
0.25 MG Park Street
Elevated Storage Tank
Overflow Elev.: 1,000 ft
BCWCID # 1
(3) 5.0 MG Ground Storage Tanks
Pump Station # 6
(3) 3,500 GPM Pumps
Pump Station # 2
(3) 1,200 GPM Pumps
2.0 MG Ground Storage Tank
1.5 MG Bundrant
Elevated Storage Tank
Overflow Elev.: 1,000 ft
Pump Station # 3
(4) 2,450 GPM Pumps
(2) 5.0 MG Ground Storage Tanks
Pump Station # 4
(4) 2,550 GPM Pumps
1.5 MG Ground Storage Tank
Airport Pump Station
(2) 1,050 GPM Pumps
1.0 MG Rodeo
Elevated Storage Tank
Overflow Elev.: 1,000 ft
1.0 MG Airport
Elevated Storage Tank
Overflow Elev.: 1,164 ft
(2) 1.5 MG McMillan
Ground Storage Tanks
Overflow Elev.: 1,125 ft
2.5 MG Southeast
Elevated Storage Tank
Overflow Elev.: 1,000 ft
190
195
0
3,000
6,000
SCALE IN FEET
PRESSURE PLANES
Airport
Lower
Middle
New Park
PRV
Upper
FIGURE E-3
CITY OF KILLEEN
2029 MAXIMUM DAY DEMAND
MINIMUM PRESSURE
LEGEND
Modeled Pressures
Under 35 psi
35 - 50 psi
50 - 80 psi
80 - 100 psi
Over 100 psi
Elevated Storage Tank
Ground Storage Tank
Pump Station
10" and Smaller Water Line
12" and Larger Water Line
Road
Railroad
Stream
Lake
Parcel
City Limit
FREESE NICHOLS

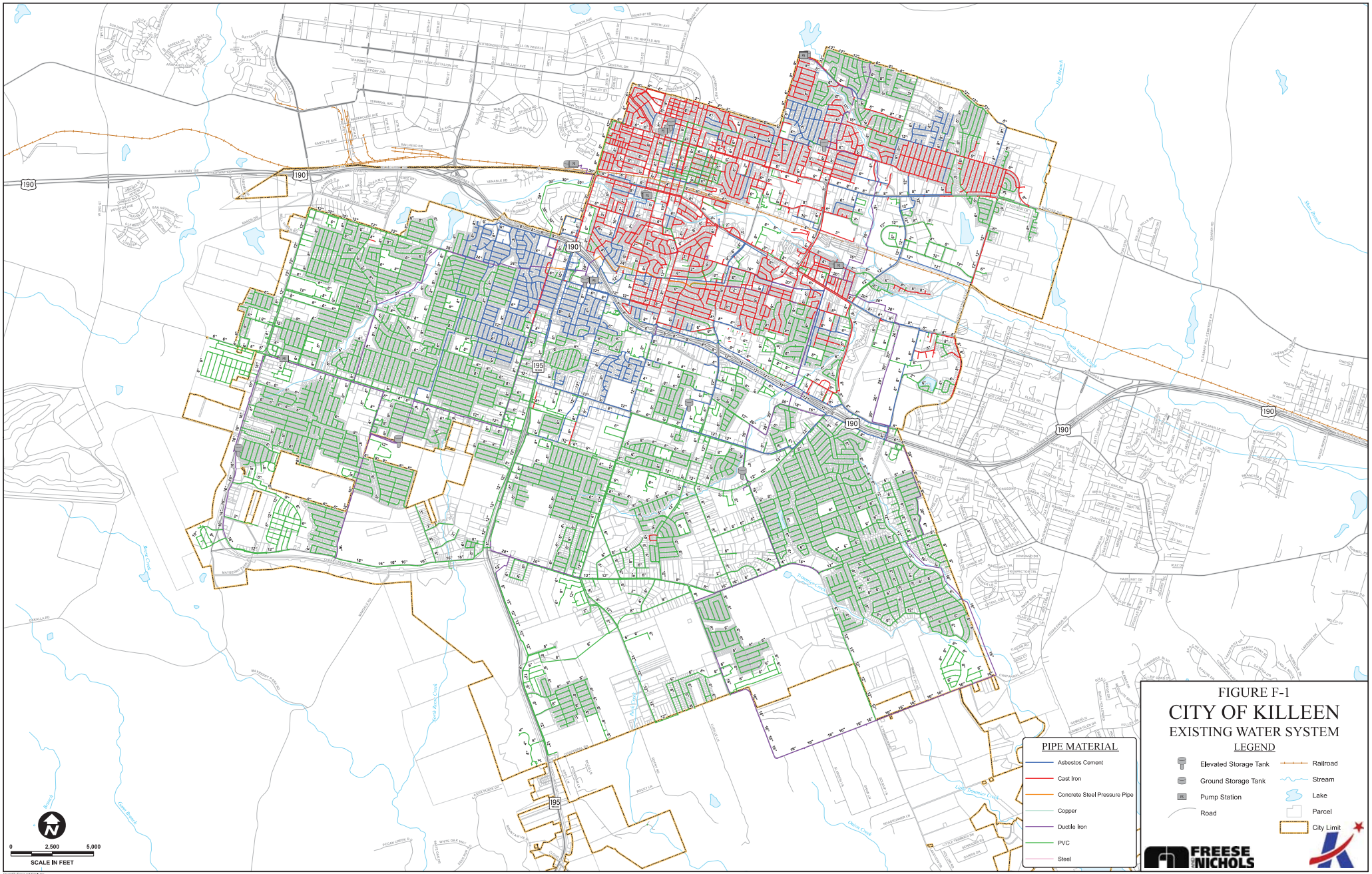

Pump Station # 5
(3) 2,100 GPM Pumps
2.5 MG Ground Storage Tank
0.25 MG Park Street
Elevated Storage Tank
Overflow Elev.: 1,000 ft
BCWCID # 1
(3) 5.0 MG Ground Storage Tanks
Pump Station # 6
(3) 3,500 GPM Pumps
Pump Station # 2
(3) 1,200 GPM Pumps
2.0 MG Ground Storage Tank
1.5 MG Bundrant
Elevated Storage Tank
Overflow Elev.: 1,000 ft
Pump Station # 3
(4) 2,450 GPM Pumps
(2) 5.0 MG Ground Storage Tanks
Pump Station # 4
(4) 2,550 GPM Pumps
1.5 MG Ground Storage Tank
Airport Pump Station
(2) 1,050 GPM Pumps
1.0 MG Rodeo
Elevated Storage Tank
Overflow Elev.: 1,000 ft
1.0 MG Airport
Elevated Storage Tank
Overflow Elev.: 1,164 ft
(2) 1.5 MG McMillan
Ground Storage Tanks
Overflow Elev.: 1,125 ft
2.5 MG Southeast
Elevated Storage Tank
Overflow Elev.: 1,000 ft
190
195
0
3,000
6,000
SCALE IN FEET
AVAILABLE FIREFLOW
Less than 500 gpm
500 - 1,000 gpm
1,000 - 2,000 gpm
2,000 - 3,500 gpm
More than 3,500 gpm
FIGURE E-4
CITY OF KILLEEN
2029 MAXIMUM DAY DEMAND
AVAILABLE FIREFLOW
LEGEND
Elevated Storage Tank
Ground Storage Tank
Pump Station
10" and Smaller Water Line
12" and Larger Water Line
Road
Railroad
Stream
Lake
Parcel
City Limit
FREESE NICHOLS


Pump Station # 5
(3) 2,100 GPM Pumps
2.5 MG Ground Storage Tank
0.25 MG Park Street
Elevated Storage Tank
Overflow Elev.: 1,000 ft
BCWCID # 1
(3) 5.0 MG Ground Storage Tanks
Pump Station # 6
(3) 3,500 GPM Pumps
Pump Station # 2
(3) 1,200 GPM Pumps
2.0 MG Ground Storage Tank
1.5 MG Bundrant
Elevated Storage Tank
Overflow Elev.: 1,000 ft
Pump Station # 3
(4) 2,450 GPM Pumps
(2) 5.0 MG Ground Storage Tanks
Pump Station # 4
(4) 2,550 GPM Pumps
1.5 MG Ground Storage Tank
Airport Pump Station
(2) 1,050 GPM Pumps
1.0 MG Rodeo
Elevated Storage Tank
Overflow Elev.: 1,000 ft
1.0 MG Airport
Elevated Storage Tank
Overflow Elev.: 1,164 ft
(2) 1.5 MG McMillan
Ground Storage Tanks
Overflow Elev.: 1,125 ft
2.5 MG Southeast
Elevated Storage Tank
Overflow Elev.: 1,000 ft
190
195
0
3,000
6,000
SCALE IN FEET
PRESSURE PLANES
Airport
Lower
Middle
New Park
PRV
Upper
FIGURE E-5
CITY OF KILLEEN
2039 MAXIMUM DAY DEMAND
MINIMUM PRESSURE
LEGEND
Modeled Pressures
Under 35 psi
35 - 50 psi
50 - 80 psi
80 - 100 psi
Over 100 psi
Elevated Storage Tank
Ground Storage Tank
Pump Station
10" and Smaller Water Line
12" and Larger Water Line
Road
Railroad
Stream
Lake
Parcel
City Limit
FREESE NICHOLS


Pump Station # 5
(3) 2,100 GPM Pumps
2.5 MG Ground Storage Tank
0.25 MG Park Street
Elevated Storage Tank
Overflow Elev.: 1,000 ft
BCWCID # 1
(3) 5.0 MG Ground Storage Tanks
Pump Station # 6
(3) 3,500 GPM Pumps
Pump Station # 2
(3) 1,200 GPM Pumps
2.0 MG Ground Storage Tank
1.5 MG Bundrant
Elevated Storage Tank
Overflow Elev.: 1,000 ft
Pump Station # 3
(4) 2,450 GPM Pumps
(2) 5.0 MG Ground Storage Tanks
Pump Station # 4
(4) 2,550 GPM Pumps
1.5 MG Ground Storage Tank
Airport Pump Station
(2) 1,050 GPM Pumps
1.0 MG Rodeo
Elevated Storage Tank
Overflow Elev.: 1,000 ft
1.0 MG Airport
Elevated Storage Tank
Overflow Elev.: 1,164 ft
(2) 1.5 MG McMillan
Ground Storage Tanks
Overflow Elev.: 1,125 ft
2.5 MG Southeast
Elevated Storage Tank
Overflow Elev.: 1,000 ft
190
195
0
3,000
6,000
SCALE IN FEET
AVAILABLE FIREFLOW
Less than 500 gpm
500 - 1,000 gpm
1,000 - 2,000 gpm
2,000 - 3,500 gpm
More than 3,500 gpm
FIGURE E-6
CITY OF KILLEEN
2039 MAXIMUM DAY DEMAND
AVAILABLE FIREFLOW
LEGEND
Elevated Storage Tank
Ground Storage Tank
Pump Station
10" and Smaller Water Line
12" and Larger Water Line
Road
Railroad
Stream
Lake
Parcel
City Limit
FREESE NICHOLS

Appendix F

Risk Based Assessment Maps


PIPE MATERIAL
Asbestos Cement
Cast Iron
Concrete Steel Pressure Pipe
Copper
Ductile Iron
PVC
Steel
FIGURE F-1
CITY OF KILLEEN
EXISTING WATER SYSTEM
LEGEND
Elevated Storage Tank
Ground Storage Tank
Pump Station
Road
Railroad
Stream
Lake
Parcel
City Limit
0
2,500
5,000
SCALE IN FEET
FREESE NICHOLS

