WASHINGTON COUNTY MUNICIPAL WATER COALITION

Water Supply Feasibility Assessment

METROPOLITAN COUNCIL

October 2016

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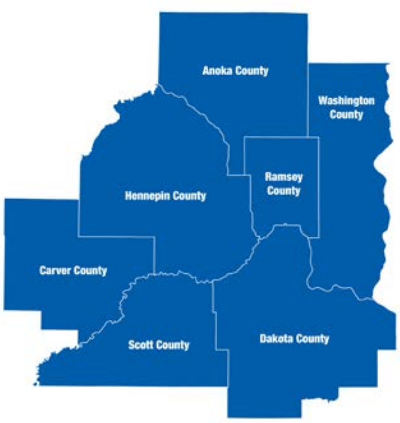

The Metropolitan Council is the regional planning organization for the seven-county Twin Cities area. The Council operates the regional bus and rail system, collects and treats wastewater, coordinates regional water resources, plans and helps fund regional parks, and administers federal funds that provide housing opportunities for low- and moderate-income individuals and families. The 17-member Council board is appointed by and serves at the pleasure of the governor.

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About this Report

The Metropolitan Council recognizes that water supply planning is an integral component of long-term regional and local comprehensive planning. The Council has implemented a number of projects to provide a base of technical information needed to make sound water supply decisions.

This report summarizes the result of work for the Washington County Municipal Water Coalition and meets the requirements of Minnesota Statutes, section 473, subdivision 1565, which calls for the Council to “carry out planning activities addressing the water supply needs of the metropolitan area”. The Washington County Municipal Water Coalition includes the cities of Bayport, Cottage Grove, Lake Elmo, Newport, Oakdale, Oak Park Heights, Stillwater, Saint Paul Park, and Woodbury.

The Metropolitan Council retained Short Elliott Hendrickson Inc. (SEH) to complete this technical assessment of the capital and operational costs, as well as potential benefits of alternative approaches to water supply in Washington County. This assessment has been carried out with input from, and engagement with stakeholders, including community public water utilities, through a technical advisory committee (TAC). This group continues to meet regularly to discuss the study along with other water supply topics of importance to group members.

Special funding for this project was provided through the Clean Water Fund.

Recommended Citation

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Table of Contents

List of Figures

List of Tables

APPENDICES

Executive Summary

The primary source of drinking water in southern Washington County is groundwater from the Prairie du Chien-Jordan aquifer. Concerns with groundwater use in the region include areas of contamination, interference with surface waters, and potential aquifer drawdown due to increased future demands. It is possible that groundwater may not be able to meet all of the future drinking water demands.

The primary objective of this study is to understand the relative costs and implementation considerations of different approaches to long term water sustainability within the study area. The study area includes the nine cities that form the Washington County Municipal Water Coalition (Coalition): the cities of Bayport, Cottage Grove, Lake Elmo, Newport, Oakdale, Oak Park Heights, Stillwater, Saint Paul Park, and Woodbury.

The study will be referenced to support future planning of metro area water supplies and water sustainability practices. As cities face increased demands on their water supplies in the future, this report provides concept level options for consideration.

This report meets the requirements of Minnesota Statutes, section 473, subdivision 1565, which calls for the Council to "carry out planning activities addressing the water supply needs of the metropolitan area". Special funding for this project was provided through the Clean Water Fund.

This study evaluates four approaches to meet future water demands in the study area:

- Approach 1: Reuse of Water from Pollution Containment Wells
- Approach 2: New Surface Water Treatment Plant (WTP) with Conjunctive Use of Surface Water and Groundwater
- Approach 3: Connection to Saint Paul Regional Water Services (SPRWS) with Conjunctive Use of Groundwater
- Approach 4: New Wellfields

This study provides communities concept level costs and considerations for various water supply approaches. It is not meant to prescribe specific solutions for implementation. Rather these approaches serve as examples to stimulate future planning that could involve a hybrid of the alternatives identified in this study or in combination with water conservation measures and other sustainability approaches.

