Tooele City
Est. 1853

DRINKING WATER SYSTEM MASTER PLAN

(HAL Project No.: 149.48.100)

FINAL REPORT

May 2021

HANSEN ALLEN & LUCE INC
ENGINEERS

TOOELE CITY

DRINKING WATER SYSTEM MASTER PLAN

(HAL Project No.: 149.48.100)

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HANSEN ALLEN & LUCE INC
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May 2021

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GLOSSARY OF TECHNICAL TERMS

Average Daily Flow: The average yearly demand volume expressed in a flow rate.

Average Yearly Demand: The volume of water used during an entire year.

Build-out: When the service area reaches the maximum number of equivalent residential connections allowed by planning regulation.

Culinary Water: Water of sufficient quality for human consumption. Also referred to as Drinking or Potable water.

Demand: The water flow rate or volume used by water system customers

Distribution System: The network of pipes, valves and appurtenances contained within a water system.

Drinking Water: Water of sufficient quality for human consumption. Also referred to as culinary or Potable water.

Equivalent Residential Connection (ERC): An ERC is a measure used in comparing water demand from non-residential connections to residential connections. Water use criteria are established based on average demand, use or need by residential connections. This is compared to the same criteria for non-residential uses.

Fire Flow: The flowrate of water supply that is available for firefighting at a residual pressure of 20 psi. Usually it is given in rate of flow (gallons per minute) for a specific period of time (hours).

Head: A measure of the water pressure in a distribution system that is expressed as feet of water. Head represents the height of the free water surface (or pressure reduction valve setting) above any point in the hydraulic system.

Head loss: The amount of pressure lost in a distribution system under dynamic conditions due to friction and other energy losses in the system.

Peak Day: The day of the year in which a maximum amount of water is used in a 24-hour period.

Peak Day Demand: The flowrate required to meet the demand on a water system during the day of highest water consumption during the year.

Peak Instantaneous Demand: The highest flowrate demanded by the water system on a peak day.

Pressure Reducing Valve (PRV): A valve used to reduce pressure in a water distribution system.

Pressure Zone: The area within a distribution system in which water pressure is maintained within specified limits.

Service Area: The geographic area for which the water system provides service or has committed to provide service.

Static Pressure: The water pressure within the system when water is not flowing through the system, i.e., during periods of little or no water use.

Storage Reservoir: A facility used to store, contain and protect Drinking water until it is needed by the customers of a water system. Also referred to as a Storage Tank.

Transmission Pipeline: A pipeline that transfers water from a source to a reservoir or from a reservoir to a distribution system.

ABBREVIATIONS AND UNITS

ac	acre [area]
ac-ft	acre-foot (1 ac-ft = 325,851 gal) [volume]
DIP	Ductile Iron Pipe
EPA	U.S. Environmental Protection Agency
EPANET	EPA hydraulic network modeling software
ERC	Equivalent Residential Connection
ft	foot [length]
ft/s	feet per second [velocity]
gal	gallon [volume]
gpd	gallons per day [flow rate]
gpm	gallons per minute [flow rate]
HAL	Hansen, Allen & Luce, Inc.
hr	hour [time]
IFC	International Fire Code
in.	inch [length]
MG	million gallons [volume]
MGD	million gallons per day [flow rate]
mi	mile [length]
psi	pounds per square inch [pressure]
s	second [time]
SCADA	Supervisory Control And Data Acquisition
yr	year[time]

ACKNOWLEDGMENTS

Successful completion of this study was made possible by the cooperation and assistance of many individuals, including the Mayor of Tooele City, City Council Members, City Staff, and the Tooele Fire Chief as shown below. We sincerely appreciate the cooperation and assistance provided by these individuals.

Tooele City

Mayor

Debbie Winn

City Council

Justin Brady
Melodi Gochis, Chair
Tony Graf
Ed Hansen
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City Staff

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Chris Shubert, Fire Chief

Hansen, Allen & Luce, Inc.

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CHAPTER 1 INTRODUCTION

PURPOSE AND SCOPE

The purpose of this Drinking Water System Master Plan is to evaluate the condition of the existing Tooele City culinary water system, provide recommendations for any needed improvements, and provide direction to Tooele City regarding water infrastructure planning and other water-related decisions that will be made now and in the future. The purpose is also to provide an adequate drinking water system for its customers at a reasonable cost. Recommendations are based on an evaluation and analysis of demand data, growth projections, Utah Division of Drinking Water (DDW) regulation, city zoning ordinances, known and anticipated planned developments, and standard engineering practices. This master plan addresses the time period of existing conditions through approximately the year 2060. Build-out is projected to occur beyond this time period. The service area considered in this master plan is the entire City of Tooele, with an additional limited connection serving the Lincoln community and a few isolated dwellings just outside Tooele City's corporate limit.

The master plan is a study of the City's drinking water system and customer water use. The following topics are addressed: growth projections, source requirements, storage requirements, distribution system requirements, water rights requirements, and energy efficiency recommendations. Based on this study, needed capital improvements have been identified and conceptual-level cost estimates for the recommended improvements have been provided.

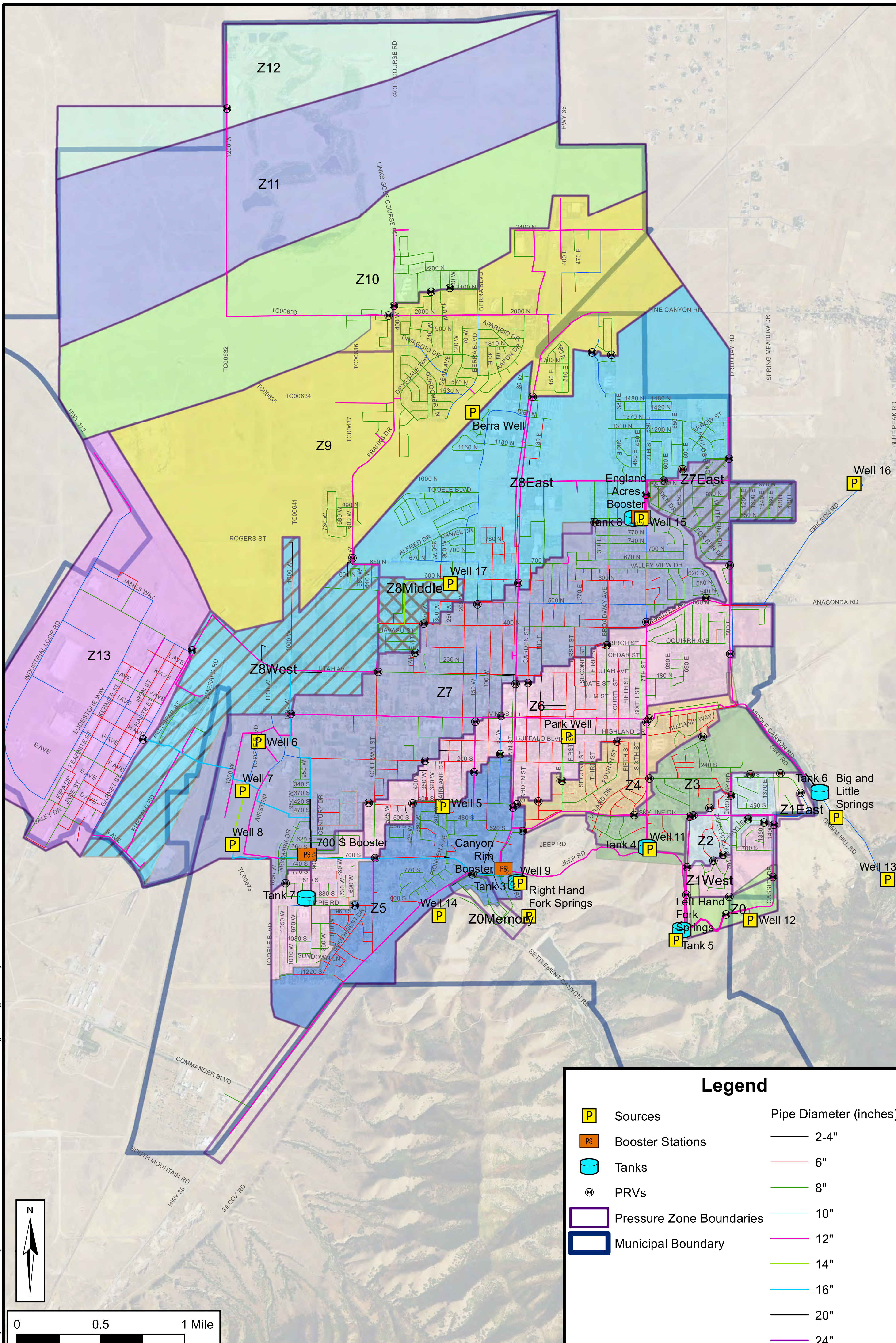
The results of the study are based on the best data available at the time of the analysis, which included data provided by the City and previous work performed by HAL. It is expected that the City will review and update this master plan every 5–10 years or as new information about development, system performance, or water use becomes available. This master plan updates the previous plan completed by Hansen, Allen & Luce, Inc. for Tooele City in April 2012.

BACKGROUND

Tooele City covers an area of approximately 24.0 square miles in the Tooele Valley, located in the foothills of the Oquirrh mountains. The city water system is owned and operated by Tooele City.

Tooele City supplies drinking water for both indoor and outdoor use throughout the service area. There is no active secondary/pressurized irrigation water system for outdoor use in the City. Some dry pipe for pressurized irrigation is located in the Overlake area, but is not in use. An agreement with some residents owning shares of Middle Canyon Irrigation Company water allows them to receive their allotment of secondary water through the City drinking water system, and the City uses the equivalent volume of Middle Canyon Irrigation water for City uses, when available.

A map of the Tooele City water system is provided as **Figure 1-1: Existing Drinking Water System**. This figure illustrates the extent of the Tooele City water system and presents a graphic description of system components and locations. The water system is separated into 13 pressure



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TOOELE CITY
DRINKING WATER MASTER PLAN

EXISTING AND APPROVED
DRINKING WATER SYSTEM

FIGURE
1-1

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zones, which have been labeled numerically from the southeast (higher elevations) to the northwest (lower elevations). The system contains a total of approximately 189 miles of distribution pipe ranging in size from 2 to 20 inches in diameter, not including service laterals.

EXISTING POPULATION AND PROJECTED GROWTH

The Tooele City population is approximately 37,000 as of 2020. Within the city there is a significant amount of developable land, primarily in the north and west parts of the city. Tooele City and State planners expect the population of Tooele City to increase significantly over the next 40 or more years, reaching at least 63,000 by 2060. **Figure 1-2: Tooele Historic and Projected Population** shows the historic and projected population of Tooele City through 2060. Additional detail is shown in Table A-1 in Appendix A. These growth estimates were generated using information from city records, the Tooele 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).

The planning period of this master plan is 40 years (through 2060) which is a typical planning period for water system master planning horizons. Tooele City is expected to have additional growth beyond 2060.

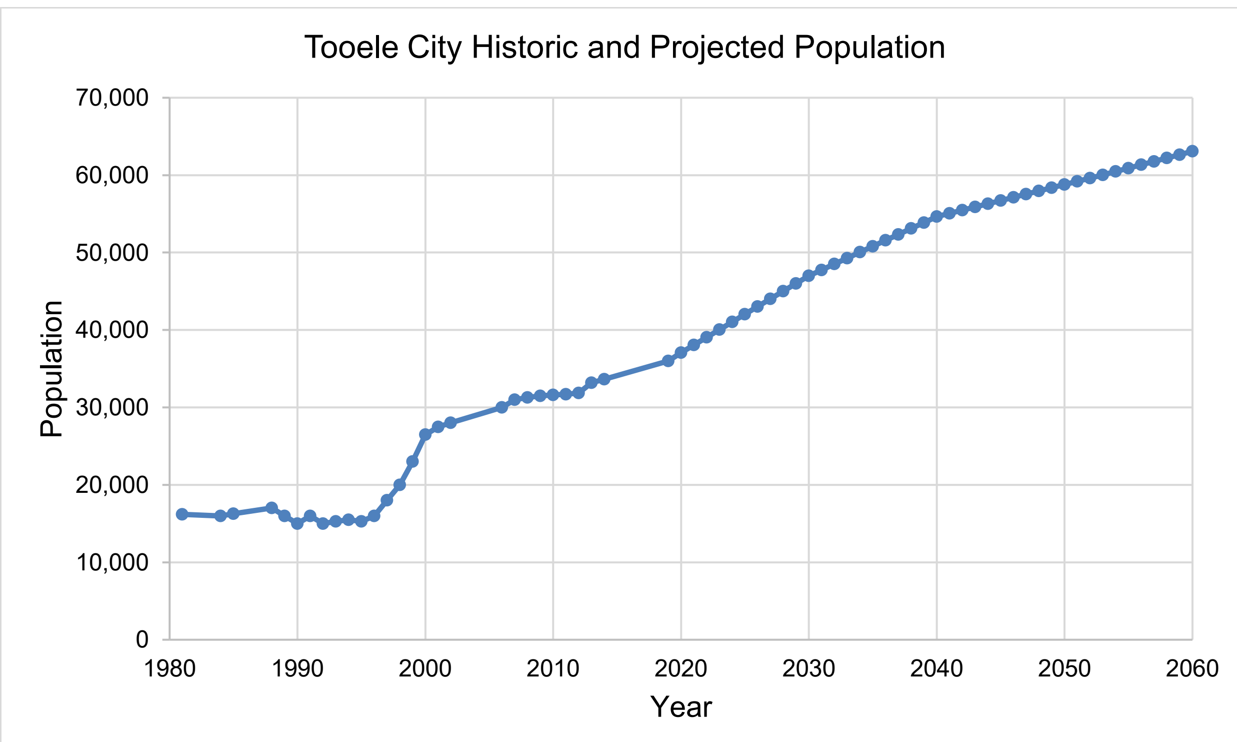


Figure 1-2: Tooele Historic and Projected Population

WATER DEMAND AND MODEL DEVELOPMENT

The Tooele City water system is made up of a variety of components, including wells, pumps/boosters, storage facilities, valves, and pipes. Design and operation of the individual components should be coordinated so that they operate efficiently under a range of demands and conditions. The City water system needs to be capable of responding to daily and seasonal variations in demand, including peak day demand, while concurrently providing adequate capacity for fire-fighting and other emergency needs. Careful planning is required to ensure that the distribution system is capable of meeting the City's needs over the next several decades.

Both present and future needs were evaluated in this master plan. Present water needs were calculated using actual water production data and billing record data provided by Tooele City, according to Utah Division of Drinking Water (DDW) minimum system-specific sizing requirements. These requirements were used to determine a level of service for the system that complies with DDW guidance. Future water demands were predicted using this level of service, the locations and densities of expected growth provided by the City, and the future estimated population growth.

This report follows the DDW requirements of Rule R309-510 ("Facility Design and Operation: Minimum Sizing Requirements") and Rule R309-105 ("Administration: General Responsibilities of Public Water Systems") of the Utah Administrative Code {R309-105 U.A.C., R309-510 U.A.C.}. The report addresses sources, storage, distribution, minimum pressures, hydraulic modeling, capital improvements, funding, and other topics pertinent to Tooele's drinking water system.

To facilitate the analysis of the drinking water system, a computer model of the system was prepared and analyzed. Recommendations for system improvement were prepared based on the results of analyses of the existing and future systems using the updated model. Completing the model was a necessary prerequisite to an accurate update of this master plan.

LEVEL OF SERVICE (LOS)

HAL analyzed production and billing data provided by Tooele City for 2017-2019. Once water production and demand patterns were determined, HAL and City personnel met to establish a level of service (LOS) that is based on this data and incorporates appropriate safety factors. Some existing water customers use Settlement Canyon Irrigation (SCI) water for outside watering. The use of SCI water has reduced the amount of water that the City needs to provide throughout the City. The existing level of service shown in Table 1-1 is an average demand per ERC which is relatively lower due to the SCI water. ERCs are equivalent residential connections (see Glossary of Technical Terms) and are discussed in more detail in the next chapter of this report. Because the SCI water is fully allocated, additional secondary irrigation water source from SCI will not be available for future development in the City. As a result, this offset water volume needs to be accounted for to compute the total level of drinking water service provided by the City for future development. The volume of SCI water used by these customers was estimated, and a revised LOS was computed for future customers that will be unable to use SCI water. A summary of the Existing and Future LOS established for Tooele City is included in Table 1-1. These values are expected to meet the minimum requirements of the DDW.

Table 1-1: System Level of Service

Criteria	Level of Service – Existing Demand*	Level of Service – Future Demand
Average Yearly Demand	0.58 ac-ft/ERC =187,975 gal/ERC	0.61 ac-ft/ERC = 197,930 gal/ERC
Peak Day Demand	1,195 gpd/ERC =0.83 gpm/ERC	1,280 gpd/ERC = 0.89 gpm/ERC
Peak Instantaneous Demand	1.75 Peaking Factor =1.45 gpm/ERC	1.75 Peaking Factor = 1.56 gpm/ERC
Equalization Storage	515 gal/ERC	542 gal/ERC

*Note: The existing levels of service as provided in the 2012 Water Master Plan are 0.85 ac-ft/ERC, 1440 gpd/ERC, 2.0 gpm Peak Instantaneous Demand/ERC, and 690 gallons of storage. The levels of service values in Table 1-1 are a reduction in level of service based on new data.

The future peak day demand LOS (1,280 gpd/ERC) was separated into indoor and outdoor components as shown in Table 1-2. Similarly, the average yearly demand LOS (0.61 ac-ft/ERC) was separated into indoor and outdoor components as shown in Table 1-3. These LOS values are based on an analysis of winter billed usage that was performed to determine the proportion of indoor and outdoor watering.

An analysis was also performed on existing residential lots in the City to determine typical irrigated areas. This analysis identified a typical irrigated acreage of 0.1 acres per ERC. This results in an average outdoor irrigation demand of 3.6 acre-feet of water per irrigated acre. Based on this analysis, 1 ERC is defined as the equivalent of 0.25 acre-feet annual indoor use and 0.36 acre-feet of annual outdoor use.

The values shown in Table 1-2 and Table 1-3 can be used to estimate peak day demand and average yearly demand for varying uses.

Table 1-2 : Peak Day Indoor and Outdoor Demand Level of Service

Indoor Peak Day Demand	245 gpd per ERC
Outdoor Peak Day Demand	1,035 gpd per ERC

Table 1-3 : Average Yearly Indoor and Outdoor Demand Level of Service

Indoor Yearly Usage	0.25 acre-feet per ERC
Outdoor Yearly Usage	0.36 acre-feet per ERC
Typical Acreage Irrigated	0.1 acres per ERC
Outdoor Usage Rate	3.6 acre-feet per irrigated acre

Values shown in Table 1-1, Table 1-2, and Table 1-3 are used for minimum sizing of the drinking water system and are based on three years of annual production data (2017-2019) for existing customers, with a factor for variability. These values represent recent average usage of existing customers of the City drinking water system and may not represent the maximum annual demand that may be experienced over future years by existing customers and new development. Demands for existing customers could change, and new development may use more water than the average usage represented by existing customers.

DESIGN AND PERFORMANCE CRITERIA

Summaries of the key design criteria and demand requirements for the drinking water system are included in Table 1-4. These summaries include the existing scenario, the existing plus approved development scenario, and the 2060 scenario. The design criteria were used in evaluating water system performance and in recommending future improvements. Criteria development is described in later chapters.

Values in tables have been rounded after calculation.

Table 1-4: System Design Criteria

<table>
<tr><th>System Component</th><th>Criteria</th><th>Existing</th><th>Existing + Approved</th><th>Projected 2060</th></tr>
<tr><td>Equivalent Residential Connections</td><td>Calculated from past water use and projected growth</td><td>13,960 ERCs</td><td>15,190 ERCs</td><td>23,760 ERCs</td></tr>
<tr><td>Source
Peak Day Demand
Average Yearly Demand</td><td>
R309-510-7 U.A.C./LOS
R309-510-7 U.A.C./LOS</td><td>
11,600 gpm
8,100 ac-ft</td><td>
12,700 gpm
8,900 ac-ft</td><td>
20,300 gpm
14,100 ac-ft</td></tr>
<tr><td>Storage
Equalization
Emergency
Fire Suppression
Total</td><td>
R309-510-8 U.A.C./LOS
City Preference
IFC/Fire Code Official
</td><td>
7.2 MG
0.6 MG
1.2 MG
9.0 MG</td><td>
7.9 MG
0.6 MG
1.2 MG
9.7 MG</td><td>
12.5 MG
0.6 MG
1.2 MG
14.3 MG</td></tr>
<tr><td>Distribution
Peak Instantaneous</td><td>
1.75x Peak Day Demand</td><td>
20,300 gpm</td><td>
22,200 gpm</td><td>
35,500 gpm</td></tr>
<tr><td>Min. Peak Day Fire Flow
Max. Operating Pressure
Min. Pressure:
Peak Day
Peak Instantaneous</td><td>IFC/ Fire Code Official
City Preference

R309-105-9 U.A.C.
R309-105-9 U.A.C.</td><td colspan="3">1,500 gpm @ 20psi
100 psi

40 psi (after 1/1/2007), 20 psi (before 1/1/2007)
30 psi (after 1/1/2007), 20 psi (before 1/1/2007)</td></tr>
</table>

[1]Fire flow requirements for new buildings are dependent on building size, construction type, and presence of approved sprinkling systems. The Tooele City Fire Official should be consulted during the City review process for new developments and new commercial buildings.

CHAPTER 2 SYSTEM GROWTH

EXISTING CONNECTIONS

According to billing records obtained for years 2017 through 2019, the Tooele City distribution network serves a total of 10,150 connections. This number includes 9,240 residential connections and 910 non-residential connections. Drinking water demands are expressed in terms of equivalent residential connections (ERCs). The use of ERCs is a standard engineering practice to describe all types of water demand by a common unit of measurement. One ERC is equal to the demand of an average residential connection. Non-residential demands are converted to ERCs for planning purposes but are not used in calculating the ERC demand. For example, a commercial building requiring six times as much water as an average residential connection is assigned an ERC of 6. The entire water demand then can be described with a single ERC count.

