Comprehensive Water System Plan Update

Comprehensive Water Plan - 2019 Supplement

Shakopee, Minnesota

SHPUC 140940 | October 4, 2019

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Shakopee, Minnesota

SEH No. SHPUC 140940

October 4, 2019

I hereby certify that this report was prepared by me or under my direct supervision, and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

Chad T. Katzenberger

Chad T. Katzenberger, PE

Date: October 4, 2019 License No.: 46613

Short Elliott Hendrickson Inc.
3535 Vadnais Center Drive
St. Paul, MN 55110-5196
651.490.2000

SEH

Executive Summary

The purpose of this report is to provide information regarding the Shakopee PUC existing and anticipated water system conditions to aid in capital planning. This report serves as an update to the 2004 Comprehensive Water Plan Update, as population and water use projections have changed since 2004 projections. Existing water supplies, storage tanks and the distribution system were analyzed to establish the current conditions of the water system. Trends from historical water use data were used to determine projection estimates through the year 2040.

The existing Shakopee PUC water system includes groundwater wells, storage tanks, and distribution facilities. This report evaluates each category to determine existing and projected water usage.

Existing Facilities Include:

- Eighteen groundwater wells that pump water from multiple aquifers. Combined the wells have a total supply capacity of 24.4 million gallons a day (MGD) and a reliable supply capacity of 20.3 MGD.
- Four elevated storage tanks with a total storage capacity of 4.25 million gallons (MG).
- Three ground storage tanks with a total storage capacity of 7.0 MG.
- Four pumping stations that supply water to four different pressure zones within the system.

Water facilities are often designed to meet maximum day demands. Historical data shows that over the last 10 years maximum day demands ranged from 9.94 to 16.26. The maximum day demands are often impacted by seasonal conditions such as dry and hot summers, land use patterns and population.

Population projections indicate a large increase in population by the year 2040. This is partially due to the annexation of Jackson Township into the Shakopee City limits. Projected maximum daily demands indicate that additional water supplies and interconnections between pressure zones will be needed to meet future maximum day demands.

Recommended Improvements Include:

- Construction of additional supply wells No. 22, No. 23 & No. 24.
- Upgrading Well No. 9 Booster Station with a flow control valve to allow water to move from First High Zone to Normal Zone.
- Construction of a 750,000 gallon elevated storage tank be constructed in the western portion of the Second High Pressure Zone
- A 250,000 gallon elevated storage tank be constructed in the central portion of the Second High Pressure Zone
- Construction of new booster station facility to provide redundant water transfer between the Normal pressure zone and 1st High Pressure Zone utilizing booster pumping and pressure reducing flow control.
- Trunk water main construction and other water distribution features to accommodate water system expansion and development.

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Comprehensive Water System Plan Update

Comprehensive Water Plan - 2019 Supplement

Prepared for Shakopee Public Utilities Commission

1 Introduction

In the year 2018, Shakopee Public Utilities (SPUC) completed a comprehensive water system evaluation which was summarized in the 2018 Comprehensive Water System Plan, published September 13, 2018. Since this system evaluation was published, the City of Shakopee has been making progress on the City's overall Comprehensive Plan. Through this process, new population projections have been developed and anticipated land use mapping has been developed. More specifically, an AUAR (Alternative Urban Areawide Review) has been in process to evaluate the development of areas along the western edge of the City that will be annexed into Shakopee from Jackson Township. The AUAR development has resulted in updated land use estimated that can be used to inform water demand estimates and projections. In addition, new population forecasts can be utilized to project corresponding water use growth.

In a similar fashion to the 2018 plan, present and future water needs of the SPUC water system have been evaluated, and recommendations made concerning improvements necessary to maintain an adequate level of water service. Current and future water needs were evaluated over a planning period extending to the year 2040. This report will serve as a plan to guide future expansion and redevelopment of the water system.

1.1 Scope

The primary purpose of this report is to update the previous 2018 plan in light of new planning information. In general, work completed in the previous report that is still valid will remain unchanged. Below is a summary of the outlined scope items that this plan supplement intends on addressing.

1. **Provide Updated Water System Demand Projections:** In conjunction with new population forecasts and land use projections, anticipated water system demand projections can be updated with new supporting data.
2. **Complement The City of Shakopee 2040 Comprehensive Plan:** Update of water use projections from data generated though the City's comprehensive planning process will help assure that the projected growth will be served by a reliable water supply.
3. **Update Projected Water System Facility Needs**: In light of water use forecast changes, the required facilities to support the growth are reviewed and developed to meet the projected need.
4. **Update Cost Estimates for Projected Water Facilities:** Updated costs for proposed facilities are provided to help guide future financial decisions.
5. **Support Water Connection Fee Study:** A parallel study will be conducted to develop recommended water system fees for future water system users. The foundation of these fees is related to the costs of the required water system facilities. This study will be the first step to inform that process.

As noted in the 2018 water system plan, water needs change with time, and municipal water system planning is a continuous function. Therefore, the longer term projections and improvements discussed in this report should be reviewed, re-evaluated and modified as necessary, to assure the adequacy of future planning efforts. Proper future planning will help assure that system expansion is coordinated and constructed in the most effective manner.

2 Existing Water System

A summary of the existing water system is summarized in the 2018 comprehensive water system plan. In short, the SPUC water system has grown to include seven storage tanks, 18 groundwater supply wells and four pumping stations. The system utilizes four pressure zones: the Normal Zone, First High Zone, East Zone and the Second High Zone. The East Zone has the same hydraulic grade line as the Second High Zone. The Second High Zone is also separated out into separate sections. The separation is due to how development has occurred with respect to the elevation of the landscape.

3 Population & Community Growth

This section summarizes the planning assumptions made regarding future service area characteristics for SPUC water service area. Since 2018, new population projections and land use information is available, below is a summary of the new data which will be utilized for this report.

3.1 Population Forecast

There is generally a close relationship between a community's population and total water consumption volumes. Future water sales can be expected to generally reflect future changes in service area population. Similarly, commercial, public, and industrial water consumption will also tend to vary proportionally.

The City's estimated population in 2018 was 41,506 according to the State of Minnesota Demographer. Table 3-1 below summarizes projected future population of the City as provided from the City's 2040 Comprehensive Plan. These population projections will inform the future water use projections

Table 3-1 – Projected Population Data

Year	Population	Annual Growth Rate (%)
2020	47,800	1.7%
2025	51,850	1.7%
2030	55,900	1.6%
2035	59,250	1.2%
2040	62,600	1.1%

Source: City of Shakopee 2040 Comprehensive Plan

Projections noted above indicate SPUC's service area total population is expected to increase to approximately 62,600 people by the year 2040. For this study, in calculating per capita water use, it is estimated that approximately 3,000 people are served by private wells in rural residential areas. It is assumed that as the boundaries of the City grow and rural areas are annexed, a similar percentage of residents (7%) may remain on private wells through the planning period. As a result, future water users are expected to grow at a rate similar to the population growth.

4 Water Requirements

This section updates water use history with current information and provides for new water use projections based on new population data.

4.1 Water Consumption History

As previously completed in the Water Comprehensive Plan, an analysis was made of past water consumption characteristics by reviewing annual pumpage and water sales records for the period from 2000 to 2018. Average and maximum day water consumption during this period, together with the amount of water sold in each customer category, was analyzed. Projections of future water requirements are based on the results of this analysis, coupled with estimates of population and community growth.

4.2 Water Demands By Customer Category

A historical summary of utility customers served is provided in Table 4-2. Residential customers, over the past five years, have accounted for 60 percent of the SPUC's sales while commercial and Industrial customers have accounted for 40 percent of the sales.

Table 4-1 – Historical Water Use

Year	Estimated City Population	Estimated Water Service Population	Average Day (AD) Water Pumped (MGD)	Maximum Day (MD) Water Pumped (MGD)	MD:AD Ratio	AD Per Capita Water Use (gpd)	MD Per Capita Water Use (gpd)
2007	33,022	30,020	5.56	14.68	2.64	185	489
2008	33,748	30,748	5.09	13.59	2.67	165	442
2009	34,525	31,525	5.12	12.83	2.51	162	407
2010	37,366	34,366	4.71	10.62	2.26	137	309
2011	38,000	35,000	4.81	10.80	2.25	137	309
2012	**38,730**	**35,730**	**5.87**	**16.26**	**2.77**	**164**	**455**
2013	39,167	36,167	4.94	13.38	2.71	137	370
2014	39,448	36,448	4.59	10.88	2.37	126	298
2015	39,981	36,981	4.52	9.94	2.20	122	269
2016	40,743	37,743	4.74	11.58	2.44	126	307
2017	41,125	38,125	4.87	13.23	2.71	128	347
2018	41,506	38,506	5.05	10.57	2.09	131	275
5 Year Average			**4.79**	**11.48**	**2.40**	**128**	**301**
Maximum			*5.87*	*16.26*	*2.77*	*185*	*489*
Service Population = City population less 3,000+ rural residential residents on private wells.							

Source: DNR Water Use Records, State demographer

Table 4-2 – Historical Average Water Sales by Customer Class

	Water Sold			Water Pumped	
Year	Average Day Residential Water Sold (MGD)	Average Day Commercial-Industrial Water Sold (MGD)	Total Average Day Water Sold (MGD)	Average Day Water Pumped (MGD)	Unmetered & Unaccounted Water (%)
2007	3.11	2.10	5.21	5.56	6.3%
2008	2.94	1.88	4.82	5.09	5.2%
2009	3.09	1.82	4.92	5.12	3.9%
2010	2.68	1.72	4.40	4.71	6.5%
2011	2.81	1.80	4.61	4.81	4.1%
2012	**3.25**	**2.06**	**5.31**	**5.87**	**9.5%**
2013	2.85	1.78	4.66	4.94	5.7%
2014	2.64	1.63	4.31	4.59	6.1%
2015	2.50	1.68	4.22	4.52	6.8%
2016	2.68	1.76	4.48	4.74	5.6%
2017	2.50	1.80	4.31	4.83	4.6%
2018	2.67	1.88	4.54	5.05	5.1%
5-Year Average	**2.63**	**1.76**	**4.41**	**4.76**	**5.4%**
% of Total	**59%**	**41%**	**100%**		

Source: DNR Water Use Records, City Records

4.3 Per Capita Usage

Historical per capita water use, including 2017 and 2018 production years is summarized below.

Table 4-3 – Historical Per Capita Water Use by Customer Class

Year	Sales			Water Pumped	
	Residential Daily Per Capita Water Use (gpcd)	Commercial-Industrial Daily Per Capita Water Use (gpcd)	Total Average Day Water Sold (gpcd)	Total Average Day Water Pumped (gpcd)	Total Maximum Day Water Pumped (gpcd)
2007	103	70	174	185	489
2008	96	61	157	165	442
2009	98	58	156	162	407
2010	78	50	128	137	309
2011	80	52	132	137	309
2012	**91**	**58**	**149**	**164**	**455**
2013	79	49	128	137	370
2014	72	45	117	126	298
2015	68	45	113	122	269
2016	71	47	118	126	307
2017	66	47	113	128	347
2018	69	49	118	131	275
5-Year Average	**71**	**47**	**118**	**128**	**301**
% of Total	**60%**	**40%**	**100%**		
Per capita water use accounts for 3,000 residents not connected to municipal water.					

Source: DNR Water Use Records, City Records

4.4 Water Consumption & Pumpage Projections

Population growth, development, customer water needs, conservation, and climate all affect future water needs. This section provides a projection of water needs to the year 2040 based on these factors. One projection is based on anticipated population growth and conservation. A second projection is based on buildout of all service areas, which represents ultimate system demand potential.

4.4.1 System Wide Water Needs Projections

4.4.1.1 Projected Water Use By Population

Table 4-4 summarizes the population based water needs projections for current water use in a drought year. Projects were solely based on the values from year 2012, as 2012 represents a hot and dry year when the system would be stressed for water. With the assumptions shown in the table, by 2040, SPUC could experience a maximum day demand of 25.0 mgd if year 2040 were a drought year. Table 4-5 summarizes the same data and tabulates it in a simple format.

Table 4-4 – Future Water Needs Projections

Demand Type	Year	2020	2030	2040
	City Population	*47,800*	*55,900*	*62,600*
	Service Population	*44,311*	*51,819*	*58,030*
	Current Practices for Drought Year (Based on Drought Year 2012)			
	Assumption	Demand (MGD)		
Residential	91 gpcd	4.03	4.72	5.28
Non-Residential				
Largest Customers	0.72 MGD	0.72	0.72	0.72
Other Population Based	35 gpcd	1.67	1.95	2.18
	Average Day Sales	*6.42*	*7.38*	*8.18*
Unaccounted Water	9.5%	0.68	0.78	0.86
	Projected Average Day Demand	**7.1**	**8.2**	**9.1**
Projected Maximum Day Demand	**277%**	**19.6**	**22.6**	**25.0**

Previously estimated per capita use applied to anticipated service population.

Table 4-5 – Projected Water Use – By Population

Year	Population	Projected (AD)	Maximum Day (MD) Water Pumped (MGD)
2020	47,800	7.1	19.6
2025	51,850	7.6	21.1
2030	55,900	8.2	22.6
2035	59,250	8.6	23.8
2040	62,600	9.0	25.0

4.4.1.2 Projected Water Use By Pressure Zone (Population Based Projection)

Similar to the system wide water needs projection, each supply service area was projected for its individual water needs. This analysis was based on population and also by land use. Historical water use billing data from meters was used to estimate water use in each pressure zone. Then, existing and planned land use was determined for each pressure zone and was used to allocate demands based on land area.

The planned pressure zones are shown in Figure 6-1. The pressure zones were shaped in a manner consistent with utility planning, also in a way where zones could be reasonably connected by water mains.

Table 4-6 – Summary of Water Needs Projections per Service Zone

Zone	Average Day Demand (MGD)	Maximum Day Demand (MGD)	Portion of Total Demand
2020			
Main Zone	5.00	13.86	70.6%
1st High Zone	1.69	4.67	23.8%
2nd High Zone Central	0.09	0.25	1.3%
2nd High Zone West	0.27	0.75	3.8%
2nd High Zone East	0.08	0.22	1.1%
Total	**7.1**	**19.6**	**100%**
2030			
Main Zone	5.37	14.87	65.9%
1st High Zone	1.91	5.29	23.4%
2nd High Zone Central	0.14	0.38	1.7%
2nd High Zone West	0.67	1.85	8.2%
2nd High Zone East	0.11	0.30	1.3%
Total	**8.1**	**22.6**	**100%**
2040			
Main Zone	5.63	15.60	62.4%
1st High Zone	2.09	5.79	23.1%
2nd High Zone Central	0.18	0.50	2.0%
2nd High Zone West	1.03	2.87	11.5%
2nd High Zone East	0.13	0.37	1.5%
Total	**9.0**	**25.0**	**100%**

4.4.1.3 Projected Water Use By Future Land Use

Due to the uncertainty with population growth projections and water use projections, it is useful to estimate future water system demands from multiple perspectives to find a range of potential outcomes. In addition to the population-based method used in the previous section, projected land uses were also examined for this plan, and water demands projected based on an assumed unit demand per area for varying land uses.

Results of the land used base water demand projections are presented in Table 4-7. The time at which this expected development occurs will be strongly dependent on market forces, therefore the yearly water use projections provide a reasonable estimate of planning period demand while the land use projections help to understand the total ultimate water system needs independent of time.

Apart from anticipated population growth, SPUC must be aware of all future potential water needs as development occurs and the City expands into new areas. The potential for future development exists as the City expands and grows to the south and west. The City of Shakopee plans to annex portions of the Jackson Township which have been outlined in the City's 2040 Comprehensive Plan and Jackson Township AUAR. Understanding the potential water needs for these areas is imperative for proper City and utility planning. Water use needs specifically for the AUAR study area are outlined in Appendix B and then fully tabulated in the overall land use water projections shown in table 4-7. The hypothetical water needs for these areas are represented in Table 4-7. Based on drought year 2012, average day water demand with full buildout could reach a potential 9.0 MGD, with a maximum day demand of approximately 25 MGD (ratio of 2.77). The development of this parallel land use based water use projection revealed estimated demands that are in line with the population based water use projections.

Table 4-7 – Projected Water Ultimate Consumption By Land Use

Land Use1	Existing Acres	Full Buildout Acres1	Estimated 2012 AD Water Use (gpd/acre)	Estimated 2012 AD Water Use (MGD)	Projected Full Buildout AD Water Use (MGD)	Projected Full Buildout MD Water Use (MGD)
Existing City Limits						
Residential						
Low Density Residential	2,644	7,118	540	1.43	3.84	10.64
Medium Density Residential	517	621	2,000	1.03	1.24	3.44
High Density Residential	88	94	5,400	0.47	0.51	1.40
Non-Residential						
Business Park	108	129	675	0.07	0.09	0.24
Commercial	547	625	675	0.37	0.42	1.17
Entertainment	356	543	500	0.18	0.27	0.75
Industrial	1,136	1,541	675	0.77	1.04	2.88
Institutional	344	368	675	0.23	0.25	0.69
Mix Use	68	99	675	0.05	0.07	0.19
Open Space	124	1,700	0	0.00	0.00	0.00
Parks	222	483	100	0.02	0.05	0.13
Existing City Limits Total	**6,153**	**13,322**	**--**	**4.62**	**7.8**	**21.5**
AUAR Study Area (Jackson Township) - See Appendix B					**AD**	**MD**
Area A					0.118	0.33
Area B					0.269	0.74
Area C					0.124	0.34
Area D					0.219	0.61
Area E					0.031	0.09
Area F					0.000	0.00
Area G					0.053	0.15
Total AUAR Study Area					**0.81**	**2.25**
Additional Sections of Jackson Township					**AD**	**MD**
Area E					0.209	0.58
Area F					0.238	0.66
Total AUAR Study Area					**0.45**	**1.24**
Total Ultimate Water Use					**9.0**	**25.0**
*Estimates based on typical historical usage						

1. 20 percent of future areas assumed to be streets and open areas. Calculated by [(Future - Existing) x 0.8] + Existing.

4.5 Potential Expansion Area – Louisville Township

As part of the overall comprehensive plan effort, a preliminary high level estimate of additional water needs for the Louisville Township was completed. Though this area is not included in the near term plan, it is important to understand the implications of demand if this area was to develop. This sections will provide a brief analysis of Louisville Township ultimate demand potential.

The potential **developable area** of expansion in the township comprises **6,400 acres**. The Township includes an additional 2,900 acres of wetlands which are not assumed to be developable. The following assumptions will be used for this analysis:

1. Development Assumed: Single family residential with ½ acre lots (Low Density Residential).
2. 80 percent of the developable area will be developed as single family residential. 20 percent will be roads or undevelopable.
3. Demand Load of 540 gpd/acre from Table 4-7.
4. MD:AD ratio of 2.77 from Table 4-7.

With the above assumptions, the potential service area in the Louisville Township could add an additional average day demand of 2.8 mgd with a maximum day demand of 7.7 mgd at full buildout. These volumes are not included in any other analysis in this water comprehensive plan up to this point, nor are they included in any other analysis or recommendation in this report.

5 Water System Evaluation

In the previous comprehensive water plan, the water system was evaluated in regards to numerous system criteria. In light of the updated water system demands, the system has been re-evaluated to provide for an updated set of recommended alternatives.

5.1 Water Supply Sources and Water Quality

A summary of water supply quality concerns was outlined in the previous Water Comprehensive Plan. The recommendation for addressing water quality concerns developed in this plan are based on previous water treatment studies as well as recent water quality trends. Some new information has been developed with regards to water quality assessments for this supplement. However, in the future there may be emerging issues at both existing and new well sites related to water quality.

In summary, the Utility utilizes three different aquifers as the water source for their public water supply. These aquifers are the Prairie du Chien-Jordan Sandstone, Tunnel City-Wonewoc, and Mt. Simon/Hinckley bedrock.

In the Shakopee area the Prairie du Chien-Jordan sandstone aquifer is close to the ground surface and is soft in structure. Wells constructed in this area have removed sandstone surrounding the well to prevent large quantities of sand from entering the well with the water.

Prairie du Chien-Jordan sandstone aquifer
The Prairie du Chien-Jordan sandstone aquifer supplies a significant quantity of water to the City's water system, and is expected to provide the majority of the water in the future. Wells No. 4 - No. 9, No. 11 - No. 13, No. 15- No. 17 and No. 20, No. 21 utilize water from the Prairie du Chien-Jordan sandstone aquifer.

Tunnel City-Wonewoc
Wells No. 2 and No. 14 utilize water from the Tunnel City-Wonewoc aquifer. This aquifer also supplied water to Well No. 1 before it was abandoned and sealed.

Mt. Simon
Wells No. 3 and No. 10 utilize water from the Mt. Simon aquifer. This aquifer also supplied water to Well No. 1 before it was abandoned and sealed. Portions of Well No.3 also access portions of the St. Lawrence aquifer.

5.1.1 Water Supply Challenges

Water use restrictions have been placed on the Mt. Simon/Hinckley bedrock aquifer. These restrictions only allow usage of the Mt. Simon/Hinckley bedrock aquifer when there is no alternate water supply available, and the water may only be used for drinking water purposes. Wells No. 3 and No. 10 are supplied with water from this aquifer. Well No. 10 has low nitrate concentrations and was established to dilute the moderate levels of nitrates in water from Wells No. 6 and No. 7.