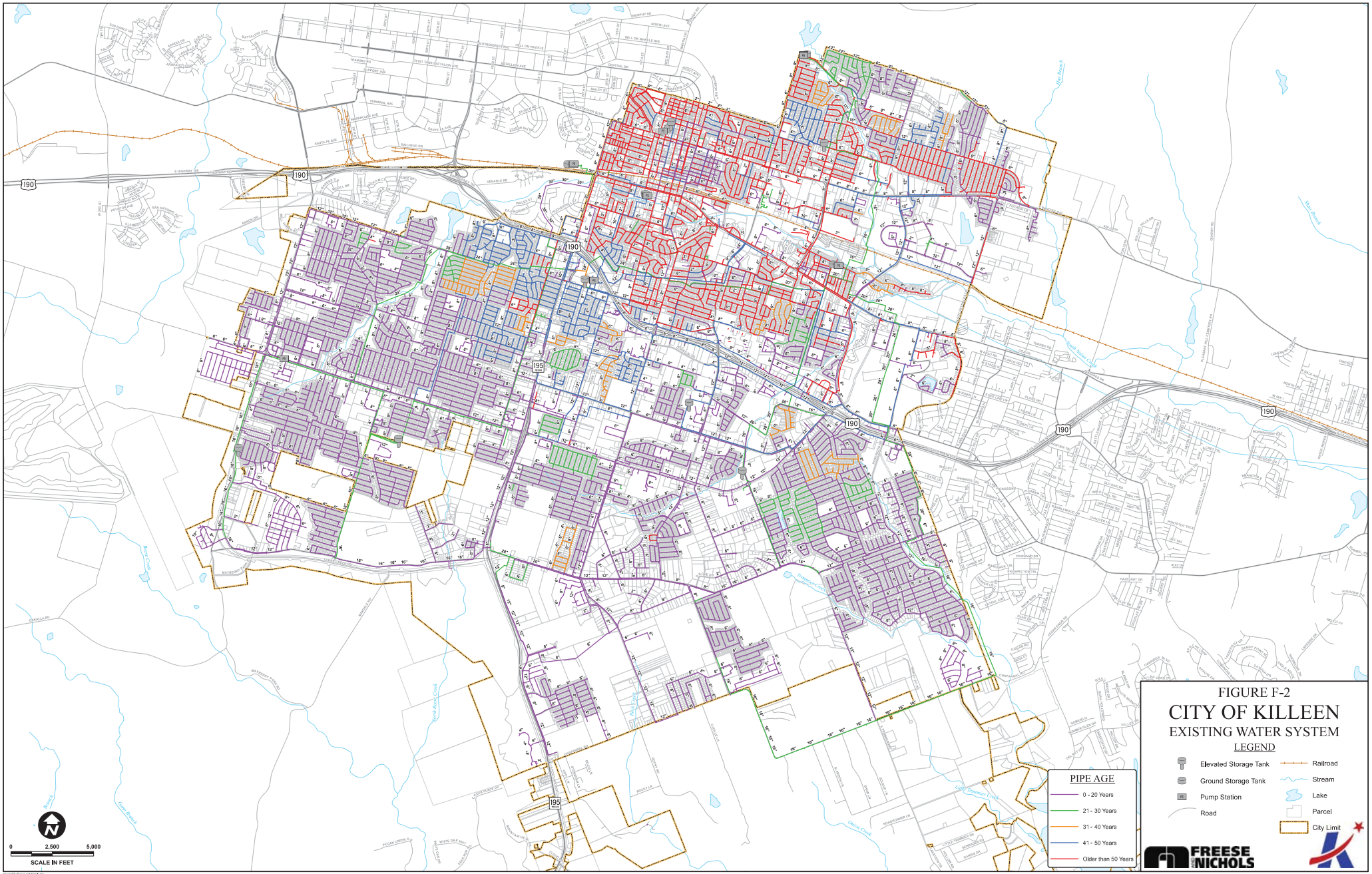


FIGURE F-2

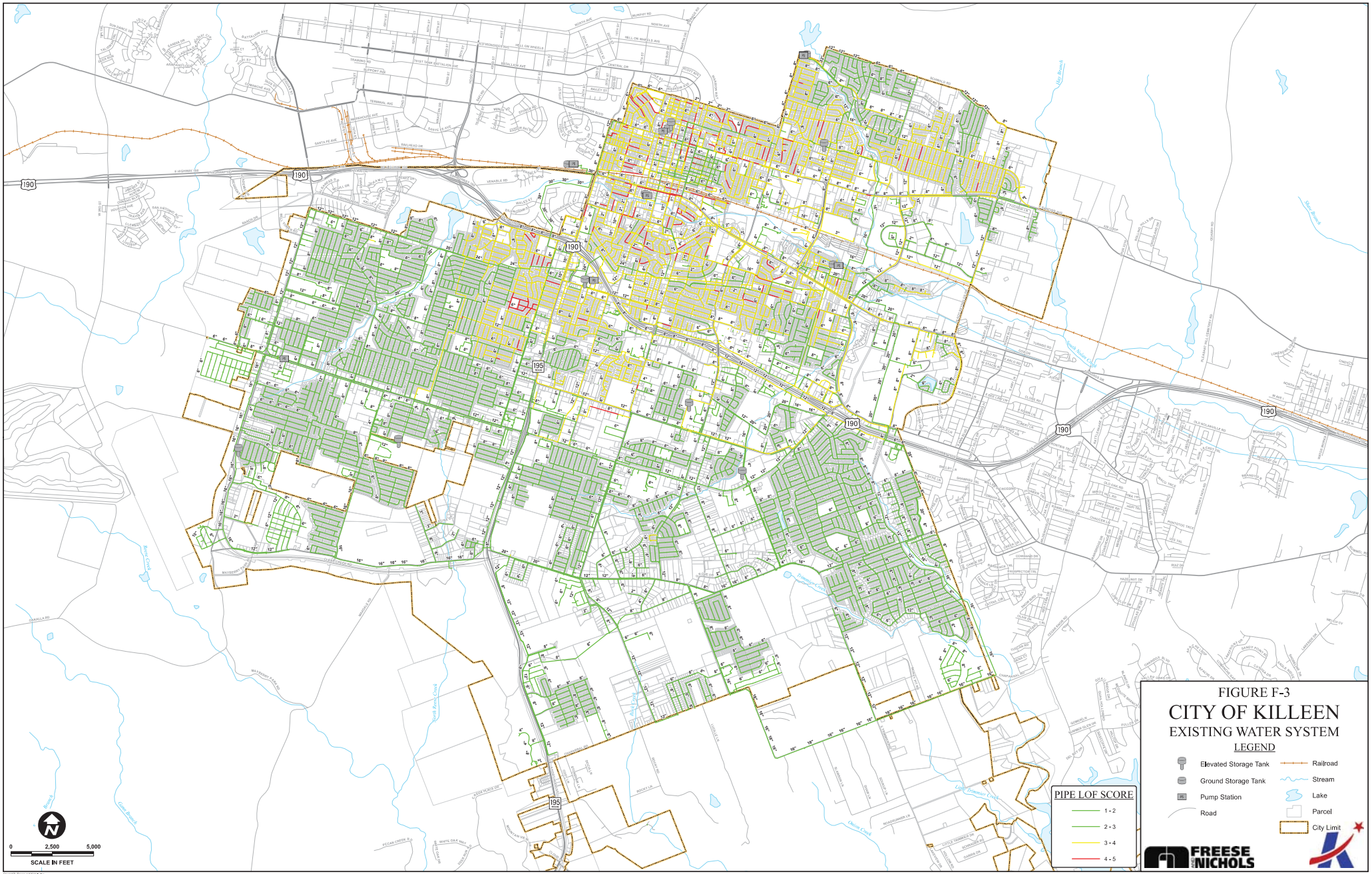
CITY OF KILLEEN

EXISTING WATER SYSTEM

LEGEND

- Elevated Storage Tank
- Ground Storage Tank
- Pump Station
- Road
- Railroad
- Stream
- Lake
- Parcel
- City Limit

FREESE NICHOLS


PIPE LOF SCORE
1 - 2
2 - 3
3 - 4
4 - 5
0
2,500
5,000
SCALE IN FEET
FIGURE F-3
CITY OF KILLEEN
EXISTING WATER SYSTEM
LEGEND
Elevated Storage Tank
Ground Storage Tank
Pump Station
Road
Railroad
Stream
Lake
Parcel
City Limit
FREESE NICHOLS

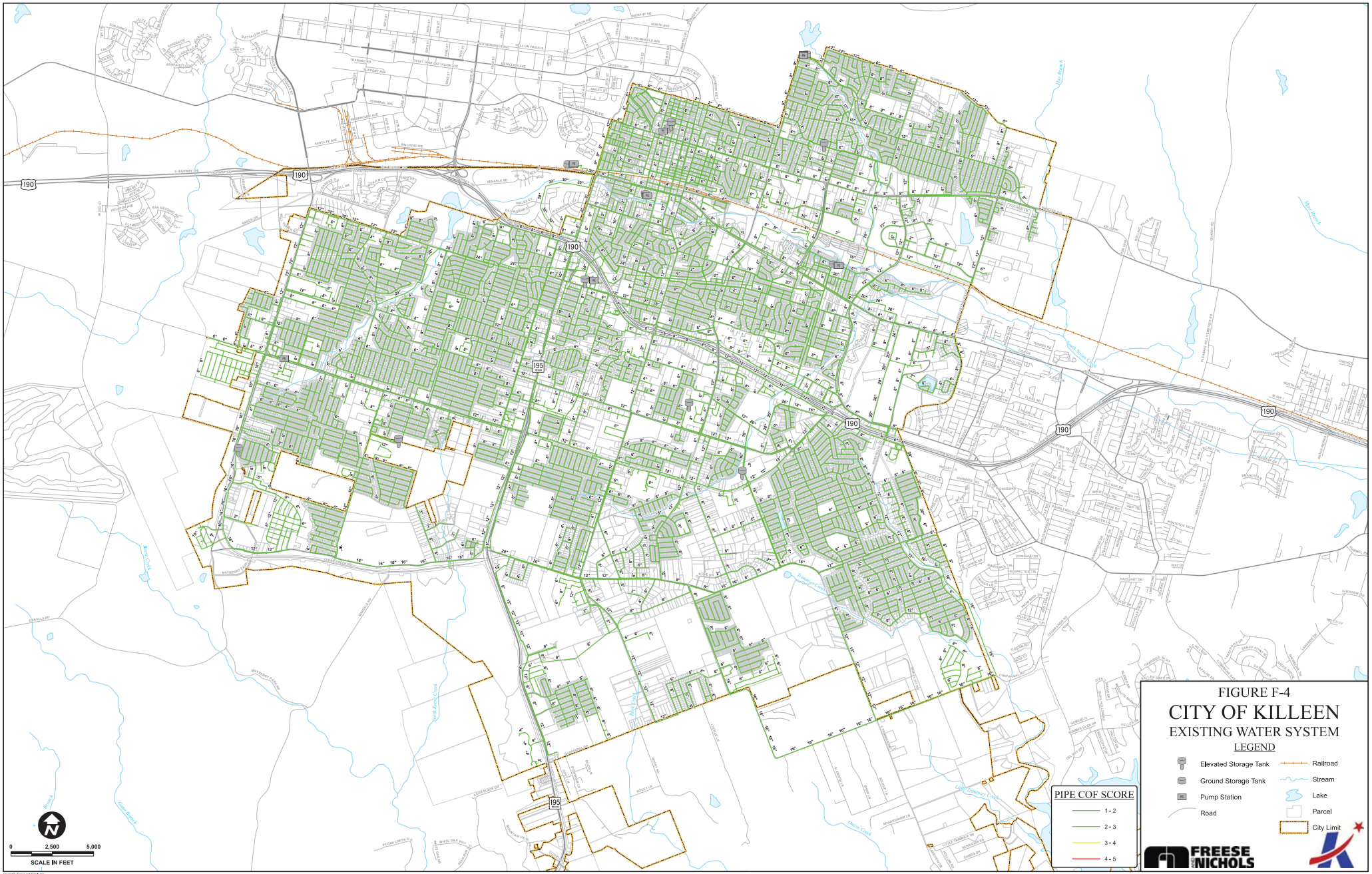


FIGURE F-4

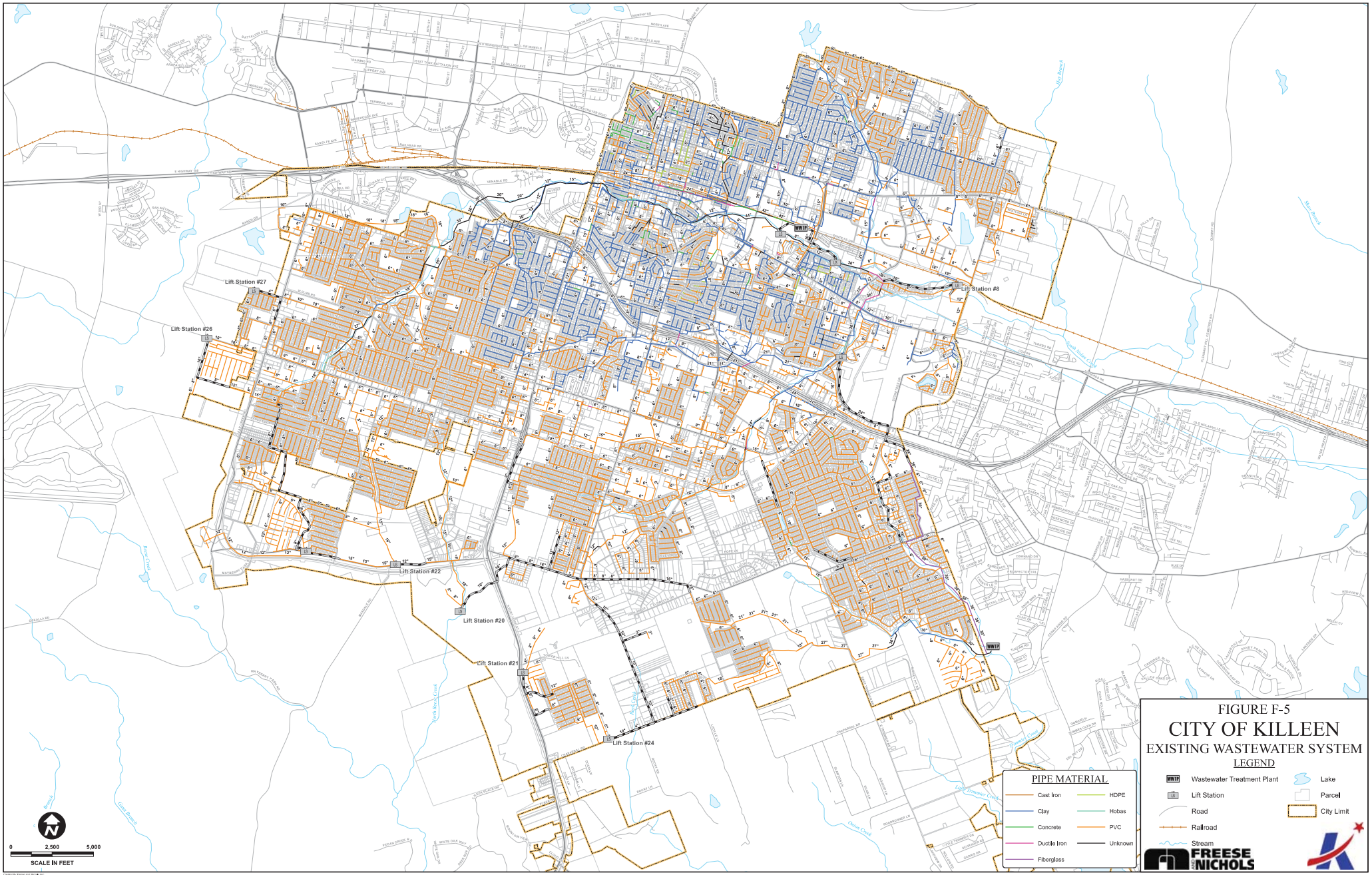
CITY OF KILLEEN

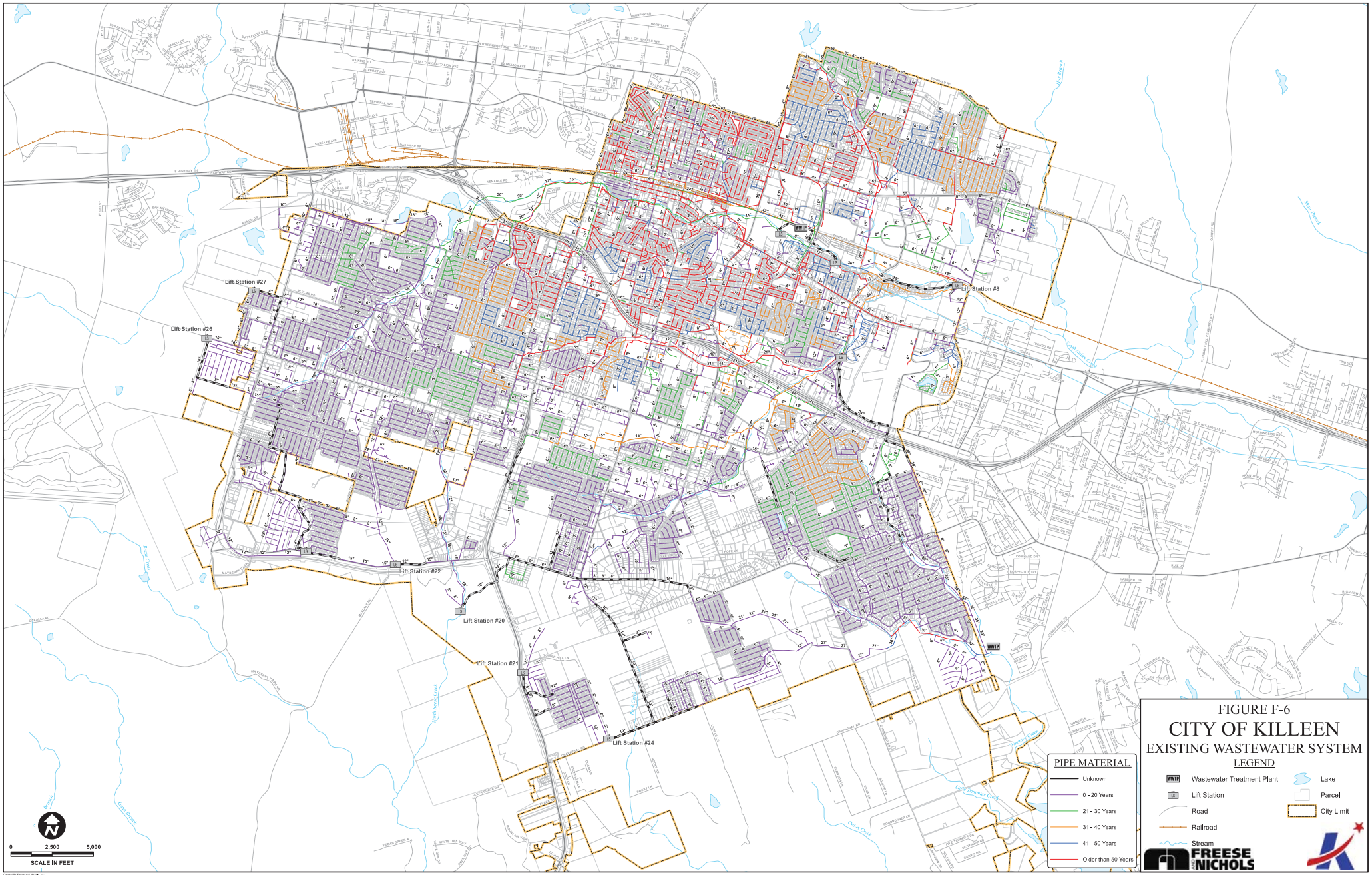
EXISTING WATER SYSTEM

LEGEND

- Elevated Storage Tank
- Ground Storage Tank
- Pump Station
- Road
- Railroad
- Stream
- Lake
- Parcel
- City Limit