HAL analyzed Tooele City's water billing data. It was determined that the existing system serves 13,960 ERCs. The City has also committed to serve an additional 1,230 ERCs (which are under construction or approved for construction), for a total of 15,190 existing and approved ERCs. In addition to this number, there are additional commitments for growth in the Overlake area, but these are not included in the 1,230 approved ERCs. The City has an agreement to provide Lincoln Township with 50 gpm during the 6-month growth season when the City is pumping Well 13 (see Chapter 3 for well descriptions). This demand has been included in the calculation of existing ERCs.

Table 2-1: Equivalent Residential Connections (ERCs)

Condition	ERCs
Existing	13,960
Existing and Approved	15,190

The existing 13,960 ERCs are distributed among the customer types shown in Table 2-2.

Table 2-2: Existing ERCs by Customer Type

Customer Type	ERCs
Church	250
Tooele City	310
Commercial	1,470
Construction Water	5
Industrial	320
Livestock	5
Middle Canyon Irrigation	215
Multi-Unit	925
Residential	9,240
Restaurant	185
School	490
Trailer Park	500
Wholesale (Lincoln)	45
Total	**13,960**

FUTURE CONNECTIONS

Future ERCs were calculated based on proposed development and land use planning and zoning maps from the Tooele City Planning Department. Water usage for future non-residential development was based on existing usage for those same development types, as shown in Table 2-3.

Table 2-3: Water Usage of Future Development Types

Development Type	Usage
General/Neighborhood Commercial	4 ERCs per acre
Light Industrial/Industrial	2 ERCs per acre

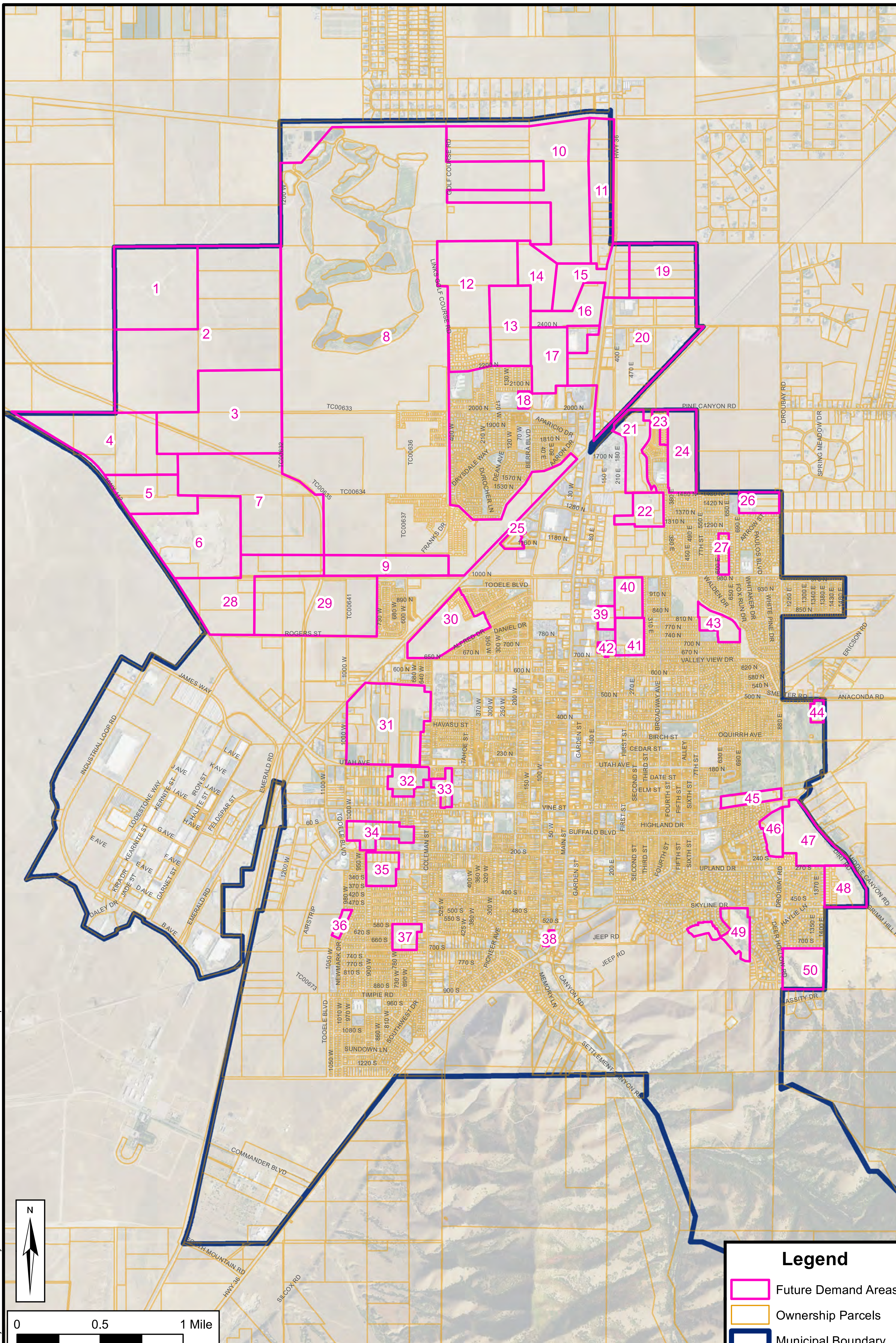
Future ERCs were distributed as shown on **Figure 2-1: Future Demand Areas** and Table 2-4. Estimated timing of development is included in the table. This master plan report addresses development through 2060 at the locations and densities shown. Additional development is likely to occur beyond 2060 based on population growth, available land for development, and regional economic trends.

Table 2-4: Future ERCs by Development Location

Area	Land Use Type	Acres	Maximum Density Unit/ Acre*	ERCs	Estimated Development Timing of ERCs			
					2020-2030	2030-2040	2040-2060	After 2060
1	Light Industrial (LI)	57	2	114	0	0	0	114
2	Light Industrial (LI)	133	2	266	0	0	0	266
3	Industrial (I)	69	2	137	0	0	0	137
4	General Commercial	58	4	231	0	0	0	231
5	Light Industrial (LI)	19	2	38	0	0	0	38
6	Industrial (I)	48	2	95	0	0	0	95
7	Light Industrial (LI)	86	2	171	0	0	0	171
8	Residential (R1-7)	1,774	5	4,320	954	905	1,500	961
9	Neighborhood	39	4	156	74	47	35	0
10	Residential (R1-7)	200	5	1,000	477	298	225	0
11	General Commercial	89	4	356	170	106	80	0
12	Residential (R1-10)	162	3.5	567	270	169	128	0
13	Residential (R1-10)	69	3.5	241	115	72	54	0
14	Residential (R1-10)	34	3.5	119	57	35	27	0
15	General Commercial	53	4	212	0	115	97	0
16	General Commercial	55	4	220	0	120	100	0
17	High School	51	1	51	51	0	0	0
18	Residential (MR-8)	6	8	48	0	0	17	31
19	Residential (MR-8)	87	8	696	50	50	207	389
20	General Commercial	227	4	908	50	50	280	528
21	Residential (MR-16)	48	16	768	366	402	0	0
22	Residential (R1-8)	27	4	108	52	56	0	0
23	Residential	9	3.7	33	16	17	0	0
24	Residential	58	5.2	300	72	228	0	0
25	Residential	12	16.6	199	0	0	69	130
26	Residential	20	3.2	63	0	0	63	0
27	Residential	10	2.3	23	23	0	0	0
28	Gen Comm (GC)/ Ind (I)	125	4	500	0	50	0	450
29	Residential (MR-8)	166	4	664	100	0	0	564
30	Residential	68	4.2	283	135	148	0	0
31	Residential	142	2.6	375	0	0	130	245
32	Residential	22	2.6	57	0	0	20	37
33	Residential	11	3.2	35	0	0	12	23
34	Residential	30	3.2	95	0	0	33	62

Area	Land Use Type	Acres	Maximum Density Unit/ Acre*	ERCs	Estimated Development Timing of ERCs			
					2020-2030	2030-2040	2040-2060	After 2060
35	Residential	24	2.5	60	0	0	15	45
36	Residential	6	14	84	84	0	0	0
37	Residential	15	4.1	61	61	0	0	0
38	Residential (MR-16)	4	16	64	64	0	0	0
39	Residential	8	16.5	132	0	0	0	132
40	Residential	27	5.0	136	136	0	0	0
41	Residential	26	4.2	110	110	0	0	0
42	Residential	5	8.8	44	0	0	0	44
43	Residential	22	4.0	87	87	0	0	0
44	Residential	6	2.2	13	13	0	0	0
45	Residential	12	5.2	62	62	0	0	0
46	Residential	21	1.4	30	0	30	0	0
47	Residential (R1-14)	53	2.5	133	0	0	75	58
48	Residential	35	1.9	66	66	0	0	0
49	Residential	40	2.7	108	108	0	0	0
50	Residential	42	2.2	89	0	0	0	89
Total		4,409	3.34 (avg.)	14,728	3,823	2,898	3,172	4,833

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



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TOOELE CITY
DRINKING WATER MASTER PLAN

FUTURE DEMAND AREAS

FIGURE
2-1

CHAPTER 3 WATER SOURCES

EXISTING WATER SOURCES

Tooele City operates 12 active wells. The City also receives water from four springs. Additionally, the City uses water from Middle Canyon Irrigation Company, and water from Settlement Canyon Irrigation Company. The sources are shown on Figure 1-1: Existing Drinking Water System and are briefly described in Table 3-1.

Capacity for the City's water sources is included in Table 3-1. The table shows nominal capacity, which is the capacity each source was designed to provide, or actually provided in the past. The table also shows reliable capacity. For wells, this is based on SCADA records during peak week conditions. For springs, this is based on the 25th percentile flow for all years of data on record (1989-2019). The City is not guaranteed to receive water from Middle Canyon Irrigation Company and Settlement Canyon Irrigation Company, so the reliable capacity of these sources is considered to be zero. The table also shows the largest annual volume produced for each source during 2017-2019.

Table 3-1: Existing Drinking Water Sources

Source	Location	Supplies	Nominal Capacity (gpm)	Reliable Capacity (gpm)	2017-2019 Highest Annual Production (acre-feet)
Wells					
Well 1	Middle Canyon Angel's Grove	Permanently out of service	n/a		
Well 2					
Well 3					
Well 4					
Well 5	400 S 300 W	Zone 5 Tank 3	500	270	150
Well 6	East of 1200 W 150 S	Tank 7	1,000	625	190
Well 7	East of 1200 W 275 S		1,000	1,180	660
Well 8	East of 1200 W 450 S		900	880	820
Well 9	Mouth of Settlement Canyon	Tank 3	1,200	1,300	1,240

Source	Location	Supplies	Nominal Capacity (gpm)	Reliable Capacity (gpm)	2017-2019 Highest Annual Production (acre-feet)
Well 10	Settlement Canyon	Permanently out of service	n/a		
Well 11 Pendleton	South of Mountaineer Drive	Tank 4	1,400	910	380
Well 12 Cassity	1400 East, south of Skyline Drive	Tank 5	2,000	1,300	610
Well 13 Devil's Kitchen	Middle Canyon	Tank 6	1,200	1,330	920
Well 14 Anderson	900 South SR-36	Tank 3	750	850	960
Well 15 England Acres	840 N 520 E	Tank 8 Zone 8E	1,200	930	780
Well 16 Kennecott B	Ericson Road	Zone 6 Tank 6	1,100	960	380
Well 17 Rodeo	240 W 500 N	Zone 8 Tank 7	750	775	820
Total Well Sources			**13,000**	**11,310**	**7,900**
Springs					
Left Hand Fork Spring[1,3]	Settlement Canyon	Tank 5	550	420	1,410
Right Hand Fork Spring[2,3]	Settlement Canyon	Tank 3	0	0	984
Small Springs[4]	Middle Canyon	Tank 6	25	0	170
Big Springs[4]	Middle Canyon	Tank 6	25	0	
Total Spring Sources			**600**	**420**	**1,580**
Irrigation Company Sources					
Middle Canyon		Tank 6	n/a	n/a	0
Settlement Canyon		Tank 3 Tank 5	n/a	n/a	984

Source	Location	Supplies	Nominal Capacity (gpm)	Reliable Capacity (gpm)	2017-2019 Highest Annual Production (acre-feet)
Total Irrigation Company Sources			n/a	n/a	984
Total Sources			**13,600 gpm**	**11,730 gpm**	**9,980 acre feet**

1 – Tooele City is allotted 2.417 acre-feet per day from Left Hand Fork Spring based on an agreement with the Settlement Canyon Irrigation Company. Water used over the allotment is purchased.
2 – Purchased from the Settlement Canyon Irrigation Company but is not always available.
3 – Water from Settlement Canyon Irrigation Company is used to irrigate the City cemetery, Red DelPapa Park, Dow James Park, and Tooele City Park (at Pratt Aquatic Center).
4 – Water exchanged with Middle Canyon Irrigation Company is used to irrigate the Oquirrh Hills Golf Course and Elton Park.

Wastewater Treatment Plant Re-Use water is used to irrigate the Links at Overlake Golf Course. This source, and the demand for the golf course, are both excluded from this master plan analysis.

The City has an agreement to provide Lincoln Township with water at a rate of 50 gpm during the 6-month growing season, when Well 13 is being pumped, resulting in a maximum of approximately 40 acre-feet per year provided to Lincoln.

PRESSURE ZONES

The existing water system is shown on **Figure 1-1: Existing Drinking Water System**. As shown in the figure, the pressure zones are numbered starting in the highest elevation area of the city in the southeast. Zone numbering generally increases to the northwest. There are PRVs at all zone boundaries, allowing lower elevation zones (higher zone number) to be supplied from higher elevation zones (lower zone number). Table 3-2 is a summary of the pressure zones, including which sources and PRVs are typically used to supply each zone.

Table 3-2: Pressure Zones

Zone	Supplied by			Supplies
	Tank	Sources	PRVs From	PRVs to
Zone 0	Tank 5	Well 12 Left Hand Fork Springs	-	Zone 1
Zone 1	-	-	Zone 0	Zone 2
Zone 2	-	-	Zone 1	Zone 3
Zone 3	-	-	Zone 2	Zone 4
Zone 4	Tank 4	Well 11	Zone 3	Zone 6
Zone 5	Tank 3	Well 5 Well 9 Well 14 Right Hand Fork Springs	None	Zone 4 Zone 6
Zone 6	Tank 6	Well 13 Well 16 Big Springs Small Springs	Zone 4 Zone 5	Zone 7
Zone 7	-	-	Zone 6	Zone 8
Zone 8 West	Tank 7	Well 6 Well 7 Well 8 Well 17	Zone 7	Zone 9
Zone 8 Middle[1]	-	-	Zone 7	-
Zone 8 East	Tank 8	Well 15	Zone 7	Zone 9
Zone 9	-	-	Zone 8W, 8E	Zone 10
Zone 10	-	-	Zone 9	Zone 12
Zone 11	Placeholder; a separate zone currently does not exist. Will be supplied by PRVs from Zone 10			
Zone 12	-	-	Zone 10	-
Zone 13	-	-	Zone 8W	-

1 – Zone 8 Middle is a small isolated area supplied by one PRV from Zone 7.

BOOSTER STATIONS

The 700 South, Canyon Rim, and Skyline booster stations allow water to be moved from lower elevation zones to higher elevation zones. The England Acres booster pumps water from a below ground tank into the distribution system. The boosters are described in Table 3-3.

Table 3-3: Booster Stations

Booster	Capacity	Pumps		Notes
		From	To	
700 South	2,000 gpm	Tank 7	Tank 3 (Zone 5)	Allows water from Wells 6, 7, 8, & Rodeo to be used in Zone 5 and lower zones. The booster is used regularly because there is currently excess capacity in these wells and additional need in zones served by Tank 3.
Canyon Rim	1,500 gpm	Tank 3	Tank 5	Allows water from Tank 3 (Zone 5) to be used in all other zones in the City.
Skyline	1,500 gpm	Tank 3	Tank 4 (Zone 4)	Not currently in use.
England Acres	2,500 gpm	Tank 8	Zone 8 East	Pumps water from below-ground Tank 8 into distribution system.

EXISTING SOURCE WATER REQUIREMENTS

According to DDW standards {R309-510-7 U.A.C.}, water sources must be able to meet the expected water demand for two conditions. First, sources must be able to provide an adequate supply of water for the 24-hour peak day demand (flow requirement). Second, sources must be able to produce a one-year supply of water, or the average yearly demand (volume requirement).

Peak day and average yearly demand are calculated using the level of service criteria shown in Table 1-1 by computing the demand from water use data, including a factor of safety for variance {R309-510-7(2) U.A.C.}.

The level of service selected is based on the DDW standard, requiring minimum source and storage sizing to be based on system-specific analysis of three years of usage data. Because the DDW may recompute the requirements in the future, these values may vary from the values shown, but are not expected to increase significantly.

Existing Peak Day Demand

Peak day demand is the water demand on the day of the year with the highest water use. It is used to determine required source capacity under existing and future conditions. Based on the requirements shown in Table 1-1, the total peak day drinking water demand for the existing condition, and the existing condition *plus* all approved development are shown in Table 3-4.

Table 3-4: Existing Peak Day Demand

Development Level	ERCs	Peak Day Demand per ERC (gpm/ERC)	Total Peak Day Demand (gpm)
Existing	13,960	0.83	11,600
Approved	1,230	0.89	1,100
Existing + Approved	15,190	0.83-0.89	12,700

The existing reliable source capacity in the system is 11,730 gpm. At the existing level of development, the system barely has sufficient source to meet this requirement, and there is no redundancy in the system. During periods of time during a typical summer, at least one City well is down for maintenance. With all approved development considered, there is a deficiency of about 970 gpm in the system. If any approved development is constructed or if a City well is unavailable during peak times, the system will not have sufficient source capacity to meet this requirement and areas in the City may see reduced pressures, or the City may need to implement water restrictions.

The City may wish to evaluate the source supply with the largest source unavailable. The largest source in the City is Well 13 (Devil's Kitchen), with a capacity of 1,330 gpm. With the largest source unavailable, the reliable capacity in the system is 10,400 gpm, and the deficiency in the system is approximately 2,300 gpm. Two wells are currently being developed that will be used to mitigate this deficiency and provide redundancy in the system.

Existing Average Yearly Demand

Average yearly demand is the volume of water used during an entire year and is used to ensure the sources can supply enough volume to meet demand under existing conditions. Based on the requirements provided in Table 1-1, the required total average yearly demand for existing and approved development is 8,900 acre-feet. See Table 3-5.

Table 3-5: Existing Average Yearly Source Demand

Existing + Approved ERCs	Average Yearly Demand (ac-ft/ERC)	Total Average Yearly Demand (ac-ft)
15,190	0.58-0.61	8,900

The City's existing sources are capable of providing this volume of water on an annual basis. The City owns sufficient water rights to meet this requirement; however, not all these water rights are associated with developed drinking water sources.

FUTURE SOURCE WATER REQUIREMENTS

Future water source requirements were evaluated based on the same criteria as existing water source requirements. To summarize, this includes the following:

1) Sufficient water source capacity is needed to meet peak day flow.
2) Water sources must also be capable of supplying the average yearly demand.
3) Consider the source capacity available to supply the system even if a well is unavailable.
4) Peak day and average yearly demand are calculated using the level of service criteria shown in Table 1-1 of this report {R309-510-7(2) U.A.C.}.
5) The level of service selected is based on the current DDW standard. Future DDW standards may vary from year to year.

As discussed in Chapter 2 of this report, this master plan covers the planning period through 2060, when the City is projected to reach 23,760 ERCs. Development in and adjacent to the City is likely to occur beyond 2060, and beyond the number of ERCs included in the planning period for this analysis.

Future Peak Day Demand

Following the methodology described for existing conditions and estimating 23,760 ERCs in 2060, the peak day source requirement is projected to be 20,300 gpm (29.2 MGD), as shown in Table 3-6.

Table 3-6: 2060 Peak Day Demand

ERCs	Peak Day Demand (gpm/ERC)	Total Peak Day Demand (gpm)
23,760	0.83-0.89	20,300

Under 2060 conditions, there is a projected source capacity deficiency of **8,600 gpm** based on the capacity of the existing sources. This deficiency does not consider the ability to provide redundancy if one of the City's wells is unavailable. Because some of the future sources discussed below are projected to have larger capacities, the recommended redundancy for 2060 conditions is 2,000 gpm.

Future Sources

Several potential sources have been identified to meet future demands. These sources have been discussed in greater detail in past master plans and other analyses and are briefly described below. Projects required to utilize these sources include well development, well houses, treatment facilities, booster pumps, equalization storage tanks, and transmission pipelines. Water rights will need to be procured for some of the projects.

Park Well

The City is developing the Park Well, located in Zone 6 at the Red DelPapa Memorial Park (70 South First Street). It is estimated the well will produce 1,000 gpm, with an annual production of 1,000 acre-feet. It is recommended the well serve Zone 7 directly. Construction of a well house and piping is required to complete the project.

Berra Well

The City is developing the Berra Well, located in Zone 9 west of the railroad tracks and east of Berra Boulevard, at approximately 1300 North. It is estimated the well will produce 1,000 gpm, with an annual production of 1,000 acre-feet. It is recommended the well be pumped to serve Zone 9. Construction of a well house and connecting piping is required to complete the project. An equalization storage tank and booster station is recommended, with a booster out of the tank serving Zone 9, with a backup pump to serve Zone 8.

East Water Sources

Tooele City has entered a water development agreement with Kennecott Utah Copper. Kennecott water rights may be used to support growth in the City. Approximate locations for well sites identified as ‘East A’ and ‘East C’ are located in eastern portions of the Tooele Valley.

East A Well

It is estimated the well will produce 1,000 gpm, with an annual production of 1,000 acre-feet. It is recommended the well serve Zone 9. A treatment facility will likely be required to mitigate water quality issues. The City owns land for a well site but does not yet have an easement for necessary transmission lines.

East C Well

It is estimated the well will produce 1,000 gpm, with an annual production of 1,000 acre-feet. It is recommended the well serve Zone 8. The City does not own land for a well site.

West A Wells

Tooele City owns water rights in western Tooele Valley. At least one well is proposed to develop these water rights. It is estimated that one or more well sites may produce up to 1,000 gpm each, with an annual production of 800 acre-feet based on the City’s current water right in the area. It is recommended that the sources be pumped to a storage tank near Tooele City, and that the sources serve Zone 10. A booster pump will be required to deliver water from the tank to the City.

