Comprehensive Evaluation for Municipal Water Treatment

Shakopee Public Utilities Commission Meeting, October 18, 2021

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Presentation Outline

- Review of SPU's Water Quality, Treatment, and Operations
- Discuss Study Results
- Present Treatment Alternatives
- Describe Recommendations

Current Water Treatment

- No Filtration
- Current Treatment
  - Chlorine
    - All wells
  - Fluoride
    - All wells
  - Polyphosphates
    - At Well 12 and soon to be Well 15
    - To reduce aesthetic issues related to manganese

Water Modeling

- Modeled using WaterGEMS
- Average Day Demand: 7MGD
- Utilized SPU's typical pumping steps & scenarios
- Modeled for:
  - Water Age
  - Nitrate Distribution

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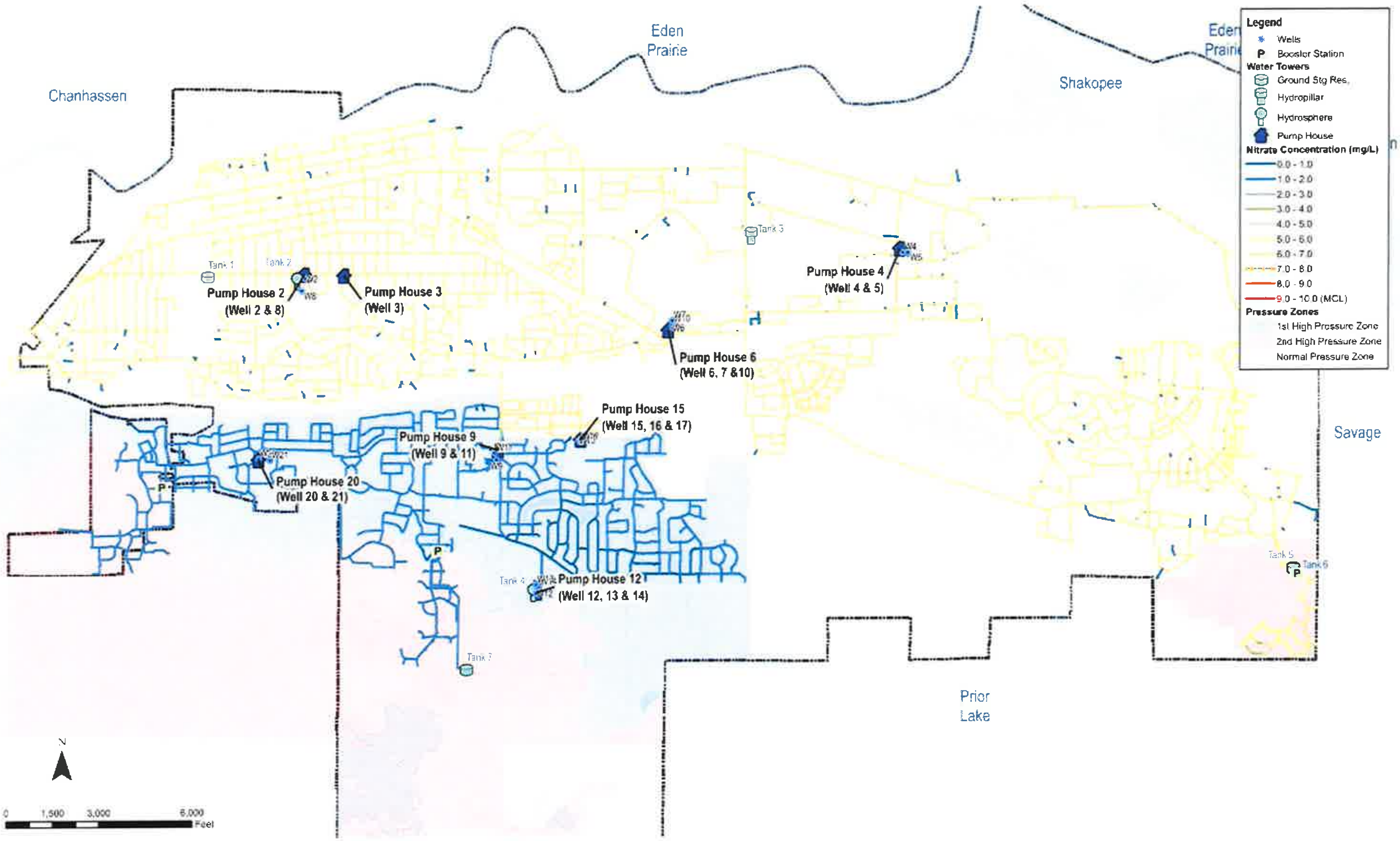
Water Quality Modeling System-Wide



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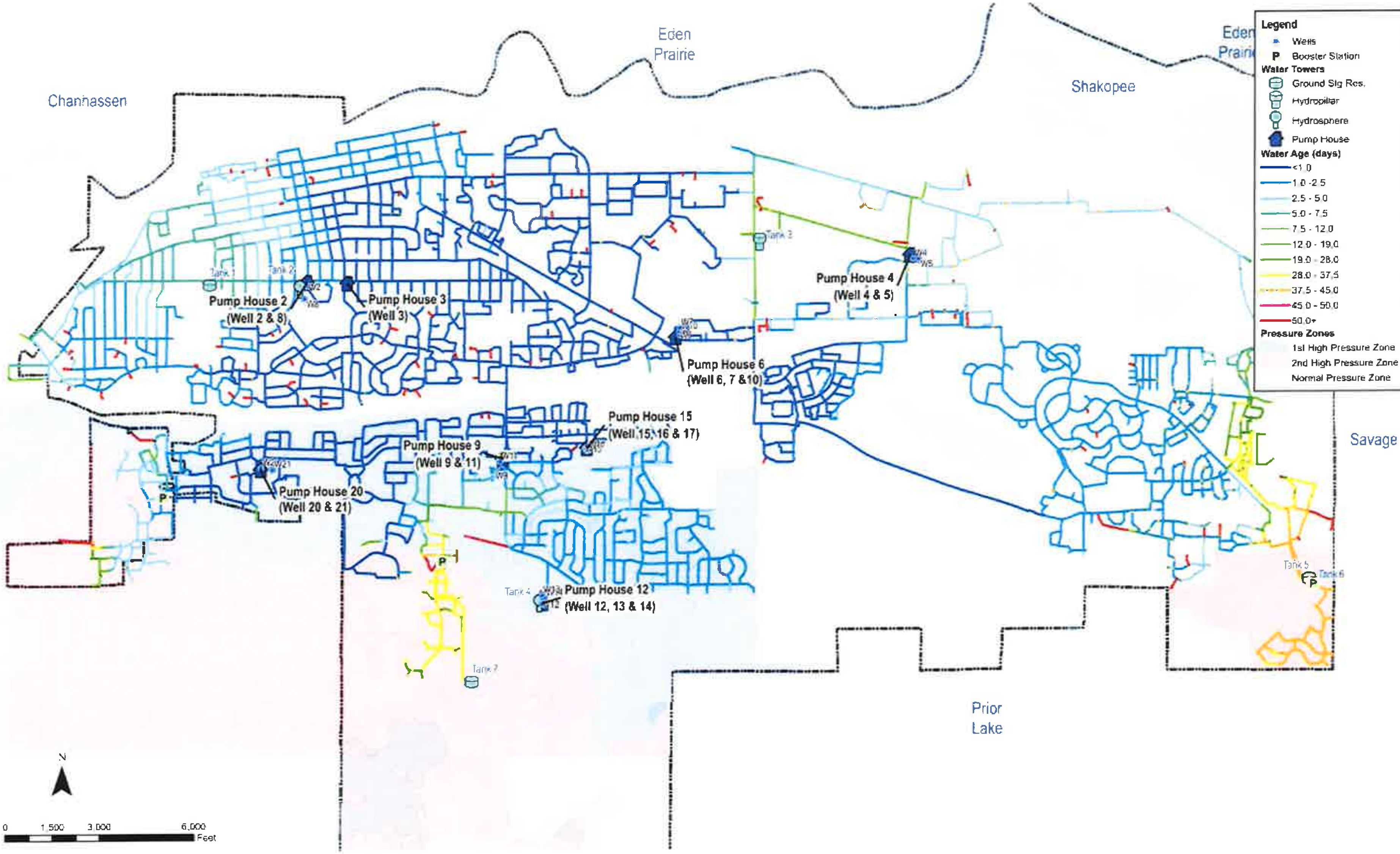
Water Age Modeling System-Wide



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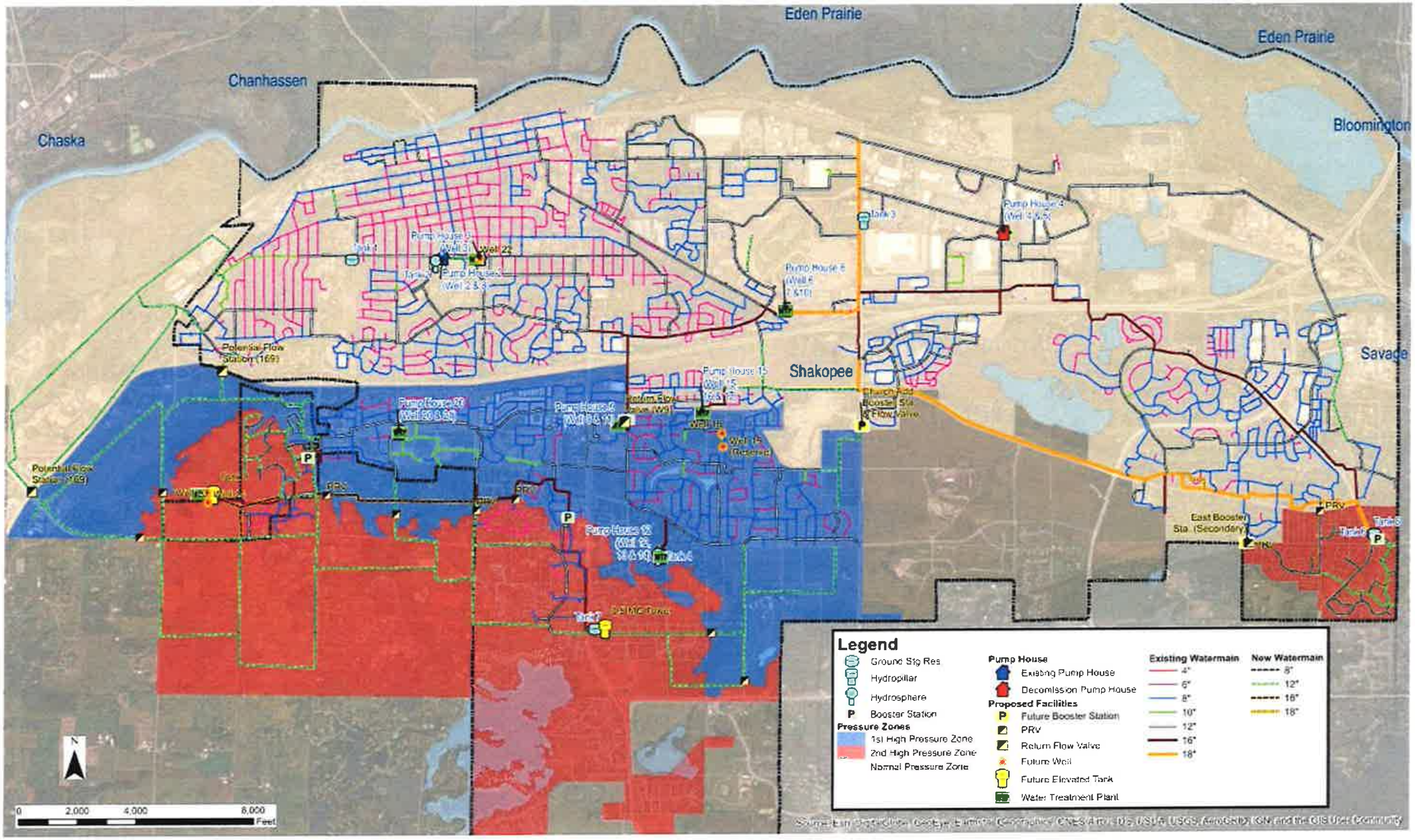
Results of Study

- SPU is meeting all enforced water quality standards by EPA
- Modeling results did not raise any concerns with operational practices
- SPU manages the system to ensure the best quality water
  - Ensures free chlorine presence at farther reaches of system
  - Feeds polyphosphates to eliminate "red" and "black" water potential
  - Uses worse quality wells <1% of total pumpage
  - Blends wells prior to distribution
- To plan for any future treatment needs, SPU may want to start implementing **NOW**

System-Wide Water Treatment

- Alternative 1 – **Satellite Treatment**
  - Pressure or Gravity Options
    - Iron and Manganese Reduction
    - Nitrate Reduction
- Alternative 2 – **Central Treatment**
  - Pressure or Gravity Options
    - Iron and Manganese Reduction
    - Nitrate Reduction
    - Lime Softening (optional)
- Alternative 3 – **Hybrid Arrangement**
  - Pressure or Gravity Options
    - Iron and Manganese Reduction
    - Nitrate Reduction

Alternative 1 - Satellite Treatment



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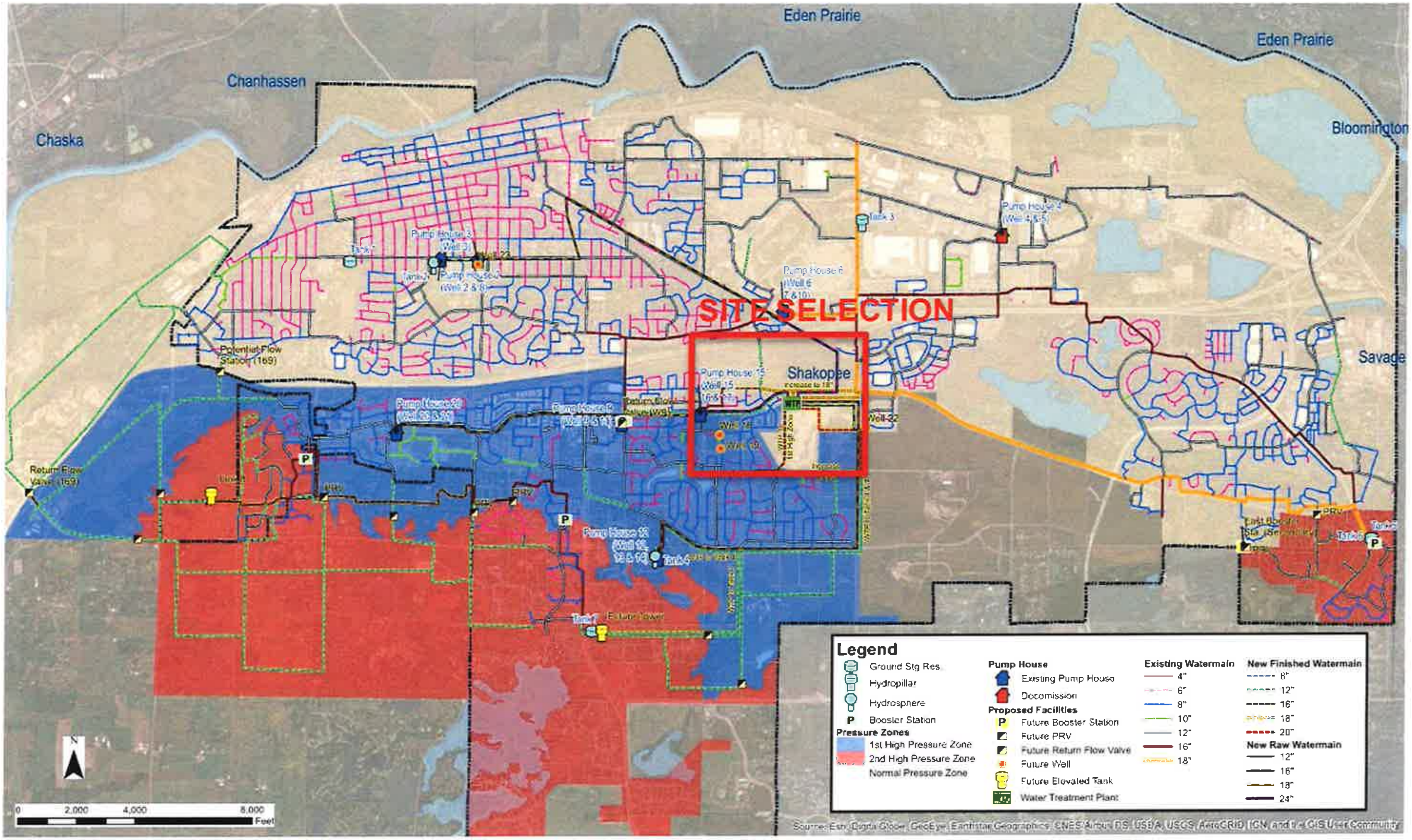
Alternative 2 - Central Treatment



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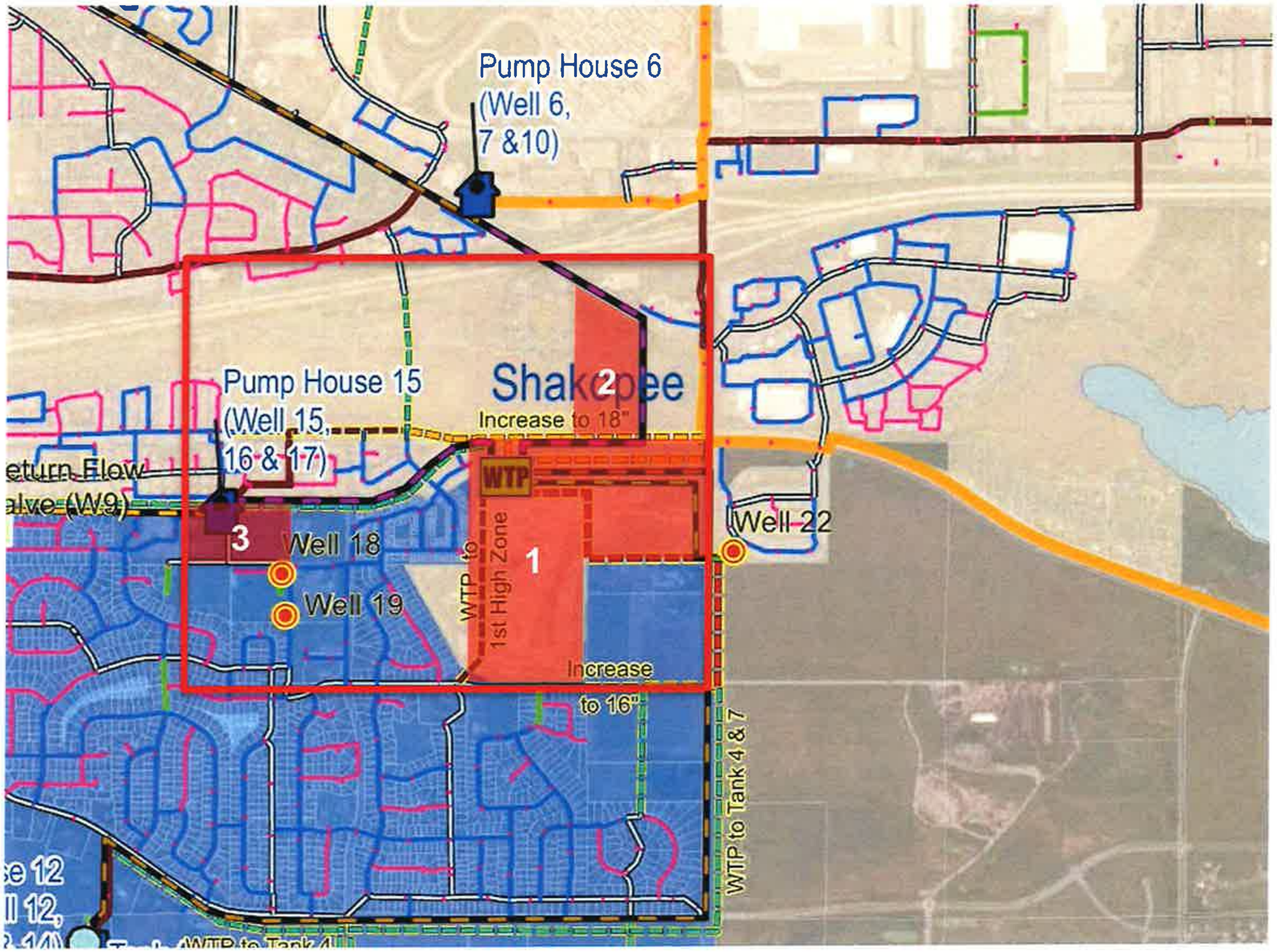
Central WTP Site Location



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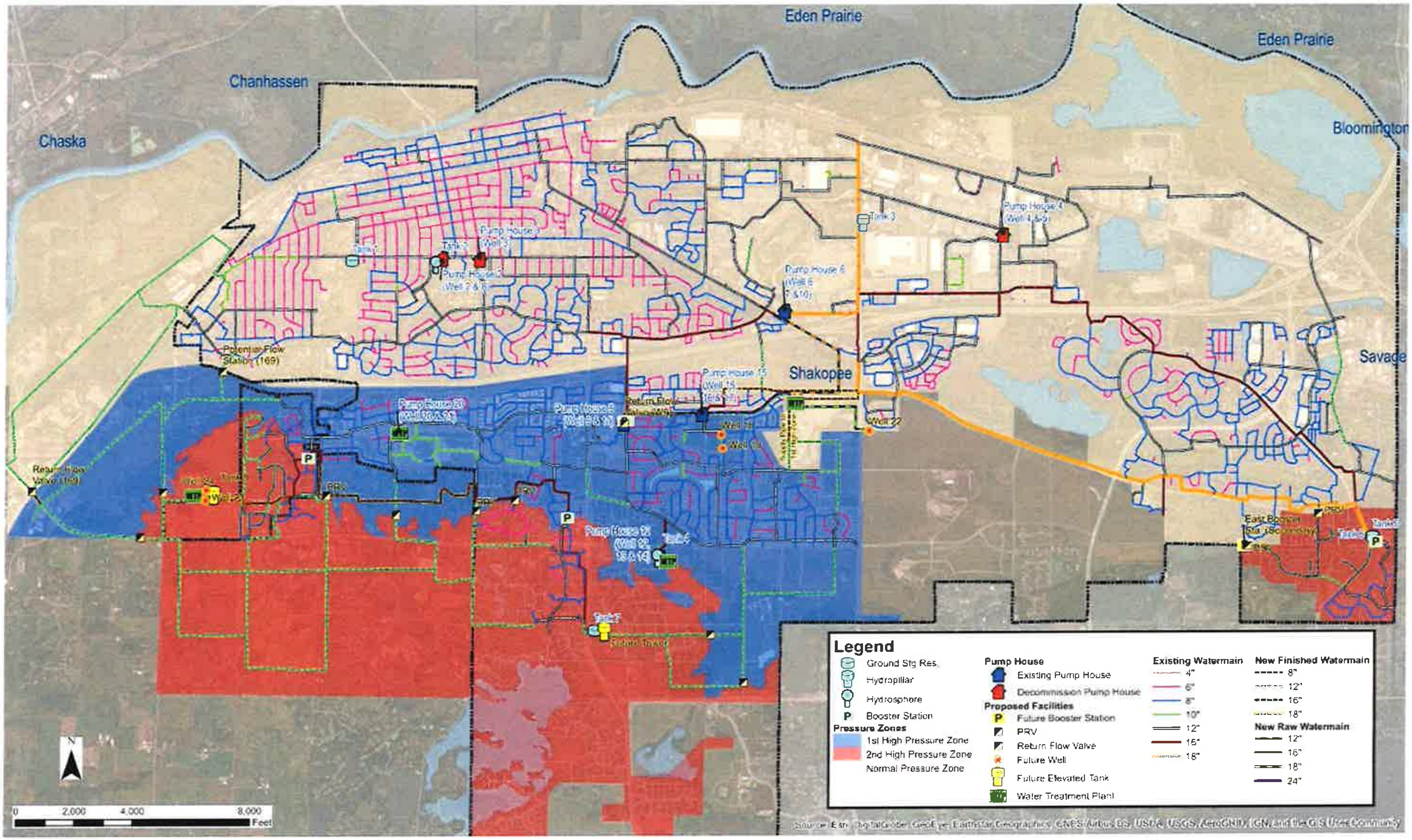
Alternative 3 - Hybrid Treatment



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Costs of Treatment Alternatives

Alternative	Filtration Type	Construction Cost			Total Probable Cost	Annual O&M
		Treatment	Wells	Watermain		
Alternative 1 – Satellite	Gravity	$50,100,000	$6,050,000	$435,000	$76,389,750	$2,795,477
Alternative 2 – Central	Gravity	$41,450,000	$4,050,000	$31,827,500	$104,392,125	$2,484,245
	Gravity w/ Softening	$66,450,000			$138,142,125	$5,345,575
Alternative 3 – Hybrid	Gravity	$47,900,000	$5,050,000	$10,228,750	$85,291,313	$2,747,911

NOTE: Does not include land acquisition costs.
At the time of design, all treatment techniques will be further explored.

Recommendations

1. Pursue Alternative 3 (Hybrid)
2. Construct gravity treatment facilities
3. Purchase a site for the Hybrid WTP between Pump House 15 and Mystic Lake Dr (CR83)
4. Sample groundwater at Tank 8
5. Ensure any installed watermains match the Alternative 3 (Hybrid) system map

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To plan for any future treatment needs, SPU may want to start implementing **NOW**

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Well Water Quality

2018-2020 Water Quality Summary

Parameter	Well No.									HBV	Secondary Standard	EPA MCL
	2	3	4	5	6	7	8	9	10			
Arsenic (µg/L)	*	2.21	*	*	*	*	*	*	1.81 - 4.8			10
Iron (mg/L)	*	**1.75**	*	*	*	*	*	*	**0.42 - 1.98**		0.3	
Manganese (mg/L)***	*	*	*	*	0.025 - 0.033	*	*	*	0.006 - 0.009	0.1	0.05	
Nitrate (mg/L)	2.20 - 6.32	**	2.40 - 6.69	5.50 - 7.88	4.30 - 5.60	4.10 - 5.30	4.62 - 6.08	1.87 - 4.45	*	10		10
Hardness, Total	318 - 346	261	323 - 366	398 - 405	318 - 319	359 - 367	326 - 367	422 - 467	163 - 192			
Radium 226/228 (pCi/L)	*	*	*	*	*	*	*	*	**6.2**			5 (combined)
Radon 226/228 (pCi/L)	*	*	*	*	*	*	*	*	280			300

Parameter	Well No.									HBV	Secondary Standard	EPA MCL
	11	12	13	14	15	16	17	20	21			
Arsenic (µg/L)	*	*	*	**18.3 - 25.3**	*	*	*	*	*			10
Iron (mg/L)	*	*	*	**0.63 - 1.2**	*	*	*	*	*		0.3	
Manganese (mg/L)***	*	**0.074 - 0.082**	0.006 - 0.013	0.032 - 0.041	0.036 - **0.118**	*	0.029 - 0.037	*	*	0.1	0.05	
Nitrate (mg/L)	2.25 - 3.07	0.53 - 0.74	0.95 - 1.28	N/D	2.82 - 5.54	3.73 - 6.76	4.77 - 7.12	1.15 - 2.01	0.33 - 3.60	10		10
Hardness, Total	415 - 436	349 - 373	371 - 386	314 - 338	351 - 361	366 - 396	366 - 390	250 - 280	291 - 366			
Radium 226/228 (pCi/L)	*	*	*	**7.2**	*	*	*	*	*			5 (combined)
Radon 226/228 (pCi/L)	*	*	*	274	*	*	*	*	*			300

* Non-Detectable concentration

** No recent data

*** EPA has set forth a lifetime health advisory value of 0.3 mg/L for manganese

Well Water Quality - Nitrate

Well No.	2018			2019			2020			HBV (mg/L)	EPA MCL (mg/L)
	Nitrate Conc. (mg/L)			Nitrate Conc. (mg/L)			Nitrate Conc. (mg/L)				
	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.		
2	2.20	3.68	6.32	2.52	3.78	5.50	2.36	4.10	5.18	10	10
4	2.40	4.28	5.50	3.11	4.16	6.50	3.10	4.07	6.69		
5	5.70	6.96	7.88	6.10	6.67	7.42	5.50	6.11	6.69		
6	4.30	4.75	5.10	4.48	4.98	5.40	5.13	5.44	5.60		
7	4.30	4.60	4.90	4.10	4.55	4.80	4.84	5.05	5.30		
8	4.89	5.67	6.08	5.08	5.35	5.60	4.62	4.96	5.25		
9	1.87	3.75	4.45	2.23	3.10	3.68	2.99	3.40	4.07		
10	N/D			< 0.05			N/D				
11	2.25	2.58	2.95	2.31	2.73	3.07	2.40	2.63	2.86		
12	0.58	0.60	0.62	0.53	0.65	0.74	0.62	0.67	0.73		
13	1.08	1.16	1.28	0.95	0.99	1.01	0.98	1.06	1.11		
14	< 0.05			N/D			N/D				
15	4.04	4.95	5.54	4.70	4.96	5.11	2.82	4.81	5.54		
16	4.60	5.25	6.76	3.99	4.54	6.50	3.73	4.04	4.30		
17	5.00	6.10	7.12	4.77	5.56	6.56	4.92	5.72	6.30		
20	1.24	1.28	1.30	1.15	1.48	1.79	1.59	1.81	2.01		
21	2.13	3.25	3.60	0.33	2.04	2.82	2.04	2.22	2.38		
6, 7, & 10 Blended	2.59	3.15	3.68	2.96	3.32	3.89	3.26	4.33	5.52		
12, 13, & 14 Blended	0.67			0.78			0.86				

Comprehensive Evaluation for Water Treatment

Shakopee Public Utilities

Shakopee, Minnesota

SEH No. 157387 | October 14, 2021

SEH

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Engineers | Architects | Planners | Scientists

Comprehensive Evaluation for Water Treatment

Shakopee Public Utilities
Shakopee, Minnesota

SEH No. 157387

October 14, 2021

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.

Miles Jensen

Date: October 13, 2021 License No.: 19869

Reviewed By: Ryan Hanson Date: October 13, 2021

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Executive Summary

The Shakopee Public Utilities (SPU) gets their water from eighteen (18) groundwater supply wells. Fourteen (14) of those groundwater wells pump water from the Prairie du Chien-Jordan Sandstone aquifer, two (2) utilize water from the Tunnel City-Wonewoc aquifer, and the other two (2) wells pump from the Mount Simon-Hinckley aquifer. The total capacity of the municipal wells is 24.4 million gallons a day (MGD) and a reliable supply capacity of 20.3 MGD, when subtracting the highest capacity well. Due to topography, there are three (3) different pressure zones in the water system; the Normal Elevation Service (NES); the First High Elevations Service (1HES), and the Second High Elevation Service (2HES) zones.

The SPU water system does not include a water treatment facility. The water pumped from the Prairie du Chien-Jordan aquifer is generally considered to be of such high quality, with respect to the US Environmental Protection Agency's (EPA) enforceable National Primary Drinking Water Regulations (NPDWR), that SPU has not had a reason, nor have they been required to actively remove anything from their groundwater source. SPU only operates and maintains fluoridation and chlorination treatment systems for the prevention of tooth decay and residual disinfection throughout the distribution system piping. SPU also has the ability to feed polyphosphates at Well No. 12 and Well No. 15, to help reduce the chance of aesthetic issues caused by iron and manganese.

SPU continuously monitors their wells to ensure they stay in compliance with the EPA's NPDWRs, as well as striving to meet the National Secondary Drinking Water Regulations (NSDWR) and other non-enforceable water quality standards. If one of SPU's wells is discovered to have a water quality parameter (iron, manganese, nitrate, arsenic, radium, etc.) that has surpassed a drinking water standard, SPU takes the necessary steps to ensure that the well is either rarely used for supply and/or properly blended with a cleaner well. Any blending that is done and reported within the SPU water system is done at the wellhouse prior to entering the distribution system.

In an effort to ensure that their customers are providing safe, good quality water, SPU has actively been monitoring nitrates throughout their wells for the last two decades. Wells utilizing water from the Jordan Sandstone aquifer have detected levels of nitrates, especially in areas of Shakopee with lower elevations due to the decreased soil cover between the ground surface and the aquifer. None of the levels of nitrate in SPU's wells are currently exceeding the EPA's Maximum Contaminant Level (MCL) of 10 mg/L, so therefore SPU is not required to treat for nitrates. The monitoring results have also shown that over the last 20 years the nitrate levels have mostly stayed the same or have diminished throughout the water supply wells. It is expected that this downward trend will continue as agriculture land is developed into residential and commercial properties throughout the watershed, reducing leaching into the aquifer.

With all of the water being supplied by SPU meeting all legally enforceable drinking water standards, SPU is not required to provide additional treatment other than their existing fluoridation and disinfection. Nevertheless, because of SPU's dedication and commitment to public health and their desire to provide abundant high-quality water to their customers, SPU completed this water treatment feasibility study to actively plan for any water quality or regulatory issues that they may face in the future. The study examined the quality of SPU's municipal water, analyzed current operating practices, evaluated supply and municipal treatment options, and recommend viable solutions to increase the quality of water being supplied to the consumers.

Systemwide Treatment Alternatives

For this study, three (3) treatment systemwide alternatives were evaluated. Each treatment alternative took into consideration the existing and planned infrastructure, water quality of each well, and economic impacts. The goal was to generate a template for the necessary upgrades to the existing and future system to provide treatment that would greatly reduce iron, manganese, nitrate and provide equally treated water to all of SPU's customers that excels beyond their already great quality water.

- **Alternative 1 – Satellite Treatment.** The satellite treatment option reduces the amount of transmission mains required to provide systemwide treatment by constructing treatment facilities within the vicinity of each of the existing wells, with exception to Well No. 2 and Well No. 8 (Pump House 2), which is most feasible to route to the nearby Well No. 3 site. This alternative proposed new well sites for the additional future capacity needed and planned the satellite treatment facilities accordingly. In total, it is recommended that seven (7) treatment facilities be constructed to provided treatment in all three (3) of SPU's pressure zones. This alternative allows each treatment facility to be tailored to the specific water quality at the site-specific wells to treat accordingly, as well as provide a better option for phased implementation based on the need for treatment. The downside to this alternative is additional infrastructure necessary to treat at seven (7) different well sites as compared to one centralized facility, which would in turn increase operations and maintenance costs.
- **Alternative 2 – Central Treatment.** The central treatment option would convey all of SPU's wells to one central location, providing equally treated water to the entire system. This proposed alternative reduces the cost of treatment facilities and required processing equipment by having one centralized treatment facility. For that reason, this alternative would be the most economical option to provide softened water, if that was desired. The main pitfall to one central facility would be the transmission mains required to convey the raw water from each of the wells and the necessary expense to transfer water to the other two (2) pressure zones. To reduce to cost, the proposed new well sites to meet the future capacity needs were selected to try and lessen watermain lengths. The most economical advantage to this alternative would be the reduced operations and maintenance costs associated with maintaining only one treatment facility versus several.
- **Alternative 3 – Hybrid Treatment.** The last alternative is a combination of the two other alternatives. The proposed alternative would include a NES zone centralized facility that would treat water from SPU's nearby wells, while less conveniently located wells would construct satellite treatment plants. This option will reduce the amount of transmission mains required and reduce the treatment processes and equipment required to provide systemwide treatment. To reduce to cost, the proposed new well sites to meet the future capacity needs were selected to try and lessen watermain lengths. This alternative attempts to reduce the infrastructure necessary by only treating at four (4) different sites as compared to seven (7) with the satellite alternative. The most economical advantage to this alternative would be reduce operations and maintenance costs associated with maintaining less facilities.