FREESE NICHOLS


Lift Station #27
Lift Station #26
Lift Station #22
Lift Station #20
Lift Station #21
Lift Station #24
Lift Station #8
WWTP
WWTP
WWTP
0
2,500
5,000
SCALE IN FEET
PIPE MATERIAL
Cast Iron
Clay
Concrete
Ductile Iron
Fiberglass
HDPE
Hobas
PVC
Unknown
FIGURE F-5
CITY OF KILLEEN
EXISTING WASTEWATER SYSTEM
LEGEND
Wastewater Treatment Plant
Lift Station
Road
Railroad
Stream
Lake
Parcel
City Limit
FREESE NICHOLS


Lift Station #27
Lift Station #26
Lift Station #22
Lift Station #20
Lift Station #21
Lift Station #24
Lift Station #8
WWTP
WWTP
0
2,500
5,000
SCALE IN FEET
PIPE MATERIAL
Unknown
0 - 20 Years
21 - 30 Years
31 - 40 Years
41 - 50 Years
Older than 50 Years
FIGURE F-6
CITY OF KILLEEN
EXISTING WASTEWATER SYSTEM
LEGEND
Wastewater Treatment Plant
Lift Station
Road
Railroad
Stream
Lake
Parcel
City Limit
FREESE NICHOLS

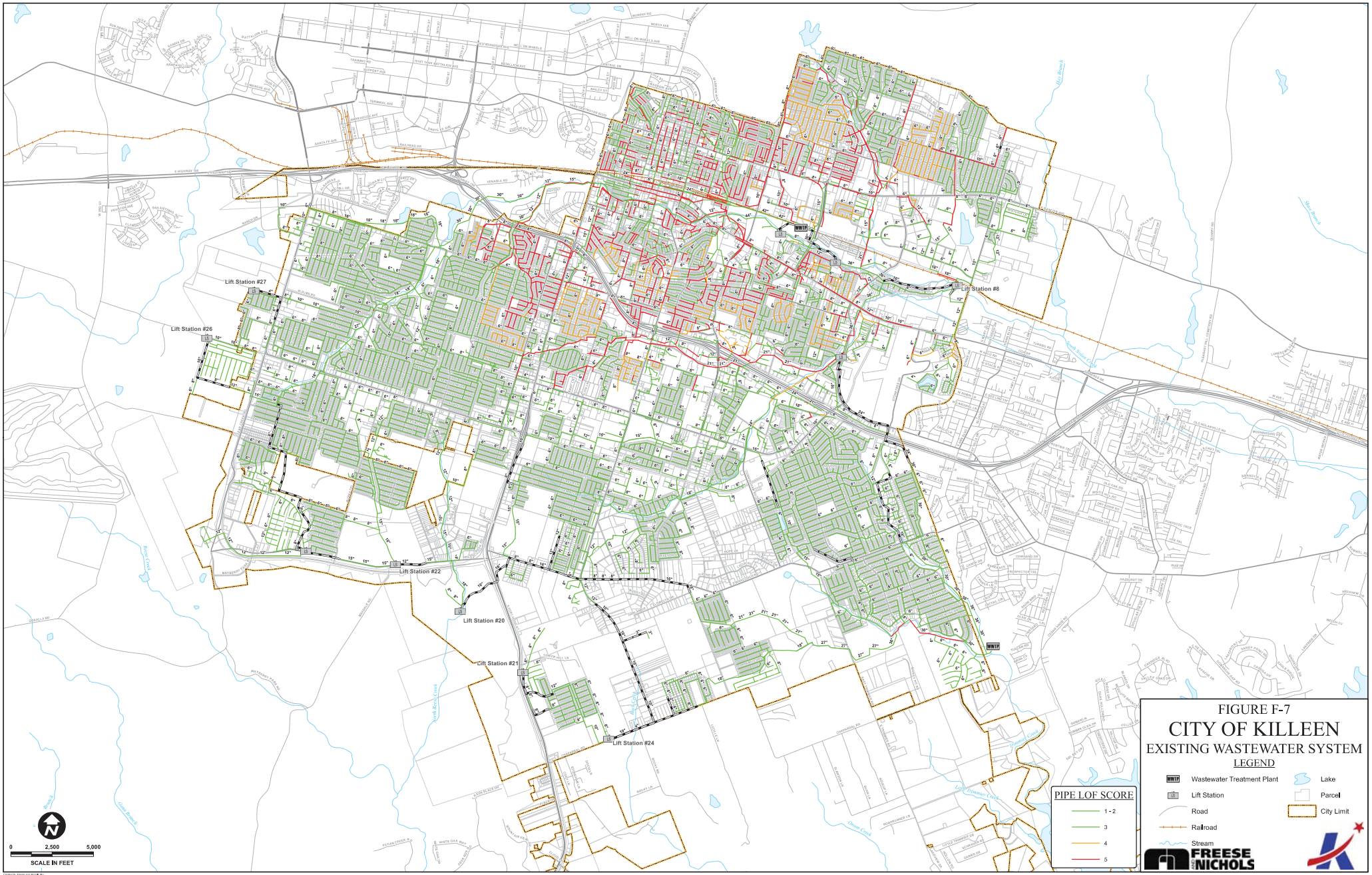


FIGURE F-7

CITY OF KILLEEN

EXISTING WASTEWATER SYSTEM

LEGEND

- Wastewater Treatment Plant
- Lift Station
- Road
- Railroad
- Stream
- Lake
- Parcel
- City Limit

FREESE NICHOLS

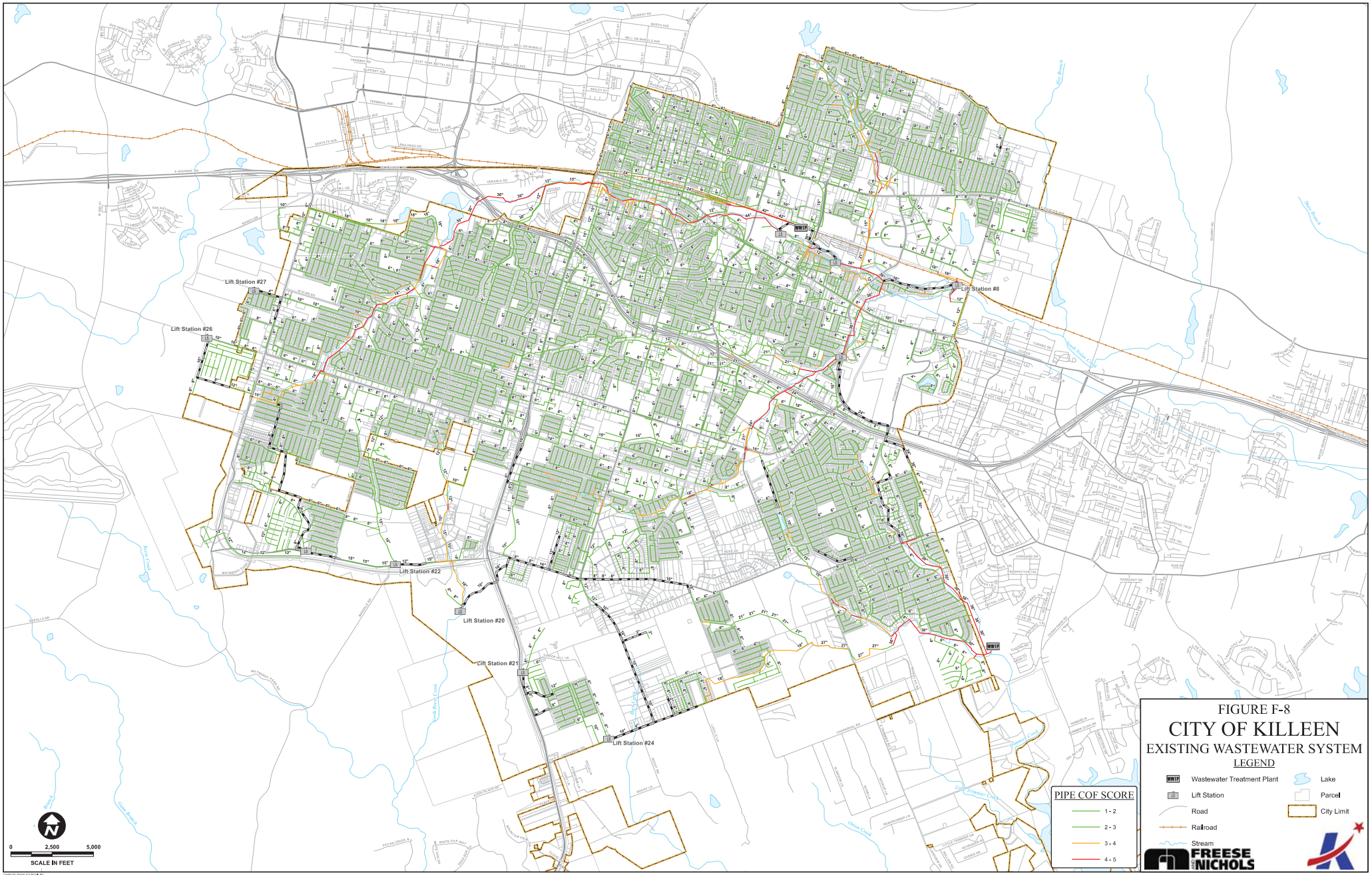


FIGURE F-8

CITY OF KILLEEN

EXISTING WASTEWATER SYSTEM

LEGEND

- Wastewater Treatment Plant
- Lift Station
- Road
- Railroad
- Stream
- Lake
- Parcel
- City Limit

FREESE NICHOLS

Appendix G

Renewal CIP Cost Tables

City of Killeen

Water Renewal Capital Improvement Cost Estimate — **October, 2019**

Construction Project Number: R1W — **Phase:** Renewal Projects

Project Name: Water Line Replacement or Rehabilitation Area #1

Project Description:

Water line renewal Area 1 contains lines that received a "High" risk score. A few distribution lines were targeted for Killeen to either replace or perform rehab in the area surrounding Bundrant EST.

Project Drivers:

The risk based assessment done using Killeen GIS data utilizes condition parameters (material, age, maintenance) and criticality parameters (diameter, accessibility, proximity to critical customers, and redundancy) to determine an overall risk score. Table 11-26 in the report displays a matrix with the various combinations of condition and criticality scores that receive "High" risk designation.

Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	6" WL & Appurtenances	71,180	LF	$ 72	$ 5,124,960
2	8" WL & Appurtenances	15,885	LF	$ 96	$ 1,524,960
3	10" WL & Appurtenances	1,460	LF	$ 120	$ 175,200
4	12" WL & Appurtenances	405	LF	$ 144	$ 58,320
5	16" WL & Appurtenances	1,935	LF	$ 192	$ 371,520
6	24" WL & Appurtenances	660	LF	$ 288	$ 190,080
				SUBTOTAL:	**$ 7,445,100**
		CONTINGENCY		20%	$ 1,489,100
				SUBTOTAL:	**$ 8,934,200**
		ENG/SURVEY		15%	$ 1,340,200
				SUBTOTAL:	**$ 10,274,400**
				Estimated Project Total:	**$ 10,274,400**

City of Killeen

FREESE AND NICHOLS | KILLEEN TEXAS

Water Renewal Capital Improvement Cost Estimate — **October, 2019**

Construction Project Number: **R2W** — **Phase: Renewal Projects**

Project Name: **Pump Station #2 Rehabilitation**

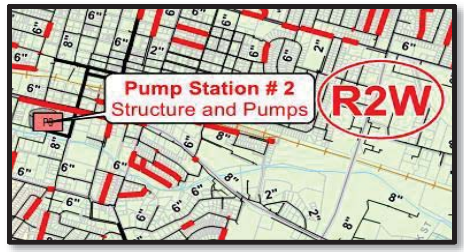
Project Description:

This project includes adding a ventilation system to prevent long term damage to electrical panels and replacing the three existing pumps with similar size pumps.

Project Drivers:

From the site visit, the team notes that windows are opened for venting, which creates water damage risk for electrical panels. The pumps are outdated and no longer manufactured so they need to be replaced.

Vicinity Map



Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Pump Station Building (Electrical, HVAC)	1	LS	$ 450,000	$ 450,000
2	1.7 MGD Pumps	3	LS	$ 259,500	$ 778,500
				SUBTOTAL:	**$ 1,228,500**
		CONTINGENCY		20%	$ 245,700
				SUBTOTAL:	**$ 1,474,200**
		ENG/SURVEY		15%	$ 221,200
				SUBTOTAL:	**$ 1,695,400**
				Estimated Project Total:	**$ 1,695,400**

City of Killeen

FREESE AND NICHOLS | KILLEEN TEXAS

Water Renewal Capital Improvement Cost Estimate	October, 2019
Construction Project Number: R3W	Phase: Renewal Projects
Project Name:	Pump Station #3 Rehabilitation

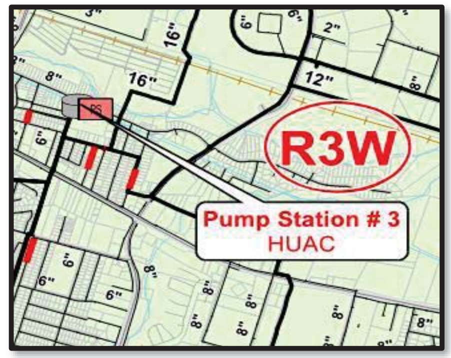
Project Description:

This project involves a ventilation system rehabilitation.

