Tooele City
Est. 1853

WASTEWATER COLLECTION SYSTEM MASTER PLAN

(HAL Project No.: 149.49.100)

HANSEN ALLEN & LUCE INC ENGINEERS

September 2022

TOOELE CITY

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September 2022

ACKNOWLEDGEMENTS

Successful completion of this master plan was made possible by the cooperation and assistance of many individuals, including the Mayor of Tooele City, Tooele City Council, and City Personnel as shown below. We sincerely appreciate the cooperation and assistance provided by these individuals.

Tooele City

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CHAPTER 1
INTRODUCTION

BACKGROUND AND PURPOSE

Tooele City (City) is a rapidly growing city in Tooele County, Utah. Located along the southeast side of Tooele Valley, between the southern shore of the Great Salt Lake and South Mountain. Tooele is a community that supports a wide range of residential, commercial, industrial, and recreational development. Tooele's strong economic vitality has created a positive environment that continues to attract many new residents and businesses, leading to rapid growth.

The rapid growth has led to increased demands on City resources, including the wastewater collection system. These demands consume available capacity of sewers. Monitoring, planning, financing and constructing new facilities are necessary to provided needed capacity to new development.

Recognizing the need for wastewater collection system planning, Tooele City retained Hansen, Allen & Luce, Inc. (HAL) to prepare this wastewater collection system master plan. The purpose of the master plan is to 1) estimate wastewater loading values for the existing system, 2) evaluate the existing system's ability to convey existing wastewater flows, 3) prepare growth projections, 4) predict growth areas with City input, 5) prepare future loading estimates based on growth, 6) evaluate future infrastructure needs and 7) recommended projects that will create the additional needed wastewater conveyance capacity to meet future loads.

The results of this study are limited by the accuracy of the development projections and other assumptions used in preparing the master plan. It is expected that the City will continue to review and update this master plan every 5-10 years, or more frequently if the assumptions included in this effort change significantly.

AUTHORIZATION

The Tooele City Council and Administration authorized Hansen, Allen & Luce, Inc. to proceed with the wastewater collection system master plan.

SCOPE OF WORK

A summary of the scope of work is as follows:

1. Communication and coordination with Tooele City.
2. Collect and review existing data and previous studies.
3. Prepare population growth projections.
4. Evaluate flow monitoring data and characterize the flows.
5. Prepare a hydraulic computer model of the existing system. Calibrate the model with flows from the existing flow monitoring data.
6. Perform modeling and identify existing conditions. Identify solutions to remedy deficiencies.

7. With the City, prepare land use and land density projections.
8. Prepare a future conditions hydraulic model.
9. Using the model, identify future infrastructure needs.
10. Prepare a capital facilities plan with cost estimates.
11. Prepare a report describing data, methodology, results and recommendations.

PREVIOUS STUDIES

This master plan is part of a long-term on-going planning effort by Tooele City. The City has prepared master plans, as needed, in the past to ensure that the wastewater collection system facilities are adequate to meet the community needs. The previous master plan is a follows:

1. *Tooele City - Wastewater Collection System Master Plan*. Hansen, Allen & Luce, Inc. December 2000.

CHAPTER 2
EXISTING WASTEWATER SYSTEM

SERVICE AREA

The service area of Tooele City's wastewater collection system includes area within the municipal boundary. This boundary is provided in Figure 2-1. The wastewater system evaluation and future planning are limited to the existing municipal boundary.

EXISTING WASTEWATER SYSTEM

The existing wastewater system consists of gravity sewers, including laterals, collectors, interceptors, and outfalls. These sewers convey flows to the wastewater reclamation facility (WWRF). This master plan evaluates the above conveyance items. Evaluation of the WWRF is not in the scope of this study. The existing wastewater system is shown in Figure 2-1.

Source of Data

The following data sources were used in preparation of the master plan.

- *Tooele City - Wastewater Collection System Master Plan*. Hansen, Allen & Luce, Inc. December 2000.
- Data files from the 2000 master plan computer hydraulic models.
- GIS files of manholes and gravity pipes provided by Tooele City.
- Data files and record drawings of historic developments that were provided by Tooele City or that were in HAL files
- Survey data for missing manhole inverts provided by Tooele City or obtained by HAL.

Collection Network

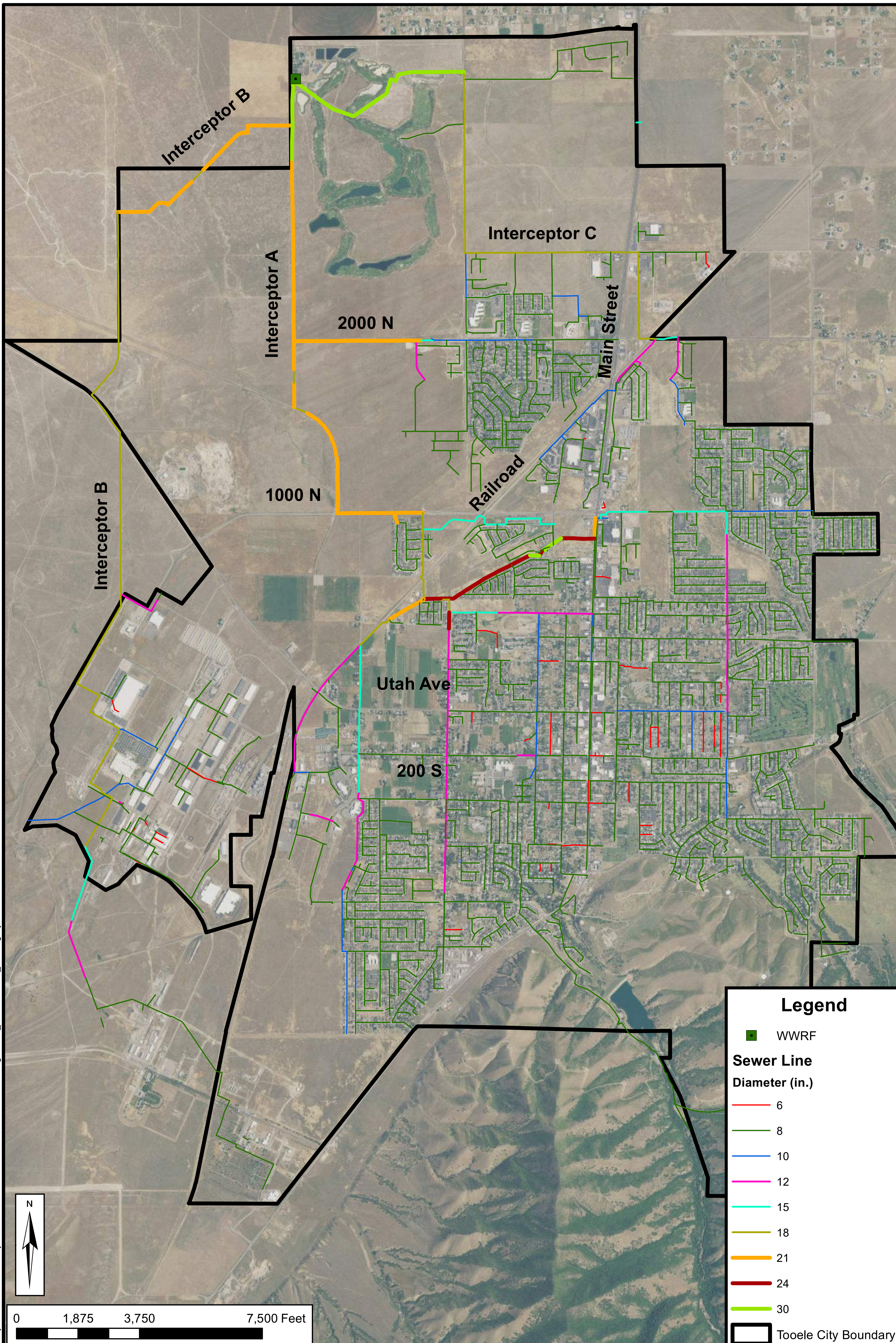
The existing Tooele City wastewater collection system consists of nearly 175 miles of pipeline and over 3,300 manholes. The pipe sizes range from 6-inch diameter to 30-inch diameter pipe.

Sewer Interceptors and Wastewater Reclamation Facility

Wastewater in the collection system is conveyed to the WWRF via two outfalls. First, Interceptor A is a gravity sewer conveys flows from the central portions of the City. Second, Interceptor B brings flows from the Tooele Industrial / Peterson Depot area and connects with Interceptor A prior to reaching the WWRF. Third, Interceptor C second is a gravity sewer that conveys flows from the north eastern portions of the City. The WWRF has a design capacity of 3.4 MGD and a permitted capacity of 2.25 MGD (not including treated water used for reuse).

Lift Stations

As a result of Tooele City being located at the base of the Oquirrh Mountains, most of the City has a relatively steep topography. This allows the City to avoid the use of lift stations. Flows have been rerouted to eliminate previously constructed lift stations. Some private companies utilize small lift stations to input their flows into the City's collection system. However, the City does not own, operate, or maintain any lift stations at this time. No lift stations have been addressed in this study.



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Tooele City
Wastewater Collection System Master Plan

Existing Wastewater Collection System

FIGURE 2-1

CHAPTER 3
FLOW MONITORING

FLOW MONITORING

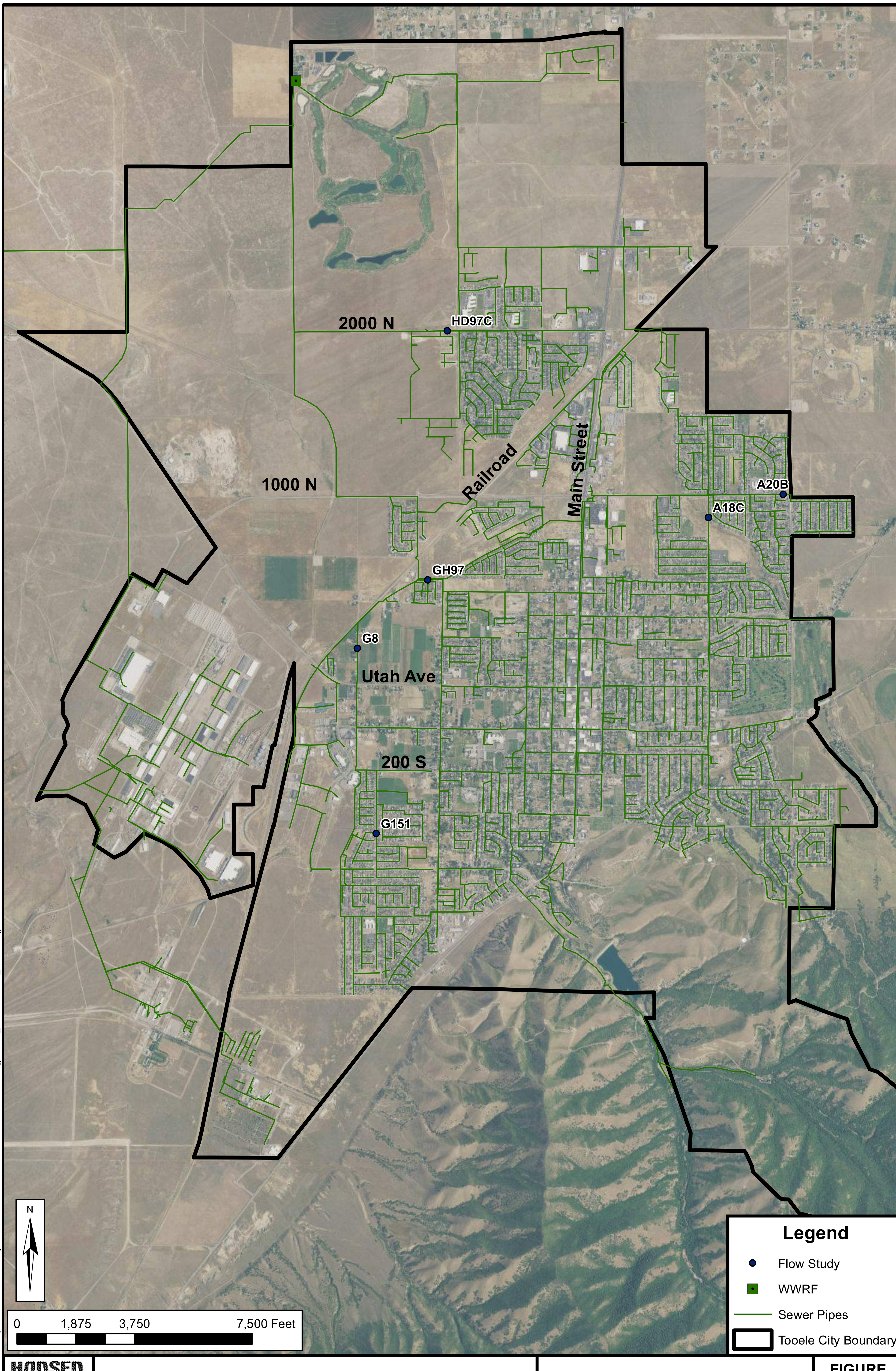
The purpose of flow monitoring is to obtain flow data at key locations throughout the City and to provide a basis for flow characterization. Flow characterization is the process to evaluate the flow data to identify typical unit flows, daily and annual flows, peaking factors and diurnal flow patterns. The characterization is used to prepare and to calibrate the hydraulic model.

Local Flow Monitoring

Flow monitoring was completed at various sites throughout Tooele City by City personnel between 2019 and 2020. The monitoring data was provided to HAL for analysis. Each of the flow studies included about one to two weeks of flow data in each location. Flow study locations are shown on Figure 3-1. Graphs of the recorded flow data are included in Appendix A.

Tooele City – WWRF Flow Monitoring

In addition to the local flow studies, the City provided HAL with flow meter data for the WWRF. Data was provided for the period between January 2017 and December 2019. The WWRF flow analysis considered the effects of inflow and infiltration.



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Tooele City Wastewater Collection System Master Plan	Flow Study Locations	FIGURE 3-1

CHAPTER 4
FLOW CHARACTERIZATION

METHODOLOGY

Flow characterization is an analysis of flow patterns and variations that occur within a wastewater collection system. This analysis helps determine whether flows occur within expected ranges and helps predict future system performance. The flow characterization includes evaluation of the following wastewater flow characteristics:

- Unit Flows
- Daily Flow Variation
- Annual Flow Variation
- Long Term Flow Variation
- Extraordinary Flows

UNIT FLOWS

Unit flows were estimated for Tooele City and are expressed as Equivalent Residential Units (ERUs). An ERU is the average wastewater flow from single family residences. The ERU is used to express all flows by the same unit. Commercial, industrial and other types of flow can be expressed by the same unit as residences. For example, a commercial development that produces a hydraulic loading of 5 times the average single-family residence will be designated with a 5 ERU loading.