Multiple aquifer wells are wells that utilize water from multiple aquifers. These types of wells are no longer allowed to be constructed in Minnesota because of the increased potential for spreading contamination to multiple aquifers. Well No. 3 is a multiple aquifer well and was once supplied with water from all three aquifers. Eventually the Prairie du Chien-Jordan sandstone aquifer was cased off due to the large quantity of sand that was entering into No. 3. Well No. 2 was also a multiple aquifer well that received water from all three aquifers. Two of the aquifers have been cased off and it currently only receive water from the Tunnel City-Wonewoc aquifer.

5.1.2 Water Quality

Health Concerns
Under existing operating conditions the system receives their drinking water from eighteen groundwater wells. At each well house chlorine and fluoride are added to the water for disinfection and public health purposes. The City monitors their wells to insure they stay in compliance with the National Primary Drinking Water Regulations (NPDWRs), National Secondary Drinking Water Regulations (NSDWRs) and other water quality standards. Water from these wells is considered a good quality, however, there are some elements present in the water which require monitoring.

Well No. 10 has a history of containing moderate concentrations of nitrate, radon and radium 226/228. SPUC has been proactive in monitoring all regulated contaminate levels. Data collected has revealed that these levels have been steadily dropping over time. The Utility will continue to sample and monitor water production wells to ensure they are staying under the NPDWR MCLs.

Well No.3, which is not currently operated, has had a history of containing radionuclides, most recent monitoring levels have been at 5.8 pCi/L for Radium 226 and 5.7 pCI/L for Radium 228 with a gross alpha level of 9.9 pCi/L. This well is available to the SPUC water system for emergency purposes only.

Aesthetics
The Utility also monitors the aesthetic conditions of the water they are supplying related to NSDWRs. EPA believes that if these contaminants are present in water at levels above these standards, the contaminants may cause the water to appear cloudy or colored, or to taste or smell bad. This may cause a great number of people to stop using water from their public water system even though the water is actually safe to drink. Secondary standards are set to give public water systems some guidance on removing these chemicals to levels that are below what most people will find to be noticeable, and are not legally enforceable.

The problems associated with NSDWRs include:

- Aesthetic effects — undesirable tastes or odors;
- Cosmetic effects — effects which do not damage the body but are still undesirable
- Technical effects — damage to water equipment or reduced effectiveness of treatment for other contaminants

Monitoring indicates that total hardness is the most common nuisance for NSDWSs. Impacts from total hardness can be offset by implementing hardness removal at the well house, which ultimately may be very costly or the addition of an in-home water softener.

A few of the wells also had moderate levels of manganese. Manganese is associated with aesthetic issues which include taste and water coloring. SPUC is currently able to successfully addresses the aesthetic issues related to manganese through chemical treatment (sequestration with polyphosphate).

5.1.3 Potential Water Treatment Needs

Historically, the SPUC water system wells have not required more advanced water treatment beyond simple chemical feed (disinfection, sequestration). However, there is the potential for more advanced water treatment needs in the future. These potential needs are described further in the sections below.

5.1.3.1 Nitrate Removal

Wells No. 5 historically been the most problematic wells related to water quality with monitored levels ranging from 6.3 – 7.7 mg/L. The EPA has set the MCL at 10 mg/L. SPUC has managed the use of this well by blending water pumped from this well with Well No.4 which has a monitored level of nitrate ranging from 2.8 – 6.3 mg/L. Both wells have been trending downward with regards to monitored nitrate levels. However, if levels in these wells eventually rise or the enforceable MCL is lowered, decisions will need to be made with regard to the use of Well No.5. Given its importance to the SPUC water system as a primary water producer, water treatment for the removal of nitrate may be needed. Budget numbers are presented later in this report, set aside to address potential future water treatment needs related to nitrate removal.

5.1.3.2 Iron & Manganese Treatment

In general the existing SPUC water production wells have minimal levels of iron and manganese. As noted earlier in this re[ort, the EPA does not enforce these secondary MCLs as they are established as guidelines to assist public water systems in managing their drinking water for aesthetic considerations, such as taste, color, and odor. These contaminants are not considered to present a risk to human health at the secondary levels. The secondary MCL for iron is 0.3 mg/L and 0.05 mg/L for manganese.

5.1.3.2.1 Iron

Only two of SPUC's existing wells have monitored iron levels (see Appendix A) above the secondary standard for iron. Well No.14, with iron levels of 0.63 mg/L is not run on a regular basis as it is available for emergency use. Additionally, when this well is operated, the water is blended with water from Well No.12 or Well No.13 which have very low levels of iron. This allows for the water to be combined to produce a finished water effluent with very minimal iron concentration Later in this report, it is noted that Well No.14 is still utilized in the reliable supply capacity analysis. It is assumed that it would be a suitable backup for a short period of time if another well were to be out of operation.

Well No.10 has iron levels at 0.42 mg/L. This well is considered a peaking well, meaning it is used sparingly, and is only operated to supplement large water use days. Additionally, when this well is operated it is blended with water from either Well No.6 or Well No.7. This type of well use management limits the use of the wells that contain iron, though they are still available to supplement quantity shortages during large water use days. Even with elevated iron levels, the iron content in these wells is relatively low, and at levels that can be managed by limiting well use and chemical treatment (sequestration with a polyphosphate) and blending with other low iron concentration wells.

5.1.3.2.2 Manganese

Manganese does not have an enforceable MCL, but the Minnesota Department of Health (MDH) has issued a health-based value of 0.1 mg/L. "Infants less than 1 year old are more sensitive to manganese and it is recommended that they only drink water, or water mixed with formula, that is 0.1 mg/L or less to avoid negative health effects," per the Health Risk Assessment Unit at MDH. MDH also suggest that adults and older children should drink water with less than 0.3 mg/L to prevent negative health effects. The 0.3 mg/L limit is a health advisory set by the EPA. Health-based values can serve as a guideline for goals in regards to use management of the wells. The presence of manganese in the SPU wells will be considered moving forward in light of the information above.

In regards to manganese, Well No.15 at 0.092 mg/L and Well No. 12 at 0.08 mg/L are the only wells that currently have moderate levels of Manganese. **None of the existing wells exceed the health advisory limit** for Manganese. These wells are used on a somewhat regular basis, but more sparingly than the more favorable wells. As the water system expands west, there has been an indication that potential future well sites may have elevated levels of manganese. If long terms water supply facilities were to be located at one of these well sites, with elevated manganese levels above the MCL, it is recommended that a filtration plant be constructed to remove the manganese. Budget numbers are presented later in this report, set aside to address potential future water treatment needs related to manganese removal.

5.2 Total System Reliable Supply Capacity

The reliable supply capacity of a water system is the total available delivery rate with the largest pumping unit(s) out of service. The reliable supply capacity is less than the total supply capacity because well and other supply pumps must be periodically taken out of service for maintenance. These water supply pumps can be off-line for periods of several days to several weeks, depending on the nature of the maintenance being performed. For a system as large as Shakopee with 18 high capacity wells, it is somewhat likely for two wells to be offline at the same time, comprising approximately 10 percent of the total supply capacity. Because of this, system wide well supply requirements will assume that the SPUC water supply system should be capable of meeting maximum day demands with the Utilities' largest two wells out of service.

The current reliable water supply capacity is given in Table 5-1. Under present operating conditions, the existing wells have a combined total capacity of about 24.4 MGD when operating 24 hours per day. However, the reliable capacity of the supply wells is approximately 20.3 MGD with the two highest yielding wells out of service. The availability of this reliable supply capacity assumes that there will be no significant declines or changes in the water supply capacity over the next 20 years.

To determine if SPUC should plan for additional supply, the demands of the system can be compared to supply capacity. The projected drought-year average day and maximum day demands are set against total and reliable supply capacities in Figure 5-1. The results in Figure 5-1 indicated a potential need for approximately **4.0 – 5.0 MGD** or more in reliable supply capacity to meet projected water system demand growth. This would equate to roughly three new wells. The suggested location for these wells on a zone by zone basis is discussed later in this section. It should also be noted that future demands are estimated projections (not records) and thus should be re-evaluated frequently (every five years ±) as water use trends can change over time.

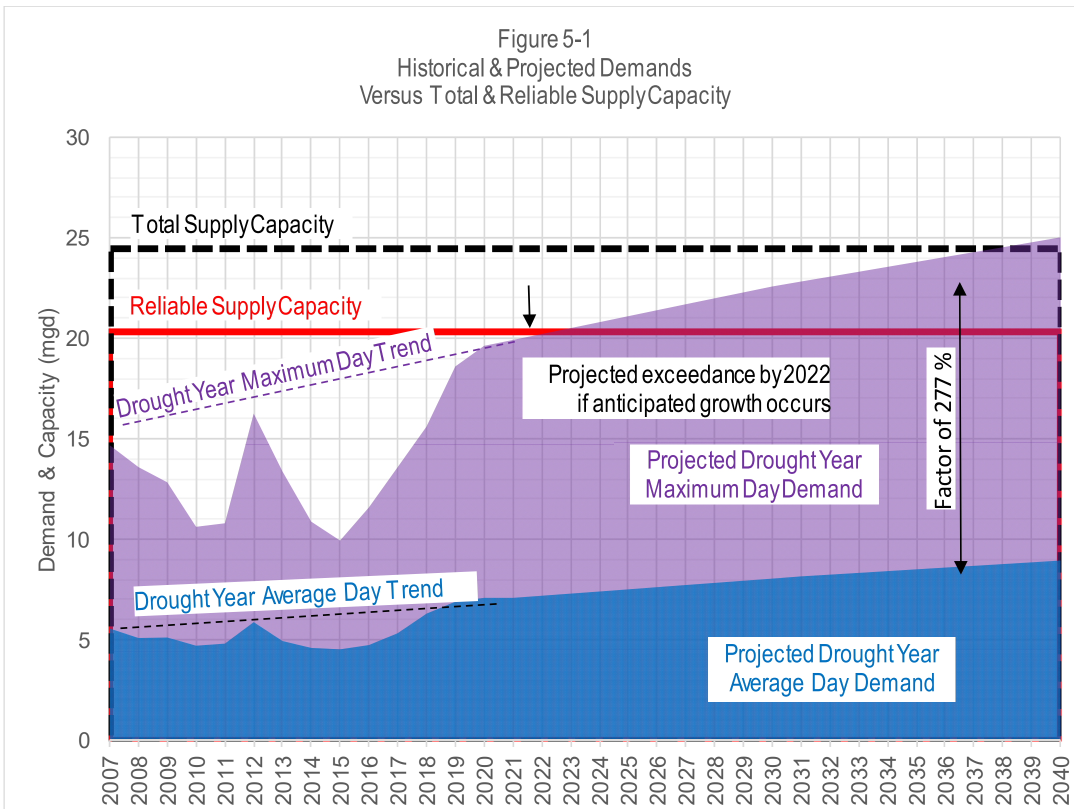


Table 5-1 – Existing Water Production Wells

Well Name	Pressure Zone	Unique Well Number	Normal Operational Capacity (gpm)	Allowed Pumping Time per Day (Hours)	Daily Capacity (MGD)
Well No.2	Normal	206803	300	24	0.4
Well No.3	Normal	205978	825	Emergency	1.2
Well No.4	Normal	206854	715	24	1.0
Well No.5	Normal	206855	850	24	1.2
Well No.6	Normal	180922	1,175	24	1.7
Well No.7	Normal	415975	1,100	24	1.6
Well No.8	Normal	500657	1,100	24	1.6
Well No.9	Normal	554214	1,050	24	1.5
Well No.10	Normal	578948	1,125	24	1.6
Well No.11	Normal	611084	1,000	24	1.4
Well No.12	1st High	626775	810	24	1.2
Well No.13	1st High	674456	1,036	24	1.5
*Well No.14	1st High	694904	381	24	0.5
Well No.15	Normal	694921	1,150	24	1.7
Well No.16	Normal	731139	1,450	24	2.1
Well No.17	Normal	731140	1,400	24	2.0
Well No.20	1st High	722624	1,142	24	1.6
Well No.21	1st High	722625	1,175	24	1.7
Total			**17,784**	**--**	**24.4**
Two Highest Yielding Wells (Well No. 16 & 17)					**4.1**
Firm Capacity (Minus Two Wells)					**20.3**

*Well No.14 is only operated if needed and is factored into the firm capacity analysis.

Source: City Records

5.3 Reliable Pumping Capacity & Storage

The previous comprehensive water plan developed sizing criteria for reliable pumping capacity. This supplement updates that analysis in relation to revised projected water demands.

To determine the water supply and storage needs of a community, average daily demands, peak demands, and emergency needs must be considered. In the sections below, calculations are used to determine future water supply and storage volume requirements for the SPUC water system. Water storage facilities should be capable of supplying the desired rate of fire flow for the required length of time during peak demands when the water system is already impacted by other uses and with the largest supply pump out of service.

The calculations below assume that maximum day demands are occurring on the system, storage volume is reduced by peak demands greater than firm supply pumping rate (i.e. equalization storage is expended). For purposes of this analysis, it is assumed that the "firm capacity" of the water supply wells and booster pumps (largest pump out of service) is capable of supplying maximum day demands.

Because there are multiple pressure zones in the SPUC water system, served by elevated storage, it is important to evaluate the needs of each zone separately. The previous calculations were revisited in light of new demand projections. The result of these updated calculations are updated in the tables below.

5.3.1 Total System Pumping and Storage

The previous Water Comprehensive Plan evaluated the total water system storage needs as well as each individual pressure zone. The plan did not identify any total water system storage needs, meaning when analyzed as a complete system, additional storage is not recommended. Rather each individual pressure zone needs to be analyze for storage needs within that zone. To determine the water storage needs of a community, average daily demands, peak demands, and emergency needs must be considered. The storage tanks of the water system are listed in Table 5-2. The volumes in Table 5-2 are compared to the projected storage needs within each pressure zone. The documented calculations for the System are included in Appendix A, with a summary of the results documented below.

Table 5-2 – Existing Water Storage Facilities

Facility Name	Capacity (gal)	Useable Volume (gal)	Overflow Elev.	Headrange (ft)	Construction Style
Main Zone					
Tank 1	2,000,000	2,000,000	933.0	43.0	Stand Pipe
Tank 2	250,000	250,000	933.0	24.0	Pedestal Sphere
Tank 3	1,500,000	1,500,000	933.0	35.0	Hydropillar
Tank 5	2,500,000	2,000,000	933.0	35.0	Ground
Tank 6	2,500,000	2,000,000	933.0	35.0	Ground
1st High Zone					
Tank 4	500,000	500,000	1015.0	28.0	Pedestal Spheroid
Tank 7	2,500,000	2,000,000	1015.0	34.5	Ground
Total	**11,750,000**	**10,250,000**			

5.3.2 Individual Pressure Storage Analysis Summary

Appendix C contains the revised supply and storage calculation. Water pumping/transfer needs as well as water storage needs were calculated for each pressure zone. In essence, each pressure zone was analyzed individually in relation to water pumping and storage needs. For example, if a pressure zone is short on transfer/pumping capacity, it is feasible that it can "borrow" water from a neighboring zone via gravity(see main zone calculations below). The primary purpose of the summarized calculations below is to assure that each pressure zone has sufficient storage capacity as well as supply capacity whether it be an internal zone supply well or pumping station.

Table 5-3 – Summary of Future Water Storage Needs - By Pressure Zone

	Main	1st High	*2nd High Central	*2nd High Zone West	Combined 2nd High	2nd High Zone East
Existing Firm Pump Cap. (MGD)	12.8	4.9	1.4	1.4	4.3	1.4
Existing Storage Volume MG)	6.8	2.5	-	-	-	-
2020 Planning Period						
Assumed Firm Pump Cap. (MGD)**	15.8	4.9	1.4	1.4	4.3	1.4
Average Day Demand (MGD)	5.0	1.7	0.09	0.27	0.4	0.08
Max Day Demand (MGD)	13.9	4.7	0.25	0.75	1.0	0.22
Additional Storage Recommended (MG)	**-**	**-**	**0.2**	**0.5**	**0.6**	**N/A**
2040 Planning Period						
Assumed Firm Pump Cap. (MGD)**	15.8	4.9	1.4	4.3	5.8	1.4
Average Day Demand (MGD)	5.6	2.1	0.2	1.0	1.2	0.13
Max Day Demand (MGD)	15.6	5.8	0.5	2.9	3.4	0.37
Additional Storage Recommended (MG)	**-**	**-**	**0.3**	**1.1**	**1.0**	**N/A**

*The long term water system plan includes the connection of the 2nd High Central and West zones to form the Combined second high zone, which will influence redundancy and water storage requirements.

**Assumed firm pump capacity accounts for additional supply sources added to zone in the future.

See Appendix C for storage calculations

5.3.3 Pressure Zone Pumping/Transfer Analysis

This section summarizes the pumping capacity needs of each pressure zone as they relate to both supply and inter-zone pumping. While the total supply section determines the adequacy of supply at a total system level, this section aims to assure each pressure zone can move water internally to satisfy the system demand from either an internal supply source or through transfer of water from a neighboring zone. An individual pressure zone analysis for pumping capacity is included in Tale 5-4 below. The table below summarizes the assumed firm pumping capacities for each pressure zone including unit wells and booster pumping station units which deliver water to water demand within each pressure zone.

Table 5-4 – Summary of Interzone Pumping/Transfer Needs

	Main	1st High	2nd High Central	2nd High Zone West	Combined 2nd High (C+W)	2nd High Zone East
Existing Firm Pump Cap. (MGD)	15.8	4.9	1.4	1.4	4.3	1.4
2020 Planning Period						
Max Day Demand (MGD)	13.9	4.7	0.1	0.7	0.8	0.3
Pumping/Transfer Surplus/Shortfall	1.9	0.2	1.4	0.7	3.5	1.2
Additional Transfer/Pumping Recommended (MGD)	0	0	0	0	0	0
2040 Planning Period						
Max Day Demand (MGD)	15.6	5.8	0.3	2.9	3.2	0.4
Pumping/Transfer Surplus/Shorfall	0.2	-0.9	1.1	-1.4	1.1	1.0
Additional Transfer/Pumping Recommended (MGD)	**0**	**0.9**	**0**	**1.4**	**0**	**0**
Table Notes: Negative value indicates supply shortfall, Interzone Supply/Pumping Recommended represents water that would need to flow from a higher elevation zone.						

5.4 Water Distribution System Analysis

The previous water system plan provided a comprehensive review of the water distribution system through the use of a calibrated water distribution system model. The assessment of the existing water system is still valid in light of this update. Information revealed through this prior analysis will be accounted for in the recommended improvements section.

6 Recommended Improvements

With updated water use projections and new ultimate land use planning information, the recommended short and long term water system improvement recommendations have been revisited and summarized below. Many of the improvements previously identified have been confirmed and a more exhaustive list of improvements has been developed.

The purpose of this section of the report is to review and recommend facility improvement priorities for the water system moving forward. With growth of the City, and therefore the water system expected during the next planning period, additional water system to facilities should be planned for so that all customers receive exceptional water service. As previously mentioned, the new growth and expansion of the water system is expected to occur in the western portions of the first and second high pressure zones. While it is impossible to know exactly how the area will grow in terms of specific users and road alignment, some general estimates in relation to future land-use can be made and facilities planned for based on these assumptions.

The ultimate water system planning map, presented in Figure 6-1 represents a guiding document for the growth and expansion of the water supply, distribution and storage systems. Expansion of the water system in a manner as outlined in this document will help to assure that exceptional and robust water system is provided to all customers in the future.

This section will provide recommendations to remediate deficiencies and to prepare the system for future growth. A map of planned improvements is shown in Figure 6-1 and will be reference throughout this section.

6.1 Supply Improvements

A community's water supply capacity is sized to meet maximum day demands reliably. The industry standard is to provide enough pumping capacity to meet the maximum day demand rate with the largest two pumps out of service (i.e. firm capacity). Current well supply capacity in Shakopee is 24.4 MGD, and the firm pumping capacity is 20.3 MGD. Maximum day demands reached a peak of 16.3 MGD in 2012. That rate has fluctuated since then, but could reach that level during an extreme drought year.

Based upon the peak demand projections in Table 4-4 and the well analysis discussed in section 5.2, it is estimated that projected maximum daily demand may exceed firm/reliable well supply capacity. For that reason, additional capacity is recommended in the future. The previous section of this report identified the need for approximately **4.0 – 5.0 MGD** or more in reliable supply capacity to meet projected water system demand growth through the 2040 planning period

Before recommendations on supply can be made, regulations regarding supply must be first reviewed. The requirements of Minnesota state code apply, as well as any special requirements placed upon Shakopee. There is a concern in the Eastern portions of the City regarding the influence of groundwater drawdown on the nearby Fen wetland. While working with the Minnesota Department of Natural Resources (DNR), it has become apparent that the construction of any new wells east of the easternmost well in the City will not be permitted. Thus, new well construction is not permissible east of County Road 83, and no future wells will be planned east of Well 5.

A deficiency in overall water supply capacity was shown to be possible in Figure 5-1. The system has 18 wells in total. It is not unreasonable to assume that up to two wells may be offline at a time, as in Figure 5-1. Supply calculations completed in Appendix C show that both the Normal Zone and/or the First High Zone could have a supply deficiency in the coming years, depending on growth.