Summary of Results

Several alternatives were evaluated under each approach. Table ES-1 summarizes the water supply system capacity and costs as a range for the various alternatives evaluated for each approach. A wide range of system options were considered that supplied water to various subsets of communities, ranging from a portion of one community to six entire communities.

Table ES-1. Approach Summary.

Approach	Description	Water Provided (MGY)	Capital Cost	Total Annual Cost	Cost per 1,000 gallons
1	Non-potable and potable reuse of 3M pollution containment water. Components include GAC or RO treatment and pipelines.	1,260 – 1,575	$18,900,000–$37,500,000	$1,700,000–$6,000,000	$1.10 – $4.70
2	New surface WTP on Mississippi or St. Croix River to serve various subsets of communities. Components include new WTP, watermain, booster stations, blending stations.	1,225 – 6,680	$68,600,00-$184,900,000	$7,600,000-$23,900,000	$3.50-$6.20
3	Connect various subsets of communities to SPRWS. Components include watermain, booster stations, blending stations.	120 – 4,900	$4,800,000-$96,500,000	$900,000-$20,800,000	$3.20-$7.12
4	Drill new wells in optimized locations.	3,150	$25,000,000-$30,600,000	$3,500,000-$3,800,000	$1.10-$1.20

Key findings of this study are as follows:

<u>Approach 1</u> – Reuse of Water from Pollution Containment Wells

- The non-potable reuse alternatives evaluated do not appear to be feasible (Alternatives 1A-1D). Due to the potential for unknown contaminants, using treated (granular activated carbon [GAC] treatment) containment water for Valley Creek augmentation or irrigation may not be allowed by regulatory agencies. Sending the water to Northern Tier Refining is technically feasible, but it would be expensive and does not provide any clear benefits over its existing use.
- Utilizing the treated pollution containment water for potable drinking water (Alternatives 2A-2C) is a more beneficial use of the water than as process water. However, concept level cost estimates indicate that reverse osmosis (RO) treatment of the water is very expensive from a capital and O&M standpoint, potentially even more expensive than building a surface WTP.

Approach 2 – New Surface Water Treatment Plant

- Providing treated surface water to Coalition communities via a new WTP would be significantly more expensive than the existing groundwater systems and would require major treatment and conveyance infrastructure. However, if a new water source were needed and groundwater was not available, building a new surface WTP would be feasible and may be a cost effective option.

Approach 3 – Connection to Saint Paul Regional Water Services

- Providing treated surface water to small subsets of Coalition communities appears to be feasible. However, once the demand exceeds the capacity of the Hazel Park pressure zone, significant new trunk water main would be required through urban areas. At this point, the alternatives are less cost effective than building a new surface WTP. A switch to SPRWS would result in higher water rates for all of the alternatives.

Approach 4 – New Wellfields

- Drilling new wells is by far the lowest cost approach for a new water source evaluated in this study. Without an incentive to switch to a new source of water, communities will continue to drill new wells. However, significant areas of contamination exist in Washington County. In addition, aquifer drawdown could be affecting surface waters in eastern Woodbury.

Approach 1 – Reuse of Water from Pollution Containment Wells

Pollution containment wells owned and operated by 3M on the Woodbury/Cottage Grove border pump approximately 3,000 gallons per minute (gpm) of groundwater that is contaminated with perfluorinated compounds (PFCs) to the 3M Cottage Grove facility where it is treated with GAC, used as process water, and discharged to the Mississippi River. Approach 1 alternatives evaluate the feasibility of different uses of the pollution containment water. Table ES-2 summarizes the Approach 1 alternatives.

Table ES-2. Summary of Approach 1 Alternatives.