In order to estimate the flow for an ERU, the amount of drinking water used during winter was examined. Winter drinking water is mostly consumed indoors and can be identified by use type (i.e. residential) from the billing record codes. The amount of indoor water used is essentially the same as the amount of wastewater generated. It is therefore possible to estimate residential indoor wastewater generation from the drinking water billing records.

Several years of City billing records were obtained and analyzed to determine the current average indoor water use for an equivalent residential unit (ERU) in the City during the winter months. The months of November through May were used to calculate the average monthly usage per residential connection. The average monthly residential usage during this time period was about 5,000 gal/month. Data from January 2019 was chosen to calculate existing ERUs because it represents a normal winter usage month. The total volume of water used during January 2019 was 71,941,144 gallons. This volume divided by 5,000 gal/month results in:

Existing ERUs: 14,400

January 2019 flows arriving at the treatment plant were also totaled in order to calculate the average flow generation per ERU. The total volume of wastewater arriving at the treatment plant in January 2019 was 74,899,594 gallons, or about 2,416,116 gallons per day. The volume per day divided by the existing ERUs calculates the average flow generation per ERU.

Flow Generation per ERU = January Wastewater Volume (gal) / Existing ERUs
= 2,416,116 gpd / 14,400 ERUs
= 167.8 gpd/ERU

The average day load was increased to a level of service of 170 gpd per ERU to account for possible future variability above the current usage. It is assumed that all indoor water usage will be converted to wastewater flow, resulting in a system design wastewater flow as follows:

Hydraulic Loading / ERU = 170 gallons/day

TOOELE WWRF METER DATA

Two flow meters are located at the WWRF headworks. One is a Flo-Dar radar sensor and the other is a HydroRanger ultrasonic sensor installed at a Palmer-Bowlus flume. Data were provided for the WWRF headworks at a 15-minute interval from January 2017 through December 2019. The flowrate data for the complete period of record is provided on Figure 4-1. Also provided on the figure is the daily moving average wastewater flowrate (labeled as the 7-day moving average). This line on the figure shows the average flowrate over a rolling 7-day period and helps with a comparison between peak, minimum and average flowrates.

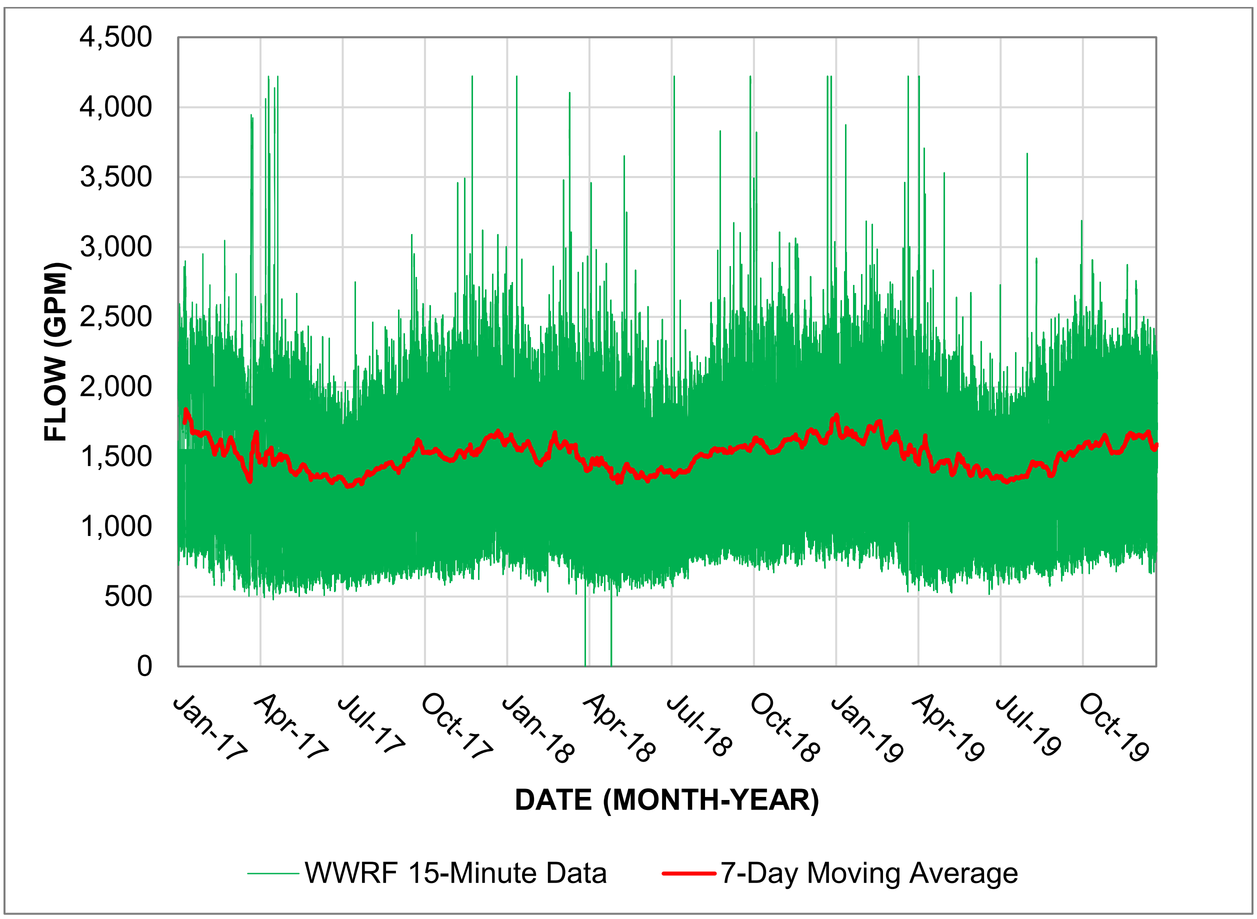


FIGURE 4-1 WWRF HEADWORKS FLOW

It may be observed that flows have generally been in the same range suggesting that a sustained changing trend is not occurring. However, as the population continues to grow, wastewater production will inevitably increase.

DAILY FLOW VARIATION AT THE WWRF

Flow in a wastewater collection system varies continuously throughout the day. Figure 4-2 shows the flow from an average day at the WWRF.

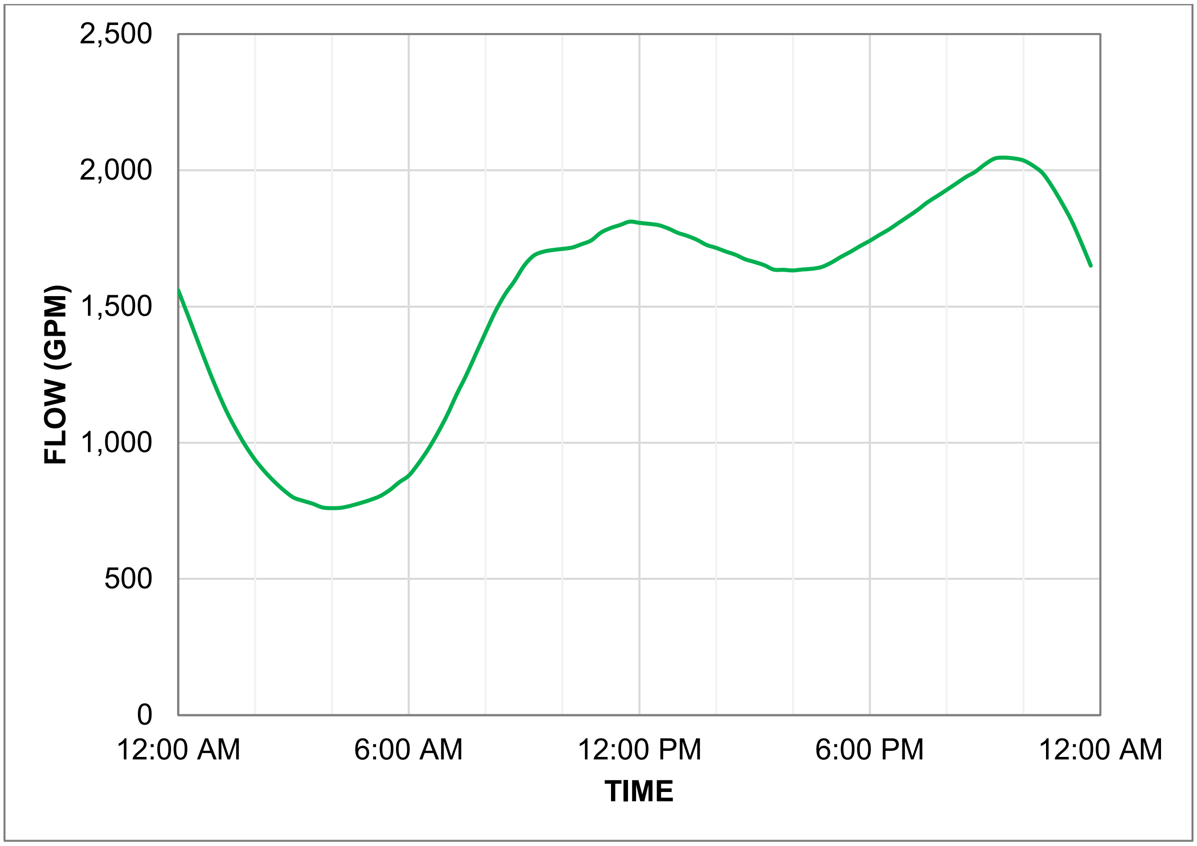


FIGURE 4-2 AVERAGE DAILY WWRF HEADWORKS FLOW

From the data, it may be observed that the minimum flow generally occurs during the early morning between 3:00 AM and 5:00 AM. Maximum or peak flows typically occur during the evening between 9:00 PM and 11:00 PM, with a smaller peak in the morning to early afternoon between 9:00 AM and 1:00 PM.

Peaking Factor at the WWRF

Peaking factors were developed for the Tooele wastewater collection system. The peaking factor is the ratio between the peak instantaneous flow and the average daily flow. These peaking factors were calculated based on the recorded flows arriving at the WWRF. The daily maximum flows were averaged to calculate an average daily maximum of 2,334 gpm. The average daily flow was 1,511 gpm. Dividing the average daily maximum flow by the average daily flow gives a peaking factor at the treatment plant of 1.54.

Flow Patterns for Development Types

In addition to peaking factors and the flow pattern for the WWRF, flow patterns have been identified for key development types. Flow monitoring data was collected by Tooele City at several locations. However, most of the flow data collected was for residential areas. There were no flow studies performed in predominantly commercial or industrial areas to base patterns upon. Therefore, patterns for all development types were assumed to be similar to patterns from recently completed wastewater master plans for other Utah communities of similar size. Adjustments were made so that the resulting outfall pattern match the WWRF data. Figure 4-3 shows the patterns used to model wastewater flows by type.

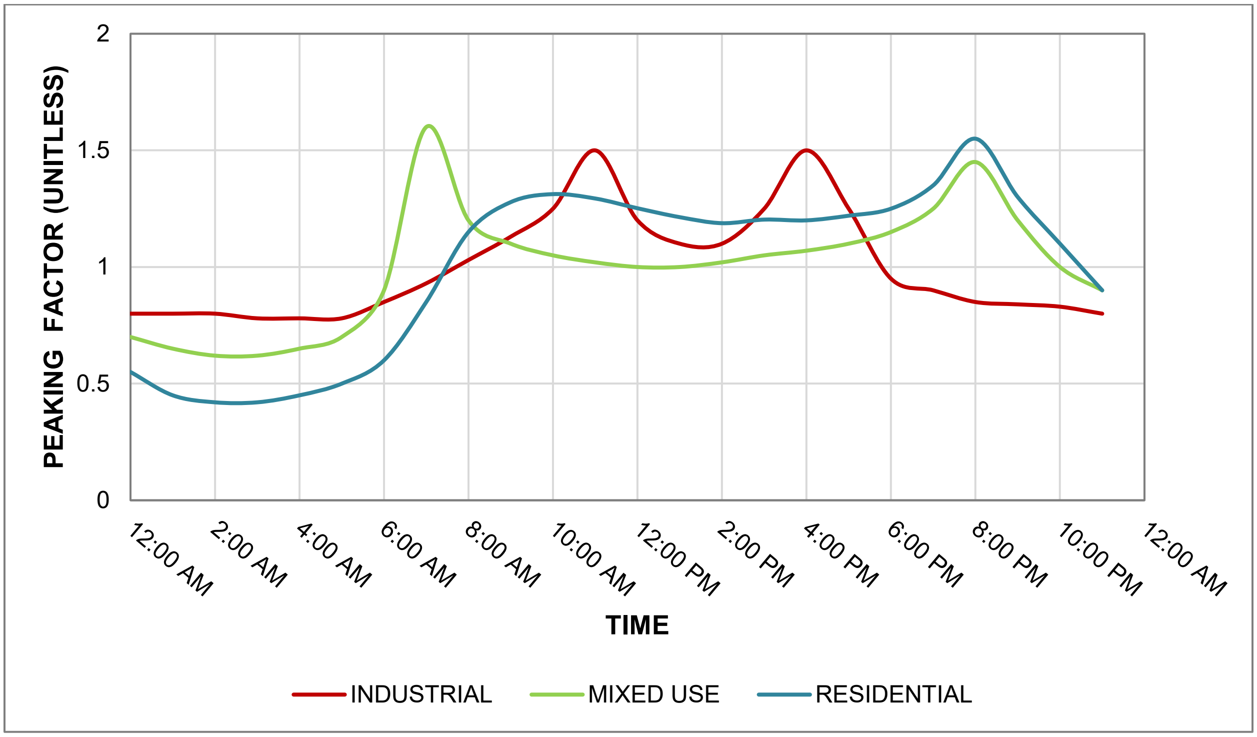


FIGURE 4-3 DIURNAL CURVES

SYNTHETIC HYDROGRAPHS

Synthetic hydrographs were developed for the existing condition, the 2030 projected population and the 2060 projected population. In each case, the wastewater hydrograph was developed using the hydraulic model. Collection areas are designated as residential, commercial/industrial, or mixed use. A diurnal curve pattern was assigned to hydraulic loadings in each collection area. The model applies the loading to each collection area based on the pattern. An outflow hydrograph results for each collection area. The model also performs routing calculations to determine how the wastewater flows are routed to the WWRF.

ANNUAL FLOW VARIATION

As seen in Figure 4-1, wastewater systems can experience annual flow variation due to infiltration and other seasonal inflows, such as irrigation or precipitation events.