A cost effective solution to dealing with the firm capacity in separate pressure zones is to provide water supply sources which benefit multiple pressure zones. As development occurs and when the firm capacity of the system is exceeded by the maximum day demand, It is recommended that the City construct additional supply wells which are capable of serving multiple pressure zones.

6.1.1 New Water Production Wells

Figure 6-1 shows potential locations for up to four future wells. Long term, it is anticipated that three new wells may be needed to satisfy water demands across the entire system. Previous analysis showed that the Normal and 1st high pressure zones may eventually have supply deficits. Additionally, it is beneficial to have supply sources in each of the major pressure zones to reduce dependency on booster stations and support diverse redundant operation. In regards to potential well location, SPUC has identified multiple potential well sites which could all be feasible site options. When considering overall system redundancy and system zone transfer, it would be beneficial to locate the long term wells in growing zones that are absent of supply (2nd High West) or the Normal or 1st high pressure zones.

Well No.22
The construction of new well No.22 next to existing will No.3 provides for an option to gain additional capacity beyond the new well. As noted previously in the report, existing Well No.3 is not operated due to subpar water quality associated with Radionuclides. The construction of a new water production well would allow water from the new well to be blended with water from Well No.3 and producing an effluent that meets the primary drinking water standards. By constructing such a well, the capacity of Well No.3 could then be utilized to reduce the need for additional supply. Additionally, the construction of this well would not require an additional building and the new well could be piped into Pump house 3, becoming a joint facility to facilitate blending and chemical addition.

Well No.23 + Well No.24
Well No.23 and Well No.24, would be located in the Second High Zone (West) and would work in conjunction with a new water tower serving the Second High Zone. These wells would normally serve the Second High Zone, but due to their location in a higher pressure zone, they could also easily feed water to the lower pressure zones by gravity. Additionally, the construction of these wells near each other would allow for them to share a common pump house facility.

Additional well sites
SPUC has additional potential well sites to facilitate the construction of new wells if needed. Well No. 18 and Well No.19 have potential sites located in the vicinity of the Shakopee Soccer Association soccer fields. Additional reserve well sites include the Church Addition and Wood Duck Trail near tank No.7. Though these sites are not identified in the current planning period, they may be needed if development patterns change or of existing wells fail and additional supply is required.

6.1.2 Existing Well Maintenance

6.1.2.1 Pump House Reconstruction

Maintaining existing facilities will reduce the need for additional wells as existing facilities can be optimized. SPUC has been proactive about maintenance and restoration of ageing facilities. Currently the pump house that serves Well No.2 and Well No.8 is in need of major upgrades. This upgrade will require the complete razing of the existing building which includes electrical and control equipment, metering, chemicals and chemical feed equipment. The completion of this work will require the existing facility to be taken offline for about a year which will make these wells unavailable for use. The upgrade and modernization of this facility is much needed due to the limited size of the existing facility and antiquated equipment within the building. Since Wells No.2 and No.8 will need to be taken offline to complete this work, it is recommended to have a new water supply source be online and available to replace the lost capacity.

Additionally, the pump house that serves Well No. 4 and Well No.5 will eventually need rehabilitation and replacement, though there are not near term plans, it can be assumed that this work will be completed during the current 20 year planning period.

6.1.2.2 Production Well Maintenance

At existing well locations where the aquifer produces good well capacity and acceptable water quality, as the well declines in capacity and condition it should be rehabilitated and returned to normal service to take advantage of the investment of surrounding transmission capacity. Wells in this category should be identified by future well assessments that are outside the scope of this study.

6.2 Interzone Transfer Improvements

6.2.1 East Zone – Riverview Booster Station - Online

The East Zone is planned to be raised to the hydraulic grade line of the Second High Zone. In order to accomplish this, the East Zone would need a booster station. A future booster station containing two 1,000 gpm pumps was shown to be suitable for the East Zone. This booster station is now online. – This facility is now online and operational.

6.2.2 East Zone – Secondary Booster Station

It was previously thought that the East pressure zone may someday be served by an elevated water storage tank. However recent land use trends indicate that total connections in this area may be limited, therefore will be served by a booster station long term. Because of this it is recommended that a second redundant booster station be constructed to boost system pressure to this zone in the event of the failure of the primary booster station. While the primary station is being designed and constructed with two 1,000 gpm service pumps, to account for fire protection, it would be reasonable to design the secondary station on a smaller scale to accommodate typical system demands. Therefore a small scale booster station with two 100 gpm pumps is recommended. Such a station is small enough that it could be installed in a below grade vault or small flip top enclosure. Construction of a secondary booster station would allow the pressure zone to be supplied with water from two different entry points which would aid in system redundancy and water circulation.

6.2.3 Windermere Booster Station - Online

The Second High West Zone is planned to be constructed with the same hydraulic grade line of the Second High Central Zone. In order to accomplish this, the Second High West Zone would need a booster station, which is currently underway. A booster station containing two 1,000 gpm pumps was shown to be suitable for the Second High Central Zone. This Station will be going online soon. – This facility is now online and operational.

6.2.4 Upgrade Well 9 Booster Station with Flow Control Valve

SPUC currently owns a booster station at Well 9 which moves water from the Normal Zone to the First High Zone. It is recommended that a flow control valve be added to the Well 9 booster station to allow water to move from the First High Zone to the Normal Zone. This will allow for operational flexibility as needed to control water flow from zone to zone. Without this improvement, water could still be moved from zone to zone, through PRV’s or manual valve operation, however, the flow rate could not be controlled nor the volume of water accounted for.

6.2.5 Church Addition Booster Station

Long range planning indicates that only a few more wells will be needed to accommodate future growth through the 2040 planning period. With this in mind, a focus on system redundancy can be a long term goal. If the Utility were to lose the ability to safely operate multiple wells in the 1st High Zone, additional water transfer ability from the Normal Zone would be beneficial. The interzone transfer/pumping analysis revealed a potential 0.9 mgd supply shortfall if a well was taken offline. While a portion of this shortfall could be accommodated by pumping from the main pressure zone through the well No.9 booster station, a second booster feed into this pressure zone would be beneficial. The Utility currently owns a portion of property near the Church Addition Development. Since this site borders the Normal and 1st high pressure zones, it would be a prime site to serve a multiple purpose function of two direction water transfer. Such a facility would supplement emergency water supplies to the 1st high zone by the addition of a high service booster pump and interconnecting water main. In a like manner, the facility would provide emergency water supplies to the Normal pressure zone via of pressure-reducing/pressure-sustaining control valve to allow water to flow from the 1st High Zone to the Normal Zone.

While there is not a short term need for this facility, as the high pressures zones expand, and water supply is needed, the investment in multifunction water supply and transfer facilities will help SPUC to maintain a high level of service. The need for this facility is decreased if additional wells are placed in the higher pressures zones as system pumping redundancy would be accomplished with these wells.

6.2.6 Highway 169 West Return Flow Valve

Highway 169 bisects the existing water system and acts as a barrier between pressure zones, with limited crossings. To increase redundancy in the system, connections between pressure zones would promote the ability to move water between the Normal Zone and the First High Zone. While not an immediate need, if development leads to the construction of a trunk water main crossing highway 169, it is recommended that a Pressure Reducing Valve (PRV) with flow control capabilities be installed along the zone boundary. This would allow for a controlled amount of flow to be transferred from the First High Zone to the Normal Zone. This crossing would add redundancy to the system as growth occurs to the west, and the controlled flow valve would assist the Normal Zone in case two wells were offline in the Normal Pressure Zone.

6.3 Water Quality Improvements

6.3.1 Nitrate Removal

As previously mentioned in the report, SPUC is currently successfully managing nitrate levels through the use of water blending with other wells with low nitrate levels. Nonetheless, for the purposes of this report, a nitrate removal plant is being budgeted if the need for the plant becomes a reality. For the estimate, a 3.0 MGD plant is assumed, capable of treating water from two typical SPUC wells concurrently.

6.3.2 Manganese Filtration

The emergence of manganese as a potential water quality issue in new and existing wells has presented the possibility of the need for a manganese (&iron) filtration plant. As new water sources are pursued in the South and western parts of the City (Expansion areas) early indications have revealed the potential for manganese to be present in the water. As a result, a filtration plant is budgeted to address potential iron and manganese issues. A 3.0 MGD plant, capable of treating water from two typical SPUC wells is presented as a budgetary placeholder.

6.3.3 Unidirectional Flushing

Unidirectional Water Main Flushing (UDF) has been gaining popularity across the water industry to help improve the effectiveness of flushing. Standard water main flushing has traditionally been considered an effective method to help clean water distribution system piping to help reduce unwanted tastes, odors or discolorations of the water, and to improve chlorine residual. UDF, a more sequential and planned activity, provides greater cleaning of pipes and uses less water than traditional flushing. The main goal of UDF implementation is to isolate sections of pipe by closing specific valves and opening specific hydrants sequentially, which assures optimal flushing velocity is achieved throughout the entire water distribution system. Sustaining a minimum flow velocity of 5 fps in a water main is key to effectively scouring the main to deliver desired flushing results.

UDF plan is a proven effective tool for maintaining water distribution water quality. A UDF plan can reduce water quality complaints, improve taste and odor, increase disinfectant residuals, improve hydraulic capacity, and reduce levels of biological growth within the water distribution system. The UDF plan improves flushing effectiveness by increasing flushing velocity. Higher velocities allow for scouring of the water main which more effectively removes sediments such as iron, manganese, sand, rust, and other mineral deposits that can accumulate within the water mains.

Given the desire to deliver high quality water, the SPUC water system may benefit from the development of a UDF program. Over time, minerals and sediment can build up in water mains. Traditional flushing may not always properly scour mains and may stir up sediment, leading to water quality complaints. The development and implementation of a UDF program will help to keep distribution system piping clean to provide high quality water. Given the development of the update computer water system model and advanced GIS mapping, these tool cam be leveraged to provide an effective, low cost water distributions quality investment.

6.4 Storage Improvements

The need for water storage was summarized in great detail within the previous report. This supplement reviews previous findings and produces consistent recommendations. Since the last publication, SPUC has moved forward with the option to build the 750,000 gallon tank in the 2nd High West zone to meet near and long term storage needs in the 2nd high zone.

Much of the future population growth is expected to occur in the second high pressure zone. As this pressure zone grows, so will the water that is demanded. Standalone water booster stations will be capable of serving these areas for a time, however, as the system grows, additional elevated water storage tanks will need to be added to these pressures zones. The west and central portions of the second high pressure zone are expected to see the first sustained growth and expansion. Currently these portions of the second high pressure zone are not connected, it is unknown as to when they may eventually connect since it will depend on system development and growth. The water storage analysis previously completed in this report indicated that ultimately 1,000,000 gallons of elevated water storage should be added to the water system and the second high pressure zone to sustain and support ultimate water system demand projections. Currently developers are active in the western portions of the second type pressure zone, with potential water tower sites now being discussed. With current developments now underway, the natural choice for the construction of a storage tank would be in this area to serve in new customers. It may not be prudent to place all of the 1,000,000 gallons of needed water storage at one location. Since a water tank best serves customers within a reasonable proximity depending on connected trunk water main, a single tank placed in the west would not be well positioned to serve the central portion of the second high pressure zone. Therefore it is ultimately recommended that two elevated water tanks be constructed with in the second high-pressure zone (West and central)

6.4.1.1 Construct 250,000 & 750,000 Gallon Elevated Tank for Second High Zone(s)

The section above documented the case and need for water storage to serve the Second high pressure zone. With initial development anticipated to be concentrated in the Western portions of the Second high pressure zone, there would be the option to construct a 750,000 gallon tank at this location and a 250,000 gallon tank at the Central location. With this rational, one tank will be suitable to serve a large portion of the development built out. As long term development plans become clearer, and the central part of the second high zone is connected to the west, the proposed second water tower size can be reevaluated. The construction of the first 750,000 gallon water tower will initially benefit the western portions of the second high zone as well as the first high zone as it will suppler flows via inter-zone flow through PRV stations.

6.5 Water Main Improvements

As development progresses into the expansion areas, a trunk water main system must be constructed to deliver adequate flows for various conditions including emergency fire flow. A trunk water main is defined as a pipe sized such that it can supply water for nearby users as well as serve a greater function by transporting water across the system to meet the demands of the extended water system. The majority of trunk water main improvements identified are outside of the existing service area and should be constructed as development occurs and road improvements are constructed. Figure 6-1 presented the proposed preliminary routing of trunk water mains to serve future development areas. Actual main routing will depend on a variety of local factors as individual projects progress. This map should be seen as a recommendation for the general hydraulic capacity of the distribution system as it is extended to serve new development. Generally speaking, the trunk main layout is comprised of a gridded network of 16-inch and 12-inch diameter water mains. In addition Figure 6-1 shows some key water main improvements to the existing system piping. Some improvements were for system reliability and others were for fire protection. This section will review each existing system improvement in greater detail.

As stated above, the improvements presented in Figure 6-1 represent a conceptual plan for potential long term water system improvements to improve and expand the hydraulic capacity of the water distribution system. These improvements are presented to improve flow capacity, increase system reliability and support long term community development and growth. Although the local knowledge of development patterns was utilized in the preparation of the trunk water main plan, as a conceptual plan, the actual size and location of the improvements will depend upon future planning efforts and the circumstances at the time of the improvement are implemented and may not follow exactly as shown in the figure.

6.5.1 Trunk Water Main Infill

In addition to trunk water main to be constructed in expansion area, there are some section of existing trunk water main backbones that are still in need of final infill. These sections of water main are also outlined in figure 6-1.

6.5.2 Ultimate Trunk Water Main Grid

As development progresses into the expansion areas, a trunk water main system must be constructed to deliver adequate flows for various conditions including emergency fire flow. A trunk water main is defined as a pipe sized such that it can supply water for nearby users as well as serve a greater function by transporting water across the system to meet the demands of the extended water system. The majority of trunk water main improvements identified are outside of the existing service area and should be constructed as development occurs and road improvements are constructed. Figure 6-1 presented the proposed preliminary routing of trunk water mains to serve future development areas. Actual main routing will depend on a variety of local factors as individual projects progress. This map should be seen as a recommendation for the general hydraulic capacity of the distribution system as it is extended to serve new development. Generally speaking, the trunk main layout is comprised of a gridded network of 12-inch water mains (1/2 mile spacing) with some 16-inch main sized for transmission capacity. Where more defined development is in progress, 8-inch water main grids on a tighter installation scale are also included.

In Figure 6-1, a proposed trunk water main layout has been drawn, with 12-inch loops helping to balance the future water system by allowing large volumes of water to flow between supply, storage, and points of use. These trunk main loops will be required to effectively transport water to the extremities of the proposed expansion areas. Looping is recommended wherever possible to minimize dead-ends in the water system.

Dead-ends, or branched water systems are less reliable since water must come from one direction. This forces the utility to shut off water to some customers during repairs or maintenance. In addition, larger head losses (or pressure losses) are experienced on dead-ends than on looped systems. This can limit available flow rates during fire protection activities.

6.6 System Planning

Figure 6-1 illustrates the water system master plan to meet current and projected water system needs through the 2040 planning period. As mentioned previously, these improvements are intended to correct existing deficiencies as well as meet the needs for future growth and development. To demonstrate the effectiveness of the recommended improvements, Figures 6-2 and 6-3 illustrate the anticipated maximum day demand pressures and maximum day fire flows, respectively, with the recommended improvements under projected 2040 demands conditions.

The recommended improvement plan to serve the future service area has been developed as a tool to guide SPUC in the siting and sizing of future system improvements. While the plan may represent the current planned expansion of the SPUC system, future changes in land use, water demands, or customer characteristics could substantially alter the implementation of the plan. For this reason, it is recommended that the plan be periodically reviewed and updated using area planning information to reflect the most current projections of SPUC service area growth and development.

The improvement plan is a guidance document that details existing conditions and recommendations for the future. The plan is based on future conditions as perceived in 2017. As time progresses, additional information will become available and events will shape the development of the SPUC service area. The plan must be dynamic in response; it should be studied and used but also adjusted to conform to the changes and knowledge that will come with time. Updates should be made on a regular basis, probably every five to ten years.

7 Capital Improvements Plan

One of the main objectives of this study was to develop a long-range Capital Improvement Plan (CIP) for water system facilities. The CIP provides information on the anticipated cost and timing of future water supply, storage and distribution improvements.

The previous section summarizes the recommended water system improvements anticipated throughout the planning period. This section summarizes the recommended water system improvements and presents a proposed Water Utility capital improvements program. The recommended Capital Improvements Plan prioritizes system improvements and provides a schedule for the timing of construction. Budget cost estimates for each improvement are also summarized.

7.1 Supply

Based upon the current and projected water system needs, additional wells will be required to provide reliable supply capacity for current and future water demands. While near term water system demands can supplied by current well capacities, additional wells will be required to support growth and development. Three new wells are identified to support water system growth and replace aging wells through the 2040 planning period.

7.2 Treatment

Two potential treatment plants, an iron and manganese plant as well as a nitrate plant are budgeted as place holders in the event that water quality declines in the existing wells, or if subpar water quality exists at new and proposed well sites.

7.3 Storage

The current water system is supported by robust water storage volumes, however as the water system grows into the Second High pressure zone, elevated water storage should be added to the system in this zone to support system operation and provide the type of water service that is similar to the other pressure zones. Historically, it has been a practice to add elevated storage to a pressure zone when the number of users connected approaches 250 homes. With commercial and residential development now occurring in the Wester portions of the second high pressure zone, planning for the next elevated water tank should begin now. A second tank in the second high pressure zone will be eventually needed depending on development for a total of 1, 000,000 gallons of water storage in the second high pressure zone.

7.4 Water Booster Stations and Flow Control

Movement of water between the pressure zones is important from a redundancy standpoint. As new wells are added throughout the system, a demand to move the supplied water from zone to zone will be required. As a result a series of booster stations are planned to move water from the lower service zones to higher zones. In a similar fashion, flow control valves located at the booster station facilities are beneficial to move water in a controlled fashion from the higher zones to lower zones.

7.5 Distribution

Figure 6-1 is the proposed SPUC 2040 Water System Master Plan. The figure illustrates recommended improvements to the existing distribution system to serve the current service area. The improvements have been recommended to strengthen the existing water distribution network, and support system expansion into future service areas. The Figure also shows how long range trunk water mains might be installed. Trunk main looping should be a priority in the expansion of the service area and in water main replacement projects. The proposed layout of trunk water mains in this report would provide water supply and fire protection capabilities to existing and projected service areas. In addition, recommended trunk mains will connect water supply and storage facilities with points of use on the system.

7.6 CIP Costs

The table below provides a high level summary of short and long range water system facility capital costs. These costs are based on recent projected history an anticipated system growth.