Alternative	Components	Water Provided (MGY)	Capital Cost	Total Annual Cost	Cost per 1,000 gallons
1A – Pollution containment water from 3M Woodbury to Valley Creek – nonpotable water	GAC treatment, watermain	1,575	$18,900,000	$1,743,000	$1.10
1B – Pollution containment water from 3M Woodbury to Northern Tier Refinery – nonpotable water	GAC treatment, watermain	1,575	$20,100,000	$1,840,000	$1.20
1C – Pollution containment water from 3M Cottage Grove to Northern Tier Refinery – nonpotable water	GAC treatment, watermain	1,575	$24,700,000	$2,170,000	$1.40
1D – Pollution containment water from 3M Woodbury to golf courses and Northern Tier Refinery – nonpotable water	GAC treatment, watermain	1,575	$32,200,000	$2,810,000	$1.80
2A – Pollution containment water to Woodbury – potable water	RO treatment, watermain	1,260	$32,300,000	$5,560,000	$4.40
2B – Pollution containment water to Cottage Grove – potable water	RO treatment, watermain	1,260	$32,200,000	$5,550,000	$4.40
2C – Pollution containment water to Woodbury & Cottage Grove – potable water	RO treatment, watermain	1,260	$37,500,000	$5,980,000	$4.70

Approach 2 – New Surface Water Treatment Plant – Conjunctive Use

An option for reducing reliance on groundwater for the Coalition is to build a new water treatment facility with a surface water source for conjunctive use with the existing groundwater systems. Conjunctive use means that existing groundwater systems would be used (in conjunction) with new surface water systems during periods of high demand. Approach 2 looks at scenarios with water treatment facilities located on the Mississippi and St. Croix rivers serving various communities. Table ES-3 summarizes the Approach 2 alternatives.

Table ES-3. Summary of Approach 2 Alternatives.

Alternative	Communities Served	Components	Water Provided (MGY)	Capital Cost	Total Annual Cost	Cost per 1,000 gallons
4A – New Surface WTP on Mississippi River	Cottage Grove, Woodbury	New WTP, watermain, booster stations, blending stations	4,900	$131,400,000	$17,790,000	$3.50
4B – New Surface WTP on Mississippi River	Cottage Grove, Woodbury, Lake Elmo, Oakdale, Newport, St. Paul Park	New WTP, watermain, booster stations, blending stations	6,680	$174,500,000	$23,390,000	$3.50
5A – New Surface WTP on St. Croix River	Stillwater, Oak Park Heights, Bayport	New WTP, watermain, booster stations, blending stations	1,225	$68,600,000	$7,560,000	$6.20
5B – New Surface WTP on St. Croix River	Woodbury, Cottage Grove, Lake Elmo, Oakdale	New WTP, watermain, booster stations, blending stations	6,470	$184,900,000	$23,850,000	$3.70

Approach 3 – Connect to Saint Paul Regional Water Services – Conjunctive Use

In Approach 3, various subsets of Coalition communities would connect to SPRWS, a major water utility that receives approximately 90% of its water from the Mississippi River. Portions of the SPRWS system border the Coalition communities. Table ES-4 summarizes the Approach 3 alternatives.

Table ES-4. Summary of Approach 3 Alternatives.

Alternative	Components	Water Provided (MGY)	Capital Cost (millions)	Total Annual Cost	Cost per 1,000 gal
6A – Connect portion of Woodbury to SPRWS – Not Conjunctive Use	Watermain, booster station	730	$4,800,000	$2,300,000	$3.20
6B – Connect all of Woodbury to SPRWS – Conjunctive Use	Watermain, blending station	3,210	$77,600,000	$14,700,000	$4.60
6C – Connect all of Woodbury, Cottage Grove to SPRWS – Conjunctive Use	Watermain, blending stations, booster station	4,900	$96,500,000	$20,800,000	$4.23
6D – Connect all of Newport to SPRWS – Conjunctive Use	Watermain, blending station	120	$6,500,000	$850,000	$7.12
6E – Connect all of Oakdale to SPRWS – Conjunctive Use	Watermain, blending station, booster station	1,020	$13,100,000	$3,800,000	$3.70
6F – Connect all of Oakdale and Lake Elmo to SPRWS – Conjunctive Use	Watermain, blending stations, booster stations	1,470	$16,000,000	$5,300,000	$3.59
6G – Connect portion of Woodbury and all of Newport to SPRWS – Conjunctive Use for Newport	Watermain, blending station, booster station	842	$10,200,000	$3,100,000	$3.66

Approach 4 – New Well Fields

Approach 4 investigates the feasibility of constructing new wells and a preliminary analysis of areas in the region where there are less drawdown or contamination concerns. Table ES-5 summarizes the Approach 4 alternatives.