Infiltration

Infiltration is defined as groundwater that enters a wastewater collection system through pipe joints, cracks in the pipe, and leaks in manholes. Infiltration may occur due to increases in groundwater levels either caused by seasonal changes or a storm. For Tooele, the groundwater levels are relatively deep, thus reducing the possible impact of continuous groundwater flowing into their wastewater collection system. An exception could be water intercepted by collection system pipes as water is percolating down to the water table. Additionally, there could be localized groundwater benches providing an opportunity for infiltration into collection system piping.

In examining the baseflow of the study data set in Figure 4-1, it appears that baseflow fluctuates about 300 gpm throughout the year. The source of this fluctuation is unknown, but could potentially be due to impacts from infiltration.

Inflow

Inflow is defined as surface water that enters a wastewater collection system (including building connections) through roof drains, basements, foundations, yards, area drains, cooling water discharges, manhole covers, cross connections from storm drains, culinary water main flushing, etc.

In order to estimate the amount of inflow, the WWRF data was compared to precipitation data. It was observed that during medium to large storm events, flows at the WWRF increase during or shortly after a rainfall event. One of the larger events in the data set occurred during the first and seconds weeks of April 2017. The rainfall data and the WWRF flows were plotted together to observe the correlations. This comparison is found in Figure 4-4.

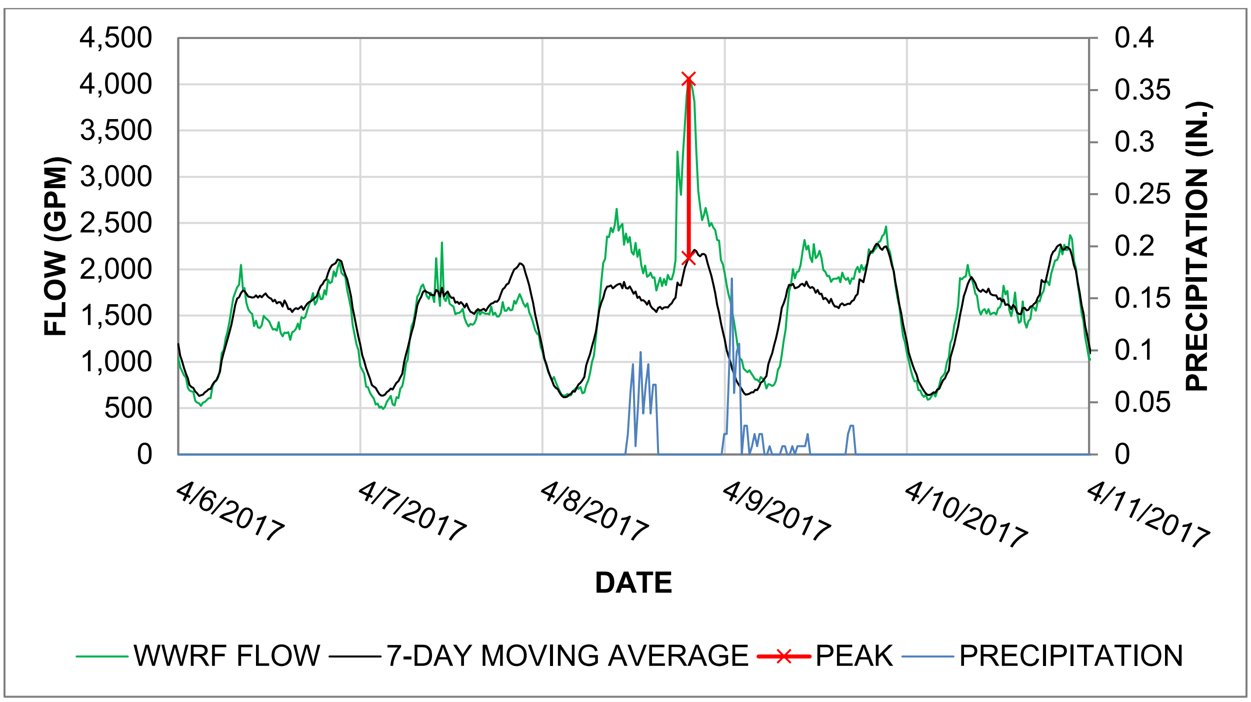


FIGURE 4-4 WWRF FLOW VS. PRECIPITATION

A significant spike in flows arriving at the reclamation facility can be seen following the storm event. Based on a comparison of peaks before and during the storm, it appears that a peak loading of 1,935 gpm higher than normal occurred at the WWRF due to the storm. Other storms showed similar results. It is possible that a larger storm event could cause a greater peak flow at the WWRF than observed in the data set. This information was discussed with City personnel. It was decided that an inflow value of 2,000 gpm would be assumed for the hydraulic analysis.

Existing Flow Summary and Modeling Application

After reviewing the data with the City, it was decided that an existing flow of 4,300 gpm would be assumed as the current peak loading value. This includes the impacts from inflow and infiltration. The design flows are summarized in Table 4-1.

TABLE 4-1 EXISTING PEAK FLOW SUMMARY

Flow Type	Flowrate (gpm)	Flowrate (MGD)
Existing Development (accounting for infiltration and seasonal variation)	2,300	3.3
Inflow	2,000	2.9
TOTAL	4,300	6.2

It may be observed in Table 4-1 that the assumed peak flow for modeling purposes includes an allowance of 2,000 gpm for inflow. Due to the random nature in which storm events can pass over the City, it is difficult to predict precipitation distribution. Therefore, the peak flow of 2,000 gpm from inflow was divided into 20 loads of 100 gpm spread randomly throughout the collection system.

The amount of inflow observed is a significant amount as it is just under half of the total flow to the WWRF. It is recommended that flow monitoring studies be commissioned to study the collection system and better identify where inflow may be entering the system. Additionally, pipelines can be videoed to document and track pipe condition and potentially visually identify sources of inflow. Other ways to reduce the amount of inflow entering the system is to raise low manhole lids and replace old pipes. Raising low manholes prevents water from puddling during a storm even and reduces the amount of water entering the manhole lids. Replacing old pipes removes potential weak points where inflow and infiltration can enter the system at failed or faulty joints or cracked pipes.

LONG TERM FLOW VARIATION

Average annual wastewater flows vary from year to year, although the variation between years is typically not extreme. The most predictable changes in average annual flows are typically associated with changes in population. Long term flow variations may also be caused by changes in weather patterns. Changes in weather patterns can result in changes in infiltration and water use patterns. Decreased precipitation results in lower groundwater levels and less infiltration. Water conservation measures implemented during droughts result in reduction in both indoor and outdoor water use. A reduction in indoor use results in less domestic wastewater. A reduction in outside use for watering lawns and gardens may lead to lowering of the groundwater table and less infiltration.

EXTRAORDINARY FLOWS

Extraordinarily high flows may occasionally occur. These may be due to holidays or other events. In the Tooele Valley, the Thanksgiving and Christmas Holidays are often days with high flows. Additionally, in the area of 600 North and Coleman Street there have been identified instances of wastewater flooding in residents' basements. Long-term flow data is not available to characterize the flow aside from reports from City staff that the pipes at these locations were flowing full. In an effort to locally calibrate the hydraulic model and to reflect a full pipe flow condition, an inflow storm event was added along both 600 North and Coleman Street. Additional long-term flow metering would be beneficial in this area to address uncertainty in calibration and magnitude of inflow and infiltration. As discussed later, it is recommended that some excess capacity be included in the sewers for unexpected events.

CHAPTER 5
WASTEWATER FLOW PROJECTIONS

PLANNING PERIOD

The planning period of this master plan is through 2060 (40 years) which is typical for wastewater system master planning. Tooele City is expected to have additional growth beyond 2060. However, projections beyond this time period are difficult to make accurately due to the uncertainty of long-term growth patterns.

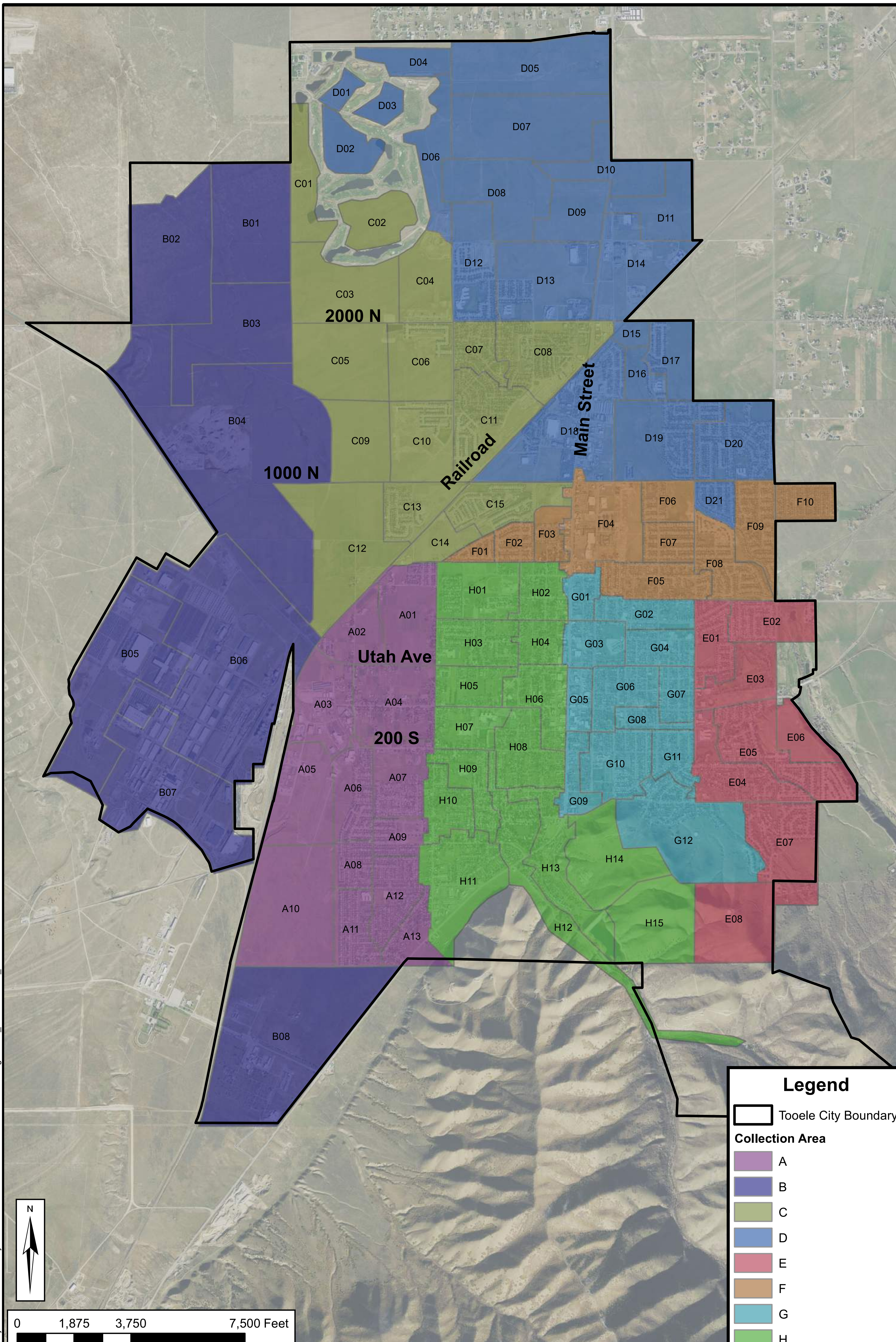
The wastewater collection system master plan planning periods for evaluation were established in consultation with City personnel. The periods that were modeled include the existing condition, existing conditions plus approved development, and projected loads through 2030 (10-Year) and through 2060 (40-Year). Growth areas and growth projections were developed in cooperation with the City personnel. Additionally, growth areas within the next ten years were identified. This enabled identification of projects that are needed within the 10-year timeframe. Typically, projects that are expected to start within the next 10 years are included in the assessment of impact fees.

COLLECTION AREAS

A collection area is defined as a geographic area that contributes flow to a common point in the collection system. Collection areas were delineated in the 2000 master plan and these were used as a starting point in the current master plan. The delineated collection areas were refined based on the locations of existing sewers. Future collection areas were based on the location of the existing system and based on predicted areas of collection area expansion. Collection areas for this master plan are mostly the same as the previous master plan, but have been updated to match current growth projections, sewer manholes, topography, and to reflect improvements made to the collection system since 2000. The collection areas were also discussed and reviewed by the wastewater collection system operators. Collection areas are generally less than 400 acres, with many less than 150 acres and generally have an existing contribution of less than 400 units. This allowed the analysis to be performed with greater definition. The delineated collection areas are shown in Figure 5-1.

GROWTH PROJECTIONS

The Tooele City population is approximately 37,000 as of 2020. There is a significant amount of developable land, primarily in the northern and western areas of the City. State and City planners expect the population of Tooele to increase significantly over the next 40 or more years, reaching a population of 63,000 by 2060. Figure 5-2 shows the historic and projected population of Tooele City through 2060. Additional detail is shown in Appendix B. The growth estimates were generated using information from City records, the City Planning Department, and projections from the Governor's Office of Management and Budget (2012), Kem C. Gardner Institute (2016), and Wasatch Front Regional Council (2020). HAL and City personnel met and discussed the various population projections and developed the following projection for use in this plan.