Table 7-1 – Proposed Water System Improvements – Through 2040

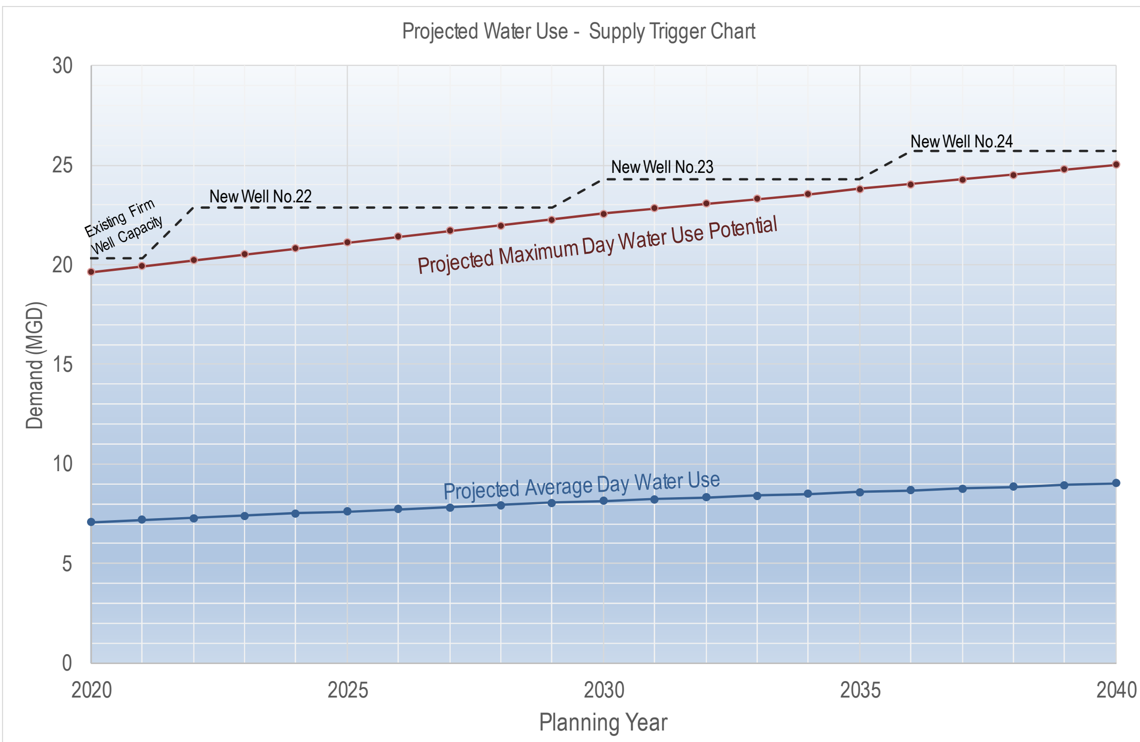
Type	Improvement				Planning Period	Estimated Cost
Supply	Well No.22 - Well, Pump & Connection W/ Well No.3				2020-2025	$1,400,000
Supply	Well No.23 - Well, Pump, Building and Connections				2025-2030	$3,000,000
Supply	Well No.24 - Well, Pump, Connections				2035-2040	$1,400,000
Transfer	Church Addition Booster Station				TBD	$2,600,000
Transfer	Secondary East Booster Station				TBD	$550,000
Transfer	Well No.9 Flow Control Valve Upgrades				2025-2030	$175,000
Transfer	HWY 169 Flow Control Station				TBD	$350,000
Storage	West 2nd High 750K Tank				2020-2025	$2,700,000
Storage	Central 2nd High 250 K Tank				2030-2035	$1,700,000
Treatment	3.0 MGD Nitrate Removal Plant				TBD	$9,500,000
Treatment	3.0 MGD Manganese Filtration Plant				TBD	$9,100,000
Type	**Improvement**	**Quantity**	**Unit**	**Price**	**Planning Period**	**Estimated Cost**
Distribution	Upsize 6 to 8-Inch Main	28,700	LF	$12	TBD	$351,000
Distribution	Upsize 6 to 12-Inch Trunk Main	144,600	LF	$48	TBD	$6,897,000
Distribution	Upsize 6 to 16-Inch Trunk Main	12,600	LF	$92	TBD	$1,159,000
Distribution	Upsize 8 to 12-Inch Trunk Main	27,600	LF	$35	TBD	$979,000
Distribution	Upsize 8 to 16-Inch Trunk Main	2,700	LF	$80	TBD	$215,000
Distribution	Zone Boundary PRV's	7	EA	$85,000	TBD	$595,000
Distribution	Highway Crossing / Casing	500	LF	$700	TBD	$350,000

7.7 Trigger Chart

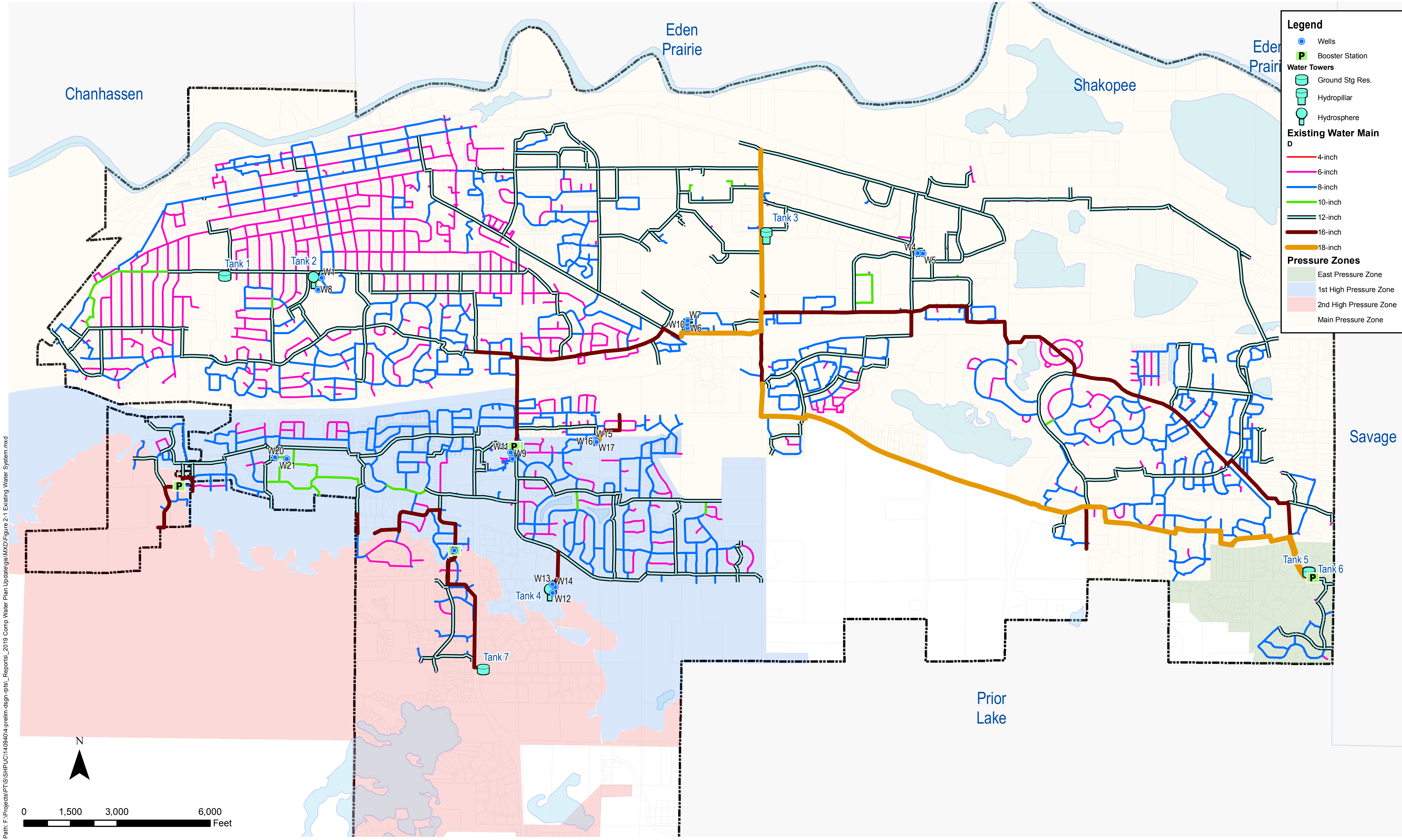
The timing of future water improvements will be influenced by a number of parameters. Items such as development pressure in specific areas, aging facilities and/or facilities which are undersized, availability of funds, etc. all play a role in the timing of future improvements.

Because of the factors involved, it is difficult to accurately predict the timing of future improvements, especially those which may occur far into the future.

A trigger chart is presented in below, which correlates well and storage improvements to system demands. Future capital improvement planning can thus be tied to actual system demands and the timeline adjusted as necessary.



Figures



Project Number: SHPUC 140940
Print Date: Print Date: 10/21/2019

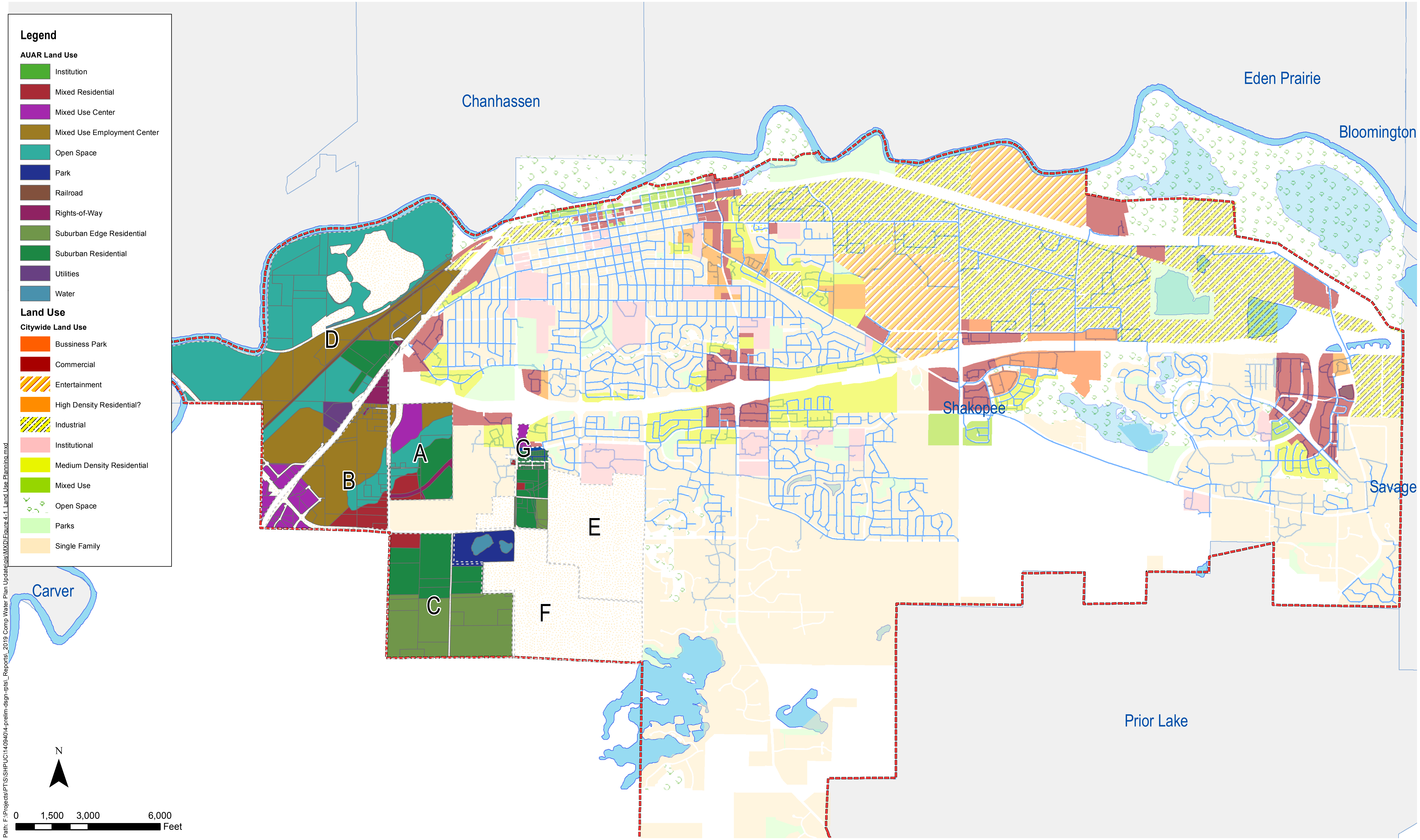
Map by:
Projection:
Source:

SEH

Comprehensive Water Plan Update - 2019 Supplement

Shakopee Public Utilities
Shakopee, Minnesota

FIGURE 2-1
Existing Water System Model Map



Project Number: SHPUC 140940
Print Date: Print Date: 10/17/2019

SEH

Map by:
Projection:
Source:

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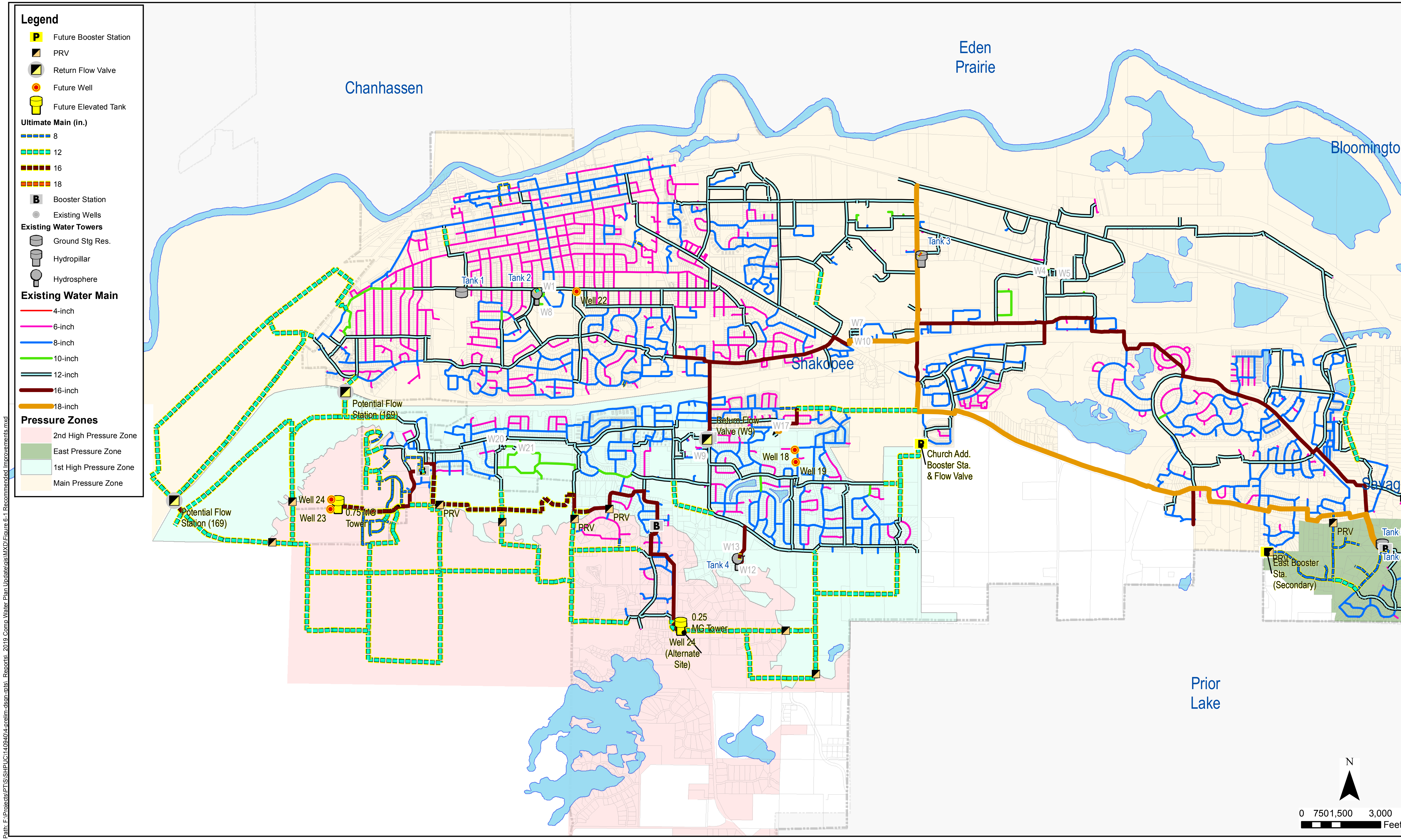
Shakopee, Minnesota

FIGURE 4-1
Future
Land Use Planning



SEH

Project Number: SHPUC 140940
Print Date: Print Date: 10/21/2019

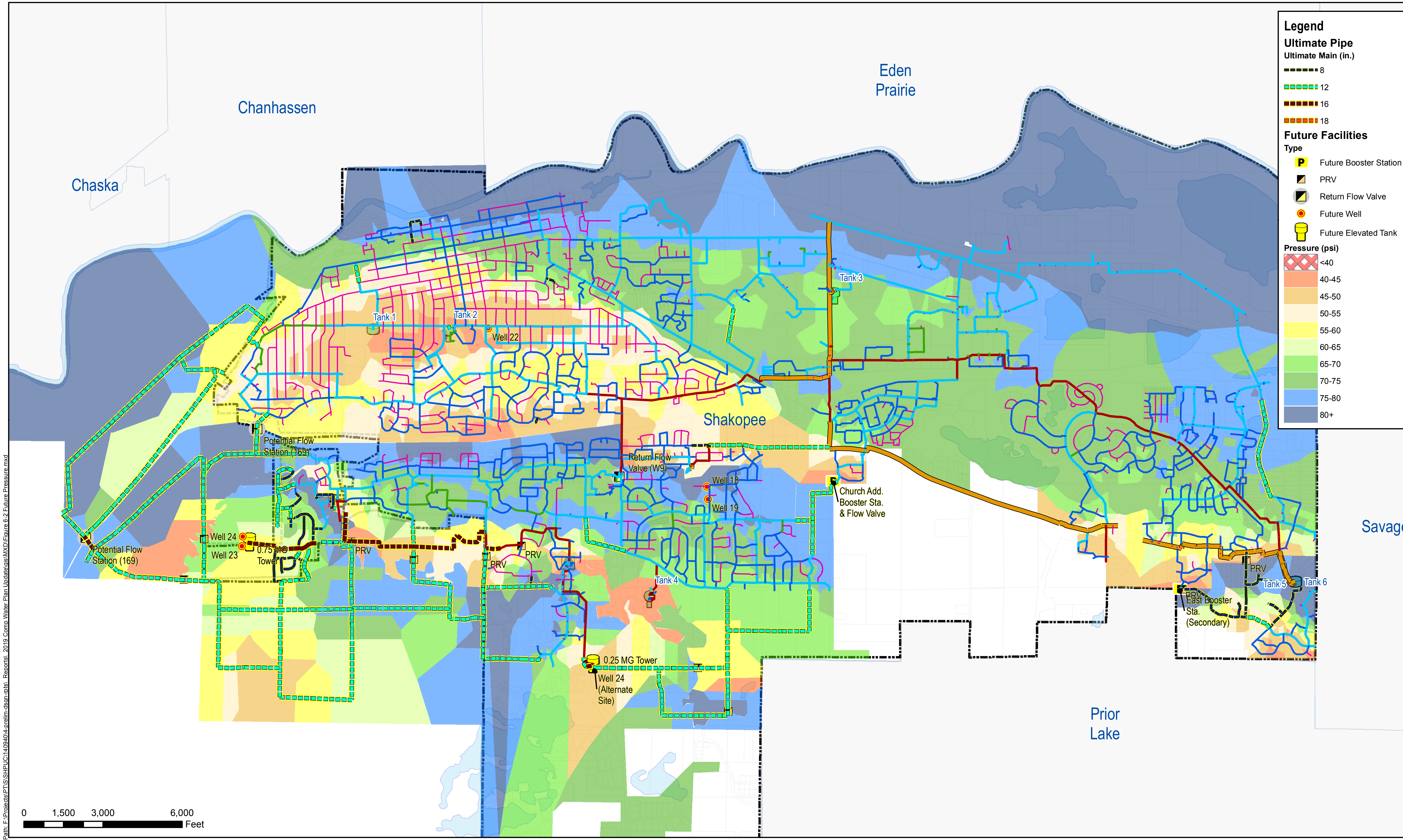
Map by:
Projection:
Source:

Comprehensive Water Plan Update - 2019 Supplement

Shakopee Public Utilities
Shakopee, Minnesota

FIGURE 6-1

Proposed 2040 Water System Improvements



Path: F:\Projects\PT\S\SHPUC\140940\4-prelim-dsgn-rpts_Reports_2019 Comp Water Plan Update\gis\MXD\Figure 6-2 Future Pressure.mxd

SEH

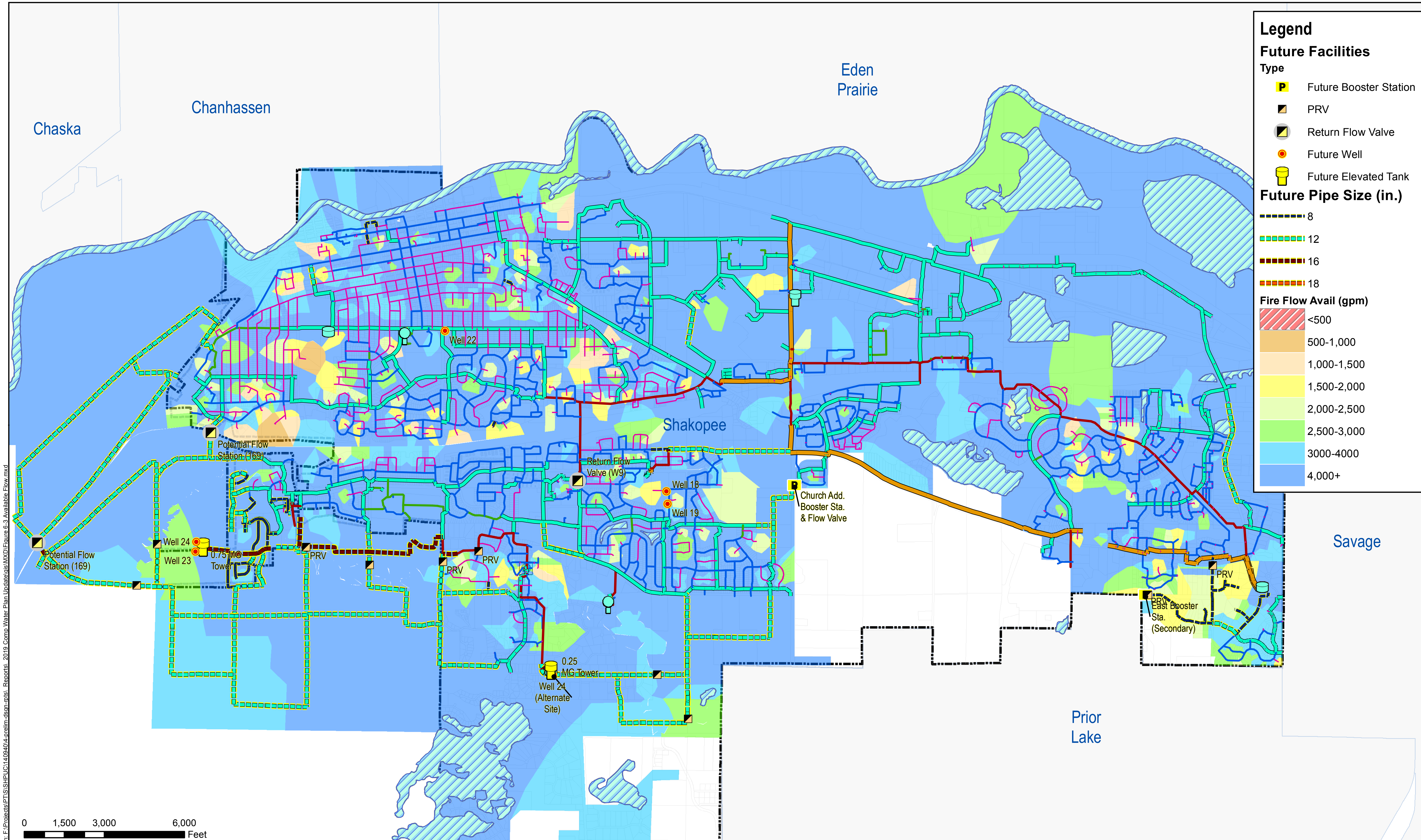
Project Number: SHPUC 140940
Print Date: Print Date: 10/21/2019