Cost Analysis

SPU has designed their system to utilize their good quality water by distributing supply wells throughout the three (3) pressure zones. If treatment was ever needed, SPU intended to implement treatment at the individual well sites. A supply, treatment, and storage capacity fund was set up to help fund any future treatment needs, however, it is unlikely that the fund would be able to support the entire project and the expected operations and maintenance costs. That is why, it is important that SPU be economical with which alternative they pursue.

Table ES-1 provides a summary of the capital and annual costs of each alternative.

Table ES-1 – Alternative Summary

Alternative	Type	Construction Cost			Total Probable Cost	Annual O&M
		Wells	Watermain	Treatment		
Alternative 1 - Satellite	Pressure	$6,050,000	$435,000	$45,600,000	$70,314,750	$2,944,638
	Gravity			$50,100,000	$76,389,750	$2,795,477
Alternative 2 - Central	Pressure	$4,050,000	$31,827,500	$36,450,000	$97,642,125	$2,616,050
	Gravity			$41,450,000	$104,392,125	$2,484,245
	Gravity w/ Softening			$66,450,000	$138,142,125	$5,344,957
Alternative 3 - Hybrid	Pressure	$5,050,000	$10,228,750	$41,400,000	$76,516,313	$2,888,255
	Gravity			$47,900,000	$85,291,313	$2,747,911

Recommendations

Based on the results of this study, additional treatment beyond the current fluoride and chlorine additions is not warranted at this time. The water system is managed and operated to continually supply good drinking water quality that meets EPA's mandatory water quality standards for drinking water contaminants.

To address the potential of future treatment needs, the following recommendations are presented below:

1. Given that the annual operation and maintenance costs associated with Alternative 3 (Hybrid) are lower than Alternative 1 (Satellite), it is recommended that the configuration of Alternate 3 be followed. To that end, it is recommended that appropriate property acquisitions and pipeline installations be carried out to ensure that the water infrastructure is established should treatment ever become necessary.
2. Construct the water treatment facilities to be gravity treatment plants, due to the advantages this type of design offers at a comparable cost.
3. Purchase a site for the NES zone centralized treatment facility between Pump House 15 and Mystic Lake Dr (Co Rd 83), due to the proximity to other nearby wells.
4. Sample the groundwater of the proposed future wells at the Tank 8 site in the 2HES zone, prior to designing a satellite WTP.
5. Ensure that any currently planned watermain extensions match the Alternative 3 (Hybrid) proposed watermain system map supplied in Appendix D.

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Comprehensive Evaluation for Water Treatment

Prepared for Shakopee Public Utilities

1 Introduction

The Shakopee Public Utilities (SPU) owns and operates the municipal drinking water system that serves the City of Shakopee, which is a community of approximately 42,000 people located in the northern part of Scott County. The water system has a long history with the first well being constructed in 1910, which fed a small network of water main and a wooded storage tank which sustained pressure. The small network of watermain continued to grow and extend out as the community grew, which now feeds approximately 39,000 people via an estimated 11,000 metered accounts.

SPU's water system has grown to include eighteen (18) groundwater supply wells, four (4) elevated storage tanks, three (3) ground storage facilities, and four (4) booster stations. The system utilizes three (3) pressure zones: the Normal Elevation Service (NES); the First High Elevations Service (1HES), and the Second High Elevation Service (2HES) zones. SPU maintains over 208 miles of water mains ranging in material (cast iron, ductile iron, and PVC) and size up to 18 inches in diameter.

The City of Shakopee's location with respect to nearby major urban centers, principal transportation corridors, and available lands makes the community an ideal place for both continued steady residential and commercial growth and development. To stay ahead of the increasing population and its demand for high quality drinking water, SPU regularly reviews and updates its long-range planning documents. Following on the heels of completing an update to their Comprehensive Water System Plan in 2019, SPU is now evaluating its need for municipal water treatment with this study.

The purpose of this feasibility study is to examine water quality, analyze current operating practices, evaluate supply and municipal treatment options, and recommend viable solutions to increase the quality of water being supplied to their consumers.

2 Existing Water Infrastructure

The following sections describe the water supply and treatment infrastructure for SPU's water system.

2.1 Existing Supply

SPU's water supply is made up of eighteen (18) groundwater supply wells. Fourteen (14) of those groundwater wells pump water from the Prairie du Chien-Jordan Sandstone aquifer, two (2) utilize water from the Tunnel City-Wonewoc aquifer, and the other two (2) wells pump from the Mount Simon-Hinckley aquifer. The total capacity of the municipal wells is 17,859 gallons per minute (gpm), which is equivalent to 24.4 million gallons a day (MGD), and a reliable supply capacity of 20.3 MGD when subtracting the highest capacity well.

SPU designed their system to utilize their good quality water by distributing supply wells throughout the pressure zones. Some of the wells pump to a common wellhouse to allow for blending of the water prior to entering the water distribution system. Any blending that is done and reported within the SPU water system is done at the wellhouse prior to being delivered to any SPU customer.

Table 1 provides a summary of each well.

Table 1: SPU Well Information

Well No.	MN Unique Well #	Year Installed	Zone	Pump House No.	Capacity (gpm)	Well Depth (Feet)	Status	Aquifer
Well 2	206803	1944/ 2002	NES	Pump House 2	300	525	Active	Tunnel City-Wonewoc
Well 3*	205978	1956	NES	Pump House 3	900	755	Out of Service	Mount Simon
Well 4	206854	1971	NES	Pump House 4	715	254	Active	Jordan
Well 5	206855	1971	NES	Pump House 4	850	253	Active	Jordan
Well 6	180922	1981	NES	Pump House 6	1175	222	Active	Jordan
Well 7	415975	1986	NES	Pump House 6	1100	218	Active	Jordan
Well 8	500657	1989	NES	Pump House 2	1100	262	Active	Jordan
Well 9	554214	1994	1HES	Pump House 9	1050	315	Active	Jordan
Well 10**	578948	2001	NES	Pump House 6	1125	800	Active	Mount Simon
Well 11	611084	2001	1HES	Pump House 9	1000	312	Active	Jordan
Well 12	626775	2001	1HES	Pump House 12	810	352	Active	Jordan
Well 13	674456	2002	1HES	Pump House 12	1036	338	Active	Jordan
Well 14	694904	2004	1HES	Pump House 12	381	597	Emergency	Tunnel City-Wonewoc
Well 15	694921	2005	NES	Pump House 15	1150	295	Active	Jordan
Well 16	731139	2006	NES	Pump House 15	1450	285	Active	Jordan
Well 17	731140	2007	NES	Pump House 15	1400	290	Active	Jordan
Well 20	722624	2005	1HES	Pump House 20	1142	275	Active	Jordan
Well 21	722625	2005	1HES	Pump House 20	1175	275	Active	Jordan

* Well No. 3 is no longer used and merely serves as an emergency, standby well

** Well No. 10 is used less than 1% of the total water pumped annually

2.1.1 Water Pumpage

Historical water pumping data for SPU's water supply wells, including 2018-2020 production years, is summarized in the Table 2 below. The wells pumping from the Prairie du Chien-Jordan aquifer supplies a significant quantity of water to the SPU's water system and is expected to provide most of the water in the future. Based on pumping records, approximately 97% of the water supplied is from the Prairie du Chien-Jordan aquifer and less than 3% from the Tunnel City-Wonewoc and Mount Simon aquifer.

If one of SPU's wells is discovered to have a water quality parameter that does not meet water quality standards, SPU takes the necessary steps to ensure that the well is either rarely used for supply and/or properly blended with a cleaner well prior to distribution. This is the case for Well No. 3 and Well No. 14, which are essentially not used for supply, and Well No. 10, which is used less than 1% of the total water pumped annually.

Table 2 provides a pumping summary of each well for 2018 to 2020.

Table 2: Historical Water Pumpage (2018-2020)

Well No.	2018		2019		2020	
	Total (1,000 gal)	% of total	Total (1,000 gal)	% of total	Total (1,000 gal)	% of total
2	47,675	2.6%	39,631	2.4%	48,770	2.7%
3	0	-	0	-	0	-
4	50,745	2.8%	102,669	6.2%	67,067	3.7%
5	154,146	8.4%	102,042	6.1%	68,226	3.8%
6	114,322	6.2%	153,619	9.2%	187,253	10.4%
7	198,541	10.8%	173,743	10.4%	236,255	13.1%
8	285,218	15.5%	205,578	12.4%	274,138	15.3%
9	181,998	9.9%	37,118	2.2%	120,479	6.7%
10	5,489	0.3%	186	0.0%	161	0.0%
11	101,831	5.5%	64,237	3.9%	117,210	6.5%
12	66,115	3.6%	78,390	4.7%	84,312	4.7%
13	89,528	4.9%	94,647	5.7%	151,674	8.4%
14	23	-	0	-	0	-
15	54,056	2.9%	107,141	6.4%	47,975	2.7%
16	137,825	7.5%	184,210	11.1%	124,929	7.0%
17	113,720	6.2%	130,532	7.8%	67,595	3.8%
20	105,617	5.7%	67,810	4.1%	129,327	7.2%
21	133,750	7.3%	122,357	7.4%	71,526	4.0%
Total (1,000 gal)	**1,840,599**		**1,663,910**		**1,796,897**	

2.2 Existing Treatment

The SPU water system does not include a water treatment facility. The water pumped from the Prairie du Chien-Jordan aquifer is generally considered to be of such high quality, with respect to the Environmental Protection Agency's (EPA) enforceable National Primary Drinking Water Regulations (NPDWR), that SPU has not had a reason, nor have they been required to actively remove anything from their groundwater source. SPU only operates and maintains fluoridation and chlorination treatment systems for the prevention of tooth decay and residual disinfection throughout the distribution system piping. SPU also has the ability to feed polyphosphates at Well No. 12 and Well No. 15, to help reduce the chance of aesthetic issues caused by iron and manganese.

2.3 Water Storage

Water storage tanks play an important role in the operation of a water system by sustaining system pressure and supplying water when needed. Four (4) elevated tanks and three (3) ground level reservoirs provide distribution storage for the SPU water system. An eighth tank (Tank 8) is currently being built on the south-western edge of the system to supply the west 2HES. All facilities provide "floating" storage for the system meaning, they supply flow from the tank via gravity.

Table 3 provides a summary of each storage facility.

Table 3: Existing Storage Facilities

Structure Name	Type of Storage Structure	Year Constructed	Primary Material	Overflow Elev. (ft)	Storage Capacity (Gallons)
Tank 1	Elevated	1966	Steel	933	2,000,000
Tank 2	Elevated	1940	Steel	933	250,000
Tank 3	Elevated	1980	Steel	933	1,500,000
Tank 4	Elevated	2002	Steel	1015	500,000
Tank 5	Ground	2005	Steel	933	2,500,000
Tank 6	Ground	2005	Steel	933	2,500,000
Tank 7	Ground	2015	Steel	1015	2,000,000
Tank 8*	Elevated	2020	Steel	1115	750,000
Total Capacity (million gallons)					**12.0**

*Currently under construction.

2.4 Booster Stations

The SPU water system currently has four (4) booster stations that transfer water between zones, as well as sustain pressure in the corresponding pressure zone.

Table 4 provides a summary of each of the booster pumps at each of the interzone booster pumping stations.

Table 4: Existing Booster Stations

Facility	From Pressure Zone	To Pressure Zone	Pump No.	Capacity (gpm)	Total Station Capacity (MGD)
Well 9 Booster	NES	1HES	1	1000	2.9
			2	1000	
Valley Creek	1HES	2HES	1	1000	2.9
			2	1000	
Windermere (West)	1HES	2HES	1	1000	2.9
			2	1000	
Riverview (East)	NES	2HES	1	1000	2.9
			2	1000	

2.5 Distribution System

SPU's water distribution system is made up of over 208 miles of water mains ranging in material (cast iron, ductile iron, and PVC) and size up to 18 inches in diameter. The presence of large water main as exists in the Shakopee water system supports the ability of the water system to transmit large system flows. Below are the lengths of various diameters of pipe:

- 0.015 miles of 4" diameter
- 57.6 miles of 6" diameter
- 80.6 miles of 8" diameter
- 3.4 miles of 10" diameter
- 51.5 miles of 12" diameter
- 9.5 miles of 16" diameter
- 5.6 miles of 18" diameter

3 Water System Evaluation

In the previous comprehensive water plans, the water system was evaluated in regards to numerous system criteria to continuously update and set a list of recommended alternatives. For this study, an evaluation of SPU's water system was performed to determine the need for future treatment and any additional supply that would be required to meet future water needs.

3.1 Source Water Quality

Desirable water quality implies water that is clear, tasteless, odorless, and free of chemical and microbiological contaminants. The quality of water delivered by the community water supplier must meet legislated water quality standards and should meet other standards recognized as desirable by the water industry.

3.1.1 Water Quality Standards

SPU and all public utilities are required to meet water quality rules and regulations under the Safe Drinking Water Act. SPU must meet all regulations and participate in required programs established by the governing bodies, the U.S. Environmental Protection Agency (EPA), and the Minnesota Health of Department (MDH).

3.1.1.1 National Primary Drinking Water Regulations (NPDWR)

The National Primary Drinking Water Regulations (NPDWR) are legally enforceable primary standards and treatment techniques that apply to public water systems. Primary standards and treatment techniques protect public health by limiting the levels of contaminants in drinking water.

The NDPWRs are standards enforceable by law established to protect drinking water and public health. These standards create limits, referred to as the Maximum Concentration Levels (MCL), on the concentrations of contaminants present in drinking water and water sources. Levels are also established within the regulation to indicate at what concentrations and length of exposure a contaminant can impact human health. Governing bodies can take legal actions against utilities if public water supplies are not in compliance with the MCLs.

Please visit the EPA's website for the complete list of National Primary Drinking Water Regulations.

3.1.1.2 National Secondary Drinking Water Regulations (NSDWR)

The NSDWRs are non-enforceable standards for contaminants that impact the aesthetic of drinking water. EPA believes that if these contaminants are present in your 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 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. It is recommended that public water supplies meet these drinking water standards even though they are not legally enforceable.

Please visit the EPA's website for the complete list of National Secondary Drinking Water Regulations.

3.1.1.3 Minnesota Department of Health (MDH) Requirements

All regulations established by the U.S. EPA are adopted by the MDH. The MDH also developed health-based rules and guidance to evaluate potential human health risks from exposures to chemicals in groundwater. Health-Based Values (HBVs) and Health Risk Limits (HRLs) are developed by toxicologists at MDH using the best science and public health policies available at the time of their development. An HBV or HRL is the level of a contaminant that can be present in water and pose little or no health risk to a person drinking that water. HBVs and HRLs are developed to protect sensitive or highly exposed populations. HBVs and HRLs are guidance used by the public, risk managers, and other stakeholders to make decisions about managing the health risks of contaminants in groundwater and drinking water.

Please visit the MDH's website for the complete list of health-based water guidance values.

3.1.2 Existing Drinking Water Quality

SPU is proud of the fact that their drinking water is supplied directly from the naturally safe wells and has consistently tested below levels that would require any filtration or other extensive treatment. SPU continuously monitors their wells to ensure they stay in compliance with the EPA's NPDWRs, as well as striving to meet the National Secondary Drinking Water Regulations (NSDWR) and other non-enforceable water quality standards. If one of SPU's wells is discovered to have a water quality parameter (iron, manganese, nitrate, arsenic, radium, etc.) that has surpassed a drinking water standard, SPU takes the necessary steps to ensure that the well is either rarely used for supply and/or properly blended with a cleaner well. Any blending that is done and reported within the SPU water system is done at the wellhouse prior to entering the distribution system.

The tables presented in Appendix A identify the general water quality parameters for the SPU's source water supply wells for the years 2018, 2019, and 2020. Also included in Appendix A is a separate table of extensive water testing results for nitrate during the same period. A further description of the parameters of potential concern are described below in more detail.

3.1.2.1 Iron

Iron occurs naturally in rocks and soil across Minnesota and is often found in most groundwater sources. However, iron is not a health risk but can cause discolored water, stained plumbing fixtures, and an unpleasant metallic taste to the water. This can lead to customer complaints about the water. Iron deposits can also buildup in pressure tanks, storage tanks, water heaters, and pipelines, causing decrease capacity, reduce pressure, and increase maintenance for the utility and user. As of right now, the only drinking water guidance value for iron is EPA's NSDWR for iron of 0.3 mg/L.

To satisfy their customers and to reduce any potential of aesthetic, taste, or odor complaints, SPU has largely considered the NSDWR concentration of 0.3 mg/L of iron to be their water quality goal that would be supplied to their customers. Any well that tests above that value is considered high and is monitored closely.

Only three (3) of SPU's existing wells have recorded iron levels above the NSDWR of 0.3 mg/L. Well No. 14, with iron levels between 0.63 mg/L and 1.20 mg/L, is not rarely operated as it is only 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.

Well No. 10 has also reported high iron levels, which are between 0.42 mg/L and 1.98 mg/L. This well is considered a peaking well, meaning it is used sparingly, and is only operated to supplement large water use days; typically less than 1% of the total annual water pumped. When the well is operated it is blended with water from either Well No. 6 or Well No. 7.

In addition to Well No. 10 and Well No. 14, Well No. 3 is known to have high levels of iron. It was reported in 2020 that Well No. 3 contained a concentration of 1.75 mg/L. SPU regards Well No. 3 as an emergency well and does not use it.

3.1.2.2 Manganese

Manganese occurs naturally in rocks and soil across Minnesota and the upper Midwest and is often found in groundwater sources. Your body needs some manganese to stay healthy, but too much can be harmful. Studies have found that children and adults who drink water with high levels of manganese for a long time may have problems with memory, attention, and motor skills. Infants (babies under one year old) are much more susceptible to acute exposure, which may lead to development of learning and behavior problems if they drink water with too much manganese in it.

Currently, there is no federally enforceable maximum contaminant levels (MCLs) for manganese in drinking water. In 2004, EPA set a non-enforceable lifetime health advisory (HA) level of 0.3 mg/L for chronic exposure to manganese and a 1-day and 10-day HA of 1 mg/L for acute exposure. The EPA suggests 0.3 mg/L be used for both chronic and acute exposure for infants younger than 6 months old.

To further keep household drinking water safe, the MDH has developed their own guidance value or HBV of 0.10 mg/L, which was developed to be a safe level of manganese for bottle fed babies. However, if everyone in your household is more than one year old or an infant who never drinks tap water or formula made with tap water, the MDH believes that a safe level of manganese in your water is 0.30 mg/L or less. This coincides with the EPA's lifetime health advisory level.

To reduce the potential of staining and taste concerns in the water supply, the EPA has also set a NSDWR for manganese of 0.05 mg/L. Public water systems are not required to meet this value; however, it can serve as a helpful guideline to reduce customer complaints. To satisfy their customers and to reduce any potential of aesthetic, taste, or odor complaints, SPU has largely considered the NSDWR value of 0.05 mg/L of manganese to be their water quality goal that would be supplied to their customers. Any well that tests above that value is considered high and is monitored closely.

Only two (2) of SPU's existing wells have reported manganese levels above the NSDWR of 0.05 mg/L. Well No. 12 has reported manganese levels between 0.07 mg/L and 0.08 mg/L, which is only slightly above the NSDWR, but not surpassing the MDH's HBV. To combat any water aesthetic issues as a result of the manganese levels, SPU feeds polyphosphates to the Well No. 12. SPU has also been approved to start feeding polyphosphates to Well No. 15, which has reported manganese levels between 0.04 mg/L and 0.12 mg/L. Both of these wells are used on a somewhat regular basis (less than 10% of total annual water supplied), but more sparingly than the wells with more favorable water quality.

3.1.2.3 Nitrate

Nitrate contamination is often attributed to runoff from fertilizer use; leaking from septic tanks, sewage; erosion of natural deposits and livestock waste. The EPA's MCL for nitrate is 10 mg/L.

Consuming levels of nitrate above 10 mg/L can affect how blood carries oxygen and can cause methemoglobinemia (also known as blue baby syndrome). Other symptoms connected to methemoglobinemia in infants include decreased blood pressure, increased heart rate, headaches, stomach cramps, and vomiting.

In an effort to ensure that their customers are providing safe, good quality water, SPU has actively been monitoring nitrates throughout their wells for the last two decades. Wells utilizing water from the Jordan Sandstone aquifer have detected levels of nitrates, especially in areas of Shakopee with lower elevations due to the decreased soil cover between the ground surface and the aquifer.

None of the levels of nitrate in SPU's wells are currently exceeding the EPA's MCL of 10 mg/L, but many have reported levels around or above 5.0 mg/L, which has raised some concerns throughout their customers. From 2018 to 2020, SPU's Well No. 2, Well No. 4, Well No. 5, Well No. 6, Well No. 7, Well No. 8, Well No. 15, Well No. 16, and Well No. 17 reported levels above 5.0 mg/L of nitrate, with Well No. 5, Well No. 6, Well No. 8, and Well No. 17 averaging above 5.0 mg/L of nitrate. SPU will continue to monitor these wells to ensure that they remain below the MCL of 10 mg/L and that the water is safe for their customers.

It should be noted that the monitoring results have shown nitrate levels, in all of SPU's wells, have mostly stayed the same or gotten lower over the past 20 years. It is expected that this downward trend will continue as agriculture land is developed into residential and commercial properties throughout the watershed, reducing leaching into the aquifer.

3.1.2.4 Radium

Radium becomes an issue when naturally occurring deposits erode. Certain rock types have naturally occurring trace amounts of "mildly radioactive" elements (radioactive elements with very long half-lives) that serve as the "parent" of other radioactive contaminants ("daughter products"). These radioactive contaminants, depending on their chemical properties, may accumulate in drinking water sources at levels of concern. The "parent radionuclide" often behaves very differently from the new element, the "daughter radionuclide" in the environment. The EPA set the MCL for radium 226/228 to be 5 pCi/L.

Well No. 14 and Well No. 3, which SPU uses as emergency wells only, as well as Well No. 10, have a history of containing moderate concentrations of combined radium 226/228 that exceed the MCL. All three (3) wells have been observed to have radium levels that exceed the EPA MCL of 5 pCi/L. Since Well No. 3 and Well No. 14 are not currently in use, they are less of a concern. Well No. 10 is used very sparingly and is always blended with water from Well No. 6 and Well No. 7 at the pump house. The concentration of radium in the blended water is well below the MCL prior to entering the distribution system.

3.1.2.5 Arsenic

Arsenic occurs naturally in rocks and soil across Minnesota. Small amounts can dissolve into groundwater that may be used for drinking water. Drinking water contaminated with low levels of arsenic over a long period of time is associated with diabetes and increased risk of cancers of the bladder, lungs, liver, and other organs. The enforceable standard for arsenic is a MCL of 10 µg/L.

From 2018 to 2020, Well No. 14 reported arsenic concentrations between 18.4 and 25.30 µg/L and is the only well that has concentration of arsenic that exceed the EPA MCL of 10 ug/L. As explained above, SPU regards Well No. 14 an emergency well and rarely uses it for supply.

3.1.2.6 Sodium

Sodium is a naturally occurring element that is found widely throughout the environment. Due to issues with hypertension and other health concerns, some people have a sodium restricted diet. A goal of 2,400 mg per day of dietary sodium has been proposed by several government and health agencies. Drinking water containing between 30 and 60 mg/L is unlikely to be perceived as salty by most individuals and would contribute only 2.5% to 5% of the dietary goal if tap water consumption is 2 liters per day.

From 2018 to 2020, the sodium concentrations in SPU's wells ranged from 8.27 mg/L to 63.6 mg/L over the past three years. These sodium concentrations indicate that SPU's water is not likely to contribute a significant amount of sodium to a resident's diet.

3.1.2.7 Hardness

Water above 100 mg/L of hardness is considered hard. The raw water from all of the wells is hard with total hardness ranging from the SPU wells ranges from 163 mg/L to 446 mg/L. Hardness levels in these ranges are very common to groundwater supplied systems across the Midwest. Water that is considered "hard" has a hardness of approximately 150 to 300 mg/L as $CaCO_3$ and is considered "very hard" with $CaCO_3$ above 300 mg/L. It can be assumed that much of the water supplied by SPU is considered "very hard" and requires softening to prevent calcium buildup on appliances at the tap.

3.2 Hydraulic Modeling

A hydraulic computer model was generated to evaluate the performance of the SPU's current water distribution system. The model used the most recent geographical information system (GIS) data for SPU's water system assets, and was created using WaterGEMS®, a pipe network program developed by Bentley®. The previously calibrated model was verified using hydraulic and pumping data supplied by SPU from June 2020.

Since pressures in the current system are not of concern, the model was utilized to assess water quality throughout the system. Using an average day demand of 7 MGD and utilizing four (4) pump priority or "steps" used by SPU, shown in the following table (Table 5), the system was modeled for water distribution age and nitrate distribution throughout the system. The following sections describe the results in detail.

Table 5: Typical Well Steps Used for Operation

Well No.	Zone	Tank Level Controls	Week 1 Steps	Week 2 Steps	Week 3 Steps	Week 4 Steps
2	NES	Tank 1	3	1	2	1
3	NES	Tank 1	Not Used	Not Used	Not Used	Not Used
4	NES	Tank 1	1	3	3	2
5	NES	Tank 1	1	3	3	2
6	NES	Tank 1	3	1	1	1
7	NES	Tank 1	3	1	1	1
8	NES	Tank 1	1	2	1	1
9	NES	Tank 1	1	3	1	3
10	NES	Tank 1	5	5	5	5
11	NES	Tank 1	2	1	2	1
12	1HES	Tank 4	2	1	2	1
13	1HES	Tank 4	1	2	1	2
14	1HES	Tank 4	Emergency	Emergency	Emergency	Emergency
15	NES	Tank 3	3	2	1	3
16	NES	Tank 3	1	3	2	1
17	NES	Tank 3	2	1	3	2
20	1HES	Tank 4	2	1	2	1
21	1HES	Tank 4	1	2	1	2

3.2.1 Water Distribution Age Modeling

The water age refers to the time it takes for water to travel from a water source to consumers and is influenced by water distribution system flow velocities and pipe lengths. Water age is an important performance indicator to many utilities because excessive age can cause problems with the water quality.

The water age distribution model was run through a 50-day age simulation to generate water ages throughout the system (Appendix B). In general, most of the service area is under 24-hours of age in the system. The areas with higher water age are in the vicinity of the larger ground storage tanks. This is caused by a low turnover of water in these larger tanks, causing older water to be supplied nearest the tank. The fear in the higher water age areas of the system is chlorine residual being too low, causing various taste and odor issues. SPU has indicated that there has not been taste and odor issues commonly occurring anywhere throughout the system. It is the goal of SPU to have a chlorine residual of 0.9 mg/L in the distribution system. Recent tests show that the chlorine residual at Tank 5 and Tank 6, which have the highest water age in the system, are maintaining a chlorine residual of 0.3-0.4 mg/L, which is still above the typical minimum recommendation of 0.2 mg/L.

There are no concerns with current operations by SPU with regards to the water age throughout the system.

3.2.2 Nitrate Distribution Modeling

As for the nitrate distribution throughout the system. The system was modeled using a max concentration over the last three years (2018-2020) at each well, to create a “worst-case” scenario. The nitrate distribution model was run through an extended period simulation to generate peak concentrations through the system (Appendix B).

The modeling results indicate that enough wells that supply the NES zone have high enough concentrations of nitrate that much of the zone could potentially receive nitrate concentrations above 5.0 mg/L. Conversely, the modeling results indicate that the 1HES zone is utilizing wells with lower nitrate concentration could potentially receive blended nitrate concentrations of 1.0 mg/L to 3.0 mg/L. However, the concentrations in the NES zone are not above the EPA's MCL of 10 mg/L of nitrate, some areas are receiving much higher levels of nitrate compared to some areas in the 1HES zone.

3.3 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 SPU with eighteen (18) high-capacity wells, it is somewhat likely for two (2) 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 SPU water supply system should be capable of meeting maximum day demands (MDD) with the largest two (2) wells out of service.

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 (2) 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.

As previously completed in the previous water system plans, 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 to create projections of future water requirements. Table 6 identifies the projections that were made in that analysis. It was determined that by 2040, SPU's projected drought-year average day with full buildout could reach a potential 9.0 MGD, with a maximum day demand of approximately 25 MGD if year 2040 were a drought year. This indicates a potential need for approximately 4.0 – 5.0 MGD more in reliable supply capacity to meet projected water system demand growth. This would equate to roughly three (3) new wells by 2040, as dictated by the previous studies. The suggested location for these wells is discussed later in this report.

Table 6: Summary of Water Needs Projections per Service Zone

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

Source: Comprehensive Water Plan - 2019 Supplement

4 Water Treatment Techniques

Based on the water quality information; with proper blending and prioritizing better water quality wells, SPU is not required to provide additional treatment other than their existing fluoridation and disinfection. Nevertheless, because of SPU's dedication and commitment to public health and their desire to provide abundant high-quality water to their customers, SPU completed this water treatment feasibility study to actively plan for any water quality or regulatory issues that they may face in the future.

The following treatment systems are included in this evaluation. This evaluation will help present the cost of treatment to SPU and their customers to determine if municipally treated water is something to be desired.

4.1 Iron and Manganese Removal

The most common and most cost-effective option for iron and manganese removal is chemical oxidation followed by filtration. In groundwater, the manganese and iron ions are in solution. When a strong oxidant is added to the water, typically chlorine or oxygen and permanganate, iron and manganese is converted from soluble compounds to filterable solids. The iron and manganese can be subsequently removed in the filtration process.

Other options for iron and manganese removal is chemical oxidation followed by membrane filtration or reverse osmosis. Both options are very expensive from a capital cost and operations and maintenance standpoint and are not being considered further.

4.2 Nitrate Removal

Nitrates are very difficult contaminants to eliminate from water. Nitrates will not be removed by sediment filters, carbon filters, or by the hollow fiber membrane of an ultrafiltration system. Similarly, a traditional cation exchange water softener will not reduce or remove nitrates. To remove nitrate from drinking water, a few common methods are anion exchange, reverse osmosis, biological denitrification over fluidize beds, and electrodialysis reversal (EDR).

4.2.1 Anion Exchange

Anion exchange is a process that can be utilized to remove nitrate (a monovalent anion) from water. The anion exchange resin (small plastic beads) are embedded with basic (pH) functional groups. The nitrate and other anions displace chloride on the ion exchange resin and are removed from the water. This process is identical to home water softening, except that water softening is a cation exchange process. The anion exchange resin is periodically regenerated with salt brine to clean the nitrate off of the resin. For every million gallons of water treated, approximately 2 tons (4,000 lbs) of salt and 45,000 gallons of water is used. The spent salt brine is then discharged to the sewer.

4.2.2 Reverse Osmosis

Reverse osmosis (RO) is a membrane process that is used to remove dissolved solutes from water. Unlike ultrafiltration membranes which use small pores to filter out solids, RO uses preferential diffusion for separation. Water is pumped at high pressure across the surface of the membrane, causing a portion of the water to diffuse through the membrane. The water that passes through the membrane is referred to as permeate and the remaining water is referred to as reject water. RO filtration has the following characteristics:

- Ability to remove 99% of dissolved salts (nitrate, hardness, sulfates, etc.)
- Removes 60-80% of TOC
- Approximately 82% water recovery (18% reject water)
- Provides a potential barrier against future contamination or emerging contaminants (particularly with the addition of advanced oxidation processes)

4.2.3 Biological Denitrification

Biological denitrification can be utilized to remove nitrate from water. Denitrification is a process where bacteria in low oxygen (anoxic) conditions reduce nitrate into nitrogen gas. Denitrification happens naturally in the environment as part of the nitrogen cycling process.

Biological denitrification requires a carbon substrate for the reaction to occur. In wastewater treatment, where denitrification is common, the wastewater contains the necessary carbon substrate. For denitrifying drinking water, a carbon substrate needs to be added, commonly acetic acid. It is possible that other nutrients (phosphorus) could also be required for cell growth.

The biological denitrification process would require an acetic acid chemical feed, fluidized bed reactors, followed by aeration to strip the nitrogen gas from the water and add oxygen.

4.2.4 Electrodialysis Reversal

Electrodialysis reversal (EDR) is a membrane process that can be utilized to remove dissolved salts, including nitrate, from water. EDR is used to transport salt ions from one solution through membranes to another solution under the influence of an electric potential difference. The EDR process does not require regeneration.

EDR has the following filtering characteristics:

- Ability to remove 75% of dissolved salts (nitrate, hardness, sulfates, etc.) with 2 stages
- Approximately 90% water recovery (10% reject water)
- Does not remove suspended solids or uncharged dissolved solids (TOC)

4.3 Municipal Softening

The majority of the metro area communities do not soften their water and leave the choice of softening up to the individual residents. However, some metro area communities including Minneapolis, St. Paul, Richfield, Eden Prairie, White Bear Lake, Bloomington, Tonka Bay, and Forest Lake soften their water at a municipal level. However, many of the metro area communities do not soften their water and leave the choice of softening up to the individual residents. Municipal scale water softening is very expensive from a capital, operations, and maintenance standpoint and would likely require increased water rates to accomplish.

4.3.1 Lime Softening

Lime softening is a water treatment process that uses calcium hydroxide, or limewater, to soften water by removing calcium and magnesium ions. In this process, hydrated lime is added to the water to raise its pH to a point where the calcium carbonate is no longer soluble in the water. By forming calcium carbonate precipitate; the calcium can be removed by filtration. The lime softening process offers many benefits, including the reduction of dissolved minerals in the water and the reduction of heavy metals and other elements such as barium, arsenic, and uranium that naturally exist in some water sources.

After the water is softened by the use of lime, the precipitated solids must be removed before the water can be used for drinking. This is typically done by taking the lime slurry generated in the clarifier and removing the water from it (dewatering) using a filter press. The clear filtrate, or liquid, that results from this process is ready for the next step in the water treatment process. The resulting dewatered filter cake, consisting primarily of lime, can then be easily disposed of, or even used by farmers as a soil amendment.

4.3.2 Ion Exchange Softening

Ion exchange softening involves exchanging calcium and magnesium ions for sodium ions with an ion exchange resin. This is exactly the same process that is used in a home water softener. To regenerate an ion exchange softener, the resin is flushed with a concentrated solution of brine. This regeneration process uses large quantities of salt. For every million gallons of water treated, approximately 2 tons (4,000 lbs) of salt and 45,000 gallons of water is used. The spent salt brine is then discharged to the sewer.

Since SPU sends their wastewater to the Metropolitan Council Environmental Services (MCES) Metro Wastewater Treatment Plant, the discharge would ultimately be discharged to the Mississippi River. While the MCES Metro Wastewater Treatment Plant currently meets its discharge limits, chlorides have received more regulatory scrutiny recently. Operating a municipal scale ion exchange softening process may become less feasible in the future due to chlorides in wastewater.