Project Drivers:

From the site visit, the team notes that heaters don't work. It was reported that all pumps at this pump station can be running at the same time. The pump station does not have air conditioning and can get very warm inside. It appears there are aftermarket A/C units on the back of the MCC.

Vicinity Map



Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Pump Station Building (Electrical, HVAC)	1	LS	$ 450,000	$ 450,000
				SUBTOTAL:	**$ 450,000**
		CONTINGENCY		20%	$ 90,000
				SUBTOTAL:	**$ 540,000**
		ENG/SURVEY		15%	$ 81,000
				SUBTOTAL:	**$ 621,000**
				Estimated Project Total:	**$ 621,000**

City of Killeen

FREESE AND NICHOLS | KILLEEN TEXAS

Water Renewal Capital Improvement Cost Estimate — **October, 2019**

Construction Project Number: R4W — **Phase:** Renewal Projects

Project Name: Pump Station #4 & #5 Rehabilitation

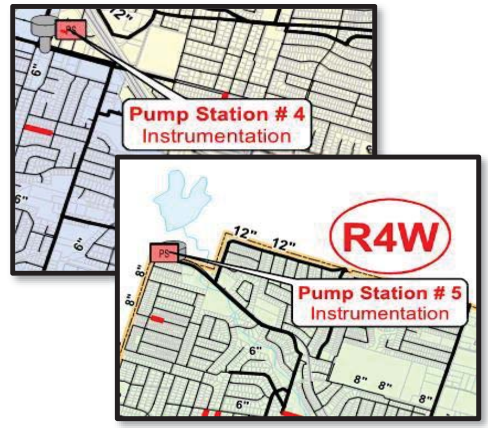
Project Description:

This is an instrumentation update project to address flow monitoring needs and SCADA deficiencies.

Project Drivers:

From the site visit, the team notes that no discharge pressure or flow currently being sent back to SCADA.

Vicinity Map



Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	SCADA System Improvements	1	LS	$ 100,000	$ 100,000
				SUBTOTAL:	**$ 100,000**
		CONTINGENCY		20%	$ 20,000
				SUBTOTAL:	**$ 120,000**
		ENG/SURVEY		15%	$ 18,000
				SUBTOTAL:	**$ 138,000**
				Estimated Project Total:	**$ 138,000**

City of Killeen

Water Renewal Capital Improvement Cost Estimate | **October, 2019**

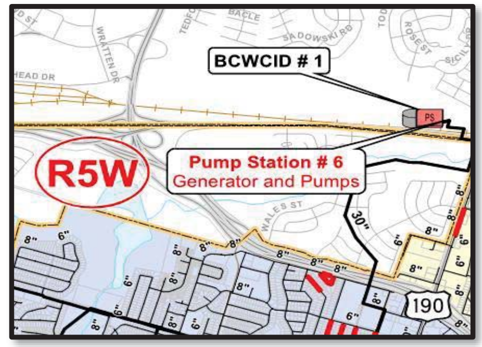
Construction Project Number: **R5W** | **Phase: Renewal Projects**

Project Name: **Pump Station #6 Rehabilitation**

Project Description:

This project involves adding a generator to the site.

Vicinity Map



Project Drivers:

From the site visit, the team noted that one of two transformers melted a year ago and was replaced. The second transformer is original and there is no generator or backup power on site.

Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Generator	1	LS	$ 500,000	$ 500,000
			SUBTOTAL:	**$ 500,000**
		CONTINGENCY		20%	$ 100,000
				SUBTOTAL:	**$ 600,000**
		ENG/SURVEY		15%	$ 90,000
				SUBTOTAL:	**$ 690,000**
				Estimated Project Total:	**$ 690,000**

City of Killeen

FREESE AND NICHOLS | KILLEEN TEXAS

Water Renewal Capital Improvement Cost Estimate	October, 2019
Construction Project Number: R6W	Phase: Renewal Projects
Project Name:	Airport Pump Station Rehabilitation

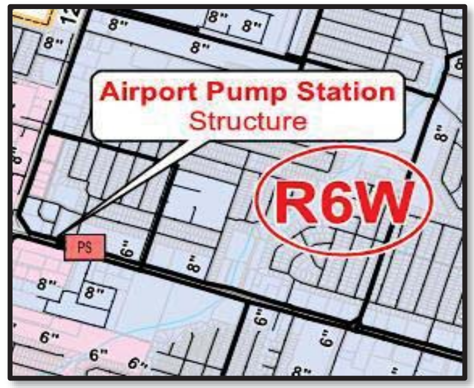
Project Description:

This project involves rehabing the pump station roof.

Project Drivers:

From the site visit, the team noted that there was a leak over MCC, which could damage control equipment.

Vicinity Map



Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Pump Station Building (Structure)	1	LS	$ 100,000	$ 100,000
				SUBTOTAL:	$ 100,000
		CONTINGENCY		20%	$ 20,000
				SUBTOTAL:	$ 120,000
		ENG/SURVEY		15%	$ 18,000
				SUBTOTAL:	$ 138,000
				Estimated Project Total:	$ 138,000

City of Killeen

FREESE AND NICHOLS | KILLEEN TEXAS

Water Renewal Capital Improvement Cost Estimate — **October, 2019**

Construction Project Number: **R7W** — **Phase: Renewal Projects**

Project Name: **Southeast EST Rehabilitation**

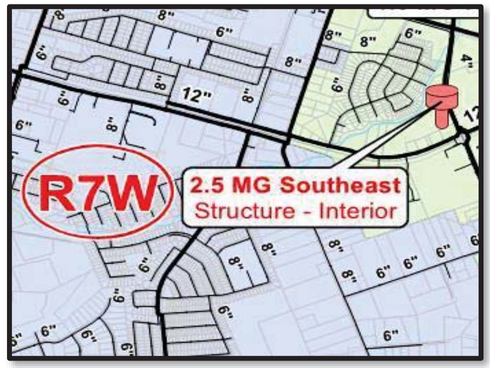
Project Description:

This project involves a tank interior rehab.

Project Drivers:

The site visit team also used camera inspections provided by the City and noticed that there appears to be bulking on the center access tube, scaling on the tank walls, sediment on the bottom of the tank, and paint is delaminating from the tank celling.

Vicinity Map



Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Elevated Tank Interior Rehabilitation	1	LS	$ 200,000	$ 200,000
				SUBTOTAL:	**$ 200,000**
		CONTINGENCY		20%	$ 40,000
				SUBTOTAL:	**$ 240,000**
		ENG/SURVEY		15%	$ 36,000
				SUBTOTAL:	**$ 276,000**
				Estimated Project Total:	**$ 276,000**

City of Killeen

Wastewater Renewal Capital Improvement Cost Estimate — **October, 2019**

Construction Project Number: R1S — **Phase:** Renewal Projects

Project Name: Wastewater Line Replacement and Rehabilitation Area #1

Project Description:

Wastewater line renewal Area 1 contains lines that received a "High" risk score. The interceptor and collector lines that were targeted for Killeen to either replace or rehab are from the South Nolan Creek and WWTP Subbasins just upstream of the North WWTP.

Project Drivers:

The risk based assessment done using Killeen GIS data utilizes condition parameters (material, age, maintenance) and criticality parameters (diameter, accessibility, proximity to environmentally sensitive areas) to determine an overall risk score. Table 11-26 in the report displays a matrix with the various combinations of condition and criticality scores that receive "High" risk designation.

Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	6" Pipe < 10 feet deep	86,475	LF	$ 36	$ 3,113,100
2	8" Pipe < 8 feet deep	50,715	LF	$ 48	$ 2,434,320
3	10" Pipe < 8 feet deep	11,875	LF	$ 60	$ 712,500
4	12" Pipe < 8 feet deep	12,230	LF	$ 72	$ 880,560
5	15" Pipe < 8 feet deep	2,800	LF	$ 90	$ 252,000
6	18" Pipe < 8 feet deep	1,475	LF	$ 108	$ 159,300
7	21" Pipe < 8 feet deep	4,315	LF	$ 126	$ 543,690
8	24" Pipe < 8 feet deep	1,425	LF	$ 144	$ 205,200
9	36" Pipe < 8 feet deep	2,730	LF	$ 216	$ 589,680
10	4' Diameter Manhole Rehab	349	EA	$ 5,000	$ 1,745,000
			SUBTOTAL:		**$ 10,635,400**
			CONTINGENCY	20%	$ 2,127,100
			SUBTOTAL:		**$ 12,762,500**
			ENG/SURVEY	15%	$ 1,914,400
			SUBTOTAL:		**$ 14,676,900**
				Estimated Project Total:	**$ 14,676,900**

City of Killeen

Wastewater Renewal Capital Improvement Cost Estimate — **October, 2019**

Construction Project Number: R2S — **Phase: Renewal Projects**

Project Name: Lift Station #1 Rehabilitation

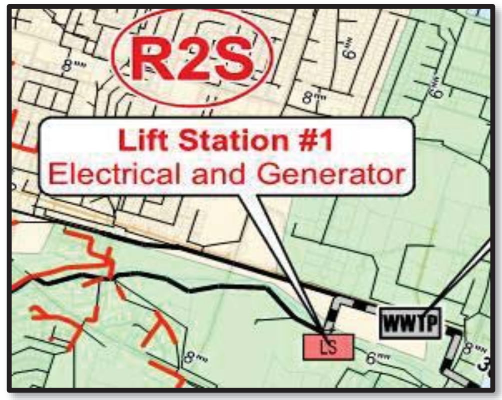
Project Description:

This project includes adding a generator at the site to replace the existing dual service.

Project Drivers:

The dual services are from the same pole line and therefore offer very little in redundancy. The dual service also terminates to a transfer switch that when switched over continuously has issues and requires service.

Vicinity Map



Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Generator	1	LS	$ 500,000	$ 500,000
			SUBTOTAL:	**$ 500,000**
		CONTINGENCY	20%		$ 100,000
				SUBTOTAL:	**$ 600,000**
		ENG/SURVEY	15%		$ 90,000
				SUBTOTAL:	**$ 690,000**
				Estimated Project Total:	**$ 690,000**

City of Killeen

Wastewater Renewal Capital Improvement Cost Estimate — **October, 2019**

Construction Project Number: **R3S** — **Phase: Renewal Projects**

Project Name: **Lift Station #2 Rehabilitation**

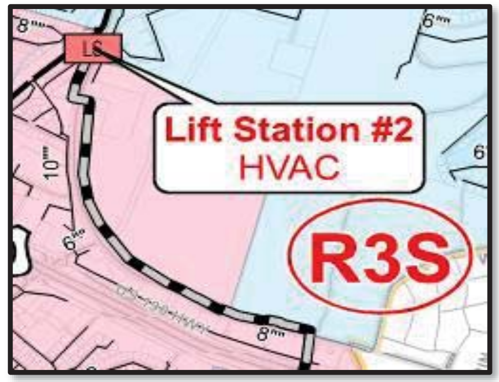
Project Description:

This project includes adding a forced air system in the pump room.

Project Drivers:

From the site visits, the team noted that there were issues with HVAC and no forced air ventilation for the pump room.

Vicinity Map



Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Lift Station Building (Electrical, HVAC)	1	LS	$ 100,000	$ 100,000
				SUBTOTAL:	**$ 100,000**
		CONTINGENCY		20%	$ 20,000
				SUBTOTAL:	**$ 120,000**
		ENG/SURVEY		15%	$ 18,000
				SUBTOTAL:	**$ 138,000**
				Estimated Project Total:	**$ 138,000**

City of Killeen

FREESE AND NICHOLS | KILLEEN TEXAS

Wastewater Renewal Capital Improvement Cost Estimate	**October, 2019**
Construction Project Number: R4S	**Phase: Renewal Projects**
Project Name:	**Lift Station #6 Rehabilitation**

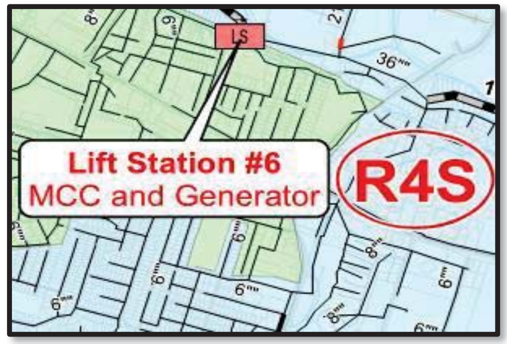
Project Description:

This project includes verifying how long the generator can run at full capacity with its existing tank and rehabing the MCC.

Project Drivers:

From the site visits, the team noted the following:
-The generator appears to be original and near its expected useful life. It is also showing sign of wear with its enclosure bulging out. The generator fuel tank also appears to be small.
-The MCC also appears to be original and nearing its expected useful life. The last vertical section of the MCC (in the corner) does not have the required clearance in front of it as required by the NEC, due to a cabinet that was added along the wall perpendicular to it.

Vicinity Map



Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Generator	1	LS	$ 500,000	$ 500,000
2	Lift Station MCC Rehabilitation	1	LS	$ 400,000	$ 400,000
			SUBTOTAL:	**$ 900,000**
		CONTINGENCY		20%	$ 180,000
				SUBTOTAL:	**$ 1,080,000**
		ENG/SURVEY		15%	$ 162,000
				SUBTOTAL:	**$ 1,242,000**
				Estimated Project Total:	**$ 1,242,000**

City of Killeen

Wastewater Renewal Capital Improvement Cost Estimate | **October, 2019**

Construction Project Number: **R5S** | **Phase: Renewal Projects**

Project Name: **Lift Station #21 Rehabilitation**

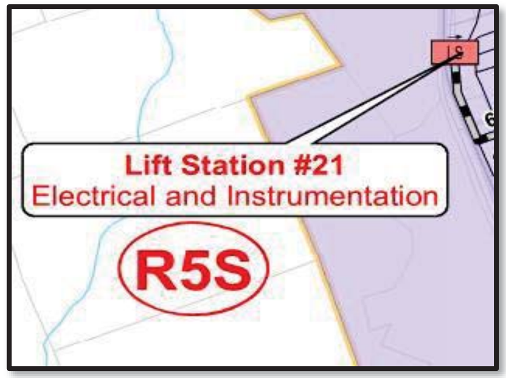
Project Description:

This project includes adding arc proofing tape to service conductors to protect other cables in event of a fault on the service. It will also add a level transducer for continuous monitoring of wet well level.

Project Drivers:

From the site visits, the team noted the following:
-Service entrance cables are routed in the same raceway as other conductors which does not meet the NEC.
-No level transducer at lift station.