Southern Water Sources

Several sources of water exist or may be developed in the southern Tooele Valley or in Rush Valley, as far as 35 miles away from the municipal boundary of Tooele City. Transmission pipelines to bring this water to the City will require large investments and ongoing operations and maintenance. It is recommended these sources be pumped to an equalization storage tank in the southwestern part of the City. The tank can likely be placed at a high enough elevation in the foothills that no booster out of the tank will be required. The potential southern water sources include the following:

West B Source

It may be possible to develop new sources in the southwestern region of the Tooele Valley. It is assumed that two wells would be constructed, and 1,000 gpm may be produced at each, with a total annual production of 1,000 acre-feet. Tooele City does not own water rights at this location and would need to procure or transfer them to this location, in addition to procuring well sites and transmission line easements.

Honerine Mine Source

The City owns water rights at the Honerine Mine. It is anticipated a well would provide 1,000 gpm, with an annual production of 1,000 acre-feet. The City owns 444.5 acre-feet of water rights at this location, but additional water rights may be able to be transferred here. While it may be possible to access water directly from the mine workings, it is expected that this would require significant cost to access the site and treat the water. It may be more practical to transfer the water rights to a nearby location and drill a new well. It is recommended that the Utah Division of Water Rights be consulted when the City is ready to pursue this water source.

South A

The City owns water rights near South Mountain (northwest of Stockton, Utah). It is anticipated a well could be constructed and produce 1,000 gpm, with an annual production of 1,000 acre-feet. The City owns 346.7 acre-feet of water rights in this area, and additional water rights could possibly be transferred here.

Barrick Wells

The City owns 1,229.4 acre-feet of water rights and 3 wells with well houses near Ophir, Utah. It is anticipated these wells will provide a total of 2,000 gpm, with an annual production of 1,229 acre-feet. The wells may need to be re-equipped to produce the desired flows and pressures. Transmission line easements will need to be acquired, possibly as well as one or more booster pump locations.

Vernon Wells

Tooele City owns water rights near Vernon, Utah. The design flowrate for these wells is 4,000 gpm, with an annual production of 2,060 acre-feet. These wells are located 35 miles from the City. Transmission line easements will need to be acquired, possibly as well as one or more booster pump locations.

Sources Outside Tooele Valley and Rush Valley

For development beyond 2060, Tooele City will require sources of water from outside Tooele Valley or Rush Valley. There have been feasibility level discussions about receiving water from Salt Lake City, Jordan Valley Water Conservancy District, or other sources if identified. Tooele City may consider discussions with these groups to determine if water may become available for sale to Tooele City.

Local Partnerships
It may be possible to obtain water through partnerships with Grantsville City, Stansbury Park Improvement District, Tooele County, or other local water suppliers. Wells, along with the associated well houses, pump stations, and transmission projects, can take several years to permit, design, and construct, and the process must begin earlier than the date each source is projected to be required. It is recommended that Tooele City consider pursuing additional sources of water as soon as possible.

Table 3-7 shows the projected source capacities for existing and future Tooele sources. Estimated timing for each source is based on the number of ERCs served as predicted by the population projections. The approximate number of ERCs triggering the need for each source and the approximate year the City is expected to reach this level of growth are shown in the table. Redundancy is included when considering the timing for sources after 2020. Redundancy of 1,500-2,000 gpm is projected to be available in the system through 2060 if all existing sources continue to produce their reliable flows, and if all other sources are constructed and supply the projected flow rates at the timing shown in the table.

Table 3-7: Future Drinking Water Sources

Source	Approximate Year Required	ERCs Triggering Need for Source	Estimated Flow (gpm)	Estimated Annual Production Capacity (ac-ft)
Existing Wells	-	-	11,310	7900[1]
Existing Springs	-	-	420	340[2]
Park Well	2020	14,000	1,000	1,000
Berra Well	2020	14,000	1,000	1,000
East A Well	2023	14,900	1,000	1,000
East C Well	2025	15,800	1,000	1,000
West A Wells	2028	16,900	1,000	800
Honerine Mine Well	2032	18,100	1,000	445
West B Wells	2036	19,200	2,000	1,000
South A Well	2042	20,900	1,000	1,000
Barrick Wells	2050	22,000	2,000	1,000
Vernon Wells	>2060	24,200	4,000	2,060
Total			**26,730**	**18,545**

Source	Approximate Year Required	ERCs Triggering Need for Source	Estimated Flow (gpm)	Estimated Annual Production Capacity (ac-ft)
Demand			**20,300 + 2,000 redundancy = 22,300**	**14,100**
Excess			**4,430 gpm**	**4,445 acre-feet**

1 – Production capacity for the existing wells was based on summing the highest annual production of each well during the highest of the last 3 years. The actual ultimate capacity of the wells is higher.
2 – Production capacity for the springs was based on flowing the reliable volume for 6 months out of the year.

Table 3-7 shows that if all sources can be developed as planned, the system will have an excess of over 4,000 gpm if the Vernon wells are added to the system shortly after 2060. This demonstrates that the 4,000 gpm flow capacity of the Vernon wells would not be required at that time, but the first well could be brought online, and development of additional wells could take place in phases.

Transmission from Vernon to the City is a major project and planning for it should begin early to ensure water is available when needed. Development may occur more quickly than projected in this analysis, and the source could be needed sooner than anticipated. It is critical to note that if any of the other recommended sources are not available or not able to be developed to the extent projected, the Vernon wells will need to be developed and brought into service sooner. The order of source development included in Table 3-6 is based on proximity to the City. However, as the City pursues additional source development, the order of source development may change.

Older wells can reduce production or stop producing over time due to a variety of reasons including biofouling and chemical encrusting. If any existing City wells or springs reduce or stop production and cannot be successfully redeveloped, this may require other sources to be constructed sooner than projected. If several sources reduce or stop production, or several new sources are not able to be developed, sources from outside Tooele Valley and Rush Valley could be required to support development sooner than 2060.

Recommended source projects are shown in Table 3-8 and projects within the City are shown on **Figure 7-1: Recommended Capital Facility Projects**. Equalization tanks associated with these sources are discussed in Chapter 4 of this report. Transmission projects and pump stations required to convey the new sources to and through the City are discussed in Chapter 5 of this report. In the Capital Facility Plan in Chapter 7 of this report, the source projects are grouped together with the associated tanks, transmission, and pump stations.

Table 3-8: Drinking Water Source Projects, 2020 Through 2060

Project Number and Location		Year
	Park Well	
44	Complete Development and Well House	2021
	Berra Well	
46	Complete Development and Well House	2021
	East A Well	
53	East A Well and Well House	2023
54	East A Arsenic Treatment Plant	2023
	East C Well	
56	East C Well and Well House	2025
	West A Wells	
58	West A Wells and Well Houses	2028
	South Water Sources	
62	Honerine Mine Well and Well House	2032
78	West B Well(s) and Well House(s)	2036
80	South A Well and Well House	2042
83	Barrick Wells Refurbishment	2050
86	Vernon Wells and Well Houses	>2060
87	Vernon Arsenic Treatment Plant	>2060

Future Average Yearly Demand

Following the methodology described for existing conditions and estimating 23,760 ERCs in 2060, the average yearly source requirement is projected to be 14,100 ac-ft, as shown in Table 3-9. This demand is used to determine the physical sufficiency of the City's sources to provide water on an annual basis in accordance with the Utah Division of Drinking Water minimum sizing requirements.

Table 3-9: 2060 Average Yearly Source Demand

ERCs	Average Yearly Demand (ac-ft/ ERC)	Total Average Yearly Demand (ac-ft)
23,760	0.58-0.61	14,100

FUTURE WATER RIGHTS

As the City continues to grow, they will need to track water rights owned compared to water rights required by existing and future development. In addition to the water rights required by the 23,760 ERCs projected by 2060, the City should have sufficient water rights to irrigate 157 acres of City properties currently irrigated by the Settlement Canyon Irrigation Company and Middle Canyon Irrigation Company, including Elton Park (11 acres), Dow James Park (12 acres), Red DelPapa Park (5 acres), the City cemetery (21 acres), and Oquirrh Hills Golf Course (108 acres). Additionally, it is assumed that the existing 28 acres of parks will grow proportionally with population to maintain the parks level of service, and this additional park acreage will need to be accounted for in the water rights requirement.

As the City evaluates the needed water right volume to be conveyed to the City for development, they should keep in mind that the Utah Division of Water Rights has indicated that they currently require 100% depletion for all indoor use in the City due to the City's use of a full use reclamation facility. This is a higher rate of depletion than would be required if the City operated a traditional sewer treatment plant. Therefore, the City may need to obtain a relatively greater volume of water rights, based upon the original use of the conveyed rights, in order to account for the 100% depletion requirement. Outdoor usage in the City assumes 55% depletion, as is typical in other communities.

Similar to other components of the water system, water rights should have redundancy. The City anticipates that future development of the full water right holdings may be limited due to limitations in aquifer yield, well interference, and seasonal fluctuations of both the surface and groundwater resources. Water rights conveyed to the City may not be available to be developed at all or may not be capable of being proofed at the volumes and flow rates conveyed to the City. Moreover, the City may need additional rights in case the State Engineer reduces flow or volumetric limitations or prohibits change applications moving water rights. Therefore, the City needs to plan on obtaining additional water rights as development occurs so that the City will have the necessary water rights to meet the needs to future development.

SUMMARY OF WATER SOURCES AND WATER RIGHTS RECOMMENDATIONS

The City should continue to maximize use of the existing City wells and complete construction of the Park Well and Berra Well and associated transmission facilities. It is recommended that the City continue to pursue development of additional water sources. It is recommended that the City continue to obtain water rights as needed that can be used at the recommended source sites, or that can be exchanged for water rights at these sites.

CHAPTER 4 WATER STORAGE

EXISTING WATER STORAGE

The City's existing drinking water system includes six storage facilities with a total capacity of **14.2 MG**. Tank locations are shown on **Figure 1-1: Existing Drinking Water System**. Table 4-1 presents a listing of the names and select attributes of the City water storage tanks. Tank elevations are based on previous data and aerial contours provided by the City. Prior to completing any projects related to tanks, it is recommended that the City complete a land survey to verify elevations.

Table 4-1: Existing Storage Tanks

Tank Name	Diam. (ft)	Calculated Volume (MG)	Base/ Outlet Elevation	Emergency Storage Volume (gallons)	Fire Suppression Volume (gallons)	Minimum Level (Elevation) of Equalization Volume	Overflow Level (Elevation)
3	168	3.3	5279.2	100,000	960,000	6.4 (5285.6)	21.8 (5301.0)
4	132	2.0	5363.0	100,000		1.0 (5364.0)	19 (5382.0)
5	148	2.6	5854.0	100,000	180,000	2.2 (5856.2)	20 (5874.0)
6	159	2.7	5302.4	100,000		0.7 (5303.0)	18 (5320.4)
7	154	2.5	5030.4	100,000		0.7 (5031.1)	18 (5048.4)
8	100	1.1	4925.0	100,000		1.7 (4926.7)	18 (4943.0)
Total		**14.2**		**600,000**	**1,140,000**		

EXISTING WATER STORAGE REQUIREMENTS

According to DDW standards outlined in R309-510-8 U.A.C., storage tanks must be able to provide: 1) equalization storage volume to make up the difference between source and demand; 2) fire suppression storage to supply water for firefighting; and 3) emergency storage. Each of the requirements is addressed below.

Equalization Storage

As shown in Table 1-1, Tooele City has planned for an updated existing level of service of 515 gallons equalization storage per ERC and a future level of service of 542 gallons equalization storage per ERC. With 15,190 existing and approved ERCs, the City needs 7.9 MG of equalization storage in its drinking water system. This level of storage has been revised based on new data. Prior to this master plan, the level of service was 690 gallons/ERC.

Fire Suppression Storage

Fire suppression storage is required for water systems that provide water for firefighting {R309-510-8(3) U.A.C.}. HAL has consulted with the local fire authority to determine the requirements for fire suppression storage. The contact information for the Tooele City fire code official is as follows:

Fire Code Official:	Chris Shubert, Tooele City Fire Chief
Phone:	(435) 843-2200
Email:	tooelefirechief@gmail.com

The Tooele City Fire Official indicated that the typical minimum fire flow requirement is 1,500 gpm for 2 hours, however there are exceptions for some residences. Larger structures may require larger fire flows when determined by the fire official. The largest fire flow requirements for each zone are shown in Table 4-2.

Table 4-2: Existing Fire Suppression Requirements

Zone	Largest Building Type	Fire Flow Requirement		Fire Suppression Volume (MG)	Provided in Tank
		Flow (gpm)	Duration (hours)		
0-4	Residential	1,500	2	0.18	5
5-13	Non-Residential	4,000	4	0.96	3
Total				**1.14**	

The water system should be managed so that the storage volume dedicated to fire suppression is available to meet fire flow requirements as needed. This can be accomplished by designating minimum storage tank water levels that provide a reserve storage equal to the fire suppression storage required. Even though it is important to utilize equalization storage, typical daily water fluctuations in the tanks should not be allowed below the minimum established levels, except during fire or emergency situations. All fire storage volume for the City can be provided by Tank 3 and Tank 5. Tank 5 can provide water to all areas of the City except Zone 5. Tank 3 can provide water to Zones 5 through 13. Only residential buildings and possibly smaller businesses are located in Zones 0 through 4. A fire storage volume of 180,000 gallons should be reserved in Tank 5 to supply fire flow for Zones 0 through 4. A fire storage volume of 960,000 gallons should be reserved in Tank 3 to supply fire flow for Zones 5 through 13. The minimum levels for fire and emergency storage are shown in Table 4-1. During an actual fire, water will be pulled from tanks throughout the City as available, and the source normally provided to those areas from the tanks can be provided to customers from Tanks 3 and 5.

Emergency Storage

DDW standards suggest that emergency storage be considered in the sizing of storage facilities. Emergency storage is intended to provide a safety factor that can be used in the case of unexpectedly high demands, pipeline failures, equipment failures, electrical power outages, water supply contamination, or natural disasters. During planning meetings with Tooele City engineering and public works staff, a discussion was held to discuss emergency storage. The engineering and public works staff selected a standard of 100,000 gallons of emergency storage in each tank, for a total emergency storage level of service of 600,000 gallons, based on their experience operating the system.

Total Storage

A summary of existing storage requirements is included in Table 4-3.

Table 4-3: Existing and Approved Storage Requirements

ERCs	Storage Requirements (MG)				Existing Storage (MG)	Remaining (MG)
	Equalization	Fire Suppression	Emergency	Total		
15,190	7.86	1.14	0.60	9.60	14.2	4.7

Based on the requirements shown, the existing storage meets existing requirements.

FUTURE WATER STORAGE REQUIREMENTS

Storage requirements through the 2060 planning period were assessed using the same methodology as outlined for existing conditions.

Equalization Storage

Following the methodology described for existing conditions and calculating 23,760 ERCs in 2060, the projected equalization storage requirement per the standards shown in Table 1-1 is 12.5 MG.

Fire Suppression Storage

Fire suppression storage is assumed to remain similar to current conditions, as shown in Table 4-2. Some buildings may require approved sprinkling systems to reduce their fire flow requirement to the flow rates available. All new buildings should be constructed to meet these requirements as required by adopted building codes.

Emergency Storage

The same emergency volume of 0.6 MG was maintained for future conditions.

Total Storage

A summary of storage requirements for 2060 is included in Table 4-4.

Table 4-4: 2060 Storage Requirements

ERCs	Recommended Storage Requirements (MG)				Existing Storage (MG)	Deficit (MG)
	Equalization	Fire Suppression	Emergency	Total		
23,760	12.50	1.14	0.60	14.24	14.2	0.1

A nominal 0.1 million gallons storage is required to meet 2060 requirements. However, equalization storage tanks are recommended to facilitate operation of the Berra well, West A wells, and all sources south of the City (West B, Barrick, Honerine, and Vernon wells). Additionally, a storage tank may be required for the East A well to facilitate water quality treatment. A summer base flow of at least 2,000 gpm is anticipated for Zones 9-12, which may allow one or two of the wells (for example, East A and East C) to flow into the system without an equalization storage tank. Equalization storage tank sizes are based on providing capacity for half the daily flow of the associated source, as shown in Table 4-5. As discussed, all the tanks shown in Table 4-5 may not be required.

Table 4-5: Future Equalization Storage Tank Capacity

Source	Approximate Year Required	Estimated Flow (gpm)	Typical Equalization Tank Volume (MG)
Berra Well	2020	1,000	0.72
East A Well	2023	1,000	0.72
East C Well	2025	1,000	0.72
West A Wells	2028	1,000	0.72
Honerine Mine Well	2032	1,000	0.72
West B Wells	2035	2,000	1.44
South A Well	2042	1,000	0.72
Barrick Wells	2050	2,000	1.44
Vernon Wells	2060	4,000	2.88

A brief discussion of possible locations for these tanks is as follows:

Berra
The tank can be constructed near the site of the well, and a booster pump will be used to serve water from the tank.

East A
The East A well is intended to serve Zone 9. A potential tank site could be located near the well or along Pine Canyon Road. A tank at these locations would not float off the system but could be used to regulate flows from the well or to provide treatment capacity.

East C
The East C well is intended to serve Zone 8, The East C site is lower in elevation than Zone 8. The well could be equipped with a variable frequency drive and used to provide base flow into the zone with no equalization tank, or an equalization tank and booster pump could be used.

West A
The West A wells are intended to serve Zones 10-12. If the storage tank is west of the City, water will need to be boosted to Zone 10, because no elevations high enough are available. A tank could be located near the location of the former Tooele City water reclamation facility and then water could gravity flow to Zone 10, but this would require constructing a longer length of transmission to the tank.

West B, Honerine, South A, Barrick, and Vernon
The sources south of the City are intended to serve Zone 5, as well as lower elevation zones. No tank site in the valley, or along Highway 36 is at a high enough elevation, but sufficient elevation is available in the foothills east of Highway 36, including near the existing Tank 3. It is assumed that one tank site will be used for the storage from all these sources.

Recommended equalization storage projects are shown in Table 4-6 and on **Figure 7-1: Recommended Capital Facility Projects**. Source projects associated with these tanks were discussed in Chapter 3 of this report. Transmission projects required to convey source from these tanks to and through the City are discussed in Chapter 5 of this report.

Table 4-6: Future Equalization Tank Projects, 2020 Through 2060

Project Number and Associated Source		Approximate Year Required	Tank Capacity (MG)
47	Berra Well	2020	0.72
60	West A Wells	2028	0.72
66	Honerine Mine Wells	2032	0.72
66b	West B Wells	2036	1.44
66c	South A Wells	2042	0.72
66d	Barrick Wells	2050	1.44
Total Through 2060			**5.8**
66e	Vernon Wells	2060	2.88
Total Including Vernon			**8.6**

SUMMARY OF WATER STORAGE RECOMMENDATIONS

The City currently requires 9.6 MG of drinking water storage for existing and approved development. The City will need a total of 14.3 MG of drinking water storage by 2060. The City currently owns a total of 14.2 MG storage. A nominal 0.1 MG storage is needed to meet current DDW requirements for the predicted 2060 level of development, and an additional 8.6 MG of storage is recommended to facilitate operation of future sources located at significant distances from the City, sources requiring operation with booster pumps, or sources requiring water quality treatment. Potential locations for future drinking water storage tanks are shown on Figure 7-1: Recommended Capital Facility Projects.

It is recommended that the City maintain sufficient levels in the tanks to provide fire flow and emergency capacity, as shown in Table 4-1. It is recommended the City review all future building projects to ensure that buildings are constructed so that their required fire flowrates are within the flowrates available from the City water system.

CHAPTER 5 WATER DISTRIBUTION

HYDRAULIC MODEL

Development

A computer model of the City's drinking water distribution system was developed during 2019-2020 to analyze the performance of the existing and future distribution system and to prepare solutions for existing facilities not meeting distribution system requirements. The model was developed with the InfoWater 12.4 software (Innovyze, 2020). InfoWater simulates the hydraulic behavior of pipe networks. Sources, tanks, pipes, valves, controls, and other data used to develop the model were obtained from the previous City hydraulic model and other updated information supplied by the City. The model has been transferred to EPANET (EPA) and CityWater (Aquaveo) to allow the City to use the model as desired.

HAL developed models for four phases of drinking water system development – 1) existing /calibration, 2) existing + approved, 3) 10-year (2030), and 4) 40-year (2060). The first phase is a model representing the existing system (existing model). This model was used to calibrate the model and identify deficiencies in the existing system. Extensive field calibration of the existing system model has been performed in the past. Calibration for the master plan model was performed by utilizing past calibration efforts and comparing model results to system performance information gathered by City personnel, including well flow rates, tank levels, fire flow testing, and pressure testing. The model is considered to be calibrated adequately to represent actual field conditions using field measurements and observations. Calibration data is included in Appendix B.

The second phase was a model representing the existing system with approved development (existing + approved model). This model was used to represent the maximum requirements the distribution system could be required to meet if all approved development was constructed now.

The third and fourth phases were models representing future conditions and improvements necessary to accommodate growth. A model was created to represent the level of growth projected to be reached by 2030 (2030 model) and includes 17,700 ERCs. The 2030 model was used to evaluate timing and priority of future source, storage, and transmission projects. The final future model represents the level of growth projected to be reached by 2060 (2060 model) and includes 23,760 ERCs. This model was used to evaluate the ultimate size of future source, storage, and transmission projects.

All models included demand for the drinking water system to water the Oquirrh Hills Golf Course, City cemetery, Elton park, Dow James park, and Red DelPapa park. Water for these uses is not included in the regulatory requirements for the City because the City could stop watering them if needed in case of drought or otherwise insufficient water source. The City may consider watering the parks during off-peak times to reduce peaking requirements on the drinking water system.

Model Components

The two basic elements of the model are pipes and nodes. A pipe is described by its inside diameter, length, minor friction loss factors, and a roughness value associated with friction head losses. A pipe can contain elbows, bends, and check valves. Nodes are the endpoints of a pipe and can be categorized as junction nodes or boundary nodes. A junction node is a point where two or more pipes meet, where a change in pipe diameter occurs, or where flow is added (source) or removed (demand). A boundary node is a point where the hydraulic grade is known (a reservoir, tank, or PRV). Other model elements include tanks, reservoirs, pumps, valves, and controls.