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Tooele City
Wastewater Collection System Master Plan

Wastewater Collection Areas

FIGURE 5-1

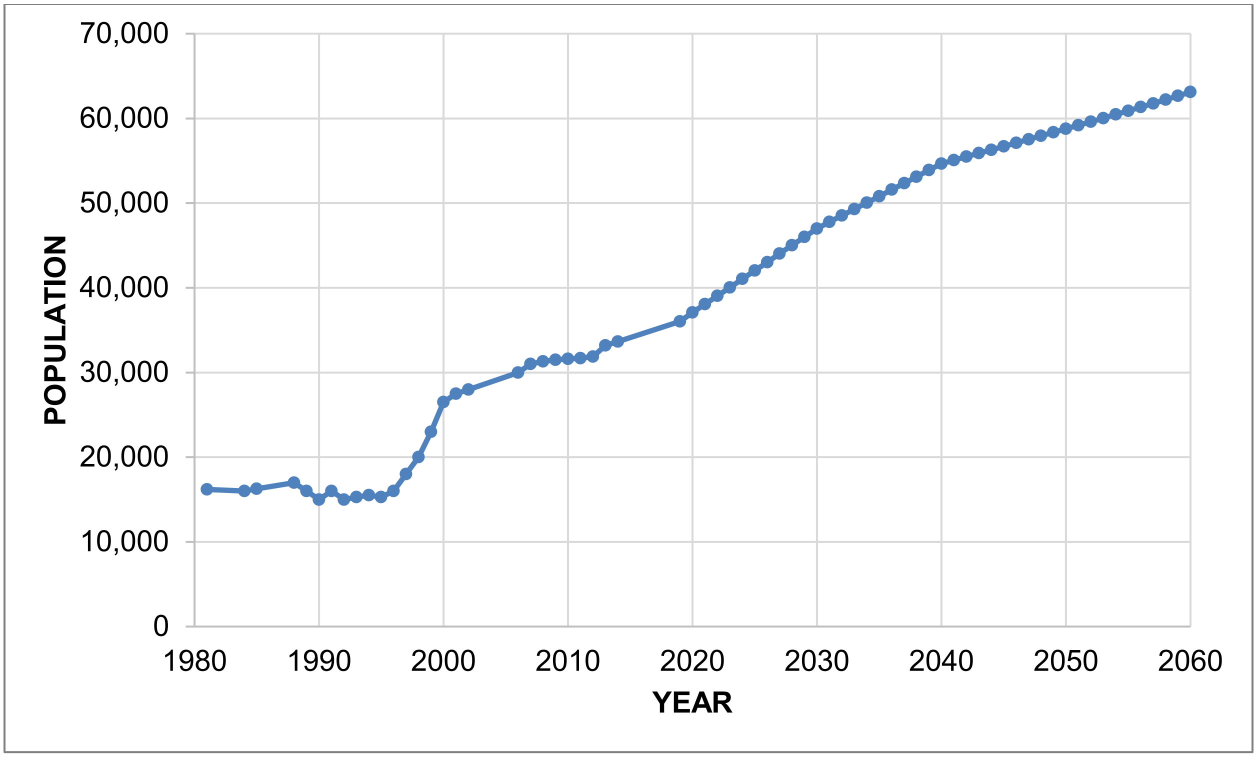


FIGURE 5-2 TOOELE HISTORIC AND PROJECTED POPULATION

As discussed in Chapter 3, it was determined that the existing collection system serves about 14,400 ERUs. The City has also committed to serve an additional 1,227 ERUs (which are under construction or approved for construction), for a total of 15,627 existing and approved ERUs. In addition to this number, there are additional commitments for growth in the Overlake area, but these are not included in the 1,227 approved ERUs.

Future ERUs were distributed as shown on Table 5-1 and Figure 5-3. Estimated timing of development is included in the table. This master plan report addresses development through 2060 at the locations and densities shown. Additional development is likely to occur beyond 2060 based on population growth, available land for development, and regional economic trends.

TABLE 5-1 FUTURE ERUS BY DEVELOPMENT LOCATION

Area	Land Use Type	Acres Developed	Maximum Density Unit/ Acre*	ERUs	Estimated Development Timing of ERUs		
					2020-2030	2030-2040	2040-2060
1	Light Industrial (LI)	0	2	0	0	0	0
2	Light Industrial (LI)	0	2	0	0	0	0
3	Industrial (I)	0	2	0	0	0	0
4	General Commercial	0	4	0	0	0	0
5	Light Industrial (LI)	0	2	0	0	0	0
6	Industrial (I)	0	2	0	0	0	0

Area	Land Use Type	Acres Developed	Maximum Density Unit/ Acre*	ERUs	Estimated Development Timing of ERUs		
					2020-2030	2030-2040	2040-2060
7	Light Industrial (LI)	0	2	0	0	0	0
8	Residential (R1-7)	668	5	3,340	954	905	1,481
9	Neighborhood	30	4	121	74	47	0
10	Residential (R1-7)	200	5	999	475	299	225
11	General Commercial	89	4	356	170	106	80
12	Residential (R1-10)	162	3.5	568	271	169	128
13	Residential (R1-10)	69	3.5	241	115	72	54
14	Residential (R1-10)	34	3.5	120	57	36	27
15	General Commercial	91	4	362	50	115	197
16	General Commercial	30	4	120	0	120	0
17	High School	51	1	51	51	0	0
18	Residential (MR-8)	2	8	18	0	0	18
19	Residential (MR-8)	32	8	252	0	50	202
20	General Commercial	93	4	370	50	50	270
21	Residential (MR-16)	48	16	769	367	402	0
22	Residential (R1-8)	27	4	108	52	56	0
23	Residential	11	3.7	40	40	0	0
24	Residential	61	5.2	317	72	245	0
25	Residential	6	16.6	100	100	0	0
26	Residential	20	3.2	63	0	0	63
27	Residential	9	2.3	21	21	0	0
28	Gen Comm (GC)/ Ind (I)	9	4	35	0	0	35
29	Residential (MR-8)	38	4	150	100	50	0
30	Residential	67	4.2	283	135	148	0
31	Residential	50	2.6	130	0	0	130
32	Residential	8	2.6	20	0	0	20
33	Residential	4	3.2	12	0	0	12
34	Residential	10	3.2	33	0	0	33
35	Residential	11	2.5	28	7	0	21
36	Residential	6	14	84	84	0	0
37	Residential	13	4.1	55	55	0	0
38	Residential (MR-16)	4	16	64	64	0	0
39	Residential	0	16.5	0	0	0	0
40	Residential	27	5.0	136	136	0	0
41	Residential	26	4.2	111	111	0	0
42	Residential	0	8.8	0	0	0	0

Area	Land Use Type	Acres Developed	Maximum Density Unit/ Acre*	ERUs	Estimated Development Timing of ERUs		
					2020-2030	2030-2040	2040-2060
43	Residential	22	4.0	87	87	0	0
44	Residential	6	2.2	13	13	0	0
45	Residential	12	5.2	62	62	0	0
46	Residential	21	1.4	30	0	30	0
47	Residential (R1-14)	30	2.5	75	0	0	75
48	Residential	35	1.9	66	66	0	0
49	Residential	40	2.7	108	108	0	0
50	Residential	0	2.2	0	0	0	0
Additional Approved Areas Outside of Future Development Areas		N/A	Varies	170	170	0	0
Total		N/A	N/A	10,088	4,117	2,900	3,071

*The total number of ERUs in an area is based on projections developed with City planners and staff. Some areas are not expected to be fully developed to maximum density within the master plan projected growth periods.

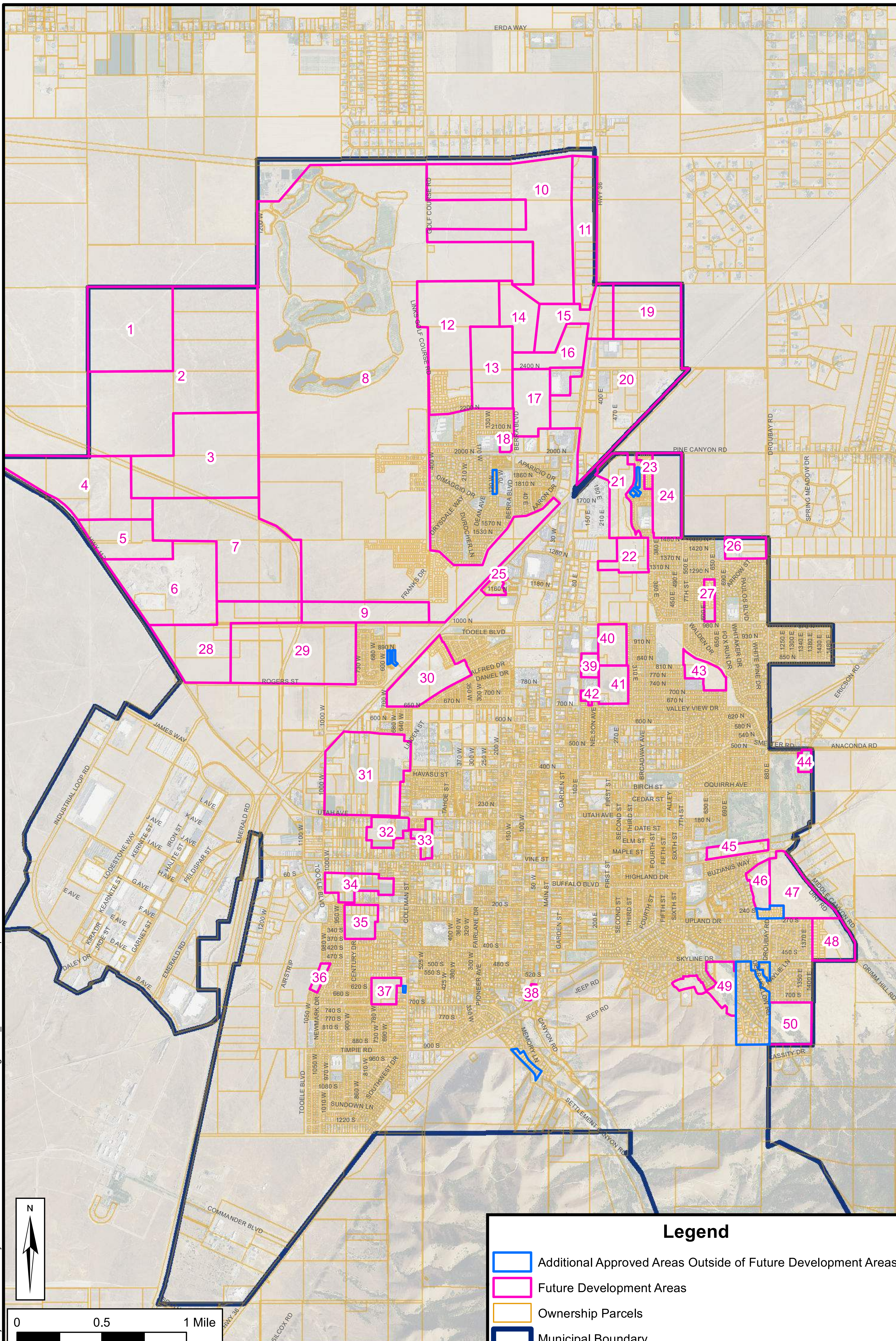
Using the guidance from the City and the projected ERU count by year for each planning period, the total projected populations were divided up and assigned to collection areas. ERU estimates for the existing wastewater collection system and growth projections are summarized in Table 5-2.

TABLE 5-2 WASTEWATER ERU PROJECTIONS

Approximate Year	Additional ERUs	Total ERUs	Description
2020	-	14,400	Existing System
2020	1,227	15,627	Existing System Plus Approved
2030	2,890	18,517	10-Year Development
2060	5,971	24,488	40-Year Development

FLOW PROJECTIONS

Flow projections were prepared based on the number of projected ERUs. For the 2030 and 2060 planning periods, the number of additional ERUs are provided in Table 5-2. For the analysis, ERUs were distributed to collection areas throughout the City. The specific distribution of ERUs was based on workshops and discussions with City personnel. This distribution considered property locations for development application, existing available water and wastewater infrastructure and transportation routes. Generally, most of the growth is expected to occur in the northern areas of the City, with some growth occurring at other locations throughout the City.



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Tooele City
Wastewater Master Plan

Future Development Areas

FIGURE 5-3

In order to estimate future hydraulic loadings, the unit loading of 170 gpd/ERU was multiplied by the future number of ERUs for each collection area. The estimated existing and future average wastewater flows are shown in Table 5-3.

TABLE 5-3 SYSTEM FLOW PROJECTIONS

Planning Period	Total ERUs	*Projected Average Flow Plus Inflow (gpm)	Projected Average Flow (MGD)	*Projected Average Flow Plus Inflow (MGD)
Existing Conditions	14,400	3,700 gpm	2.4	5.3
Existing Plus Approved	15,627	3,845 gpm	2.7	5.5
2030 (10-Year)	18,517	4,186 gpm	3.1	6.0
2060 (40-Year)	24,488	4,890 gpm	4.2	7.0

*Including inflow (2,000 gpm) and infiltration.

CHAPTER 6
WASTEWATER COLLECTION SYSTEM EVALUATION

This section describes the steps involved in developing Tooele City's wastewater collection system model. The steps are as follows:

- Choosing the model software
- Establishing the system layout in the model
- Developing the design criteria for the collection system
- Calibrating the model
- Creating different scenarios in the model
- Analyzing model results

MODEL SELECTION

HAL and Tooele personnel discussed options for the modeling software and decided to use the Autodesk Storm and Sanitary Analysis (SSA) Model Software for the master plan. SSA is effective in modeling storm and sanitary flows, and has the ability to import and export GIS data, and export models to the EPA SWMM software (free distribution). This improves the City's ability use the model without software license limitations.