Vicinity Map



Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Misc. Electrical	1	LS	$ 200,000	$ 200,000
2	SCADA System Improvements	1	LS	$ 100,000	$ 100,000
				SUBTOTAL:	**$ 300,000**
		CONTINGENCY		20%	$ 60,000
				SUBTOTAL:	**$ 360,000**
		ENG/SURVEY		15%	$ 54,000
				SUBTOTAL:	**$ 414,000**
				Estimated Project Total:	**$ 414,000**

City of Killeen

Wastewater Renewal Capital Improvement Cost Estimate — **October, 2019**

Construction Project Number: **R6S** — **Phase: Renewal Projects**

Project Name: **Lift Station #26 Rehabilitation**

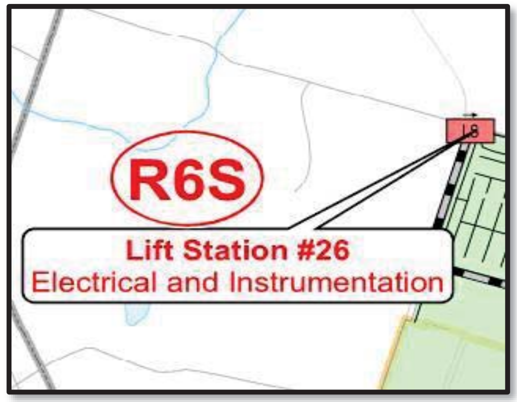
Project Description:

This project includes adding arc proofing tape to service conductors to protect other cables in event of a fault on the service. It will also adding a level transducer for continuous monitoring of wet well level.

Project Drivers:

From the site visits, the team noted the following:
-Service entrance cables are routed in the same raceway as other conductors which does not meet the NEC.
-No level transducer at lift station

Vicinity Map



Opinion of Probable Construction Cost

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Misc. Electrical	1	LS	$ 200,000	$ 200,000
2	SCADA System Improvements	1	LS	$ 100,000	$ 100,000
				SUBTOTAL: $ **300,000**
		CONTINGENCY		20%	$ 60,000
				SUBTOTAL:	$ **360,000**
		ENG/SURVEY		15%	$ 54,000
				SUBTOTAL:	$ **414,000**
				Estimated Project Total:	$ **414,000**

Appendix H

Facility Site Visit Sheets

Pump Station 2

Inspection Date: 1/29

Facility Information	
Address:	302 S Park
Year in Service:	1999
Type of Facility:	
Number of Pumps:	3
Capacity:	3-1,200 gpm pumps
Horsepower:	75
Monitoring:	
Generator:	

CONDITION ASSESSMENT

	Component Group	Component Condition Rating	Weight Factor	Weighted Component Rating	Comments
Electircal	MCC, Switch Gear	3	15%	0.45	Water leaking from roof over MCC. MCC enclosure is rated NEMA 12 which is rated for dripping or light splashing of liquid but is not waterproof. No visible damage inside MCC but signs of dripping water outside.
	Alternate Power (dual power feed or back up generator)	2	10%	0.20	No generator on site. Providing a generator or quick connect on site will improve reliability in case of a power outage. This is the only Pump Station on this pressure plain - Is a generator required here per TCEQ?
Mechanical	HVAC	1	5%	0.05	No AC (not issue for electrical) but heater works
	Piping	1	5%	0.05	No issues
	Valves	2	5%	0.10	Corrosion
	Meters	1	5%	0.05	
	Pumps	2	15%	0.30	Minor corrosion visible but no reported issues
	Motors	1	15%	0.15	Rewound motor a couple years ago
Structure	Walls	1	5%	0.05	No issues
	Roof	5	5%	0.25	Leak over MCC. Recommend fixing to prevent long term damage to MCC.
	Foundation	1	5%	0.05	No cracks
	Instrumentation	1	5%	0.05	No reported issues.
	SCADA	1	5%	0.05	No reported issues.
	Condition Rating			**1.80**	No ground storage & US pressure monitored to ensure UPP does not drop below 20 psi. UPP to airport is only 39 ft of head difference. Getting TCEQ exception? Wants GST at site - Not in previous master plan project?

CRITICALITY ASSESSMENT

Component Group	Percent of PP Capacity	Criticality Rating	Weight Factor	Weighted Component Rating	Comments
Capacity Affected	24%	5	50%	2.50	Pumping capacity with largest pump out of service equates to approximately 24% of Lower Pressure Plane Max Day Demand
Public Image/Regulatory Impact		2	20%	0.40	
Outage Duration		3	30%	0.90	
Criticality Rating		-	100%	**3.80**	

RISK BASED ASSESSMENT

	Condition Rating	Criticality Rating	Overall Risk Rating	Risk Category
Pump Station 2 Risk Rating	1.80	3.80	6.84	Moderate

Pump Station 3

Inspection Date: 1/30

Facility Information	
Address:	304 S 48th St
Year in Service:	1999
Type of Facility:	
Number of Pumps:	4
Capacity:	4-2,000 gpm pumps
Horsepower:	150 min
Monitoring:	
Generator:	

CONDITION ASSESSMENT

	Component Group	Component Condition Rating	Weight Factor	Weighted Component Rating	Comments
Electircal	MCC, Switch Gear	3	15%	0.45	Soft starter for Pump 2 caught fire 3 years ago. Repairs were made to the starter unit, but not all parts/wiring were replaced. Currently Pump 4 Soft Starter is out of service (capacitance fail). Reported that main breaker on the ATS trips on when 2 pumps are called to start at the same time causing the generator to start. Pump Station is run in manual. Recommend a coordination study of the power system be done.
	Alternate Power (dual power feed or back up generator)	1	10%	0.10	Site currently has a generator- it is regularly excercised and maintenanced.
Mechanical	HVAC	4	5%	0.20	Heaters don't work. It was reported that all pumps at this pump station can be running at the same time. The pump station does not have air conditioning and can warm inside. It appears there are aftermarket A/C units on the back of the MCC. Recommend an evaluation of the heat loss of the equipment in the pump station.
	Piping	2	5%	0.10	Inside piping looks good. Outside piping has a bare spot.
	Valves	1	5%	0.05	systems have been replaced in last 2 years. Pump 1 clay valve was just rebuilt.
	Meters	1	5%	0.05	Steve mentioned meter does not have enough distance from discharge to operate accurately
	Pumps	5	15%	0.75	Pumps 3 & 4 had impellers replaced. Pumps 1 & 2 need replacing as well. Pump 4 is down because soft starter is out.
	Motors	1	15%	0.15	No reported issues
Structure	Walls	1	5%	0.05	
	Roof	1	5%	0.05	
	Foundation	1	5%	0.05	
	Instrumentation	1	5%	0.05	No reported issues
	SCADA	2	5%	0.10	It was noted that a HIM screen was needed on the SCADA cabinet for remote control of the pump station and tank status. Also, as reported above, the main breaker on the ATS trips on when 2 pumps are called to start at the same time causing the generator to start. Recommend to modify programming or implement a programmed time delay between 2 pumps starting.
	Condition Rating			**2.15**	Possibly installing new crane

CRITICALITY ASSESSMENT

Component Group	Percent of PP Capacity	Criticality Rating	Weight Factor	Weighted Component Rating	Comments
Capacity Affected	72%	5	50%	2.50	Pumping capacity with largest pump out of service equates to approximately 72% of Lower Pressure Plane Max Day Demand
Public Image/Regulatory Impact		4	20%	0.80	
Outage Duration		5	30%	1.50	
Criticality Rating		-	100%	**4.80**	

RISK BASED ASSESSMENT

	Condition Rating	Criticality Rating	Overall Risk Rating	Risk Category
Pump Station 3 Risk Rating	2.15	4.80	10.32	Moderate

Pump Station 4

Inspection Date: 1/29

Facility Information

Address: 907A W Jasper

Year in Service:

Type of Facility:

Number of Pumps: 4

Capacity: 3-2,550 gpm pumps

Horsepower:

Monitoring:

Generator:

CONDITION ASSESSMENT

Component Group		Component Condition Rating	Weight Factor	Weighted Component Rating	Comments
Electircal	MCC, Switch Gear	3	15%	0.45	Motor Control center is nearing end of expected life and equipment parts for this model are becoming obsolete. Pump 2 motor starter has been replaced.
	Alternate Power (dual power feed or back up generator)	2	10%	0.20	Single power source feeding pump staiton. No generator on site; providing one will improve reliabilty in case of a power outage.
Mechanical	HVAC	4	5%	0.20	A few heaters broken. Not all vents open
	Piping	3	5%	0.15	Paint pealing and corrosion visible on discharge header
	Valves	2	5%	0.10	Pump #3 leaks. Need to adjust packing seal
	Meters	5	5%	0.25	Currently no metering. In process of replacing old venturi meter with mag meter
Pumps		2	15%	0.30	Pump #3 needs adjustment
Motors		1	15%	0.15	Minor corrosion visible
Structure	Walls	1	5%	0.05	
	Roof	1	5%	0.05	
	Foundation	1	5%	0.05	
Instrumentation		4	5%	0.20	No Discharge Pressure & Flow currently being sent back to SCADA.
SCADA		1	5%	0.05	No issues noted.
Condition Rating				**2.20**	

CRITICALITY ASSESSMENT

Component Group	Percent of PP Capacity	Criticality Rating	Weight Factor	Weighted Component Rating	Comments
Capacity Affected	74%	5	50%	2.50	Pumping capacity with largest pump out of service equates to approximately 74% of Upper Pressure Plane Max Day Demand
Public Image/Regulatory Impact		2	20%	0.40	
Outage Duration		5	30%	1.50	
Criticality Rating		-	100%	**4.40**	

RISK BASED ASSESSMENT

	Condition Rating	Criticality Rating	Overall Risk Rating	Risk Category
Pump Station 4 Risk Rating	2.20	4.40	9.68	Moderate

Pump Station 5

Inspection Date: 1/29

Facility Information	
Address:	2001 Westcliff
Year in Service:	1985
Type of Facility:	
Number of Pumps:	3
Capacity:	3 - 2,100 gpm
Horsepower:	
Monitoring:	
Generator:	

CONDITION ASSESSMENT

	Component Group	Component Condition Rating	Weight Factor	Weighted Component Rating	Comments
Electircal	MCC, Switch Gear	3	15%	0.45	Motor Control Center is nearing end of expected life and equipment parts for this model is becoming obsolete.
Electircal	Alternate Power (dual power feed or back up generator)	2	10%	0.20	No generator on site. City has had issues with the transformer being taken out of service from car accidents. Providing backup power on site will improve reliablity in case of a power outage.
Mechanical	HVAC	3	5%	0.15	2 of the heaters not functioning. Vents all working.
Mechanical	Piping	2	5%	0.10	Interior piping is good. Exterior piping has corrosion.
Mechanical	Valves	3	5%	0.15	Pilot systems had to be redone for pump control valve? Isolation valves are difficult to close.
Mechanical	Meters	1	5%	0.05	Calibrated beginning of 2018.
	Pumps	3	15%	0.45	Pump shafts need work. Issues with packing?
	Motors	1	15%	0.15	Pump 3 motor was reworked.
Structure	Walls	2	5%	0.10	Want to install new hoist - electric instead of manual. Door difficult to open
Structure	Roof	1	5%	0.05	
Structure	Foundation	1	5%	0.05	Operators would like to add guard rail
	Instrumentation	4	5%	0.20	No discharge pressure and flow being sent back to SCADA.
	SCADA	1	5%	0.05	No reported issues.
	Condition Rating			**2.15**	

CRITICALITY ASSESSMENT

Component Group	Percent of PP Capacity	Criticality Rating	Weight Factor	Weighted Component Rating	Comments
Capacity Affected	41%	4	50%	2.00	Pumping capacity with largest pump out of service equates to approximately 41% of Lower Pressure Plane Max Day Demand
Public Image/Regulatory Impact		3	20%	0.60	
Outage Duration		4	30%	1.20	
Criticality Rating			100%	**3.80**	

RISK BASED ASSESSMENT

	Condition Rating	Criticality Rating	Overall Risk Rating	Risk Category
Pump Station 5 Risk Rating	2.15	3.80	8.17	Moderate

Pump Station 6

Inspection Date: 1/29

Facility Information	
Address:	201 N Fort Hood
Year in Service:	
Type of Facility:	
Number of Pumps:	3
Capacity:	3-3,500 gpm pumps
Horsepower:	
Monitoring:	
Generator:	

CONDITION ASSESSMENT

	Component Group	Component Condition Rating	Weight Factor	Weighted Component Rating	Comments
Electircal	MCC, Switch Gear	1	15%	0.15	MCC has a 1200A main breaker. Two transformers, fed from the same overhead power line, both feed Main breaker supplying the require amperes for the pump station load.
Electircal	Alternate Power (dual power feed or back up generator)	4	10%	0.40	One of two transformers melted a year ago and was replaced; the second transformer is original - No generator/backup power on site. Providing a generator on site will improve reliability in case of a power outage. Is a generator required at this site per TCEQ requirements?
Mechanical	HVAC	3	5%	0.15	AC was replaced. Vents in pump room don't work.
Mechanical	Piping	2	5%	0.10	Corrosion on bolts on flange
Mechanical	Valves	1	5%	0.05	No reported issues
Mechanical	Meters	3	5%	0.15	Discrepancy between amount received from WCID and Killeen's meter. Meter will be recalibrated soon
	Pumps	1	15%	0.15	Pump #2 shaft reworked about a year ago
	Motors	1	15%	0.15	No reported issues
Structure	Walls	1	5%	0.05	
Structure	Roof	1	5%	0.05	
Structure	Foundation	1	5%	0.05	
	Instrumentation	2	5%	0.10	WCID owns the flow meters in vault on the discharge lines; no feedback to SCADA for status.
	SCADA	1	5%	0.05	New SCADA cabinet installed 2017.
	Condition Rating			**1.60**	

CRITICALITY ASSESSMENT

Component Group	Percent of PP Capacity	Criticality Rating	Weight Factor	Weighted Component Rating	Comments
Capacity Affected	68%	5	50%	2.50	Pumping capacity with largest pump out of service equates to approximately 68% of Upper Pressure Plane Max Day Demand
Public Image/Regulatory Impact		5	20%	1.00	
Outage Duration		5	30%	1.50	
Criticality Rating		-	100%	**5.00**	

RISK BASED ASSESSMENT

	Condition Rating	Criticality Rating	Overall Risk Rating	Risk Category
Pump Station 6 Risk Rating	1.60	5.00	8.00	Moderate

Pump Station 7

Inspection Date: 1/29

Facility Information	
Address:	5119 Stan Schlueter
Year in Service:	2001
Type of Facility:	
Number of Pumps:	2
Capacity:	2 - 1,050 gpm
Horsepower:	60 min
Monitoring:	
Generator:	

CONDITION ASSESSMENT

	Component Group	Component Condition Rating	Weight Factor	Weighted Component Rating	Comments
Electircal	MCC, Switch Gear	3	15%	0.45	Water leaking from roof over MCC. MCC enclosure is rated NEMA 12 which is rated for dripping or light splashing of liquid but is not waterproof. No visible damage inside MCC but signs of dripping water outside.
	Alternate Power (dual power feed or back up generator)	2	10%	0.20	No generator on site. Providing a generator or quick connect on site will improve reliability in case of a power outage. This is the only Pump Station on this pressure plain - Is a generator required here per TCEQ?
Mechanical	HVAC	1	5%	0.05	No AC (not issue for electrical) but heater works
	Piping	1	5%	0.05	No issues
	Valves	2	5%	0.10	Corrosion
	Meters	1	5%	0.05	
	Pumps	2	15%	0.30	Minor corrosion visible but no reported issues
	Motors	1	15%	0.15	Rewound motor a couple years ago
Structure	Walls	1	5%	0.05	No issues
	Roof	5	5%	0.25	Leak over MCC. Recommend fixing to prevent long term damage to MCC.
	Foundation	1	5%	0.05	No cracks
	Instrumentation	1	5%	0.05	No reported issues.
	SCADA	1	5%	0.05	No reported issues.
	Condition Rating			**1.80**	No ground storage & US pressure monitored to ensure UPP does not drop below 20 psi. UPP to airport is only 39 ft of head difference. Getting TCEQ exception? Wants GST at site - Not in previous master plan project?