5 Water Quality Survey

The public involvement process incorporates citizens and stakeholders in the early stages of the planning process and encourages their participation throughout a project's lifecycle. Collaborating with the public allows policy makers to foster a shared project vision and enjoy a higher level of acceptance among planners, citizens, and other project stakeholders. The planning process can come to life when the community emerges to share their voices. To accomplish this, SEH worked with SPU to develop a series of questions to pose to SPU's customers, regarding their satisfaction with their water quality. The questions were designed to gauge the customers interest and support for municipal treatment throughout SPU's system. The survey asked customers to weigh in on the following issues:

- Customers' perception of the current quality of water they receive
    - Concerns with taste and odor
    - Comfort with current manganese levels
    - Comfort with current nitrate levels
- Current cost of water service (water rates)
- Customers' interest, or willingness, to pay more for advanced water treatment
- Willingness to pay for municipally softened water

See the attached Memorandum 3 – Water Quality Survey (Appendix C), which describes in detail the results of the survey.

6 Proposed System Improvements

After analyzing SPU's distribution system layout, water concentrations in each well, and distribution modeling results, three (3) systemwide treatment alternatives were developed. These alternatives will each provide treated water to the entire system. See Appendix D for the complete maps representing each of the following options. All three (3) of these options designed to satisfy a projected ultimate demand of 25 MGD.

6.1 Alternative 1 – Satellite Treatment

6.1.1 Description

This systemwide treatment alternative proposes individual treatment facilities to be constructed within the vicinity of each water supply well (See Appendix D). This satellite alternative reduces the amount of transmission mains required to provide systemwide treatment by source treating at each of existing pump house sites, with exception to Pump House 2, which is most feasible to route to Pump House 3. In total, it is recommended that seven (7) treatment facilities be constructed to provide treatment in all three (3) of SPU's pressure zones. This alternative allows each treatment facility to be tailored to the specific water quality at the site-specific wells to treat accordingly, as well as provide a better option for phased implementation based on need for treatment.

Table 7 describes the proposed treatment facilities included in Alternative 1 (Satellite). The proposed facilities are described in more detail in the following sections.

Table 7: Alternative 1 (Satellite) Proposed Water Treatment Facilities

Satellite WTP Location	Supply Wells			Water Quality (2018 - 2020) [1]			Proposed Treatment
	Existing Wells	New Wells[2]	MGD[3]	Iron	Manganese	Nitrate	
Pump House 3 Site	2, 8	Well 22	3.7	0.00	0.00	2.2-6.3	Nitrate Removal
Pump House 15 Site	15, 16, 17	Well 18 & 19	9.2	0.0-0.03	0.0-0.12	2.8-7.1	Iron, Manganese, & Nitrate Removal
Pump House 9 Site	9, 11	NONE	3.0	0.00	0.00	1.9-4.5	Nitrate Removal
Pump House 12 Site	12, 13, 14	NONE	2.7	0.0-1.2	0.1-0.08	0.0-0.9	Iron & Manganese Removal
Pump House 20 Site	20, 21	NONE	3.3	0.00	0.00	1.1-3.6	Nitrate Removal
Pump House 6 Site	6, 7, 10	NONE	4.9	0.0-0.42[4]	0.0-0.03	0.0-5.6	Iron & Manganese Removal[5]
Tank 8 Site	NONE	22, 23	3.3	Unknown water quality.			Iron, Manganese, and Nitrate Removal[6]

[1] Ranges based on existing supply wells concentration from 2018-2020
[2] New well capacities assumed to be 1,250 gpm.
[3] Assumes all supply wells are running.
[4] In 2020, Well 10 recorded an unexpected iron concentration of 1.98 mg/L
[5] If Well 10 is to be utilized, nitrate levels could be diluted below 5.0 mg/L, but the iron levels would require removal. However, if Well 10 is to be decommissioned, the nitrate levels would require nitrate removal.
[6] Treatment technique should be reassessed after determining the new well's water quality.

6.1.2 Pump House 3 Site

The proposed satellite treatment plant will be within the Pump House 3 site and will treat water supplied from Well No. 2 and Well No. 8, as well as a potential new well that will share the site (Well No. 22). This would require watermains to be constructed from Pump House 2 to the Pump House 3 site. As noted previously in the report, existing Well No. 3 is not operated due to subpar water quality and will remain as a last resort emergency well that would require blending when operating.

If Well No. 2, Well No. 8, and the new Well No. 22 were all running, the plant's capacity would need to be designed to treat 3.7 MGD (5.0 MGD with Well No. 3 running). Assuming the concentration of the new Well No. 22 would be similar to the nearby wells out of the Jordan aquifer, a water quality analysis of water from Well 2, Well 8, and Well 22 estimates that nitrate could range from 2.2 mg/L to 6.3 mg/L (without blending), depending on which well is running, and expect iron and manganese levels to be near zero. To achieve reduced levels of nitrate, the proposed satellite WTP should be designed as a nitrate removal facility. A potential layout for a 3 MGD ion exchange WTP adjacent to Pump House 3 is shown on Appendix E.

It should be noted that Well No. 3 has elevated levels of iron that could cause fouling on ion exchange resin. Well No. 3 should be only run when it is diluted with the other three (3) wells and should be used sparingly.

6.1.3 Pump House 6 Site

The proposed satellite treatment plant will be within the Pump House 6 site and will treat water supplied from Well No. 6, Well No. 7, and Well No. 10. Well 10 is currently used less than 1% of the total yearly pumpage due to a history of containing moderate concentrations of iron, radon and radium 226/228. If Well No. 10 is going to supply the satellite WTP, it will need to always blended with water from Well No. 6 and Well No. 7 to reduce the concentration of radium and radon. If all three (3) wells were running, the plant's capacity would need to be designed to treat 5.0 million gallons per day.

A water quality analysis of the water from Well No. 6, Well No. 7, and Well No. 10 estimates that nitrate could range from 2.7 mg/L to 3.7 mg/L, depending on which well is running and ensuring Well No. 10 is always being blended with another well, and expect iron and manganese levels to be near 0.66 mg/L and 0.01 mg/L respectively. To achieve reduced levels of iron, the proposed satellite WTP should be designed as an iron and manganese removal facility. If Well No. 10 was to not be utilized as a supply well, the satellite WTP should be designed as a nitrate removal facility.

Due to the size of the site, additional land will likely need to be acquired to fit the WTP on the site. SPU indicated that there is a possibility to purchase some of the land to the west owned by the Shakopee Energy Park. This would have to be worked out during the design phase of the project. A potential layout for a 5 MGD gravity filtration WTP adjacent to Pump House 6 is shown in Appendix E.

6.1.4 Pump House 9 Site

The proposed satellite treatment plant will be within the Pump House 9 site and will treat water supplied from Well No. 9 and Well No. 11. If both wells running, the plant's capacity would need to be designed to treat 3.0 million gallons per day. A water quality analysis of water from Well No. 9 and Well No. 11 estimates that nitrate could range from 1.87 mg/L to 4.45 mg/L, depending on which well is running, and expect iron and manganese levels to be near zero. To achieve reduced levels of nitrate, the proposed satellite WTP should be designed as a nitrate removal facility.

Due to the size of the site, additional land will likely need to be acquired to the west of Pump House 9. SPU indicated that there is a possibility to convert some of the parking lot to the west to incorporate the water treatment facility. This would have to be worked out during the design phase of the project. A potential layout for a 3 MGD ion exchange WTP is shown in Appendix E.

6.1.5 Pump House 12 Site

The proposed satellite treatment plant will be within the Pump House 12 site and will treat water supplied from Well No. 12, Well No. 13, and Well No. 14. As noted previously in the report, existing Well No. 14 is not operated frequently due to subpar water quality and will remain as a last resort emergency well that would require blending when operating. Due to the low pumping capacity of Well No. 14, it may be more economical to decommission the well rather than pay for the upkeep.

If Well No. 12 and Well No. 13 were both running, the plant's capacity would need to be designed to treat 2.7 MGD (3.2 MGD with Well No. 14 running). A water quality analysis of water from Well No. 12 and Well No. 13 estimates that manganese could range from 0.01 mg/L to 0.08 mg/L, depending on which well is running, and expect iron and nitrate levels to be near zero. To achieve reduced levels of manganese, the proposed satellite WTP should be designed as an iron and manganese removal facility. These processes will also remove the high levels of iron from Well No. 14, if it was required to supply the WTP. A potential layout for a 3 MGD filtration WTP is shown in Appendix E.

6.1.6 Pump House 15 Site

The proposed satellite treatment plant will be within the Pump House 15 site and will treat water supplied from Well No. 15, Well No. 16, and Well No. 17, as well as two (2) potential new wells (Well No. 18 and Well No. 19). If Well No. 15, Well No. 16, and Well No. 17 were all running, the plant's capacity would need to be designed to treat 5.8 million gallons per day. With the potential new wells supplying approximately 1.8 MGD each, the water treatment capacity should be increased to 9.4 MGD.

Assuming the concentration of the new wells would be similar to the nearby wells out of the Jordan aquifer, a water quality analysis of water from the wells estimates that nitrate could range from 2.8 mg/L to 7.1 mg/L, depending on which wells are running, and expect iron levels to be between 0.0 mg/L and 0.03 mg/L, and manganese levels between 0.0 mg/L and 0.12 mg/L. To achieve reduced levels of nitrate, iron, and manganese, the proposed satellite WTP should be designed as an iron, manganese, and nitrate removal facility.

Due to the size of the Pump House 15 site, additional land will likely need to be acquired. SPU indicated that there is a possibility to utilize some of the 17th Avenue Sports Complex land near Pump House 15. This would have to be worked out during the design phase of the project. A potential layout for a 10 MGD filtration and ion exchange WTP is shown in Appendix E.

6.1.7 Pump House 20 Site

The proposed satellite treatment plant will be within the Pump House 20 site and will treat water supplied from Well No. 20, and Well No. 21. If both wells were running, the plant's capacity would need to be designed to treat 3.3 million gallons per day. A water quality analysis of water from Well No. 20 and Well No. 21 estimates that nitrate could range from 1.1 mg/L to 3.6 mg/L, depending on which well is running, and expect iron and manganese levels to be near zero. To achieve reduced levels of nitrate, the proposed satellite WTP should be designed as a nitrate removal facility.

Due to the size of the site, additional land will likely need to be acquired to the west of Pump House 20. SPU indicated that there is a possibility to convert some of the parking lot to the west to incorporate the water treatment facility. This would have to be worked out during the design phase of the project. A potential layout for a 3.0 MGD ion exchange WTP is shown in Appendix E.

6.1.8 Tank 8 Site

The proposed satellite treatment plant will be at the new Tank 8 site on the west side of town. The proposed WTP will be supplied by two (2) new wells (Well No. 23 and Well No. 24). It is anticipated that the capacity would need to be designed to treat 3.0 million gallon per day. Since there hasn't been a water quality analysis done at the proposed site, it should be assumed that the WTP should be designed to treat for iron, manganese, and nitrates. To achieve reduced levels of iron, manganese, and nitrates, the proposed satellite WTP should be designed as an iron and manganese, and nitrate removal facility. A potential layout for a 3 MGD filtration and ion exchange WTP is shown in Appendix E.

6.1.9 Supply Wells Improvements

As discussed above, it can be expected that future project demands will cause SPU to see supply deficiencies. Thus, this alternative suggests adding four (4) new wells to satisfy water demands across the entire system and decommissioning two (2) of SPU's existing wells. SPU has identified multiple potential well sites which could all be feasible site options to increase supply to meet future demands. The proposed new wells for the Alternative 1 (Satellite) will be Well No. 18, Well No. 22, Well No. 23, and Well No. 24, as well as Well No. 19, which will be considered a reserve site for future increased demands.

6.1.9.1 Well No. 18 & Well No. 19 (Reserve)

With anticipation of demand increases in the future, SPU planned ahead and constructed watermain to two (2) potential well sites that would feed Pump House 15 (Well No. 18 and Well No. 19). Well No. 18 and Well No.19 have potential sites that have already been located by SPU in the vicinity of the Shakopee Soccer Association soccer fields. For the Alternative 1 (Satellite), it is proposed that Well No. 18 be constructed as planned to feed the satellite WTP at the Pump House 15 site and Well No. 19 be held as a reserve option for any additional capacity that would need to be added down the road.

6.1.9.2 Well No. 22

In order to satisfy future demands in the NES zone, the proposed Well No. 22 would be located next to Well No. 3. As noted previously in the report, the existing Well No.3 is not operated due to subpar water quality. The construction of a new water production well would allow water from the new well to be blended with water from Well No. 3, as well as Well No. 2 and Well No. 8, to produce an effluent that meets the drinking water standards. By constructing such a well, the capacity of Well No.3 could potentially be utilized to reduce the need for additional supply.

6.1.9.3 Tank 8 Site (Well No. 23 & Well No. 24)

In order to satisfy future demands in the 2HES (west) and to not rely solely on a booster station, additional capacity may be needed on the west side of the system. For the Alternative 1 (Satellite), it is proposed that Well No. 23 and Well No. 24 be constructed to supply this area. The proposed location of the wells would be on the same site as newly constructed Tank 8 in the 2HES (west) and would work in conjunction with Tank 8. Due to their location in a higher-pressure zone, they could also easily feed water to the lower pressure zones by gravity.

6.1.9.4 Decommission Wells

It is being proposed that Well No. 4 and Well No. 5, which accounts for 1,500 gpm of the system's capacity, would be decommissioned due to their poor water quality and lack of capacity. To make up for this capacity, one of the additional four (4) wells will satisfy the lost capacity. If SPU decides to treat Well No. 4 and Well No. 5, neither Well No. 18 and Well No. 19 would be needed and could be kept as reserve for future supply.

6.1.9.5 Watermain Improvements

Under the Alternative 1 (Satellite), a series raw water and finished water distribution mains must be constructed to deliver adequate flows. These watermains were modeled to accurately determine the size for the anticipated flows from the 2040 demands. Although the local knowledge of development patterns was utilized in the preparation of the watermain additions, as a conceptual plan, the actual 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. The following watermain additions are included in the Alternative 1 conceptual plan:

Raw Watermain

- 12" DIP – 1,500 feet

6.1.10 Construction Costs

The following table (Table 8) is the estimated probable cost to implement this alternative. The cost estimate only includes the work needed to implement systemwide treatment based on the described Alternative 1 (Satellite) above and does not include land acquisition costs and work that was already part of the SPU's existing Capital Improvement Plan (CIP). The estimated total cost to implement systemwide satellite treatment is $70,314,750 for satellite pressure WTPs and $76,389,750 for satellite gravity WTPs.

Table 8: Alternative 1 (Satellite) Cost Estimate

Item	Cost	
New Wells	$6,000,000	
Decommissioning Wells	$50,000	
Raw Watermain	$435,000	
Finished Watermain	-	
Treatment	**Pressure**	**Gravity**
Iron & Manganese Removal	$26,000,000	$30,500,000
Nitrate Removal	$19,600,000	$19,600,000
Lime Softening	-	-
Construction Subtotal	**$52,085,000**	**$56,585,000**
Contingency (15%)	$7,812,750	$8,487,750
Construction Total	**$59,897,750**	**$65,072,750**
Engineering & Admin (20%)	$10,417,000	$11,317,000
Total Probable Cost	**$70,314,750**	**$76,389,750**

NOTE: Probable cost does not include any land acquisition that may be required.

6.1.11 Operations and Maintenance Costs

The following table (Table 9) is the estimated operations and maintenance cost associated with Alternative 1.

Table 9: Alternative 1 (Satellite) Annual Operation, Maintenance, & Replacement Costs

Item	Annual Cost	
	Pressure	Gravity
Annual Equipment Replacement	$1,124,768	$885,622
Labor	$390,000	$390,000
Gas	$48,000	$44,000
Chemicals	$666,156	$666,156
Insurance	$50,000	$60,000
Electricity	$544,375	$642,688
Equip. Repair	$121,338	$107,012
Total Annual Cost	**$2,944,638**	**$2,795,477**

NOTE: Does not include existing utility annual costs.

6.2 Alternative 2 – Central Treatment

6.2.1 Description

This systemwide treatment alternative proposes a singular centralized treatment facility for the whole system (See Appendix D). This alternative would convey all of SPU's water supply wells to one central location, providing equally treated water to the entire system. This proposed alternative reduces the cost of facilities and required processing equipment by having one centralized treatment facility. For that reason, this alternative would be the most economical option to provide softened water, if that was desired. The main pitfall to a central plant would be the transmission mains required to convey the raw water from each of the wells to one central location.

To meet maximum day demands for SPU through 2040, the central WTP is proposed to be 25 MGD. The WTP should be designed to include filtration, ion exchange, and potential lime softening. A potential layout for a 25 MGD filtration and ion exchange WTP is shown in Appendix E.

6.2.2 Location

The WTP is proposed to be located on the gravel pit site (1650 Co Rd 83, Shakopee, MN), which is southwest of the intersection of Mystic Lake Dr and 17th Ave E. An extension of Philipp Ave will eventually run through the gravel site parallel to 17th Ave E. The proposed WTP should be located south of the future road to allow enough room for future development. If SPU decides that this location is not the most advantageous for the central WTP, a similar site between Pump House 15 and Mystic Lake Dr (Co Rd 83) should be selected due to the proximity to nearby wells. This would have to be worked out during the design phase of the project.

6.2.3 Treatment

6.2.3.1 Filtration

The design of the WTP is based on the reduction of iron and manganese to below secondary standards of 0.30 mg/L and 0.05 mg/L, respectively. This is proposed to be achieved by adding the oxidants (chlorine or oxygen and sodium permanganate) and filter the soluble compounds out through sand filtration. For the filtration process, the WTP can be designed to be either gravity or pressure filtration with sand as the primary filtration media. For gravity filtration, the WTP requires high service pumps after the filtration to pump to the distribution system. High service pumps are not required in a pressure filtration system because the well pumps push the water through the process units to the water tower and distribution system.

Sand filters (gravity and pressure) require periodic backwashing to remove solids from the filters. After a backwash, the solids are allowed to settle and the clear water is recycled back to the filters. This can be done with backwash tanks or lamella plate settlers. The major benefit of plate settlers is the elimination for the need for batch processing of backwash water from backwash tanks and provide significant operational flexibility. Either option will need to be further discussed in the design phase.

6.2.3.2 Anion Exchange

In addition to iron and manganese removal, SPU is looking to reduce the nitrate concentration in their distribution system. The anion exchange process would follow the filtration process. The anion exchange layout will consist of anion-exchange vessels holding the resin, intermediate pumps to pressurize the vessels, and salt silos. The anion exchange resin is periodically regenerated with salt brine to clean the nitrate off of the resin. The spent salt brine is then discharged to the sewer. Typically, for every million gallons of water treated, approximately 2 tons (4,000 lbs) of salt and 45,000 gallons of water is used. Operating at 25 MGD capacity, almost 50 tons of salt would be used and needed to be discharged to the sewer every day.

6.2.3.3 Lime Softening

An optional addition to the WTP is to add softening. To reduce chloride being discharged into the system, designing for lime softening is a good treatment method. The lime softening layout would consist of lime silos, lime slackers, clarifiers, and a dewatering facility. Lime softening will create a large capital expense and generate higher operation and maintenance costs. In addition, a 25 MGD lime softening WTP could easily generate up to 200,000 pounds of solid waste that would need to be repurposed or disposed of by the utility.

6.2.4 Building Layout/General Sequence

A potential gravity filter building layout is included in Appendix E. The chemical rooms are located on the west side of the building, with exterior doors accessible for deliveries. The electrical, mechanical, high service pump room, and generator rooms are located in close proximity to each other to allow for short conduit runs to motor controls.

The gravity filter layout occurs on two levels to allow for filter height to provide head for the filtering process. The raw water enters the building through the high service pump room where chlorine and potassium permanganate are added. The water travels through the filters by gravity to the clearwell. The water travels from the clearwell to the high service pump chamber where it is pumped into the distribution system. Fluoride and chlorine will be added to the finished water.

When the filters are being backwashed, the wastewater will need to be conveyed to a backwash tank. The backwash tank will allow for the particulate to settle out and provide on-site retention to better control the water being supplied to the sewer.

6.2.5 Supply Well Improvements

As discussed above, it can be expected that future project demands will cause SPU to see supply deficiencies. Thus, this alternative suggests adding four (4) new wells to satisfy water demands across the entire system, and decommissioning two (2) of SPU's existing wells. SPU has identified multiple potential well sites which could all be feasible site options to increase supply to meet future demands. The proposed new wells for the Alternative 2 (Central) will be Well No. 18, Well No. 19 Well No. 22, and Well No. 23.

6.2.5.1 Well No. 18 & Well No. 19

With anticipation of demand increases in the future, SPU planned ahead and constructed watermain to two (2) potential well sites that would feed Pump House 15 (Well No. 18 and Well No. 19). Well No. 18 and Well No.19 have potential sites that have already been located by SPU in the vicinity of the Shakopee Soccer Association soccer fields. Since the piping is already in place, the wells could either feed directly to the proposed WTP or feed to Pump House 15, where it will then be conveyed to the WTP.

6.2.5.2 Well No. 22

The proposed Well No. 22 would be located next to Well No. 3 on the same site. The construction of this well would not require an additional building and the new well could be piped directly into the Pump House 3 where it will then be conveyed to the WTP.

6.2.5.3 Well No. 23

SPU currently owns a portion of property near the Church Addition Development. For the Alternative 2 (Central), it is proposed that a well (Well No. 23) be constructed on this site to supply the WTP. Centrally located, this well site could provide and economic location for a new well that would have a short watermain to feed the WTP.

6.2.5.4 Decommission Wells

It is proposed that Well No. 4 and Well No. 5, which accounts for 1,500 gpm of the system's capacity, would be decommissioned due to the long watermain that would be required to feed the central WTP. To make up for this capacity, one of the additional four (4) wells will satisfy the lost capacity.

6.2.5.5 Watermain Improvements

Under the Alternative 2 (Central), a series raw water and finished water distribution mains must be constructed to deliver adequate flows. These watermains were modeled to accurately determine the size for the anticipated flows from the 2040 demands. Although the local knowledge of development patterns was utilized in the preparation of the watermain conceptual plan, the actual 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. The following watermain additions are included in the Alternative 2 (Central) WTP conceptual plan:

Raw Watermain

- 12" DIP – 5,000 feet
- 16" DIP – 40,500 feet
- 18" DIP – 3,250 feet
- 24" DIP – 9,750

Finished Watermain

- 12" DIP – 26,250 feet
- 16" DIP – 13,000 feet
- 18" DIP – 3,400 feet
- 20" DIP – 4,250 feet

6.2.6 Construction Cost

The following table (Table 10) is the estimated probable cost to implement this alternative. The cost estimate only includes the work needed to implement systemwide treatment based on the described alternative above and does not include land acquisition and work that was already part of the SPU's existing Capital Improvement Plan (CIP). Some of the pipes that are included in the current CIP are needing to be upsized if this alternative is selected. SPU should plan ahead and upsize those pipes when they are constructed initially.

The estimated total cost to implement a centralized treatment facility is $97,642,125 for a central pressure WTP and $104,392,125 for a central gravity WTP. The treatment would consist of filtration and ion exchange. If SPU would like to municipally soften their water, a lime softening process would need to be included. The estimated total cost to implement a centralized lime softening, as well as iron, manganese and nitrate removal facility, would be $138,142,125.

Table 10: Alternative 2 (Central) Cost Estimate

Item	Cost		
New Wells	$4,000,000		
Decommissioning Wells	$50,000		
Raw Watermain	$20,700,000		
Finished Watermain	$11,127,500		
Treatment	**Pressure**	**Gravity**	**Gravity w/ Softening**
Iron & Manganese Removal	$27,000,000	$32,000,000	$32,000,000
Nitrate Removal	$9,450,000	$9,450,000	$9,450,000
Lime Softening	-		$25,000,000
Construction Subtotal	**$72,327,500**	**$77,327,500**	**$102,327,500**
Contingency (15%)	$10,849,125	$11,599,125	$15,349,125
Construction Total	**$83,176,625**	**$88,926,625**	**$117,676,625**
Engineering & Admin (20%)	$14,465,500	$15,465,500	$20,465,500
Total Probable Cost	**$97,642,125**	**$104,392,125**	**$138,142,125**

NOTE: Probable cost does not include any land acquisition that may be required.

6.2.7 Operations and Maintenance Costs

The following table (Table 11) is the estimated operations and maintenance cost associated with Alternative 2 (Central).

Table 11: Alternative 2 (Central) Annual Operation, Maintenance, & Replacement Costs

Item	Annual Cost		
	Pressure	Gravity	Gravity w/ Softening
Annual Equipment Replacement	$853,435	$601,720	$738,474
Labor	$156,000	$156,000	$811,200
Gas	$20,000	$20,000	$24,000
Chemicals	$854,875	$854,875	$2,504,875
Insurance	$28,750	$40,250	$60,250
Electricity	$598,000	$717,600	$842,400
Equip. Repair	$104,990	$93,800	$364,376
Total Annual Cost	**$2,616,050**	**$2,484,245**	**$5,345,575**

NOTE: Does not include existing utility annual costs.

6.3 Alternative 3 – Hybrid Treatment

6.3.1 Description

This hybrid treatment alternative is a combination of the two other alternatives. This alternative proposes a NES zone centralized treatment facility that would convey water from SPU's nearby wells, while less conveniently located wells will construct satellite treatment plants (See Appendix D). This will reduce the infrastructure for treatment processes and equipment required by only treating at four (4) different sites as compared to seven (7) with the satellite alternative. It will also reduce the amount of transmission mains required to provide systemwide treatment.

Table 12 describes the proposed treatment facilities as part of Alternative 3 (Hybrid). The proposed facilities are described in more detail in the following sections.

Table 12: Alternative 3 (Hybrid) Proposed Water Treatment Facilities

Satellite WTP Location	Supply Wells			Water Quality (2018 - 2020) [1]			Proposed Treatment
	Existing Wells	New Wells[2]	MGD[3]	Iron	Manganese	Nitrate	
Gravel Site	Well No. 6, 7, 9, 10, 11, 15, 16, and 17	Well No. 18, 19, & 22	18.8	Unknown water quality for Well No. 18, 19, and 22			Iron, Manganese, and Nitrate Removal[4]
Pump House 12	12, 13, 14	NONE	2.7	0.0-1.2	0.1-0.08	0.0-0.9	Iron & Manganese Removal
Pump House 20	20, 21	NONE	3.3	0.00	0.00	1.1-3.6	Nitrate Removal
Tank 8	NONE	Well No. 23 & 24	3.3	Unknown water quality.			Iron, Manganese, and Nitrate Removal[4]

[1] Ranges based on existing supply wells concentration from 2018-2020
[2] New well capacity assumed to be 1,200 gpm.
[3] Assumes all supply wells are running.
[4] Treatment technique should be reassessed after determining the new well's water quality.

6.3.2 NES Zone WTP (Gravel Site)

The proposed WTP will treat water supplied from all the SPU's NES zone wells (Well No. 6, 7, 9,10, 11, 15, 16, and 17) as well and three (3) new wells (Well No. 18, 19, and 22). If all the wells were running, the plant's capacity would need to be designed to treat 18.8 million gallons per day. A water quality analysis of water is difficult to determine, since not all the wells will be running at the same time and three (3) of the eleven (11) supply wells are new wells. To allow for changing water conditions and full operational control, the WTP should be designed to reduce the levels of iron, manganese, and nitrate.

A potential layout for an 18 MGD filtration and ion exchange WTP is shown in Appendix E.

6.3.2.1 Site Location

The WTP is proposed to be located on the gravel pit site (1650 Co Rd 83, Shakopee, MN), which is southwest of the intersection of Mystic Lake Dr and 17th Ave E. An extension of Philipp Ave will eventually run through the gravel site parallel to 17th Ave E. The proposed WTP should be located south of the future road to allow enough room for future development. If SPU decides that this location is not the most advantageous for the central WTP, a similar site between Pump House 15 and Mystic Lake Dr (Co Rd 83) should be selected due to the proximity to nearby wells. This would have to be worked out during the design phase of the project.

6.3.3 Pump House 12 Site

The proposed satellite treatment plant will be within the Pump House 12 site and will treat water supplied from Well No. 12, Well No. 13, and Well No. 14. As noted previously in the report, existing Well No. 14 is not operated frequently due to subpar water quality and will remain as a last resort emergency well that would require blending when operating. Due to the pumping capacity of Well No. 14, it may be more economical to decommission the well rather than pay for the upkeep.

If Well No. 12 and Well No. 13 were both running, the plant's capacity would need to be designed to treat 2.7 MGD (3.2 MGD with Well No. 14 running). A water quality analysis of water from Well 12 and Well 13 estimates that manganese could range from 0.01 mg/L to 0.08 mg/L, depending on which well is running, and expect iron and nitrate levels to be near zero. To achieve reduced levels of manganese, the proposed satellite WTP should be designed as an iron and manganese removal facility. These processes will also remove the high levels of iron from Well No. 14, if it was required to supply the WTP. A potential layout for a 3 MGD filtration WTP is shown in Appendix E.

6.3.4 Pump House 20 Site

The proposed satellite treatment plant will be within the Pump House 20 site and will treat water supplied from Well No. 20 and Well No. 21. If both wells were running, the plant's capacity would need to be designed to treat 3.3 million gallons per day. A water quality analysis of water from Well No. 20 and Well No. 21 estimates that nitrate could range from 1.1 mg/L to 3.6 mg/L, depending on which well is running, and expect iron and manganese levels to be near zero. To achieve reduced levels of nitrate, the proposed satellite WTP should be designed as a nitrate removal facility.

Due to the size of the site, additional land will likely need to be acquired to the west of Pump House 20. SPU indicated that there is a possibility to convert some of the parking lot to the west to incorporate the water treatment facility. This would have to be worked out during the design phase of the project. A potential layout for a 3.0 MGD ion exchange WTP is shown in Appendix E.

6.3.5 Tank 8 Site

The proposed satellite treatment plant will be at the new Tank 8 site on the west side of town. The proposed WTP will be supplied by two (2) new wells (Well No. 23 and Well No. 24). It is anticipated that the capacity would need to be designed to treat 3.0 million gallon per day. Since there hasn't been a water quality analysis done at the proposed site, it should be assumed that the WTP should be designed to treat for iron, manganese, and nitrates. To achieve reduced levels of iron, manganese, and nitrates, the proposed satellite WTP should be designed as an iron and manganese, and nitrate removal facility. A potential layout for a 3 MGD filtration and ion exchange WTP is shown in Appendix E.

6.3.6 Supply Wells Improvements

As discussed above, it can be expected that future project demands will cause SPU to see supply deficiencies. Thus, this alternative suggests adding five (5) new wells to satisfy water demands across the entire system and decommissioning five (5) of SPU's existing wells. SPU has identified multiple potential well sites which could all be feasible site options to increase supply to meet future demands. The proposed new wells for the Alternative 3 (Hybrid) will be Well No. 18, Well No. 19, Well No. 22, Well No. 23, and Well No. 24.

6.3.6.1 Well No. 18 & Well No. 19

With anticipation of demand increases in the future, SPU planned ahead and constructed watermain to two (2) potential well sites that would feed Pump House 15 (Well No. 18 & Well No. 19). Well No. 18 and Well No.19 have potential sites located in the vicinity of the Shakopee Soccer Association soccer fields. Since the piping is already in place, the wells could either feed directly to the proposed WTP or feed to Pump House 15, where it will then be conveyed to the WTP.

6.3.6.2 Well No. 22

SPU currently owns a portion of property near the Church Addition Development. As proposed in the 2019 Water System Plan Update, this site would be utilized for the Church Addition Booster Station and Flow Control Valve. Centrally located, this well site could provide and economic location for a new well that would have a short watermain expenses to feed to the WTP.

6.3.6.3 Tank 8 Site (Well No. 23 & Well No. 24)

In order to satisfy future demands in the 2HES zone (west) and to not rely solely on a booster station, additional capacity may be needed on the west side of Shakopee. For the Alternative 3 Hybrid), it is proposed that Well No. 23 and Well No. 24 be constructed to supply this area. The proposed location of the wells would be on the same site as new Tank 8 in the 2HES zone (west) and would work in conjunction with Tank 8. 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, as well as the proposed WTP, would allow for shorter watermains to be constructed.

6.3.6.4 Decommission Wells

As part of this Alternative 3 (Hybrid) Treatment, it is proposed that Well No. 2, Well No. 3, Well No. 8, Well No. 4 and Well No. 5, which accounts for 3,800 gpm (5.5 MGD) of the system's capacity. To make up for this capacity, two (2) of the additional five (5) wells will satisfy the lost capacity. If SPU decides to treat Well No. 4 and Well No. 5, or Well No. 2 and Well No. 8, then Well No. 19 could be ignored as a new source of supply.

6.3.6.5 Watermain Additions

Under this alternative, a series raw water and finished water distribution mains must be constructed to deliver adequate flows to and from the NES Zone WTP. These watermains were modeled to accurately determine the size for the anticipated flows from the 2040 demands. Although the local knowledge of development patterns was utilized in the preparation of the watermain conceptual plan, the actual 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. The following watermain additions are included in the Alternative 3 (Hybrid) conceptual plan:

Raw Watermain

- 12" DIP – 3,250 feet
- 16" DIP – 3,250 feet
- 18" DIP – 5,500 feet
- 24" DIP – 4,250 feet

Finished Watermain

- 12" DIP – 4,250 feet
- 16" DIP – 5,000 feet
- 18" DIP – 750

6.3.7 Construction Cost

The following table (Table 13) is the estimated probable cost to implement this alternative. The cost estimate only includes the work needed to implement systemwide treatment based on the described alternative above and does not include land acquisition costs and work that is already part of the SPU's existing Capital Improvement Plan (CIP). The estimated total cost to implement Alternative 3 (Hybrid) is $76,516,313 for pressure WTPs and $85,291,313 for gravity WTPs.

Table 13: Alternative 3 (Hybrid) Cost Estimate

Item	Cost	
New Wells	$5,000,000	
Decommissioning Wells	$50,000	
Raw Watermain	$6,427,500	
Finished Watermain	$3,801,250	
Treatment	**Pressure**	**Gravity**
Iron & Manganese Removal	$28,000,000	$34,500,000
Nitrate Removal	$13,400,000	$13,400,000
Lime Softening	-	-
Construction Subtotal	**$56,678,750**	**$63,178,750**
Contingency (15%)	$8,501,813	$9,476,813
Construction Total	**$65,180,563**	**$72,655,563**
Engineering & Admin (20%)	$11,335,750	$12,635,750
Total Probable Cost	**$76,516,313**	**$85,291,313**

NOTE: Probable cost does not include any land acquisition that may be required.

6.3.8 Operations and Maintenance Costs

The following table (Table 14) is the estimated operations and maintenance cost associated with Alternative 3 (Hybrid).

Table 14: Alternative 3 (Hybrid) Annual Operation, Maintenance, & Replacement Costs

Item	Annual Cost	
	Pressure	Gravity
Annual Equipment Replacement	$1,093,235	$842,841
Labor	$390,000	$390,000
Gas	$30,667	$30,667
Chemicals	$733,480	$733,480
Insurance	$50,000	$60,000
Electricity	$472,763	$588,516
Equip. Repair	$118,109	$102,407
Total Annual O&M Cost	**$2,888,255**	**$2,747,911**

NOTE: Does not include existing utility annual costs.