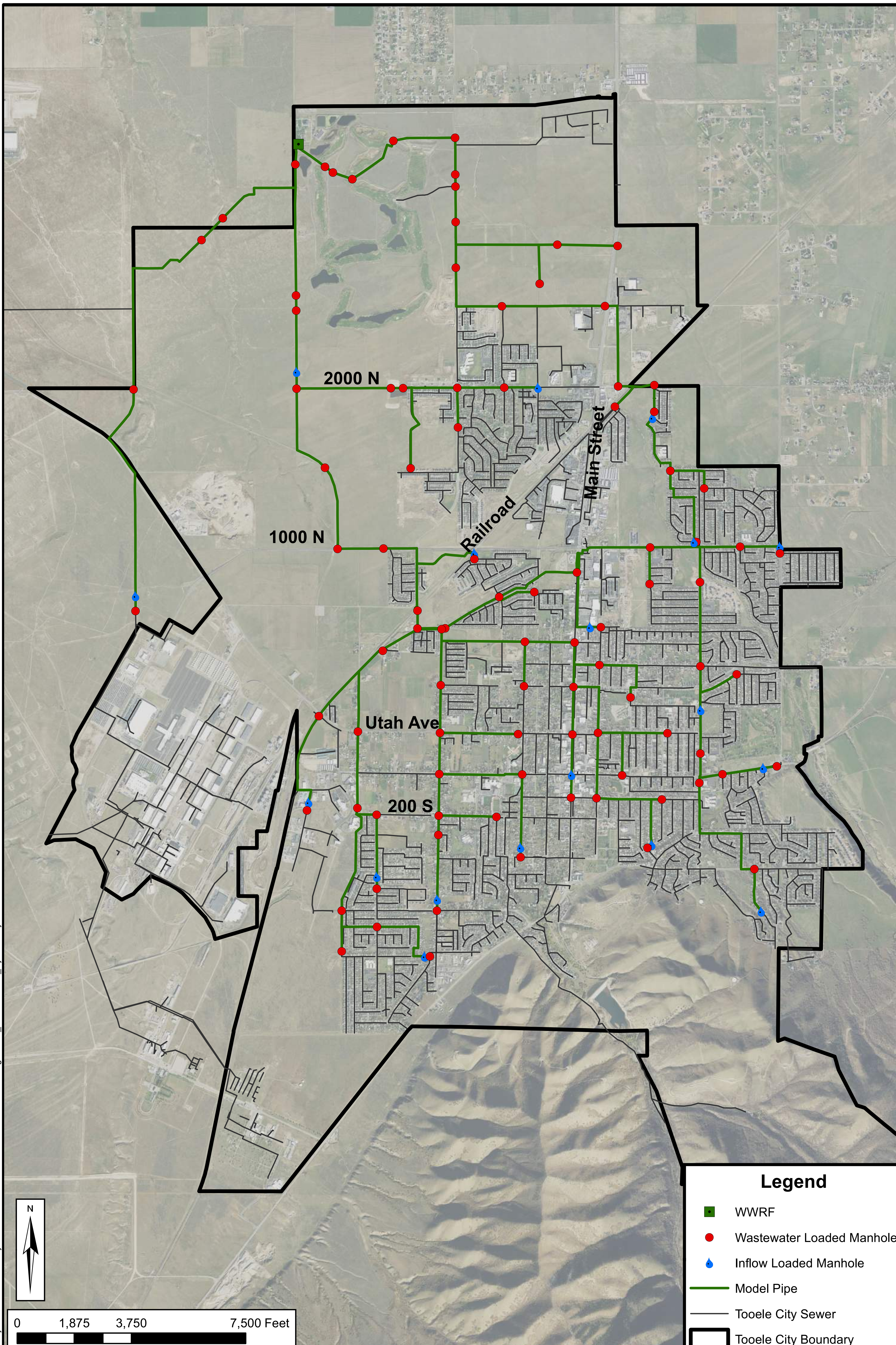
SYSTEM LAYOUT

AutoCAD and construction record drawings were used to build the wastewater hydraulic model. The data was compiled and analyzed in GIS and then imported to SSA. Wastewater loading allocation within the model was performed using GIS and model data. Inflow loads were determined using flow data from the WWRF and precipitation data. As questions came during model creation, HAL and Tooele City personnel coordinated to correct identified errors or to add newly available data to the model.

Each collection area was assigned a percentage of the flow arriving at the WWRF based on how many ERUs were being represented within the collection area. The number of existing ERUs in each collection area was determined based on water meter billing data. The inflow data were distributed across the collection system in key locations as shown in Figure 6-1.

MODELING CRITERIA

Several potential modeling criteria and values were suggested by HAL and reviewed by Tooele City. The criteria and values adopted for this modeling effort are included in Table 6-1.



HANSEN ALLEN & LUCE inc ENGINEERS

Tooele City Wastewater CollectionSystem Master Plan	Model System Layout	FIGURE 6-1

Date: 5/13/2022
Document Path: H:\Projects\149 - Tooele City\49.100 - 2019 Wastewater Master Plan\GIS\Figure 6-1_Tooele SSMP_System Layout.mxd

TABLE 6-1 MODELING CRITERIA

CRITERIA	VALUE OR ASSUMPTION
System Loading	The existing system flows are based on the WWRF data and the distribution of flows throughout the City is based on winter water use. Future flows are based on existing unit flows and upon projected land use patterns.
Daily Flow Variation	Residential, Commercial and Mixed Use patterns weren't available for Tooele City from flow monitoring records, and are therefore, based on typical patterns from other similar Utah communities.
Peak Flow	Peaking factors and diurnal curves were developed based on flow data.
Inflow and Infiltration	Inflow values were determined by reviewing WWRF data and precipitation values. The LOS was developed to account for seasonal fluctuations. The fluctuation is believed to be caused by infiltration. By extension, the LOS is assumed to account for infiltration. Inflow values were distributed throughout the City.
Planning Period	Years 2030 (10-Year) and 2060 (40-Year).
Land Use & Population Projections	Provided by Tooele in 2020.
Pipe Capacity	Roughness Coefficient = 0.013 Manning's n Maximum d/D for pipes 12-inches or smaller = 0.5 (To prevent blockages) Maximum d/D for pipes larger than 12-inches = 0.75

MODEL CALIBRATION

The flow loaded into the model representing each collection area was peaked according to the previously discussed diurnal curves. The total flow was adjusted until the model results matched the peak design flow from Table 4-1.

Model calibration included comparing hydrographs generated by the model with actual flows measured in the collection system, followed by making adjustments to the model to better reflect measured flows. Flow data observations at the WWRF were used to calibrate the model. The flow studies were also included in the calibration process. Figure 6-2 shows the average daily curve at the treatment plant, including 2,000 gpm for inflow, compared to the hydrograph generated from the model.

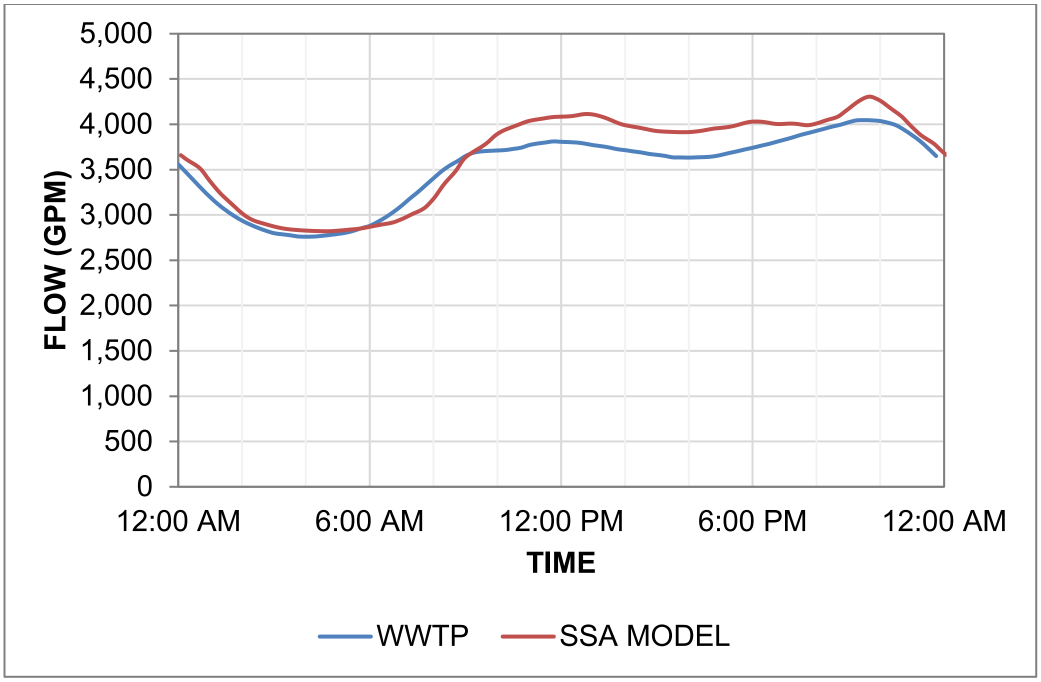


FIGURE 6-2 MODEL VS. WWRF AVERAGE DAILY FLOW

MODEL SCENARIOS

Four modeling scenarios were developed and evaluated for the Tooele wastewater collection system as shown in Table 6-2.

TABLE 6-2 MODEL SCENARIOS

SCENARIO	DESCRIPTION
Existing (Approved)	The Existing scenario was used to identify deficiencies in the wastewater collection system, accounting for approved developments, and to establish a baseline for evaluation of future conditions.
Existing Corrected	The Existing Corrected scenario reflects system improvements that resolve all existing deficiencies.
2030 (10-Year)	The 2030 (10-Year) scenario was used to identify deficiencies in the wastewater collection system under 2030 development conditions.
2060 (40-Year)	The 2060 (40-Year) scenario was used to identify deficiencies in the wastewater collection system under 2060 development conditions.

MODEL RESULTS

The wastewater hydraulic models were run and the collection system was analyzed. The average loadings discussed in Chapter 5 were placed into the hydraulic models at the manholes shown in Figure 6-1. The models applied peaking factors to generate peak hydraulic loadings at the WWRF. All models included 2,000 gpm for inflow. The existing and future peak hydraulic loadings are provided in Table 6-3.

TABLE 6-3 PEAK HYDRAULIC LOADINGS

Planning Period	Peak Hydraulic Loading* (gpm)	Peak Hydraulic Loading* (MGD)
Existing Conditions	4,306	6.2
Existing Plus Approved	4,514	6.5
2030 (10-Year)	5,007	7.2
2060 (40-Year)	5,981	8.6

*Including inflow (2,000 gpm).

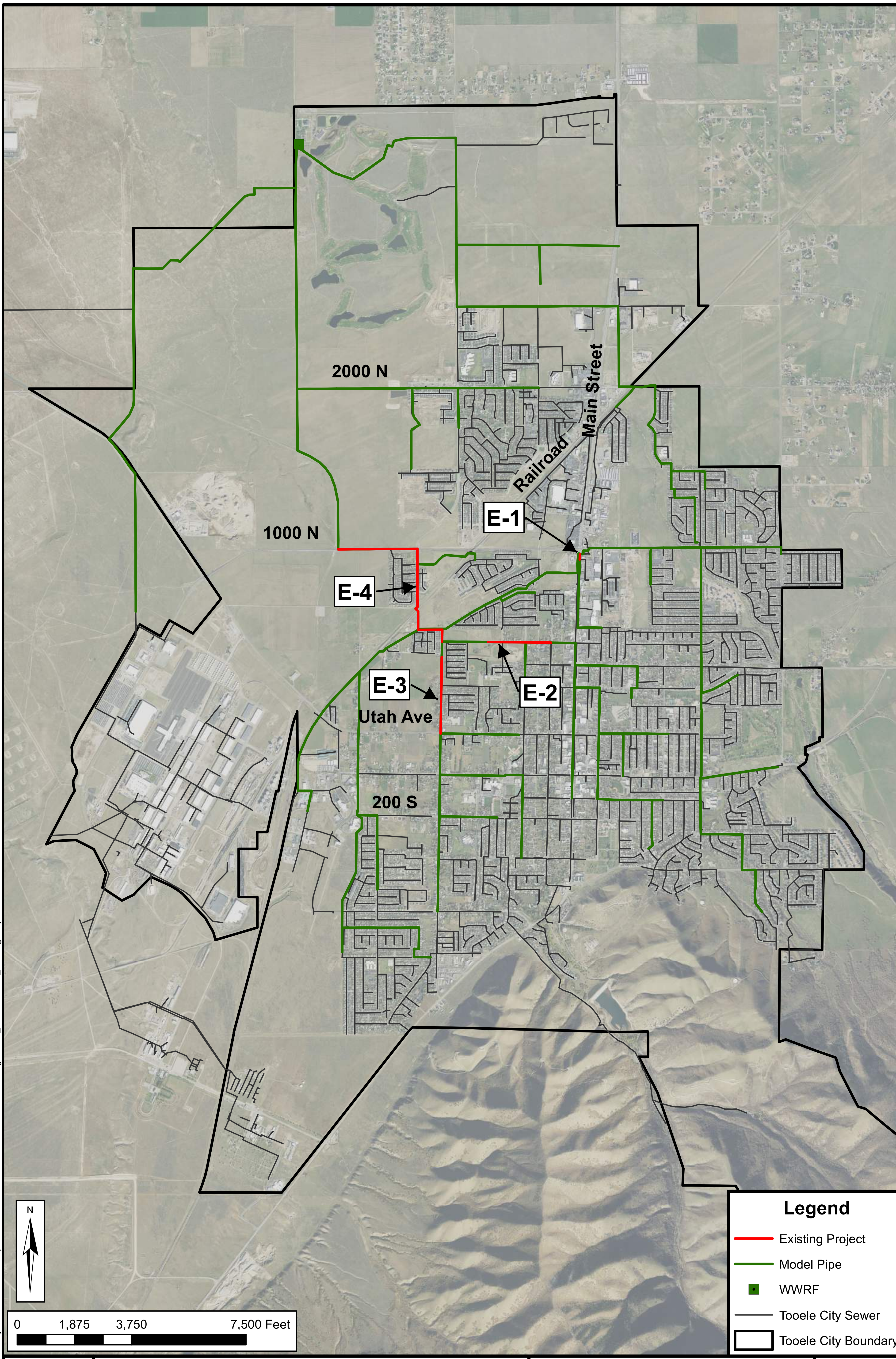
It may be observed in Table 6-3 that the existing peak hydraulic loading is 4,306 gpm (6.2 MGD), and the projected peak hydraulic loading by 2060 is just under 6,000 gpm (8.6 MGD). These values all exceed the current WWRF design capacity of 3.4 MGD.

EXISTING DEFICIENCIES

The maximum depth ratio is the ratio of the maximum flow depth that occurs in the pipe and the diameter of the pipe (d/D). Deficiencies were identified as pipes in the model that exceeded a set d/D during peak flow conditions. The d/D capacity criteria adopted by the City is 0.5 for pipes 12-inches or smaller and 0.75 for pipes larger than 12-inches. Pipe capacity deficiencies identified in the Existing (Approved) scenario model are summarized in Table 6-4 and shown in Figure 6-3.

TABLE 6-4 EXISTING PIPE CAPACITY DEFICIENCIES AND SOLUTIONS

PROJECT ID	LOCATION	ISSUE	SOLUTION
E-1	Along Main Street near 1000 North	Pipe exceeds capacity because d/D > 0.5 (0.64)	Remove and upgrade existing 8" gravity line to 200 ft of 10" gravity line.
E-2	Along 600 North between 100 West and 370 West	Pipe exceeds capacity because d/D > 0.5 (1.0)	Remove and upgrade existing 12" gravity line to 2,100 ft of 15" gravity line.
E-3	Along Coleman Street between Utah Avenue and McKellar Street	Pipe exceeds capacity because d/D > 0.5 (1.0)	Remove and upgrade existing 12" gravity line to 2,550 ft of 15" gravity line.
E-4	Along existing sewer alignment between 600 North to 1000 North and Coleman Street to 1100 West	Pipe exceeds capacity because d/D > 0.75 (1.0)	Remove and upgrade existing 18" and 21" gravity line to 6,500 ft of 24" gravity line. Contains 36" bore for 115 ft under railroad tracks.