Map by:
Projection:
Source:

Comprehensive Water Plan Update - 2019 Supplement

Shakopee Public Utilities
Shakopee, Minnesota

FIGURE 6-2
2040 Water System
Static Pressures



Project Number: SHPUC 140940
Print Date: Print Date: 10/21/2019

Map by:
Projection:
Source:

SEH

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Shakopee, Minnesota

FIGURE 6-3
2040 Water System
Calc. Availale Fire Flow

Appendix A

Water Quality Data

2019 Mineral Analysis

	Well 2 Result	Unit	Well 8 Result	Unit	Blend
Copper	< 0.005	mg/L	< 0.005	mg/L	
Arsenic	< 0.5	µg/L	< 0.5	µg/L	
Chloride	37.10	mg/L	48.20	mg/L	42.65
Iron	< 0.03	mg/L	< 0.03	mg/L	
Manganese	< 0.005	mg/L	< 0.005	mg/L	
Sulfate		mg/L		mg/L	
Alkalinity, Total*	266	mg/L	261	mg/L	264
Calcium	73.70	mg/L	76.80	mg/L	75.25
Magnesium	32.60	mg/L	34.40	mg/L	33.50
Sodium	14.70	mg/L	15.30	mg/L	15.00
Zinc	< 0.01	mg/L	< 0.01	mg/L	
Hardness, Total	318	mg/L	333	mg/L	326

	Well 20 Result	Unit	Well 21 Result	Unit	Blend
Copper	< 0.005	mg/L	< 0.005	mg/L	
Arsenic	< 0.5	µg/L	< 0.5	µg/L	
Chloride	34.20	mg/L	36.20	mg/L	35.20
Iron	< 0.03	mg/L	< 0.03	mg/L	
Manganese	< 0.005	mg/L	< 0.005	mg/L	
Sulfate		mg/L		mg/L	
Alkalinity, Total*	214	mg/L	259	mg/L	237
Calcium	62.70	mg/L	73.60	mg/L	68.15
Magnesium	22.70	mg/L	30.00	mg/L	26.35
Sodium	12.40	mg/L	12.20	mg/L	12.30
Zinc	< 0.01	mg/L	< 0.01	mg/L	
Hardness, Total	250	mg/L	307	mg/L	279

	Well 15 Result	Unit	Well 16 Result	Unit	Well 17 Result	Unit	Blend
Copper	< 0.01	mg/L	0.005	mg/L	< 0.005	mg/L	
Arsenic	< 0.5	µg/L	< 0.5	µg/L	< 0.5	µg/L	
Chloride	43.50	mg/L	51.70	mg/L	43.00	mg/L	46.07
Iron	< 0.015	mg/L	< 0.015	mg/L	< 0.03	mg/L	
Manganese	0.118	mg/L	< 0.005	mg/L	0.036	mg/L	0.077
Sulfate		mg/L		mg/L		mg/L	
Alkalinity, Total*	279	mg/L	299	mg/L	295	mg/L	291.00
Calcium	82.20	mg/L	95.40	mg/L	82.90	mg/L	86.83
Magnesium	35.40	mg/L	38.40	mg/L	38.50	mg/L	37.43
Sodium	17.30	mg/L	17.90	mg/L	16.00	mg/L	17.07
Zinc	< 0.01	mg/L	< 0.01	mg/L	< 0.01	mg/L	
Hardness, Total	351	mg/L	396	mg/L	366	mg/L	371

	Well 4 Result	Unit	Well 5 Result	Unit	Blend
Copper	< 0.005	mg/L	< 0.005	mg/L	
Arsenic	< 0.5	µg/L	< 0.5	µg/L	
Chloride	155.00	mg/L	72.70	mg/L	113.85
Iron	< 0.015	mg/L	< 0.015	mg/L	
Manganese	< 0.005	mg/L	< 0.005	mg/L	
Sulfate		mg/L		mg/L	
Alkalinity, Total*	259	mg/L	240	mg/L	250
Calcium	83.40	mg/L	105.00	mg/L	94.20
Magnesium	29.60	mg/L	34.70	mg/L	32.15
Sodium	26.70	mg/L	54.00	mg/L	40.35
Zinc	< 0.01	mg/L	< 0.01	mg/L	
Hardness, Total	330	mg/L	405	mg/L	368

	Well 9 Result	Unit	Well 11 Result	Unit	Blend
Copper	< 0.005	mg/L	< 0.005	mg/L	
Arsenic	< 0.5	µg/L	< 0.5	µg/L	
Chloride	63.60	mg/L	42.10	mg/L	52.85
Iron	< 0.015	mg/L	< 0.015	mg/L	
Manganese	< 0.005	mg/L	< 0.005	mg/L	
Sulfate		mg/L		mg/L	
Alkalinity, Total*	329	mg/L	338	mg/L	334
Calcium	97.90	mg/L	95.00	mg/L	96.45
Magnesium	43.00	mg/L	43.20	mg/L	43.10
Sodium	18.20	mg/L	14.70	mg/L	16.45
Zinc	< 0.01	mg/L	< 0.01	mg/L	
Hardness, Total	422	mg/L	415	mg/L	419

CD - 1

	Well 6 Result	Unit	Well 7 Result	Unit	Well 10 Result	Unit	Blend
Copper	< 0.005	mg/L	< 0.01	mg/L	< 0.005	mg/L	
Arsenic	< 0.5	µg/L	< 0.5	µg/L	1.95	µg/L	
Chloride	76.30	mg/L	124.00	mg/L	12.10	mg/L	70.80
Iron	< 0.03	mg/L	< 0.015	mg/L	0.417	mg/L	
Manganese	0.026	mg/L	< 0.005	mg/L	0.006	mg/L	0.012
Sulfate		mg/L		mg/L		mg/L	
Alkalinity, Total*	256	mg/L	262	mg/L	200	mg/L	239.33
Calcium	73.80	mg/L	85.40	mg/L	42.80	mg/L	67.33
Magnesium	32.60	mg/L	36.60	mg/L	16.80	mg/L	28.67
Sodium	32.60	mg/L	56.30	mg/L	24.90	mg/L	37.93
Zinc	< 0.01	mg/L	< 0.01	mg/L	< 0.01	mg/L	0.01
Hardness, Total	319	mg/L	364	mg/L	176	mg/L	286
Radium 226					2.10	pCi/L	
Radium 228					4.10	pCi/L	
Radon 222					280.00	pCi/L	

CD - 2

	Well 12 Result	Unit	Well 13 Result	Unit	Well 14 Result	Unit	Blend
Copper	< 0.01	mg/L	< 0.01	mg/L	< 0.005	mg/L	
Arsenic	< 0.5	µg/L	< 0.5	µg/L	18.40	µg/L	
Chloride	14.00	mg/L	21.40	mg/L	< 3.00	mg/L	12.80
Iron	< 0.015	mg/L	< 0.015	mg/L	0.63	mg/L	
Manganese	0.08	mg/L	0.01	mg/L	0.03	mg/L	0.041
Sulfate		mg/L		mg/L		mg/L	
Alkalinity, Total*	323	mg/L	329	mg/L	289	mg/L	313.67
Calcium	83.30	mg/L	85.60	mg/L	78.60	mg/L	82.50
Magnesium	40.00	mg/L	41.80	mg/L	28.60	mg/L	36.80
Sodium	8.42	mg/L	10.50	mg/L	8.16	mg/L	9.03
Zinc	< 0.01	mg/L	< 0.01	mg/L	< 0.01	mg/L	0.01
Hardness, Total	373	mg/L	386	mg/L	314	mg/L	358
Radium 226					2.70	pCi/L	
Radium 228					4.50	pCi/L	
Radon 222					274.00	pCi/L	

Welll 14 is emergency run only. When pumped, it pumps to waste and not into the distribution system.

	MCL
Copper	1.3
Arsenic	10
Chloride	N/A
Iron	N/A
Manganese	N/A
Sulfate	N/A
Alkalinity, Total*	N/A
Calcium	N/A
Magnesium	N/A
Sodium	N/A
Zinc	N/A
Hardness, Total	N/A

* as CaCO3

< indicates below detection limit for the test method.

Averages System Wide

Chloride	51.65
Sulfate	
Alkalinity	276.35
Calcium	81.06
Magnesium	34.05
Sodium	21.19
Hardness	342.65
grains	20

Averages by Zone

	Normal	1HES	2HES
Chloride	64.11	21.76	
Sulfate			
Alkalinity	273.67	282.8	
Calcium	82.86	76.76	
Magnesium	34.65	32.62	
Sodium	25.72	10.34	
Hardness	349.58	326	
grains	20	19	

Unit Analogies

Parts per Million
1 inch in 16 miles
1 minute in 2 years
1 second in 11.5 days

Parts per Billion (µg/L)
1 second in 32 years
4 drops in 50,000 gallons
6 people to the population of the earth

Parts per Trillion
1/2 drop in 6 million gallons
1 square inch in 250 square miles
1 second in 32,000 years

Alkalinity is a measure of the ability of a solution to neutralize acid without changing the pH. It both controls and maintains water pH. Carbonate **hardness** is measured in degrees (dKH), parts per million of calcium carbonate (ppm $CaCo_3$), or milliequivalents per liter (meq/L).

SHAKOPEE PUBLIC UTILITIES COMMISSION

"Lighting the Way - Yesterday, Today and Beyond"

MEMORANDUM

TO: John R. Crooks, Utilities Manager

FROM: Lon R. Schemel, Water Superintendent

SUBJECT: Nitrate Results Update -- Advisory

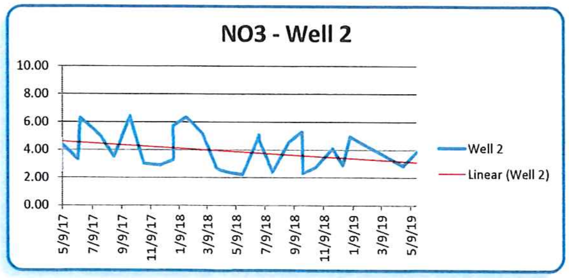
DATE: June 24, 2019

Attached are the latest nitrate test results for the wells. The analyses provided are for the prior 2 years of data collected with trend graphs.

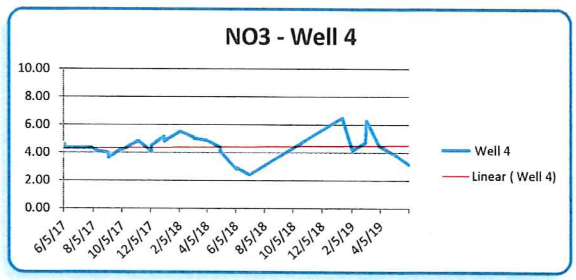
Post Office Box 470 ◆ 255 Sarazin Street ◆ Shakopee, Minnesota 55379-0470
(952) 445-1988 ◆ (952) 445-7767
www.shakopeeutilities.com

Shakopee Public Utilities Commission
Water Department
Nitrate Results
Reported in mg/L

Location	Sample Collected	Results Received	Results	Lab	Run Time
2	5/9/17	5/25/17	4.33	MVTL	168 hrs prior
2	6/8/17	6/28/17	3.30	MDH	168 hrs prior
2	6/8/17	7/27/17	3.40	MDH	
2	6/13/17	6/20/17	6.28	MVTL	192 hrs prior
2	7/25/17	8/1/17	5.00	MVTL	192 hrs prior
2	8/22/17	8/28/17	3.50	MVTL	168 hrs prior
2	9/26/17	10/4/17	6.42	MVTL	168 hrs prior
2	9/26/17	10/20/17	6.30	MDH	
2	10/24/17	11/17/17	3.00	MVTL	168 hrs prior
2	11/28/17	12/11/17	2.90	MVTL	168 hrs prior
2	12/26/17	1/9/18	3.28	MVTL	168 hrs prior
2	12/26/17	2/20/18	5.70	MDH	
2	1/23/18	2/20/18	6.32	MVTL	168 hrs prior
2	2/27/18	3/9/18	5.14	MVTL	168 hrs prior
2	3/27/18	5/31/18	2.70	MDH	
2	4/3/18	4/10/18	2.55	MVTL	168 hrs prior
2	4/24/18	5/9/18	2.37	MVTL	168 hrs prior
2	5/22/18	5/31/18	2.21	MVTL	168 hrs prior
2	5/22/18	6/14/18	2.20	MDH	
2	6/26/18	7/2/18	5.07	MVTL	312 hrs prior
2	6/26/18	8/17/18	4.70	MDH	
2	7/24/18	8/17/18	2.41	MVTL	264 hrs prior
2	8/28/18	10/15/18	4.57	MVTL	168 hrs prior
2	9/25/18	10/15/18	5.30	MVTL	168 hrs prior
2	9/26/18	10/15/18	2.30	MDH	
2	10/23/18	11/7/18	2.76	MVTL	168 hrs prior
2	11/27/18	12/5/18	4.12	MVTL	168 hrs prior
2	12/18/18	12/26/18	2.89	MVTL	168 hrs prior
2	12/18/18	1/14/19	2.90	MDH	
2	1/2/19	1/14/19	4.97	MVTL	168 hrs prior
2	4/23/19	5/1/19	2.84	MVTL	168 hrs prior
2	4/23/19	5/17/19	2.90	MDH	
2	5/21/19	5/29/19	3.83	MVTL	168 hrs prior



4	6/5/17	7/27/17	4.60	MDH	
4	6/6/17	6/14/17	4.33	MVTL	168 hrs prior
4	7/5/17	7/20/17	4.35	MVTL	168 hrs prior
4	8/1/17	8/7/17	4.35	MVTL	168 hrs prior
4	8/14/17	10/20/17	4.10	MDH	
4	9/5/17	9/26/17	3.99	MVTL	168 hrs prior
4	9/5/17	9/26/17	3.60	MDH	
4	10/3/17	10/20/17	4.29	MVTL	168 hrs prior
4	10/3/17	11/17/17	4.20	MDH	
4	11/7/17	3/2/18	4.83	MVTL	168 hrs prior
4	12/5/17	12/22/17	4.12	MVTL	192 hrs prior
4	12/5/17	1/8/18	4.50	MDH	
4	1/2/18	1/16/18	5.15	MVTL	168 hrs prior
4	1/2/18	2/20/18	4.80	MDH	
4	2/6/18	2/20/18	5.50	MVTL	168 hrs prior
4	3/6/18	3/26/18	5.09	MVTL	168 hrs prior
4	3/6/18	3/26/18	5.00	MDH	
4	4/3/18	4/10/18	4.89	MVTL	168 hrs prior
4	5/1/18	5/9/18	4.40	MVTL	168 hrs prior
4	5/1/18	6/26/18	4.10	MDH	
4	6/5/18	6/14/18	2.80	MVTL	168 hrs prior
4	6/5/18	7/18/18	2.90	MDH	
4	7/3/18	11/19/18	2.40	MDH	168 hrs prior
4	1/15/19	1/29/19	6.50	MVTL	168 hrs prior
4	2/5/19	2/12/19	4.16	MVTL	168 hrs prior
4	3/5/19	3/14/19	4.76	MVTL	168 hrs prior
4	3/5/19	3/29/19	4.80	MDH	
4	3/7/19	3/25/19	6.30	MDH	168 hrs prior
4	4/2/19	4/11/19	4.48	MVTL	168 hrs prior
4	5/7/19	5/14/19	3.82	MVTL	168 hrs prior
4	6/4/19	6/21/19	3.14	MVTL	168 hrs prior

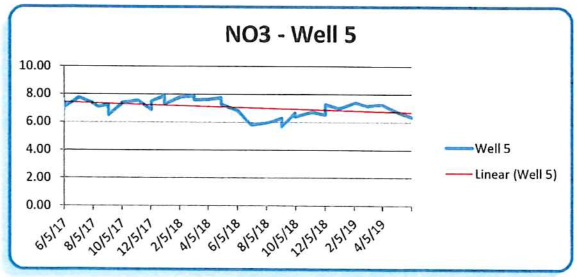


MVTL = Minnesota Valley Testing Laboratories
MDH = Minnesota Department of Health
TCWC = Twin City Water Clinic

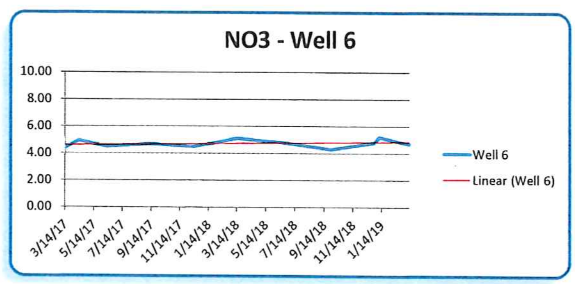
Run times will represent the well being in step 1 for one week (168 hrs)

Shakopee Public Utilities Commission
Water Department
Nitrate Results
Reported in mg/L

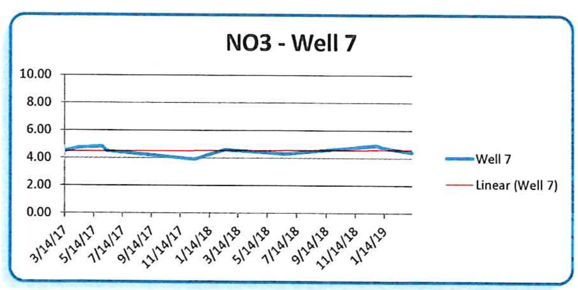
Location	Sample Collected	Results Received	Results	Lab	Run Time
5	6/5/17	7/27/17	7.40	MDH	
5	6/6/17	6/14/17	7.12	MVTL	168 hrs prior
5	7/5/17	7/20/17	7.74	MVTL	168 hrs prior
5	8/1/17	8/7/17	7.40	MVTL	168 hrs prior
5	8/14/17	10/20/17	7.10	MDH	
5	9/5/17	9/26/17	7.27	MVTL	168 hrs prior
5	9/5/17	9/26/17	6.50	MDH	
5	10/3/17	10/20/17	7.33	MVTL	168 hrs prior
5	10/3/17	11/17/17	7.40	MDH	
5	11/7/17	3/2/18	7.57	MVTL	168 hrs prior
5	12/5/17	12/22/17	6.89	MVTL	192 hrs prior
5	12/5/17	1/8/18	7.50	MDH	
5	1/2/18	1/16/18	7.88	MVTL	168 hrs prior
5	1/2/18	2/20/18	7.30	MDH	
5	2/6/18	2/20/18	7.80	MVTL	168 hrs prior
5	3/6/18	3/26/18	7.84	MVTL	168 hrs prior
5	3/6/18	3/26/18	7.60	MDH	
5	4/3/18	4/10/18	7.62	MVTL	168 hrs prior
5	5/1/18	5/9/18	7.75	MVTL	168 hrs prior
5	5/1/18	6/26/18	7.30	MDH	
5	6/5/18	6/14/18	6.83	MVTL	168 hrs prior
5	6/5/18	7/18/18	6.80	MDH	
5	7/3/18	11/19/18	5.80	MDH	
5	8/7/18	8/20/18	5.99	MVTL	168 hrs prior
5	9/4/18	10/15/18	6.32	MVTL	168 hrs prior
5	9/4/18	10/15/18	5.70	MDH	
5	10/2/18	10/15/18	6.67	MVTL	168 hrs prior
5	10/2/18	11/19/18	6.40	MDH	
5	11/6/18	11/19/18	6.74	MVTL	168 hrs prior
5	12/4/18	12/11/18	6.55	MVTL	168 hrs prior
5	12/4/18	12/26/18	7.30	MDH	
5	1/2/19	1/14/19	7.01	MVTL	168 hrs prior
5	1/2/19	3/4/19	7.00	MDH	
5	2/5/19	2/12/19	7.42	MVTL	168 hrs prior
5	3/5/19	3/14/19	7.16	MVTL	168 hrs prior
5	3/5/19	3/29/19	7.20	MDH	
5	4/2/19	4/11/19	7.29	MVTL	168 hrs prior
5	5/7/19	5/14/19	6.73	MVTL	168 hrs prior
5	6/4/19	6/21/19	6.38	MVTL	168 hrs prior



6	3/14/17	4/24/17	4.40	MDH	168 hrs prior
6	4/11/17	4/17/17	4.94	MVTL	168 hrs prior
6	6/8/17	7/27/17	4.50	MDH	168 hrs prior
6	9/12/17	10/20/17	4.70	MDH	168 hrs prior
6	12/12/17	1/8/18	4.50	MDH	168 hrs prior
6	3/13/18	4/10/18	5.10	MDH	168 hrs prior
6	6/19/18	7/18/18	4.80	MDH	456 hrs prior
6	9/26/18	10/15/18	4.30	MDH	192 hrs prior
6	12/27/18	2/5/19	4.80	MDH	168 hrs prior
6	1/8/19	1/14/19	5.21	MVTL	168 hrs prior
6	3/12/19	3/29/19	4.70	MDH	168 hrs prior