7 Alternative Evaluation and Recommendation

With all the water being supplied by SPU meeting all legally enforceable drinking water standards, SPU is not required to provide additional treatment other than their existing fluoridation and disinfection. However, due to SPU's dedication and commitment to public health and their desire to provide abundant high-quality water to their customers, SPU completed this water treatment feasibility study to actively plan for any water quality or regulatory issues that they may face in the future. The study examined the quality of SPU's municipal water, analyzed current operating practices, evaluated supply and municipal treatment options, and recommended viable solutions to increase the quality of water being supplied to the consumers.

For this study, three (3) treatment systemwide alternatives were evaluated. Each treatment alternative took into consideration the existing and planned infrastructure, water quality of each well, and economical impacts to the customer base. The goal was to generate a template for the necessary upgrades to the existing and future system to provide treatment that would greatly reduce iron, manganese, nitrate and provide equally treated water to all of SPU's customers that excels beyond their already great quality water.

7.1 Alternative Evaluation

The study laid out three (3) alternatives to supply SPU's customers with treated water, based on the water quality analysis of the source water. Alternative 1 (Satellite) looked at point source treatment at individual wells with satellite WTPs, Alternative 2 (Central) laid out an approach to conveying all supply water to one centralized treatment facility, and Alternative 3 (Hybrid) combined both approaches with a combination of centralized and satellite WTPs.

Feasibility level opinions of probable cost (OPC) broken down by construction category were prepared above for the gravity and pressure filtration alternatives. A breakdown of each of the alternative's capital costs are included in Table 15. It can be seen that the construction cost of treatment for Alternative 2 (Central) and Alternative 3 (Hybrid) is lower than the construction cost of treatment for Alternative 1 (Satellite). This is due to the economy of scale, which is a proportionate saving in costs gained by an increased scale of construction. However, Alternative 2 (Central) and Alternative 3 (Hybrid) make up for the difference in construction costs by requiring more watermain construction costs. See the full alternatives cost analysis breakdown in Appendix F.

Table 15: Comparison of Estimate of Probable Cost

Item	Alternative 1 - Satellite		Alternative 2 - Central			Alternative 3 - Hybrid	
	Pressure	Gravity	Pressure	Gravity	Gravity Lime Softening	Pressure	Gravity
Iron & Manganese Removal	$26,000,000	$30,500,000	$27,000,000	$32,000,000	$32,000,000	$28,000,000	$34,500,000
Nitrate Removal	$19,600,000	$19,600,000	$9,450,000	$9,450,000	$9,450,000	$13,400,000	$13,400,000
Lime Softening	-	-	-		$25,000,000	-	-
Treatment Subtotal	**$45,600,000**	**$50,100,000**	**$36,450,000**	**$41,450,000**	**$66,450,000**	**$41,400,000**	**$47,900,000**
New Wells	$6,000,000		$4,000,000			$5,000,000	
Decommission Wells	$50,000		$30,000			$50,000	
Raw watermain	$435,000		$20,700,000			$6,427,500	
Finished Watermain	-		$14,621,250			$3,900,000	
Construction Subtotal	**$52,085,000**	**$56,585,000**	**$72,327,500**	**$77,327,500**	**$102,327,500**	**$56,678,750**	**$63,178,750**
Contingency (15%)	$7,812,750	$8,487,750	$10,849,125	$11,599,125	$15,349,125	$8,501,813	$9,476,813
Construction Total	**$59,897,750**	**$65,072,750**	**$83,176,625**	**$88,926,625**	**$117,676,625**	**$65,180,563**	**$72,655,563**
Engineering & Admin (20%)	$10,417,000	$11,317,000	$14,465,500	$15,465,500	$20,465,500	$11,335,750	$12,635,750
Total Probable Cost	**$70,314,750**	**$76,389,750**	**$97,642,125**	**$104,392,125**	**$138,142,125**	**$76,516,313**	**$85,291,313**

In all three (3) of the alternatives, the capital cost of the pressure filter treatment plant is slightly less than the gravity filter treatment plant. However, Table 16 identifies that the annual cost of the pressure filter treatment plant is more than the gravity filter treatment plant. The pressure filter treatment plant has a higher life cycle cost due to the expense of painting and maintaining the steel filters; whereas concrete gravity filters require very little maintenance. See the full alternatives operations and maintenance analysis breakdown in Appendix F.

Table 16: Annual Costs Alternatives Analysis

Alternative	Type	Annual Operation and Maintenance Cost
Alternative 1 - Satellite	Pressure	$2,944,638
	Gravity	$2,795,477
Alternative 2 - Central	Pressure	$2,616,050
	Gravity	$2,484,245
	Gravity w/ Softening	$5,345,575
Alternative 3 - Hybrid	Pressure	$2,888,255
	Gravity	$2,747,911

In addition to having lower life cycle costs, gravity filters have other advantages over pressure filters including:

- Gravity filters provide for more treatment options including aeration and detention without requiring another pumping step. If regulations change or the water becomes contaminated, additional treatment steps can more easily be added to gravity filters.
- Water from the gravity filters does not go immediately into the distribution system. If problems with the filters occur or if sodium permanganate is overfed (causing pink water), operators have time to react and correct the problem.
- Gravity filters are open to view and access. This enhances the observation, operation and maintenance of the filter functions and components.
- Gravity filtration systems have a greater amount of flexibility with less disruption during normal maintenance procedures.
- Gravity filters could potentially be converted from groundwater to surface water in the future if it became necessary.

7.1.1 Effect on Water Rates

The Shakopee Public Utilities currently uses a two-tiered structure to charge their customers for water which is charged per 1,000 gallons used by the customer. After the first 5,000 gallons, the cost per 1,000 of water used gets progressively more expensive. In addition to the water usage charge, SPU charges their customers a $0.42 per 1,000 gallons reconstruction charge, and a fixed service charge depending on the size of their line. The reconstruction charge was implemented to create a Reconstruction Charge Fund, which would support any future supply and treatment needs that SPU would face in the future.

To predict the impact of the implementation of systemwide treatment on SPU's customers water charges, the annual operations & maintenance, as well as the annual loan repayment, must be calculated into the current water rate structure. According to SPU, the Reconstruction Charge Fund could supply approximately $20M for the proposed water treatment alternative. Assuming that the funds set aside would be applied to the capital construction cost of the project and the remaining costs would require a 20-year loan, SPU could expect to see annual payments of their loan between $2.5M and $5M ($7M with lime softening). Adding the additional operations and maintenance costs, SPU will require additional annual revenues between $5.5M and $7.5M ($12.5M for lime softening).

Table 17: Annual Costs Alternatives Analysis

Alternative	Type	Construction Cost	Total Probable Cost	Annual O&M	Construction Costs Annual Loan Repayment (20-yr @ 5%)		Additional Annual Revenue Needed (w/ $20M reserves applied)
					(no reserves applied)	($20M in reserves applied to capital)	
Alternative 1 - Satellite	Pressure	$52,085,000	$70,314,750	$2,944,638	$4,179,435	$2,574,583	$5,519,221
	Gravity	$56,585,000	$76,389,750	$2,795,477	$4,540,527	$2,935,675	$5,731,152
Alternative 2 - Central	Pressure	$72,327,500	$97,642,125	$2,616,050	$5,803,746	$4,198,894	$6,814,944
	Gravity	$77,327,500	$104,392,125	$2,484,245	$6,204,959	$4,600,107	$7,084,351
	Gravity w/ Softening	$102,327,500	$138,142,125	$5,345,575	$8,211,023	$6,606,172	$11,951,747
Alternative 3 - Hybrid	Pressure	$56,678,750	$76,516,313	$2,888,255	$4,548,050	$2,943,198	$5,831,452
	Gravity	$63,178,750	$85,291,313	$2,747,911	$5,069,626	$3,464,775	$6,212,686

7.2 Recommendation

Based on the results of this study, additional treatment beyond the current fluoride and chlorine additions is not warranted at this time. The water system is managed and operated to continually supply good drinking water quality that meets EPA's mandatory water quality standards for drinking water contaminants. SPU is proud of the fact that their drinking water is supplied directly from the naturally safe wells that provides high-quality water to their customers without extensive treatment. However, due to SPU's dedication and commitment to public health and their desire to provide abundant high-quality water to their customers, SPU completed this water treatment feasibility study to actively plan for any water quality or regulatory issues that they may face in the future. This report laid out three (3) possible alternatives to provide systemwide treatment and increase the quality of water being supplied to the consumers.

SPU designed their system to utilize their good quality water by distributing supply wells evenly throughout the pressure zones. If treatment was ever needed, SPU intended to implement treatment at the individual well sites. For that reason, it is recommended that SPU not pursue Alternative 2 (Central), unless municipal softening is planned to be implemented. The costs associated with watermain construction are too great to be economical. If SPU decides to pursue systemwide treatment, Alternative 1 (Satellite) and Alternative 3 (Hybrid) are both very viable solutions to systemwide treatment.

To address the potential of future treatment needs, the following recommendations are presented below:

1. Given that the annual operation and maintenance costs associated with Alternative 3 (Hybrid) are lower than Alternative 1 (Satellite), it is recommended that the configuration of Alternate 3 be followed. To that end, it is recommended that appropriate property acquisitions and pipeline installations be carried out to ensure that the water infrastructure is established should treatment ever become necessary.

2. Construct the water treatment facilities to be gravity treatment plants, due to the advantages this type of design offers at a comparable cost.

3. Purchase a site for the NES zone centralized treatment facility between Pump House 15 and Mystic Lake Dr (Co Rd 83), due to the proximity to other nearby wells.

4. Sample the groundwater of the proposed future wells at the Tank 8 site in the 2HES zone, prior to designing a satellite WTP.

5. Ensure that any currently planned watermain extensions match the Alternative 3 (Hybrid) proposed watermain system map supplied in Appendix D.

Appendix A

Water Quality Tables (2018-2020)

2018 Water Quality Summary

Parameter	Well No. 2	3	4	5	6	7	8	9	10	HBV	Secondary Standard	EPA MCL
Copper (mg/L)	< 0.005	NA	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005		1	1.3
Arsenic (µg/L)	< 1		< 0.5	< 0.5	< 1	< 0.5	< 1	< 2	1.81			10
Chloride (mg/L)	32		113	147	87.6	139	55.4	77	13.7		250	
Iron (mg/L)	< 0.015		< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.03	**0.422**		0.3	
Manganese (mg/L)	< 0.005		< 0.005	< 0.005	0.025	< 0.005	< 0.005	< 0.005	0.008	0.1	0.05	
Sulfate (mg/L)	19.3		11.8	15	10.5	10.4	13.8	21.1	6.9		250	
Alkalinity, Total (as CaCO3)	269		249	260	250	271	258	328	207			
Calcium (mg/L)	83.2		93.2	103	76.2	86.4	87.3	110	39.4			
Magnesium (mg/L)	33.6		32.3	35.4	31	34.7	35.5	46.8	15.8			
Sodium (mg/L)	13.1		39.3	46.4	35.2	63.6	19.2	20.8	32.1			
Zinc (mg/L)	< 0.01		< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	2	5	
Hardness, Total	346		366	403	318	359	364	467	163			

Parameter	Well No. 11	12	13	14	15	16	17	20	21	HBV	Secondary Standard	EPA MCL
Copper (mg/L)	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005		1	1.3
Arsenic (µg/L)	< 2	< 0.5	< 1	**25.3**	< 1	< 1	< 1	< 1	< 1			10
Chloride (mg/L)	32.8	16.3	23.5	< 3	32.5	48.6	44.3	32.8	34.7		250	
Iron (mg/L)	< 0.015	< 0.015	< 0.015	**1.2**	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015		0.3	
Manganese (mg/L)	< 0.005	**0.076**	0.013	0.041	0.036	< 0.005	0.037	< 0.005	< 0.005	0.1	0.05	
Sulfate (mg/L)	20	15.3	15.9	42.8	11.8	15.4	16	7.69	14.4		250	
Alkalinity, Total (as CaCO3)	336	315	315	280	274	292	294	230	283			
Calcium (mg/L)	100	81.5	86.5	87.4	82.9	93.4	91.3	70.2	88.9			
Magnesium (mg/L)	44	35.3	37.6	29.2	34.9	36.8	39.4	24.8	35			
Sodium (mg/L)	12.1	8.35	11.6	8.97	15.3	17.5	17.4	11.4	11			
Zinc (mg/L)	< 0.01	< 0.01	< 0.01	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	2	5	
Hardness, Total	431	349	371	338	351	385	390	277	366			

* EPA has set forth a lifetime health advisory value of 0.3 mg/L for manganese

2019 Water Quality Summary

Parameter	Well No.									HBV	Secondary Standard	EPA MCL
	2	3	4	5	6	7	8	9	10			
Copper (mg/L)	< 0.005	NA	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005		1	1.3
Arsenic (µg/L)	< 0.5	NA	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	1.95			10
Chloride (mg/L)	37.1	NA	155	72.7	76.3	124	48.2	63.6	12.1		250	
Iron (mg/L)	< 0.03	NA	< 0.015	< 0.015	< 0.03	< 0.015	< 0.03	< 0.015	**0.417**		0.3	
Manganese (mg/L)	< 0.005	NA	< 0.005	< 0.005	0.026	< 0.005	< 0.005	< 0.005	0.006	0.1	0.05	
Sulfate (mg/L)		NA									250	
Alkalinity, Total (as CaCO3)	266	NA	259	240	256	262	261	329	200			
Calcium (mg/L)	73.7	NA	83.4	105	73.8	85.4	76.8	97.9	42.8			
Magnesium (mg/L)	32.6	NA	29.6	34.7	32.6	36.6	34.4	43	16.8			
Sodium (mg/L)	14.7	NA	26.7	54	32.6	56.3	15.3	18.2	24.9			
Zinc (mg/L)	< 0.01	NA	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	2	5	
Hardness, Total	318	NA	330	405	319	364	333	422	176			
Radium 226/228 (pCi/L)		NA							**6.2**			5 (combined)
Radon 222 (pCi/L)		NA							280			300

Parameter	Well No.									HBV	Secondary Standard	EPA MCL
	11	12	13	14	15	16	17	20	21			
Copper (mg/L)	< 0.005	< 0.01	< 0.01	< 0.005	< 0.01	0.005	< 0.005	< 0.005	< 0.005		1	1.3
Arsenic (µg/L)	< 0.5	< 0.5	< 0.5	**18.4**	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5			10
Chloride (mg/L)	42.1	14	21.4	< 3	43.5	51.7	43	34.2	36.2		250	
Iron (mg/L)	< 0.015	< 0.015	< 0.015	**0.633**	< 0.015	< 0.015	< 0.03	< 0.03	< 0.03		0.3	
Manganese (mg/L)	< 0.005	**0.082**	0.01	0.032	**0.118**	< 0.005	0.036	< 0.005	< 0.005	0.1	0.05	
Sulfate (mg/L)											250	
Alkalinity, Total (as CaCO3)	338	323	329	289	279	299	295	214	259			
Calcium (mg/L)	95	83.3	85.6	78.6	82.2	95.4	82.9	62.7	73.6			
Magnesium (mg/L)	43.2	40	41.8	28.6	35.4	38.4	38.5	22.7	30			
Sodium (mg/L)	14.7	8.42	10.5	8.16	17.3	17.9	16	12.4	12.2			
Zinc (mg/L)	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	2	5	
Hardness, Total	415	373	386	314	351	396	366	250	307			
Radium 226/228 (pCi/L)				**7.2**								5 (combined)
Radon 222 (pCi/L)				274								300

* EPA has set forth a lifetime health advisory value of 0.3 mg/L for manganese

2020 Water Quality Summary

Parameter	Well No. 2	3	4	5	6	7	8	9	10	HBV	Secondary Standard	EPA MCL
Copper (mg/L)	< 0.005	0.017	< 0.01	< 0.01	< 0.005	< 0.01	< 0.005	< 0.01	0.046		1	1.3
Arsenic (µg/L)	< 0.5	2.21	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	4.8			10
Chloride (mg/L)	16.5	11	83	158	63.1	123	56.9	70.8	13.7		250	
Iron (mg/L)	< 0.015	**1.75**	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	**1.98**		0.3	
Manganese (mg/L)*	< 0.005	0.034	< 0.005	< 0.005	0.033	< 0.005	< 0.005	< 0.005	0.009	0.1	0.05	
Sulfate (mg/L)	14.7	13.1	8.8	11.2	9.8	13.3	10.4	18.2	9		250	
Alkalinity, Total (as $CaCO_3$)	271	267	243	261	256	270	250	337	205			
Calcium (mg/L)	77	62.3	80.6	102	76.7	89.4	78.9	104	46.4			
Magnesium (mg/L)	30.8	25.6	29.6	34.7	31	34.9	31.4	45.2	18.5			
Sodium (mg/L)	14.4	20.8	33.4	61.9	26.3	53.9	19.1	18.7	13.6			
Zinc (mg/L)	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	2	5	
Hardness, Total	319	261	323	398	319	367	326	446	192			

Parameter	Well No. 11	12	13	14	15	16	17	20	21	HBV	Secondary Standard	EPA MCL
Copper (mg/L)	< 0.005	< 0.01	< 0.005	< 0.005	< 0.01	0.005	< 0.005	< 0.01	< 0.005		1	1.3
Arsenic (µg/L)	< 0.5	< 0.5	< 0.5	**19.4**	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5			10
Chloride (mg/L)	41.7	18.3	24.3	< 3	44.6	46.4	51.4	34.6	35.9		250	
Iron (mg/L)	< 0.015	< 0.015	< 0.015	**0.776**	< 0.015	< 0.015	< 0.03	< 0.015	< 0.015		0.3	
Manganese (mg/L)*	< 0.005	**0.074**	0.006	0.036	**0.084**	< 0.005	0.029	< 0.005	< 0.005	0.1	0.05	
Sulfate (mg/L)	17.4	15	17.6	62.7	11.2	14	14.9	5.1	< 5		250	
Alkalinity, Total (as $CaCO_3$)	337	326	334	287	286	305	303	231	242			
Calcium (mg/L)	99.8	87.3	86.7	81.2	88.5	89.7	92.7	72.3	72.5			
Magnesium (mg/L)	45.3	37.7	38.6	28.5	34	34.6	36.1	24.2	26.7			
Sodium (mg/L)	15.1	8.92	10.3	8.27	16.8	15.7	16.6	12.5	12.9			
Zinc (mg/L)	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	2	5	
Hardness, Total	436	373	375	320	361	366	380	280	291			

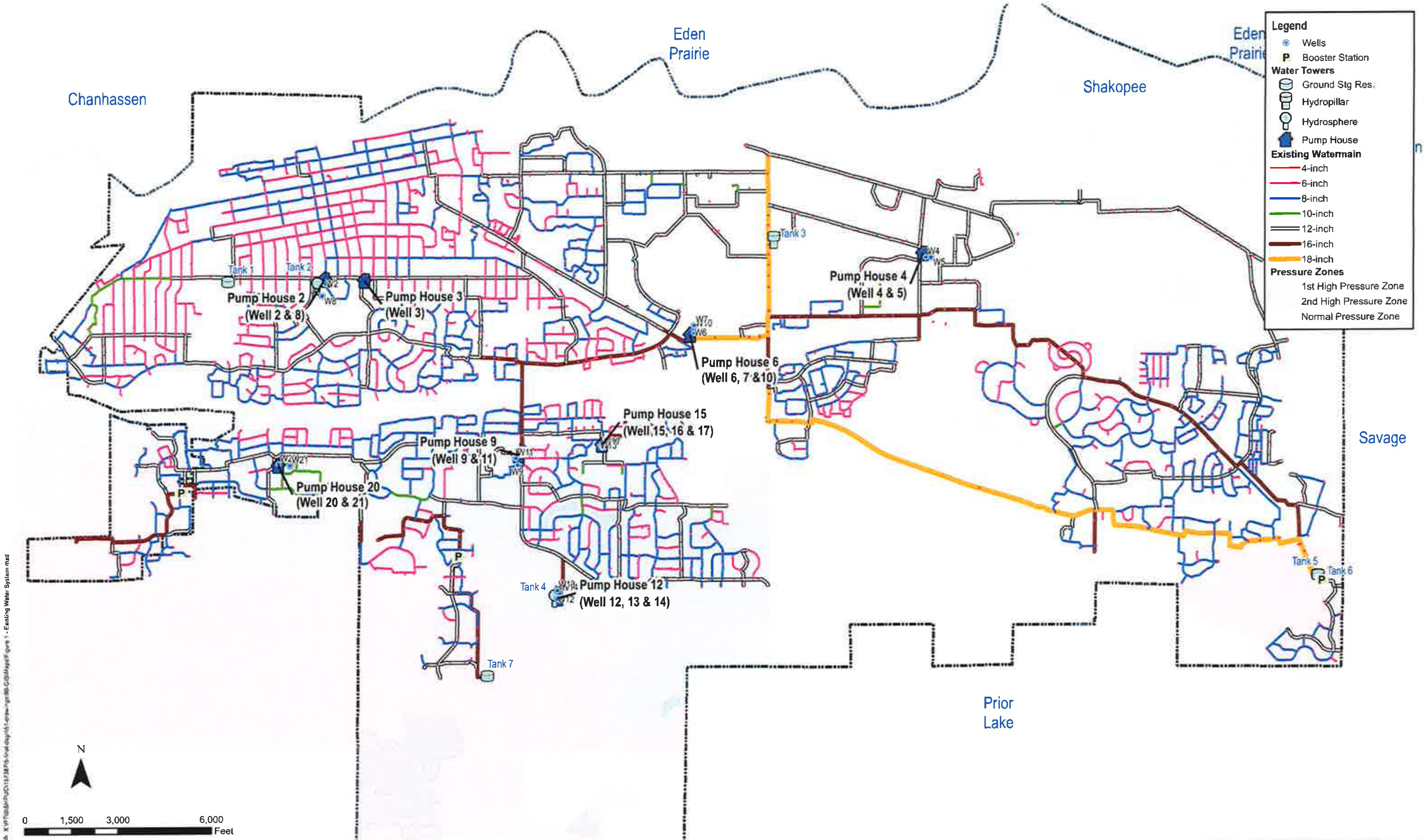
* EPA has set forth a lifetime health advisory value of 0.3 mg/L for manganese

Nitrate Water Quality Summary (2018-2020)

Well No.	2018 Nitrate Conc. (mg/L)			2019 Nitrate Conc. (mg/L)			2020 Nitrate Conc. (mg/L)			HBV (mg/L)	EPA MCL (mg/L)
	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.		
2	2.20	3.68	6.32	2.52	3.78	5.50	2.36	4.10	5.18	10	10
4	2.40	4.28	5.50	3.11	4.16	6.50	3.10	4.07	6.69		
5	5.70	6.96	7.88	6.10	6.67	7.42	5.50	6.11	6.69		
6	4.30	4.75	5.10	4.48	4.98	5.40	5.13	5.44	5.60		
7	4.30	4.60	4.90	4.10	4.55	4.80	4.84	5.05	5.30		
8	4.89	5.67	6.08	5.08	5.35	5.60	4.62	4.96	5.25		
9	1.87	3.75	4.45	2.23	3.10	3.68	2.99	3.40	4.07		
10	N/D			< 0.05			N/D				
11	2.25	2.58	2.95	2.31	2.73	3.07	2.40	2.63	2.86		
12	0.58	0.60	0.62	0.53	0.65	0.74	0.62	0.67	0.73		
13	1.08	1.16	1.28	0.95	0.99	1.01	0.98	1.06	1.11		
14	< 0.05			N/D			N/D				
15	4.04	4.95	5.54	4.70	4.96	5.11	2.82	4.81	5.54		
16	4.60	5.25	6.76	3.99	4.54	6.50	3.73	4.04	4.30		
17	5.00	6.10	7.12	4.77	5.56	6.56	4.92	5.72	6.30		
20	1.24	1.28	1.30	1.15	1.48	1.79	1.59	1.81	2.01		
21	2.13	3.25	3.60	0.33	2.04	2.82	2.04	2.22	2.38		
6, 7, & 10 Blended	2.59	3.15	3.68	2.96	3.32	3.89	3.26	4.33	5.52		
12, 13, & 14 Blended	0.67			0.78			0.86				

Appendix B

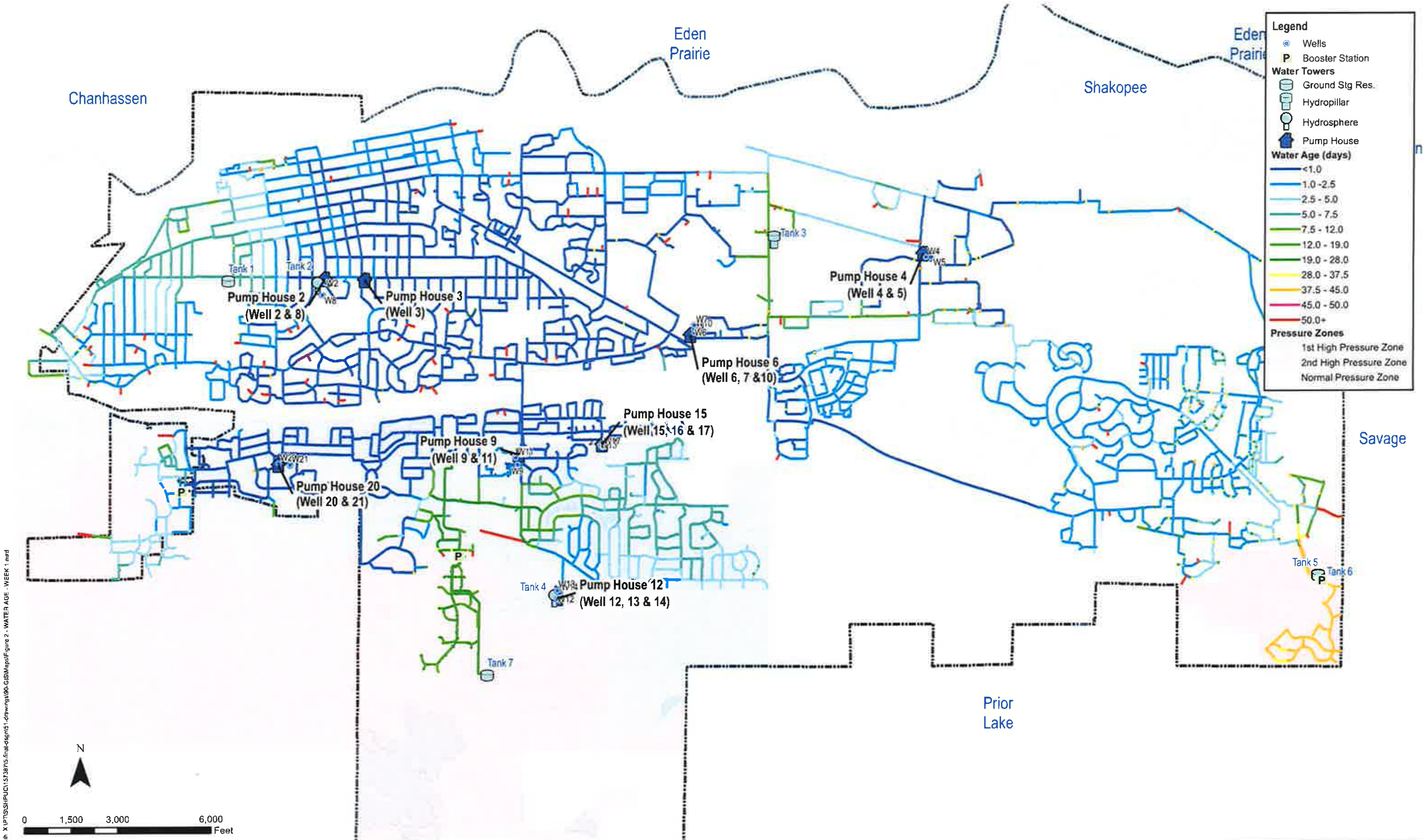
Water Modeling Maps



Project Number: SHPUC 157387
Print Date: Print Date: 1/27/2021
Map by:
Projection:
Source:

Existing Water System Map
Shakopee Public Utilities
Shakopee, Minnesota

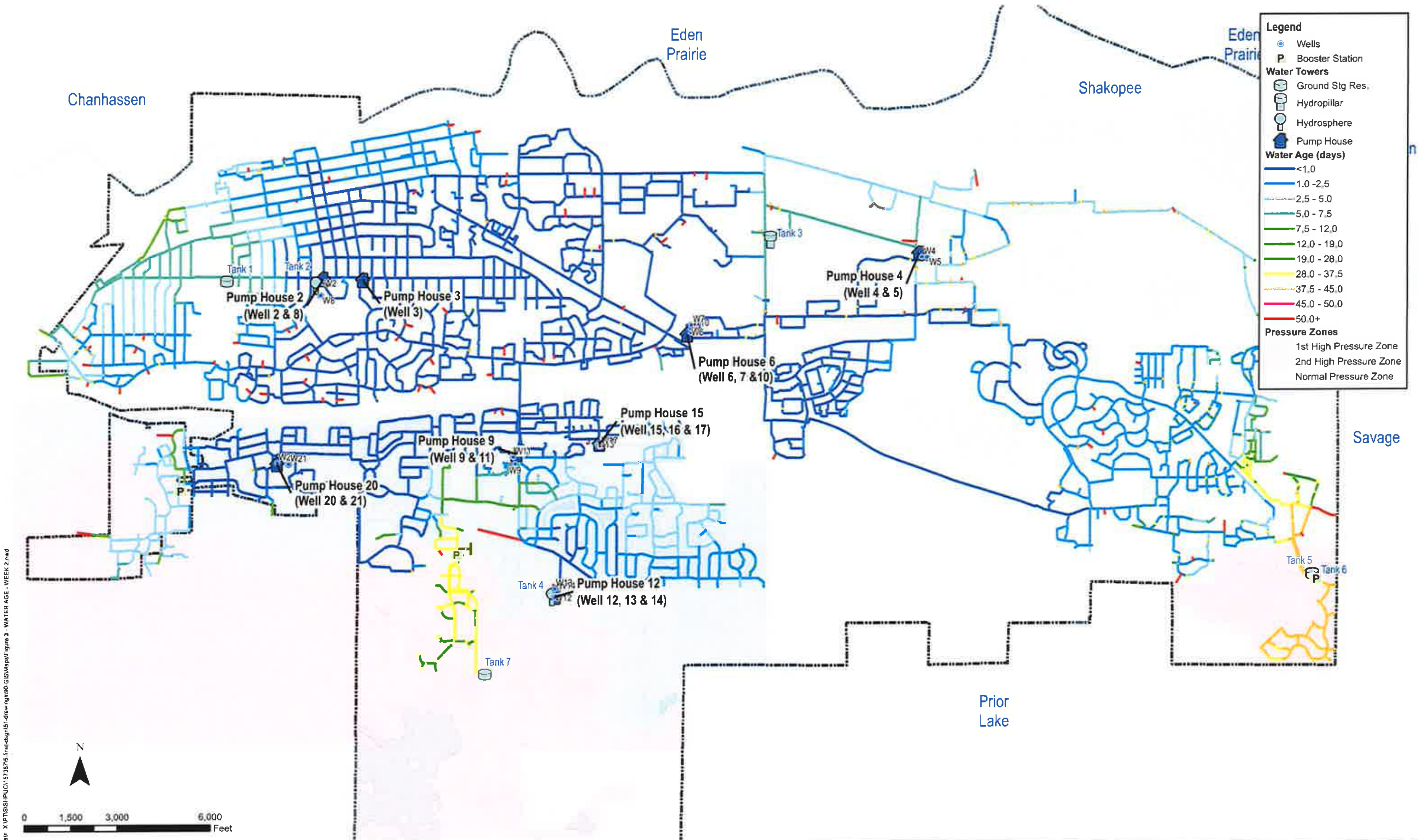
FIGURE 1
Existing Water System Map



Project Number: SHPUC 157387
Print Date: Pnnt Date: 1/27/2021
Map by:
Projection:
Source:

Water Age - Week 1 Well Steps
Shakopee Public Utilities
Shakopee, Minnesota

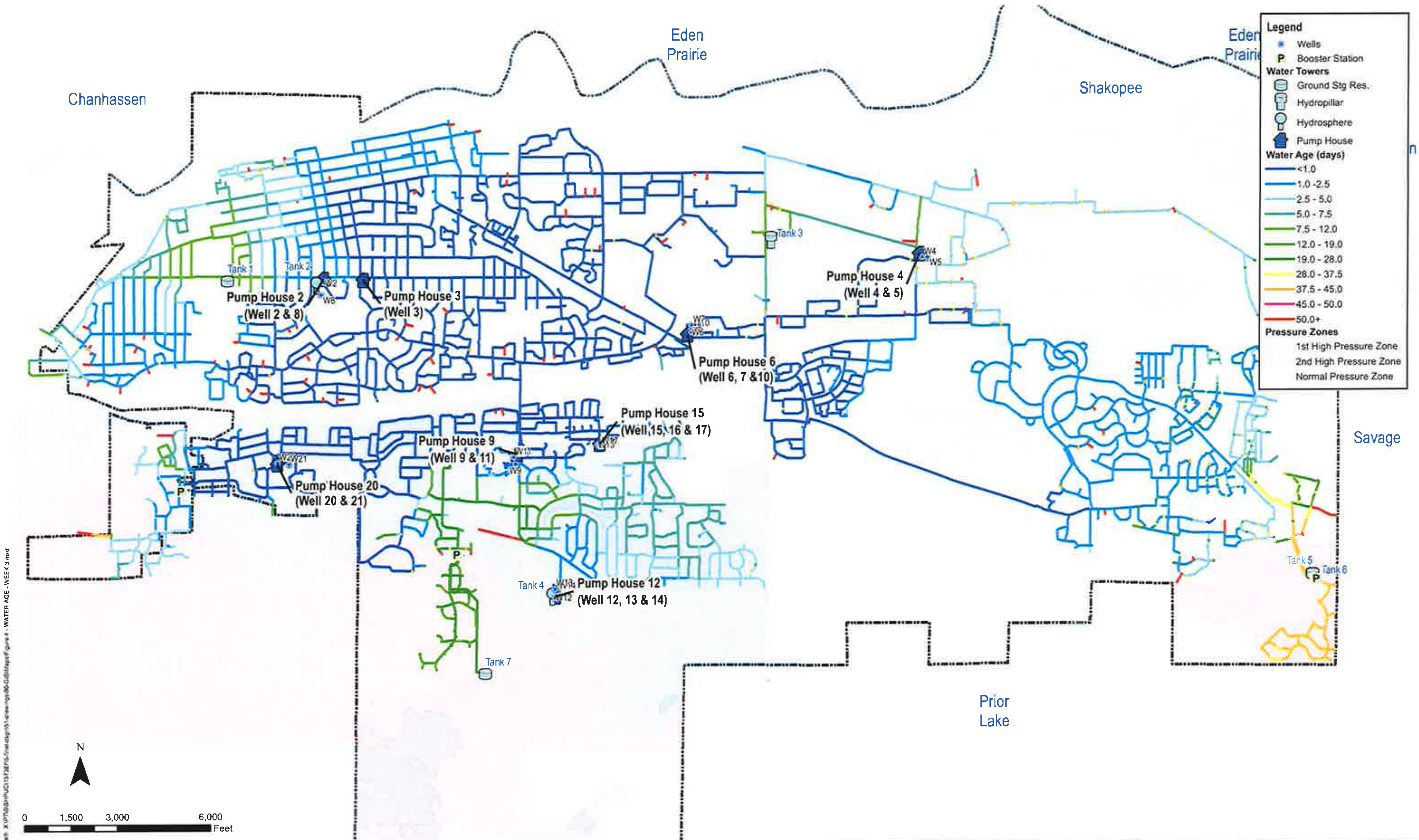
FIGURE 2
Existing Water System Map



Project Number: SHPUC 157387
Print Date: Print Date: 1/27/2021
Map by:
Projection:
Source:

Water Age - Week 2 Well Steps
Shakopee Public Utilities
Shakopee, Minnesota

FIGURE 3
Existing Water System Map

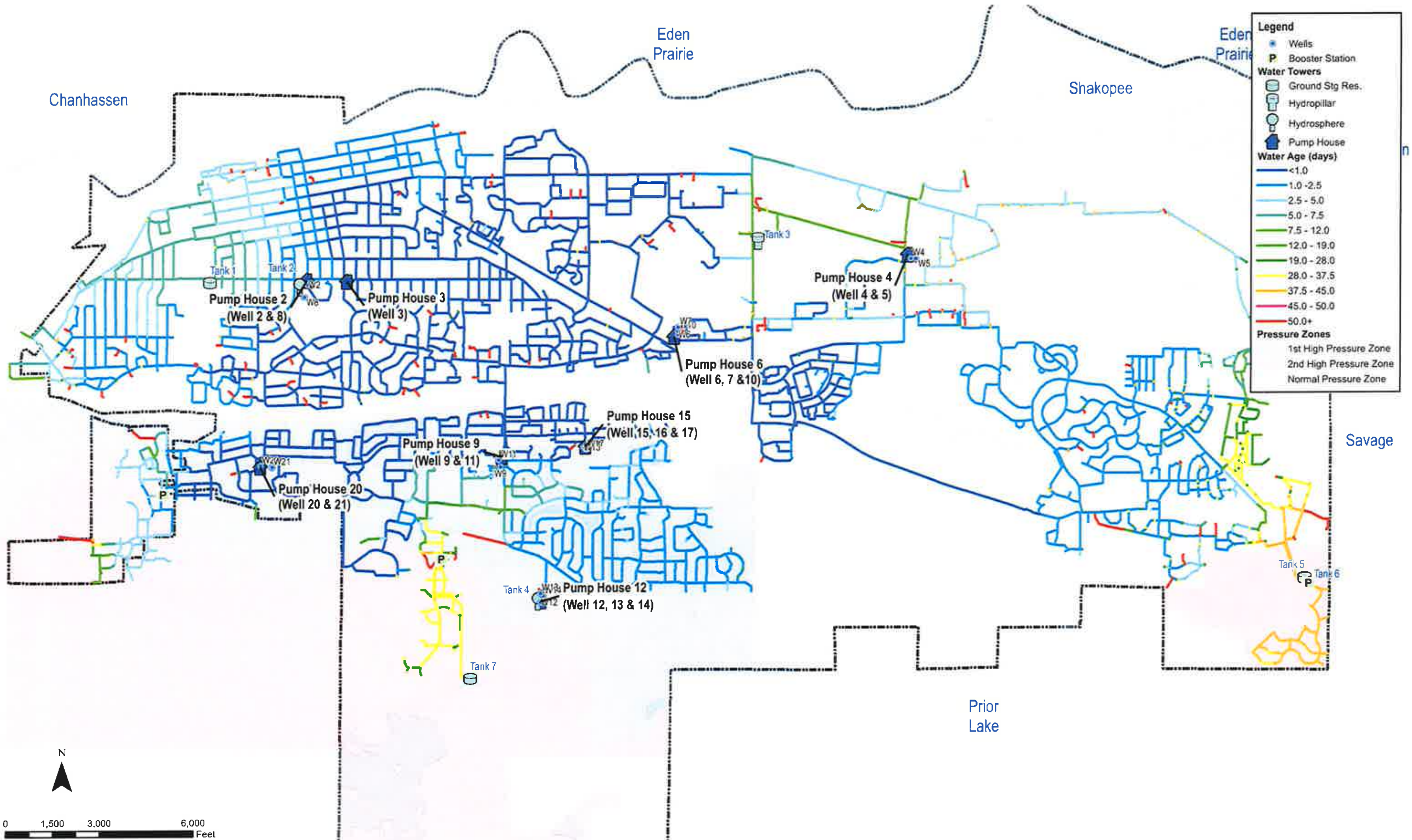


Project Number: SHPUC 157387
Print Date: Print Date: 1/28/2021

SEH

Water Age - Week 3 Well Steps
Shakopee Public Utilities
Shakopee, Minnesota

FIGURE 4
Existing Water System Map



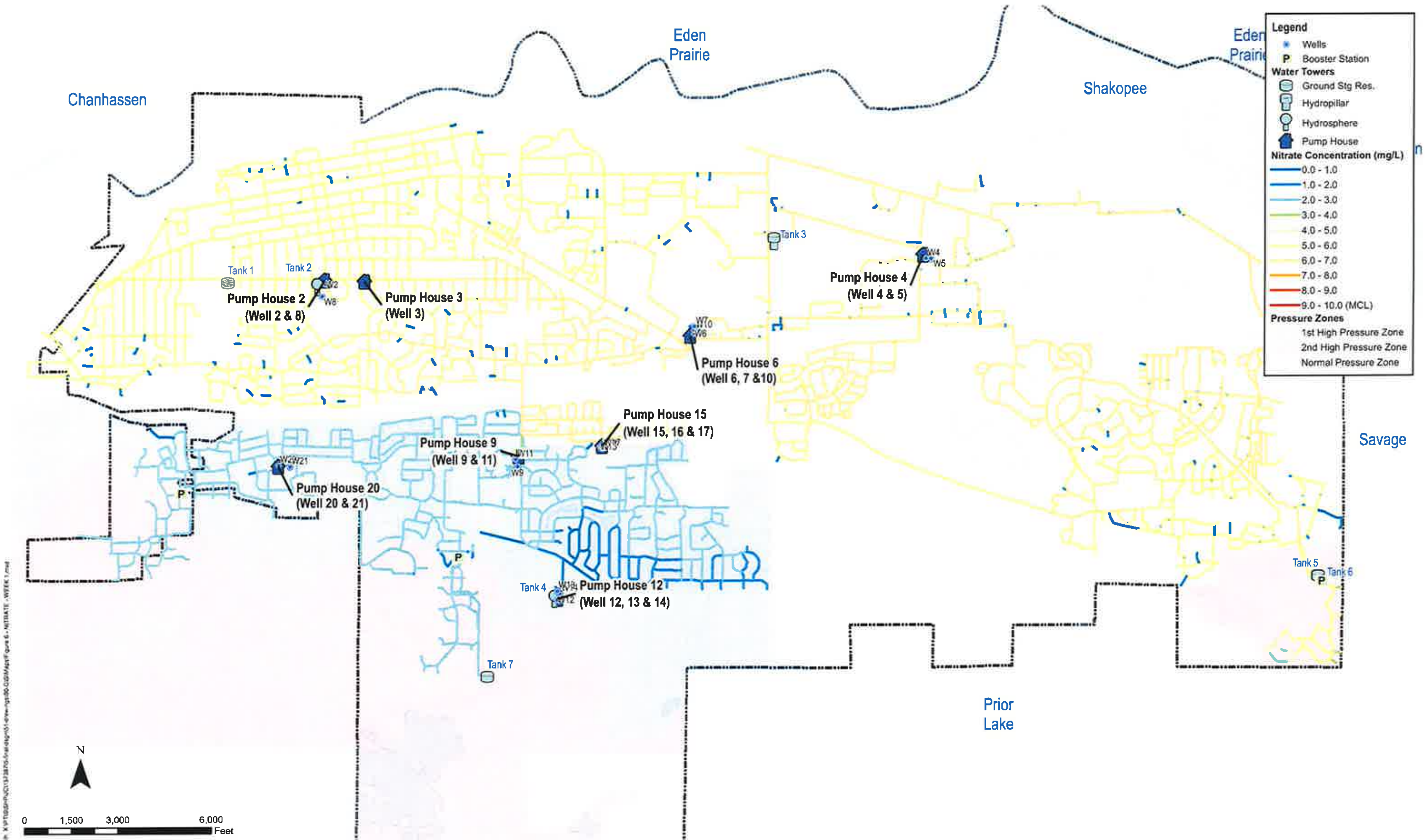
Project Number: SHPUC 157387
Print Date: Print Date: 1/27/2021

Map by:
Projection:
Source:

SEH

Water Age - Week 4 Well Steps
Shakopee Public Utilities
Shakopee, Minnesota

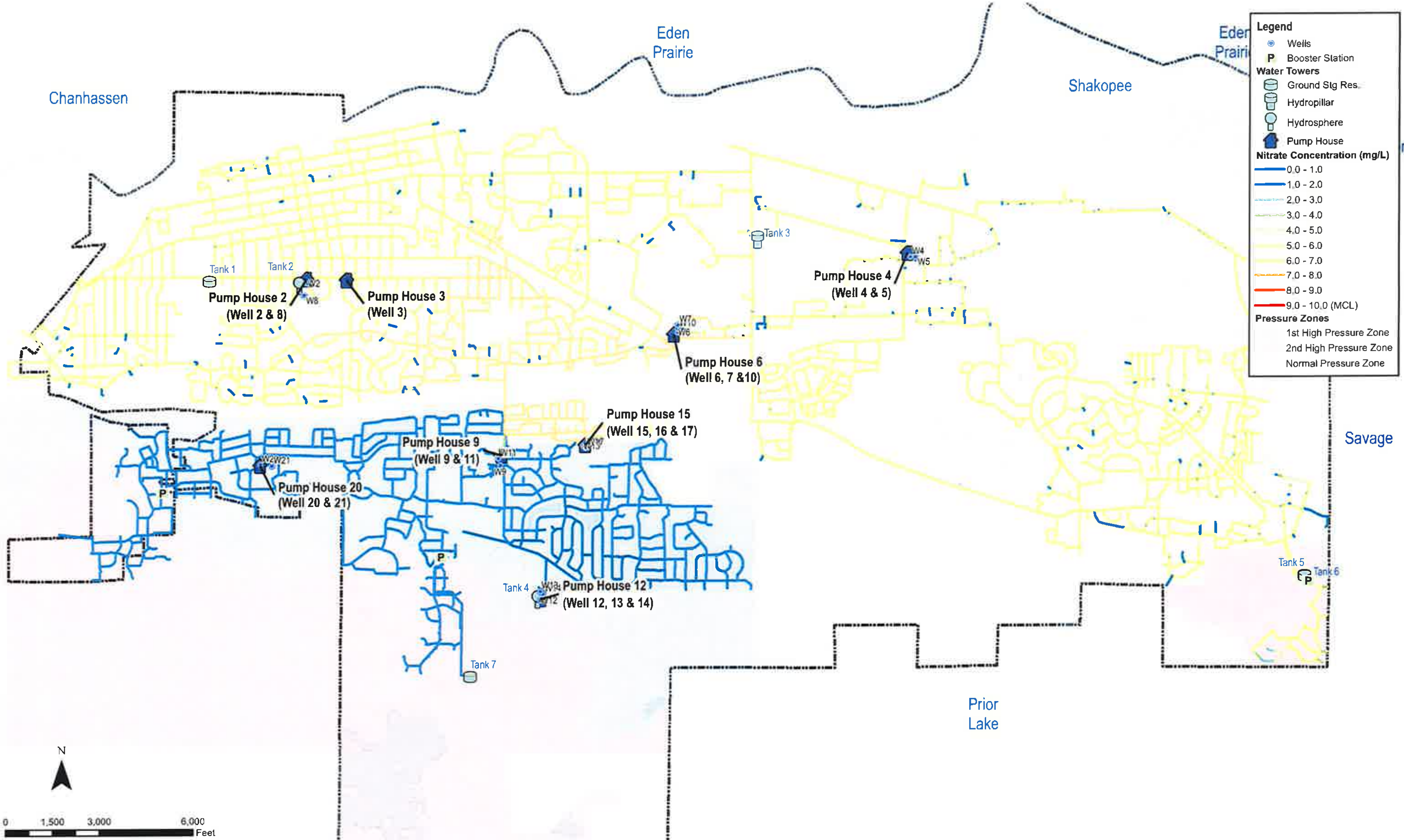
FIGURE 5
Existing Water System Map



Project Number: SHPUC 157387
Print Date: Print Date: 1/29/2021
Map by:
Projection:
Source:

Nitrate - Week 1 Well Steps
Shakopee Public Utilities
Shakopee, Minnesota

FIGURE 6
Existing Water System Map



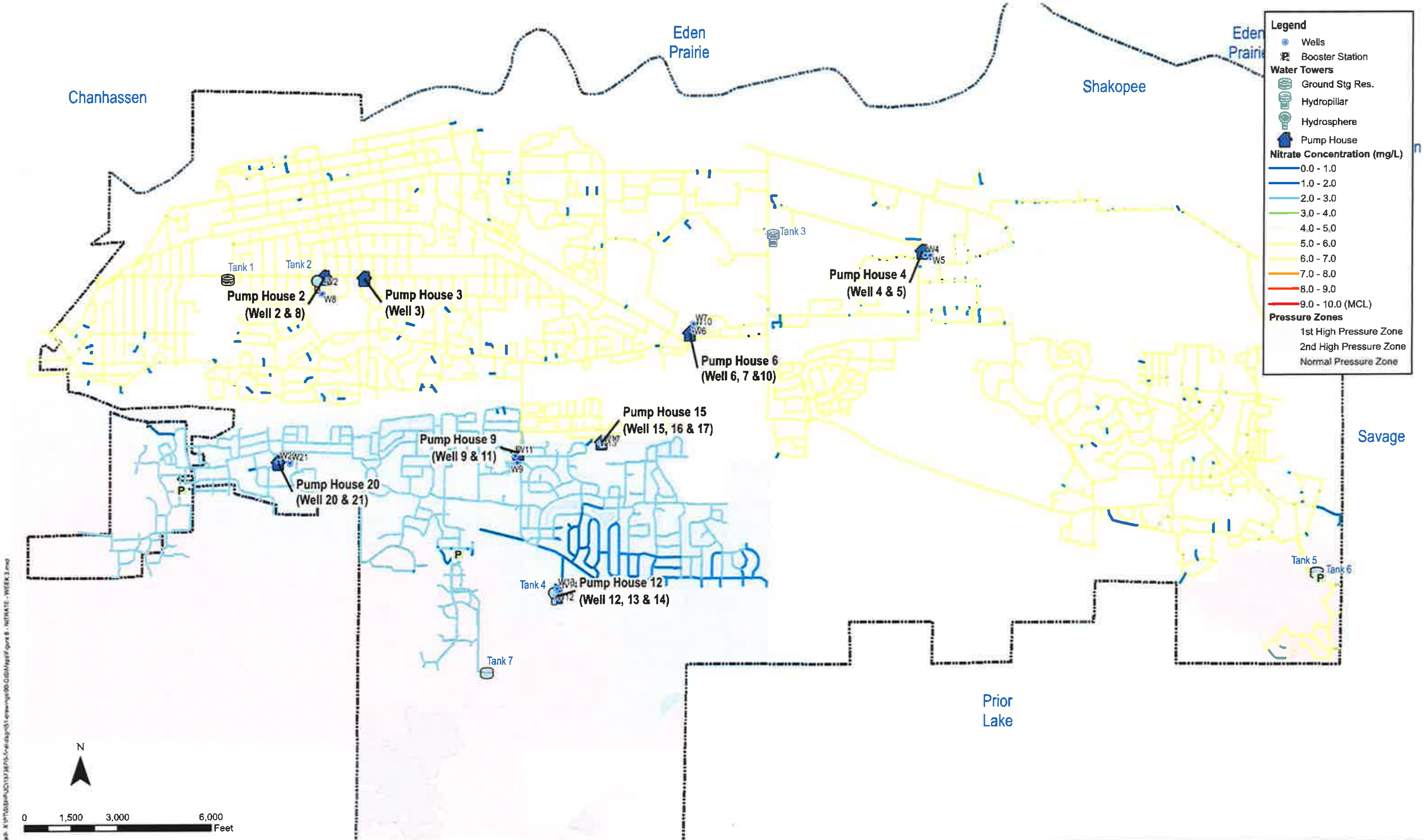
SEH

Project Number: SHPUC 157387
Print Date: Print Date: 1/29/2021

Map by:
Projection:
Source:

Nitrate - Week 2 Well Steps
Shakopee Public Utilities
Shakopee, Minnesota

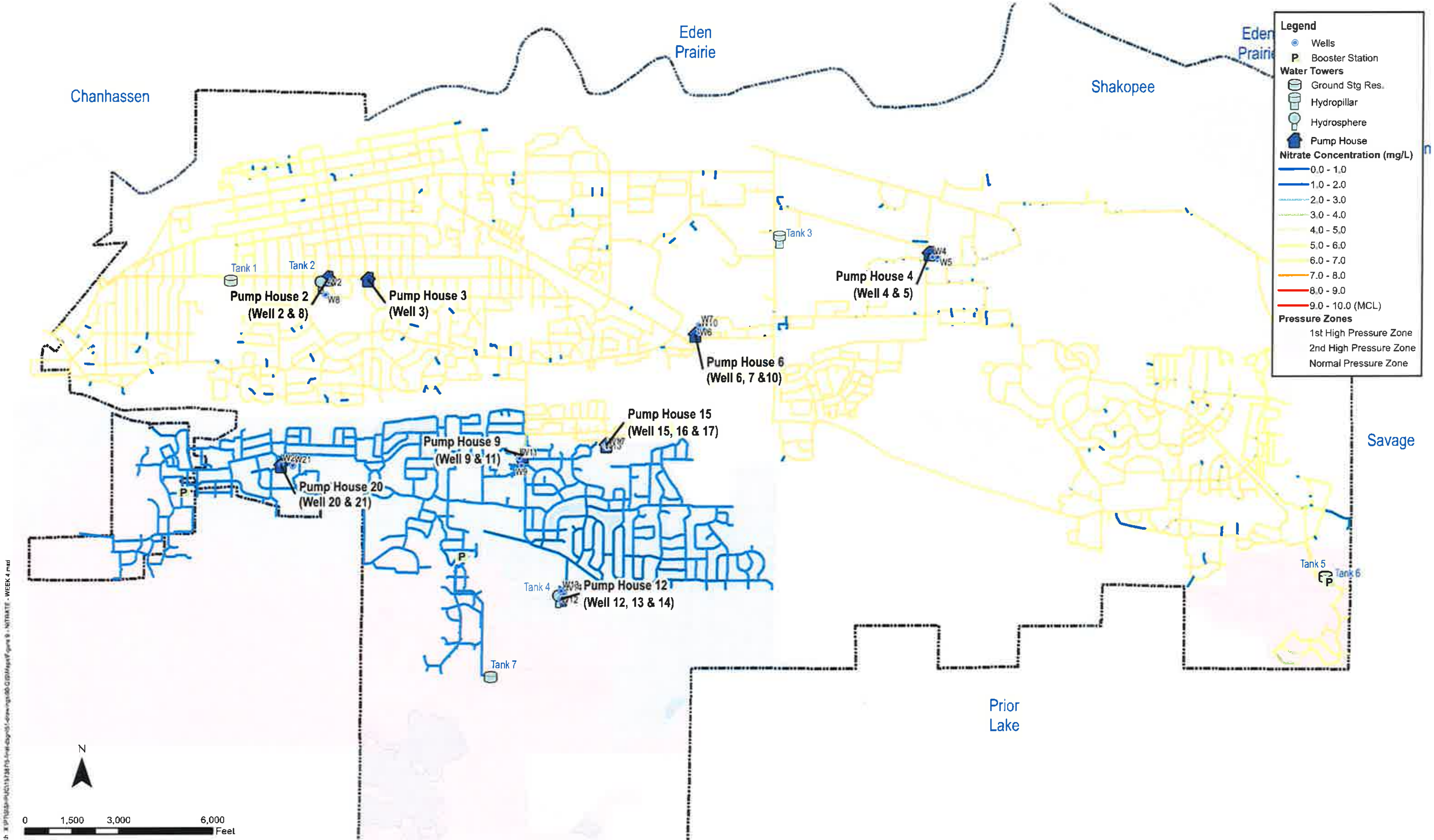
FIGURE 7
Existing Water System Map



Project Number: SHPUC 157367
Print Date: Print Date: 1/29/2021
Map by:
Projection:
Source:

Nitrate - Week 3 Well Steps
Shakopee Public Utilities
Shakopee, Minnesota

FIGURE 8
Existing Water System Map



Project Number: SHPUC 157387
Print Date: Print Date: 1/28/2021

Map by:
Projection:
Source:

SEH

Nitrate - Week 4 Well Steps

Shakopee Public Utilities
Shakopee, Minnesota

FIGURE 9
Existing Water System Map

Appendix C

Memorandum 3 – Water Quality Survey

Building a Better World for All of Us®

MEMORANDUM

TO: Lon Schemel

FROM: Miles Jensen

DATE: April 27, 2021

RE: Memorandum 3 - Water Quality Survey
SEH No. 157387 14.00

Dear Lon Schemel,

The following memorandum is submitted to satisfy the Memorandum No. 3 that was proposed for this project. This will be a steppingstone to start future conversations with Shakopee Public Utilities' (SPU) customer about the water quality and the potential for advanced treatment of the water their being provided.

Public Involvement

The public involvement process incorporates citizens and stakeholders in the early stages of the planning process and encourages their participation throughout a project's lifecycle. Collaborating with the public allows policy makers to foster a shared project vision and enjoy a higher level of acceptance among planners, citizens, and other project stakeholders. The planning process can come to life when the community emerges to share their voices. Now, we also recognize there is no single technique that works for all situations. This survey is the first step towards collaboration with SPU's customers about their water quality and the potential for advanced treatment.

Survey Overview

SEH worked with SPU to develop a series of questions to pose to SPU's customers, regarding their satisfaction with their water quality. The survey provides background information on SPU's current water quality, applicable regulatory standards, and health and age based issues. The questions were designed to gauge the customers interest and support for municipal treatment throughout SPU's system. The survey asked customers to weigh in on the following issues:

- Customers' perception of the current quality of water they receive
  - Concerns with taste and odor
  - Comfort with current manganese levels
  - Comfort with current nitrate levels
- Current cost of water service (water rates)
- Customers' interest, or willingness, to pay more for advanced water treatment
- Willingness to pay for municipally softened water

The survey was available online from February to March 2021 and the URL was provided through SPU's website, SPU's water bill (email and letter form), and through a SPU's Facebook post. From the time it was available, it was able to generate 312 complete survey responses and 140 partial responses. This is estimated to be about 2%-3% of the residential homeowners served by SPU (based on approximately 16,500 residential households served). See the attached survey and results in **APPENDIX A**.

When reviewing the survey results, it is important to consider that respondents may be more likely to complete an opinion survey if they have complaints than if they are fully satisfied. This survey yielded a balanced mix of comments that give a range of customer opinions and preferences. That being said, this survey should not speak for all of SPU's customers. Further discussions with customers will be required to get a better understanding of what the customer's want. This survey was not intended to make a decision, but to start the conversation of water quality and the potential for advanced treatment of the water they're being provided.

Shakopee Public Utilities Water Quality Survey Results

Water Quality Concerns

Participants were asked about their satisfaction with the quality of their water supplied by SPU. In general, it seems to be about a 50/50 split from the respondents on the satisfaction with their water.

Of the 396 responses:

- 79 (20%) are very satisfied with the quality their water
- 122 (31%) are mostly satisfied with the quality of their water
- 189 (48%) are not satisfied with the quality of their water

The following question asked participants had any concerns or issues with tastes and/or odors with your water in the past 5 years. Of the 51% of respondents from the previous question that we satisfied with the quality of their water, it appears that some of them have experienced some taste and odor issues over the last 5 years.

Of the 393 responses:

- 138 (35%) haven't had concerns or issues with taste/odor
- 126 (32%) have had concerns or issues with taste/odor on occasion
- 118 (30%) have had concerns or issues with taste/odor frequently

Between these two questions, respondents supplied optional comments to backup their answers. The following are some of the frequent comments supplied:

- Bad taste
- Very hard water
- Strong chlorine smell/taste
- Suspended particles
- Occasional staining on toilets

Using the addresses provided by respondents, SPU was able to put together a heat map of water quality satisfaction **(APPENDIX B)**. It can be seen that some grouping of respondents who are not satisfied with the quality of their water can be found throughout the distribution system, however most of the responses are intermixed. Some areas with dense grouping of negative responses that should be investigated further are as follows:

- Homes near 17th Ave E and Sarazin St
- Homes near 10th Ave E and Naumkeag St S
- Homes northeast of the Townline Ave and 17th Ave E intersection
- The Hamlet at Southbridge (Co Rd 21 & Co Rd 18)
- Blakewood Estates (Eagle Creek Blvd & Mystic Lake Dr)

Cost of Water
Supplied with the following table, participants were asked their opinion of the current cost of water.

Availability	USAGE CHARGE (per 1000 GALLONS)		RECONSTRUCTION CHARGE (per 1000 GALLONS)
RESIDENTIAL SERVICE	1 - 5000 GALLONS $2.49	PLUS	$0.42
	>5000 GALLONS $2.98		

Of the 391 respondents:

- 297 (76%) think that their current cost of water is appropriate
- 66 (17%) think that their current cost of water is higher than expected
- 28 (7%) think that their current cost of water is lower than expected

The following are some of the frequent comments supplied, regarding the current cost of water:

- How does the price of water compare to other cities without treatment?
- Price is high for untreated water
- Willingness to pay for better water

Manganese in SPU's Water
Participants were asked about their comfort level with the current manganese levels found in SPU's wells. In particular, this is a complex question. Manganese concentrations in finished water is not enforced by the Environmental Protection Agency (EPA), only recommendations for aesthetic guidelines have been made (0.05 mg/L). In addition to EPA's recommendations, Minnesota Department of Health (MDH) has also put forth non-enforced guidelines for manganese concentrations in finished water (0.1 mg/L for infants, 0.3 mg/L for general public). Although a vast majority of SPU's wells have tested below the EPA's guideline for aesthetic considerations (0.05 mg/L), a couple of the wells have tested at or slightly below MDH's guideline of 0.1 mg/L. In an attempt to communicate this information in the simplest way possible, the information in the following table was presented as part of the survey.

Year	Manganese Concentrations in SPU's Groundwater Wells[1]			EPA's Aesthetic Quality Guideline[3]	MDH's Health Quality Guideline[4]	
	Minimum (mg/L)	Average (mg/L)	Maximum (mg/L)		for Infants (<1 year)	for General Public (>1 year)
2018	<0.005	0.015	0.076	0.05	0.1	0.3[5]
2019	<0.005	0.021	**0.118[2]**			
2020	<0.005	0.018	0.084			

[1] Does not include two (2) wells that SPU considers as emergency wells and do not use.
[2] Only on one occasion in 2019 did a well exceed the MDH's health quality guideline (0.10 mg/L).
[3] The EPA's Secondary Max Contaminant Levels (SMCL) were developed to assist public water systems in managing their drinking water for aesthetic considerations, such as taste, color, and odor, and are not federally enforceable.
[4] The MDH's health based values (HBVs) were developed to better keep your household drinking water safe.
[5] EPA has set forth a lifetime health advisory value of 0.3 mg/L for manganese.

Of the 338 respondents:

- 101 (30%) are comfortable with the current manganese levels
- 43 (13%) are comfortable with the current manganese levels, but would be willing to pay more to reduce the levels further

- 130 (39%) are not comfortable with the current manganese levels and would be willing to pay more to reduce the levels further
- 57 (17%) answered "Neutral/I don't know", which may indicate that more information may need to be provided to make an educated answer.

Nitrate in SPU's Water

Participants were asked their comfort level with the current nitrate levels found in SPU's wells. Compared to manganese, this is a simpler question as the EPA has a regulated Maximum Contaminant Level (MCL) of 10 mg/L. This is an enforceable standard that is accepted by the MDH. The EPA and MDH considers any level of nitrate below 10 mg/L to have no known or expected risk to health of a consumer.

In the last 5 years, there hasn't been a case in any of SPU's wells with nitrate levels exceeding EPA's MCL of 10 mg/L, however, a few of the wells have seen values above 5.0 mg/L (maximum of 7.9 mg/L), which may indicate a degradation of ground water quality and requires monitoring to ensure nitrate concentrations do not increase to dangerous levels. In an attempt to communicate this information in the simplest way possible, the information in the following table was presented as part of the survey.

Year	Nitrate Concentrations in SPU's Groundwater Wells[1]			EPA's Maximum Contaminant Level[2][3]	MDH's Health Quality Standard[4]
	Minimum (mg/L)	Average (mg/L)	Maximum (mg/L)		
2018	0.6	3.7	7.9		
2019	0.3	3.5	7.4		
2020	0.6	3.5	6.7		

NOTE: Nitrate levels in all of SPU's wells have been naturally dropping over the past 20 years with decreasing agricultural land in the area.
[1] Does not contain two (2) wells that SPU considers as emergency wells and do not use.
[2] The EPA's Maximum Contaminant Level (MCL) is an enforceable maximum allowable amount of a contaminant in drinking water which is delivered to the consumer.
[3] The EPA's Maximum Contaminant Level Goal (MCLG) for nitrate is 10mg/L. The EPA considers any level of a contaminant below which has no known or expected risk to health of a consumer.
[4] The MDH's Health Risk Limit (HRL) is based off EPA's MCL.

Of the 333 respondents:

- 123 (37%) are comfortable with the current nitrate levels
- 149 (45%) are not comfortable with the current nitrate levels and would be willing to pay more to reduce the levels further
- 61 (18%) participants answered "Neutral/I don't know", which may indicate that more information may need to be provided to make an educated response.

Price to Treat SPU's Water

As a follow up to the questions regarding manganese and nitrate concentrations, participants were asked how much they would be willing to pay to receive treated water with reduced the levels of manganese and nitrate. A preliminary cost estimate for systemwide treatment determined that rate increases could easily triple (3x) the current cost of water to construct satellite water treatment facilities, and almost quadruple (4x) the current rates to construct a centralized treatment facility.

Of the 320 respondents:

- 101 (32%) are comfortable with their water quality and do not want to pay for treatment
- 47 (15%) are not comfortable with their water quality and would be willing to pay as much as triple (3x) their current rate
- 32 (10%) are not comfortable with their water quality and would pay whatever is necessary

- 99 (31%) are not comfortable with their water quality, but do not want to pay more
- 41 (13%) opted to supply a write-in answer, rather than one of the supplied answers

This question included many written-out comments. Below are some of the frequent comments supplied, regarding the rate increase to construct systemwide treatment:

- Wanting more information on how rates were calculated
- Wanting a comparison of other cities water quality and price of water
- Require demonstrated improvements to make an informed decision
- Willingness to pay more, but concerned with triple (3x) the cost being too high

Price to Soften SPU's Water

With the anticipation that many of SPU's customers struggle with hard water, participants were asked how much they would be willing to pay to receive municipally softened water. Much like the cost estimate to reduce manganese and nitrate, a preliminary cost estimate was put together to municipally soften SPU's water. The construction of a softening plant requires more capital costs than a conventional water treatment plant. That is why, the only economically feasible option to soften SPU's water would be a centralized treatment facility. The plant would require filtration for particulate and manganese removal, ion exchange (or other) for nitrate removal, and lime softening processes to soften the water. In addition to the treatment processes, a centralized facility would require many miles of water main to be constructed to bring all of SPU's wells to one central location. To pick up these costs, it is estimated that rate increases could easily require water to cost $13.00 per 1,000 gallons.

Of the 318 respondents:

- 114 (36%) are comfortable with their water hardness and do not want to pay for treatment
- 60 (19%) would be willing to pay up to $13 per 1,000 gallons
- 23 (7%) would pay whatever is necessary
- 91 (29%) are not comfortable with their water hardness, but do not want to pay more
- 30 (9%) opted to supply a write-in answer, rather than one of the supplied answers.

Below are some of the frequent comments supplied, regarding the rate increase for municipally softened water:

- Wanting more information on how rates were calculated
- Wanting a comparison of other cities water rates with softened water
- Concerns with the financial impact of low-income residents
- Require demonstrated improvements to make an informed decision
- Willingness to pay more, but concerned with $13 per 1,000 gallons being too high

Public Information Meeting

Based on the survey results, we recommend SPU host a public informational meeting to discuss the survey results and share more information on SPU's current water quality. SPU rarely gets calls and/or complaints regarding the quality of their water, so it is concerning the number of customers dealing with poor water quality or water quality concerns. An open house format would allow SPU to help customers get their questions answered and to work towards potential solutions to issues that face the water users. SEH can supply supplementary drawings and cost estimates to support conversations about the state of SPU's water treatment moving forward. Below are some of the recommended topics to cover, in response to concerns submitted through the survey:

- Comparison of other cities water quality and price of water
- Discussion regarding taste, odor, and/or particulate in customer's water
- Demonstrated improvements that would be required to provide system-wide treatment
- Rate increases and additional cost information to provide treated water

- Information on water softener maintenance
- Required processes to provide municipally softened water, costs, benefits, and downsides

Schedule

I. *Task 1 – Project Initiation & Data Collection (COMPLETED)*
   A. Memorandum No. 1 (Water Quality Assessment)

II. *Task 2 – Water Quality Model (COMPLETED)*
   A. Prepare Memorandum No. 2 (For February 1, 2021 Commission Meeting)

III. *Task 3 – Public Involvement (COMPLETED)*
   A. Public Involvement Process
      1. Water Quality Survey
   B. Prepare Memorandum No. 3
   C. Public Open House (TBD)

IV. *Task 4 – Preliminary Analysis (COMPLETED)*
   A. Water Treatment Plant layout design.
   B. Utility site locations.

V. *Task 5 – Conduct Technical Analysis (In Progress, Due May 12, 2021)*
   A. Review feasible facility layouts and major process element sizing.

VI. *Task 6 – Cost Estimates (In Progress, Due May 12, 2021)*
   A. Finalize cost estimates based on Technical Analysis
   B. Apply to rate increases

VII. *Task 7 - Feasibility Report (In Progress, Anticipated May 31 2021)*
   A. Incorporate customer feedback and previous Memorandums
   B. Submit draft feasibility report to SPU *(For May 17, 2021 Commission Meeting)*
   C. Hold Meeting with the SPU staff to review the draft Feasibility Report
   D. Update the Feasibility Report following input from SPU
   E. Transmit the Final Feasibility Report to SPU *(Anticipated May 31, 2021)*

Attachments

- Shakopee Public Utilities Water Quality Survey Results
- Water Survey Results Map

APPENDIX A

WATER QUALITY SURVEY
QUESTIONS & RESULTS

YOUR OPINION MATTERS

Shakopee Public Utilities Water Quality Survey

Dear SPU Customer,

Thank you for your interest in water quality and providing your feedback. Your response is very important to us.

Please fill out this survey and return to SPU in one of two ways:

- Place it in an envelope **labeled "Water Survey"** and put in the **24-hour drop box** at the SPU Service Center located at: 255 Sarazin Street, Shakopee, MN (*No postage necessary)*
- Add postage and mail to:

  SPU, Attn: Water Survey
  PO Box 540
  Shakopee, MN 55379

Thank you again for your participation.