CRITICALITY ASSESSMENT

Component Group	Percent of PP Capacity	Criticality Rating	Weight Factor	Weighted Component Rating	Comments
Capacity Affected	127%	5	50%	2.50	Pumping capacity with largest pump out of service equates to approximately 127% of Airport Pressure Plane Max Day Demand
Public Image/Regulatory Impact		5	20%	1.00	
Outage Duration		3	30%	0.90	
Criticality Rating		-	100%	**4.40**	

RISK BASED ASSESSMENT

	Condition Rating	Criticality Rating	Overall Risk Rating	Risk Category
Pump Station 7 Risk Rating	1.80	4.40	7.92	Moderate

Bundrant EST

Inspection Date:

Facility Information	
Address:	2905 Lake Road
Year in Service:	2008
Type of Tank:	Composite
Capacity:	1.5 MG
Overflow Elevation:	1000'
Diameter:	90'
Tank Entry Point:	Bottom

CONDITION ASSESSMENT

Component Group		Component Condition Rating	Weight Factor	Weighted Component Rating	Comments
Structure	Internal	2	25%	0.50	Assessed using camera inspections Light corrosion on the ladder and fall protection inside the tank. Light corrosion on inlet raiser. Sediment on the bottom of the tank.
Structure	External	1	20%	0.20	
Mechanical - Hatches, Valves, & Vents		1	20%	0.20	No issues with flow meter. Clay valve tries to maintain certain flow into tank - causes operational issues Per inspection video report: Hatches are in good condition, and are not labeled Confined Space.
Electrical & Instrumentation		1	15%	0.15	No issues noted.
Chemical Boosting		2	10%	0.20	Valve - not used in a while
Overflow		1	10%	0.10	
Condition Rating				1.35	

CRITICALITY ASSESSMENT

Component Group	Percent of PP Capacity	Component Condition	Weight Factor	Weighted Component Rating	Comments
Capacity Affected	10%	2	50%	1.00	Tank volume equates to approximately 10% of Lower Pressure Plane Max Day Demand
Public Image/Regulatory Impact		3	20%	0.60	
Outage Duration		4	30%	1.20	
Criticality Rating		-	100%	**2.80**	

RISK BASED ASSESSMENT

	Condition Rating	Criticality Rating	Overall Risk Rating	Risk Category
Bundrant EST Risk Rating	1.35	2.80	3.78	Low

Ground Storage Tank - Pump Station 2

Inspection Date:

Facility Information	
Address:	301 S Park Street
Year in Service:	
Type of Tank:	Prestressed concrete tank
Capacity:	2.0 MG
Overflow Elevation:	844.5'
Dimensions:	118' x 155'
Tank Entry Point:	Overhead

CONDITION ASSESSMENT

Component Group		Component Condition Rating	Weight Factor	Weighted Component Rating	Comments
Structure	Internal	2	25%	0.50	Assessed using camera inspections Access Ladder in poor condition with heavy aamount of corrosion.
Structure	External	1	20%	0.20	
Mechanical - Hatches, Valves, & Vents		3	20%	0.60	Staff reported issues with hatch by tank inspectors. Per inspection report: Vents and screens are in good condition.
Electrical & Instrumentation		2	15%	0.30	Lighting over tank no longer working. Conduit around GST no longer being supported on wall and needs to be secured.
Roof Slope		5	10%	0.50	Grass and gravel on roof
Overflow		4	10%	0.40	PVC pipe (overflow line) is exposed
Condition Rating				2.50	

CRITICALITY ASSESSMENT

Component Group	Percent of PP Capacity	Component Condition	Weight Factor	Weighted Component Rating	Comments
Capacity Affected	14%	3	50%	1.50	Tank volume equates to approximately 14% of Lower Pressure Plane Max Day Demand
Public Image/Regulatory Impact		4	20%	0.80	
Outage Duration		2	30%	0.60	
Criticality Rating		-	100%	**2.90**	

RISK BASED ASSESSMENT

	Condition Rating	Criticality Rating	Overall Risk Rating	Risk Category
Pump Station 2 GST Risk Rating	2.50	2.90	7.25	Moderate

Rodeo EST

Inspection Date:

Facility Information	
Address:	2004 Little Nolan Road
Year in Service:	1976
Type of Tank:	Steel
Capacity:	1.0 MG
Overflow Elevation:	1000'
Diameter:	
Tank Entry Point:	Bottom

CONDITION ASSESSMENT

Component Group		Component Condition Rating	Weight Factor	Weighted Component Rating	Comments
Structure	Internal	1	25%	0.25	Assessed using camera inspections Minor corrosion on tank ceiling. Sediment on the bottom of the tank.
Structure	External	1	20%	0.20	Minor corrosion spots on legs. Chalking on access tube.
Mechanical - Hatches, Valves, & Vents		2	20%	0.40	Corrosion on hatch and ladder for vault. Groundwater infiltration causes need for sump pump within tower.
Electrical & Instrumentation		2	15%	0.30	Radio communication was reported to be intermittent.
Chemical Boosting		1	10%	0.10	No boosting at tank
Overflow		1	10%	0.10	
Condition Rating				1.35	

CRITICALITY ASSESSMENT

Component Group	Percent of PP Capacity	Component Condition	Weight Factor	Weighted Component Rating	Comments
Capacity Affected	7%	2	50%	1.00	Tank volume equates to approximately 7% of Lower Pressure Plane Max Day Demand
Public Image/Regulatory Impact		3	20%	0.60	
Outage Duration		4	30%	1.20	
Criticality Rating		-	100%	**2.80**	

RISK BASED ASSESSMENT

	Condition Rating	Criticality Rating	Overall Risk Rating	Risk Category
Rodeo EST Risk Rating	1.35	2.80	3.78	Low

Southeast EST

Inspection Date:

Facility Information	
Address:	4303 Cunningham Road
Year in Service:	2002
Type of Tank:	Composite
Capacity:	2.5 MG
Overflow Elevation:	1000'
Diameter:	
Tank Entry Point:	Bottom

CONDITION ASSESSMENT

	Component Group	Component Condition Rating	Weight Factor	Weighted Component Rating	Comments
Structure	Internal	4	25%	1.00	Assessed using camera inspections There appears to be bulking on the center access tube. There is scaling on the tank walls. Sediment on the bottom of the tank. Paint delaminating from tank celling
Structure	External	2	20%	0.40	Door frame and pipes rusting
	Mechanical - Hatches, Valves, & Vents	1	20%	0.20	Flow meter is broken. No isolation valve to be able to replace seal on BFV. Valve cannot be controlled with SCADA.
	Electrical & Instrumentation	2	15%	0.30	No flow back to SCADA. Ultrasonic is mounted on pipe but doesn't work. Chemical building on site is not in use and currently not functional.
	Chemical Boosting	1	10%	0.10	No boosting at tank
	Overflow/Piping	2	10%	0.20	Corrosion on inlet pipe & valves. PVC stub out on overflow
	Condition Rating			2.20	Square safety climb rail is preferred to existing safety rail.

CRITICALITY ASSESSMENT

Component Group	Percent of PP Capacity	Component Condition	Weight Factor	Weighted Component Rating	Comments
Capacity Affected	17%	3	50%	1.50	Tank volume equates to approximately 17% of Lower Pressure Plane Max Day Demand
Public Image/Regulatory Impact		4	20%	0.80	
Outage Duration		5	30%	1.50	
Criticality Rating		-	100%	**3.80**	

RISK BASED ASSESSMENT

	Condition Rating	Criticality Rating	Overall Risk Rating	Risk Category
Southeast EST Risk Rating	2.20	3.80	8.36	Moderate

Ground Storage Tank - Pump Station 4

Inspection Date: 1/29

Facility Information	
Address:	907 W Jasper Drive
Year in Service:	1986
Type of Tank:	Prestressed concrete
Capacity:	1.5 MG
Overflow Elevation:	
Diameter:	86.4'
Tank Entry Point:	

CONDITION ASSESSMENT

Component Group		Component Condition Rating	Weight Factor	Weighted Component Rating	Comments
Structure	Internal	3	25%	0.75	Assessed using camera inspections Corrison on ladder. Corrion on the over flow pipe Sediment on the bottom of the tank.
	External	1	20%	0.20	
Mechanical - Hatches, Valves, & Vents		3	20%	0.60	Issues with tank inlet valve (butterfly valve) - can't be controlled by SCADA. Drain valve is leaking. No manway Per Tank Inspection: Vent is in good condition.
Electrical & Instrumentation		4	15%	0.60	No discharge pressure or flow being sent back to SCADA. Reference Pump Station 4 for addidtional comments.
Roof Slope		1	10%	0.10	
Overflow		2	10%	0.20	Corrosion on vavle. Erosion around splash pad
Condition Rating				2.45	

CRITICALITY ASSESSMENT

Component Group	Percent of PP Capacity	Component Condition	Weight Factor	Weighted Component Rating	Comments
Capacity Affected	10%	2	50%	1.00	Tank volume equates to approximately 10% of Upper Pressure Plane Max Day Demand
Public Image/Regulatory Impact		2	20%	0.40	
Outage Duration		5	30%	1.50	
Criticality Rating		-	100%	**2.90**	

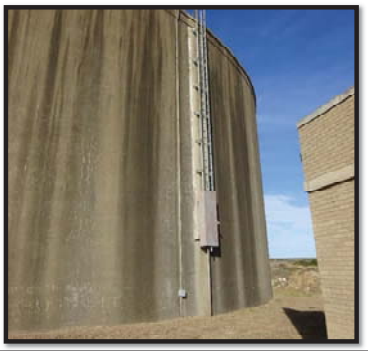
RISK BASED ASSESSMENT

	Condition Rating	Criticality Rating	Overall Risk Rating	Risk Category
Pump Station #4 GST Risk Rating	2.45	2.90	7.11	Moderate

Ground Storage Tank - Pump Station 5

Inspection Date: 1/29

Facility Information	
Address:	2001 Westcliff Road
Year in Service:	1984
Type of Tank:	Prestressed concrete
Capacity:	2.5 MG
Overflow Elevation:	
Diameter:	105'
Tank Entry Point:	



CONDITION ASSESSMENT

Component Group		Component Condition Rating	Weight Factor	Weighted Component Rating	Comments
Structure	Internal	2	25%	0.50	Assessed using camera inspections Minor corrosion on overflow pipe. Minor cracks on tank floor.
	External	1	20%	0.20	
Mechanical - Hatches, Valves, & Vents		4	20%	0.80	Divers had issues with rusted hatch
Electrical & Instrumentation		4	15%	0.60	No discharge pressure and flow from tank being sent back to SCADA. Reference Pump Station 5 for additonal comments.
Roof Slope		1	10%	0.10	
Overflow		2	10%	0.20	Minor corrosion on overflow pipe
Condition Rating				2.40	

CRITICALITY ASSESSMENT

Component Group	Percent of PP Capacity	Component Condition	Weight Factor	Weighted Component Rating	Comments
Capacity Affected	17%	3	50%	1.50	Tank volume equates to approximately 17% of Lower Pressure Plane Max Day Demand
Public Image/Regulatory Impact		3	20%	0.60	
Outage Duration		4	30%	1.20	
Criticality Rating		-	100%	**3.30**	

RISK BASED ASSESSMENT

	Condition Rating	Criticality Rating	Overall Risk Rating	Risk Category
Pump Station #5 GST Risk Rating	2.40	3.30	7.92	Moderate

McMillan Mountain GST #1

Inspection Date:

Facility Information	
Address:	5600 Bunny Trail
Year in Service:	1995
Type of Tank:	Prestressed concrete
Capacity:	1.5 MG
Overflow Elevation:	1122'
Diameter:	90'
Tank Entry Point:	Bottom

CONDITION ASSESSMENT

Component Group		Component Condition Rating	Weight Factor	Weighted Component Rating	Comments
Structure	Internal	2	25%	0.50	Assessed using camera inspections Minor corrosion on overflow pipe Minor cracking on tank floor.
	External	1	20%	0.20	Minor cracking
Mechanical - Hatches, Valves, & Vents		1	20%	0.20	One manway (24"x36") on tank. Fall protection needs modification Per inspecton report: the vent is in good condittion.
Electrical & Instrumentation		1	15%	0.15	Replaced the PLC (programmable logic controller) at the end of 2018 Refer to McMillan GST #2 for additional comments.
Roof Slope		1	10%	0.10	
Overflow		1	10%	0.10	Minor erosion
Condition Rating				1.25	Prefer to have fall protection match airport tank

CRITICALITY ASSESSMENT

Component Group	Percent of PP Capacity	Component Condition	Weight Factor	Weighted Component Rating	Comments
Capacity Affected	10%	2	50%	1.00	Tank volume equates to approximately 10% of Upper Pressure Plane Max Day Demand
Public Image/Regulatory Impact		5	20%	1.00	
Outage Duration		4	30%	1.20	
Criticality Rating		-	100%	**3.20**	

RISK BASED ASSESSMENT

	Condition Rating	Criticality Rating	Overall Risk Rating	Risk Category
McMillan GST #1 Risk Rating	1.25	3.20	4.00	Moderate

McMillan Mountain GST #2

Inspection Date:

Facility Information	
Address:	5600 Bunny Trail
Year in Service:	2005
Type of Tank:	Prestressed concrete
Capacity:	1.5 MG
Overflow Elevation:	1122'
Diameter:	90'
Tank Entry Point:	Bottom