Table ES-5. Summary of Approach 4 Alternatives.

Alternative	Communities Served	Components	Water Provided (MGY)	Capital Cost	Total Annual Cost	Cost per 1,000 gallons
7A – New Well Field on Woodbury/Cottage Grove Border	Woodbury, Cottage Grove	Wells, watermain	3,150	$26,400,000	$3,450,000	$1.10
7A – New Well Field in Denmark Township	Woodbury, Cottage Grove	Wells, watermain	3,150	$30,600,000	$3,770,000	$1.20
7A – New Well Field in Southern Cottage Grove	Woodbury, Cottage Grove	Wells, watermain	3,150	$25,000,000	$3,530,000	$1.10

Cost Sharing

Because the costs would be significantly higher to develop an alternative water source for the Coalition communities than traditional groundwater sources, implementation is not likely to occur without incentive, and a mechanism to share the costs amongst a broad range of beneficiaries. The motivation for the reduction in groundwater use is regional in nature – to protect natural resources from the cumulative effects of groundwater use. A single community or a small subset of communities should not bear the cost of regional water sustainability needs. This analysis considered cost sharing from two perspectives:

- A scenario where only the communities served by the hypothetical alternate water system would pay for the system. This scenario considers the cost impacts to those communities, and also the degree of outside funding that would be necessary to bring the costs to the individual communities in line with other water systems in the region.
- A scenario where the costs are shared amongst all of the communities in the DNR North and East Metro Groundwater Management Area (GWMA). In this case, the model for ownership and cost sharing would include the creation of a district that would own and operate the alternate water delivery system, with fees paid by all communities within the GWMA to promote equity amongst users of the groundwater resource.

Alternative 4B – Connecting Cottage Grove, Woodbury, Lake Elmo, Oakdale, Newport, and St. Paul Park to a new surface WTP sized for conjunctive use with the existing groundwater systems was used to compare the different cost sharing structures. If the costs were shared among the member communities based on water usage, the total cost per 1,000 gallons is estimated to be $5.69. This is 78% higher than what SPRWS retail customers currently pay at $3.20 per 1,000 gallons. For rates to be similar to SPRWS rates, approximately $16 million per year would need to be subsidized or the capital cost of the project ($212.7 million) would need to be covered by another funding source. If cost sharing is provided across the North and East GWMA, a $0.54 per 1,000 gallon groundwater use fee would be required for all groundwater users (municipal, industrial, and private) to provide rates for the six example communities that are equal to those of other surface water supply communities.

Efficiency

The Coalition communities use approximately 2.3 billion gallons of water annually for non-essential uses. This does not include inefficiencies in existing fixtures or losses in the distribution system. Based on the water projections, the non-essential water use in 2040 could be 2.9 billion gallons of water per year.

Significant opportunities exist for Coalition communities to use water more efficiently. These opportunities include more efficient irrigation, low flow toilets, faucet aerators, and Energy Star labeled washing machines. Significant opportunities also exist for industrial and commercial water users. The Minnesota Technical Assistance Program can provide assistance in identifying industrial water efficiency opportunities.

The largest cost saving benefit that could be realized by water efficiency is by reducing peak demand. Water systems are constructed to meet peak day demands. As much as half of the water supply infrastructure is in place to meet maximum day demands due primarily to non-essential water use.

Additional study to develop more detailed water use trends, costs, benefits, and implementation obstacles of efficiency is recommended.

Chapter 1 – Introduction

Metropolitan Council Environmental Services (MCES) is involved with projects supporting a regional water supply sustainability initiative in the Twin Cities metropolitan area. One of these initiatives is the Washington County Municipal Water Coalition Water Supply Feasibility Assessment. The Washington County Municipal Water Coalition (Coalition) consists of interested community stakeholders engaged to address the long-term sustainability of water supplies within the area. Metropolitan Council, working with the communities of the Coalition, is leading a study to examine the feasibility of approaches to address water sustainability in the area.