SPU
Shakopee Public Utilities

Shakopee Public Utilities
Water Quality Survey

We are requesting your feedback to understand what is important to you, and what additional costs you would be willing to support to increase water quality above what we have already achieved. Please take a few minutes to put some thought into the following questions to help us understand what is important to you in your drinking water.

Water System Background

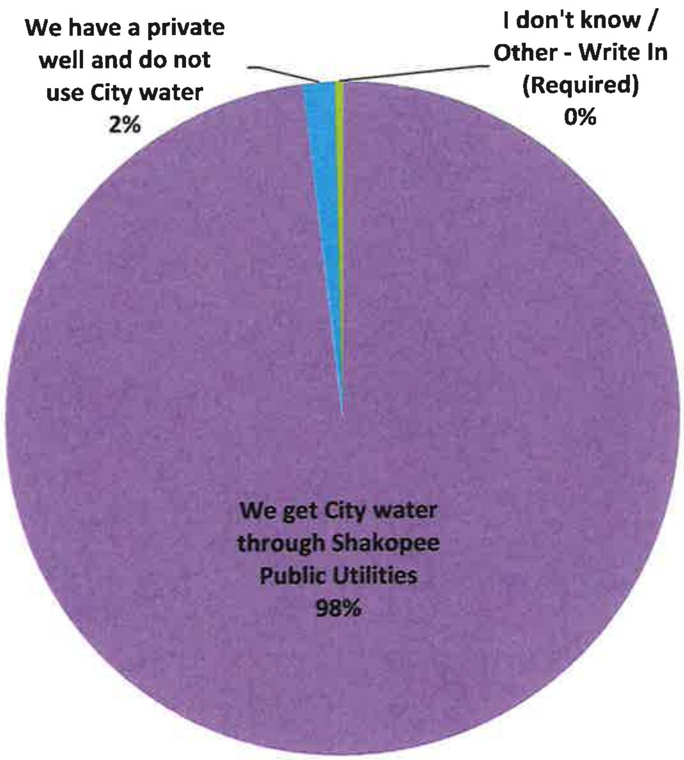
The Shakopee Public Utilities (SPU) supplies water and utilities to the City of Shakopee with water from eighteen (18) groundwater wells throughout the city. Throughout the year, SPU collects and tests the groundwater frequently in order to ensure that it meets or exceeds Environmental Protection Agency (EPA) standards for safety.

SPU is proud to share that our water has consistently tested below levels that would require any filtration. Your drinking water is supplied directly from the naturally clean wells where it is treated with the addition of chlorine for disinfection, and fluoride to prevent of tooth decay.

Nevertheless, because of SPU's commitment to public health and the provision of abundant high-quality water to its customer, SPU is engaged in a comprehensive evaluation of municipal water treatment alternatives.

General Questions

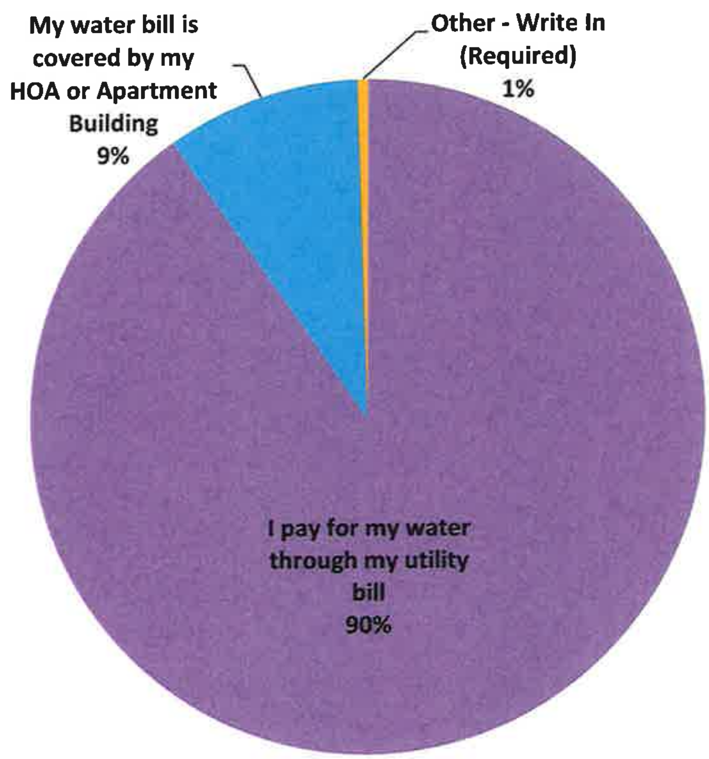
1) How do you get your water? (required)*



Comments:

- Not sure
- Cub Foods water

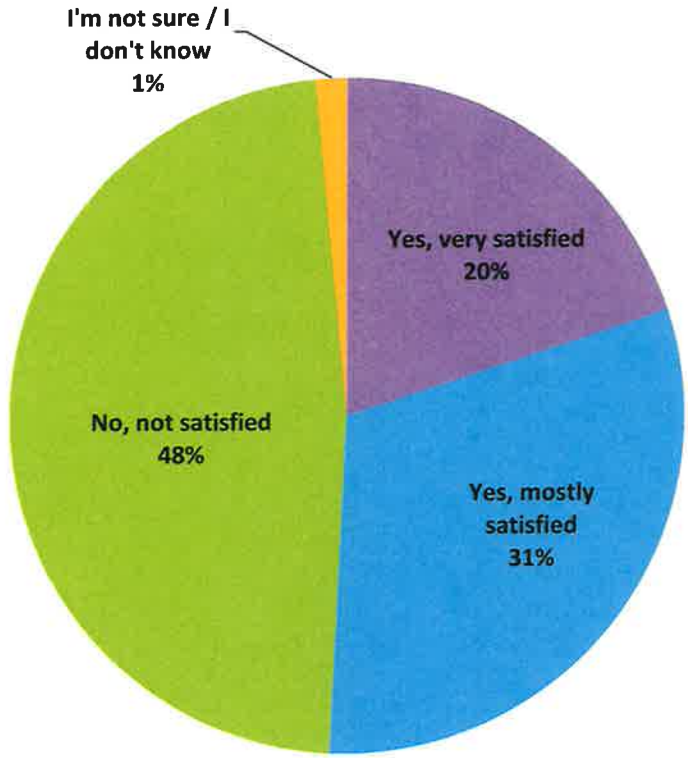
2) How do you pay for your water?



Comments:

- Our townhome charges us 20.00 a month for water

3) Are you satisfied with the quality of your water today?



Comments:

- Too many minerals in the water, bad taste
- While very hard, the water is otherwise great for city water. I use a water softener for most of my inside the house water.
- The taste of the water is not good. My whole household has to drink filtered, bottled or sparkling water. The smell of chlorine is often very strong too
- We've lived in Shakopee for nearly 60 years and have never had a problem with the water quality
- Water is very hard and occasionally smells

- Too many chemicals (always smells and tastes like bleach), the ph is too high for my plants, the water is so hard the pipes have to be replaced ahead of recommended timeline.
- I can for sure taste a difference when the system is shocked. And when they flush the hydrants. But overall. Good.
- Very hard and it tastes/smells like chlorine
- The water is very hard and leaves stains with cleaning.
- I don't feel it filters out enough cancer causing chemicals
- We have some of the hardest water in the nation. The required use of salt and the resulting brine dumped down the drain at every household is not cost effective, efficient, or environmentally friendly. In addition to my water softener I've had to install a whole-home water filter to reduce extreme skin irritation following showers.
- The water is horrible. It gives my dog bladder stones and I have sores from it.
- Extremely hard water.
- Water is very hard.
- The water is very hard and has a chemical taste
- I will not drink tap water, it tastes horrible and usually smelly fishy. It also seems like it's really hard and there is a lot of deposits.
- Could be much better and safer
- The water is so hard I had to replace my water softener. It is set to 20 which is near the highest. I get drinking water from the EP artesian spring
- My main concern is that the nitrates are too high. Nearly every city around us treats their water for nitrates, but Shakopee doesn't. I have a fish tank, and the main reason for changing water in the tank is nitrates that build up from fish waste. There are times when I test my dirty fish tank water and also test the tap water, and find the nitrate levels are the same. So not only does that make it impossible to lower the nitrates in my tank by doing a water change, it also worries me that I'm drinking water that has a level of nitrates that is harmful to fish. I know Shakopee water technically is under the limit for nitrates, but it worries me how close it gets to that limit at times
- Very hard water

- Tastes bad
- It's cloudy and has particles in it
- Too hard. Stinks sometimes
- Have lived in multiple surrounding suburbs, water here is unbelievably hard.
- My water is fine when we use a softener for washing and showering. We don't drink it. It doesn't taste good.
- Sometimes smells like chemicals. Is cloudy on occasion.
- Even after it is filtered, witha filter changed regularly, it leaves a nasty white film on everything. My tub and toilet are also gross. I grew up on well water with high iron content and that was nice and tested better
- Way too hard without a softener. Ruined pipes
- Tastes terrible, even with a water softener and testing the water (yes it's soft) Shakopee water does not clean dishes well and leaves spots. Have to use softener in laundry or clothes smell
- Very hard water even with water softener. Tastes terrible, sometimes almost has a chlorine smell
- We have a filter for drinking water. The water that comes out of the tap does not taste good.
- I've lived in Shakopee for 44 years, and have been drinking it as well. Very good water.
- Bad taste, lots of buildup on faucets and showers/tubs
- The water has far too much calcium and other minerals / hardness
- I am from Eden Prairie and moved to Shakopee last year. The water here tastes dirty and my family and I are forced to buy bottled water.
- Just wish it wasn't so hard and left so many hard water stains even with a brand new water softener.
- Tap water is unpleasant taste
- Water has been excellent.

- The amount of calcium deposits ruin appliances. I need to run vinegar monthly. Sometimes the water smells like a pool coming out of the tap
- Water softener was mush after 6 years. Neighbors too so the quality is killing the softeners.
- The water is fine but I really wish we had a treatment facility and could get rid of these water softeners.
- Would love to have the water softened before it reaches the house. I moved from Bloomington MN and that's one thing I miss.
- Very hard water...I've had to replace toilets, water heater and dishwasher, along with faucet heads due to the lime scale build up. Even with regular cleaning. I'm now looking into a water softener to help prevent this.
- The water leaves residue and some kind of build up on everything.
- Water tastes bad and have to make sure its well filtered to drink.
- Extremely hard water despite our water softener. Our shower and sink are full of stains.
- The water has too much sediment on kettles after boiling it
- I moved here from Chaska so anything would be an improvement. I do find the water here to be very good and I regularly drink tap water exclusively. In Chaska I would only drink bottled water.
- The hardness of the water has caused deposit build-ups on faucets causing a need to replace sooner than preferred. Not everyone can afford a water softener
- I only drink tap water, love it
- I use a water softener, and I keep it supplied with salt for the lat 4 years.
- Hard
- Smells like chlorine all the time.
- Extremely hard water despite our softner. Stains in every bath and sink.
- Extremely hard water despite our water softener. Stains on every sink and tub.
- Very hard water

- I brush my teeth so please pass on the fluoride
- The water is too hard and has a clorine smell
- Its pretty horrible.Hard water..leaves white stuff everywhere and turns my floors completely yellow from washing them from the tap. WE NEED SOFTER WATER PLEASE PLEASE PLEASE.
- I wish it was pre-conditioned so I don't have to use a water softener, like the SMSC does for their water
- Sometimes rhw taste is not the best
- Too hard. Awful taste. I have to buy water to drink and to use in my coffee maker
- I've noticed the taste of the water get worse the past 5 years. I'm actually buying bottled water to drink now. I never thought I would. In the summer, I can taste the chlorine. At other times I can only drink it if it's cold.
- It is hard water if you don't have a water softener, I can tell when my water softener is getting low or happens to run out. We don't drink it we use filtered water
- Water is very hard and easily calcified. I use filtered water for everything.
- Our drinking water is good!
- Quality reads ABOVE safe levels for dissolved particles. I can't even drink if, the taste is not good and tastes like chemicals. Use filters to get lower particles and they don't last low due to quality.
- We've lived in many cities in different states and Shakopee's water is the best tasting water we've had anywhere, certainly the best in the metro area. Because I was Manager of Scott County Environmental Health for 36 years I monitored water quality throughout the County and am very appreciative of Shakopee's water. It doesn't have the iron problems common in other municipal water supplies from other aquifers used in the county. I was instrumental in working with the State to develop the first county-wide geologic atlas in the state to help identify ground water risk areas.
- We moved from Bloomington 4 years ago. Shakopee water sucks.
- SPUC billing rates can be outrageous. Not sustainable for certain households.
- There is a pink reticule from the water
- Build up on faucets even with water softener

- Shakopee water is ridiculously hard even with a new water softener.
- It is very hard and metallic
- Everything in my house that comes in contact with the water is covered in white build-up: sinks, plumbing fixtures, dishes, shower heads, etc. Filters I use for tap water have to be changed more frequently than in previous residences.
- We've lived in Shakopee for more than 40 years, and have always been satisfied with the water quality. We don't understand all of the complaints.
- I have to filter the water because it doesn't taste good from the tap and I don't trust the quality
- Very hard and not treated
- I think it smells like chlorine and I don't like the taste of it. We filter our water through our fridge but want to get a whole house filtration system. Saving up for that.
- Taste funny
- Need water softener and still have water heaters failing early. Also for drinking does not taste the cleanest.
- My water leaves residue on everything, clogs filters and tastes off.
- My water from the faucet Tate's funny, leave residue in my ice and is very hard on my faucets, pipes, fixtures.
- Extremely hard
- Requires a lot of water softening
- Water is very hard. Went through one Water softener.
- Very good
- Taste is awful, it is super hard water, fill up a glass its cloudy even after I run for a minute and after it clears, a bunch of ice at the bottom of my glass
- It tastes gross and the calcium build up is beyond horrible.
- Clear and fresh
- The water is way too hard and causes build up in appliances, damaging them.

- The water is very hard and difficult to treat at home. Requires very high settings and frequent regenerations of water softener which leads to excessive salt usage and waste. Hard on appliances and humidifiers.
- It's a little hard
- Hard water. Ruins toilets, appliance, showers and ice cubes have vehicle floaters
- My water is very hard and has a terrible taste, I don't drink it.
- I don't like the taste of the faucet water
- I'm concerned about nitrates leaking into the water system during the warm months.
- Best water ever
- The taste of the water is horrible and hardness level is way high. We have had to purchase a reverse osmosis drinking water system and a water softener with approximately 50 lbs of salt per week.
- We soften our water and have filtration systems in place. We believe this is the responsibility of the home owner and not the city. The utility company should maintain water safety.
- We have very hard water. Residue on all appliances. Even appliances that are only 1 year old
- The water is awful and I would never drink it. Sometimes it is orange. Can you please test it?
- it tastes yucky
- The water looks and tastes horrible
- I like it, except I do not like the chlorine smell in it :(
- Very satisfied with water. Not interested in paying more for treatment.
- cloudy and tastes old/stale
- Very hard water so keep checking all the time.
- It's black and moldy I toilet bowl tanks, tastes terrible for drinking water even through a clean filter in the fridge. Water softener can't even soften it.

- I don't like the flouride
- I have drank the water fresh from the tap, but it is not the best tasting water. Plus it has an extremely high calcium content, evident by the continued clogging of my coffee pot.
- So hard and I don't have space for a water softener
- Water is hard and leaves white (probably calcium) deposits on dishes, etc.
- The water is far too hard, even though I have a water softener. I have to soak my electric kettle in vinegar every other week due to the mineral build up.
- Very hard water. Water does not taste good at all. The ppm count is on the border of max allowed. Water from the faucet is not drinkable unless ita filtered. Very disappointing.
- I am concerned about nitrate levels and other harmful contaminants in SPU water that are "under the minimum safety standards".. just under the legal limits doesn't mean it is desirable, safe or morally correct. Spend some money and treat the water.
- can smell the chlorine in the summer; so much goopy sedimentation on the bottom of glasses, never use to be like that; cut out the fluoride poison
- We have to buy bottled water because the taste of the water that comes from the faucet is salty, undrinkable.
- Love city water!! I personally think it tastes great. It is better then other well water and great taste in comparison to other towns. I would recommend leaving it as is because it is great water!
- I don't like it calcifying my coffee maker.
- Shakopee is known for very hard water. Wish quality was improved at the city level for those getting it from the city
- It doesn't taste good.
- A little on the hard side.
- I have a water softener, keep it filled, and we have a filter in our fridge. Non-filtered water tastes terrible and we have damage to our glassware due to poor water quality.
- It's a bit hard, and requires softening to prevent eczema for several in our family.
- hard water, bad taste

- I buy bottled H2O and use a PUR Filter and never drink tap water. The ring of sediment on my H20 softener, toilet tanks, icemaker shows me undrinkable. At times there is dirt ring in less used toilet.
- Dislike the taste and the water does not meet standards for pregnant women or an infant and toddlers which are present in my home.
- I wish the water was treated. We have a water softener, but have considered getting a whole-house filter.
- Shakopee has excellent water.
- Water is very hard
- Please get a water treatment plant like all the other cities.
- Hard water, taste at the tap is a bit off but fine.
- It doesn't have a good taste
- I have reverse osmosis to drink, and softener for all other faucets
- I don't like how it washes white clothes (things get dingy and gray very quickly) and it is very, very hard, so I'm constantly battling with hard water deposits
- The water is too hard. It's destroying our appliances
- Little things floating. Really gross
- Water is very hard. No issues with taste
- Water is too hard and doesn't taste good. I have a water filter for drinking. I almost didn't move to Shakopee because of water taste
- The water is hard, has to be filtered and requires a water softener. It leaves deposits that requires water heaters to be consistently replaced.
- The water is very hard in Shakopee. Other than that, we have been happy overall.
- We are finding more deposits in our water
- It smells heavy of chlorine
- Basic pond water.

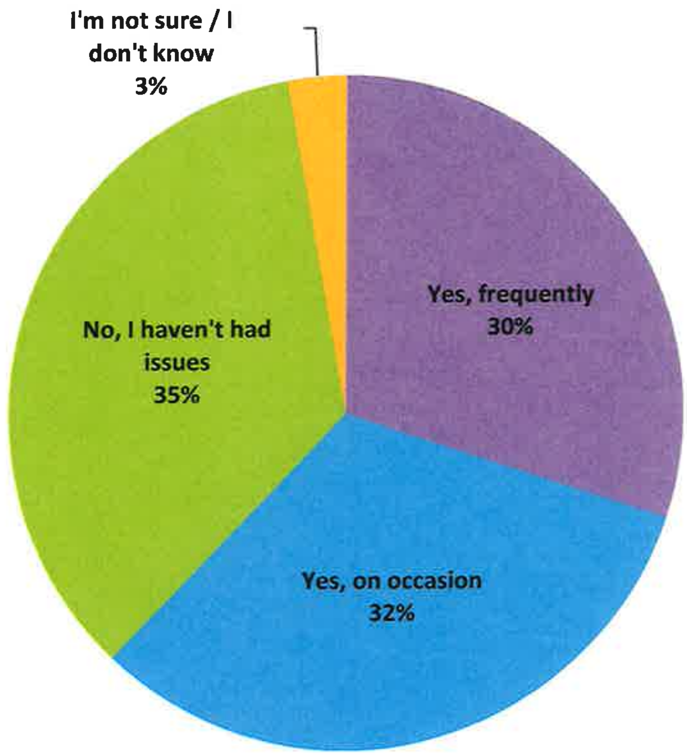
- Smells like chlorine
- Even with water softener, still to hard. White marks on stainless steel pots when boiling water to cook...
- The taste is bad, which makes me wonder what might be in it. Surprised a town of our size does not have a water treatment facility. The extremely hard water seems bad for lawns and pipes... and coffee makers. ;)
- My water is very hard. I even got a new water softener and it's still hard and my hair doesn't always get clean and soap doesn't lather well. Although getting a new water softener was an improvement.
- Hope the hard water level is much lower
- I drink a lot of water and it tastes almost metallic to start the day, like out of a hose most days. It seems to get better throughout the day but it's definitely not good first thing.
- The chlorine taste and smell is overwhelming!
- We use a filter system
- Often tastes too bad to drink
- My water frequently tastes / smells like chlorine
- Would like water treatment plant
- It has many minerals that leave marks on glass and smells of chlorine
- There is too much iron. I used to work for Culligan so I know how the water tests. My water is terrible unless I have an iron filter
- Our water is extremely hard & has an off taste. It is hard on our appliances and fixtures. We spend time and money filtering or purchasing drinking water, constantly cleaning, repairing and replacing fixtures and appliances. Our coffee maker, as a small example, has had to be replaced almost every year we have lived in Shakopee.
- It's ok, hate the chlorine smell and taste
- Other than being very hard- water is ok
- Water is very hard and taste is not desired. We get all our drinking water from the well in EP

- Newly moved here. Taste is good from tap.
- We moved here from Bloomington and in my opinion, no one has better water than Bloomington.
- We don't drink the water we filter it before use.
- It's terrible. I've had to replace multiple faucets because of the corrosion. 3 kitchen sink, 4 shower, 2 bathroom sink. Soon fridge water dispenser.
- Tested the water quality myself 300 times over the limit for sediments. Very not safe. I tested the water in two locations here in shakopee same results by a water company.
- I have been drinking this water for 80 years and never had any problems with the cleanliness or taste.
- Hard water and our water pressure sucks
- It is very hard.
- I would like to see it properly treated to remove nitrates.
- Very hard and bad taste
- Tastes awful
- We have a water softener now so much better
- HORRIBLE HORRIBLE HORRIBLE white film all over every single thing...has wreaked 2 toilets..my diswasher..I am begging for help
- I'm always having to clean faucet heads bc of calcium build up and the toilets always have a line in the bowl.
- It's extremely hard
- It's very hard and leaves build up if we don't keep up with it. Also, we can't use it on crush appliances, ie coffee maker, because the hard water ends up ruining it.
- Water is extremely hard and damaging to everything it touches. The taste is very bitter and gross.
- Terrible taste, also have to use CLR cleaner almost weekly to clean the excessive amount of buildup off of all my faucets and shower heads. Had to start using distilled water in my coffee maker because it will be clogged in about 2 weeks. Worst water quality I have

ever seen. Me and my family have seriously been considering moving out of Shakopee and the water is a major factor. We all have developed skin problems as well in the last 5 years living here

- Taste to salty and leaves rust in the tub
- Water is hard and full of minerals.
- Tastes awful and I will not drink fluoride
- Very hard water, leaves a lot of stains.
- The water quality is mostly good, but there always seems to be a white residue that is left over when the water dries, or when I water my houseplants a white residue will form on the soil
- Horrible taste and too hard
- Get rid of the lime in the water.
- Too much chlorine/pool water odor.
- The water seems very hard compared to other counties we've been in and it always needs salt or our dishes are covered in thick film of coating hard water.
- Taste has alot of chlorine, you can just smell it when you turn the tap on
- White partials in the water if not filtered.
- I feel like my toilets and sinks are hard to clean. Water tastes ok but not great. I do have a special filter for my sink for drinking water but do use unfiltered water for cooking.
- Water is too hard.
- Damn the water is so "hard" which kills my household appliances.
- Water is horrible. Tastes awful. Very hard water. Seems to be getting wore. One of our considerations for staying/moving is the quality of our water.
- The water is drinkable but we do not like it. We get our drinking water from a spring in Eden Prairie

4) Have you had any concerns or issues with tastes and/or odors with your water in the past 5 years?



Comments:

- We don't drink out of the faucets due to the bad taste.
- We all know, or should know, that city water must be treated to make it safe. I have an inexpensive 3-stage filter under the kitchen sink for drinking and cooking water.
- We have a Culligan system in our home, but when from the tap it tastes terrible.
- The water in Shakopee has a less than desirable taste. I've helped install multiple carbon filters for people to help with this. Shakopee's bad water taste was even brought up during an MPR segment on Appetites on July 11, 2019. Have a listen here (Starting at the 3 minute mark): https://www.mprnews.org/story/2019/07/11/appetites-tap-water
- TASTE
- We don't drink the water

- It's terrible and I won't drink it.
- It used to taste fine, but a year or so ago it started tasting bad. I have been using a Britta filter and that helps, but it makes me worried what might be getting through the filter.
- It used to taste fine, but about a year ago it started tasting bad. I've been using a Britta filter, which has helped the taste.
- Sulfur smell.
- Have only lived her for 3 years
- I think our tap water tastes terrible, we always filter or buy drinking water.
- We've run into issues where water has been brown looking and water pressure can be very low.
- Smells like chlorine often
- Yellow at times
- The water taste is horrible.
- Different areas of town are worse, lived on Bluestem and that water wasn't drinkable had to buy bottle water. On Providence the water is better but seems to be getting progressively bad tasting.
- We have to use a water filter the taste is terrible.
- Every once in a while we get a halogen tasts that is noticeably different and unappealing but running water for 10 minutes solves it
- I didn't like the taste, and the minerals caused issues with my humidifier and shower heads, so I use a water softener
- Prominent chlorine smell.
- Tastes awful, would not drink it. We use a filter.
- Tastes terrible, have to use a brita filter.
- I feel like the hardness level of our water fluctuates. We have a softener but still end up with calcium build up, even after making adjustments to the softener

- We go to cub to get our drinking water as well as our water we use to put in our coffee maker and electric tea maker. We are unable to use tap water in anything electric or it destroys the coffee maker or etc. WE NEED CITY WATER TO HAVE SOFTNER IN IT..LIKE ST PAUL OR MPLS. IT DESTROYS HAIR AND SKIN..
- We buy bottled water now. We have a filter on our fridge and the water still doesn't taste good.
- Sulfurous odors
- We filter our water so I am unsure how it tastes, we will not drink it straight from the tap
- Cannot drink it as the taste is off. Drink filtered water only
- Yes-chemically and doesn't taste good
- Shakopee has excellent water quality.
- Taste is so bad and water is so hard that we had to invest in whole house filtration
- Water is very hard & causes havoc on household appliances.
- No issues with odors; however, taste is not great. Also, prefer not to have to chew my water (there are always white floaties).
- when my filter broke and I had to drink tap water. the taste is worse than when it's filtered.
- But I haven't inquired. It's smells like chlorine coming from the tap.
- I trust the SPU
- I have had a full house carbon filter and R.O. drinking water for >5yrs bc I want cleaner and more trustworthy water for my family.
- Turn on the faucet and have drinking water
- Smells skunky at times
- Sometimes I notice the chorine when it's added.
- I run the water through a Brita filter, so I am not really sure how the water is without it.
- We do not drink our water

- rusty water
- There should not be an odor or taste to the water
- only the chlorine
- Occasionally smells almost chlorine like
- Actually all the time, because water is unpleasant for consumption, unless it filteted
- Water is very hard. Taste is not great
- yes smells like chlorine, tastes weird, like heavy metals
- The water occasionally turns brown, I don't use it
- We have been buying water for drinking from the grocery store because our water does not taste good and sometimes stinks.
- Always.
- There has been some white buildup in appliances that frequently use water. Unsure if this is from the softening process from the water softener or residual that could not be resolved with softening/ filtering
- smells when you get a glass of water we stopped drinking it three years ago
- I don't drink my tapwater
- Please get a water treatment plant like all the other cities.
- Taste issue
- Sometimes smells like chlorine. I only drink it filtered through the refrigerator and replace the filters frequently
- Doesn't taste like pure water unless it's run through a filter
- Taste isn't good
- Water always tastes bad. Sometimes you smell chlorine
- I've had to install a water softener to help. Next step is water filtration system.
- Smells like chlorine

- That why we buy water filtered and drink from dispenser
- I switched to a whole house water filtration system and reverse osmosis, that's how bad it was.
- No odors really, but definitely taste.
- Chlorine seems high. I wish there wasn't Fl
- Tastes / smells like chlorine.
- We have installed filtration for drinking water. In past 5 years I believe I recall one notice for this topic. It's not about taste. I want it safe.
- Chlorine. There are "floatys" in the ice too
- I will not drink the cities water
- Taste
- It's just not as good as we were used to
- We have purchased a water softener, dechlorinator and whole house filter, along with a drinking water (Reverse osmosis) system to combat the taste and smell of the water we have had while on city water.
- Way too much chlorine all at once.
- I grew up in Bloomington and always drank the water out of the tap. I wouldn't think of doing that in Shakopee after seeing how gross the filter gets in our in home filter. Also I am not a fan of water softeners at all.
- We use a filter water pitcher
- On occasion it will be rusty or smell bad
- Tastes awful
- City hall micro management
- It tastes so terrible and has wreaked all my glasses and plates due to hardness..tastes so bad I have to go to Cub and fill gallon jugs. How will I do this in a few years? Im 62. Its horrible to do when its super cold out...I HATE THE WATER
- It always tastes HORRIBLE.

- I sometimes smell a strong odor like chlorine.
- I don't like the regular taste. I have an Eco Smart water purifier.
- Literally shit floating in the water
- Salty
- Tastes Bad
- Not very often, but sometimes there is a smell or slight taste of chemicals
- Taste seems off
- Without my water filters I couldn't relay on SPUC water.
- Awful water. Getting worse each year.,
- The water is drinkable but we do not like it. We get our drinking water from a spring in Eden Prairie
- Water seems to be aggressive on my plumbing

Cost of SPU's Water

SPU's 2021 residential water rates are $2.49 per 1,000 gallons of water plus a monthly service fee of less than $4.00. Usage greater than 5,000 gallons is billed at $2.98 per 1,000 gallons.

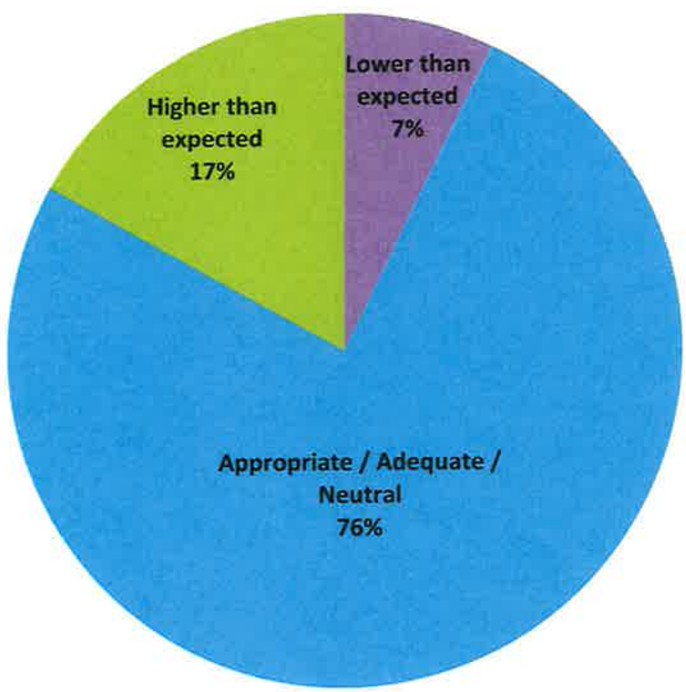
(The average SPU residential customer uses about 2,250 gallons per month per person, which would cost an individual resident approximately $9.00 per month.)

SPU Residential Water Rates (Effective January 2021)

Availability	USAGE CHARGE (per 1000 GALLONS)		RECONSTRUCTION CHARGE (per 1000 GALLONS)
RESIDENTIAL SERVICE	1 - 5000 GALLONS $2.49	PLUS	$0.42
	>5000 GALLONS $2.98		

Please refer to SPU's 2021 Water Rates for more information regarding your water bills.

5) How do you feel about the current cost of your water?



Comments:

- I'd pay more for better water
- I believe the cost has been low as not much filtering or treatment goes into it
- How much more per month would it cost to filter it?
- Way cheaper then living in Bloomington
- Water is included in my rent.
- HOA overs our bill.
- Paid through HOA so I never see the amount. Please dramatically increase the rate above a certain threshold in the summer to discourage lawn irrigation
- People around the nation have to purchase bottled water because their municipal water supplies provide poor tasting or quality water. Shakopee's drinking water is better than bottled water.
- When one considers the required necessity of water softening and filtration the price of shock P water is extremely high.
- SPUC prices are high.
- I would pay more for better water
- Will be nice to know what other cities charge is I can compare.
- Lived in lakeville before. There you only paid for all sewer water and street lights every 3 months. Water was cheaper but the other 3 items were about 1/3 the cost. I feel it is a lower quality water for a very high price! That said I do want it to be clean and safe.
- Seems ok
- Why we pay Sewer to the Met Council?
- This is me just using Google to look at the average price of water in the US.
- I don't have a cost to compare it against. Sometimes I dont even use 1000 gallons a month. I'm satisfied with the cost.

- No increase of fee for over 5000 gallons used. Ridiculous. Question the reconstruction charge as well.
- The cost is too high for the poor quality water that is provided
- it's all the extra fees that are bothersome
- I would pay higher rates for better/safer water
- Paying anything for terrible water is too high. That being said, I would happily pay double for water as good as I had in Bloomington- WITHOUT a softener or filter.
- When I lived in Eden Prairie the cost was much less and better water
- The water rates are too high for water that is not treated with a water treatment plant and can't believe a community this size does not have higher standards for water quality. Yes it meets the bare minimum quality standards but water rates are not significantly lower compared to water rates of communities who provide treatment. Many residents are not even aware there is no water treatment plant.
- Neutral - it is part of my HOA so I'm not sure what the bill would be separate.
- Please get a water treatment plant like all the other cities.
- How would I know what I should be paying? 🤷‍♀️
- I trust your judgement. I will do more research across the metro
- Only lived here for 8 months
- I grew up in Richfield which has awesome water. No need for softener or filters. Wish we had that here.
- I hate paying for shit water
- Too high for hard water with poor taste
- Higher than it should be for the quality of the water.

Iron & Manganese in SPU's Water

Manganese occurs naturally in rocks and soil across Minnesota and is often found in Minnesota ground and surface water. While a small amount of manganese is essential for human health, drinking water with too much manganese can be a risk to health. Manganese can also cause discoloration and an unpleasant taste in drinking water. It can also stain laundry or cause a brownish-black or black stain on your toilet.

Iron may affect the appearance and taste of water by giving it a slightly red color and a metallic taste that can affect how food and beverages taste. For the most part, however, **iron** does not usually present a health risk. For the purposes of this survey we will focus on manganese as iron would be removed if filtration were installed.

Current Regulatory Agency Guidelines

Parameter	EPA's Aesthetic Quality Guideline[1]	MDH's Health Quality Guideline[2]	
		for Infants (<1 year)	for General Public (>1 year)
Manganese (mg/L)	0.05	0.1	0.3[3]

[1] The EPA's Secondary Max Contaminant Levels (SMCL) were developed to assist public water systems in managing their drinking water for aesthetic considerations, such as taste, color, and odor, and are not federally enforceable.
[2] The MDH's health based values (HBVs) were developed to better keep your household drinking water safe.
[3] EPA has set forth a lifetime health advisory value of 0.3 mg/L for manganese.

If you would like to learn more about manganese in Minnesota's water sources, please visit the MDH's page on manganese.