CONDITION ASSESSMENT

Component Group		Component Condition Rating	Weight Factor	Weighted Component Rating	Comments
Structure	Internal	1	25%	0.25	Assessed using camera inspections Major scaling on later safety fall protection.
	External	3	20%	0.60	Minor leaks visible at foundation. Alligator cracking & outer crack about 4-5' off ground around a quarter of the tank. Recommend DN Tanks take a look at the tank.
Mechanical - Hatches, Valves, & Vents		1	20%	0.20	No reported issues
Electrical & Instrumentation		2	15%	0.30	Electrical power panel appears to be orignal. There is no surge protection on incoming main of power panel or SCADA cabinet. Flow from pressure transmitter on Tank 2 is not being sent back to SCADA.
Roof Slope		1	10%	0.10	
Overflow		1	10%	0.10	Flap valve looks good
Condition Rating				1.55	Prefer to have fall protection match airport tank

CRITICALITY ASSESSMENT

Component Group	Percent of PP Capacity	Component Condition	Weight Factor	Weighted Component Rating	Comments
Capacity Affected	10%	2	50%	1.00	Tank volume equates to approximately 10% of Upper Pressure Plane Max Day Demand
Public Image/Regulatory Impact		5	20%	1.00	
Outage Duration		4	30%	1.20	
Criticality Rating			100%	**3.20**	

RISK BASED ASSESSMENT

	Condition Rating	Criticality Rating	Overall Risk Rating	Risk Category
McMillan GST #2 Risk Rating	1.55	3.20	4.96	Moderate

Airport EST

Inspection Date: 1/29

Facility Information	
Address:	6520 Clear Creek Road
Year in Service:	2003
Type of Tank:	Composite
Capacity:	5.0 MG
Overflow Elevation:	1164.5'
Diameter:	69'
Tank Entry Point:	Bottom

CONDITION ASSESSMENT

Component Group		Component Condition Rating	Weight Factor	Weighted Component Rating	Comments
Structure	Internal	1	25%	0.25	Assessed using camera inspections Minor Corrosion on tank overflow Minor scaling and corrosion on ladder.
	External	1	20%	0.20	
Mechanical - Hatches, Valves, & Vents		2	20%	0.40	Expansion joint cracking is concern
Electrical & Instrumentation		1	15%	0.15	No reported issues.
Chemical Boosting		1	10%	0.10	No boosting at this site - has some issues with residuals
Overflow		1	10%	0.10	No visual issues
Condition Rating				1.20	

CRITICALITY ASSESSMENT

Component Group	Percent of PP Capacity	Component Condition	Weight Factor	Weighted Component Rating	Comments
Capacity Affected	84%	5	50%	2.50	Tank volume equates to approximately 10% of Upper Pressure Plane Max Day Demand
Public Image/Regulatory Impact		4	20%	0.80	
Outage Duration		4	30%	1.20	
Criticality Rating		-	100%	**4.50**	

RISK BASED ASSESSMENT

	Condition Rating	Criticality Rating	Overall Risk Rating	Risk Category
Airport EST Risk Rating	1.20	4.50	5.40	Moderate

Lift Station #1

Inspection Date:

Facility Information	
Address:	106 S W.S. Young Dr
Year in Service:	1994 (Plans)
Type of Facility:	Submersible
Number of Pumps:	3 - VFD
Design Point:	3.168 MGD @ 46'
Horsepower:	125.0
Capacity:	18.7 MGD
Monitoring:	SCADA
Generator:	No Generator / Dual Service

CONDITION ASSESSMENT

Component Group	Component Condition Rating	Weight Factor	Weighted Component Rating	Comments
Electrical (MCC, Back-up Power, Cables) & Instrumentation (SCADA, alarms)	5	25%	1.25	Recommend adding a generator or generator connection at th site to replace the existing dual service. The dual services are from the same pole line and therefore offer very little in redundancy. The dual service also terminates to a transfer switch that when switched over continioulsy has issues and requires service.
Pumps and Motors	3	20%	0.60	Corrosion on pumps
Structure - Hatches, Corrosion, Cracks, Leaking	1	20%	0.20	
Piping and Valves	1	15%	0.15	
Mechanical - Ventilation, Odor Control, Crane, Mixers, Meters	2	10%	0.20	Odor complaints from trail users & some mixer issues
Site - Drainage, Access Drive, Security, Fencing	1	10%	0.10	Creek has been seen 10" below finished floor of station & minor gaps in fence.
Condition Rating	-	-	**2.50**	

CRITICALITY ASSESSMENT

Component Group	Component Criticality Rating	Weight Factor	Weighted Component Rating	Comments
Environmentally Sensitive Areas	5	40%	2.00	Within 250' of water body or floodplain
Population Served	5	30%	1.50	Served population of approximately 40,000
High Impact Areas	5	30%	1.50	
Criticality Rating	-	100%	**5.00**	

RISK BASED ASSESSMENT

	Condition Rating	Criticality Rating	Overall Risk Rating	Risk Category
Lift Station #1 Risk Rating	2.50	5.00	12.50	Moderate

Lift Station #2

Inspection Date:

Facility Information		
Address:	1807 MLK Blvd	
Year in Service:	2005 (Plans)	
Type of Facility:	Submersible	
Number of Pumps:	4 - VFD	
Design Point:	4.032 MGD @ 83'	
Horsepower:	105.0	
Capacity:	20.2 MGD	
Monitoring:	SCADA	
Generator:	MTU	420kW

CONDITION ASSESSMENT

Component Group	Component Condition Rating	Weight Factor	Weighted Component Rating	Comments
Electrical & Instrumentation – MCC, Back-up Power, Cables, SCADA, alarms	1	25%	0.25	
Pumps and Motors	1	20%	0.20	
Structure - Hatches, Corrosion, Cracks, Leaking	1	20%	0.20	
Piping and Valves	2	15%	0.30	gate on splitter box sticks - needed to be manually lifted up and down
Mechanical - Ventilation, Odor Control, Crane, Mixers, Meters	4	10%	0.40	Mixer out of service, issues with HVAC, & no forced air ventilation for pump room
Site - Drainage, Access Drive, Security, Fencing	1	10%	0.10	Generator needs stairs/steps to reach panel
Condition Rating	-	-	**1.45**	

CRITICALITY ASSESSMENT

Component Group	Component Criticality Rating	Weight Factor	Weighted Component Rating	Comments
Environmentally Sensitive Areas	5	40%	2.00	Within 250' of water body or floodplain
Population Served	5	30%	1.50	Served population of approximately 17,000
High Impact Areas	5	30%	1.50	
Criticality Rating	-	100%	**5.00**	

RISK BASED ASSESSMENT

	Condition Rating	Criticality Rating	Overall Risk Rating	Risk Category
Lift Station #2 Risk Rating	1.45	5.00	7.25	Moderate

Lift Station #6

Inspection Date:

Facility Information		
Address:	3816 Water St	
Year in Service:	Plans Illegible	
Type of Facility:	Submersible	
Number of Pumps:	3	
Design Point:	Fixed Capacity	
Horsepower:	135.0	
Capacity:	17.3 MGD	
Monitoring:	SCADA	
Generator:	Kohler	420 kW

CONDITION ASSESSMENT

Component Group	Component Condition Rating	Weight Factor	Weighted Component Rating	Comments
Electrical & Instrumentation – MCC, Back-up Power, Cables, SCADA, alarms	4	25%	1.00	Generator appears to be original and near its expected useful life. Generator also showing sign of wear and enclosure bulging out. The generator fuel tank also appears to be very small. Recommend the City verifying how long the generator can run at full capacity off its existing tank and if its exceeds the longest outage the site has seen in the last 5 years. The MCC also appears to be original and nearing its expected useful life. The last vertical section of the MCC (in the corner) does not have the required clearnace in front of it as required by the NEC, due to a cabinet that was added along the wall perpendicual to it.
Pumps and Motors	1	20%	0.20	
Structure - Hatches, Corrosion, Cracks, Leaking	1	20%	0.20	
Piping and Valves	2	15%	0.30	Minor corrosion on elbows
Mechanical - Ventilation, Odor Control, Crane, Mixers, Meters	3	10%	0.30	Issues with mixers and meter
Site - Drainage, Access Drive, Security, Fencing	2	10%	0.20	Areas where fence is not six feet tall
Condition Rating	-	-	**2.20**	

CRITICALITY ASSESSMENT

Component Group	Component Criticality Rating	Weight Factor	Weighted Component Rating	Comments
Environmentally Sensitive Areas	5	40%	2.00	Within 250' of water body or floodplain
Population Served	5	30%	1.50	Served population of approximately 59,000
High Impact Areas	5	30%	1.50	
Criticality Rating	-	100%	**5.00**	

RISK BASED ASSESSMENT

	Condition Rating	Criticality Rating	Overall Risk Rating	Risk Category
Lift Station #6 Risk Rating	2.20	5.00	11.00	Moderate

Lift Station #8

Inspection Date:

Facility Information		
Address:	100 N Roy Reynolds Dr	
Year in Service:	1975 (Plans)	
Type of Facility:	Submersible	
Number of Pumps:	3	
Design Point:	1.944 MGD @ 70'	
Horsepower:	40.0	
Capacity:	3.9 MGD	
Monitoring:	SCADA	
Generator:	Generac	180 kW

CONDITION ASSESSMENT

Component Group	Component Condition Rating	Weight Factor	Weighted Component Rating	Comments
Electrical & Instrumentation – MCC, Back-up Power, Cables, SCADA, alarms	1	25%	0.25	
Pumps and Motors	1	20%	0.20	
Structure - Hatches, Corrosion, Cracks, Leaking	2	20%	0.40	Corrosion on hateches & minor cracking on concrete
Piping and Valves	2	15%	0.30	Corrosion on piping
Mechanical - Ventilation, Odor Control, Crane, Mixers, Meters	2	10%	0.20	Chain on catch basket is attached to light (support broken)
Site - Drainage, Access Drive, Security, Fencing	1	10%	0.10	Back gate has large gap someone could fit through
Condition Rating	-	-	**1.45**	

CRITICALITY ASSESSMENT

Component Group	Component Criticality Rating	Weight Factor	Weighted Component Rating	Comments
Environmentally Sensitive Areas	5	40%	2.00	Within 250' of water body or floodplain
Population Served	5	30%	1.50	Served population of approximately 9,000
High Impact Areas	2	30%	0.60	
Criticality Rating	-	100%	**4.10**	

RISK BASED ASSESSMENT

	Condition Rating	Criticality Rating	Overall Risk Rating	Risk Category
Lift Station #8 Risk Rating	1.45	4.10	5.95	Moderate

Lift Station #9

Inspection Date:

Facility Information	
Address:	2631 Polk Street
Year in Service:	1975 (Plans)
Type of Facility:	Submersible
Number of Pumps:	1
Design Point:	1.944 MGD @ 70'
Horsepower:	2.0
Capacity:	3.9 MGD
Monitoring:	Manhole Monitor over Cellular Network
Generator:	None

CONDITION ASSESSMENT

Component Group	Component Condition Rating	Weight Factor	Weighted Component Rating	Comments
Electrical & Instrumentation – MCC, Back-up Power, Cables, SCADA, alarms	5	25%	1.25	Site does not include a generator or connection for a portable as required by TCEQ.
Pumps and Motors	5	20%	1.00	No reported issues but only one pump at lift station
Structure - Hatches, Corrosion, Cracks, Leaking	1	20%	0.20	
Piping and Valves	1	15%	0.15	
Mechanical - Ventilation, Odor Control, Crane, Mixers, Meters	1	10%	0.10	
Site - Drainage, Access Drive, Security, Fencing	1	10%	0.10	
Condition Rating	-	-	**2.80**	

CRITICALITY ASSESSMENT

Component Group	Component Criticality Rating	Weight Factor	Weighted Component Rating	Comments
Environmentally Sensitive Areas	1	40%	0.40	
Population Served	1	30%	0.30	
High Impact Areas	3	30%	0.90	
Criticality Rating	-	100%	**1.60**	

RISK BASED ASSESSMENT

	Condition Rating	Criticality Rating	Overall Risk Rating	Risk Category
Lift Station #9 Risk Rating	2.80	1.60	4.48	Low

Lift Station #20

Inspection Date:

Facility Information		
Address:	8196 ST HWY 201	
Year in Service:	2008 (Plans)	
Type of Facility:	Submersible	
Number of Pumps:	2 - VFD	
Design Point:	2.016 MGD @ 125'	
Horsepower:	148.0	
Capacity:	2.0 MGD	
Monitoring:	SCADA	
Generator:	Generac	500 kW

CONDITION ASSESSMENT

Component Group	Component Condition Rating	Weight Factor	Weighted Component Rating	Comments
Electrical & Instrumentation – MCC, Back-up Power, Cables, SCADA, alarms	2	25%	0.50	Magnetic flow meter does not work.
Pumps and Motors	2	20%	0.40	Trouble keeping up with flow. Pumps to be upgraded to larger impeller. Firm capacity may be issue even after new impellers. Sump pump in meter vault not working - mag meter does not work.
Structure - Hatches, Corrosion, Cracks, Leaking	1	20%	0.20	
Piping and Valves	3	15%	0.45	Corrosion visible on elbow, bents, valves & piping
Mechanical - Ventilation, Odor Control, Crane, Mixers, Meters	2	10%	0.20	Vent screen has hole
Site - Drainage, Access Drive, Security, Fencing	3	10%	0.30	Access issues? During wet weather events?
Condition Rating	-	-	**2.05**	

CRITICALITY ASSESSMENT

Component Group	Component Criticality Rating	Weight Factor	Weighted Component Rating	Comments
Environmentally Sensitive Areas	1	40%	0.40	
Population Served	5	30%	1.50	Served population of approximately 9,000
High Impact Areas	1	30%	0.30	
Criticality Rating	-	100%	**2.20**	

RISK BASED ASSESSMENT

	Condition Rating	Criticality Rating	Overall Risk Rating	Risk Category
Lift Station #20 Risk Rating	2.05	2.20	4.51	Moderate

Lift Station #21

Inspection Date:

Facility Information		
Address:	10526 S Fort Hood Rd	
Year in Service:	No Plans	
Type of Facility:	Submersible	
Number of Pumps:	2	
Design Point:	Fixed Capacity	
Horsepower:	30.0	
Capacity:	1.0 MGD	
Monitoring:	SCADA	
Generator:	Generac	80 kW

CONDITION ASSESSMENT

Component Group	Component Condition Rating	Weight Factor	Weighted Component Rating	Comments
Electrical & Instrumentation – MCC, Back-up Power, Cables, SCADA, alarms	4	25%	1.00	Service entrance cables are routed in the same raceway as other conductors which does not meet the NEC. Recommned as a minimum adding arc proofing tape to service conductors to protect other cables in event of a fault on the service. Recommend adding a level transducer for continous monitoring of wet well level
Pumps and Motors	1	20%	0.20	
Structure - Hatches, Corrosion, Cracks, Leaking	1	20%	0.20	
Piping and Valves	2	15%	0.30	Corrosion on piping in wet well
Mechanical - Ventilation, Odor Control, Crane, Mixers, Meters	1	10%	0.10	
Site - Drainage, Access Drive, Security, Fencing	2	10%	0.20	Errosion at southwest corner of site. Bollards do not protect electrical equipment
Condition Rating	-	-	**2.00**	