HANSEN ALLEN & LUCE inc ENGINEERS

Tooele City
Wastewater Collection System Master Plan

Existing Projects

FIGURE
6-3

Date: 8/2/2022
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With the construction of projects listed in Table 6-4, additional capacity will be added to the collection system. Though the projects are necessary to alleviate existing deficiencies, there should be excess capacity remaining in the improved sewer lines. This excess capacity can be used by future developments and a proportional amount of the project cost can be accounted for and reimbursed through future impact fees. Additionally, existing non-deficient pipes have excess capacity that can be used for new development. These are eligible for impact fee reimbursement.

While it is anticipated that the final construction of these projects will be completed as shown in Table 6-4, additional information may become available during the design process or conditions may change prior to construction. Therefore, it is recommended that a local specific study be performed prior to design and construction to verify current conditions and the applicability of the project. A land survey should be completed to verify elevations and flow studies be completed to verify that current flow conditions align with those predicted in the master plan hydraulic model. The flow data can also be used to update and calibrate a current hydraulic model tracking growth and development as it is proposed and approved.

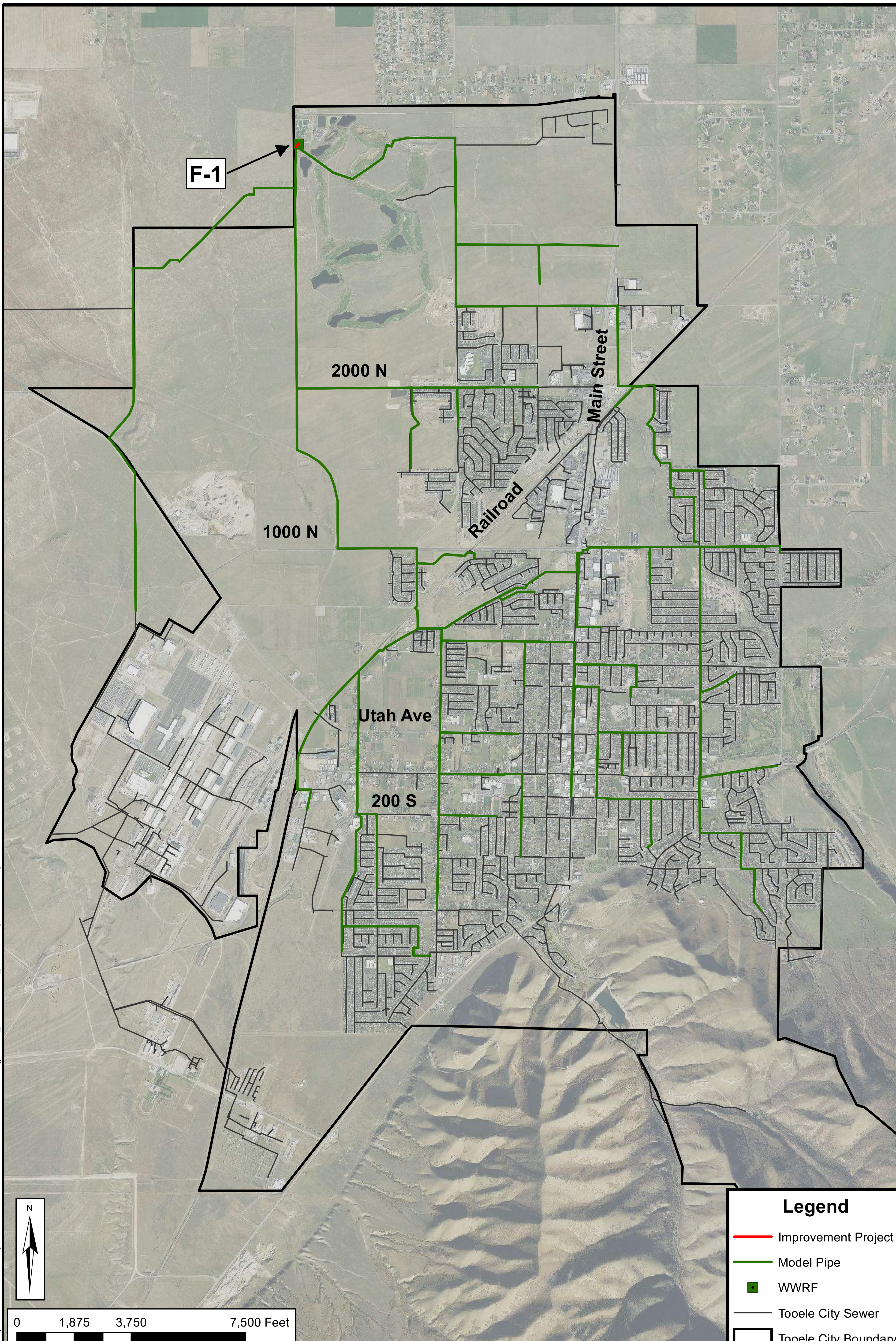
FUTURE IMPROVEMENTS

The improvements identified in the future scenarios are predicted to provide capacity that could be needed if development occurs as projected. Future improvements that will remedy the potential future deficiencies were determined from an evaluation of the 10-Year and 40-year modeling results. Pipe capacity improvements that were identified for the 10-Year model are summarized in Table 6-5 and shown in Figure 6-4. No additional improvements were identified in the 40-Year model. All of the previously identified existing deficiencies would remain problems in the future scenarios if improvements are not implemented. The maximum depth ratios of future improvements are often larger than existing deficiencies due to increased flow from future redevelopment.

TABLE 6-5 10-YEAR PIPE CAPACITY IMPROVEMENTS

PROJECT ID	LOCATION	ISSUE	SOLUTION
F-1	WWRF	Pipe exceeds capacity because d/D > 0.75 (0.78)	Remove and upgrade existing 30" gravity line to 160 ft of 36" gravity line.

The City is in the process of designing improvements to the WWRF headworks. These improvements will provide the City with more flexibility to reroute flows to maintain the headworks. The improvement identified in Table 6-5 will be incorporated and resolved by the planned headworks project.



HANSEN ALLEN & LUCE INC ENGINEERS

Tooele City
Wastewater Collection System Master Plan

10-Year Improvement Projects

FIGURE 6-4

Date: 4/12/2022
Document Path: H:\Projects\149 - Tooele City\49.100 - 2019 Wastewater Master Plan\GIS\Figure 6-4_Tooele SSMP_10-Year Improvement Projects.mxd

CHAPTER 7
OPERATIONS AND MAINTENANCE ALTERNATIVES

Recommendations for key operations and maintenance procedures have been developed. Many of these recommendations are a continuation of procedures already in effect. A discussion is included below, along with a recommendation for continued practice. These items are as follows:

SYSTEM AGING

Pipe age can be used to identify areas that might require more repairs. The typical design life for a sanitary sewer is between 50 and 100 years. Factors affecting design life may include pipe material, soil conditions and quality of construction. Because of the variability of these factors, it is difficult to determine the condition of the wastewater collection system based on age alone. Tooele uses sewer video inspection technology to evaluate the structural integrity of the pipes in the sewer network. Sewer video inspection is very useful at identifying cracks, holes, offset joints, erosion, low points in pipes, and significant inflow/infiltration. It is recommended that Tooele City continue the system video schedule and use the inspection to plan for future repair projects.

PIPELINE IMPROVEMENTS

The following improvement alternatives are typically considered when addressing pipeline deficiencies.

Cleaning

If the slope of the pipe is insufficient to provide adequate flow velocity, deposition of solids may occur. Deposition of solids reduces pipe capacity. Some locations in Tooele are relatively flat, causing sewer slope to be less than ideal. It is recommended that Tooele continue cleaning pipes in the system on a regular schedule. Problem areas should be cleaned more frequently.

Replacement Sewers

Historically, where pipe capacity has been identified as being insufficient, the typical solution has been to provide additional capacity by replacing the existing sewer with a larger sewer.

New Sewers

New sewers are often the only option to collect flows from future development or previously inaccessible areas. Because future growth in Tooele is expected to occur in areas of the City without existing sewer networks, new sewer networks are expected to be constructed in the foreseeable future.

Alternative Construction Technologies

Within the last few years, several alternative technologies have become popular when sewers need to be replaced, when pipeline capacity needs to be increased, or when there are significant constraints to more conventional construction methods. Typical alternative technologies include:

New Construction

- Directional Drilling
- Micro-tunneling
- Jack and Bore

Sewer Pipe Rehabilitation

- Cured-in-Place Pipe
- Slip Lining
- Pipe Bursting
- Thermoforming (Fold and Form)

For difficult installations or rehabilitation projects, Tooele City should consider whether any of these technologies are applicable.

COMPARISON OF IMPROVEMENT ALTERNATIVES

Sewers

For the purposes of this report, most of the sewer replacements were assumed to be open-cut to provide conservative cost estimates for budgeting purposes. Locations where alternative construction methods were assumed are specified.

CHAPTER 8
CAPITAL IMPROVEMENTS PLAN

Recommendations for improvements to the wastewater collection system have been prepared based on the findings described in the previous chapters. These recommendations include the correction of existing deficiencies as soon as practical and the implementation of future improvements corresponding with population growth. Cost estimates have been prepared for recommended improvements of existing deficiencies and for future improvements through 2030.

PROJECT COST ESTIMATES

Typical unit costs were used to prepare the project construction cost estimates. Sources of typical unit costs include HAL's bid tabulation records for similar recent projects in Utah, and the RS Means Heavy Construction Cost Index. Project cost estimates are included in Appendix D.

ACCURACY OF COST ESTIMATES

When considering cost estimates, there are several levels or degrees of accuracy, depending on the purpose of the estimate and the percentage of detailed design that has been completed. The following levels of accuracy are typical:

Type of Estimate	Accuracy
Master Plan	-50% to +100%
Preliminary Design	-30% to +50%
Final Design or Bid	-10% to +10%

For example, at the master plan level (or conceptual or feasibility design level), if a project is estimated to cost $1,000,000, then the accuracy or reliability of the cost estimate would typically be expected to range between approximately $500,000 and $2,000,000. While this may not seem very accurate, the purpose of master planning is to develop general sizing, location, cost and scheduling information on a number of individual projects that may be designed and constructed over a period of many years. Master planning also typically includes the selection of common design criteria to help ensure uniformity and compatibility among future individual projects. Details such as the exact capacity of individual projects, the level of redundancy, the location of facilities, the alignment and depth of pipelines, the extent of utility conflicts, the cost of land and easements, the construction methodology, the types of equipment and material to be used, the time of construction, interest and inflation rates, permitting requirements, etc., are typically developed during the more detailed levels of design.

At the preliminary design level, some of the previously noted information will have been developed. Major design decisions such as the size of facilities, selection of facility sites, pipeline alignments and depths, and the selection of the types of equipment and material to be used during construction, will typically have been made. At this level of design, the accuracy of the cost estimate for the same $1,000,000 project would typically be expected to range between approximately $700,000 and $1,500,000.

After the project has reached final design, and is ready to bid, all design plans and technical specifications will have been completed and nearly all of the significant details about the project should be known. At this level of design, the accuracy of the cost estimate for the same $1,000,000 project would typically be expected to range between approximately $900,000 and $1,100,000.

RECOMMENDED IMPROVEMENT PROJECTS

Preparation of recommended improvements projects included of a number of factors as follows:

- Input by City sewer system operation personnel regarding their experience with, and opinions regarding, the deficiency and potential solutions.
- Input from City personnel regarding a wide range of issues including: development schedules, budgeting issues, coordination with other public works projects, etc.
- Priority indicated by the modeling efforts and by the operational personnel's experience with the repair projects
- Project cost estimates

Table 8-1 identifies the recommended improvement projects to correct existing deficiencies and Table 8-2 identifies the recommended improvement projects to address capacity issues caused by future projected flows in the wastewater system and the estimated cost associated with each project.

TABLE 8-1 EXISTING IMPROVEMENT PROJECT COST ESTIMATES

PROJECT ID	DESCRIPTION	COST[1]
E-1	Remove and upgrade existing 8" gravity line to 200 ft of 10" gravity line.	**$ 120,000**
E-2	Remove and upgrade existing 12" gravity line to 2,100 ft of 15" gravity line.	**$1,260,000**
E-3	Remove and upgrade existing 12" gravity line to 2,550 ft of 15" gravity line.	**$1,520,000**
E-4	Remove and upgrade existing 18" and 21" gravity line to 6,500 ft of 24" gravity line. Contains 36" bore for 115 ft under railroad tracks.	**$5,260,000**
	TOTAL	**$8,160,000**

[1] All costs include 25% for engineering, administrative costs, and contingencies. Costs are shown in 2022 dollars.

TABLE 8-2 10-YEAR IMPROVEMENT PROJECT COST ESTIMATES

PROJECT ID	DESCRIPTION	COST[1]
F-1	Remove and upgrade existing 30" gravity line to 160 ft of 36" gravity line.	**$ 450,000**
	TOTAL	**$ 450,000**

[1] All costs include 25% for engineering, administrative costs, and contingencies. Costs are shown in 2022 dollars.

Table 8-3 summarizes the estimated project cost totals from both the existing and future improvement projects.

TABLE 8-3 IMPROVEMENT PROJECT COST ESTIMATES SUMMARY

PROJECT IDs	PROJECTS	COST
E-1 to E-4	Existing Recommended Improvement Projects	**$8,160,000**
F-1	10-Year Recommended Improvement Project	**$ 450,000**
	TOTAL	**$8,610,000**

While it is anticipated that the final construction of these projects will be completed as shown, additional information may become available during the design process or conditions may change prior to construction. Therefore, it is recommended that a local specific study be performed prior to design to verify current conditions and the applicability of the project. A land survey should be completed to verify elevations, and current flow studies be completed to verify flow conditions.

REFERENCES

RS Means, 2020. *RS Means Heavy Construction Cost Data*. Norwell, MA: Construction Publishers & Consultants.