The model is not an exact replica of the water system, although efforts were made over two years to make the model as complete and accurate as possible. Pipeline locations used in the model are approximate and not every pipeline may be included in the model. The locations, diameters, materials, and condition of the City's oldest pipes are not always precisely known. Moreover, it is not necessary to include all distribution system pipes in the model to accurately simulate its performance. The model includes all known distribution system pipes of all sizes, sources, storage facilities, pump stations, pressure reducing valves, control valves, controls, and settings.

Pipe Network

The pipe network layout originated from previous modeling efforts and data provided by the City. Projects completed in recent years were added/updated in the model. Elevation information was obtained from an aerial survey of the City, as well as publicly available data. The Hazen-Williams pipe flow method was used, and roughness coefficients for pipes in this model ranged from 90-150, which is typical for these pipe materials in modeling software (Rossman 2000, 31).

The existing water system contains approximately 190 miles of pipe with diameters of 2 inches to 24 inches. Figure 5-1 presents a summary of pipe length by diameter. Pipe materials used include ductile iron and PVC and may include other unknown materials.

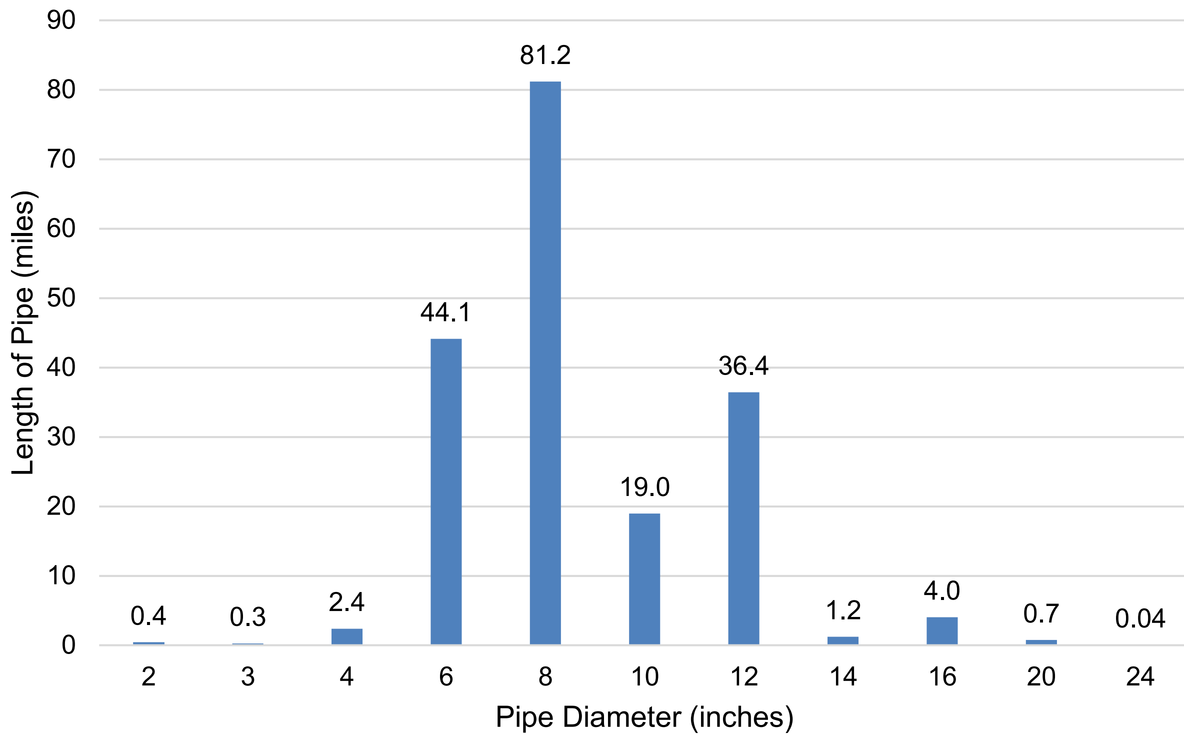

Figure 5-1: Summary of Pipe Length by Diameter

<u>Water Demands</u>

Water demands were allocated in the model based on billed usage and billing locations. The peak month demand was determined for each customer and linked to the physical location for each customer through a process called geocoding. Geocoding uses the billing address to physically locate the demand at a point location. The geocoded demands were then assigned to the closest model node. With the proper spatial distribution, demands were scaled to reach the peak day demand determined in Chapter 3. For the 2060 model, future demands were estimated as described previously in this report. Future demands were assigned to new nodes representing the expected location of new development in each pressure zone.

The pattern of water demand over a 24-hour period is called the diurnal curve, or daily demand curve. The diurnal curve for this master plan was taken from recent peak week SCADA data from the City. The diurnal curve for this study has a peaking factor of 1.75. The diurnal curve was input into the model to simulate changes in the water system throughout the day.

In summary, the spatial distribution of demands followed geocoded water use data, the flow and volume of demands followed the level of service standards described in Chapter 1, and the temporal pattern of demand followed a diurnal curve developed from SCADA data.

Water Sources and Storage Tanks

The sources of water in the model are the City wells and springs. A well or spring is represented by a reservoir and pump, or by a constant head reservoir and flow control valve. Actual tank location, height, diameter, and volume are represented in the model. The extended-period model predicts water levels in the tanks as they fill from sources and as they empty to meet demand in the system.

SYSTEM ANALYSIS METHODOLOGY

HAL used extended-period and steady-state modeling to analyze the performance of the water system with current and projected future demands. An extended-period model represents system behavior over a period of time: tanks filling and draining, pumps turning on or off, pressures fluctuating, and flows shifting in response to demands. A steady-state model represents a snapshot of system performance. The peak day extended period model was used to set system conditions for the steady-state model, evaluate zone to zone water transfers, analyze system controls and the performance of the system over time, and to analyze system recommendations for performance over time. The steady-state model was used for analyzing the peak day plus fire flow conditions.

Two operating conditions were analyzed with the extended period model: peak day conditions and peak instantaneous conditions. Peak day plus fire flow conditions were analyzed using a steady-state model. Each of these conditions is a worst-case (high-demand) situation so the performance of the distribution system may be analyzed for compliance with DDW standards and City preferences.

Existing with Approved Development – Peak Day Condition

Low Pressure

The DDW requires that during peak day demand, a minimum pressure of 20 psi must be maintained at the point of connection for all areas constructed prior to January 1, 2007, and 40 psi must be maintained for all areas constructed after January 1, 2007 {R309-105-9(2) U.A.C.}. Tooele City’s preference is that 50 psi minimum should be maintained where possible. Peak day demand was evaluated at the level of service shown in Table 1-1. For existing with approved development, this amounts to a peak day demand of 12,700 gpm. The model also includes demand for Oquirrh Hills Golf Course, City cemetery, Elton park, Dow James park, and Red DelPapa park. All points of connection meet DDW requirements, and **there are no existing deficiencies** for this demand condition. The paragraphs below describe locations not meeting Tooele’s preference of 50 psi.

During average peak day conditions, the model predicts pressures of 40-50 psi at the top (highest elevations) of pressure zones 3 through 13. The model uses PRV settings as low as 40 psi to represent conditions that will reduce water loss and increase energy efficiency. PRV settings at pressure boundaries can be increased if pressures in these regions are insufficient. However, increasing PRV settings will also increase maximum pressures in the lower elevations of each pressure zone.

Two connections on the east side of Main Street/Highway 36 between 550 South and 700 South are served by a pipe on 50 West street. These two connections are at higher elevations, and the model predicts pressures as low as 30 psi at these locations during peak day conditions. Both locations meet DDW standards. No City capital projects are proposed to mitigate low pressures. Anticipated future developments may improve connectivity and slightly improve pressures toward the City's preference.

High Pressure

The model predicts that many areas of the City experience pressures higher than the City's preferred maximum of 100 psi, particularly during low demand times. These areas include the bottom (lowest elevations) of pressure zones 1, 2, 3, 5, 6, 8, and 9. The maximum predicted pressures are 115-120 psi during typical operating conditions. These pressures are generally not considered to be problematic. PRV settings could be lowered to reduce pressures, but this would also reduce pressures in the higher elevations of each zone. The City should require individual PRVs for each new customer connection, particularly in areas of known high pressure. No pressure changes to reduce pressure are recommended, because this would reduce pressures in the upper portions of those zones to levels below the minimum desired. No capital projects are recommended to mitigate high pressures.

High Velocity

The model predicts that several pipes experience velocities higher than 7 feet per second (fps) during average peak day conditions. These high velocities are not causing unacceptable pressure drops or pressure swings. No capital projects are recommended to mitigate high velocities.

Pressure Swings

Pressures changes of less than 20 psi during the peak day are desirable to maintain steady pressures for customers. High pressure swings may indicate transmission is undersized, or that pumps into a zone are pumping at a higher pressure than the settings of the PRVs into the zone. The model predicts the following areas of the City experience pressure swings of 20-25 psi during the peak day:

- Pressure Zone 4, between 7th Street and Droubay Road,
- Zone 5 between 200 South and 500 South,
- Zone 5 along 550 South from 425 West to 525 West,
- Zone 8 west of Main Street from Quartz Road to 1650 North,
- Zone 8 east of Main Street from 1100 North to 1500 North.

This is not considered a deficiency and no mitigation projects are recommended. Pressure swings in all other areas of the City are less than 20 psi on the peak day.

Existing with Approved Development – Peak Instantaneous Condition

Low Pressure

The DDW requires that during peak instantaneous demand, a minimum pressure of 20 psi must be maintained at the point of connection for all areas constructed prior to January 1, 2007, and 30 psi must be maintained for all areas constructed after January 1, 2007 {R309-105-9(2) U.A.C.}. Peak instantaneous demand was defined based on SCADA data for the peak day demand in Tooele. The highest peaking factor present on the peak day was 1.75, resulting in a peak instantaneous demand for existing and approved development of 22,160 gpm. The model also includes demand for Oquirrh Hills Golf Course, City cemetery, Elton park, Dow James park, and Red DelPapa park. All points of connection meet DDW requirements, and **there are no existing deficiencies** for this demand condition.

The hydraulic model indicates that the system is capable of providing at least 30 psi at nearly every point of connection in the system at this level of demand. The model predicts that the two high elevation connections east of Main Street between 550 South and 700 South (described above) will experience pressures of 26-27 psi during peak instantaneous condition. These locations meet DDW standards. No capital projects are proposed to mitigate low pressures.

High Velocity

The model predicts that several pipes experience velocities higher than 7 feet per second (fps) during peak instantaneous conditions. These high velocities are not causing unacceptable pressure drops or pressure swings. No capital projects are recommended to mitigate high velocities.

Existing with Approved Development – Peak Day plus Fire Flow Condition

A minimum pressure of 20 psi must be maintained while delivering fire flow to a particular location within the system and supplying the peak day demand to the entire system {R309-105-9(2) U.A.C.}. As specified by the Tooele fire code official, a typical minimum fire flow of 1,500 gpm is required throughout the City.

The computer model was used to predict fire flow pressures. The computer analysis should not replace physical fire flow tests at fire hydrants as the primary method of determining fire flow capacity.

A map of predicted available system fire flows during the peak day average condition was provided to the fire code official. Several locations requiring additional fire flow were identified. Recommended projects to increase fire flow are shown in Table 5-1 and numbered on **Figure 7-1: Recommended Capital Facility Projects**, located at the end of Chapter 7.

Table 5-1: Projects to Resolve Low Fire Flow

Project Number and Location		Fire Flow Available (gpm)	Pipe Size (inches)	Length (feet)
-	Oakridge Drive cul-de-sac south of Skyline Drive. *Developers* will connect Oakridge Drive through from Zone 1 to this location.	880	8	1100
1	Benchmark Village. The model predicts fire flow within the development is as low as 1100 gpm, and field conditions indicate even lower flow available. Connect Benchmark Village to the pipe in Vista Circle to increase available flow.	1100-1990	10	299
2	100 South 200 West. Fire flow at this location is sufficient for one hydrant. Additional flow is available within a block in any direction. If desired, increase pipe size from Vine Street to 100 South to 8-inch to increase flow at this location.	1180	8	656
3 4	Henwood Mobile Park, 300 West Joshua Street. Install an 8-inch pipe and PRV on 300 West from 450 North to Joshua Street.	810	8	280 PRV
5	Henwood Mobile Park, 475 North Landmark Drive. Fire flow at this location is sufficient for one hydrant. If additional flow is desired, an 8-inch pipe serving the fire hydrant can be constructed to 400 North and connected to Zone 7 (instead of Zone 8).	1130	8	379
6	Grandview Village, north of 400 North, east of Coleman Street. Pipe size within the development is unknown. The maximum fire flow available is 1285. A pipe can be installed from Coleman Street to one of the hydrants within the development to provide additional flow.	1285	8	182
7	1000 West, Utah Avenue to Rogers Street. The existing long dead-end pipe is 6-inch diameter for 3000 feet, and then 4-inch for 1180 feet. A 10-inch pipe can be constructed to provide higher fire flow.	445-840	10	4176

ADDITIONAL PROJECTS

Add Tank Outlet Line

Tank 5 has two outlet lines, one exiting the tank to the north, and one exiting to the east toward Cassity Drive. The north line is located at the floor of the tank and capable of utilizing the full volume of the tank. The east outlet line is located several feet above the tank floor. Adding a 12-inch connection between the north line and the east line will allow both lines to utilize the entire volume of the tank if needed. This project is shown on Figure 7-1 and included in Table 5-2.

Backup Supply for Middle Canyon Road

Adding a connection between 270 South (east of 1400 East) and Middle Canyon Road will provide redundancy for customers on Middle Canyon Road. This project is shown on Figure 7-1 and included in Table 5-2.

Replace 700 South Pipe, 700 South Booster to Tank 3

The 16-inch line conveying water from the 700 South booster to Tank 3 is aging and should be prioritized for replacement.

Table 5-2: Additional Projects

Project Number and Location		Description	Pipe Diameter (inches)	Length (feet)
8	Tank 5 north outlet to east outlet	Connection	12	450
9	270 South to Middle Canyon Road	Connection	12	550
10	700 South Booster to Tank 3	Transmission	16	6,900

FUTURE WATER DISTRIBUTION SYSTEM

2030 Model

A 2030 hydraulic mode was prepared. This model was used to evaluate timing and priority for projects identified as part of the analysis of the 2060 model (discussed below). The model was constructed as described below for the 2060 condition but included only 10 years of development demand added. Predicted pressures for the 2030 model were reviewed and found to be within the pressure level of service standards.

2060 Peak Day and Peak Instantaneous Conditions

Similar to the existing condition, the DDW requires that during future peak day demand conditions, a minimum pressure of 20 psi be maintained at the point of connection for all areas constructed prior to 2007, and 40 psi be maintained for all areas constructed after January 1, 2007 {R309-105-9(2) U.A.C.}. During future peak instantaneous demand conditions, a minimum pressure of 20 psi must be maintained at the point of connection for all areas constructed prior to 2007, and 30 psi must be maintained for all areas constructed after January 1, 2007 {R309-105-9(2) U.A.C.}. Tooele City's preference is that 50 psi should be maintained where possible in all conditions.

Future peak day demand and future demand locations are discussed in Chapter 3 of this report. Future demand areas are shown on Figure 2-1: Future Demand Areas. A significant portion of the increased future demand will be required in the Overlake area, north of the railroad tracks. City planners expect to see additional development at other locations throughout the City, as shown on the figure. The City is projected to continue growing beyond the 40-year planning period of this analysis (ending in 2060).

With 23,760 ERCs projected, the system's 2060 peak day demand is estimated at 20,300 gpm. Peak instantaneous demands were calculated in a similar manner to existing conditions. The peak day to peak instantaneous peaking factor is 1.75 and the total peak instantaneous demand is 35,500 gpm. The model also includes demand for Oquirrh Hills Golf Course, City cemetery, Elton park, Dow James park, and Red DelPapa park. The model predicts that most points of connection in the City can maintain 50 psi under peak instantaneous demand, after projects proposed in this analysis are completed.

Similar to the existing conditions analysis, PRVs in the future condition were set to minimize water loss and optimize energy efficiency. The model predicts locations at the top (higher elevations) of pressure zones 3 through 9 will experience pressures between 40-50 psi during peak day and peak instantaneous conditions when using the modeled PRV settings. PRV settings can be adjusted if pressures at these locations are too low, though this will also increase high pressures at the bottom (lower elevations) in each zone.

The 2060 peak day and peak instantaneous conditions were evaluated using the design criteria and standards discussed previously. The transmission projects shown in Table 5-3 and numbered on Figure **7-1: Recommended Capital Facility Projects** are required to meet peak day and peak instantaneous requirements through 2060. All transmission projects parallel to existing transmission are intended to be used **along with** the existing transmission, or an equivalent pipe size with the same capacity as the sum of the capacities of the existing and new pipes should be constructed in place of the existing pipe. Details for recommended source and storage infrastructure have been discussed in chapters 3 and 4 of this report.

Table 5-3: Transmission Projects, 2020 Through 2060

Project Number and Location		Pipe or PRV Size (inches)	Length of Pipe (feet)
Developer-Installed Infrastructure Larger than 8-inch Diameter			
Developers will construct numerous local distribution lines throughout the City. The majority will be 8-inch diameter, though some 12-inch and 14-inch diameter pipes will be needed. The City may participate in the cost of upsizing these pipes.			
12	Brook Avenue, 700 North to 1000 North	12	2,350
13	400 East, 2200 North to 2275 North	12	440
14	Broadway Avenue, 1310 North to 1500 North	12	1,010
15	1000 West, 750 North to 1500 North	14	4,660
16	Main Street, 2550 North to 3000 North	12	3,080
17	PRV - 400 East - Z9-Z10	12	-
18	PRV - 400 East - Z10-Z11	12	-
19	400 West, 2400 North to Tiger Drive	12	3,980
20	PRV - 400 West - Z10-Z11	12	-
21	Rogers Street, 600 West to 1100 West	12	2,250
22	2600 North, 100 West to 600 East	12	2,750
23	PRV - 1200 West - Z10-Z11	12	-
Park Well Transmission			
45	First/Vine/Main Street, DelPapa Park to Utah Avenue	12	3,930
Berra Well Transmission			
48	Booster pump from Berra tank to transmission lines	-	-
49	Berra well to 2000 North	12	3,470
50	Berra well to 1280 North	12	860

Project Number and Location		Pipe or PRV Size (inches)	Length of Pipe (feet)
Berra Boulevard Zone 9 – Zone 9 PRV			
Add 12-inch pipe and PRV between Zone 8 and Zone 9, between 1280 North and Berra Boulevard.			
51	1570 North, 1280 North to Berra Boulevard	12	770
52	PRV - Berra Boulevard Z8-Z9 (1280 North/Berra Blvd)	12	-
Tank 4 Fill Line			
Add 12-inch Tank 4 fill line from Canyon Rim line.			
24	Canyon Rim Road to Tank 4	12	200
25	Control Valves at Fill Line	-	-
Tank 4 Outlet			
Add second 12-inch outlet line from Tank 4 to Skyline Drive. As an alternative, the existing fill line can be converted to an outlet line after projects 24 and 25 are completed.			
26	Mountaineer Drive, Tank 4 to Skyline Drive	12	980
7th Street Transmission			
27	7th Street, Skyline Drive to Vine Street	8	2,970
28	7th Street, Birch Street to Oquirrh Street	10	130
East A Well Transmission			
55	East A Well to Zone 10	12	15,400
East C Well Transmission			
57	East C Well to Zone 9	12	5,700
Droubay Road Transmission			
29	Droubay Road, 280 North to 670 North	10	3,030
30	Parallel to Droubay Road, Valley View Drive to Fox Run Drive	8	1,500

Project Number and Location		Pipe or PRV Size (inches)	Length of Pipe (feet)
Zone 8 to Zone 9 & 10 Transmission, Coleman Street/400 West			
31	Coleman Street, 400 North to 650 North	8	2,380
32	650 North, 680 West to 700 West	12	530
33	600 West/400 West, 650 North to 1500 North	12	5,650
34	400 West, 1500 North to 2000 North	8	2,640
West A Wells Transmission			
59	West A Well to Tooele 1200 West	16	27,750
61	Booster pump from West A tank to transmission lines	-	-
Transmission from Honerine Mine Wells Through City to Zone 7			
63	Honerine Mine to Highway 36	10	2,830
64	Highway 36, Honerine to West B	30	10,860
65	Highway 36, West B to Coleman Avenue	30	8,070
67	Coleman Street, Highway 36 to Timpie Road	24	1,650
68	Timpie Road, Coleman Street to 900 West	16	2,330
69	Coleman Street, Timpie Road to 700 South	20	1,510
70	PRV – Coleman Street - Z5-Z6	16	-
71	Coleman Street, 700 South to Vine Street	16	4,540
72	PRV – Coleman Street - Z6-Z7	16	-
Small Connection Projects			
73	Coleman Street, Vine Street to Utah Avenue	8	1,420
74	Timpie Road & Coleman St, Coleman to Southwest Drive	8	340
75	600 North, Main Street west to Main Street east	10	90
76	1310 North, 350 East to 380 East	8	270
77	Pioneer Avenue, 700 South to Millcreek Way	8	780
West B Well Transmission			
79	West B Well to Highway 36	14	58,970

Project Number and Location		Pipe or PRV Size (inches)	Length of Pipe (feet)
Tank 7 to Zone 9 & 10 Transmission, 700/900 West			
35	900 West, 900 South to 700 South	16	1,190
36	900 West, 700 South to 480 South	16	1,320
37	900-1000 West, 480 South to Utah Avenue	20	5,200
38	1000 West, Utah Avenue to 750 North	16	4,100
39	PRV - 1000 West - Z8-Z9	16	-
40	Utah Avenue, 1000 West to Coleman Avenue	12	2,800
Zone 8 to Zone 9 & 10 Transmission, Main Street			
41	Main Street and Progress Way, 1540 North to 2000 North	12	2,630
42	2000 North and 400 East, Progress Way to 2200 North	10	1,860
43	400 East, 2400 North to 2550 North	8	1,050
South A Well Transmission			
81	South A Well to Highway 36	10	26,300
82	Highway 36, South A to Honerine	24	6,180
Barrick Wells Transmission			
84	Barrick Wells to Highway 36	10	36,970
85	Highway 36, Barrick to South A	24	27,500
Total Cost for Transmission Projects Through 2060			
Vernon Wells Transmission			
88	Highway 36, Vernon to Barrick	20	99,090

2060 Peak Day plus Fire Flow Conditions

The same fire requirements used in the existing condition have been used in the 2060 condition. Fire flow requirements may decrease at some areas in the City as older buildings are removed and new buildings are constructed using more fire-resistant materials and approved fire sprinkling systems. Fire flow available does not significantly decrease in the 2060 condition and the available flow increases in some areas as better connectivity is achieved. A site-specific analysis of available fire flow should be performed for each new development early in the development review process. All new construction should be required to use building materials and sprinkling systems to reduce the required fire flows to the amount the system is capable of providing.