7	3/14/17	4/24/17	4.50	MDH	168 hrs prior
7	4/11/17	4/17/17	4.74	MVTL	168 hrs prior
7	6/1/17	7/27/17	4.80	MDH	168 hrs prior
7	6/8/17	7/27/17	4.50	MDH	168 hrs prior
7	9/12/17	10/3/17	4.20	MDH	168 hrs prior
7	12/12/17	1/8/18	3.90	MDH	168 hrs prior
7	2/13/18	3/26/18	4.60	MDH	168 hrs prior
7	6/19/18	7/18/18	4.30	MDH	456 hrs prior
7	9/18/18	10/15/18	4.60	MDH	216 hrs prior
7	12/27/18	2/5/19	4.90	MDH	168 hrs prior
7	1/8/19	1/14/19	4.78	MVTL	168 hrs prior
7	3/12/19	3/29/19	4.40	MDH	168 hrs prior



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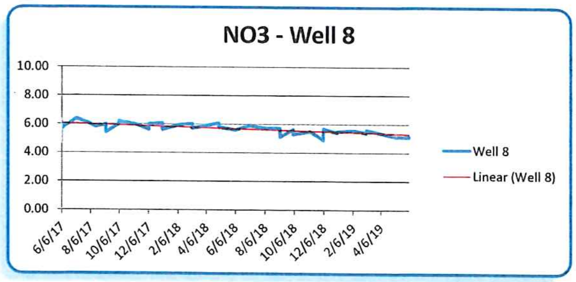
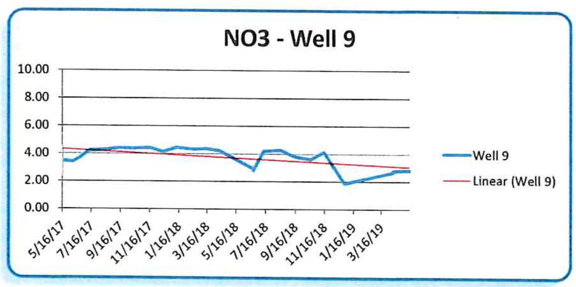
Run times will represent the well being in step 1 for one week (168 hrs)

Shakopee Public Utilities Commission
Water Department
Nitrate Results
Reported in mg/L

Location	Sample Collected	Results Received	Results	Lab	Run Time
8	6/6/17	6/14/17	**5.71**	MVTL	168 hrs prior
8	6/8/17	7/27/17	**5.80**	MDH	168 hrs prior
8	7/5/17	7/20/17	**6.36**	MVTL	144 hrs prior
8	8/1/17	8/7/17	**6.03**	MVTL	216 hrs prior
8	8/14/17	10/20/17	**5.80**	MDH	
8	9/5/17	9/26/17	**5.98**	MVTL	216 hrs prior
8	9/5/17	9/26/17	**5.40**	MDH	
8	10/3/17	10/20/17	**6.00**	MVTL	168 hrs prior
8	10/3/17	11/17/17	**6.20**	MDH	
8	11/7/17	3/2/18	**5.97**	MVTL	168 hrs prior
8	12/5/17	12/22/17	**5.61**	MVTL	192 hrs prior
8	12/5/17	1/8/18	**6.00**	MDH	
8	1/2/18	1/16/18	**6.07**	MVTL	168 hrs prior
8	1/2/18	2/20/18	**5.60**	MDH	
8	2/6/18	2/20/18	**5.94**	MVTL	168 hrs prior
8	3/6/18	3/26/18	**6.03**	MVTL	168 hrs prior
8	3/6/18	3/26/18	**5.70**	MDH	
8	4/3/18	4/10/18	**5.88**	MVTL	168 hrs prior
8	5/1/18	5/9/18	**6.08**	MVTL	168 hrs prior
8	5/1/18	6/26/18	**5.80**	MDH	
8	6/5/18	6/14/18	**5.59**	MVTL	168 hrs prior
8	6/5/18	7/18/18	**5.60**	MDH	
8	7/3/18	11/19/18	**5.90**	MDH	
8	8/7/18	8/20/18	**5.72**	MVTL	168 hrs prior
8	9/4/18	10/15/18	**5.72**	MVTL	168 hrs prior
8	9/4/18	10/15/18	**5.10**	MDH	
8	10/2/18	10/15/18	**5.65**	MVTL	168 hrs prior
8	10/2/18	11/19/18	**5.30**	MDH	
8	11/6/18	11/19/18	**5.51**	MVTL	168 hrs prior
8	12/4/18	12/11/18	**4.89**	MVTL	168 hrs prior
8	12/4/18	12/26/18	**5.70**	MDH	
8	1/2/19	1/14/19	**5.41**	MVTL	168 hrs prior
8	1/2/19	3/4/19	**5.50**	MDH	
8	2/5/19	2/12/19	**5.58**	MVTL	168 hrs prior
8	3/5/19	3/14/19	**5.41**	MVTL	168 hrs prior
8	3/5/19	3/29/19	**5.60**	MDH	
8	4/2/19	4/11/19	**5.40**	MVTL	168 hrs prior
8	5/7/19	5/14/19	**5.13**	MVTL	168 hrs prior
8	6/4/19	6/21/19	**5.12**	MVTL	168 hrs prior



9	5/16/17	5/25/17	**3.47**	MVTL	168 hrs prior
9	6/5/17	6/28/17	**3.40**	MDH	168 hrs prior
9	6/20/17	6/27/17	**3.69**	MVTL	168 hrs prior
9	7/11/17	7/20/17	**4.23**	MVTL	144 hrs prior
9	8/8/17	8/14/17	**4.27**	MVTL	168 hrs prior
9	9/12/17	9/26/17	**4.40**	MVTL	132 hrs prior
9	10/10/17	10/20/17	**4.38**	MVTL	144 hrs prior
9	11/14/17	11/21/17	**4.43**	MVTL	168 hrs prior
9	12/12/17	12/22/17	**4.14**	MVTL	168 hrs prior
9	1/9/18	1/16/18	**4.45**	MVTL	168 hrs prior
9	2/13/18	2/20/18	**4.33**	MVTL	168 hrs prior
9	3/13/18	3/26/18	**4.36**	MVTL	168 hrs prior
9	4/10/18	4/18/18	**4.23**	MVTL	168 hrs prior
9	6/19/18	6/26/18	**2.92**	MVTL	96 hrs prior
9	6/19/18	7/18/18	**2.80**	MDH	
9	7/10/18	7/18/18	**4.20**	MVTL	240 hrs prior
9	8/14/18	8/20/18	**4.29**	MVTL	168 hrs prior
9	9/11/18	10/15/18	**3.83**	MVTL	168 hrs prior
9	10/16/18	11/7/18	**3.61**	MVTL	168 hrs prior
9	11/13/18	11/29/18	**4.15**	MVTL	168 hrs prior
9	12/27/18	1/14/19	**1.87**	MVTL	168 hrs prior
9	4/9/19	4/16/19	**2.69**	MVTL	168 hrs prior
9	4/9/19	5/1/19	**2.80**	MDH	
9	5/14/19	5/20/19	**2.82**	MVTL	168 hrs prior



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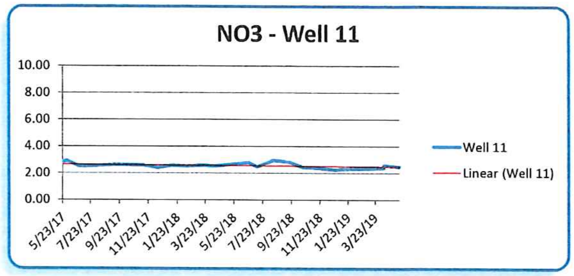
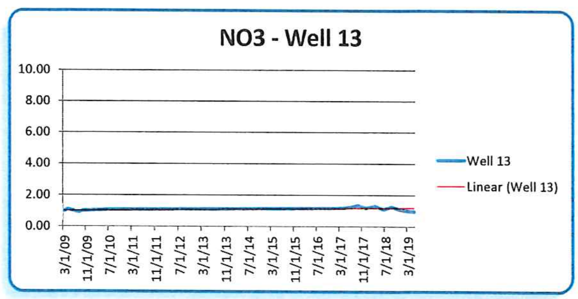
Run times will represent the well being in step 1 for one week (168 hrs)

Shakopee Public Utilities Commission
Water Department
Nitrate Results
Reported in mg/L

Location	Sample Collected	Results Received		Results	Lab	Run Time
10	4/17/12	4/20/12	<	1.00	TCWC	158 hrs prior
10	1/21/14	1/29/14	<	1.00	TCWC	144 hrs prior
10	3/25/14	4/1/14		3.61	MVTL	96 hrs prior
10	4/23/14	5/7/14	<	0.20	MVTL	24 hrs prior
10	4/23/14	6/16/14	<	0.05	MDH	*
10	6/16/15	6/26/15	<	0.05	MVTL	144 hrs prior
10	4/11/17	4/17/17	<	0.05	MVTL	168 hrs prior
10	1/8/19	1/14/19	<	0.05	MVTL	168 hrs prior
11	5/23/17	5/30/17		2.83	MVTL	168 hrs prior
11	6/1/17	6/15/17		2.90	MDH	192 hrs prior
11	6/27/17	7/5/17		2.50	MVTL	168 hrs prior
11	7/11/17	7/20/17		2.50	MVTL	168 hrs prior
11	8/8/17	8/14/17		2.55	MVTL	168 hrs prior
11	9/12/17	9/26/17		2.62	MVTL	168 hrs prior
11	10/10/17	10/20/17		2.61	MVTL	144 hrs prior
11	11/14/17	11/21/17		2.57	MVTL	168 hrs prior
11	12/12/17	12/22/17		2.39	MVTL	168 hrs prior
11	1/9/18	1/16/18		2.57	MVTL	168 hrs prior
11	2/13/18	2/20/18		2.54	MVTL	168 hrs prior
11	3/13/18	3/26/18		2.59	MVTL	168 hrs prior
11	4/10/18	4/18/18		2.53	MVTL	168 hrs prior
11	6/22/18	7/18/18		2.80	MDH	24 hrs prior
11	7/10/18	7/18/18		2.48	MVTL	24 hrs prior
11	8/14/18	8/20/18		2.95	MVTL	168 hrs prior
11	9/18/18	10/15/18		2.83	MVTL	168 hrs prior
11	10/16/18	11/7/18		2.45	MVTL	168 hrs prior
11	11/13/18	11/29/18		2.41	MVTL	168 hrs prior
11	12/27/18	1/14/19		2.25	MVTL	168 hrs prior
11	1/8/19	1/14/19		2.31	MVTL	168 hrs prior
11	4/9/19	4/16/19		2.40	MVTL	168 hrs prior
11	4/9/19	5/1/19		2.60	MDH	
11	5/14/19	5/20/19		2.48	MVTL	168 hrs prior
12	4/11/17	4/17/17		0.92	MVTL	168 hrs prior
12	9/5/17	9/26/17		0.72	MVTL	168 hrs prior
12	12/5/17	12/22/17		0.72	MVTL	168 hrs prior
12	9/4/18	10/15/18		0.62	MVTL	168 hrs prior
12	12/4/18	12/11/18		0.58	MVTL	144 hrs prior
12	3/5/19	3/14/19		0.68	MVTL	168 hrs prior
12	5/28/19	6/6/19		0.53	MVTL	
13	3/12/09	3/26/09		0.96	MVTL	46 hrs prior
13	4/14/09	4/27/09		1.10	MVTL	60 hrs prior
13	8/4/09	8/12/09		0.90	MVTL	1013 hrs prior
13	9/24/09	10/5/09		0.98	MVTL	51 hrs prior
13	7/14/10	7/27/10		1.07	MVTL	42 hrs prior
13	3/11/11	3/16/11		1.08	MVTL	100 hrs prior
13	4/11/17	4/17/17		1.19	MVTL	48 hrs prior
13	9/5/17	9/26/17		1.35	MVTL	128 hrs prior
13	12/5/17	12/22/17		1.20	MVTL	168 hrs prior
13	3/6/18	3/26/18		1.32	MVTL	168 hrs prior
13	6/5/18	6/14/18		1.11	MVTL	24 hrs prior
13	9/4/18	10/15/18		1.28	MVTL	168 hrs prior
13	12/4/18	12/11/18		1.08	MVTL	168 hrs prior
13	3/5/19	3/14/19		0.98	MVTL	168 hrs prior
13	5/28/19	6/6/19		0.95	MVTL	168 hrs prior
14	4/23/14	6/16/14	<	0.05	MDH	*
14	4/11/17	4/17/17	<	0.05	MVTL	20 hrs prior
14	9/5/17	9/26/17	<	0.05	MVTL	24 hrs prior
14	12/5/17	12/22/17	<	0.05	MVTL	168 hrs prior
14	3/6/18	3/26/18	<	0.05	MVTL	168 hrs prior
14	6/5/18	6/14/18	<	0.05	MVTL	24 hrs prior





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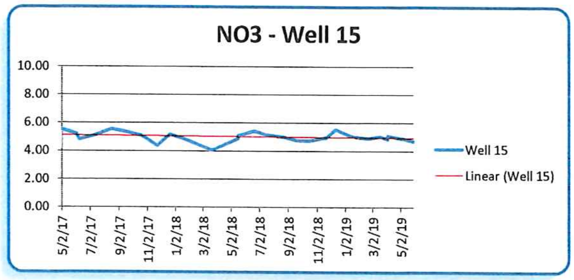
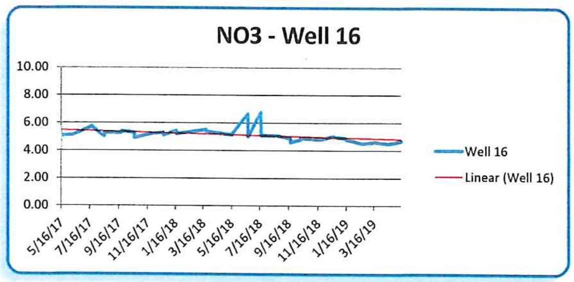
Run times will represent the well being in step 1 for one week (168 hrs)

Location	Sample Collected	Results Received	Results	Lab	Run Time
15	5/2/17	5/10/17	5.50	MVTL	144 hrs prior
15	6/1/17	6/15/17	5.20	MDH	168 hrs prior
15	6/6/17	6/14/17	4.80	MVTL	168 hrs prior
15	7/18/17	7/24/17	5.20	MVTL	168 hrs prior
15	8/15/17	8/21/17	5.54	MVTL	168 hrs prior
15	9/19/17	9/26/17	5.32	MVTL	168 hrs prior
15	10/17/17	11/17/17	5.10	MVTL	168 hrs prior
15	11/21/17	12/11/17	4.36	MVTL	168 hrs prior
15	12/19/17	12/27/17	5.17	MVTL	192 hrs prior
15	1/16/18	2/20/18	4.88	MVTL	168 hrs prior
15	3/20/18	3/27/18	4.04	MVTL	168 hrs prior
15	5/15/18	5/31/18	4.88	MVTL	168 hrs prior
15	5/15/18	5/31/18	5.10	MDH	
15	6/19/18	6/26/18	5.40	MVTL	408 hrs prior
15	7/17/18	8/17/18	5.16	MVTL	120 hrs prior
15	8/21/18	10/15/18	5.02	MVTL	168 hrs prior
15	9/18/18	10/15/18	4.76	MVTL	168 hrs prior
15	10/16/18	11/7/18	4.74	MVTL	168 hrs prior
15	11/20/18	11/29/18	4.98	MVTL	168 hrs prior
15	12/11/18	12/21/18	5.54	MVTL	168 hrs prior
15	1/15/19	1/29/19	5.05	MVTL	168 hrs prior
15	2/19/19	3/4/19	4.91	MVTL	168 hrs prior
15	3/15/19	3/25/19	5.05	MVTL	168 hrs prior
15	4/2/19	4/11/19	4.87	MVTL	168 hrs prior
15	4/2/19	5/1/19	5.10	MDH	
15	5/7/19	5/14/19	4.89	MVTL	168 hrs prior
15	5/28/19	6/6/19	4.70	MVTL	168 hrs prior



Location	Sample Collected	Results Received	Results	Lab	Run Time
16	5/16/17	5/25/17	5.07	MVTL	168 hrs prior
16	6/8/17	7/27/17	5.10	MDH	168 hrs prior
16	7/18/17	7/24/17	5.72	MVTL	168 hrs prior
16	8/14/17	10/20/17	5.00	MDH	
16	8/15/17	8/21/17	5.28	MVTL	168 hrs prior
16	9/19/17	9/26/17	5.25	MVTL	168 hrs prior
16	9/19/17	10/20/17	5.40	MDH	
16	10/17/17	11/17/17	5.29	MVTL	168 hrs prior
16	10/17/17	3/9/18	4.90	MDH	
16	11/21/17	12/11/17	5.21	MVTL	168 hrs prior
16	12/19/17	12/27/17	5.29	MVTL	192 hrs prior
16	12/19/17	2/20/18	5.10	MDH	
16	1/16/18	2/20/18	5.44	MVTL	168 hrs prior
16	1/16/18	3/9/18	5.20	MDH	
16	3/20/18	3/27/18	5.53	MVTL	168 hrs prior
16	3/20/18	5/31/18	5.40	MDH	
16	5/15/18	5/31/18	5.14	MVTL	168 hrs prior
16	5/15/18	6/26/18	5.20	MDH	
16	6/19/18	6/26/18	6.65	MVTL	408 hrs prior
16	6/19/18	7/18/18	5.00	MDH	
16	7/17/18	8/17/18	6.76	MVTL	408 hrs prior
16	7/17/18	11/19/18	5.10	MDH	
16	9/18/18	10/15/18	4.87	MVTL	168 hrs prior
16	9/18/18	10/15/18	4.60	MDH	
16	10/9/18	10/15/18	4.79	MVTL	168 hrs prior
16	10/9/18	11/19/18	4.90	MDH	
16	8/21/18	10/15/18	5.09	MVTL	192 hrs prior
16	11/20/18	11/29/18	4.81	MVTL	168 hrs prior
16	12/18/18	12/26/18	5.06	MVTL	192 hrs prior
16	12/18/18	1/14/19	5.00	MDH	
16	1/15/19	1/29/19	4.90	MVTL	168 hrs prior
16	1/15/19	3/4/19	4.80	MDH	
16	2/19/19	3/4/19	4.51	MVTL	168 hrs prior
16	3/19/19	3/25/19	4.63	MVTL	168 hrs prior
16	3/19/19	4/4/19	4.60	MDH	
16	4/16/19	4/23/19	4.50	MVTL	168 hrs prior
16	5/14/19	5/20/19	4.68	MVTL	168 hrs prior



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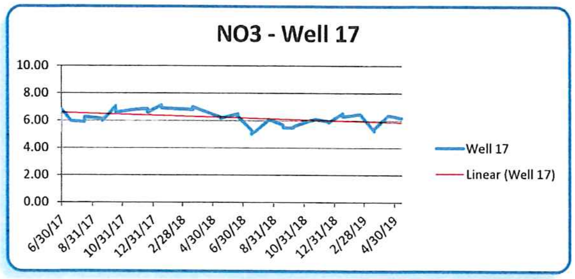
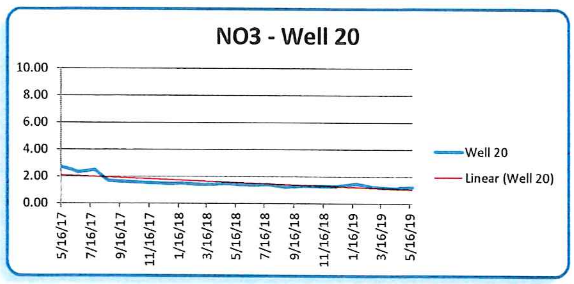
Run times will represent the well being in step 1 for one week (168 hrs)

Shakopee Public Utilities Commission
Water Department
Nitrate Results
Reported in mg/L