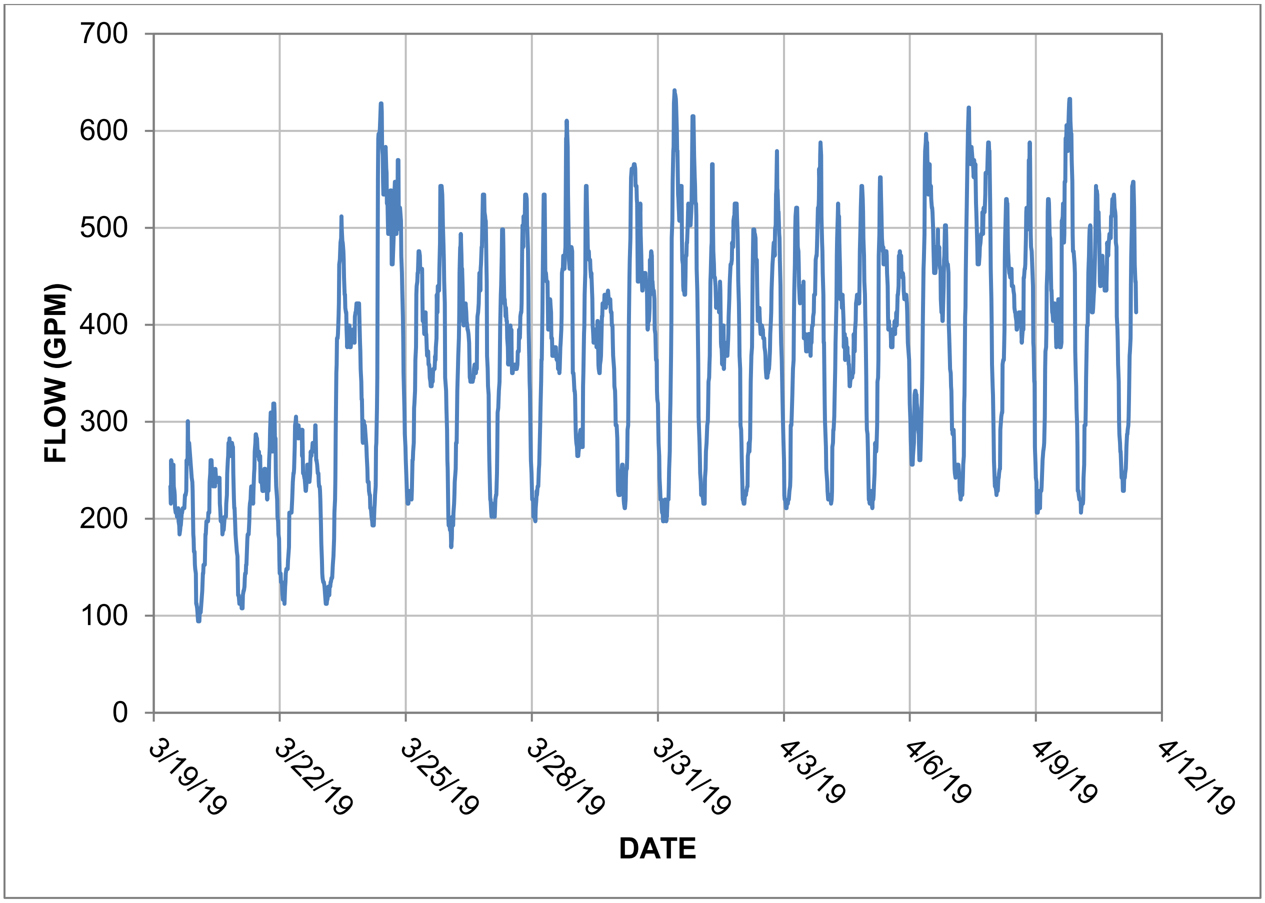
Tooele City - Wastewater Collection System Master Plan. Hansen, Allen & Luce, Inc. December 2000.

Utah Division of Administrative Rules. 2019. *Utah Administrative Code, R317-3*. The Department of Administrative Services.

APPENDIX A
Flow Study Results

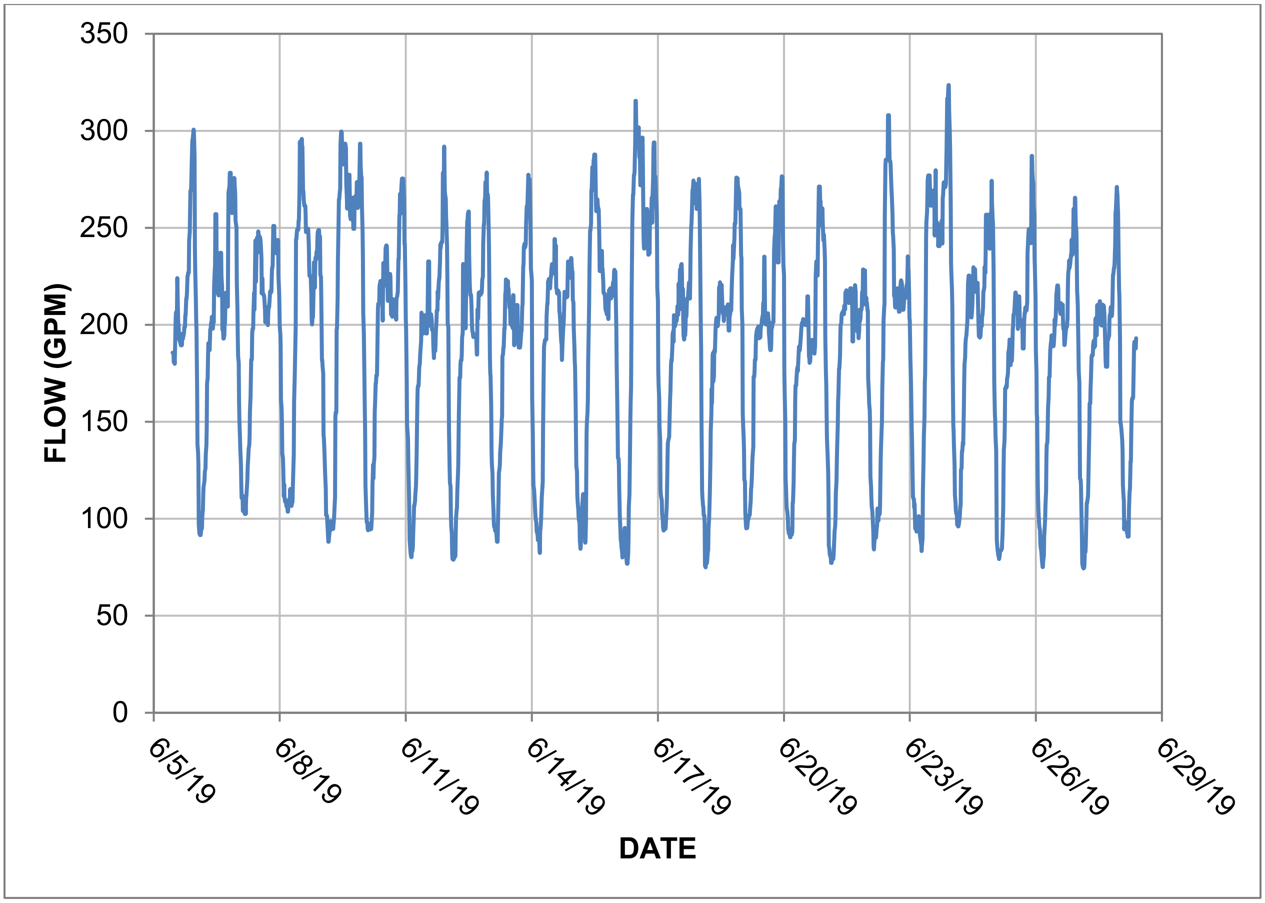
A18C

Site Location: 900 N 520 E, Tooele, UT 84074
Maximum Flow: 642 gpm
Minimum Flow: 94 gpm
Average Flow: 365 gpm
Peaking Factor: 1.76



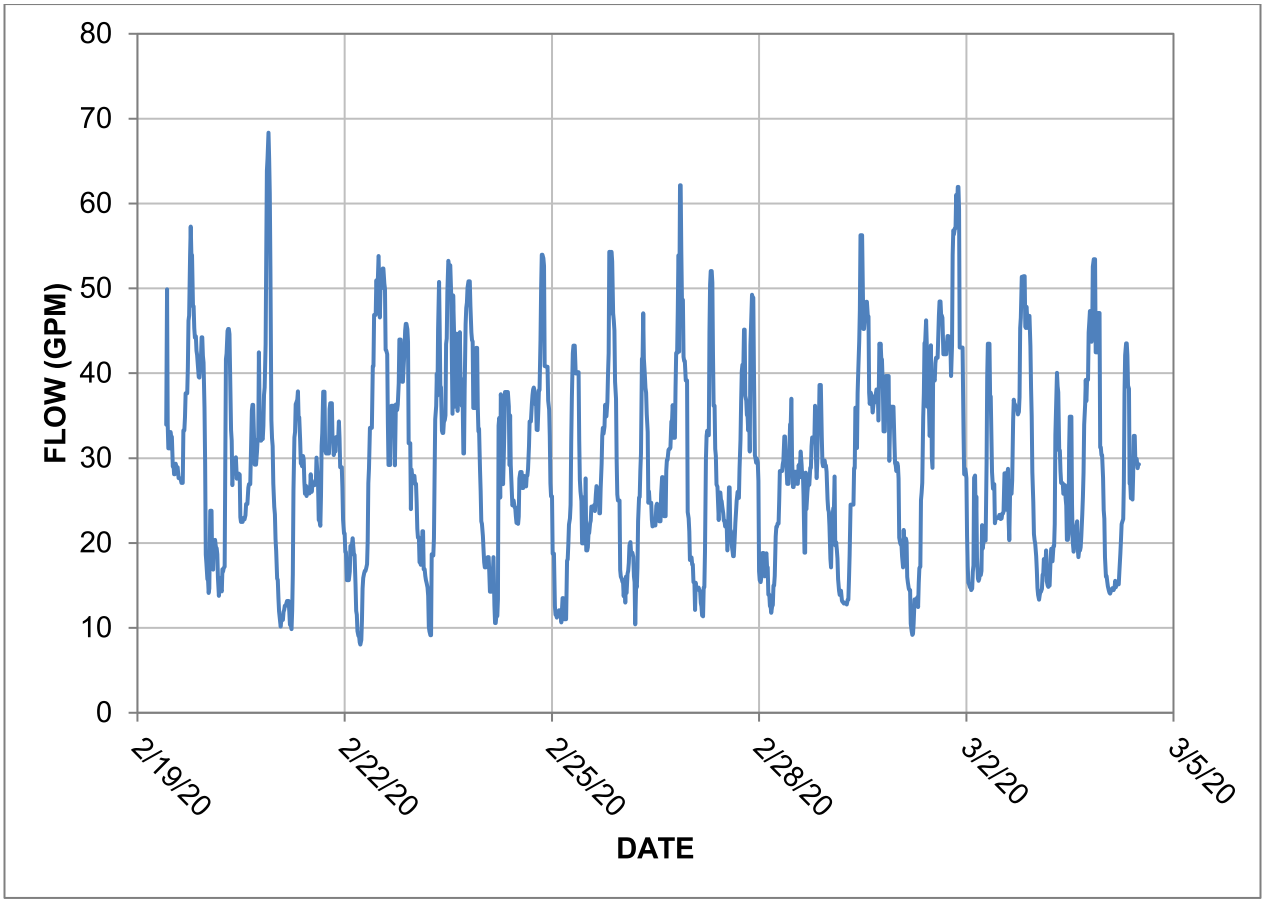
G8

Site Location: Near 400 N 1000 W, Tooele, UT 84074
Maximum Flow: 324 gpm
Minimum Flow: 74 gpm
Average Flow: 193 gpm
Peaking Factor: 1.68



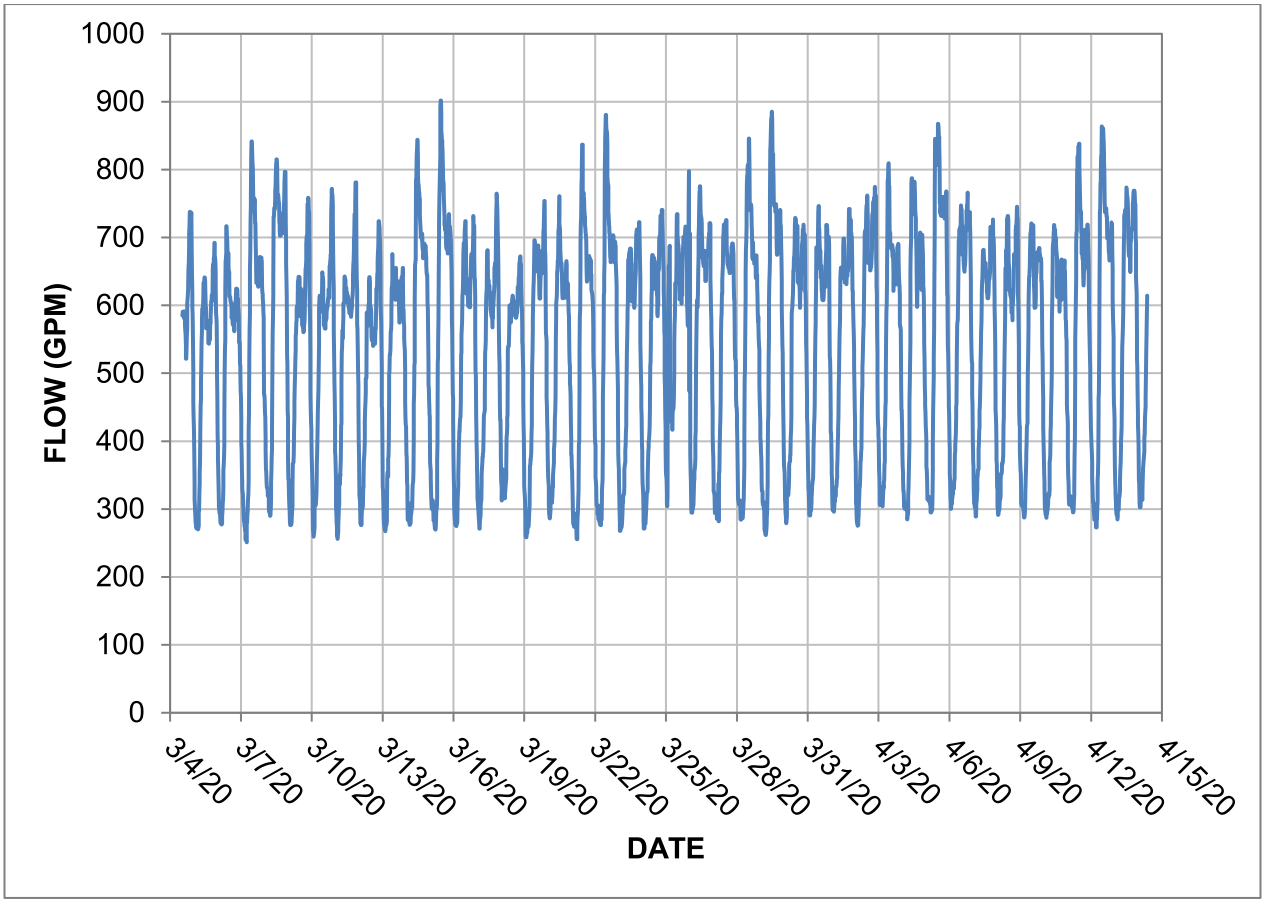
A20B

Site Location: 1000 N and Droubay Road, Tooele, UT 84074
Maximum Flow: 68 gpm
Minimum Flow: 8 gpm
Average Flow: 29 gpm
Peaking Factor: 2.32