CONTINUED USE OF THE MODEL

The model output primarily consists of the computed pressures at nodes and flow rates through pipes. The model also provides additional data related to pipeline flow velocity and head loss to help evaluate the performance of the various components of the distribution system. Results from the model are available through the CityWater web browser application. Due to the large number of pipes and nodes in the model, it is impractical to prepare a figure which illustrates pipe numbers and node numbers. Refer to CityWater to review model output.

The model should continue to be updated as the water system changes. The City can use the model as a tool for determining the effect of changes to the system and capacity of the system to provide fire flows for new developments. Fire flow tests should be completed on an ongoing basis to refine the model calibration as system conditions change.

SUMMARY OF WATER DISTRIBUTION SYSTEM RECOMMENDATIONS

In addition to all projects recommended in Table 5-1 through Table 5-3, additional localized distribution pipelines are expected to be installed as the City develops. The locations and lengths of these pipelines will vary depending on the final location of future streets and should be reviewed by the City as they are submitted.

Additional recommendations include the following:

- The City require future construction to use building materials and approved fire sprinklers as needed to reduce required fire flows to the amounts the City system can provide.

- The model be updated as new development occurs, and as the City completes projects related to the drinking water system.

- The City continue to gather the results of fire flow tests and perform calibration testing as needed and update the model with results where possible.

CHAPTER 6 ENERGY OPTIMIZATION

OPTIMIZATION OVERVIEW

Three parameters drive the operation of a water system: system performance, water quality, and energy efficiency (Figure 6-1). Water systems can be characterized by any degree or combination of these three parameters. One system may perform well but incur high energy costs. Another may be energy efficient but is not sufficiently pressurized during peak demand. Still another may perform well hydraulically but fail to meet requirements for chlorine residual. System optimization is the process whereby a distribution network is evaluated to identify potential improvements that will allow the network to operate in the region where energy efficiency, system performance, and water quality are balanced.

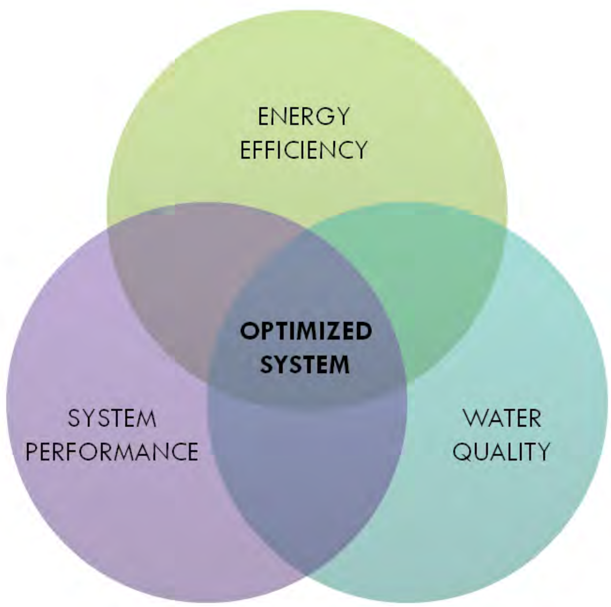

Figure 6-1: Water System Optimization Diagram

System optimization was considered throughout the development of this master plan. One of the basic principles used was to limit unnecessary energy losses. Energy losses have a direct impact on energy efficiency and system performance. Many of the changes that reduce energy losses also promote water circulation, which improves water quality. The following paragraphs describe how optimization was applied in the development of the recommendations included in this master plan to further optimize the system.

ENERGY AND SYSTEM PERFORMANCE

PRV settings are an ideal example for the application of optimization principles. PRVs can provide a useful means of reducing pressure fluctuations in lower zones by allowing water to flow to the lower zone during peak flow events. However, setting a PRV too high can have the opposite effect within the upper zone. High PRV flows elevate the flow velocity in the upper zone, which in turn increases pressure fluctuations. Furthermore, high PRV settings prevent the equalization storage in tanks from being fully utilized, leading to wasted energy. The solution is to set PRVs at a level where pressures in the lower zones are protected, but flow through the PRV is limited. The settings used in the master planning modeling were chosen to keep daily pressure fluctuations under approximately 20 psi while meeting minimum pressure standards for peak day, peak instantaneous, and emergency demand scenarios.

The following is an example of how PRV settings affect tank levels. Tank 5 serves Pressure Zones 0, 1, 2, and 3. The settings of PRVs between Zones 3 and 4 will greatly influence the flow of water coming out of Tank 5. If the PRVs between Zones 3 and 4 are set too high, excess water will come out of Tank 5 (and too little water will come out of Tank 4). These principles are valid for other tanks in the system as well. The PRV settings between Pressure Zones 7 and 8 should also be minimized to reduce excess water flowing out of higher elevation tanks.

Pumping Costs

Producing, treating, and delivering high-quality water requires energy, which is usually a water utility's largest operational expense and can account for 30%–40% of municipal energy consumption (EPA 2015). Efforts to increase energy efficiency bring financial savings and can facilitate improvements in water quality and hydraulic performance. The City should prioritize water usage from sources with the lowest cost water. Spring sources are the cheapest sources because no pumping is needed. Tooele should prioritize use of Spring water. When ample spring water is available the settings of PRVs between Zones 3 and 4 should be raised to prioritize flow of water out of Tank 5 (which receives spring water), and PRVs into Zone 6 should also be raised to prioritize flow of water out of Tank 6 (if spring flows are significant).

As part of Tooele City's participation in the Rocky Mountain Power Water Strategic Energy Management Cohort, Cascade Energy performed a qualitative review of the City's pumping facilities. Energy intensity describes the amount of energy needed to produce a unit volume of water and is often measured in kilowatt-hours per million gallons. Since energy use and pumping costs are directly related, energy intensity serves as a useful proxy for comparing the relative pumping costs of different sources. The energy intensity of a pumped source is proportional to the pump's lift, assuming efficiency is constant. Therefore, if two wells with identical pump efficiencies are considered, one that lifts water from a depth of the 500 feet, and one that lifts from a depth 1,000 feet, the well that lifts water 500 feet will have half the energy intensity of the other well and produce water at half the cost in energy.

Cascade Energy produced the following preliminary Energy Map, showing the energy usage of sources ordered from least energy intensive (least energy use per million gallons) to most energy intensive. When a choice is possible, Tooele City should prioritize sources with lower energy intensities. Note that if water must be pumped through a booster station, this energy usage must be accounted for as well. For example, if water is pumped from Well 8 (910 kWh/acre-foot) and pumped to Tank 3 via the 700 South booster (400 kWh/acre-foot), the total energy intensity is the energy intensity of the well plus the energy intensity of the booster (1,310 kWh/acre-foot).

Typically, using booster pumps is inefficient and should be avoided when possible, but sometimes it may be more efficient to use a booster. In the example above, using Well 8 and the 700 South booster is more energy efficient than using Well 15, Well 6, Well 5, or Well 16.

Table 6-1: Preliminary Energy Map
Source Energy Intensity (Cascade Energy)

Description		Energy Intensity (kWh/acre-foot)
All Springs		0
Well 13	Devil's Kitchen	530
Well 9		680
Well 14	Anderson	880
Well 8		910
Well 11	Pendleton	910
Well 7		1,070
Well 17	Rodeo	1,110
Well 12	Cassity	1,170
Well 15	England Acres	1,390
Well 6		1,400
Well 5		1,530
Well 16	Kennecott B	1,680
700 South Booster		400 (estimated)
Canyon Rim Booster		900 (estimated)

Another example of applying optimization principles during the development of this master plan is in selecting which zone should be served by wells under construction and future wells. Serving higher elevation zones with the new wells would provide more redundancy in the system but would increase pumping costs. Where multiple options are acceptable, it may be best to serve the lower elevation zone under normal circumstances but equip the well house with a backup pump and transmission piping that can serve the higher elevation zone under unusual or emergency circumstances.

Summary of Optimization Opportunities

Opportunities to increase energy efficiency in the system are summarized as follows:

1. Reduce PRV settings to the lowest pressure tolerable by customers, particularly at the pressure boundary between Zones 3 and 4, and between Zones 7 and 8. This will allow tanks

to serve their designated areas of the City without encouraging excess water to enter the system and be boosted back up to the tanks again. Lower pressures also reduce water loss via minor leaks in the system.

2. Unless it is desired to prioritize flow through a specific PRV, balance PRV settings at zone boundaries based on hydraulic grade line (elevation plus pressure).

3. The Kennecott B well enters the system above (south of) the PRV on Droubay Road. The system was constructed this way to provide redundancy by allowing the Kennecott B well to fill Tank 6. Bringing the well into the system below (north of) the PRV would require less pumping energy from the well. The well is already equipped with a variable frequency drive (VFD) that would allow this operational change. A valve vault could be constructed to allow the well to switch between pumping above the PRV or below the PRV as needed.

4. Construct an inlet pipe to allow Tank 4 to be filled from the Canyon Rim transmission line. If water from Tank 5 is required to fill Tank 4, this will allow water to be conveyed though the Canyon Rim line, rather than be conveyed through the Cassity/1400 East/Skyline Drive system, causing high head loss in those pipes. This project has been included in the recommended Capital Facilities Plan in this report.

5. Convert the existing inlet pipe into Tank 4 to an outlet pipe. This project has been included in the recommended Capital Facilities Plan in this report.

6. Use a pressure sustaining valve (PSV) on the 7th Street transmission line from Tank 4 to Zone 6 (Vine Street). In years when high spring flow into Tank 5 is available, and excess flow fills Tank 4, a PSV will allow water from the spring to be prioritized.

7. Well 6 and possibly even Well 7 could be connected to serve Zone 7 directly. This would require use of a VFD.

8. As an alternative to pumping Wells 6 and 7 into Zone 7 directly, install a smaller booster at the 700 South booster station to pump water from Wells 6, 7, and 8 into Zone 7, rather than boosting the water to Tank 3 (Zone 5) and allowing it to trickle back down to Zone 7. The existing 700 South booster station building likely does not have room for an added booster, which may make this project infeasible unless a new building is constructed.

9. Avoid use of the 700 South booster and Canyon Rim booster where possible. Allow Tank 3 to draw down to the design level.

10. Zone 8 West and Zone 8 East are disconnected. Connecting these zones would allow water from Zone 8 West (Well 6, 7, 8, & Rodeo Well) to be used to supply Zone 8 East, or vice versa. However, the hydraulic grade line (HGL) in Zone 8 East is typically higher than the HGL in Zone 8 West. Under normal circumstances, connecting these two zones will cause water from Zone 8 East to supply Zone 8 West, preventing Tank 7 and the above wells from being fully utilized. This would not be beneficial to operation of the system. However, in conditions

where sources to Zone 8 East are unavailable, the connections between the zones could be opened and would allow the Zone 8 West sources to be used in Zone 8 East without first boosting them to Tank 3 (Zone 5) and allowing them to trickle back down to Zone 8 East. A check valve could be used to allow one-way operation of the connection from Zone 8 West to Zone 8 East.

11. Rodeo Well could be connected to serve Zone 8 East directly. The well currently serves only Zone 8 West to allow chlorine contact time in a long transmission pipe. A tank would be required to provide the necessary contact time if the well is connected to Zone 8 East directly.

12. The Berra well could serve Zone 8 or Zone 9. Pumping it to Zone 8 would require more energy but would provide flexibility. Pumping to Zone 9 would require less energy but would remove the flexibility of pumping to Zone 9. The booster pump could include a VFD and a valve vault could be designed to allow pumping to either zone.

13. Prioritize use of spring flow over pumping wells.

14. Prioritize use of wells requiring less energy over wells requiring more energy.

SUMMARY OF ENERGY OPTIMIZATION RECOMMENDATIONS

It is recommended that the City consider implementing the energy optimization recommendations discussed. Energy optimization recommendations 4 and 5 are included in the Capital Facility Plan because they are also needed for non-energy reasons. The other energy optimization recommendations are not included in the Capital Facility Plan.

CHAPTER 7 CAPITAL FACILITY PLAN

GENERAL

Throughout the master planning process, the three main components of the City's water system (source, storage, and distribution) were analyzed to determine the system's ability to meet existing demands and anticipated future demands. System deficiencies identified in the master planning process and described previously in this report were presented to City staff. Possible solutions were discussed for system deficiencies, maintenance, and other system needs not identified in the system analysis.

A plan has been prepared to meet existing and projected future infrastructure needs for the Tooele City water system. The purpose of this section is to summarize all drinking water facilities required for the 40-year planning period to meet the demands placed on the system by future development. This section also includes fire flow projects and City requested projects.

Cost estimates have been prepared for the recommended projects and are included in Table 7-1 and Table 7-2. Unit costs for the construction cost estimates are based on conceptual level engineering and are shown in the unit costs table in Appendix C. Sources used to estimate construction costs include:

1. "Means Heavy Construction Cost Data, 2020"
2. Price quotes from equipment suppliers
3. Recent construction bids for similar work in Utah

All costs are presented in 2020 dollars. Costs shown below include 10% for contingency and 15% for design. Recent price and economic trends indicate that future costs are difficult to predict with certainty. Engineering cost estimates provided in this study should be regarded as conceptual level for use as a planning guide.

PRECISION OF COST ESTIMATES

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

Type of Estimate	Precision
Master Planning	±50%
Preliminary Design	±30%
Final Design or Bid	±10%

For example, at the master planning level, if a project is estimated to cost $1,000,000, then the precision or reliability of the cost estimate would typically be expected to range between approximately $500,000 and $1,500,000. While this may seem imprecise, 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.

The cost for new sources varies based on the costs of land, labor, and difficulty of drilling and developing wells. Average expected costs are shown in the tables below. The cost for adding new storage facilities varies based on site constraints and the costs of land, labor, and construction materials. An average of $1.15 per gallon of storage has been found to be a reasonable, conservative estimate. All transmission costs shown in this master plan are based on the 2020 RS Means Heavy Construction Cost Data, as shown in the unit costs table in Appendix C.

It is recommended that 10% of the estimated cost should be added for contingency and 15% for engineering. All costs below include these amounts.

SYSTEM IMPROVEMENT PROJECTS

All projects recommended in previous chapters of this report are included in Table 7-1 and Table 7-2. Additional detail for projects is shown in the cost estimates in Appendix C. The Map ID corresponds to the project number on **Figure 7-1: Recommended Capital Facility Projects**, located at the end of this chapter. Projects for future growth are divided into three phases: 0-6 year (2021-2026), 7-20 year (2027-2040), and 21-40 year (2041-2060). As discussed in Chapter 3, timing for source projects was based on expected growth and the calculated expected source needed each year. As discussed in Chapter 4, storage projects are all required to aid in the operation of new sources; therefore, phasing of storage projects is based on the phasing of the associated source project. As discussed in Chapter 5, some transmission projects are associated with source/storage projects, and their timing is based on the timing of the associated source/storage project. Phasing of other transmission projects is based on meeting level of service requirements and aiding operational control of the system. Projects may be needed sooner or later than projected, based on growth rates and timely completion of all recommended projects.

Table 7-1: Recommended Capital Facility Projects

Type	Map ID	Project Description	Cost
Projects to Increase Fire Flow			
Fire Flow	1	Benchmark Village to Vista Circle	$65,000
	2	200 West, 100 South to Vine Street	$155,000
	3 4	Henwood Mobile Park – 300 West, 450 North to Joshua Street PRV	$67,000 $132,000
	5	Henwood Mobile Park – Landmark Drive, 400-475 North	$90,000
	6	Coleman Street to Grandview Village	$34,000
	7	1000 West, Utah Avenue to Rogers Street (Project superceded by transmission project 38)	$1,124,000 (not included)
Total Cost, Projects to Increase Fire Flow			**$543,000**
Other Projects			
Transmission	8	Tank 5 north outlet to east outlet	$60,000
Transmission	9	Zone 3 to Middle Canyon Road backup supply	$135,000
Transmission	10	700 South Booster to Tank 3 replacement	$2,719,000
Total Cost, Other Projects			**$2,914,000**

Table 7-2: Recommended Capital Facility Projects Attributed to Growth, 2020 Through 2060

Type	Map ID	Project Description	Cost
Growth Projects, 0-6 Year Phasing (2021-2026)			
City Participation to Upsize Developer-Installed Transmission	12	Brook Avenue, 700 North to 1000 North	$146,000
	13	400 East, 2200 North to 2275 North	$28,000
Source	44	Park Well House	$987,000
Transmission	45	Park Well – First/Vine/Main Street, DelPapa Park to Utah Ave	$1,171,000

Type	Map ID	Project Description	Cost
Source	46	Berra Well House	$987,000
Storage	47	Equalization Tank for Berra Well	$1,362,000
Source	48	Booster pump out of Berra tank	$400,000
Transmission	49	Berra Well transmission to 2000 North	$852,000
Transmission	50	Berra well to 1280 North	$212,000
Transmission	51	1570 North, 1280 North to Berra Boulevard	$190,000
Transmission	52	PRV - Berra Drive Z8-Z9	$132,000
Transmission	24	Canyon Rim Road to Tank 4	$52,000
Transmission	25	Control Valves at Tank 4 Fill Line	$132,000
Transmission	26	Mountaineer Drive, Tank 4 to Skyline Drive	$290,000
Transmission	27	7th Street, Skyline Drive to Vine Street	$702,000
Transmission	28	7th Street, Birch Street to Oquirrh Street	$34,000
Source	53	East A Well	$2,802,000
Source	54	Arsenic Treatment Plant for East A Well	$1,645,000
Transmission	55	East A Well to Zone 10	$4,590,000
Source	56	East C Well	$2,855,000
Transmission	57	East C Well to Zone 9	$1,700,000
Total Cost, Growth Projects, 0-6 Year Phasing (2021-2026)			**$21,269,000**
Growth Projects, 7-20 Year Phasing (2027-2040)			
City Participation to Upsize Developer-Installed Distribution/ Transmission	14	Broadway Avenue, 1310 North to 1500 North	$63,000
	15	1000 West, 750 North to 1500 North	$305,000
	16	Main Street, 2550 North to 3000 North	$224,000
	17	PRV - 400 East - Z9-Z10	$33,000
	18	PRV - 400 East - Z10-Z11	$33,000
	19	400 West, 2400 North to Tiger Drive	$247,000
	20	PRV - 400 West - Z10-Z11	$33,000
	21	Rogers Street, 600 West to 1000 West	$140,000
	22	2600 North, 100 West to 600 East	$171,000
Transmission	29	Droubay Road, 280 North to 670 North	$814,000
Transmission	30	Parallel to Droubay Road, Valley View Drive to Fox Run Drive	$278,000

Type	Map ID	Project Description	Cost
Transmission	31	Coleman Street, 400 North to 650 North	$564,000
Transmission	32	650 North, 680 West to 700 West	$157,000
Transmission	33	600 West/400 West, 650 North to 1500 North	$2,012,000
Transmission	34	400 West, 1500 North to 2000 North	$624,000
Source	58	West A Well	$2,855,000
Transmission	59	West A Well to Tooele 1200 West	$7,433,000
Storage	60	Equalization Tank for West A Wells	$1,362,000
Source	61	Booster pump out of West A tank	$400,000
Source	62	Honerine Mine Well	$2,855,000
Transmission	63	Honerine Well to Highway 36	$616,000
Transmission	64	Highway 36, Honerine Well to West B	$7,194,000
Transmission	65	Highway 36, West B to 400 South	$6,227,000
Storage	66	Equalization Tank for Honerine Well	$1,362,000
Source	66f	Booster pump out of Honerine tank	$400,000
Transmission	67	Coleman Street, Highway 36 to Timpie Road	$805,000
Transmission	68	Timpie Road, Coleman Street to 900 West	$790,000
Transmission	69	Coleman Street, Timpie Road to 700 South	$625,000
Transmission	70	PRV - Main Street - Z5-Z6	$132,000
Transmission	71	Coleman Street, 700 South to Vine Street	$1,537,000
Transmission	72	PRV - Main Street - Z6-Z7	$132,000
Transmission	73	Coleman Street, Vine Street to Utah Avenue	$336,000
Transmission	74	Timpie Road & Coleman Street, Coleman to Southwest Drive	$81,000
Transmission	75	600 North, Main Street west to Main Street east	$23,000
Transmission	76	1310 North, 350 East to 380 East	$64,000
Transmission	77	Pioneer Avenue, 700 South to Millcreek Way	$185,000
Source	78	West B Well(s)	$2,855,000
Transmission	79	West B Well to Highway 36	$14,601,000
Storage	66b	Expand Equalization Tank for West B Wells	$2,724,000
Transmission	35	900 West, 900 South to 700 South	$403,000
Transmission	36	900 West, 700 South to 480 South	$447,000

Type	Map ID	Project Description	Cost
Transmission	37	900-1000 West, 480 South to Utah Avenue	$2,707,000
Transmission	38	1000 West, Utah Avenue to 750 North	$1,715,000
Transmission	39	PRV - 1000 West - Z8-Z9	$132,000
Transmission	40	Utah Avenue, 1000 West to Coleman Avenue	$832,000
Total Cost, Growth Projects, 7-20 Year Phasing (2027-2040)			**$67,528,000**
Growth Projects, 21-40 Year Phasing (2041-2060)			
City Participation to Upsize Developer-Installed Transmission	23	PRV - 1200 West - Z10-Z11	$33,000
Transmission	41	Main Street and Progress Way, 1540 North to 2000 North	$1,113,000
Transmission	42	2000 North and 400 East, Progress Way to 2200 North	$500,000
Transmission	43	400 East, 2400 North to 2550 North	$248,000
Source	80	South A Well	$2,855,000
Transmission	81	South A Well to Highway 36	$5,710,000
Transmission	82	Highway 36, South A to Honerine	$3,276,000
Storage	66c	Expand Equalization Tank for South A Well	$1,362,000
Source	83	Barrick Wells Refurbishment	$264,000
Transmission	84	Barrick Wells to Highway 36	$8,031,000
Transmission	85	Highway 36, Barrick to South A	$14,527,000
Storage	66d	Expand Equalization Tank for Barrick Wells	$2,724,000
Source	86	Vernon Wells	$11,414,000
Source	87	Arsenic Treatment Plant for Vernon Wells	$1,645,000
Transmission	88	Highway 36, Vernon to Barrick	$43,711,000
Storage	66e	Expand Equalization Tank for Vernon Wells	$5,447,000
Total Cost, Growth Projects, 21-40 Year Phasing (2041-2060)			**$102,860,000**

SUMMARY OF COSTS

Table 7-3 includes projects shown in Table 7-1 and Table 7-2 and is a summary of project costs through 2060. This cost represents a best estimate for total cost in 2020 dollars to maintain the desired level of service while accommodating future growth through 2060 conditions. This table does not include any financing costs associated with funding options.