Location	Sample Collected	Results Received	Results	Lab	Run Time
17	6/30/17	7/27/17	6.80	MDH	168 hrs prior
17	7/18/17	7/24/17	5.97	MVTL	168 hrs prior
17	8/14/17	10/20/17	5.90	MDH	
17	8/15/17	8/21/17	6.27	MVTL	168 hrs prior
17	9/19/17	9/26/17	6.13	MVTL	168 hrs prior
17	9/19/17	10/20/17	6.00	MDH	
17	10/17/17	11/17/17	7.06	MVTL	168 hrs prior
17	10/17/17	3/9/18	6.60	MDH	
17	11/21/17	12/11/17	6.79	MVTL	168 hrs prior
17	12/19/17	12/27/17	6.85	MVTL	192 hrs prior
17	12/19/17	2/20/18	6.60	MDH	
17	1/16/18	2/20/18	7.12	MVTL	168 hrs prior
17	1/16/18	3/9/18	6.90	MDH	
17	3/20/18	5/31/18	6.80	MDH	
17	3/20/18	3/27/18	7.00	MVTL	168 hrs prior
17	5/15/18	5/31/18	6.27	MVTL	168 hrs prior
17	5/15/18	6/26/18	6.20	MDH	
17	6/19/18	6/26/18	6.52	MVTL	408 hrs prior
17	6/19/18	7/18/18	6.30	MDH	
17	7/17/18	8/17/18	5.30	MVTL	408 hrs prior
17	7/17/18	11/19/18	5.00	MDH	
17	8/21/18	10/15/18	6.10	MVTL	168 hrs prior
17	9/18/18	10/15/18	5.70	MVTL	168 hrs prior
17	9/18/18	10/15/18	5.50	MDH	
17	10/9/18	10/15/18	5.50	MVTL	168 hrs prior
17	10/9/18	11/19/18	5.60	MDH	
17	11/20/18	11/29/18	6.13	MVTL	168 hrs prior
17	12/18/18	12/26/18	5.97	MVTL	168 hrs prior
17	12/18/18	1/14/19	5.90	MDH	
17	1/15/19	1/29/19	6.56	MVTL	168 hrs prior
17	1/15/19	3/4/19	6.30	MDH	
17	2/19/19	3/4/19	6.49	MVTL	168 hrs prior
17	3/19/19	3/25/19	5.25	MVTL	168 hrs prior
17	3/19/19	4/4/19	5.40	MDH	
17	4/16/19	4/23/19	6.40	MVTL	168 hrs prior
17	5/14/19	5/20/19	6.19	MVTL	168 hrs prior



20	5/16/17	5/25/17	2.68	MVTL	168 hrs prior
20	6/5/17	6/28/17	2.50	MDH	144 hrs prior
20	6/20/17	6/27/17	2.30	MVTL	168 hrs prior
20	7/25/17	8/1/17	2.49	MVTL	144 hrs prior
20	8/22/17	8/28/17	1.67	MVTL	192 hrs prior
20	9/26/17	10/4/17	1.61	MVTL	168 hrs prior
20	10/24/17	11/17/17	1.56	MVTL	168 hrs prior
20	11/28/17	12/11/17	1.51	MVTL	168 hrs prior
20	12/26/17	1/9/18	1.46	MVTL	168 hrs prior
20	1/23/18	2/20/18	1.51	MVTL	168 hrs prior
20	2/27/18	3/9/18	1.41	MVTL	168 hrs prior
20	3/27/18	4/10/18	1.43	MVTL	168 hrs prior
20	4/24/18	5/9/18	1.49	MVTL	168 hrs prior
20	5/22/18	5/31/18	1.42	MVTL	168 hrs prior
20	5/22/18	6/14/18	1.40	MDH	
20	6/26/18	7/2/18	1.39	MVTL	72 hrs prior
20	7/24/18	8/17/18	1.42	MVTL	576 hrs prior
20	8/28/18	10/15/18	1.24	MVTL	192 hrs prior
20	9/25/18	10/15/18	1.30	MVTL	168 hrs prior
20	10/23/18	11/7/18	1.30	MVTL	216 hrs prior
20	12/11/18	12/21/18	1.29	MVTL	168 hrs prior
20	1/22/19	2/5/19	1.49	MVTL	168 hrs prior
20	2/26/19	3/6/19	1.25	MVTL	168 hrs prior
20	3/26/19	4/1/19	1.18	MVTL	168 hrs prior
20	4/23/19	5/1/19	1.15	MVTL	168 hrs prior
20	4/23/19	5/17/19	1.20	MDH	
20	5/21/19	5/29/19	1.21	MVTL	168 hrs prior

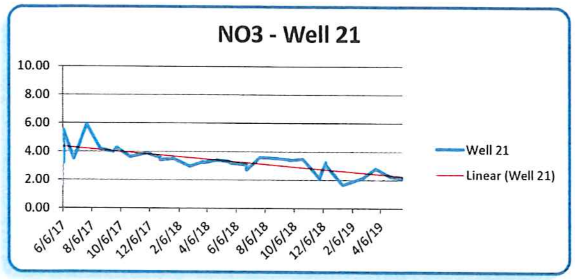


MVTL = Minnesota Valley Testing Laboratories
MDH = Minnesota Department of Health
TCWC = Twin City Water Clinic

Run times will represent the well being in step 1 for one week (168 hrs)

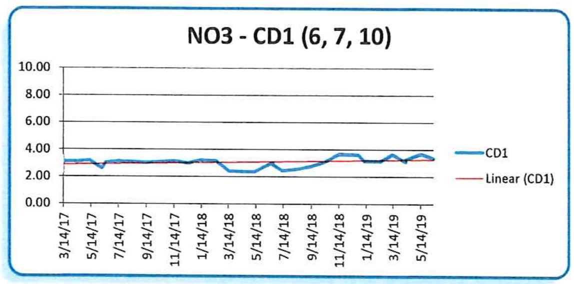
Shakopee Public Utilities Commission
Water Department
Nitrate Results
Reported in mg/L

Location	Sample Collected	Results Received	Results	Lab	Run Time
21	6/6/17	6/28/17	3.20	MDH	144 hrs prior
21	6/6/17	7/27/17	5.50	MDH	
21	6/27/17	7/5/17	3.48	MVTL	168 hrs prior
21	7/25/17	8/1/17	5.90	MVTL	144 hrs prior
21	8/22/17	8/28/17	4.18	MVTL	192 hrs prior
21	9/19/17	10/20/17	4.00	MDH	
21	9/26/17	10/4/17	4.29	MVTL	168 hrs prior
21	10/24/17	11/17/17	3.61	MVTL	168 hrs prior
21	11/28/17	12/11/17	3.90	MVTL	168 hrs prior
21	12/26/17	1/9/18	3.58	MVTL	168 hrs prior
21	12/26/17	2/20/18	3.40	MDH	
21	1/23/18	2/20/18	3.49	MVTL	168 hrs prior
21	2/27/18	3/9/18	2.95	MVTL	168 hrs prior
21	3/27/18	4/10/18	3.28	MVTL	168 hrs prior
21	3/27/18	5/31/18	3.20	MDH	
21	4/24/18	5/9/18	3.40	MVTL	168 hrs prior
21	5/22/18	5/31/18	3.30	MVTL	168 hrs prior
21	5/22/18	6/14/18	3.20	MDH	
21	6/26/18	7/2/18	3.07	MVTL	240 hrs prior
21	6/26/18	8/17/18	2.70	MDH	
21	7/24/18	8/17/18	3.60	MVTL	576 hrs prior
21	8/28/18	10/15/18	3.54	MVTL	168 hrs prior
21	9/25/18	10/15/18	3.45	MVTL	216 hrs prior
21	9/26/18	10/15/18	3.40	MDH	
21	10/23/18	11/7/18	3.49	MVTL	168 hrs prior
21	11/27/18	12/5/18	2.13	MVTL	192 hrs prior
21	12/11/18	12/21/18	3.28	MVTL	168 hrs prior
21	12/11/18	1/14/19	3.10	MDH	
21	1/15/19	1/29/19	1.65	MVTL	168 hrs prior
21	2/26/19	3/6/19	2.13	MVTL	168 hrs prior
21	3/26/19	4/1/19	2.82	MVTL	168 hrs prior
21	4/23/19	5/1/19	2.31	MVTL	168 hrs prior
21	4/23/19	5/17/19	2.30	MDH	
21	5/21/19	5/29/19	2.12	MVTL	168 hrs prior



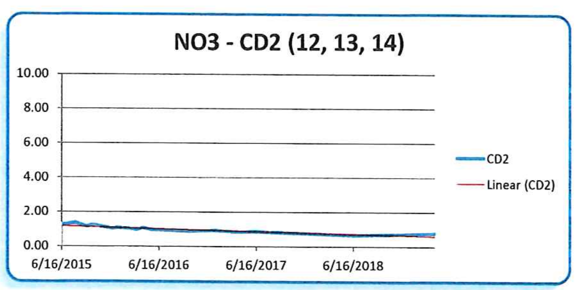
Combined Discharge - Wells 6-7-10

Location	Sample Collected	Results Received	Results	Lab	Run Time
CD 1	3/14/17	3/23/17	3.11	MVTL	168 hrs prior
CD 1	4/11/17	4/17/17	3.11	MVTL	120 hrs prior
CD 1	5/9/17	5/25/17	3.19	MVTL	212 hrs prior
CD 1	6/5/17	6/28/17	2.60	MDH	168 hrs prior
CD 1	6/13/17	6/20/17	3.03	MVTL	168 hrs prior
CD 1	7/11/17	7/20/17	3.12	MVTL	168 hrs prior
CD 1	8/8/17	8/14/17	3.08	MVTL	168 hrs prior
CD 1	9/12/17	9/26/17	3.03	MVTL	168 hrs prior
CD 1	10/10/17	10/20/17	3.09	MVTL	168 hrs prior
CD 1	11/14/17	11/21/17	3.16	MVTL	168 hrs prior
CD 1	12/12/17	12/22/17	3.00	MVTL	168 hrs prior
CD 1	1/9/18	1/16/18	3.23	MVTL	168 hrs prior
CD 1	2/13/18	2/20/18	3.18	MVTL	168 hrs prior
CD 1	3/13/18	3/26/18	2.42	MVTL	168 hrs prior
CD 1	5/8/18	5/31/18	2.36	MVTL	168 hrs prior
CD 1	6/19/18	6/26/18	3.05	MVTL	168 hrs prior
CD 1	6/19/18	7/18/18	2.90	MDH	
CD 1	7/10/18	7/18/18	2.46	MVTL	240 hrs prior
CD 1	8/14/18	8/20/18	2.59	MVTL	168 hrs prior
CD 1	9/11/18	10/15/18	2.78	MVTL	168 hrs prior
CD 1	10/9/18	10/15/18	3.06	MVTL	168 hrs prior
CD 1	11/13/18	11/29/18	3.68	MVTL	168 hrs prior
CD 1	12/27/18	1/14/19	3.63	MVTL	168 hrs prior
CD 1	1/8/19	1/14/19	3.19	MVTL	168 hrs prior
CD 1	2/12/19	2/22/19	3.16	MVTL	168 hrs prior
CD 1	3/12/19	3/18/19	3.67	MVTL	168 hrs prior
CD 1	4/9/19	4/16/19	3.13	MVTL	168 hrs prior
CD 1	4/9/19	5/1/19	3.30	MDH	
CD 1	5/14/19	5/20/19	3.69	MVTL	168 hrs prior
CD 1	6/11/19	6/21/19	3.37	MVTL	168 hrs prior



Combined Discharge - Wells 12-13-14

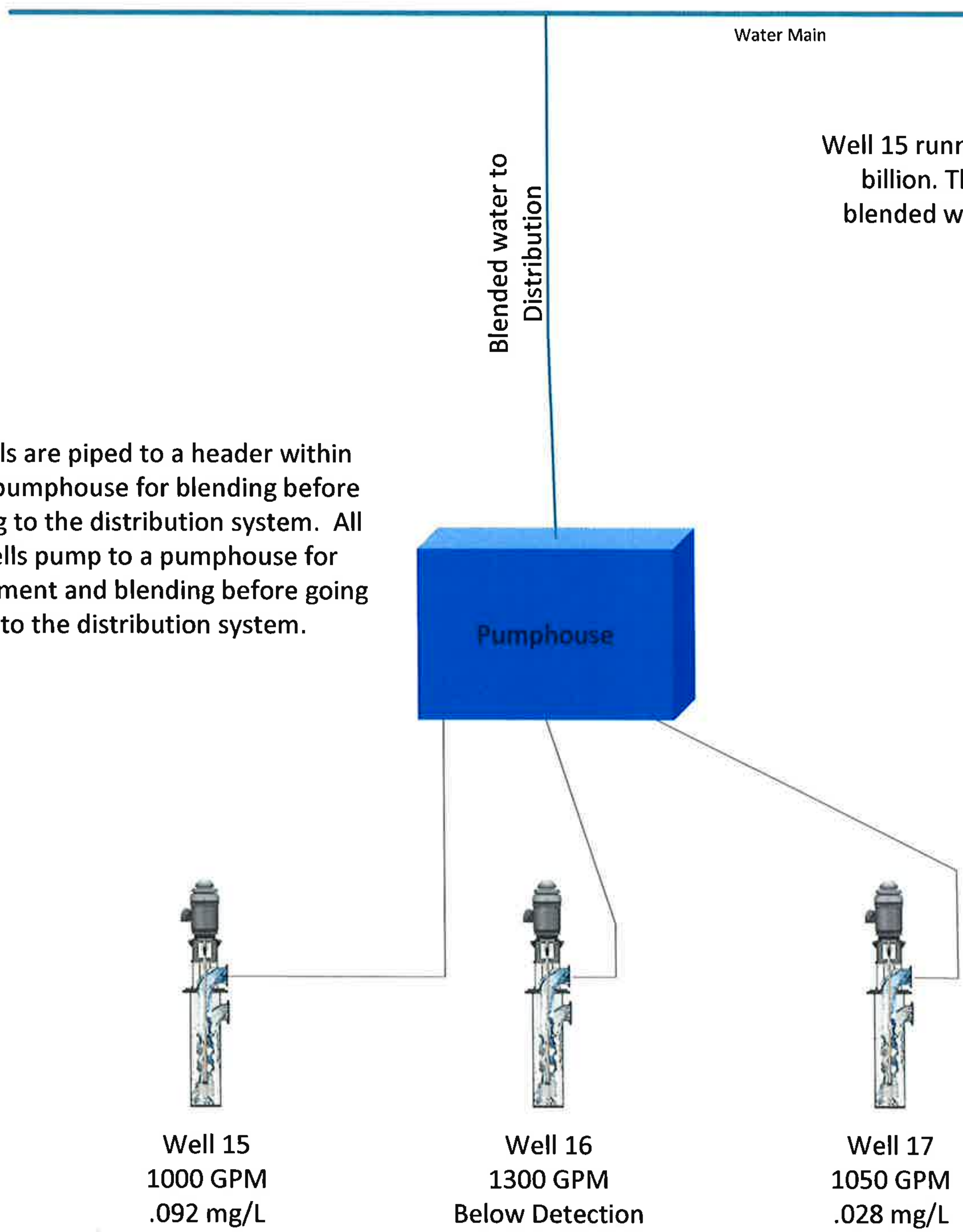
Location	Sample Collected	Results Received	Results	Lab	Run Time
CD 2	6/16/2015	6/26/2015	1.26	MVTL	126 hrs prior
CD 2	8/4/2015	8/10/2015	1.35	MVTL	168 hrs prior
CD 2	9/15/2015	9/22/2015	1.15	MVTL	144 hrs prior
CD 2	10/6/2015	10/14/2015	1.25	MVTL	208 hrs prior
CD 2	12/22/2015	12/30/2015	1.03	MVTL	168 hrs prior
CD 2	1/5/2016	1/13/2016	1.08	MVTL	192 hrs prior
CD 2	2/23/2016	2/29/2016	1.03	MVTL	208 hrs prior
CD 2	3/22/2016	3/28/2016	0.96	MVTL	288 hrs prior
CD 2	4/12/2016	4/19/2016	1.07	MVTL	120 hrs prior
CD 2	5/10/2016	5/16/2016	0.98	MVTL	165 hrs prior
CD 2	5/10/2016	6/2/2016	0.97	MDH	
CD 2	7/12/2016	7/18/2016	0.93	MVTL	170 hrs prior
CD 2	10/11/2016	10/17/2016	0.87	MVTL	168 hrs prior
CD 2	11/8/2016	11/17/2016	0.91	MVTL	168 hrs prior
CD 2	1/10/2017	1/20/2017	0.92	MVTL	216 hrs prior
CD 2	4/11/2017	4/17/2017	0.85	MVTL	144 hrs prior
CD 2	6/8/2017	6/28/2017	0.86	MDH	144 hrs prior
CD 2	6/22/2018	7/18/2018	0.67	MDH	528 hrs prior
CD 2	4/16/2019	5/1/2019	0.78	MDH	165 hrs prior



MVTL = Minnesota Valley Testing Laboratories
MDH = Minnesota Department of Health
TCWC = Twin City Water Clinic

Run times will represent the well being in step 1 for one week (168 hrs)

Wellfield Manganese Levels



Wells are piped to a header within the pumphouse for blending before going to the distribution system. All wells pump to a pumphouse for treatment and blending before going to the distribution system.

Well 15 running by itself is below the guideline of 100 parts per billion. The latest value is from 9-9-19. The highest value blended with a 10% safety factor is 70 parts per billion, well below the 100 or 300 ppb levels.

Manganese Blending

Result	GPM	Wells
0.092	1000	15
0.005	1300	16
0.036	1050	17

0.041	mg/L	Weighted Average
0.045	plus 10%	

Result	GPM	Wells
0.092		15
0.005	1300	16
0.036	1050	17

0.019	mg/L	Weighted Average
0.021	plus 10%	

Result	GPM	Wells
0.092	1000	15
0.005		16
0.036	1050	17

0.063	mg/L	Weighted Average
0.070	plus 10%	

Running

Appendix B

AUAR Water Use Projections

Building a Better World for All of Us®

MEMORANDUM

TO: Shakopee Public Utilities

FROM: Chad T. Katzenberger

DATE: August 19, 2019

RE: Jackson Township AUAR – Water System Demand Projections
SEH No. SHPUC 140940 14.00

BACKGROUND

This memo provides an estimate of projected water use for the land area to be developed in the identified AUAR Study area. Land use projections and study area information was provided by the City of Shakopee and SRF Consulting Group in August of 2019. Additional, per capita water use figures developed as part of SPUC's 2018 Compressive water plan were utilized for residential water use projections. The land use areas contained in the AUAR are broken down into seven sub-districts and represent anticipated development through the year 2040. The demand projections presented in this memo represent the expected Average Daily and Maximum Daily municipal water demand potential for the AUAR study area.

PROPOSED LAND USE & DEMAND PROJETIONS

A breakdown of projected land use for the AUAR study area was provided by the City of Shakopee, included in attachment A. This information includes land use development characteristics, developable acreage and other applicable information such as commercial building square footage. This information was then applied to the water use projection calculations provided in Attachment B.

PROJECTED WATER SYSTEM DEMAND

Results of the land used base water demand projections are presented in Attachment B. The time at which this expected development occurs will be strongly dependent on market forces. These water use projections are based on anticipated land use and help to understand the total ultimate water system needs, independent of time. Assuming total build out of the AUAR study area, the study area has a projected **Average Daily Demand** of **1.2 MGD** (Million Gallons per Day) and a **Maximum Daily Demand** of **3.4 MGD**

SUMMARY

The information documented above provides for a reasonable estimate of future water system demands. These demands can be updated further as additional development information is available.

ctk
Attachment
c: Miles Jensen, SEH
s:\pt\s\shpuc\140940\4-prelim-dsgn-rpts_reports_2019 comp water plan update\auar water use\m-2019 auar water use esimate.docx