1.1 Problem Statement

The primary source of drinking water in southern Washington County is groundwater from the Prairie du Chien-Jordan aquifer. Concerns with groundwater use in the region include areas of contamination, interference with surface waters, and potential aquifer drawdown due to increased future demands. It is possible that groundwater may not be able to meet all of the future drinking water demands.

1.2 Study Objectives

The primary objective of this study is to understand the relative costs and implementation considerations of different approaches to long term water sustainability within the study area. The study area includes the nine cities that form the Coalition: the cities of Bayport, Cottage Grove, Lake Elmo, Newport, Oakdale, Oak Park Heights, Stillwater, Saint Paul Park, and Woodbury.

The study will be referenced to support future planning of metro area water supplies and water sustainability practices. As cities face increased demands on their water supplies in the future, this report provides concept level options for consideration.

This study evaluates four approaches to water supply:

- Approach 1: Use of Treated Effluent from Pollution Containment Wells
- Approach 2: New Surface Water Treatment Plant (WTP) with Conjunctive Use of Surface Water and Groundwater
- Approach 3: Connection to Saint Paul Regional Water Services (SPRWS) with Conjunctive Use of Groundwater
- Approach 4: New Wellfields

A summary of water efficiency opportunities and best management practices in also included in this report.

These are not the only viable approaches to achieve water sustainability in the study area. There could be many other configurations of approaches that include other municipal water systems, private water users, and other approaches in addition to the infrastructure solutions considered in this study.

The alternatives evaluated should be viewed as examples. The best option for moving forward may be a hybrid of the examples considered in this study, and could involve approaches that were not considered. For example, communities in the coalition could utilize less expensive approaches which might include water efficiency to reduce groundwater pumping before making large-scale investments in alternative infrastructure solutions. Such a plan could couple these less expensive options with aggressive monitoring of groundwater and surface water, and set triggers for further action in the event these less expensive approaches are not effective.

Ongoing activities will better inform decision-making practices related to water use in the Coalition communities as they are completed:

1. The Council has completed a feasibility assessment of the potential for aquifer recharge and reusing stormwater in the North and East Metro Groundwater Management Area. The study area for this feasibility assessment includes the communities in the Coalition as well as additional communities in Anoka, Ramsey, and Washington counties. This study evaluates the potential of using alternative approaches to reduce impacts to lakes, aquifers, and to address other identified water sustainability issues within the Groundwater Management Area.
2. The DNR is completing a management plan for the North and East Metro Groundwater Management Area. This plan is currently being implemented and could impact future groundwater appropriations, groundwater monitoring activities, and the assessment of water use sustainability in the area.

The results of these activities will provide supporting information to help chart the course for water resource sustainability practices for the study area. In addition, several communities participating in this study are interested in implementing more active efficiency programs. Other investigations are being considered to assess the potential for efficiency to reduce future groundwater use and decrease the aquifer drawdown.

1.3 Feasibility Assessment Process

This study defines concept level water infrastructure systems to deliver the approaches to water sustainability identified in the study objectives. The basic elements of the assessment include:

1. Description of concept system alternatives
2. Planning level cost estimates
3. Considerations for implementation
4. Comparison of potential benefits of alternative / approach combinations to the sustainability of water resources and system reliability in the study area