Table 7-3: Summary of Costs, All Recommended Projects

Projects	Cost
Increase Fire Flows	$543,000
Other Projects	$2,914,000
Accommodate Future Demand, 0-6 Year	$21,269,000
Accommodate Future Demand, 7-20 Year	$67,528,000
Accommodate Future Demand, 21-40 Year	$102,860,000
Total	**$195,114,000**

FUNDING OPTIONS

Funding options for the recommended projects, in addition to water use fees, could include the following options: general obligation bonds, revenue bonds, State/Federal grants and loans, inter-fund loans and impact fees. The City may need to consider a combination of these funding options. The following discussion describes each of these options.

User Fees

User fees cover the costs of producing and delivering water and operating and maintaining the water system. User fees can also be considered as a funding source for construction of new capital facilities and improving the level of service. It is recommended that rate studies be performed periodically to ensure that the collected fees are adequate to cover costs, including debt funding.

General Obligation Bonds

The City may issue general obligation bonds to fund capital improvements and replacement. General obligation bonds are debt instruments backed by the full faith and credit of the City, which would be secured by an unconditional pledge of the City to levy assessments, charges, or ad valorem taxes necessary to retire the bonds. General obligation bonds are the lowest-cost form of debt financing available to local governments and can be combined with other revenue sources such as specific fees, or special assessment charges to form a dual security through the City's revenue generating authority. These bonds are supported by the City as a whole, so the amount of debt issued for the water system is limited to a fixed percentage of the real market value for taxable property within the City. This revenue source is subject to the vote of the residents in a municipal election.

Revenue Bonds

This form of debt financing is also available to the City for utility related capital improvements. Revenue bonds are not backed by the City as a whole but constitute a lien against the water service charge revenues of a Water Utility. Revenue bonds present a greater risk to the investor than do general obligation bonds, since repayment of debt depends on an adequate water revenue stream, legally defensible rate structure, and sound fiscal management by the issuing jurisdiction. Due to this increased risk, revenue bonds generally require a higher interest rate than general obligation bonds. This type of debt also has very specific coverage requirements in the form of a reserve fund specifying an amount, usually expressed in terms of average or maximum debt service due in any future year. This debt service is required to be held as a cash reserve for annual debt service payment to the benefit of bondholders.

State/Federal Grants and Loans

Historically, both local and county governments have experienced significant infrastructure funding support from state and federal government agencies in the form of block grants, direct grants in aid, interagency loans, and general revenue sharing. State and federal grants and loans may be investigated as possible funding sources for needed system improvements.

Interfund Loans

Moneys may be transferred between funds within a local government budget under certain conditions. If excess moneys are available in one fund, they may be loaned to another fund to help pay expenses related to the capital facilities plan, subject to City Council approval after a public hearing.

Impact Fees

Impact fees can be applied to water related facilities under the Utah Impact Fees Act. The Utah Impacts Fees Act is designed to provide a framework for establishing new development assessments. It is also designed to establish the basis for the fee calculation which the City must follow to comply with the statute. However, the fundamental objective for the fee structure is the imposition on new development of only those costs associated with providing or expanding water infrastructure to meet the capacity needs created by new development. Also, impact fees cannot be applied retroactively.

SUMMARY OF RECOMMENDATIONS

Several recommendations were made throughout the master plan report. The following is a summary of the recommendations.

1. Connect the Park Well to Zone 7.
2. Connect the Berra Well to Zone 9. Consider installing a booster pump to allow pumping to Zone 8 for redundancy.
3. Continue to pursue new water sources.
4. Complete project included in the capital facility plan.
5. Maintain sufficient levels in storage tanks to provide the selected levels of fire flow and emergency water.
6. Require future construction to use building materials and approved fire sprinklers as needed to reduce required fire flows to the amounts the City system can provide.
7. Continue to update the model as the water system changes (including verification of pipe diameters). Use the model as a tool for determining the effect of changes to the system and capacity of the system to provide fire flows.
8. Continue to conduct fire flow tests on an ongoing basis to refine the model calibration as system conditions change.
9. Consider implementing energy optimization recommendations.
10. Develop an Impact Fee Facilities Plan, including a Capital Facilities Plan which indicates project priorities and schedules, for the six-year horizon.
11. Develop an Impact Fee Analysis showing the impact fee levels needed to accomplish the IFFP in #10, above.

TOOELE CITY DRINKING WATER MASTER PLAN	RECOMMENDED CAPITAL FACILITY PROJECTS	FIGURE 7-1

HANSEN ALLEN & LUCE inc ENGINEERS

Date: 4/24/2021
Document Path: H:\Projects\149 - Tooele City\48.100 - 2019 Water Master Plan\GIS\Tooele Capital Facility Plan.mxd

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APPENDIX A

Growth Projections and Projected ERCs

Table A-1
Projected ERCs

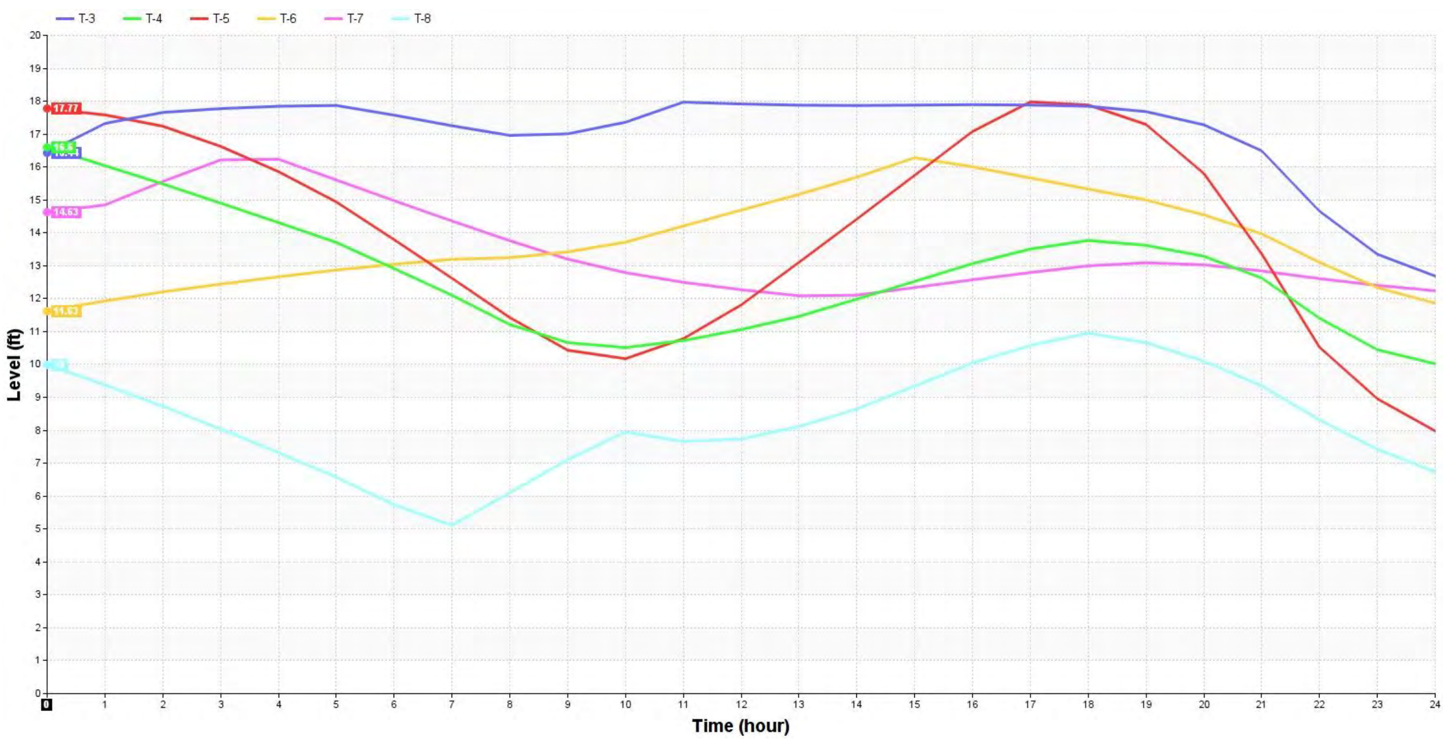
Year	Projected ERCs
2020	13,960
2021	14,332
2022	14,706
2023	15,081
2024	15,453
2025	15,828
2026	16,201
2027	16,575
2028	16,950
2029	17,322
2030	17,697
2031	17,983
2032	18,273
2033	18,560
2034	18,848
2035	19,135
2036	19,424
2037	19,711
2038	20,000
2039	20,289
2040	20,577
2041	20,731
2042	20,887
2043	21,043
2044	21,197
2045	21,353
2046	21,508
2047	21,664
2048	21,818
2049	21,973
2050	22,130
2051	22,288
2052	22,447
2053	22,607
2054	22,768
2055	22,930
2056	23,093
2057	23,258
2058	23,424
2059	23,591
2060	23,759

APPENDIX B
Calibration Data

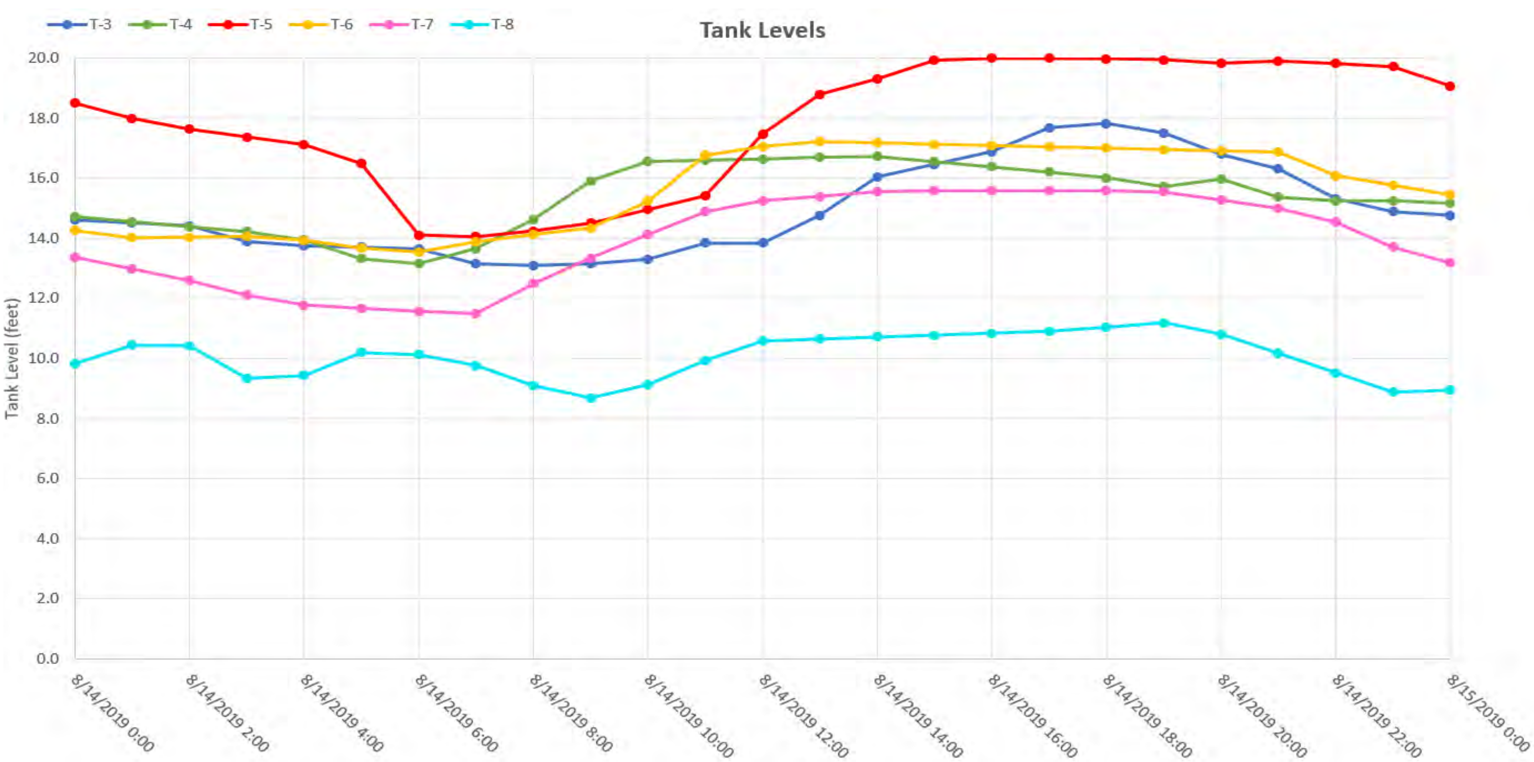
Tooele City Drinking Water System – Existing Model Calibration

Tooele City modeled tank level patterns show good correlation to SCADA tank levels. An exact match is not achieved, but the tanks show similar cyclical behavior, and the model is considered sufficiently accurate to represent conditions likely to be experienced in the water delivery system.

Tooele City Existing system model:



City SCADA from peak week:



Field pressures collected in Tooele City from September 2019 to March 2020 are shown below. All pressures were obtained outside the peak demand time of year represented in the model, so an exact correlation is not expected. Most zones show a good correlation between field pressures and modeled pressures. The model is considered to adequately represent the actual field conditions. It is noted that pressures in Zone 5 (supplied by Tank 3) are consistently higher in the field than in the model. The elevation of the tank in the model has been verified with City elevation data. It is possible this zone was being supplied by a PRV set to a higher HGL than Tank 3 during the time of these field tests.

Table B- 1: Tooele City Drinking Water System - Field Pressures and Modeled Pressures

Zone	Date	Location	Field Pressure (psi)	Modeled Pressure (psi)
Z9	9/16/2019	150 E 2050 N	105	93-100
Z6	9/17/2019	Howsden 1250 E Smelter Road	54-98	69-100
Z2	9/26/2019	673 Deer Hollow Road	68-70	70
Z5	10/10/2019	Skyline/Main Street or Hampton/Main	72-74	51-54
Z8East	11/15/2019	600 North Main Street	59	51-58
Z7	"	550 North Garden Street	95	85-100
Z7	"	600 North Garden Street	98	85-100
Z8East	"	650 North Garden Street	58	50-58
Z8East	"	700 North Garden Street	61, 62	53-61
Z7	"	550 North 100 East	92	83-98
Z7	"	600 North 100 East	95	88-102
Z8East	"	700 North 100 East	58, 60	49-57
Z8East	"	750 North 100 East (east side)	60	42-60
Z7	"	620 North Parkway Avenue	95	88-102
Z7	"	700 North Parkway Avenue	100	92-106
Z7	"	700 North Nelson Avenue	100	91-105
Z5	1/22/2020	900 S Coleman Street	91	78-87
Z8West	1/28/2020	102 Feldspar Street	83	83
Z6	2/14/2020	360 W 200 S	120	83-120
Z5	2/26/2020	Hood Street, near car wash	70-72	48-58
Z9	2/29/2020	400 W 2000 N	124	115-123
Z5	3/3/2020	Canyon Road, south end on dead end	47-50	28-33
Z3	3/4/2020	Skyline at 7th Street	86-103	51-94
Z5	3/5/2020	480 S 100 W	86-88	64-75
Z10	3/19/2020	454 W 1860 N	64-65	106-114

APPENDIX C

Unit Costs and Cost Estimates

AVERAGE WATER PIPE COST PER FOOT

Diameter (in)	Diameter (ft)	Outside Diameter (ft)	Pipe Material & Installation (1)	Excavation	Imported Bedding Installed	Hauling Excess Native Mat'l	Trench Backfill Installed (3)	Trench Box per Day (2)	Average Daily Output	Trench Box Cost	Top Trench Width (ft)	Road Repair Width (ft)	Asphalt Cost	Service Lateral Cost	Fire Hydrant Cost	Valves & Fittings Cost	Pipeline Connection Costs	Conflicts (9)	Trench Dewatering (4)	Subtotal Cost per Foot of Pipe	Subtotal Cost Out of Street	Diameter (in)
4	0.3	0.39	9.75	2.75	9.42	0.94	2.68	210.00	380.00	0.55	2.99	6.99	31.56	25.00	16.00	1.63	12.00	0.00	8.72	121.00	91.19	4
6	0.5	0.58	13.15	3.07	10.96	1.12	2.88	210.00	316.00	0.66	3.18	7.18	32.22	25.00	16.00	2.26	13.63	0.00	9.82	130.78	100.42	6
8	0.7	0.78	18.65	3.40	12.54	1.32	3.09	210.00	264.00	0.80	3.38	7.38	32.89	25.00	16.00	3.48	15.25	0.00	11.03	143.45	112.53	8
10	0.8	0.97	25.00	3.75	14.16	1.53	3.29	210.00	220.00	0.95	3.57	7.57	33.56	25.00	16.00	5.60	22.31	0.00	12.41	163.56	132.09	10
12	1.0	1.17	32.50	4.12	15.81	1.76	3.49	210.00	186.00	1.13	3.77	7.77	34.23	25.00	16.00	3.94	29.38	0.00	13.87	181.23	149.20	12
14	1.2	1.36	27.00	4.50	17.49	2.01	3.69	210.00	213.00	0.99	3.96	7.96	34.90	25.00	16.00	5.89	32.20	0.00	13.48	183.15	150.57	14
16	1.3	1.56	31.00	4.90	19.21	2.27	3.90	210.00	200.00	1.05	4.16	8.16	35.57	25.00	16.00	7.62	35.20	9.80	14.30	205.81	162.87	16
18	1.5	1.75	45.50	5.32	20.96	2.54	4.10	210.00	160.00	1.31	4.35	8.35	36.24	25.00	16.00	9.85	38.00	11.06	16.28	232.16	187.41	18
20	1.7	1.94	52.00	5.75	22.75	2.83	4.30	210.00	133.00	1.58	4.54	8.54	36.91	25.00	16.00	12.73	41.00	11.96	18.29	251.09	204.88	20
24	2.0	2.33	72.00	6.67	26.43	3.46	4.70	210.00	107.00	1.96	4.93	8.93	38.25	25.00	16.00	19.61	46.80	14.12	21.42	296.42	246.95	24
30	2.5	2.92	113.00	8.17	32.22	4.53	5.31	210.00	80.00	2.63	5.52	9.52	40.25	25.00	16.00	25.48	55.36	17.73	26.63	372.30	317.54	30
36	3.0	3.50	158.00	9.81	38.31	5.73	5.92	210.00	80.00	2.63	6.10	10.10	42.26	25.00	16.00	33.45	64.00	21.45	27.97	450.53	390.39	36

Reference: 2020 RS Means Heavy Construction Cost Data Updated by: JKN 12/7/2020

Assumptions:		Equation #:	Costs:	
N	**Total Import Trench Backfill? (Y/N)**	1	$ 14.62	/CY Native Trench backfill - sec. 31 23 23.16 (0200): Fill by borrow [sand, dead or bank x 1.20 O&P] w/o materials (26.98-18.25)*(32.50/26.98) and convert from loose to compacted volume. $10.52/LCY * 1.39 LCY/ECY (see Note 5)
Y	**Dewatering? (Y/N)**	2	$ 57.86	/CY Imported Select Fill - sec. 31 23 23.16 (0200), 31 23 23.20 (4266), 31 23 23.23 (8050): Sand, dead or bank w/ hauling and compaction. ($32.50/LCY + $4.99/LCY)*1.39 LCY/ECY + $5.75/ECY (see Note 5)
PVC	**Pipe Material (PVC/DIP/HDPE) - Note 1**	3	$ 5.90	/CY Excavation - sec. 31 23 16.13 (6372): 10-14 ft deep, 1 CY excavator, Trench Box.
10	v :1h trench side slope (use trench boxes)	4	$ 30.96	/SY 4" Asphalt Pavement - sec. 32 11 23.23 (0390), 31 23 23.20 (4268), 32 12 16.13 (0120), 32 12 16.13 (0380): 9" Bank Run GravelBase Course ($7.10/SY), 2" Binder ($9.55/SY), 2" Wear ($10.70/SY [4"=$20.50/SY]) and Hauling [Item 4268] ($7.
4	' average depth to top of pipe	5	$ 3.76	/LF 4" Asphalt cutting - sec. 02 41 19.25 (0015, 0020): Saw cutting asphalt up to 3" deep ($2.44/LF), each additional inch of depth ($1.37/LF)
0.33	' thick asphalt road covering	6	$ 2,500.00	/EA Service Lateral Connection (see Note 7)
0.75	' thick untreated base course	7	$ 8,000.00	/EA Fire hydrant assembly including excavation and backfill (see Note 8)
2	ft + Outside Diameter = Bottom trench widtl	8	$ 5.63	/CY Hauling - sec. 31 23 23.20 (4262): 20 CY dump truck, 6 mile round trip and conversion from loose to compacted volume. $4.05/LCY * 1.39 LCY/ECY (see Note 5)
1	ft bedding over pipe	9	$ 210.00	/day Trench Box - sec. 31 52 16.10 (4500): 7' deep, 16' x 8'
0.5	ft bedding under pipe	10	$ 62.03	/CY Stabilization Gravel - sec. 31 23 23.16 (0050), 31 23 23.23 (8050), 31 23 23.20 (4266): Bank Run Gravel ($35.50/LCY * 1.39 LCY/ECY) plus compaction ($5.75/ECY) and hauling ($4.99/LCY * 1.39 LCY/ECY) (see Note 5)
10	# of service laterals per 1000 ft	11	$ 1,227.00	/day Dewatering - sec. 31 23 19.20 (1000, 1020): 4" diaphram pump, 8 hrs attended ($1,100.00/day). Second pump ($127.00/day)
2	# of fire hydrants per 1000 ft			
1	# of valves per 1000 ft (see Note 10)			
1	# of fittings per 1000 ft (see Note 10)			
2	# pipeline connections per 1000 ft			

NOTES:

(1) For RS Mean section reference and pipe description see "PIPE AND FITTING COSTS" below. "Material Costs" tab also has costs for Prestressed Concrete pipe (PCCP) and steel pipes of various wall thicknesses.
(2) 7' deep trench box (16' x 8') - on page 263
(3) Backfill Material & Installation assumes in street. For out of street unit costs, the backfill material cost has been added in place of base course and asphalt.
(4) Dewatering assumes 1' stabilization gravel at the bottom of the trench plus dewatering pumps
(5) Conversion from loose to compacted volumes assumes 125 PCF for compacted density and 90 PCF for loose density. Or (125 PCF/ECY)/(90 PCF/LCY) = 1.39 LCY/ECY
(6) Conversion from cubic yards to square yards for hauling of asphalt paving assumed a total thickness of 13". 3 ft x 3 ft x (13 in)/(12 in/ft) = 0.361 CY/SY
(7) Service Lateral costs are based on average service connections from projects in Murray (026.46.100), Midvale (141.28.200) , and South Jordan (176.35.100).
(8) Fire Hydrant assembly costs are based on average service connections from projects in Murray (026.46.100), Midvale (141.28.200) , and South Jordan (176.35.100).
(9) Conflicts amounted to be 2% of the cost on the Springville 400 South Pipeline project. Use 5% of total cost per ft.
(10) Joint Restraint has NOT been included in this spreadsheet.