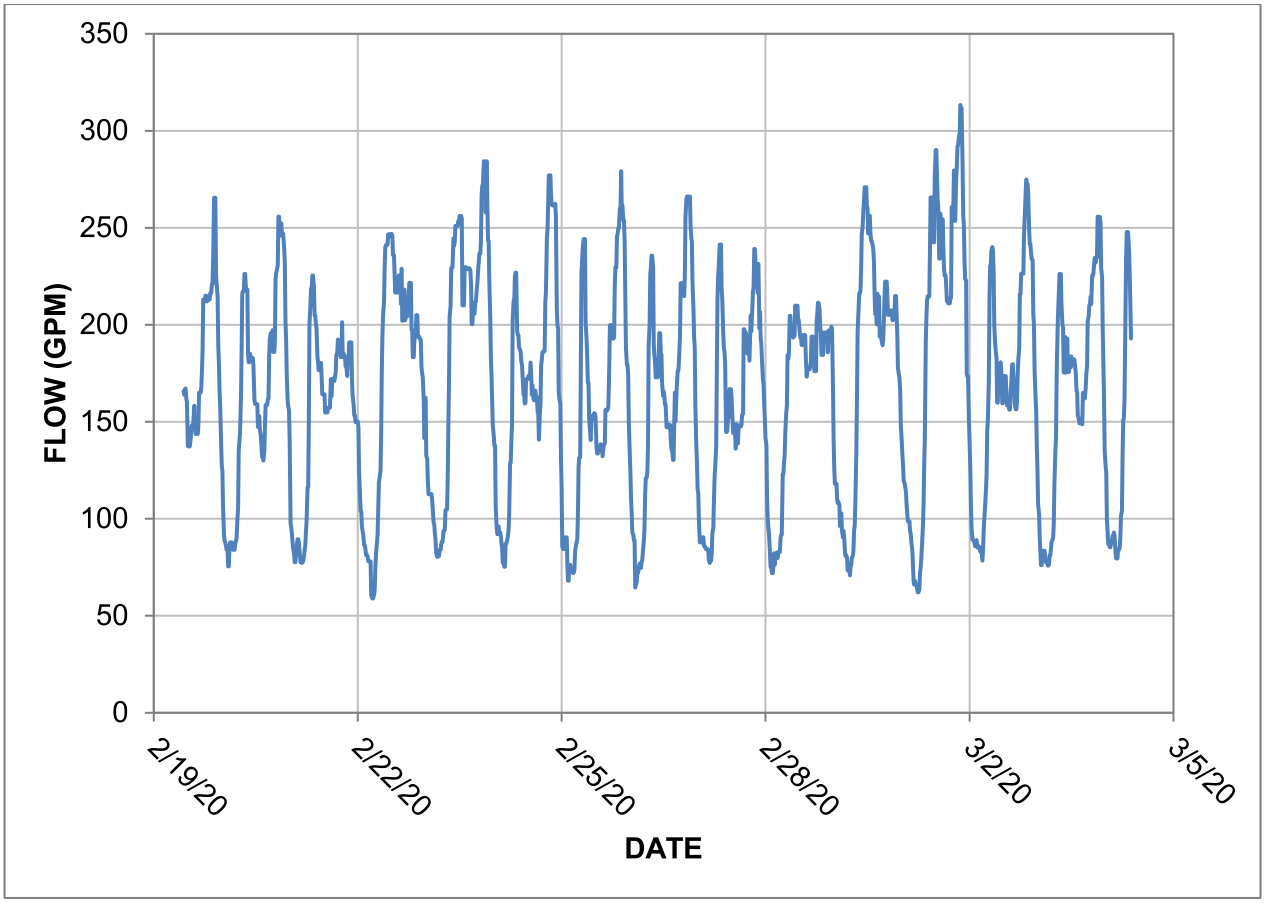
GH97

Site Location: 650 N 640 W, Tooele, UT 84074
Maximum Flow: 902 gpm
Minimum Flow: 251 gpm
Average Flow: 547 gpm
Peaking Factor: 1.65



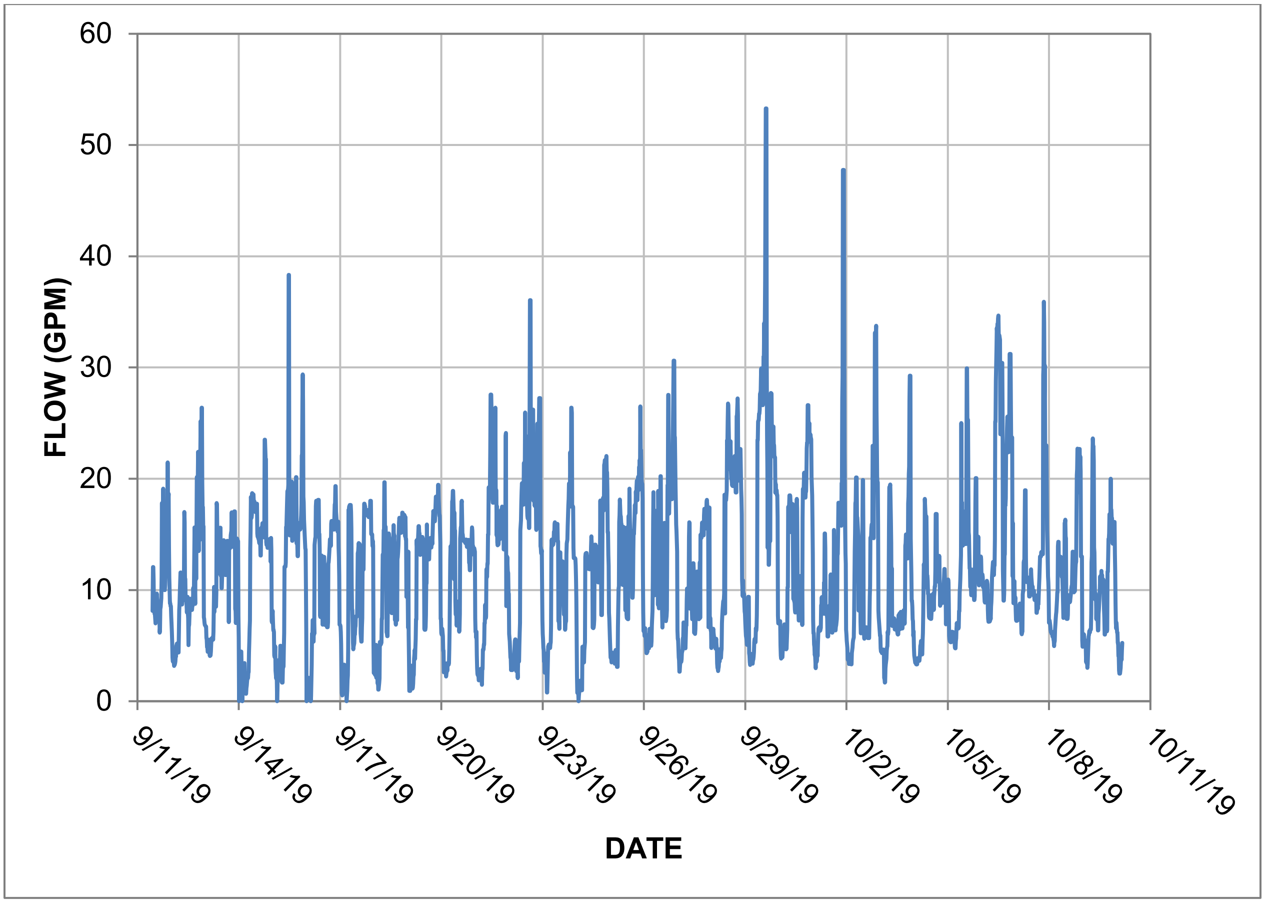
HD97C

Site Location: 2000 N 460 W, Tooele, UT 84074
Maximum Flow: 313 gpm
Minimum Flow: 59 gpm
Average Flow: 168 gpm
Peaking Factor: 1.87



G151

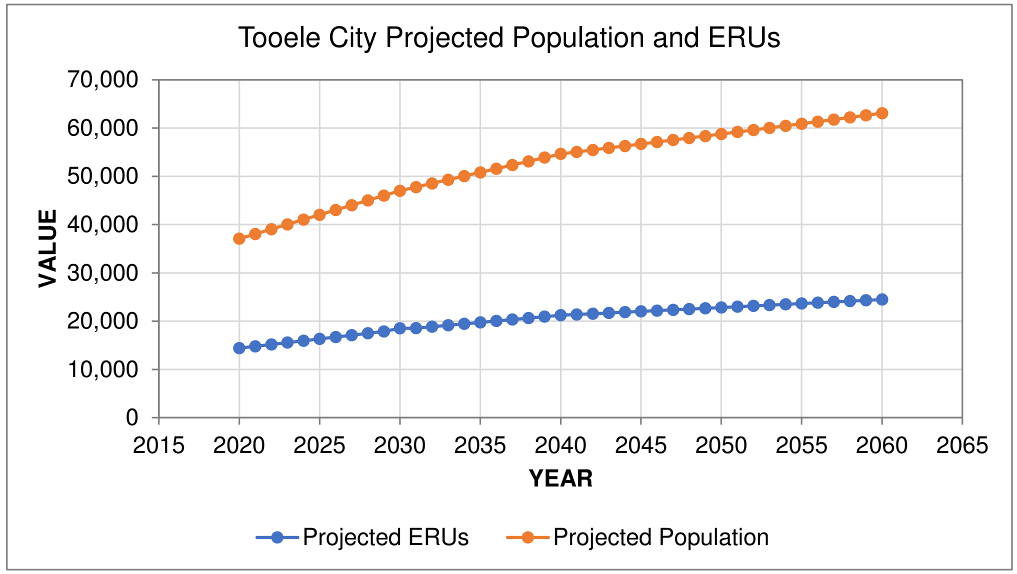
Site Location: 500 S 900 W, Tooele, UT 84074
Maximum Flow: 53 gpm
Minimum Flow: 0 gpm
Average Flow: 12 gpm
Peaking Factor: 4.50



APPENDIX B

Growth Projections and Projected ERUs

Year	Growth Rate	Projected ERUs	Projected Population
2020	**2.9%**	**14,400**	**37,076**
2021	2.7%	14,784	38,064
2022	2.6%	15,169	39,056
2023	2.6%	15,556	40,053
2024	2.5%	15,940	41,040
2025	2.4%	16,326	42,036
2026	2.4%	16,712	43,029
2027	2.3%	17,097	44,021
2028	2.3%	17,484	45,016
2029	2.2%	17,868	46,006
2030	2.2%	**18,517**	47,001
2031	1.6%	18,550	47,761
2032	1.6%	18,849	48,530
2033	1.6%	19,145	49,292
2034	1.6%	19,442	50,057
2035	1.5%	19,739	50,821
2036	1.5%	20,036	51,588
2037	1.5%	20,333	52,351
2038	1.5%	20,630	53,117
2039	1.4%	20,929	53,886
2040	1.4%	21,225	54,649
2041	0.7%	21,384	55,058
2042	0.8%	21,545	55,473
2043	0.7%	21,706	55,886
2044	0.7%	21,865	56,295
2045	0.7%	22,026	56,711
2046	0.7%	22,186	57,123
2047	0.7%	22,347	57,536
2048	0.7%	22,506	57,946
2049	0.7%	22,666	58,358
2050	0.7%	22,827	58,774
2051	0.7%	22,990	59,192
2052	0.7%	23,154	59,614
2053	0.7%	23,319	60,039
2054	0.7%	23,485	60,467
2055	0.7%	23,653	60,898
2056	0.7%	23,821	61,333
2057	0.7%	23,991	61,770
2058	0.7%	24,162	62,210
2059	0.7%	24,334	62,654
2060	0.7%	**24,488**	63,100



APPENDIX C
Cost Estimates

Tooele City
Projects to Resolve Existing Deficiencies for Wastewater Master Plan
Estimated Cost
Date: 5/13/2022

Project ID	Pipe Diameter (inches)	Pipe Length (feet)	Cost per Foot[1]	Cost	Engineering and Contingency (25%)	Total Project Cost	Inflated Total Project Cost[3]
E-1	10	200	$ 376	$ 75,200	$ 18,800	$ 94,000	$ 120,000
E-2	15	2,100	$ 423	$ 888,300	$ 222,075	$ 1,110,375	$ 1,260,000
E-3	15	2,550	$ 423	$ 1,078,650	$ 269,663	$ 1,348,313	$ 1,520,000
E-4	24	6,500	$ 537	$ 3,490,500	$ 872,625	$ 4,363,125	$ 4,900,000
E-4_Bore[2]	36	115	$ 2,160	$ 248,400	$ 62,100	$ 310,500	$ 360,000
TOTAL		**11,465**	$	5,781,050	$ 1,445,263	**$ 7,226,313**	**$ 8,160,000**

[1] Pipe cost per foot includes pipe material and installation, excavation, dewatering, imported bedding material, hauling off excess native soil, backfill, trench box, manholes, asphalt repair, pavement markings, mobilization, traffic control, materials testing, SWPPP, potholing, surveying, and bypass pumping.

[2] Based on $60/in-ft from SVSD 10400 S Bid.

[3] 12% Inflation from 2020 Dollars to 2022 Dollars.

Tooele City
10-Year Improvement Projects for Wastewater Master Plan
Estimated Cost
Date: 5/13/2022

Project ID	Pipe Diameter (inches)	Pipe Length (feet)	Cost per Foot[1]	Cost	Engineering and Contingency (25%)	Total Project Cost	Inflated Total Project Cost[2]
F-1	36	160	$ 754	$ 120,640	$ 30,160	$ 150,800	$ 180,000
	Headworks structure			$ 65,000	$ 16,250	$ 81,250	$ 110,000
	Bypass pumping			$ 50,000	$ 12,500	$ 62,500	$ 80,000
	Diversion equipment			$ 50,000	$ 12,500	$ 62,500	$ 80,000
TOTAL			$	120,640	$ 71,410	**$ 357,050**	**$ 450,000**

[1] Pipe cost per foot includes pipe material and installation, excavation, dewatering, imported bedding material, hauling off excess native soil, backfill, trench box, manholes, asphalt repair, pavement markings, mobilization, traffic control, materials testing, SWPPP, potholing, surveying.

[2] 12% Inflation from 2020 Dollars to 2022 Dollars.