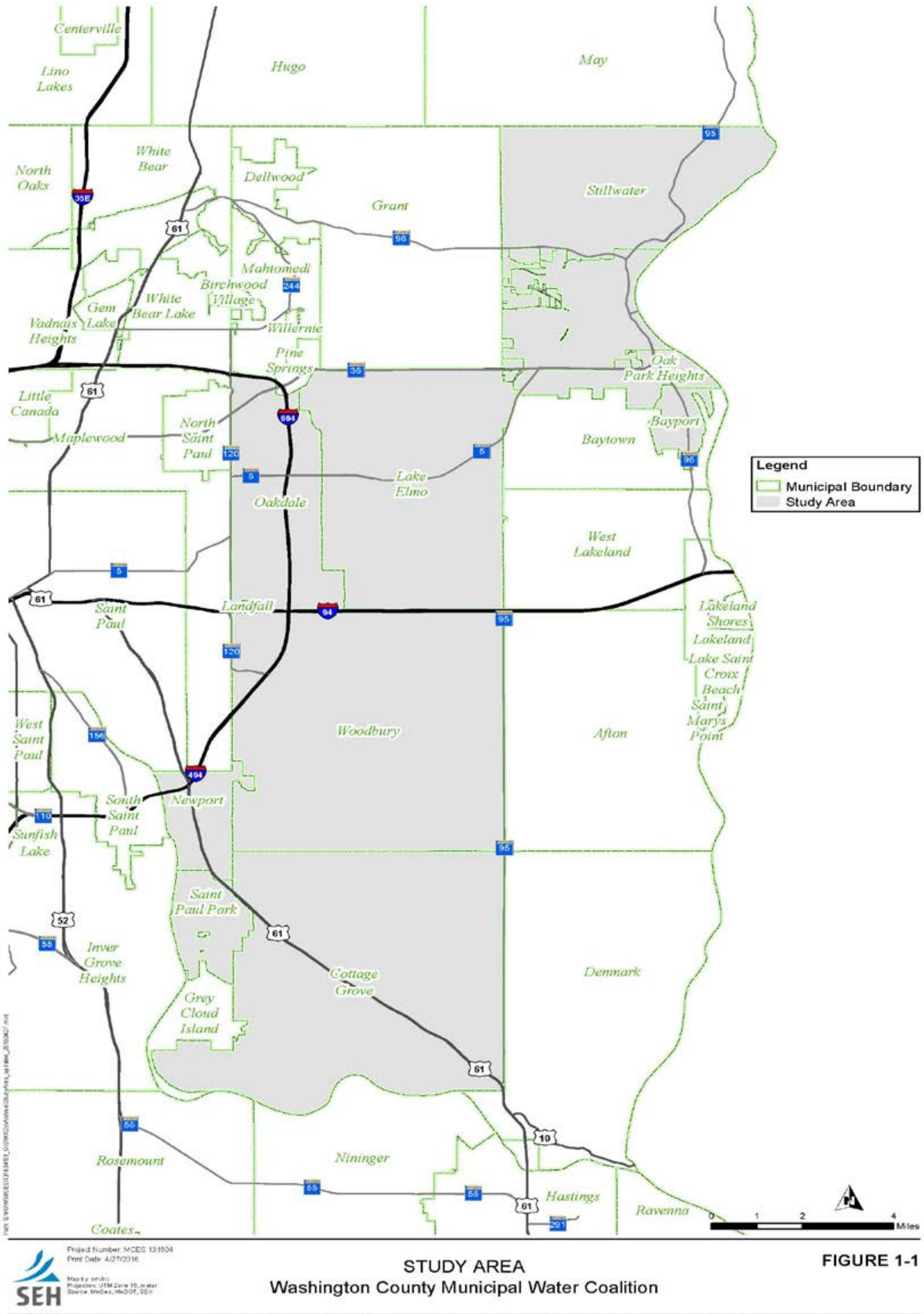
The assessment for each approach followed a similar method: preliminary screening of options, followed by secondary evaluation of options with more detailed analysis. For approaches related to drinking water supplies, different alternatives were developed for sets of communities at varying scales.

This study is not meant to provide prescriptive solutions to be implemented. It is meant to provide communities concept level costs and considerations for various water supply approaches.

1.4 Study Area

The Coalition study area is delineated in Figure 1-1. All of the study area communities lie within the Minnesota Department of Natural Resources' (DNR's) North and East Groundwater Management Area (GWMA), and all of these communities rely on groundwater as their primary source of drinking water.