Abbreviations:

VLF	vertical lineal foot
PCF	pounds per cubic foot
LCY	loose cubic yard
ECY	embankment cubic yard

Tooele City Drinking Water Master Plan - Capital Facility Plan Project Cost Estimates
Tooele City
December 2020, April 2021
by Hansen, Allen & Luce, Inc., BDM & KGJ

Map ID	Type	Description	Year	Diameter	In/Out of Street	Pipe Material	Project Type	Location (Street)	Begin	End	Quantity	Unit	Unit Cost	Developer Unit Cost	City Unit Cost	Cost	Contingency	Mobilization, Survey, Testing, SWPPP, etc.	Engineering	Total	Rounded
Fire Flow Projects																					
1	Pipe	Fire project - Benchmark Village	2021	10	Out	PVC	Existing Fire Flow	Benchmark Village	Vista Circle	Benchmark Village	299	LF	$ 132		$ 132	$ 39,495	$ 3,949	$ 13,033	$ 8,472	$ 64,949	$ 65,000
2	Pipe	Fire - 200 West	2021	8	In	PVC	Existing Fire Flow	200 West	Vine Street	Buffalo Boulevard	656	LF	$ 143		$ 143	$ 94,103	$ 9,410	$ 31,054	$ 20,185	$ 154,753	$ 155,000
3	Pipe	Fire - Millennial Park	2021	8	In	PVC	Existing Fire Flow	300 West	450 North	Joshua Street	280	LF	$ 143		$ 143	$ 40,166	$ 4,017	$ 13,255	$ 8,616	$ 66,053	$ 67,000
4	PRV	Fire - connection added with Millennial Park	2021	8	In	PVC	Existing Fire Flow	300 East Z7-Z8 East			1	Each	$ 80,000		$ 80,000	$ 80,000	$ 8,000	$ 26,400	$ 17,160	$ 131,560	$ 132,000
5	Pipe	Fire - 370 West	2021	8	In	PVC	Existing Fire Flow	370 West	400 North	500 North	379	LF	$ 143		$ 143	$ 54,368	$ 5,437	$ 17,941	$ 11,662	$ 89,407	$ 90,000
6	Pipe	Fire - Oak Street connection to Coleman	2021	8	Out	PVC	Existing Fire Flow	Oak Street	Coleman Street	Oak Street	182	LF	$ 113		$ 113	$ 20,480	$ 2,048	$ 6,759	$ 4,393	$ 33,680	$ 34,000
7	Pipe	Fire - 1000 West	2021	10	In	PVC	Existing Fire Flow	1000 West	Utah Avenue	Rogers Street	4,176	LF	$ 164		$ 164	$ 683,027	$ 68,303	$ 225,399	$ 146,509	$ 1,123,237	
																					$ 543,000
City Requested Projects																					
8	Pipe	Tank 5 Outlet - connect from N to East	2021	12	Out	PVC	City Request	Tank 5	North outlet	East outlet	244	LF	$ 149		$ 149	$ 36,405	$ 3,640	$ 12,014	$ 7,809	$ 59,868	$ 60,000
9	Pipe	Zone 3 to Middle Canyon Road Backup	2021	12	Out	PVC	City Request	Down slope	270 South	Middle Canyon Road	550	LF	$ 149		$ 149	$ 82,060	$ 8,206	$ 27,080	$ 17,602	$ 134,948	$ 135,000
10	Pipe	700 South Booster to Tank 3 replacement	2025	16	In	PVC	City Request	700 South	900 West	Tank 3	6,897	LF	$ 206		$ 206	$ 1,419,472	$ 141,947	$ 468,426	$ 304,477	$ 2,334,321	$ 2,335,000
		Working in UDOT ROW									1	LS	$ 233,500		$ 233,500	$ 233,500	$ 23,350	$ 77,055	$ 50,086	$ 383,991	$ 384,000
																					$ 2,914,000
Developer-Installed Transmission- Minimum Size																					
Projects not shown. Developers will bear costs of infrastructure, and location/alignment will depend on development plans.																					
Developer-Installed Transmission Larger than Minimum Size																					
12	Pipe	Bevan and Country View Villas	2024	12	In	PVC	Future Developer - Upsize	Brook Avenue	700 North	1000 North	2,344	LF	$ 181	$ 143	$ 38	$ 88,556	$ 8,856	$ 29,224	$ 18,995	$ 145,631	$ 146,000
13	Pipe	400 East	2025	12	In	PVC	Future Developer - Upsize	400 East	2200 North	2275 North	441	LF	$ 181	$ 143	$ 38	$ 16,661	$ 1,666	$ 5,498	$ 3,574	$ 27,399	$ 28,000
14	Pipe	Broadway Avenue	2029	12	In	PVC	Future Developer - Upsize	Broadway Avenue	1310 North	1500 North	1,010	LF	$ 181	$ 143	$ 38	$ 38,158	$ 3,816	$ 12,592	$ 8,185	$ 62,751	$ 63,000
15	Pipe	1000 West	2029	14	In	PVC	Future Developer - Upsize	1000 West	750 North	1500 North	4,658	LF	$ 183	$ 143	$ 40	$ 184,923	$ 18,492	$ 61,024	$ 39,666	$ 304,105	$ 305,000
16	Pipe	Main Street	2029	12	In	PVC	Future Developer - Upsize	Main Street	2550 North	3000 North	3,080	LF	$ 181	$ 143	$ 38	$ 116,362	$ 11,636	$ 38,400	$ 24,960	$ 191,358	$ 192,000
		Working in UDOT ROW									1	LS	$ 19,200		$ 19,200	$ 19,200	$ 1,920	$ 6,336	$ 4,118	$ 31,574	$ 32,000
17	PRV	Zone boundary PRV	2029	12	In	PVC	Future Developer - Upsize	400 East - Z9-Z10			1	Each	$ 100,000	$80,000	$ 20,000	$ 20,000	$ 2,000	$ 6,600	$ 4,290	$ 32,890	$ 33,000
18	PRV	Zone boundary PRV	2029	12	In	PVC	Future Developer - Upsize	400 East - Z10-Z11			1	Each	$ 100,000	$80,000	$ 20,000	$ 20,000	$ 2,000	$ 6,600	$ 4,290	$ 32,890	$ 33,000
19	Pipe	400 West	2029	12	In	PVC	Future Developer - Upsize	400 West	2400 North	Tiger Drive	3,975	LF	$ 181	$ 143	$ 38	$ 150,176	$ 15,018	$ 49,558	$ 32,213	$ 246,964	$ 247,000
20	PRV	Zone boundary PRV	2029	12	In	PVC	Future Developer - Upsize	400 West - Z10-Z11			1	Each	$ 100,000	$80,000	$ 20,000	$ 20,000	$ 2,000	$ 6,600	$ 4,290	$ 32,890	$ 33,000
21	Pipe	Rogers Street	2029	12	In	PVC	Future Developer - Upsize	Rogers Street	600 West	1000 West	2,247	LF	$ 181	$ 143	$ 38	$ 84,892	$ 8,489	$ 28,014	$ 18,209	$ 139,604	$ 140,000
22	Pipe	2600 North	2039	12	In	PVC	Future Developer - Upsize	2600 North	100 West	600 East	2,748	LF	$ 181	$ 143	$ 38	$ 103,819	$ 10,382	$ 34,260	$ 22,269	$ 170,731	$ 171,000
23	PRV	Zone boundary PRV	2059	12	In	PVC	Future Developer - Upsize	1200 West - Z10-Z11			1	Each	$ 100,000	$80,000	$ 20,000	$ 20,000	$ 2,000	$ 6,600	$ 4,290	$ 32,890	$ 33,000
																					$ 1,456,000
Future Transmission (not directly associated with a source project)																					
Tank 4 Fill Line from Canyon Rim Road and Outlet Line																					
24	Pipe	Tank 4 fill line	2022	12	Out	PVC	Future Transmission	Tank 4	Canyon Rim Road	Tank 4	208	LF	$ 149		$ 149	$ 31,034	$ 3,103	$ 10,241	$ 6,657	$ 51,035	$ 52,000
25	Valve	Control valves for feed into Tank 4	2022	-			Future Transmission	Near Tank 4			1	Each	$ 80,000		$ 80,000	$ 80,000	$ 8,000	$ 26,400	$ 17,160	$ 131,560	$ 132,000
26	Pipe	Tank 4 to Skyline Drive transmission	2022	12	In	PVC	Future Transmission	Mountaineer Drive	Tank 4	Skyline Drive	973	LF	$ 181		$ 181	$ 176,337	$ 17,634	$ 58,191	$ 37,824	$ 289,986	$ 290,000
																					$ 474,000
7th Street Transmission																					
27	Pipe	7th Street transmission	2022	8	In	PVC	Future Transmission	7th Street	Skyline Drive	Vine Street	2,972	LF	$ 143		$ 143	$ 426,333	$ 42,633	$ 140,690	$ 91,449	$ 701,105	$ 702,000
28	Pipe	7th Street transmission	2022	10	In	PVC	Future Transmission	7th Street	Birch Street	Oquirrh Avenue	124	LF	$ 164		$ 164	$ 20,281	$ 2,028	$ 6,693	$ 4,350	$ 33,353	$ 34,000
																					$ 736,000
Droubay Road Transmission																					
29	Pipe	Droubay Road transmission	2027	10	In	PVC	Future Transmission	Droubay Road	280 North	670 North	3,025	LF	$ 164		$ 164	$ 494,769	$ 49,477	$ 163,274	$ 106,128	$ 813,648	$ 814,000
30	Pipe	Droubay Road transmission	2027	8	Out	PVC	Future Transmission	Parallel to Droubay Road	Valley View Drive	Fox Run Drive	1,500	LF	$ 113		$ 113	$ 168,795	$ 16,880	$ 55,702	$ 36,207	$ 277,583	$ 278,000
																					$ 1,092,000
Zone 8 (Coleman Street) to Zone 9 & 10 Transmission																					
31	Pipe	Coleman Street to Zone 9 transmission	2028	8	In	PVC	Future Transmission	Coleman Street	400 North	650 North	2,387	LF	$ 143		$ 143	$ 342,415	$ 34,242	$ 112,997	$ 73,448	$ 563,102	$ 564,000
32	Pipe	Coleman Street to Zone 9 transmission	2028	12	In	PVC	Future Transmission	650 North	680 West	700 West	525	LF	$ 181		$ 181	$ 95,146	$ 9,515	$ 31,398	$ 20,409	$ 156,467	$ 157,000
33	Pipe	Coleman Street to Zone 9 transmission	2028	12	In	PVC	Future Transmission	600 West/400 West	650 North	1500 North	5,645	LF	$ 181		$ 181	$ 1,023,043	$ 102,304	$ 337,604	$ 219,443	$ 1,682,395	$ 1,683,000
		Cross Union Pacific Railroad									1	LS	$ 200,000		$ 200,000	$ 200,000	$ 20,000	$ 66,000	$ 42,900	$ 328,900	$ 329,000
34	Pipe	Coleman Street to Zone 9 transmission	2028	8	In	PVC	Future Transmission	400 West	1500 North	2000 North	2,641	LF	$ 143		$ 143	$ 378,851	$ 37,885	$ 125,021	$ 81,264	$ 623,021	$ 624,000
																					$ 3,357,000
Tank 7 to Zone 9 & 10 Transmission																					
35	Pipe	Tank 7 to Zone 9 transmission	2040	16	In	PVC	Future Transmission	900 West	900 South	700 South	1,189	LF	$ 206		$ 206	$ 244,708	$ 24,471	$ 80,754	$ 52,490	$ 402,422	$ 403,000
36	Pipe	Tank 7 to Zone 9 transmission	2040	16	In	PVC	Future Transmission	900 West	700 South	480 South	1,318	LF	$ 206		$ 206	$ 271,258	$ 27,126	$ 89,515	$ 58,185	$ 446,083	$ 447,000
37	Pipe	Tank 7 to Zone 9 transmission	2040	20	In	DIP	Future Transmission	900-1000 West	480 South	Utah Avenue	5,182	LF	$ 318		$ 318	$ 1,645,907	$ 164,591	$ 543,149	$ 353,047	$ 2,706,694	$ 2,707,000
38	Pipe	Tank 7 to Zone 9 transmission	2040	16	In	PVC	Future Transmission	1000 West	Utah Avenue	750 North	4,095	LF	$ 206		$ 206	$ 842,792	$ 84,279	$ 278,121	$ 180,779	$ 1,385,971	$ 1,386,000
		Cross Union Pacific Railroad									1	LS	$ 200,000		$ 200,000	$ 200,000	$ 20,000	$ 66,000	$ 42,900	$ 328,900	$ 329,000
39	PRV	Tank 7 to Zone 9 transmission	2040	16			Future Transmission	1000 West Z8-Z9			1	Each	$ 80,000		$ 80,000	$ 80,000	$ 8,000	$ 26,400	$ 17,160	$ 131,560	$ 132,000
40	Pipe	Tank 7 to Zone 9 transmission	2040	12	In	PVC	Future Transmission	Utah Avenue	1000 West	Coleman Avenue	2,789	LF	$ 181		$ 181	$ 505,450	$ 50,545	$ 166,799	$ 108,419	$ 831,213	$ 832,000
																					$ 6,236,000

Tooele City Drinking Water Master Plan - Capital Facility Plan Project Cost Estimates
Tooele City
December 2020, April 2021
by Hansen, Allen & Luce, Inc., BDM & KGJ

Map ID	Type	Description	Year	Diameter	In/Out of Street	Pipe Material	Project Type	Location (Street)	Begin	End	Quantity	Unit	Unit Cost	Developer Unit Cost	City Unit Cost	Cost	Contingency	Mobilization, Survey, Testing, SWPPP, etc.	Engineering	Total	Rounded
Zone 8 (Main Street) to Zone 9 & 10 Transmission																					
41	Pipe	Main Street to Zone 9 transmission	2042	12	In	PVC	Future Transmission	Main Street and Progress W	1540 North	2000 North	2,628	LF	$ 181		$ 181	$ 476,272	$ 47,627	$ 157,170	$ 102,160	$ 783,230	$ 784,000
		Cross Union Pacific Railroad									1	LS	$ 200,000		$ 200,000	$ 200,000	$ 20,000	$ 66,000	$ 42,900	$ 328,900	$ 329,000
42	Pipe	Main Street to Zone 9 transmission	2042	10	In	PVC	Future Transmission	2000 North and 400 East	Progress Way	2200 North	1,858	LF	$ 164		$ 164	$ 303,894	$ 30,389	$ 100,285	$ 65,185	$ 499,754	$ 500,000
43	Pipe	Transmission within Zone 9-10	2042	8	In	PVC	Future Transmission	400 East	2400 North	2550 North	1,049	LF	$ 143		$ 143	$ 150,479	$ 15,048	$ 49,658	$ 32,278	$ 247,463	$ 248,000
																					$ 1,861,000
Future Source, including Transmission directly associated with source projects																					
Park Well																					
44	Well	Park Well House	2021				Future Source	Park Well			1		$ 600,000		$ 600,000	$ 600,000	$ 60,000	$ 198,000	$ 128,700	$ 986,700	$ 987,000
45	Pipe	Park Well Transmission to Zone 7	2021	12	In	PVC	Future Transmission	First/Vine/Main Street	Red DelPapa Park	Utah Avenue	3,929	LF	$ 181		$ 181	$ 712,053	$ 71,205	$ 234,977	$ 152,735	$ 1,170,971	$ 1,171,000
																					$ 2,158,000
Berra Well																					
46	Well	Berra Well House	2021				Future Source	Berra Well			1		$ 600,000		$ 600,000	$ 600,000	$ 60,000	$ 198,000	$ 128,700	$ 986,700	$ 987,000
47	Tank	Equalization Tank for Berra well	2021	-			Future Storage	Berra well			720,000	Gallon	$ 1.15		$ 1.15	$ 828,000	$ 82,800	$ 273,240	$ 177,606	$ 1,361,646	$ 1,362,000
48	Pump	Booster out of Berra tank	2021	-			Future Source	Berra well			1	Each	$ 243,000		$ 243,000	$ 243,000	$ 24,300	$ 80,190	$ 52,124	$ 399,614	$ 400,000
49	Pipe	Berra well transmission to Z9	2021	12	Out	PVC	Future Transmission	none	Berra Well	2000 North	3,471	LF	$ 149		$ 149	$ 517,873	$ 51,787	$ 170,898	$ 111,084	$ 851,642	$ 852,000
50	Pipe	Berra well transmission to Z8 East	2021	12	Out	PVC	Future Transmission	none	Berra Well	1280 North	861	LF	$ 149		$ 149	$ 128,461	$ 12,846	$ 42,392	$ 27,555	$ 211,254	$ 212,000
51	Pipe	Z8-Z9 at Berra Boulevard	2021	12	Out	PVC	Future Transmission	1570 North	1280 North	Berra Boulevard	772	LF	$ 149		$ 149	$ 115,182	$ 11,518	$ 38,010	$ 24,707	$ 189,417	$ 190,000
52	PRV	Zone boundary PRV	2021	12		PVC	Future Transmission	Berra Drive Z8-Z9			1	Each	$ 80,000		$ 80,000	$ 80,000	$ 8,000	$ 26,400	$ 17,160	$ 131,560	$ 132,000
																					$ 4,135,000
East A Well																					
53	Well	Exploratory borehole	2023				Future Source	East A site			1	Each	$ 70,000		$ 70,000	$ 70,000	$ 7,000	$ 23,100	$ 15,015	$ 115,115	$ 116,000
	Well	Production well	2023				Future Source	East A site			1	Each	$ 1,000,000		$ 1,000,000	$ 1,000,000	$ 100,000	$ 330,000	$ 214,500	$ 1,644,500	$ 1,645,000
	Well	Well House	2023				Future Source	East A site			1	Each	$ 600,000		$ 600,000	$ 600,000	$ 60,000	$ 198,000	$ 128,700	$ 986,700	$ 987,000
	Well	Easements	2023				Future Source	East A site			0.5	Acre	$ 65,000		$ 65,000	$ 32,500	$ 3,250	$ 10,725	$ 6,971	$ 53,446	$ 54,000
54	WTP	East A Arsenic Treatment Plant	2023	-			Future Source	East A site			1	Each	$ 1,000,000		$ 1,000,000	$ 1,000,000	$ 100,000	$ 330,000	$ 214,500	$ 1,644,500	$ 1,645,000
55	Pipe	East A to Zone 10 transmission line	2023	12	In	PVC	Future Transmission		East A Well	Zone 10	15,400	LF	$ 181		$ 181	$ 2,790,942	$ 279,094	$ 921,011	$ 598,657	$ 4,589,704	$ 4,590,000
																					$ 9,037,000
East C Well																					
56	Well	Exploratory borehole	2025				Future Source	East C site			1	Each	$ 70,000		$ 70,000	$ 70,000	$ 7,000	$ 23,100	$ 15,015	$ 115,115	$ 116,000
	Well	Production well	2025				Future Source	East C site			1	Each	$ 1,000,000		$ 1,000,000	$ 1,000,000	$ 100,000	$ 330,000	$ 214,500	$ 1,644,500	$ 1,645,000
	Well	Well House	2025				Future Source	East C site			1	Each	$ 600,000		$ 600,000	$ 600,000	$ 60,000	$ 198,000	$ 128,700	$ 986,700	$ 987,000
	Well	Land/Easements	2025				Future Source	East C site			1	Acre	$ 65,000		$ 65,000	$ 65,000	$ 6,500	$ 21,450	$ 13,943	$ 106,893	$ 107,000
57	Pipe	East C well to Z9 transmission	2025	12	In	PVC	Future Transmission		East C Well	Zone 9	5,704	LF	$ 181		$ 181	$ 1,033,736	$ 103,374	$ 341,133	$ 221,736	$ 1,699,979	$ 1,700,000
																					$ 4,555,000
West A Well																					
58	Well	Exploratory borehole	2028				Future Source	West A site			1	Each	$ 70,000		$ 70,000	$ 70,000	$ 7,000	$ 23,100	$ 15,015	$ 115,115	$ 116,000
	Well	Production well	2028				Future Source	West A site			1	Each	$ 1,000,000		$ 1,000,000	$ 1,000,000	$ 100,000	$ 330,000	$ 214,500	$ 1,644,500	$ 1,645,000
	Well	Well House	2028				Future Source	West A site			1	Each	$ 600,000		$ 600,000	$ 600,000	$ 60,000	$ 198,000	$ 128,700	$ 986,700	$ 987,000
	Well	Land/Easements	2028				Future Source	West A site			1	Acre	$ 65,000		$ 65,000	$ 65,000	$ 6,500	$ 21,450	$ 13,943	$ 106,893	$ 107,000
59	Pipe	West A well to Z10	2028	16	Out	PVC	Future Transmission		West A Well	Zone 10	27,750	LF	$ 163		$ 163	$ 4,519,643	$ 451,964	$ 1,491,482	$ 969,463	$ 7,432,552	$ 7,433,000
60	Tank	Equalization tank for West A sources	2028	-			Future Storage	West of City			720,000	Gallon	$ 1.15		$ 1.15	$ 828,000	$ 82,800	$ 273,240	$ 177,606	$ 1,361,646	$ 1,362,000
61	Pump	Booster out of West A tank	2028	-			Future Source	West of City			1	Each	$ 243,000		$ 243,000	$ 243,000	$ 24,300	$ 80,190	$ 52,124	$ 399,614	$ 400,000
																					$ 12,050,000
Honerine Mine Well																					
62	Well	Exploratory borehole	2032				Future Source	Honerine Mine site			1	Each	$ 70,000		$ 70,000	$ 70,000	$ 7,000	$ 23,100	$ 15,015	$ 115,115	$ 116,000
	Well	Production well	2032				Future Source	Honerine Mine site			1	Each	$ 1,000,000		$ 1,000,000	$ 1,000,000	$ 100,000	$ 330,000	$ 214,500	$ 1,644,500	$ 1,645,000
	Well	Well House	2032				Future Source	Honerine Mine site			1	Each	$ 600,000		$ 600,000	$ 600,000	$ 60,000	$ 198,000	$ 128,700	$ 986,700	$ 987,000
	Well	Land/Easements	2032				Future Source	Honerine Mine site			1	Acre	$ 65,000		$ 65,000	$ 65,000	$ 6,500	$ 21,450	$ 13,943	$ 106,893	$ 107,000
63	Pipe	Transmission from site to SR-36	2032	10	Out	PVC	Future Transmission		Honerine	SR-36	2,833	LF	$ 132		$ 132	$ 374,211	$ 37,421	$ 123,490	$ 80,268	$ 615,390	$ 616,000
64	Pipe	Highway 36 transmission - to West B	2032	30	Out	DIP	Future Transmission	Highway 36	Honerine	West B	10,861	LF	$ 403		$ 403	$ 4,374,268	$ 437,427	$ 1,443,508	$ 938,280	$ 7,193,483	$ 7,194,000
65	Pipe	Highway 36 transmission - West B to City	2032	30	In	DIP	Future Transmission	Highway 36	West B	Coleman Avenue	8,068	LF	$ 469		$ 469	$ 3,786,312	$ 378,631	$ 1,249,483	$ 812,164	$ 6,226,591	$ 6,227,000
66	Tank	Equalization tank for Honerine	2032				Future Storage	South of City			720,000	Gallon	$ 1		$ 1	$ 828,000	$ 82,800	$ 273,240	$ 177,606	$ 1,361,646	$ 1,362,000
66f	Pump	Booster out of Honerine tank	2032	-			Future Source	South of City			1	Each	$ 243,000		$ 243,000	$ 243,000	$ 24,300	$ 80,190	$ 52,124	$ 399,614	$ 400,000
67	Pipe	Transmission from south sources to T7, Z5-Z7	2032	24	In	PVC	Future Transmission	Coleman Street	Highway 36	Timpie Road	1,651	LF	$ 296		$ 296	$ 489,389	$ 48,939	$ 161,499	$ 104,974	$ 804,801	$ 805,000
68	Pipe	Transmission from south sources to Tank 7	2032	16	In	PVC	Future Transmission	Timpie Road	Coleman Street	900 West	2,333	LF	$ 206		$ 206	$ 480,155	$ 48,015	$ 158,451	$ 102,993	$ 789,614	$ 790,000
69	Pipe	Transmission from south sources to Z5-Z7	2032	20	In	PVC	Future Transmission	Coleman Street	Timpie Road	700 South	1,512	LF	$ 251		$ 251	$ 379,648	$ 37,965	$ 125,284	$ 81,435	$ 624,331	$ 625,000
70	PRV	Control valve into Zone 5	2032	20			Future Transmission	Coleman - South Source to Z5			1	Each	$ 80,000		$ 80,000	$ 80,000	$ 8,000	$ 26,400	$ 17,160	$ 131,560	$ 132,000
71	Pipe	Transmission from south sources to Z7	2032	16	In	PVC	Future Transmission	Coleman Street	700 South	Vine Street	4,539	LF	$ 206		$ 206	$ 934,172	$ 93,417	$ 308,277	$ 200,380	$ 1,536,245	$ 1,537,000
72	PRV	Control valve into Zone 7	2032	16			Future Transmission	Coleman - Z6-Z7			1	Each	$ 80,000		$ 80,000	$ 80,000	$ 8,000	$ 26,400	$ 17,160	$ 131,560	$ 132,000
																					$ 22,675,000