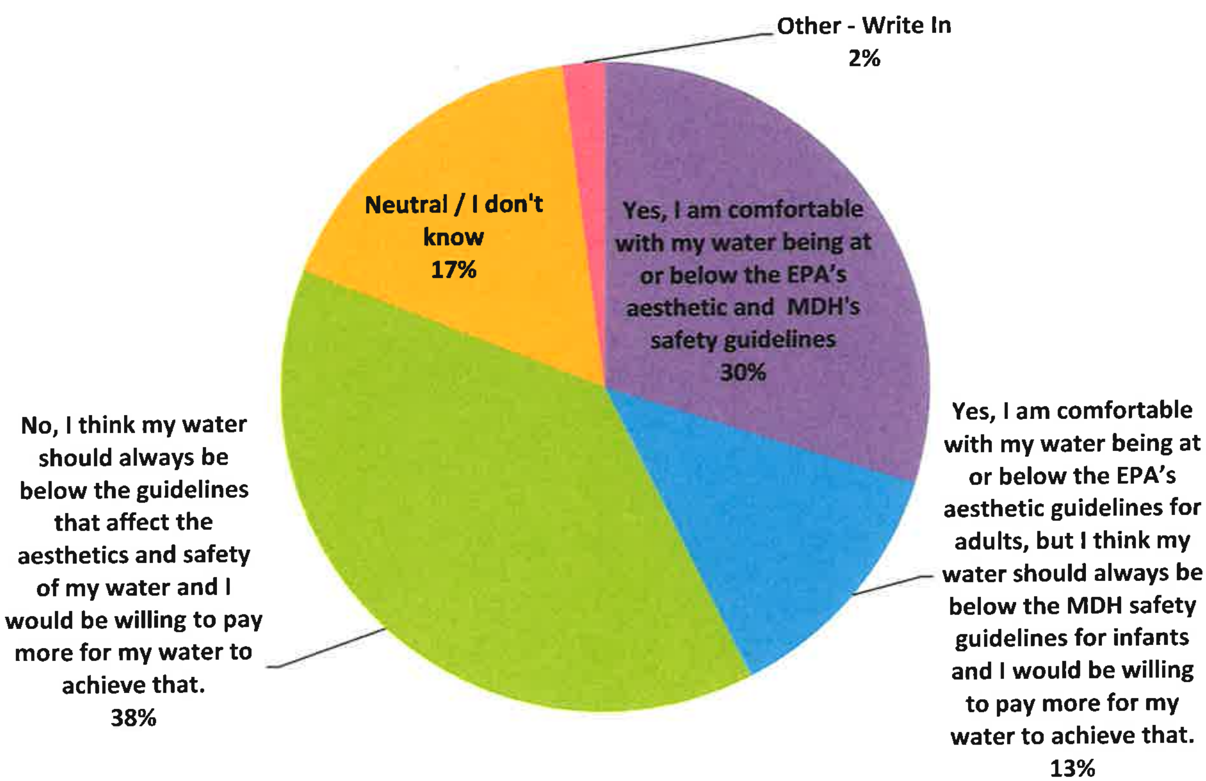
Manganese in SPU's Water

Year	Manganese Concentrations in SPU's Groundwater Wells[1]		
	Minimum (mg/L)	Average (mg/L)	Maximum (mg/L)
2018	<0.005	0.015	0.076
2019	<0.005	0.021	0.118[2]
2020	<0.005	0.018	0.084

[1] Does not include two (2) wells that SPU considers as emergency wells and do not use.
[2] Only on one occasion in 2019 did a well exceed the MDH's health quality guideline (0.10 mg/L).

In the last three years, SPU's tested groundwater manganese levels have all been below the MDH's health-based values of 0.10 mg/L (see table above), with the exception of one occasion from one well. That occasion was 0.12 mg/L in 2019. Additionally, the majority of SPU's wells have tested below the EPA's guideline for aesthetic considerations (0.05 mg/L), with a couple of well testing slightly higher (0.09 mg/L).

6) Are you comfortable with the manganese levels in SPU's water?



Comments:

- Already pay for it. Give me without charge
- I don't think you should have to pay more for water to be safe for everyone including infants
- I think it should be safe for infants without charging more.
- I want better quality water but your price is already HIGH!
- No. SPU has rates higher than neighboring cities
- No amount of treatment is going to satisfy everyone. Let those who want top quality tap water install their own treatment equipment rather than charge everyone for city water, much of which is used in toilets and on lawns and gardens.
- Perhaps you should have made the survey mobile friendly so that all charts can Bee read in full.
- Do not want to pay more. Feel the company can better budget its overhead and not overcharge consumers
- Its not good. Why we have to go with all our jugs and get water at cub. the reverse osmosis water. Its a horrible pain in the butt!!!! HELP. Water quality in Shakopee is horrible its kinda a standing joke basically we live on the wrong side of the river..everyone in st paul and mpls has great water and it does not destroy everything in their home including their skin and hair.
- Are the wells evenly blended to mitigate outliers that occasionally test outside standards?
- I shouldn't have to pay more for my water quality to reach its guidelines. If it was considerably below possibly.
- Iron and manganese are minerals essential to health and common in multi-vitamins. Even when they are high in drinking water, as in some parts of the country, they are aesthetic problems, not health concerns.
- I don't like that these rates are achieved by mixing well water. They should be the same level throughout the system. Build a treatment facility!
- Your watching
- I don't know why people in Shakopee complain
- Well, now I understand what that stain is in the toilet that I can never seem to scrub off, and we just bought new toilets last year.
- I don't really like MDH so I'm not 100% on board with a lot of their health values.

- Owners need to decide for themselves--not the city--if they want levels below safety guidelines. We like RO water but the city would be stupid to try to provide that for the entire city.
- I have those toliet stains
- Not interested in paying more..
- Numbers look good and not wanting to pay more
- wont pay more for quality water that should be in line with the Regulatory Agency Guidelines not less than the recommended levels
- Numbers look good. No need to spend more.
- How is this even a question? We deserve to have the same water quality as other communities.
- My laundry gets yellow stains. And yellow gel like substance builds up in my toilet tank. Maybe there is oil under my house? Haha!
- Please get a water treatment plant like all the other cities.
- However, if it is so close, it should not cost very much
- I dont know if it should or not have I dont know. I would think less is always better.
- I've definitely noticed black staining in all my toilets and it's really hard to clean and looks gross for guests

Nitrate in SPU's Water

Nitrate is a compound that naturally occurs causing low levels of nitrate in drinking water—usually less than 3 mg/L. Higher levels of nitrate in water can be a result of **runoff or leakage from fertilized soil, wastewater, landfills, animal feedlots, septic systems, or urban drainage**. Consuming too much nitrate can affect how blood carries oxygen and can be extremely **harmful to infants (6 months or less)** and can result in methemoglobinemia, or **blue baby syndrome**. Only recently has scientific evidence emerged to assess the health impacts of drinking water with high nitrate on adults.

SPU's nitrate levels have consistently tested below the EPA's MCL (10 mg/L).

Nitrate in SPU's Wells

Year	Nitrate Concentrations in SPU's Groundwater Wells[1]		
	Minimum (mg/L)	Average (mg/L)	Maximum (mg/L)
2018	0.6	3.7	7.9
2019	0.3	3.5	7.4
2020	0.6	3.5	6.7

NOTE: Nitrate levels in all of SPU's wells have been naturally dropping over the past 20 years with decreasing agricultural land in the area.
[1] Does not contain two (2) wells that SPU considers as emergency wells and do not use.

Nitrate Regulatory Standards

Parameter	EPA's Maximum Contaminant Level[1][2]	MDH's Health Quality Standard[3]
Nitrate (mg/L)	10	10

[1] The EPA's Maximum Contaminant Level (MCL) is an enforceable maximum allowable amount of a contaminant in drinking water which is delivered to the consumer.
[2] The EPA's Maximum Contaminant Level Goal (MCLG) for nitrate is 10mg/L. The EPA considers any level of a contaminant below which has no known or expected risk to health of a consumer.
[3] The MDH's Health Risk Limit (HRL) is based off EPA's MCL.

If you would like to learn more about nitrate in Minnesota's water systems, please refer to MDH's page on nitrates.

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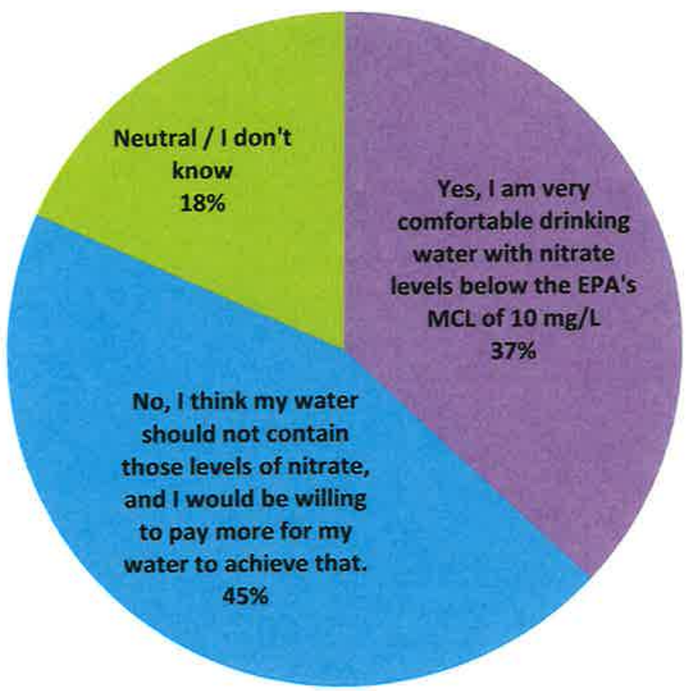
7) Are you comfortable with your water that meets EPA guidelines for nitrate, or would you like to see the levels even lower?



Comments:

- If I wasn't comfortable with city water I would install a reverse osmosis system or buy bottled water for drinking.
- My main concern is that the nitrates are too high. Nearly every city around us treats their water for nitrates, but Shakopee doesn't. I have a fish tank, and the main reason for changing water in the tank is nitrates that build up from fish waste. There are times when I test my dirty fish tank water and the tap water, and find the nitrate levels are the same. So not only does that make it impossible to lower the nitrates in my tank by doing a water change, it also worries me that I'm drinking water that has a level of nitrates that is harmful to fish. I know Shakopee water technically is under the limit for nitrates, but it worries me how close it gets to that limit at times.
- Why not aim for nitrate levels as low as possible without having to pay more??
- I am concerned that nitrates could be contributing to more issues in people with diabetes or kidney and other disease. Lack of oxygen can lead to serious issues.
- Not wanting to pay more. Be a responsible, ethical company.
- We consume nitrates in many processed foods at much higher rates than from our drinking water. Nitrates are only a concern for infants who are fed water reconstituted dry formula, and only when concentrations are considerably higher than municipal water in Shakopee. In my role as Environmental Manager for Scott County I found and mapped private wells with high concentrations of nitrates primarily the result of poor location and design of wells and old deep septic systems.
- Those rates are achieved by mixing the water in the system. Levels should be uniform throughout the system. Build a treatment facility!
- You cannot please everybody
- You should possibly remove the payment clause on these questions if you were looking for honest answers. There appears to be bias in these questions.
- Numbers look good and not willing to pay more
- Nitrates should be removed and near zero!!!
- Comfortable with guidelines AND would pay more for lower levels.
- Numbers look good. No need to spend more.
- Seriously? We harm our residents because we are ok with terrible water because that is what SPUC has always done?
- The charts above are cutoff and you can't see the reported levels. Was this done on purpose? Shakopee has high levels per MDH.
- Please get a water treatment plant like all the other cities.

- Not happy and not paying
- It would depend on how much more for all of this.
- I want the levels lower without increased cost
- No. The water should be safe. And, not expensive.
- I was unable to see the numbers that went with years 2018-2020 in the last two charts. The right side of my view was cut off.
- It's to high
- Again I don't think we should have to pay more for completely safe drinking water. All families including low income families deserve the same rights to completely safe and clean drinking water.

Filtration Treatment

To supply everyone equally treated water by reducing the iron & manganese, and/or nitrate levels prior to distribution, it can be expected that the cost of water for our customers could see a significant increase.

8) If you currently pay $2.49 per 1,000 gallons used, how much would you feel comfortable paying for water to have additional filtration and treatment? *

**Note: The increase would only apply to the water portion of your bill and would not increase the cost of electricity, stormwater or sanitary sewer portions of your bill.*

Comments:

- 25% more
- 3.69 per 1,000
- A fair rate comparable other cities with treatment plants.
- Don't think we should have to pay for water when we don't know how much we use in a townhome
- Double
- FIx the problems just do it for the health of the community.
- I already pay privately for filtration of city water. Don't increase cost. If we want cleaner, we can do it on our own.
- I am not comfortable w current water but willing to pay a little more but not triple
- I am willing to pay higher, however water treatment facilities need to be subsidized by the state.
- I am willing to pay more but not triple
- I would be willing to pay 0.50 more per 1000 gallons for treated water.
- I would be willing to pay more...perhaps 25-50% more but triple seem pretty high.
- I would like to know how much it would cost to get safe, drinkable water and be able to get rid of the water softener.
- I would pay more but would need to see what comparable municipalities are paying for the same service.
- I would pay more for better water, but not triple
- I would pay more if the water was drinkable
- I would pay what is reasonable — not whatever is necessary — to have the best water possible
- I wouldn't want to pay triple the cost; I would be ok with a slight increase
- I'd be ok with double so long as there was a notable difference
- I'd pay double.
- Is triple the cost more or less than the necessary amount? I'd be willing to pay more than currently paying for better and safer water.
- Leave it the hell alone, I do not want the Karen's telling me what to pay
- Okay with a small increase
- Reasonable rates in line with what other cities with better filtration systems pay.

- Up to double
- Up to double current rate.
- Willing to pay extra but not sure why tripling the rate is the only option. Could be double to be as effective
- Willing to pay more
- Willing to pay more but not triple the current cost
- Would pay $4 per 1000 gallon
- You provided no range below tripling the cost. Be more transparent. also how do our rates compare to neighboring communities.
- Maybe you could publish what percentage of city water is typically used for toilets, laundry, lawns, gardens, etc., and ask people if they would like that water to cost as much as the water they drink. If not, the better solution is to treat drinking and cooking water in each residence. Maybe SPU could research and offer such equipment at lower than market cost as opposed to tripling current water rates for everyone.
- I don't see the need to make any changes to our water, as long as it meets the EPA guidelines. As long as individual wells are tested regularly and kept in compliance with the EPA guidelines, I don't see the need to burden the citizens of Shakopee with increased rates, especially when it would prove to be a hardship for many families who are currently experiencing loss of jobs, and are having a hard time providing food & shelter for their families
- I am comfortable paying more. I know there are ways I can cut back on my water usage if it were to become more expensive than I would like.
- Sure I would pay 3x, but commitment to "whatever necessary" is a big step because not everyone is going to agree. I don't want to get gouged, but sharing what other cities pay would let us make an informed decision
- I don't pay for water directly and I plan on moving in the next few years.
- I am a professional engineer in the the water treatment industry. Stop saying filtration. Particulate debris is not in the discussion and your use of it in context of nitrate or hardness reduction is misleading. Almost any treatment you do will lower our water's LSI and I dont want my family drinking corrosion byproducts.
- I am in the process of installing a whole house water filtration system. Water quality has been the one negative or suprise about moving to Shakopee.
- I would be so so willing to pay for my own water here if I had much better quality!!
- I would be willing to pay more if that filtration also included methods that reduce or eliminate in home water softening.

- Money can be better spent by identifying and addressing potential sources of ground water contamination within the well-head protection areas required to be defined by state laws.
- Since I don't trust SPUC to spend our money transparently or wisely I won't offer a price
- If prices were to increase three times that of current prices, what does that say about the quality of our present water?
- this is a flawed question. We need realistic costs with demonstrated improvements to make an informed decision.
- Clean, healthy water is priceless...and helps pipes last longer!
- We filter ALL our drinking-cooking water!
- I think it's a public health issue to make sure that water is safe for everyone without costing a lot of extra money.
- Water bills shouldn't have to be increased if SPUC was managed properly
- Mix it
- Let the "complainer" pay for it
- I don't know why you would need to only have an option for triple the cost. We should be meeting standards.
- The City Council and Manager need to stay out of this. They are over reaching and causing problems where none exist. We have enough conflict as is in Minnesota.
- Not interested in paying more for treatment
- I am unwilling to pay more for water treatment
- The safety of drinking water and the health of my family is worth every dollar. Every other major metro community has water treatment and our community deserves better.
- really pathetic question, why don't you give discounted water filtration systems to customers and let them be in charge of their own water quality since you can't seem to do it right
- Why can't the city figure it out? How do we rate to other cities water quality and price? And why would have to be so much more? What is not being supplied for our residents safety?
- NOT interested in paying more when the water is fine.
- Get it done.
- Using $2.49 rate is not a good representation. That rate is for less than 5,000 gallons and an average family home should be used at rate of $2.98 per 1k gallon. Triple rates for a

family would be almost $9 per 1k and that's is absurd compared to other city water rates. Where is all the money earmarked from all these homes over all these years for a water treatment plant and monies collected with hookup rates? Very upsetting that we would be gouged for this now!

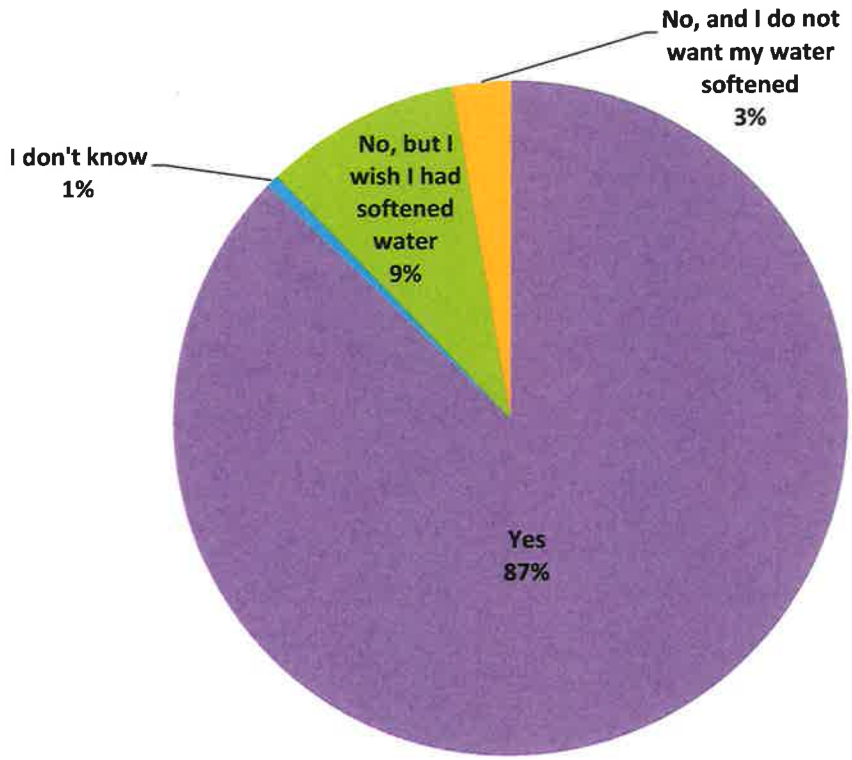
- Please get a water treatment plant like all the other cities.
- ONLY IF OUR NON DRINKING WATER IS SPLIT OUT FROM OUR DRINKING WATER!
- I already paid to filter out the smell and funky taste of the water so I'm not interested in paying more for new filtration system.
- I'm willing to pay a little more for better water, but not triple.
- Not enough selectable answers for this question.
- I have trusted you would do the right thing for 9+ years. We have a growing community with lots of manufacturing coming in. I want more than the companies to be benefited to come to our town. Our community must plan for this increase water demand. Chaska, St cloud and others have a water treatment plant. We deserve one too. There has to be some joint collaboration across the metro to support our community to get to a place to understand it's not cheap but that doesn't mean we should be sacrificing our community's safety.
- My grass doesn't need sofened water. Filtering all of it is silly.
- I am deeply concerned with how much higher water costs could negatively impact our lower income residents. We must find ways to achieve better water filtration without just simply "passing the cost" on. Access to clean potable water is a human right and we need to figure out a way to make it that way.
- And I would pay OUT OF MY OWN POCKET EVERY MONTH to have better water. Our hair and skin are destroyed
- already pay too much

Municipally Softened Water

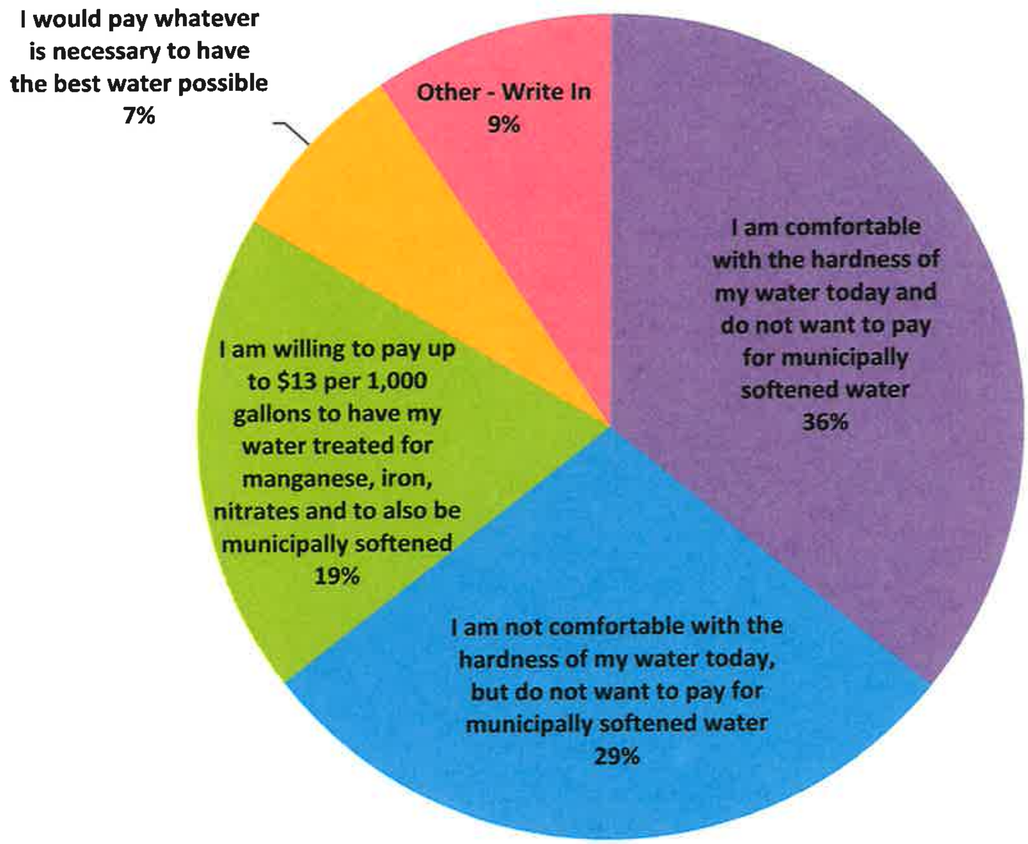
Hardness in water is caused by excess calcium and magnesium ions in the water. Hard water causes scaling on fixtures and can plug pipes. Water above 100 mg/L of hardness is considered hard. The hardness in the water from the SPU wells ranges from 163 mg/L to 446 mg/L, and averages about 350 mg/L. Currently, SPU does not soften water before delivering it to customers.

Some customers choose to soften their water with in-home water softeners, which typically costs about $1,000 to $2,500 to install, and $5 to $20 per month to run and refill with salt.

9) Do you currently soften your water at home?



10) A centralized filtration water treatment plant would be the only way to soften water for all SPU customers. If you currently pay $2.49 per 1,000 gallons used, how much would you be willing to pay for water to be softened, in addition to the other filtration treatments noted in Question 8? *



**Note: The increase would only apply to the water portion of your bill and would not increase the cost of electricity, stormwater or sanitary sewer portions of your bill.*

Comments:

- $4
- I am on a tight budget and would be willing to pay a small increase, but not a large increase at this time
- I don't trust SPUC to spend our money transparently or wisely.
- I don't want hard water but I am not a fan of paying more.
- I have a water system with ion cleaner rather than salted softener. Don't add more salt. It can cause health issues for those with conditions.
- I rent and do not pay for water directly.
- I would like to see municipally softened water, at a reasonable price
- I would need to see what the comparable rate in other municipalities with similar water situations to have an educated amount.
- I would pay $3 - $4/1000 gallons for treated water.
- I'd be willing to pay the $13.00. Hard ti say I'd pay whatever it takes without some sort of range.
- I'm not comfortable with the hardness and would be willing to pay something reasonable. But not "whatever is necessary" — bad survey question response.
- Just fix the issues
- Maybe 20% more
- Not sure
- Okay with an increase
- See comments
- Shouldn't have to pay
- This should be included
- Very few cities soften water it's up to the operator of the owner that receives it
- We do use a water softener but the water is still extremely hard. We have hard water spots in showers that are very hard to clean.
- What is the price necessary for the best water possible? But yes I'm sick of hard water in Shakopee and willing to pay more.
- Willing to pay more but not 5x current rate
- Willing to pay up to $7 more for the water to be softened

- Would pay for municipally softened water ONLY if it is done in a manner that does not harm the environment or use extra water to do so.
- would accept a moderate cost increase only for water softening
- It depends on method SPU would use to soften the water. If it's like the typical home water softener that replaces calcium and magnesium ions with sodium ions from salt, then that would be a bad idea particularly for lawns and gardens that need watering. Also, the salt gets into the ground and surface water. Road salt is already an problem for that reason.
- Again, the infrastructure to provide a central filtration water treatment plant for the citizens of Shakopee would be a financial hardship for all the citizens, not to mention the challenge of connecting all the wells and the disruption the digging all over town would would cause to our daily lives, for who knows how many years.
- Doesn't everyone drink bottled water these days anyway? If I had a concern about the water I drink from the tap I would have a conditioner installed locally.
- Again, a comparison of what other cities with softner systems would be useful.
- I don't know what is average to pay but 13$ seems incredibly high
- I strongly do not want city softened water
- Stop saying filtration!!!!!!!! Call it the right thing!!!!!!! Lime soda softening, reverse osmosis, ion exchange. Be honest and present the factual downsides or the city council will win, dissolve SPUC, and take your reserves which you have smartly set aside.
- The water hardness is so unacceptable.
- Please do not soften the municipal water. I have an R/O system and I would be unable to use with softened water.
- $13 / 1000 is too much but 350mg is too high too. Please find other alternatives.There has to be some way to lower it closer to 100mg so that home softeners would function better.
- Help!! We need better water softner. The softner system we have in our rental unit is horrific and does not work yet we have no choice. Id be so so willing to pay for water to be soft. We cannot use the city water at all to use in kitchen. I ve gone thru 2 toilets it clogs up everything and destroys everything..also has destroyed my washer clothes and my dishwasher... HELP
- Moved from Bloomington. Night and day difference. The water is so heavy here. Would rather have better water instead of over working my water heater and potential pipe issues
- The chemicals used for softening water are less healthful than the calcium and magnesium that would be removed. We do not drink soft water for that reason.

- I would pay the same price as Bloomington
- I do not think that the rate needs to be a high as $13 to pay for municipally softened water. But I think it's a huge asset for a community.
- another bad question. Water hardness is unique and personal to each person. We should know to what level you're going to soften the water, and the associated cost.
- This will help residential plumbing last longer, please do it. All other neighboring cities soften their water.
- We have a water Softener
- I care most for the water softening benefits
- Since this is cheaper to deal with from home, I'd rather do that. I don't need to soften the water that's going to end up on my lawn.
- I think those that have a water softener should get a credit of some sort should the city choose to municipally soften water.
- I must be ignorant to these costs. How do other places achieve this without a cost increase from 2.49 to 13 dollars? I can't imagine the city of Shakopee is that significantly lower than those that have this system. This makes me unable to answer the question. Maybe make it softer without this system in place.
- After filtration via refrigerator, the hardness of water in my house is 500 ppm (TDS tester) which is extremely high.
- A centralized filtration system would make water no longer affordable for many people in the community. If that is the goal of the City Council, then they should proceed.
- We installed a water softener and accept responsibility for those costs
- i already have a water softener I do not see the point to pay more to do something I have in my home
- Not interested in paying the City to soften water for me
- Softening your water should be a choice and not done for everyone nor should it be expected to make everyone pay for it..
- Please publish in the monthly SPUC letter what the cost for a water treatment facility would require and what each household can expect to pay for treated water. Is this true it would cost $13 per 1000 gallons for treated water? From the point of building a treatment facility until ??? forever??
- We already have a water softener, and don't want to pay extra for what we already have.
- $13 per 1000gallons is steep for treated and softened water.. it would make SPU water the most expensive in the metro.. why so expensive? why haven't you planned for this

in the design and layout of your infrastructure over the last 30 years that Shakopee has exploded in growth? I'll pay it, but it's irresponsible you didn't plan for this.

- again offer discounted units to individual households
- Softening water should be the customer's choice. Not willing to pay more so everyone can have it.
- I love going through jugs of CLR to keep our shower working. Also, I love replacing glasses that we received as wedding gifts 4 years ago. That seems normal.
- Water treatment should be provided and paid for by homeowner. Treatment to provide safer water for the health of our residents needs to be the priority!
- Please get a water treatment plant like all the other cities. Screw the staff at the city for trying to take over you, they can't even run the city correctly without issues.
- I would be willing to pay more, but not $13 per 1000 gallons. I would pay up to $5 if it meant I would get consistent soft water.
- Would be okay with paying up to $5.00/thousand for soft water only, not for other treatments.
- Again, major concerns with how this could impact lower income people in the area.
- I only have to buy a coffee maker every 5 months
- Willing to pay$6.50 per 1000 gal.
- Again there are counties already doing this and there bills do not come in much higher if at all higher.
- I'm curious if my water softener at home is as effective as the proposed city softening and if would give us really soft water to have both in place. I don't want to pay a ton for city softening though since we do have a pretty new water softener at home.

Customer Verification

18) Last question! What is your water service street address? (Required)*

TENNESSEN WARNING NOTICE
This information is used to confirm that survey responses have come from current SPU customers only, and that response data is not being influenced by outside parties or entities. You may choose not to provide this information, however your feedback may not be included in the response summary of verified customers. This information will only be used by the SPU to get customer feedback on water quality, and will not be shared with 3rd parties.

Thank you for taking the survey!

Your response is very important to us.