CRITICALITY ASSESSMENT

Component Group	Component Criticality Rating	Weight Factor	Weighted Component Rating	Comments
Environmentally Sensitive Areas	1	40%	0.40	
Population Served	2	30%	0.60	Served population of approximately 600
High Impact Areas	3	30%	0.90	
Criticality Rating	-	100%	**1.90**	

RISK BASED ASSESSMENT

	Condition Rating	Criticality Rating	Overall Risk Rating	Risk Category
Lift Station #21 Risk Rating	2.00	1.90	3.80	Low

Lift Station #22

Inspection Date:

Facility Information		
Address:	975 Reece Creek Rd	
Year in Service:	2009 (Plans)	
Type of Facility:	Submersible	
Number of Pumps:	2	
Design Point:	0.449 MGD @ 77.77'	
Horsepower:	50.0	
Capacity:	0.45 MGD	
Monitoring:	SCADA	
Generator:	Generac	200 kW

CONDITION ASSESSMENT

Component Group	Component Condition Rating	Weight Factor	Weighted Component Rating	Comments
Electrical & Instrumentation – MCC, Back-up Power, Cables, SCADA, alarms	3	25%	0.75	Pump Control Panel has had multiple reported issues. The panel includes sign of corrosion.
Pumps and Motors	1	20%	0.20	
Structure - Hatches, Corrosion, Cracks, Leaking	2	20%	0.40	Broken safety grate
Piping and Valves	3	15%	0.45	Corrosion on vents
Mechanical - Ventilation, Odor Control, Crane, Mixers, Meters	5	10%	0.50	Broken mixer & meter is not working
Site - Drainage, Access Drive, Security, Fencing	1	10%	0.10	
Condition Rating	-	-	**2.40**	

CRITICALITY ASSESSMENT

Component Group	Component Criticality Rating	Weight Factor	Weighted Component Rating	Comments
Environmentally Sensitive Areas	5	40%	2.00	
Population Served	4	30%	1.20	Served population of approximately 5,000
High Impact Areas	1	30%	0.30	
Criticality Rating	-	100%	**3.50**	

RISK BASED ASSESSMENT

	Condition Rating	Criticality Rating	Overall Risk Rating	Risk Category
Lift Station #22 Risk Rating	2.40	3.50	8.40	Moderate

Lift Station #23a

Inspection Date:

Facility Information	
Address:	2228 Reece Creek Rd
Year in Service:	2000 (Plans)
Type of Facility:	Submersible
Number of Pumps:	2
Design Point:	0.648 MGD @ 129'
Horsepower:	KSB 36.0 / Hydromatic 30.0
Capacity:	0.65 MGD
Monitoring:	SCADA
Generator:	Quick connect for Spectrum 135 kW

CONDITION ASSESSMENT

Component Group	Component Condition Rating	Weight Factor	Weighted Component Rating	Comments
Electrical & Instrumentation – MCC, Back-up Power, Cables, SCADA, alarms	1	25%	0.25	
Pumps and Motors	1	20%	0.20	
Structure - Hatches, Corrosion, Cracks, Leaking	2	20%	0.40	Consider coating
Piping and Valves	1	15%	0.15	
Mechanical - Ventilation, Odor Control, Crane, Mixers, Meters	1	10%	0.10	Corrosion on vents
Site - Drainage, Access Drive, Security, Fencing	2	10%	0.20	Canopy over electrical panel has holes and corrosion
Condition Rating	-	-	**1.30**	

CRITICALITY ASSESSMENT

Component Group	Component Criticality Rating	Weight Factor	Weighted Component Rating	Comments
Environmentally Sensitive Areas	5	40%	2.00	
Population Served	3	30%	0.90	Served population of approximately 1,600
High Impact Areas	3	30%	0.90	Within 500' of residential structures
Criticality Rating	-	100%	**3.80**	

RISK BASED ASSESSMENT

	Condition Rating	Criticality Rating	Overall Risk Rating	Risk Category
Lift Station #23a Risk Rating	1.30	3.80	4.94	Moderate

Lift Station #23b

Inspection Date:

Facility Information		
Address:	2228 Reece Creek Rd	
Year in Service:	No Plans	
Type of Facility:	Submersible	
Number of Pumps:	2	
Design Point:	Fixed Capacity	
Horsepower:	20.0	
Capacity:	2.5 MGD	
Monitoring:	SCADA	
Generator:	Kohler	60 kW

CONDITION ASSESSMENT

Component Group	Component Condition Rating	Weight Factor	Weighted Component Rating	Comments
Electrical & Instrumentation – MCC, Back-up Power, Cables, SCADA, alarms	2	25%	0.50	Extensive corrosion on termination cabinet and mounting hardware located above the wet well. This is due to the cabinet being located inches from a core drilled opening that vents directly to the cabinet.
Pumps and Motors	1	20%	0.20	
Structure - Hatches, Corrosion, Cracks, Leaking	2	20%	0.40	Corrosion on galvanized unistrut
Piping and Valves	1	15%	0.15	
Mechanical - Ventilation, Odor Control, Crane, Mixers, Meters	1	10%	0.10	Minor corrosion on screen
Site - Drainage, Access Drive, Security, Fencing	1	10%	0.10	
Condition Rating	-	-	**1.45**	

CRITICALITY ASSESSMENT

Component Group	Component Criticality Rating	Weight Factor	Weighted Component Rating	Comments
Environmentally Sensitive Areas	5	40%	2.00	
Population Served	3	30%	0.90	Served population of approximately 3,000
High Impact Areas	3	30%	0.90	Within 500' of residential structures
Criticality Rating	-	100%	**3.80**	

RISK BASED ASSESSMENT

	Condition Rating	Criticality Rating	Overall Risk Rating	Risk Category
Lift Station #23b Risk Rating	1.45	3.80	5.51	Moderate

Lift Station #24

Inspection Date:

Facility Information		
Address:	3006 Chapparal Rd	
Year in Service:	2005 (Plans)	
Type of Facility:	Submersible	
Number of Pumps:	2	
Design Point:	Fixed Capacity	
Horsepower:	75.0	
Capacity:	2.5 MGD	
Monitoring:	SCADA	
Generator:	Generac	200 kW

CONDITION ASSESSMENT

Component Group	Component Condition Rating	Weight Factor	Weighted Component Rating	Comments
Electrical & Instrumentation – MCC, Back-up Power, Cables, SCADA, alarms	2	25%	0.50	Recommend adding a level transducer for continous monitoring of wet well level.
Pumps and Motors	2	20%	0.40	Unable to inspect pumps & no issues reported
Structure - Hatches, Corrosion, Cracks, Leaking	2	20%	0.40	Well wasn't coated, but showed minimal corrosion.
Piping and Valves	2	15%	0.30	Corrossion at elbow
Mechanical - Ventilation, Odor Control, Crane, Mixers, Meters	1	10%	0.10	No Odor complaints from neighbors
Site - Drainage, Access Drive, Security, Fencing	1	10%	0.10	Barb wire can be tightened and a fence rail can be fixed.
Condition Rating	-	-	**1.80**	

CRITICALITY ASSESSMENT

Component Group	Component Criticality Rating	Weight Factor	Weighted Component Rating	Comments
Environmentally Sensitive Areas	5	40%	2.00	
Population Served	3	30%	0.90	Served population of approximately 3,000. Steve had concerns of capacity of both lift station and inlow pipe to serve growth.
High Impact Areas	3	30%	0.90	Within 500' of residential structures
Criticality Rating	-	100%	**3.80**	

RISK BASED ASSESSMENT

	Condition Rating	Criticality Rating	Overall Risk Rating	Risk Category
Lift Station #24 Risk Rating	1.80	3.80	6.84	Moderate

Lift Station #24b

Inspection Date:

Facility Information	
Address:	3640 Chapparal Rd
Year in Service:	No Plans
Type of Facility:	Submersible
Number of Pumps:	2-VFD
Design Point:	Fixed Capacity
Horsepower:	2.0
Capacity:	2.5 MGD
Monitoring:	SCADA
Generator:	Quick connect for Spectrum 135 kW

CONDITION ASSESSMENT

Component Group	Component Condition Rating	Weight Factor	Weighted Component Rating	Comments
Electrical & Instrumentation – MCC, Back-up Power, Cables, SCADA, alarms	1	25%	0.25	
Pumps and Motors	1	20%	0.20	Grinder pumps performing with no issues
Structure - Hatches, Corrosion, Cracks, Leaking	1	20%	0.20	
Piping and Valves	1	15%	0.15	
Mechanical - Ventilation, Odor Control, Crane, Mixers, Meters	2	10%	0.20	Mushroom vents will need to be replaced soon
Site - Drainage, Access Drive, Security, Fencing	2	10%	0.20	Access drive could be difficult for crane truck to access and operate
Condition Rating	-	-	**1.20**	

CRITICALITY ASSESSMENT

Component Group	Component Criticality Rating	Weight Factor	Weighted Component Rating	Comments
Environmentally Sensitive Areas	1	40%	0.40	
Population Served	1	30%	0.30	Not utilized in wastewater model
High Impact Areas	3	30%	0.90	Within 500' of residential structures
Criticality Rating	-	100%	**1.60**	

RISK BASED ASSESSMENT

	Condition Rating	Criticality Rating	Overall Risk Rating	Risk Category
Lift Station #24b Risk Rating	1.20	1.60	1.92	Low

Lift Station #26

Inspection Date:

Facility Information	
Address:	648 Old Copperas Cove Rd
Year in Service:	No Plans
Type of Facility:	Submersible
Number of Pumps:	2
Design Point:	Fixed Capacity
Horsepower:	15.0
Capacity:	1.0 MGD
Monitoring:	None / Soon to be fitted with Cellular
Generator:	Generac 180 kW

CONDITION ASSESSMENT

Component Group	Component Condition Rating	Weight Factor	Weighted Component Rating	Comments
Electrical & Instrumentation – MCC, Back-up Power, Cables, SCADA, alarms	4	25%	1.00	Service entrance cables are routed in the same raceway as other conductors which does not meet the NEC. Recommned as a minimum adding arc proofing tape to service conductors to protect other cables in event of a fault on the service. Recommend adding a level transducer for continous monitoring of wet well level
Pumps and Motors	1	20%	0.20	
Structure - Hatches, Corrosion, Cracks, Leaking	1	20%	0.20	
Piping and Valves	2	15%	0.30	Minor corrosion on valves
Mechanical - Ventilation, Odor Control, Crane, Mixers, Meters	1	10%	0.10	
Site - Drainage, Access Drive, Security, Fencing	2	10%	0.20	No signage & minor fence repairs needed
Condition Rating	-	-	**2.00**	

CRITICALITY ASSESSMENT

Component Group	Component Criticality Rating	Weight Factor	Weighted Component Rating	Comments
Environmentally Sensitive Areas	5	40%	2.00	
Population Served	1	30%	0.30	
High Impact Areas	1	30%	0.30	Greater than 1,000' from structures
Criticality Rating	-	100%	**2.60**	

RISK BASED ASSESSMENT

	Condition Rating	Criticality Rating	Overall Risk Rating	Risk Category
Lift Station #26 Risk Rating	2.00	2.60	5.20	Low

Lift Station #27

Inspection Date:

Facility Information	
Address:	4111 Tropicana Dr
Year in Service:	2004 (Plans)
Type of Facility:	Submersible
Number of Pumps:	2
Design Point:	Fixed Capacity
Horsepower:	15.0
Capacity:	1.0 MGD
Monitoring:	SCADA
Generator:	Quick connect for Spectrum 135 kW

CONDITION ASSESSMENT

Component Group	Component Condition Rating	Weight Factor	Weighted Component Rating	Comments
Electrical & Instrumentation – MCC, Back-up Power, Cables, SCADA, alarms	3	25%	0.75	
Pumps and Motors	1	20%	0.20	
Structure - Hatches, Corrosion, Cracks, Leaking	2	20%	0.40	Consider coating for future & noted that water backs up into dry well through pipe
Piping and Valves	2	15%	0.30	Minor corrosion and duct tape around pipe in dry well
Mechanical - Ventilation, Odor Control, Crane, Mixers, Meters	1	10%	0.10	
Site - Drainage, Access Drive, Security, Fencing	1	10%	0.10	
Condition Rating	-	-	**1.85**	

CRITICALITY ASSESSMENT

Component Group	Component Criticality Rating	Weight Factor	Weighted Component Rating	Comments
Environmentally Sensitive Areas	5	40%	2.00	
Population Served	1	30%	0.30	
High Impact Areas	3	30%	0.90	Within 500' of residential structures
Criticality Rating	-	100%	**3.20**	

RISK BASED ASSESSMENT

	Condition Rating	Criticality Rating	Overall Risk Rating	Risk Category
Lift Station #27 Risk Rating	1.85	3.20	5.92	Moderate

Wassay

Inspection Date:

Facility Information	
Address:	11344 S Fort Hood
Year in Service:	03/27/12 No Plans
Type of Facility:	Submersible
Number of Pumps:	2
Design Point:	Fixed Capacity
Horsepower:	3.0
Capacity:	1.0 MGD
Monitoring:	SCADA
Generator:	None

CONDITION ASSESSMENT

Component Group	Component Condition Rating	Weight Factor	Weighted Component Rating	Comments
Electrical & Instrumentation – MCC, Back-up Power, Cables, SCADA, alarms	5	25%	1.25	Site does not include a generator or connection for a portable as required by TCEQ.
Pumps and Motors	1	20%	0.20	Unable to inspect pumps & no issues reported
Structure - Hatches, Corrosion, Cracks, Leaking	2	20%	0.40	Possible settlement of site
Piping and Valves	5	15%	0.75	Possible break in FM between vaults or groundwater issues.
Mechanical - Ventilation, Odor Control, Crane, Mixers, Meters	1	10%	0.10	
Site - Drainage, Access Drive, Security, Fencing	3	10%	0.30	Site drainage is an issue and no signage is visible
Condition Rating	-	-	**3.00**	

CRITICALITY ASSESSMENT

Component Group	Component Criticality Rating	Weight Factor	Weighted Component Rating	Comments
Environmentally Sensitive Areas	1	40%	0.40	
Population Served	1	30%	0.30	
High Impact Areas	2	30%	0.60	Within range of 500' - 1,000' from residential or commercial structures
Criticality Rating	-	100%	**1.30**	

RISK BASED ASSESSMENT

	Condition Rating	Criticality Rating	Overall Risk Rating	Risk Category
Lift Station Wassay Risk Rating	3.00	1.30	3.90	Low