Tooele City Drinking Water Master Plan - Capital Facility Plan Project Cost Estimates
Tooele City
December 2020, April 2021
by Hansen, Allen & Luce, Inc., BDM & KGJ

Map ID	Type	Description	Year	Diameter	In/Out of Street	Pipe Material	Project Type	Location (Street)	Begin	End	Quantity	Unit	Unit Cost	Developer Unit Cost	City Unit Cost	Cost	Contingency	Mobilization, Survey, Testing, SWPPP, etc.	Engineering	Total	Rounded
Transmission Projects Within City After First South Source is Brought Online																					
73	Pipe	Transmission/connectivity	2032	8	In	PVC	Future Transmission	Coleman Street	Vine Street	Utah Avenue	1,421	LF	$ 143		$ 143	$ 203,842	$ 20,384	$ 67,268	$ 43,724	$ 335,219	$ 336,000
74	Pipe	Transmission/connectivity	2032	8	In	PVC	Future Transmission	Timpie Road and Coleman S	Coleman Street	Southwest Drive	342	LF	$ 143		$ 143	$ 49,060	$ 4,906	$ 16,190	$ 10,523	$ 80,679	$ 81,000
75	Pipe	Transmission/connectivity	2032	10	In	PVC	Future Transmission	600 North	Main Street west	Main Street east	84	LF	$ 164		$ 164	$ 13,739	$ 1,374	$ 4,534	$ 2,947	$ 22,594	$ 23,000
76	Pipe	Transmission/connectivity	2032	8	In	PVC	Future Transmission	1310 North	350 East	380 East	271	LF	$ 143		$ 143	$ 38,875	$ 3,887	$ 12,829	$ 8,339	$ 63,930	$ 64,000
77	Pipe	Transmission/connectivity	2032	8	In	PVC	Future Transmission	Pioneer Avenue	700 South	Milcreek Way	782	LF	$ 143		$ 143	$ 112,178	$ 11,218	$ 37,019	$ 24,062	$ 184,477	$ 185,000
																					$ 689,000
West B Well																					
78	Well	Exploratory borehole	2036				Future Source	West B site			1	Each	$ 70,000		$ 70,000	$ 70,000	$ 7,000	$ 23,100	$ 15,015	$ 115,115	$ 116,000
	Well	Production well	2036				Future Source	West B site			1	Each	$ 1,000,000		$ 1,000,000	$ 1,000,000	$ 100,000	$ 330,000	$ 214,500	$ 1,644,500	$ 1,645,000
	Well	Well House	2036				Future Source	West B site			1	Each	$ 600,000		$ 600,000	$ 600,000	$ 60,000	$ 198,000	$ 128,700	$ 986,700	$ 987,000
	Well	Land/Easements	2036				Future Source	West B site			1	Acre	$ 65,000		$ 65,000	$ 65,000	$ 6,500	$ 21,450	$ 13,943	$ 106,893	$ 107,000
79	Pipe	Transmission from site to SR-36	2036	14	Out	PVC	Future Transmission	West B site	West B well	Valley	58,965	LF	$ 151		$ 151	$ 8,878,360	$ 887,836	$ 2,929,859	$ 1,904,408	$ 14,600,463	$ 14,601,000
66b	Tank	Add capacity to south source equalization tank	2036	-			Future Storage	South of City			1,440,000	Gallon	$ 1.15		$ 1.15	$ 1,656,000	$ 165,600	$ 546,480	$ 355,212	$ 2,723,292	$ 2,724,000
																					$ 20,180,000
South A Well																					
80	Well	Exploratory borehole	2042				Future Source	South A site			1	Each	$ 70,000		$ 70,000	$ 70,000	$ 7,000	$ 23,100	$ 15,015	$ 115,115	$ 116,000
	Well	Production well	2042				Future Source	South A site			1	Each	$ 1,000,000		$ 1,000,000	$ 1,000,000	$ 100,000	$ 330,000	$ 214,500	$ 1,644,500	$ 1,645,000
	Well	Well House	2042				Future Source	South A site			1	Each	$ 600,000		$ 600,000	$ 600,000	$ 60,000	$ 198,000	$ 128,700	$ 986,700	$ 987,000
	Well	Land/Easements	2042				Future Source	South A site			1	Acre	$ 65,000		$ 65,000	$ 65,000	$ 6,500	$ 21,450	$ 13,943	$ 106,893	$ 107,000
81	Pipe	Transmission from site to SR-36	2042	10	Out	PVC	Future Transmission	South A	South A	Highway 36	26,282	LF	$ 132		$ 132	$ 3,471,589	$ 347,159	$ 1,145,624	$ 744,656	$ 5,709,029	$ 5,710,000
82	Pipe	SR-36 Transmission from South A to Honerine	2042	24	Out	DIP	Future Transmission	Highway 36	South A	Honerine	6,182	LF	$ 322		$ 322	$ 1,991,840	$ 199,184	$ 657,307	$ 427,250	$ 3,275,582	$ 3,276,000
66c	Tank	Add capacity to south source equalization tank	2042				Future Storage	South of City			720,000	Gallon	$ 1		$ 1	$ 828,000	$ 82,800	$ 273,240	$ 177,606	$ 1,361,646	$ 1,362,000
																					$ 13,203,000
Barrick Wells																					
83	Well	Barrick Wells Refurbishment	2050				Future Source	Barrick Well site			1	Each	$ 160,000		$ 160,000	$ 160,000	$ 16,000	$ 52,800	$ 34,320	$ 263,120	$ 264,000
84	Pipe	Transmission from site to SR-36	2050	10	Out	PVC	Future Transmission	Barrick	Barrick	Highway 36	36,971	LF	$ 132		$ 132	$ 4,883,499	$ 488,350	$ 1,611,555	$ 1,047,511	$ 8,030,915	$ 8,031,000
85	Pipe	SR-36 Transmission from Barrick to South A	2050	24	Out	DIP	Future Transmission	Highway 36	Barrick	South A	27,415	LF	$ 322		$ 322	$ 8,833,113	$ 883,311	$ 2,914,927	$ 1,894,703	$ 14,526,054	$ 14,527,000
66d	Tank	Add capacity to south source equalization tank	2050	-			Future Storage	South of City			1,440,000	Gallon	$ 1.15		$ 1.15	$ 1,656,000	$ 165,600	$ 546,480	$ 355,212	$ 2,723,292	$ 2,724,000
																					$ 25,546,000
Vernon Wells																					
86	Well	Exploratory borehole	2060				Future Source	Vernon Well site			4	Each	$ 70,000		$ 70,000	$ 280,000	$ 28,000	$ 92,400	$ 60,060	$ 460,460	$ 461,000
	Well	Production well	2060				Future Source	Vernon Well site			4	Each	$ 1,000,000		$ 1,000,000	$ 4,000,000	$ 400,000	$ 1,320,000	$ 858,000	$ 6,578,000	$ 6,578,000
	Well	Well House	2060				Future Source	Vernon Well site			4	Each	$ 600,000		$ 600,000	$ 2,400,000	$ 240,000	$ 792,000	$ 514,800	$ 3,946,800	$ 3,947,000
	Well	Land/Easements	2060				Future Source	Vernon Well site			4	Acre	$ 65,000		$ 65,000	$ 260,000	$ 26,000	$ 85,800	$ 55,770	$ 427,570	$ 428,000
87	WTP	Vernon Arsenic Treatment Plant	2060	-			Future Source	Vernon			1	Each	$ 1,000,000		$ 1,000,000	$ 1,000,000	$ 100,000	$ 330,000	$ 214,500	$ 1,644,500	$ 1,645,000
88	Pipe	SR-36 Transmission from Vernon to Barrick	2060	20	Out	DIP	Future Transmission	Highway 36	Vernon	Barrick	99,085	LF	$ 268		$ 268	$ 26,579,551	$ 2,657,955	$ 8,771,252	$ 5,701,314	$ 43,710,072	$ 43,711,000
66e	Tank	Add capacity to south source equalization tank	2060	-			Future Storage	South of City			2,880,000	Gallon	$ 1		$ 1	$ 3,312,000	$ 331,200	$ 1,092,960	$ 710,424	$ 5,446,584	$ 5,447,000
																					$ 62,217,000

APPENDIX D

Checklist for Hydraulic Model Design Elements Report

CHECKLIST FOR HYDRAULIC MODEL DESIGN ELEMENTS REPORT

The hydraulic model checklist below identifies the components included in the Hydraulic Model Design Elements Report for

Tooele City Drinking Water Master Plan
(Project Name or Description)

23004/1232
(Water System Number)

Tooele City Water Special Service District
(Water System Name)

November 19, 2020
(Date)

The checkmarks and/or P.E. initials after each item indicate the conditions supporting P.E. Certification of this Report.

1. The Report contains:

(a) A listing of sources including: the source name, the source type (i.e., well, spring, reservoir, stream etc.) for both existing sources and additional sources identified as needed for system expansion, the minimum reliable flow of the source in gallons per minute, the status of the water right and the flow capacity of the water right. *[R309-110-4 "Master Plan" definition]* ☒ KJ

(b) A listing of storage facilities including: the storage tank name, the type of material (i.e., steel, concrete etc.), the diameter, the total volume in gallons, and the elevation of the overflow, the lowest level (elevation) of the equalization volume, the fire suppression volume, and the emergency volume or the outlet. *[R309-110-4 "Master Plan" definition]* ☒ KJ

(c) A listing of pump stations including: the pump station name and the pumping capacity in gallons per minute. Under this requirement one does not need to list well pump stations as they are provided in requirement (a) above. *[R309-110-4 "Master Plan" definition]* ☒ KJ

(d) A listing of the various pipeline sizes within the distribution system with their associated pipe materials and, if readily available, the approximate length of pipe in each size and material category. A schematic of the distribution piping showing node points, elevations, length and size of lines, pressure zones, demands, and coefficients used for the hydraulic analysis required by (h) below will suffice. *[R309-110-4 "Master Plan" definition]* ☒ KJ

(e) A listing by customer type (i.e., single family residence, 40 unit condominium complex, elementary school, junior high school, high school, hospital, post office, industry, commercial etc.) along with an assessment of their associated number of ERCs. *[R309-110-4 "Master Plan" definition]* ☒ KJ

(f) The number of connections along with their associated ERC value that the public drinking water system is committed to serve, but has not yet physically connected to the infrastructure. *[R309-110-4 "Master Plan" definition]* ☒ KJ

(g) A description of the nature and extent of the area currently served by the water system and a plan of action to control addition of new service connections or expansion of the public drinking water system to serve new development(s). The plan shall include current number of service connections and water usage as well as land use projections and forecasts of future water usage. *[R309-110-4 "Master Plan" definition]* ☒ KJ

(h) A hydraulic analysis of the existing distribution system along with any proposed distribution system expansion identified in (g) above. *[R309-110-4 "Master Plan" definition]* ☒ KJ

(i) A description of potential alternatives to manage system growth, including interconnections with other existing public drinking water systems, developer responsibilities and requirements, water rights issues, source and storage capacity issues and distribution issues. *[R309-110-4 "Master Plan" definition]* ☒ KJ

2. At least 80% of the total pipe lengths in the distribution system affected by the proposed project are included in the model. *[R309-511-5(1)]* ☒ KJ

3. 100% of the flow in the distribution system affected by the proposed project is included in the model. If customer usage in the system is metered, water demand allocations in the model account for at least 80% of the flow delivered by the distribution system affected by the proposed project. *[R309-511-5(2)]* ☒ KJ

4. All 8-inch diameter and larger pipes are included in the model. Pipes smaller than 8-inch diameter are also included if they connect pressure zones, storage facilities, major demand areas, pumps, and control valves, or if they are known or expected to be significant conveyers of water such as fire suppression demand. *[R309-511-5(3)]* ☒ KJ

5. All pipes serving areas at higher elevations, dead ends, remote areas of a distribution system, and areas with known under-sized pipelines are included in the model. *[R309-511-5(4)]* ☒ KJ

6. All storage facilities and accompanying controls or settings applied to govern the open/closed status of the facility for standard operations are included in the model. *[R309-511-5(5)]* ☒ KJ

7. Any applicable pump stations, drivers (constant or variable speed), and accompanying controls and settings applied to govern their on/off/speed status for various operating conditions and drivers are included in the model. *[R309-511-5(6)]* ☒ KJ

8. Any control valves or other system features that could significantly affect the flow of water through the distribution system (i.e. interconnections with other systems, pressure reducing valves between pressure zones) for various operating conditions are included in the model. *[R309-511-5(7)]* ☒ KJ

9. Imposed peak day and peak instantaneous demands to the water system's facilities are included in the model. The Hydraulic Model Design Elements Report explains which of the Rule-recognized standards for peak day and peak instantaneous demands are implemented in the model (i.e., (i) peak day and peak instantaneous demand values per *R309-510, Minimum Sizing Requirements*, (ii) reduced peak day and peak instantaneous demand values approved by the Director per *R309-510-5, Reduction of Sizing Requirements*, or (iii) peak day and peak instantaneous demand values expected by the water system in excess of the values in *R309-510, Minimum Sizing Requirements*). The Hydraulic Model Design Elements Report explains the multiple model simulations to account for the varying water demand conditions, or it clearly explains why such simulations are not included in the model. The Hydraulic Model Design Elements Report explains the extended period simulations in the model needed to evaluate changes in operating conditions over time, or it clearly explains (e.g., in the context of the water system, the extent of anticipated fire event, or the nature of the new expansion) why such simulations are not included in the model. *[R309-511-5(8) & R309-511-6(1)(b)]* ☒ KJ

10. The hydraulic model incorporates the appropriate demand requirements as specified in *R309-510, Minimum Sizing Requirements*, and *R309-511, Hydraulic Modeling Requirements*, in the evaluation of various operating conditions of the public drinking water system. The Report includes:
    - the methodology used for calculating demand and allocating it to the model;
    - a summary of pipe length by diameter;

- a hydraulic schematic of the distribution piping showing pressure zones, general pipe connectivity between facilities and pressure zones, storage, elevation, and sources; and
- a list or ranges of values of friction coefficient used in the hydraulic model according to pipe material and condition in the system. In accordance with Rule stipulation, all coefficients of friction used in the hydraulic analysis are consistent with standard practices.

  [R309-511-7(4)] ☒ KJ

11. The Hydraulic Model Design Elements Report documents the calibration methodology used for the hydraulic model and quantitative summary of the calibration results (i.e., comparison tables or graphs). The hydraulic model is sufficiently accurate to represent conditions likely to be experienced in the water delivery system. The model is calibrated to adequately represent the actual field conditions using field measurements and observations. *[R309-511-4(2)(b), R309-511-5(9), R309-511-6(1)(e) & R309-511-7(7)]* ☒ KJ

12. The Hydraulic Model Design Elements Report includes a statement regarding whether fire hydrants exist within the system. Where fire hydrants are connected to the distribution system, the model incorporates required fire suppression flow standards. The statement that appears in the Report also identifies the local fire authority's name, address, and contact information, as well as the standards for fire flow and duration explicitly adopted from *R309-510-9(4), Fireflow*, or alternatively established by the local fire suppression agency, pursuant to *R309-510-9(4), Fireflow.* The Hydraulic Model Design Elements Report explains if a steady-state model was deemed sufficient for residential fire suppression demand, or acknowledges that significant fire suppression demand warrants extended model simulations and explains the run time used in the simulations for the period of the anticipated fire event. *[R309-511-5(10) & R309-511-7(5)]* ☒ KJ

13. If the public drinking water system provides water for outdoor use, the Report describes the criteria used to estimate this demand. If the irrigation demand map in *R309-510-7(3), Irrigation Use,* is not used, the report provides justification for the alternative demands used in the model. If the irrigation demands are based on the map in *R309-510-7(3), Irrigation Use,* the Report identifies the irrigation zone number, a statement and/or map of how the irrigated acreage is spatially distributed, and the total estimated irrigated acreage. The indicated irrigation demands are used in the model simulations in accordance with Rule stipulation. The model accounts for outdoor water use, such as irrigation, if the drinking water system supplies water for outdoor use. *[R309-511-5(11) & R309-511-7(1)]* ☒ KJ

14. The Report states the total number of connections served by the water system including existing connections and anticipated new connections served by the water system after completion of the construction of the project. *[R309-511-7(2)]*

    ☒ KJ

15. The Report states the total number of equivalent residential connections (ERC) including both existing connections as well as anticipated new connections associated with the project. In accordance with Rule stipulation, the number of ERC's includes high as well as low volume water users. In accordance with Rule stipulation, the determination of the equivalent residential connections is based on flow requirements using the anticipated demand as outlined in *R309-510, Minimum Sizing Requirements*, or is based on alternative sources of information that are deemed acceptable by the Director. *[R309-511-7(3)]* ☒ KJ

16. The Report identifies the locations of the lowest pressures within the distribution system, and areas identified by the hydraulic model as not meeting each scenario of the minimum pressure requirements in *R309-105-9, Minimum Water Pressure*. *[R309-511-7(6)]* ☒ KJ

17. The Hydraulic Model Design Elements Report identifies the hydraulic modeling method, and if computer software was used, the Report identifies the software name and version used. *[R309-511-6(1)(f)]* ☒ KJ

18. For community water system models, the community water system management has been provided with a copy of input and output data for the hydraulic model with the simulation that shows the worst case results in terms of water system pressure and flow. *[R309-511-6(2)(c)]* ☒ KJ

19. The hydraulic model predicts that new construction will not result in any service connection within the new expansion area not meeting the minimum distribution system pressures as specified in *R309-105-9, Minimum Water Pressure. [R309-511-6(1)(c)]* ☒ KJ

20. The hydraulic model predicts that new construction will not decrease the pressures within the existing water system such that the minimum pressures as specified in *R309-105-9, Minimum Water Pressure* are not met. *[R309-511-6(1)(d)]* ☒ KJ

21. The velocities in the model are not excessive and are within industry standards. ☒ KJ