Please return your survey responses to SPU in one of two ways:

- Place it in an envelope **labeled "Water Survey"** and put in the **24-hour drop box** at the SPU Service Center located at: 255 Sarazin Street, Shakopee, MN (*No postage necessary)*
- Add postage and mail to:

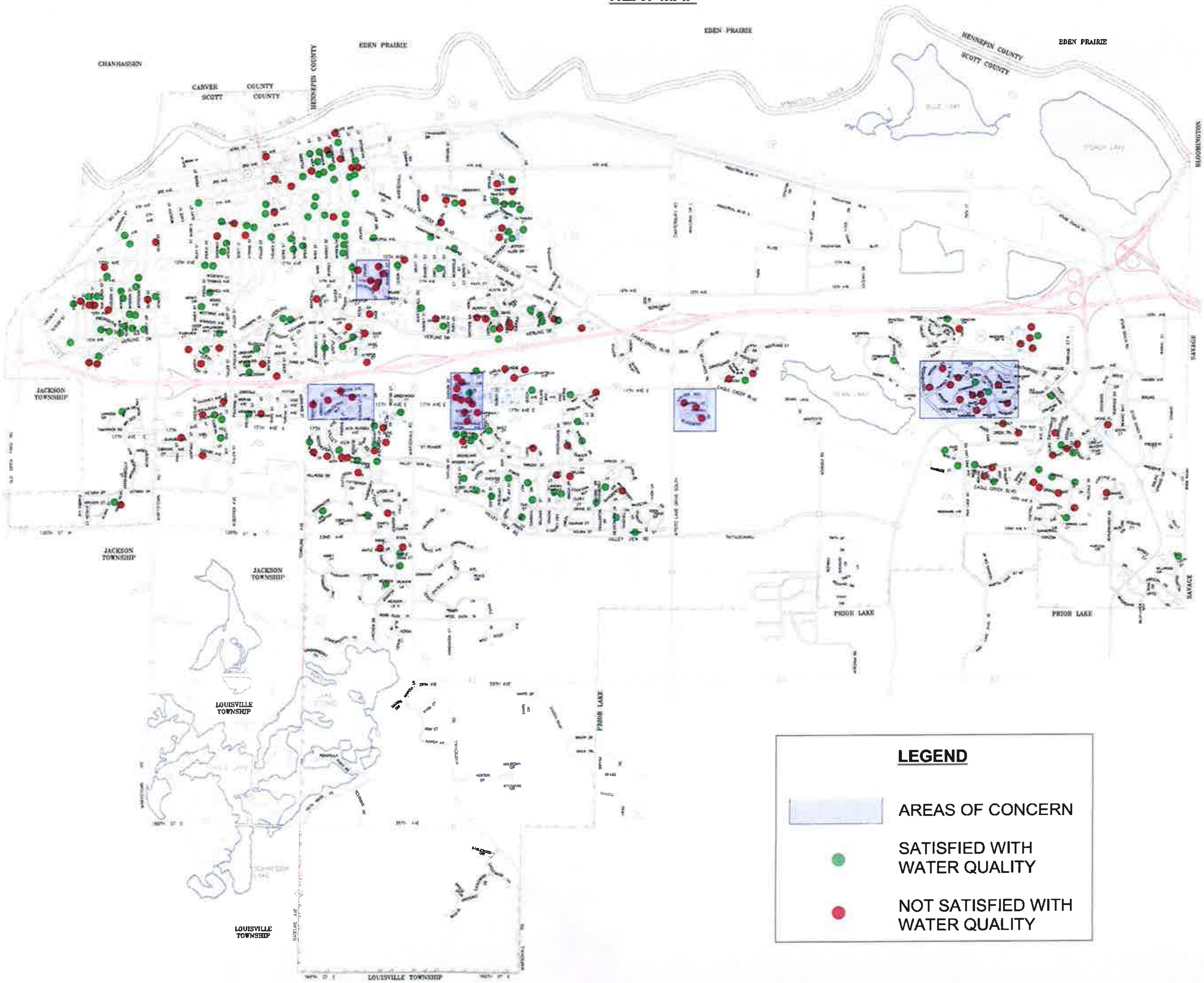
  SPU, Attn: Water Survey
  PO Box 540
  Shakopee, MN 55379

Shakopee Public Utilities

APPENDIX B

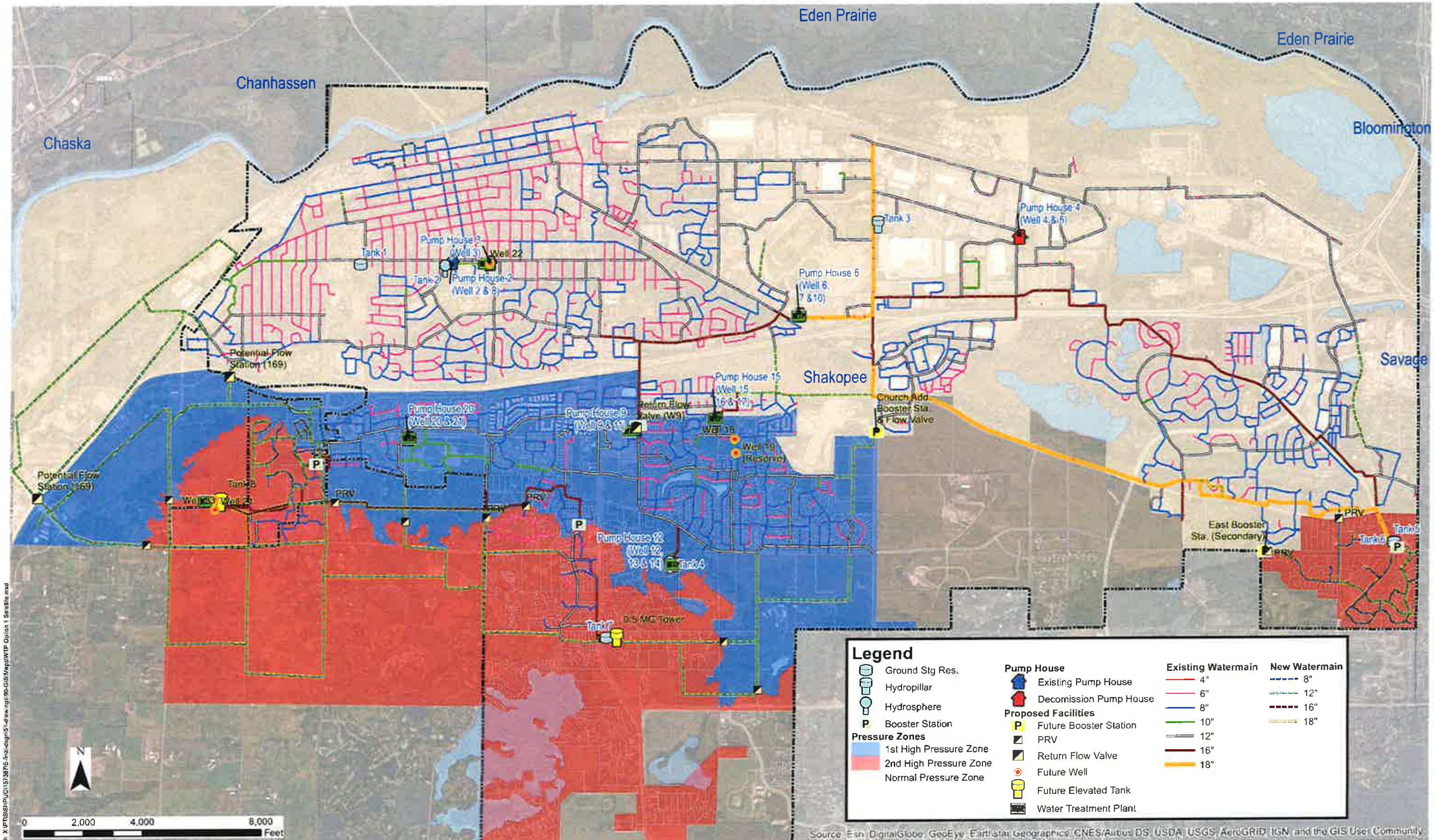
WATER QUALITY SATISFACTION HEAT MAP

WATER QUALITY SATISFACTION HEAT MAP



Appendix D

Alternatives Water System Maps



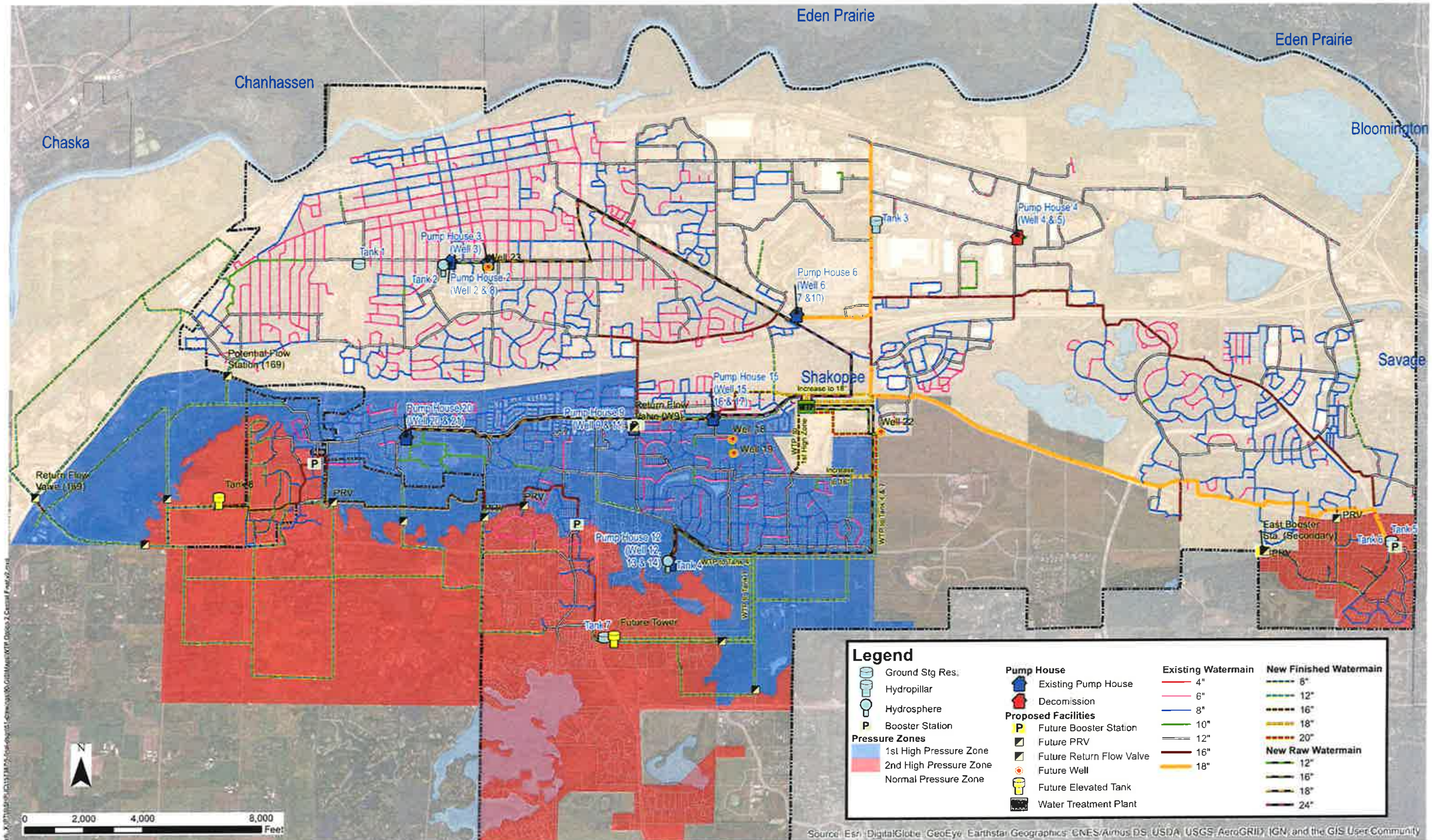
SEH

Project Number: SHPUC 157387
Print Date: 9/2/2021
Map by:
Projection:
Source:

Alternative 1 - Satellite Systemwide Treatment

Shakopee Public Utilities
Shakopee, Minnesota

FIGURE 1
Ultimate Water System Map



SEH

Project Number: SHPUC 157387
Print Date: Print Date: 9/2/2021

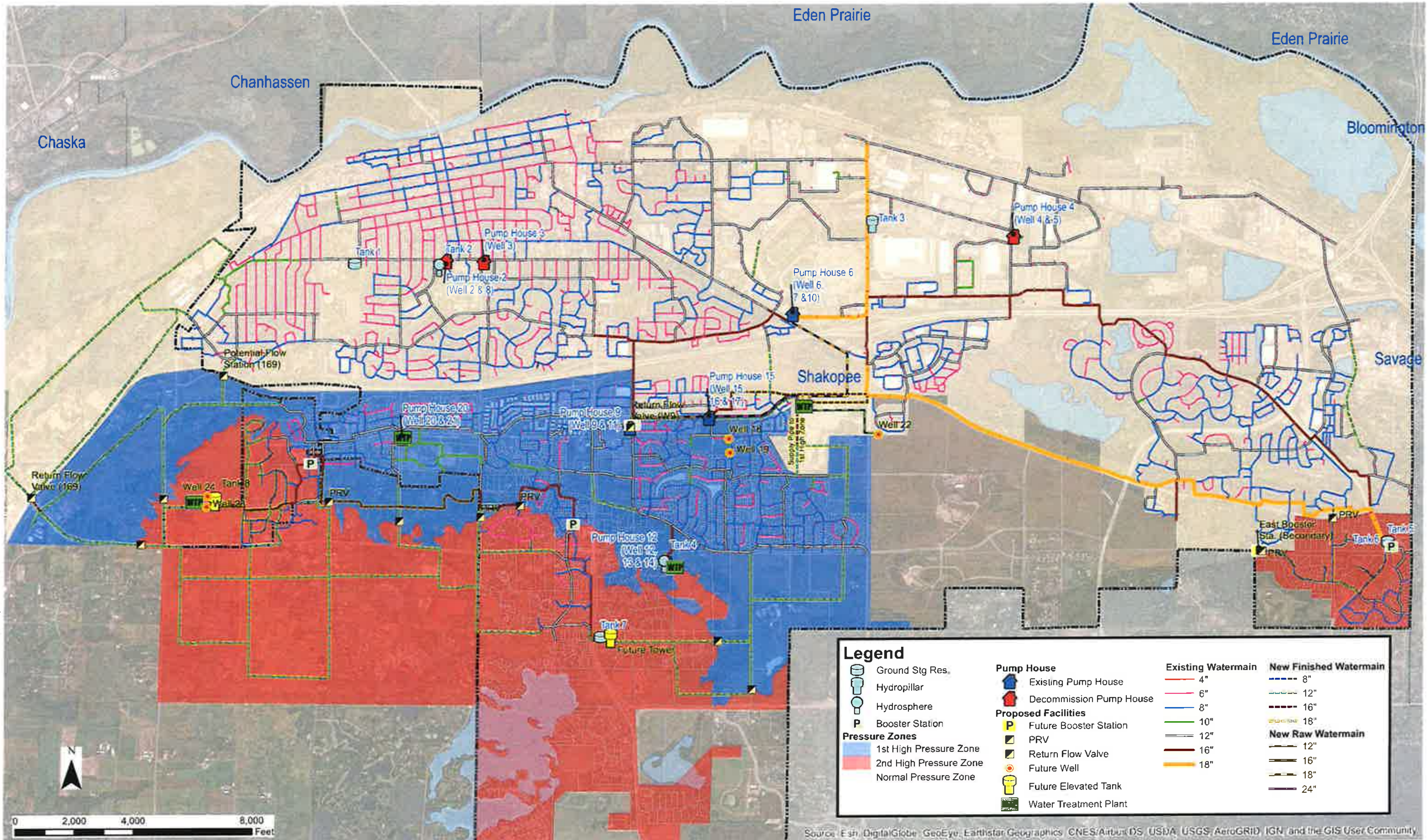
Alternative 2 - Central Systemwide Treatment

Shakopee Public Utilities

Shakopee, Minnesota

FIGURE 2

Ultimate Water System Map



Project Number: SHPUC 157387
Print Date: 9/2/2021
Map by:
Projection:
Source:

Alternative 3 - Hybrid Systemwide Treatment

Shakopee Public Utilities
Shakopee, Minnesota

FIGURE 3
Ultimate Water System Map

Appendix E

Water Treatment Plant Site/Building Layouts

PUMP HOUSE NO. 3
3MGD ION EXCHANGE WTP

SPU WATER TREATMENT FEASIBILITY STUDY

FOR SHAKOPEE PUBLIC UTILITIES
SHAKOPEE, MN

SEH

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR 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

DATE 3/15/2021 LIC. NO.

SEH FILE NO.	SHPUC 157387
PROJ. STATUS	EXHIBIT
ISSUE DATE	3/15/2021
DESIGNED BY	RAH
DRAWN BY	RAH

MARK DATE DESCRIPTION
REVISIONS

SHEET TITLE
SHAKOPEE PUBLIC UTILITIES PROPOSED WATER TREATMENT FACILITY PLAN

SHEET

PUMP HOUSE NO. 6

5MGD GRAVITY FILTRATION WTP

SPU WATER TREATMENT FEASIBILITY STUDY

FOR SHAKOPEE PUBLIC UTILITIES

SHAKOPEE, MN

SHEET TITLE

SHAKOPEE PUBLIC UTILITIES

PROPOSED WATER TREATMENT FACILITY PLAN

SHEET

PUMP HOUSE NO. 9

3MGD ION EXCHANGE WTP

SPU WATER TREATMENT FEASIBILITY STUDY

FOR SHAKOPEE PUBLIC UTILITIES
SHAKOPEE, MN

SHEET TITLE
SHAKOPEE PUBLIC UTILITIES
PROPOSED WATER TREATMENT
FACILITY PLAN

SEH FILE NO.	SHPUC 157387
PROJ. STATUS	EXHIBIT
ISSUE DATE	3/15/2021
DESIGNED BY	RAH
DRAWN BY	RAH

MARK DATE DESCRIPTION
REVISIONS

SHEET

SEH

PUMP HOUSE NO. 12
3MGD GRAVITY FILTRATION WTP

SEH

SPU WATER TREATMENT FEASIBILITY STUDY
FOR SHAKOPEE PUBLIC UTILITIES
SHAKOPEE, MN

3/15/2021

SEH FILE NO. SHPUC 157387
PROJ. STATUS EXHIBIT
ISSUE DATE 3/15/2021
DESIGNED BY RAH
DRAWN BY RAH

REVISIONS

SHEET TITLE
SHAKOPEE PUBLIC UTILITIES
PROPOSED WATER TREATMENT
FACILITY PLAN

SHEET

PUMP HOUSE NO. 15
10MGD GRAVITY FILTRATION & ION EXCHANGE WTP

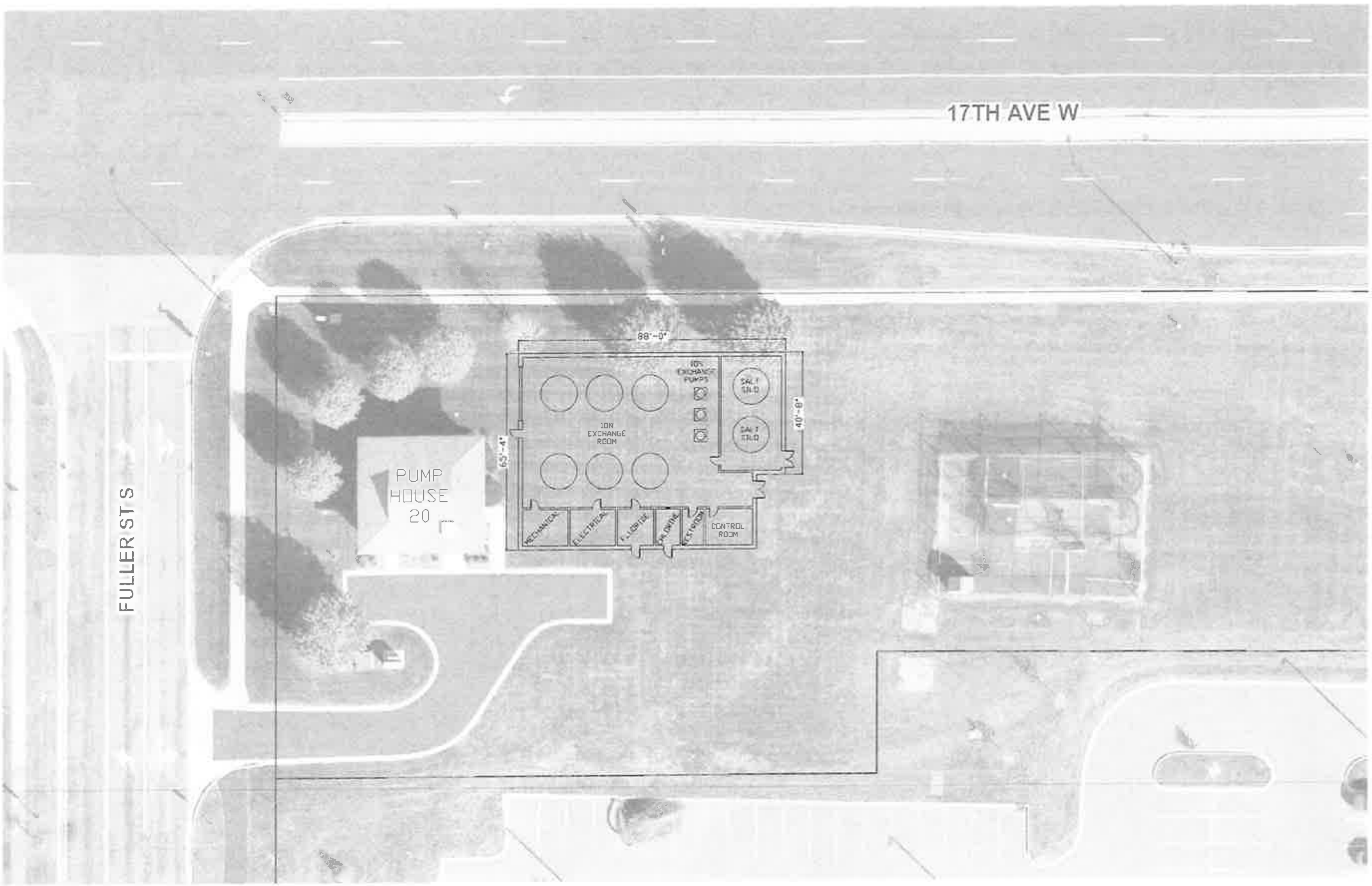
SEH

SPU WATER TREATMENT FEASIBILITY STUDY
FOR SHAKOPEE PUBLIC UTILITIES
SHAKOPEE, MN

SEH FILE NO.	SHPUC 157387
PROJ. STATUS	EXHIBIT
ISSUE DATE	3/15/2021
DESIGNED BY	RAH
DRAWN BY	RAH

SHEET TITLE
SHAKOPEE PUBLIC UTILITIES
PROPOSED WATER TREATMENT
FACILITY PLAN

SHEET



PUMP HOUSE NO. 20
3MGD ION EXCHANGE WTP

SEH

SPU WATER TREATMENT FEASIBILITY STUDY
FOR SHAKOPEE PUBLIC UTILITIES
SHAKOPEE, MN

SEH FILE NO. SHPUC 157387
PROJ. STATUS EXHIBIT
ISSUE DATE 3/15/2021
DESIGNED BY RAH
DRAWN BY RAH

SHEET TITLE
SHAKOPEE PUBLIC UTILITIES
PROPOSED WATER TREATMENT
FACILITY PLAN

SHEET

NES (HYBRID) WTP

18MGD GRAVITY FILTRATION & ION EXCHANGE WTP

SEH

SPU WATER TREATMENT FEASIBILITY STUDY

FOR SHAKOPEE PUBLIC UTILITIES
SHAKOPEE, MN

SEH FILE NO.	SHPUC 157387
PROJ STATUS	EXHIBIT
ISSUE DATE	3/15/2021
DESIGNED BY	RAH
DRAWN BY	RAH

SHEET TITLE
SHAKOPEE PUBLIC UTILITIES
PROPOSED WATER TREATMENT
FACILITY PLAN

SHEET

CENTRAL WTP
25MGD GRAVITY FILTRATION, ION EXCHANGE, & LIME SOFTENING WTP

SPU WATER TREATMENT FEASIBILITY STUDY
FOR SHAKOPEE PUBLIC UTILITIES
SHAKOPEE, MN

SHEET TITLE
SHAKOPEE PUBLIC UTILITIES PROPOSED WATER TREATMENT FACILITY PLAN

SEH FILE NO. SHPUC 157387
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REVISIONS

DATE 3/15/2021

SHEET

Appendix F

Detailed Cost Opinions

Systemwide Water Treatment Alternatives Opinion of Probable Costs Comparison

Alternative No.	WTP Type	Area	Site Location	Existing Wells	New Wells	gpm	MGD	Route	Length (ft)	Size (in.)	Unit Cost	Cost	Route	Length (ft)	Size (in.)	Unit Cost	Cost	WTP Size (MGD)	New Wells	New Water Main	Decommission Wells	[illegible]	Construction Total	Contingency	Subtotal	Engineering	Total Probable Cost for Iron & Manganese Removal	[illegible]	Construction Total	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$ [illegible]						[illegible]	$1,000,000	[illegible]			-		-		-	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]											[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$4,700,000	$4,700,000	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]											[illegible]									-	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]											[illegible]				[illegible]	$4,750,000	[illegible]	$5,462,500	[illegible]	$6,412,500			
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]											[illegible]									-	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]											[illegible]	[illegible]			[illegible]	$6,750,000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$2,400,000	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]											[illegible]	[illegible]			[illegible]	$8,000,000	[illegible]	[illegible]	[illegible]	[illegible]		-	
																	TOTAL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Cost Estimate

[illegible]

Systemwide Water Treatment Alternatives Opinion of Probable Costs Comparison

Alternative No.	WTP Type	Zone	Site Location	Supply Wells: Existing Wells	Supply Wells: New Wells	Capacity[1]: gpm	Capacity[1]: MGD	Raw Watermain: Route	Length (ft)	Size (in.)	Unit Cost	Cost	Finished Water: Route	Length (ft)	Size (in.)	Unit Cost	Cost
ALT. 1 (Satellite)	SATELLITE	N/S	Pump House 1	Well 2 & 4	Well 33	2,600	3.7	Pump House 7 to Pump House 1	3,500	12	[illegible]	$ [illegible]					
	SATELLITE	N/S	Pump House 15	Well 15, 16, & 17	Well 18 & 19	6,400	9.2										
	SATELLITE	N/S	Pump House 9	Well 9, 11	NONE	[illegible]	3.0										
	SATELLITE	SHES	Pump House 12	Well 13, 14	NONE	1,846	2.7										
	SATELLITE	SHES	Pump House 20	Well 20 & 21	NONE	[illegible]	3.3										
	SATELLITE	SHES	Tank 8	NONE	Well 23 & 24	2,400	3.5										
	SATELLITE	N/S	Pump House 6	Well 6, 7, 10	NONE	[illegible]	4.9										
																	TOTAL
ALT. 2 (Central)	CENTRAL	N/S/ SHES	Gravel Site (North West Corner)	Well 6, 7, 10, 15, 16, 17, 9, 11, 20, 21, 12, 13, 14, 2, & 4	Well 18, 19, 33, & 24	[illegible]	30.3	Pump House 7 to Pump House 1	3,500	12	290	$ [illegible]	WTP to 18" Main on Mystic Lake Dr	2,750	18	[illegible]	$ [illegible]
								Pump House 1 to Pump House 6	11,250	16	375	$ [illegible]	Valley View Rd to Tank 7	8,000	12	290	$ [illegible]
								Pump House 6 to WTP	6,750	24	450	$ 3,037,500.00	WTP to Pump House 15	4,250	12	290	$ [illegible]
								Well 33 to WTP	3,500	12	290	$ 1,015,000.00	Pump House 15 to Pump House 9	3,250	12	290	$ [illegible]
								Pump House 20 to Pump House 9	[illegible]	16	375	$ [illegible]	WTP to Tower & Intersection	4,250	20	375	$ [illegible]
								Pump House 9 to Pump House 15	3,250	18	350	$ 1,137,500.00		650	18	350	$ 227,500.00
								Pump House 15 to WTP	6,250	24	450	$ [illegible]		2,250	16	325	$ 731,250.00
								Pump House 12 to WTP	[illegible]	16	375	$ [illegible]	WTP to Pump House 13	[illegible]	17	290	$ [illegible]
																	TOTAL
ALT. 3 (Hybrid)	HYBRID	N/S	Gravel Site (North West Corner)	Well 6, 7, 10, 15, 16, 17, 9, & 11	Well 18, 19, & 33 (Development East of Crane Well)	[illegible]	18.8	Pump House 15 to WTP	4,250	24	450	$ 1,912,500.00	WTP to 18" Main on Mystic Lake Dr	2,500	18	325	$ 812,500.00
								Pump House 9 to Pump House 15	3,250	16	350	$ 1,137,500.00	WTP to SHES	1,250	16	325	$ 406,250.00
								Well 33 to WTP	3,500	12	290	$ 1,015,000.00		3,750	17	290	$ 1,087,500.00
								Pump House 6 to WTP	6,750	18	350	$ 2,362,500.00	WTP to Pump House 15	4,250	12	290	$ 1,232,500.00
													WTP to 17 Ave E	750	18	350	$ 262,500.00
	SATELLITE	SHES	Tank 8	NONE	Well 23 & 24	2,500	3.6										
	SATELLITE	SHES	Pump House 12	Well 12, 13	NONE	1,846	2.7										
	SATELLITE	SHES	Pump House 20	Well 20 & 21	NONE	[illegible]	3.3										
																	TOTAL

Cost Estimate

Alternative No.	WTP Size (MGD)	New Wells	New Water Main	Distribution Wells	Iron & Manganese WTP	Construction Total	Contingency (15%)	Subtotal	Engineering (15%)	Total Probable Cost for Iron & Manganese Removal	Nitrate Removal Process	Construction Total	Contingency (15%)	Subtotal	Engineering (20%)	Total Probable Cost for Nitrate Removal	Total Probable Cost for Nitrate, Iron & Manganese Removal
ALT. 1	[illegible]	$1,000,000	$435,000	-	-	-	-	-	-	-	$5,000,000	$6,435,000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	8.0	$2,000,000		$50,000	[illegible]	[illegible]	[illegible]	[illegible] 500	$2,[illegible],000	$18,[illegible] 500	$4,200,000	$4,200,000	$630,000	$4,830,000	[illegible]	$5,670,000	[illegible]
	3.0									-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	3.0	-	-	-	[illegible]	$4,000,000	[illegible]	$4,600,000	$800,000	$5,400,000	-	-	-	-	-	-	[illegible]
	3.0	-	-	-	-	-	-	-	-	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	3.5	[illegible]			$4,000,000	$6,000,000	$900,000	[illegible]	[illegible]	$8,100,000	$1,400,000	[illegible]	[illegible]	$1,610,000	[illegible]	$1,890,000	[illegible]
	5.0	[illegible]			[illegible]	$7,000,000	[illegible]	[illegible]	[illegible]	[illegible]				-		-	[illegible]
TOTAL	28.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ALT. 2	25.0	$4,000,000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$84,[illegible]	[illegible]	$9,450,000	[illegible]	[illegible]	[illegible]	$12,757,500	[illegible]
TOTAL	25.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ALT. 3	25.0	[illegible]	[illegible]	[illegible]	$[illegible] 000,000	$33 [illegible] 750	$4,[illegible]	[illegible]	[illegible]	$44,926,[illegible]	$7,000,000	$7,000,000	[illegible]	$8,050,000	$1,400,000	$9,450,000	[illegible]
	3.5	$2,000,000	-	-	[illegible]	$6,000,000	[illegible]	$6,900,000	[illegible]	$8,100,000	$1,400,000	$1,400,000	[illegible]	[illegible]	[illegible]	$1,890,000	[illegible]
	3.0				[illegible]	$4,000,000	$600,000	[illegible]	[illegible]	[illegible]		-		-		-	[illegible]
	3.0										[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
TOTAL	[illegible]	$5,000,000	[illegible]	$50,000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$13,400,000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

(1) New well capacity is assumed to be 1,200 gpm.

Systemwide Water Treatment Alternatives Operations, Maintenance, and Repairs Costs Comparison

ANNUAL COSTS

Alternative No.	WTP Type	Zone	Site Location	Existing Wells	New Wells	Capacity gpm	Capacity MGD	WTP Average Use (MGD)	Equipment Replacement	Labor	Gas	Chemicals	Insurance	Electricity	Equipment Repair	Total Annual O&M&R	Equipment Replacement	Labor	Gas	Chemicals	Insurance	Electricity	Equipment Repair	Total Annual O&M&R	Total Annual Cost	Equipment Replacement	Labor	Gas	Chemicals	Insurance	Disposal	Equipment Repair	O&M&R	Debt Repayment	Total Annual Cost	Total Probable Cost
ALT. 1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	7,600	[illegible]	[illegible]									[illegible]	[illegible]	56,000	[illegible]	[illegible]	$48,144	[illegible]	[illegible]	$255,597	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$244,758	[illegible]	[illegible]	[illegible]			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]											
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]									[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]											
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$9,004	[illegible]	-	-	-	-	-	-	-	-	[illegible]											
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]									[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]											
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$3,911	$60,768	$9,004	[illegible]	[illegible]			[illegible]	[illegible]	$4,094	[illegible]	[illegible]	[illegible]											
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$340,073									[illegible]											
							TOTAL	[illegible]	[illegible]	[illegible]	[illegible]	$703,750	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$464,806	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]											
ALT. 2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
							TOTAL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ALT. 3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]											
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]									[illegible]											
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]									[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]											
							TOTAL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]											

NOTES:
(1) [illegible]

Systemwide Water Treatment Alternatives Operations, Maintenance, and Repairs Costs Comparison

Alternative No	WTP Type	Zone	Site Location	Supply Wells: Existing Wells	Supply Wells: New Wells	Capacity[1]: gpm	Capacity[1]: MGD
ALT. 1 (Satellite)	SATELLITE	NES	Pump House 3	Well 2 & 8	Well 22	2,600	3.7
	SATELLITE	NES	Pump House 15	Well 15, 16, & 17	Well 18 & 19	6,400	9.2
	SATELLITE	NES	Pump House 9	Well 9, 11	NONE	2,050	3.0
	SATELLITE	1HES	Pump House 12	Well 12, 13	NONE	1,846	2.7
	SATELLITE	1HES	Pump House 20	Well 20 & 21	NONE	2,317	3.3
	SATELLITE	2HES	Tank 8	NONE	Well 23 & 24	2,400	3.5
	SATELLITE	NES	Pump House 6	Well 6, 7, 10	NONE	3400	4.9
							TOTAL:
ALT. 2 (Central)	CENTRAL	NES/ 1HES/ 2HES	Gravel Site (North West Corner)	Well 6, 7, 10, 15, 16, 17, 9, 11, 20, 21, 12, 13, 14, 2, 8, & 3	Well 18, 19, 22, & 25	21,019	30.3
							TOTAL:
ALT. 3 (HYBRID)	HYBRID	NES	Gravel Site (North West Corner)	Well 6, 7, 10, 15, 16, 17, 9, & 11	Well 18, 19, & 22 (Development East of Gravel Site)	13,050	18.8
	SATELLITE	2HES	Tank 8	NONE	Well 23 & 24	2,500	3.6
	SATELLITE	1HES	Pump House 12	Well 12, 13	NONE	1,846	2.7
	SATELLITE	1HES	Pump House 20	Well 20 & 21	NONE	2,317	3.3
							TOTAL:

ANNUAL COSTS

Pressure — IRON & MANGANESE REMOVAL

Alternative / Site Location	WTP Average Use (MGD)	Equipment Replacement	+ Labor	+ Gas	+ Chemicals	+ Insurance	+ Electricity	+ Equipment Repair	= Total Annual O&M&R
ALT. 1 – Pump House 3	0.75	-	-	-	-	-	-	-	-
ALT. 1 – Pump House 15	3.00	$383,009	$122,087	$13,565	$105,000	$13,043	$195,000	$41,474	$872,229
ALT. 1 – Pump House 9	0.75								
ALT. 1 – Pump House 12	0.75	$95,515	$30,522	$3,391	$26,250	$3,261	$48,750	$10,369	$218,057
ALT. 1 – Pump House 20	0.75	-	-	-	-	-	-	-	
ALT. 1 – Tank 8	0.75	$95,515	$30,522	$3,391	$26,250	$3,261	$48,750	$10,369	$218,057
ALT. 1 – Pump House 6	1.25	$159,191	$50,870	$5,652	$43,750	$5,435	$81,250	$17,281	$363,429
ALT. 1 TOTAL	8.0	$732,280	$234,000	$26,000	$201,250	$25,000	$373,750	$79,492	$1,671,772
ALT. 2 – Gravel Site	8.0	$742,118	$156,000	$20,000	$280,000	$25,000	$520,000	$80,761	$1,823,879
ALT. 2 TOTAL	8.0	$742,118	$156,000	$20,000	$280,000	$25,000	$520,000	$80,761	$1,823,879
ALT. 3 – Gravel Site	5.8	$580,774	$185,186	$20,621	$159,612	$19,836	$396,422	$63,046	$1,325,888
ALT. 3 – Tank 8	0.8	$75,753	$24,207	$2,690	$20,819	$2,586	$38,664	$8,223	$172,942
ALT. 3 – Pump House 12	0.8	$75,753	$24,207	$7,690	$20,819	$2,586	$38,664	$8,223	$172,942
ALT. 3 – Pump House 20	0.8	-	-	-	-	-	-	-	-
ALT. 3 TOTAL	8.0	$732,280	$234,000	$26,000	$201,250	$25,000	$373,750	$79,492	$1,671,772

Pressure — NITRATE REMOVAL

Alternative / Site Location	+ Equipment Replacement	+ Labor	+ Gas	+ Chemicals	+ Insurance	+ Electricity	+ Equipment Repair	= Total Annual O&M&R	= Total Annual Cost for Nitrate, Iron & Manganese Removal
ALT. 1 – Pump House 3	$106,951	$52,000	$7,333	$65,145	$7,790	$48,750	$10,838	$298,807	$298,807
ALT. 1 – Pump House 15	$57,309	-	-	$211,578	$1,304	$19,500	$8,295	$301,986	$1,174,215
ALT. 1 – Pump House 9	$106,951	$52,000	$7,333	$65,145	$7,790	$48,750	$10,838	$298,807	$298,807
ALT. 1 – Pump House 12	-	-	-	-	-	-	-	-	$218,057
ALT. 1 – Pump House 20	$106,951	$52,000	$7,333	$65,145	$7,790	$48,750	$10,838	$298,807	$298,807
ALT. 1 – Tank 8	$14,327	-	-	$53,895	$326	$4,875	$1,037	$74,460	$292,517
ALT. 1 – Pump House 6	-	-	-	-	-	-	-	-	$363,429
ALT. 1 TOTAL	$392,489	$156,000	$22,000	$464,906	$15,000	$170,625	$41,846	$1,272,866	$2,944,638
ALT. 2 – Gravel Site	$111,318	-	-	$574,875	$3,750	$78,000	$24,228	$792,171	$2,616,050
ALT. 2 TOTAL	$111,318			$574,875	$3,750	$78,000	$24,228	$792,171	$2,616,050
ALT. 3 – Gravel Site	$145,193	N/A	N/A	$413,191	$2,976	$44,463	$18,914	$624,736	$1,950,624
ALT. 3 – Tank 8	$18,938	-	-	$53,895	$388	$5,800	$1,645	$80,665	$253,607
ALT. 3 – Pump House 12	-	-							-
ALT. 3 – Pump House 20	$196,824	$156,000	$4,667	$65,145	$21,638	$48,750	$18,058	$511,082	$511,082
ALT. 3 TOTAL	$360,956	$156,000	$4,667	$532,230	$25,000	$99,013	$38,617	$1,216,483	$2,715,313

NOTES:

[1] New wells capacity assumed to be 1,200 gpm

Building a Better World for All of Us®

Sustainable buildings, sound infrastructure, safe transportation systems, clean water, renewable energy and a balanced environment. Building a Better World for All of Us communicates a companywide commitment to act in the best interests of our clients and the world around us.

We're confident in our ability to balance these requirements.

SEH