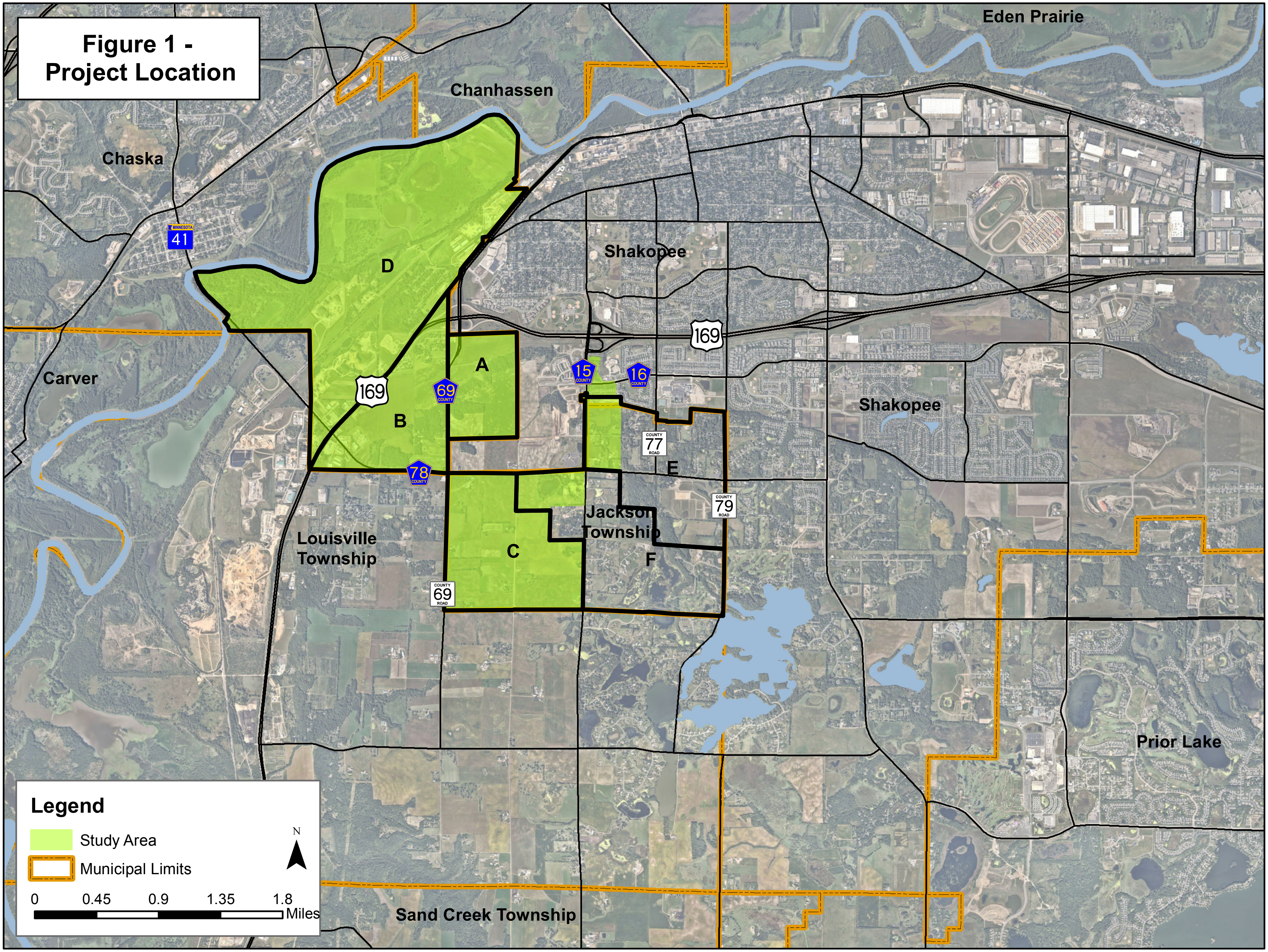


Figure 1 - Project Location

Attachment A
Jackson Township AUAR Development Area

Sub Area	2040 Land Use	Acres	Res. Units (EA)	N'Hood Retail (SF)	HWY Retail (SF)	Office (SF)	W-house (SF)	Mfg. (SF)
A	Mixed Residential	22	91	81,991				
A	Mixed Use Center	38			594,646	84,091		
A	Mixed Use Employment Center	25	31		41,706	159,240	90,994	90,994
A	Suburban Edge Residential	0						
A	Suburban Residential	67	161					
B	Mixed Residential	47	165	219,195				
B	Mixed Use Center	45			691,370	97,769		
B	Mixed Use Employment Center	214	257		350,955	1,340,008	765,719	765,719
B	Suburban Edge Residential	0						
B	Suburban Residential	0						
C	Mixed Residential	18	64	83486				
C	Mixed Use Center	0						
C	Mixed Use Employment Center	0						
C	Suburban Edge Residential	300	120					
C	Suburban Residential	166	266					
D	Mixed Residential	0						
D	Mixed Use Center	34			523,795	74,072		
D	Mixed Use Employment Center	247			212,672	1,353,369	1,082,695	1,082,695
D	Suburban Edge Residential	0						
D	Suburban Residential	57	230					
E	Mixed Residential	3	11	15007				
E	Mixed Use Center	0						
E	Mixed Use Employment Center	0						
E	Suburban Edge Residential	14	6					
E	Suburban Residential	48	96					
F	Mixed Residential	0						
F	Mixed Use Center	0						
F	Mixed Use Employment Center	0						
F	Suburban Edge Residential	0						
F	Suburban Residential	0						
G	Mixed Residential	0						
G	Mixed Use Center	10	156		112,122			
G	Mixed Use Employment Center	0						
G	Suburban Edge Residential	0						
G	Suburban Residential	10	28					

Data provided by the City of Shakopee 8/6/2019

Attachment B
Future Water Supply Needs - AUAR Area

Sub Area	2040 Land Use	Acres	Res. Units (EA)	N'Hood Retail (SF)	HWY Retail (SF)	Office (SF)	W-house (SF)	Mfg. (SF)	Avg. Day Demand (gpd)
A	Mixed Residential	22	91	81,991					**31,827**
A	Mixed Use Center	38			594,646	84,091			**62,421**
A	Mixed Use Employment Center	25	31		41,706	159,240	90,994	90,994	**37,821**
A	Suburban Residential	67	161						**43,277**
B	Mixed Residential	47	165	219,195					**64,044**
B	Mixed Use Center	45			691,370	97,769			**72,574**
B	Mixed Use Employment Center	214	257		350,955	1,340,008	765,719	765,719	**317,227**
C	Mixed Residential	18	64	83486					**24,703**
C	Suburban Edge Residential	300	120						**32,256**
C	Suburban Residential	166	266						**71,501**
D	Mixed Use Center	34			523,795	74,072			**54,984**
D	Mixed Use Employment Center	247			212,672	1,353,369	1,082,695	1,082,695	**267,452**
D	Suburban Residential	57	230						**61,824**
E	Mixed Residential	3	11	15007					**4,305**
E	Suburban Edge Residential	14	6						**1,613**
E	Suburban Residential	48	96						**25,805**
G	Mixed Use Center	10	156		112,122				**52,005**
G	Suburban Residential	10	28						**7,526**
		Totals	**1,682**	**399,679**	**2,527,266**	**3,108,549**	**1,939,408**	**1,939,408**	**1,230,000**
					***Maximum Day Demand (2.77 Multiplier)**				**3,410,000**

Demand Assumptions		
**Persons per housing unit	3.2	persons
*Residential per capita AD water use	84	gpc/d
Retail water Use	0.090	gpd/sf
Office Water Use	0.107	gpd/sf
Warehouse	0.039	gpd/sf
Manufacturing	0.056	gpd/sf

*Based on SPUC 2012 Historical Data (dry year)

**Figure provided by City of Shakopee

Non-Residential Water Use Figures Estimated from Met Council SAC City Determination Worksheet

Appendix C

Water Supply and Storage Calculations

Table C-2
Supply Capacity into Normal Zone

Well Name	Pressure Zone	Unique Well Number	Normal Operational Capacity (gpm)	Allowed Pumping Time per Day (Hours)	Daily Capacity (MGD)
Well No.2	Normal	206803	300	24	0.43
Well No.3	Normal	205978	Emergency		
Well No.4	Normal	206854	716	24	1.03
Well No.5	Normal	206855	850	24	1.22
Well No.6	Normal	180922	1,175	24	1.69
Well No.7	Normal	415975	1,100	24	1.58
Well No.8	Normal	500657	1,100	24	1.58
Well No.9	Normal	554214	1,050	24	1.51
Well No.10	Normal	578948	1,125	24	1.62
Well No.11	Normal	611084	1,000	24	1.44
Well No.15	Normal	694921	1,150	24	1.66
Well No.16	Normal	731139	1,450	24	2.09
Well No.17	Normal	731140	1,400	24	2.02
		Total	**12,416**	**--**	**17.88**
				Highest Yielding Well (Well No. 16)	**2.09**
				Firm Capacity (Minus Well No. 16)	**15.79**

Table Notes:

Source: City Records

Table C-1
Pumping Capacity & Storage Analysis for Entire System

	Design Demand Year		
Pumping Capacity Analysis	**2020**	**2030**	**2040**
Maximum Day Demand (mgd)[1]	19.6	22.6	25.0
Average Day Demand	7.1	8.1	9.0
	20.3	20.3	20.3
Recommended Storage Volume			
Maximum Day Equalization Volume (gallons)[4]	2,940,000	3,390,000	3,750,000
Fire Protection Volume (gallons)[5]	630,000	630,000	630,000
Reserve Volume (1/2 of Average Day)	3,542,000	4,075,000	4,516,000
Recommended Total Volume (gallons)	*7,112,000*	*8,095,000*	*8,896,000*
Existing Storage & Pumping Volume			
Surplus Firm Pump Volume (gallons)[7]	90,000	(280,000)	(590,000)
Tank 1	1,000,000	1,000,000	1,000,000
Tank 2	250,000	250,000	250,000
Tank 3	1,500,000	1,500,000	1,500,000
Tank 4	500,000	500,000	500,000
Tank 5	2,000,000	2,000,000	2,000,000
Tank 6	2,000,000	2,000,000	2,000,000
Tank 7	2,000,000	2,000,000	2,000,000
Total Existing Volume Available (gallons)	*9,250,000*	*9,250,000*	*9,250,000*
Water Storage Mass Balance	2,138,000	1,155,000	354,000
Additional Storage Recommended (gallons)	**None**	**None**	**None**

1. Additional firm pumping capacity may be recommended if the maximum day demand exceeds the existing firm pumping capacity.
2. Maximum Day Equalization Volume is the projected maximum volume depletion during the peak hours of the maximum day assuming the pumping rate into the service zone is equal to the maximum day demand rate. Typical residential dirunal curves were assumed with a peaking factor of 1.65.
3. Fire Protection storage was calcuated based on one fire of 3,500 gpm for 3 hours.
4. Reserve Volume is recommended to provide supply in event of a power outage
5. Surplus Firm Pump Volume is the difference between maximum day demand and Firm Pumping Capacity which is available to supplement fire protection for 3 hours.

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Table C-3
Supply & Storage Analysis for Main Zone Dependencies

	Design Demand Year		
Pumping Capacity Analysis	**2020**	**2030**	**2040**
Maximum Day Demand (mgd)[1]	13.86	14.87	15.60
Average Day Demand (mgd)	5.00	5.37	5.63
Existing Firm Supply Capacity (mgd)[2]	15.79	15.79	15.79
Firm Supply and/or Interzone Transfer Capacity Mass Balance (mgd)[3]	**1.93**	**0.92**	**0.19**
Recommended Storage Volume			
Maximum Day Equalization Volume (gallons)[4]	2,080,000	2,230,000	2,340,000
Reserve Storage (1/2 AD)	2,502,000	2,685,000	2,816,000
Fire Protection Volume (gallons)[5]	630,000	630,000	630,000
Preliminary Recommended Total Volume (gallons)	*5,212,000*	*5,545,000*	*5,786,000*
Existing Storage & Pumping Volume			
Surplus Firm Pump Volume (gallons)[7]	240,000	110,000	20,000
Tank 1	1,000,000	1,000,000	1,000,000
Tank 2	250,000	250,000	250,000
Tank 3	1,500,000	1,500,000	1,500,000
Tank 5	2,000,000	2,000,000	2,000,000
Tank 6	2,000,000	2,000,000	2,000,000
Total Existing Volume Available (gallons)	*6,750,000*	*6,750,000*	*6,750,000*
Storage or Pumping Volume Mass Balance (gallons)[3]	**1,538,000**	**1,205,000**	**964,000**
Additional Storage Recommended (gallons)	**None**	**None**	**None**

1. Includes Normal Zone and East Zone
2. See Table 5-1
3. A positive value represents a surplus. A negative valve represents a deficiency.
4. Maximum Day Equalization Volume is the projected maximum volume depletion during the peak hours of the maximum day assuming the pumping rate into the service zone is equal to the maximum day demand rate. Typical residential diurnal curves were assumed with a peaking factor of 1.65.
5. Fire Protection storage was calculated based on one fire of 3,500 gpm for 3 hours.
6. Surplus Firm Pump Volume is the difference between maximum day demand and Firm Pumping Capacity which is available to supplement fire protection for 3 hours.

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Table C-4
Supply Capacity into First High Zone

Well/Supply Name	Unique Well Number	Normal Operational Capacity (gpm)	Allowed Pumping Time per Day (Hours)	Daily Capacity (MGD)
Well No.12	626775	810	24	1.17
Well No.13	674456	1,036	24	1.49
Well No.14	694904	381	24	0.55
Well No.20	722624	1,142	24	1.64
Well No.21	722625	1,175	24	1.69
	Total	**4,544**	**--**	**6.54**
			Highest Yielding Well (Well No. 21)	**1.69**
			Firm Capacity (Minus Well No. 21)	**4.85**

Table Notes:
Source: City Records

Table C-5
Supply & Storage Analysis for 1st High Zone Dependencies

	Design Demand Year		
<u>Pumping Capacity Analysis</u>	**2020**	**2030**	**2040**
Maximum Day Demand (mgd)[1]	4.67	5.29	5.79
Average Day Demand (mgd)	1.69	1.91	2.09
Existing Firm Supply Capacity (mgd)[2]	4.85	4.85	4.85
Firm Supply and/or Interzone Transfer Capacity Mass Balance (mgd)[3]	**0.18**	**-0.43**	**-0.93**
<u>Recommended Storage Volume</u>			
Maximum Day Equalization Volume (gallons)[4]	700,000	790,000	870,000
Reserve Storage (1/2 AD)	843,000	954,000	1,044,000
Fire Protection Volume (gallons)[5]	630,000	630,000	630,000
Recommended Total Volume (gallons)	*2,153,000*	*2,374,000*	*2,544,000*
<u>Existing Storage & Pumping Volume</u>			
Surplus Firm Pump Volume (gallons)[6]	20,000	(50,000)	(120,000)
Tank 4	500,000	500,000	500,000
Tank 7	2,000,000	2,000,000	2,000,000
Total Existing Volume Available (gallons)	*2,500,000*	*2,500,000*	*2,500,000*
Storage or Pumping Volume Mass Balance (gallons)[3]	**347,000**	**126,000**	**-44,000**

1. Includes First High and both Second High Zones.
2. See Table 5-1.
3. A positive value represents a surplus. A negative valve represents a deficiency.
4. Maximum Day Equalization Volume is the projected maximum volume depletion during the peak hours of the maximum day assuming the pumping rate into the service zone is equal to the maximum day demand rate. Typical residential diurnal curves were assumed with a peaking factor of 1.65.
5. Fire Protection storage was calculated based on one fire of 3,500 gpm for 3 hours.
6. Surplus Firm Pump Volume is the difference between maximum day demand and Firm Pumping Capacity which is available to supplement fire protection for 3 hours.

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Table C-6
Pumping Capacity into 2nd High Central Zone

Pump Name	Normal Operational Capacity (gpm)	Daily Capacity (MGD)
Valley Creek 1	1,000	1.44
Valley Creek 2	1,000	1.44
Total	**2,000**	**2.88**
Largest Pump		**1.44**
Firm Capacity (Largest Pump)		**1.44**

Table Notes: Shakopee does not have any water treatment.

Source: City Records

Table C-7
Supply & Storage Analysis for 2nd High Central Zone

	Design Demand Year		
Pumping Capacity Analysis	**2020**	**2030**	**2040**
Maximum Day Demand (mgd)[1]	0.25	0.38	0.50
Average Day Demand (mgd)	0.09	0.14	0.18
Existing Firm Supply Capacity (mgd)[2]	1.44	1.44	1.44
Firm Supply and/or Interzone Transfer Capacity Mass Balance (mgd)[3]	**1.19**	**1.06**	**0.94**
Recommended Storage Volume			
Maximum Day Equalization Volume (gallons)[4]	40,000	60,000	70,000
Reserve Storage (1/2 AD)	44,000	68,000	90,000
Fire Protection Volume (gallons)[5]	300,000	300,000	300,000
Recommended Total Volume (gallons)	*234,000*	*298,000*	*340,000*
Existing Storage & Pumping Volume			
Surplus Firm Pump Volume (gallons)[6]	150,000	130,000	120,000
No Storage			
Total Existing Volume Available (gallons)	*0*	*0*	*0*
Storage or Pumping Volume Mass Balance (gallons)[3]	**-234,000**	**-298,000**	**-340,000**

1. See Table 4-6
2. See Table 5-1.
3. A positive value represents a surplus. A negative valve represents a deficiency.
4. Maximum Day Equalization Volume is the projected maximum volume depletion during the peak hours of the maximum day assuming the pumping rate into the service zone is equal to the maximum day demand rate. Typical residential diurnal curves were assumed with a peaking factor of 1.65.
5. Fire Protection storage was calculated based on one fire of 2,500 gpm for 2 hours.
6. Surplus Firm Pump Volume is the difference between maximum day demand and Firm Pumping Capacity which is available to supplement fire protection for 3 hours.

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Table C-8
Pumping Capacity into 2nd High West Zone

Pump Name	Normal Operational Capacity (gpm)	Daily Capacity (MGD)
Windermere 1	1,000	1.44
Windermere 2	1,000	1.44
Total	**2,000**	**2.88**
	Largest Pump	**1.44**
	Firm Capacity (Largest Pump)	**1.44**

Table Notes:

Source: City Records

Table C-9
Supply & Storage Analysis for 2nd High West Zone

	Design Demand Year		
Pumping Capacity Analysis	**2020**	**2030**	**2040**
Maximum Day Demand (mgd)[1]	0.75	1.85	2.87
Average Day Demand (mgd)	0.27	0.67	1.03
Existing Firm Supply Capacity (mgd)[2]	1.44	1.44	4.32
Firm Supply and/or Interzone Transfer Capacity Mass Balance (mgd)[3]	**0.69**	**-0.41**	**1.45**
Recommended Storage Volume			
Maximum Day Equalization Volume (gallons)[4]	110,000	280,000	430,000
Reserve Storage (1/2 AD)	134,000	334,000	517,000
Fire Protection Volume (gallons)[5]	300,000	300,000	300,000
Recommended Total Volume (gallons)	*454,000*	*914,000*	*1,065,000*
Existing Storage & Pumping Volume			
Surplus Firm Pump Volume (gallons)[6]	90,000	(51,000)	182,000
No Storage			
Total Existing Volume Available (gallons)	*0*	*0*	*0*
Storage or Pumping Volume Mass Balance (gallons)[3]	**-454,000**	**-914,000**	**-1,065,000**

1. See Table 4-6
2. Assumes addition of booster stations and supply wells
3. A positive value represents a surplus. A negative valve represents a deficiency.
4. Maximum Day Equalization Volume is the projected maximum volume depletion during the peak hours of the maximum day assuming the pumping rate into the service zone is equal to the maximum day demand rate. Typical residential diurnal curves were assumed with a peaking factor of 1.65.
5. Fire Protection storage was calculated based on one fire of 2,500 gpm for 2 hours.
6. Surplus Firm Pump Volume is the difference between maximum day demand and Firm Pumping Capacity which is available to supplement fire protection for 3 hours.

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Table C-10
Supply & Storage Analysis for 2nd High West + Central Zones

	Design Demand Year		
Pumping Capacity Analysis	**2020**	**2030**	**2040**
Maximum Day Demand (mgd)[1]	0.99	2.23	3.36
Average Day Demand (mgd)	0.36	0.80	1.21
Existing Firm Supply Capacity (mgd)[2]	1.44	2.88	5.76
Firm Supply and/or Interzone Transfer Capacity Mass Balance (mgd)[3]	**0.45**	**0.65**	**2.40**
Recommended Storage Volume			
Maximum Day Equalization Volume (gallons)[4]	150,000	330,000	500,000
Reserve Storage (1/2 AD)	179,000	402,000	607,000
Fire Protection Volume (gallons)[5]	300,000	240,000	240,000
Recommended Total Volume (gallons)	*569,000*	*891,000*	*1,048,000*
Existing Storage & Pumping Volume			
Surplus Firm Pump Volume (gallons)[6]	60,000	81,000	299,000
No Storage			
Total Existing Volume Available (gallons)	*0*	*0*	*0*
Storage or Pumping Volume Mass Balance (gallons)[3]	**-569,000**	**-891,000**	**-1,048,000**

1. See Table 4-6
2. Assumes addition of booster stations and supply wells
3. A positive value represents a surplus. A negative valve represents a deficiency.
4. Maximum Day Equalization Volume is the projected maximum volume depletion during the peak hours of the maximum day assuming the pumping rate into the service zone is equal to the maximum day demand rate. Typical residential diurnal curves were assumed with a peaking factor of 1.65.
5. Fire Protection storage was calculated based on one fire of 2,500 gpm for 2 hours.
6. Surplus Firm Pump Volume is the difference between maximum day demand and Firm Pumping Capacity which is available to supplement fire protection for 3 hours.

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Table C-11
Pumping Capacity into East Zone

Pump Name	Normal Operational Capacity (gpm)	Daily Capacity (MGD)
River View 1	1,000	1.44
River View 2	1,000	1.44
Total	**2,000**	**2.88**
	Largest Pump	**1.44**
	Firm Capacity (Largest Pump)	**1.44**
Table Notes:		

Source: City Records

Table C-12
Supply & Storage Analysis for East Zone

	Design Demand Year		
<u>Pumping Capacity Analysis</u>	**2020**	**2030**	**2040**
Maximum Day Demand (mgd)[1]	0.22	0.30	0.37
Existing Firm Supply Capacity (mgd)[2]	1.44	1.44	1.44
Firm Supply and/or Interzone Transfer Capacity Mass Balance (mgd)[3]	**1.22**	**1.14**	**1.07**
<u>Recommended Storage Volume</u>			
Maximum Day Equalization Volume (gallons)[4]	30,000	50,000	60,000
Fire Protection Volume (gallons)[5]	180,000	180,000	180,000
Recommended Total Volume (gallons)	*60,000*	*90,000*	*110,000*
<u>Existing Storage & Pumping Volume</u>			
Surplus Firm Pump Volume (gallons)[7]	150,000	140,000	130,000
No Storage			
Total Existing Volume Available (gallons)	*150,000*	*140,000*	*130,000*
Storage or Pumping Volume Mass Balance (gallons)[3]	**90,000**	**50,000**	**20,000**

1. See Table 4-6
2. One pump offline
3. A positive value represents a surplus. A negative valve represents a deficiency.
4. Maximum Day Equalization Volume is the projected maximum volume depletion during the peak hours of the maximum day assuming the pumping rate into the service zone is equal to the maximum day demand rate. Typical residential diurnal curves were assumed with a peaking factor of 1.65.
5. Fire Protection storage was calculated based on one fire of 1,500 gpm for 2 hours.
6. Surplus Firm Pump Volume is the difference between maximum day demand and Firm Pumping Capacity which is available to supplement fire protection for 3 hours.

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