Figure 1-1. Map of study area.



1.5 Water Demand

Current municipal well appropriations for individual cities in the study area range from 173 million gallons per year (MGY) to 3.27 billion gallons per year (BGY), and total 8.24 BGY within the study area. Table 1-1 shows the relationship between groundwater withdrawals from municipal wells in each of the cities within the study area from 2012 and the associated appropriation limits.

Projected 2040 water demands for each of the study area communities are also presented in Table 1-1. Projected average daily water use for the entire study area is estimated to be 25.3 million gallons per day (MGD), while maximum day water demand is expected to be 61.6 MGD, as summarized in Table 1-2. Annual water use in 2040 is expected to be 9.2 BGY.

Total study area demand is expected to grow by about 27% from 2012 to 2040. The 2040 projected water demands for the majority of the communities in the study area exceed the 2012 permit appropriations. Future water demands may not be met by current groundwater appropriations for some of the Coalition communities.

A graph showing water use trends for each Coalition community from 2010 through 2014 is presented in Figure 1-2.

Figure 1-2. Map of study area.

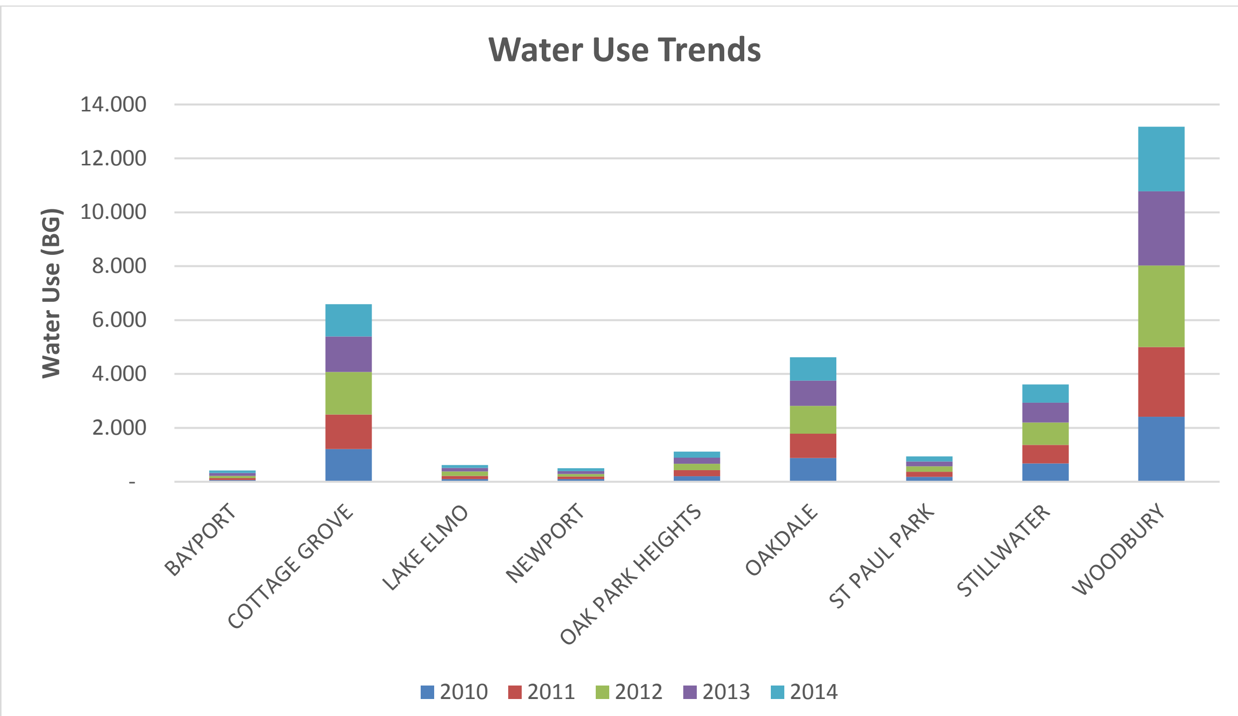


Table 1-1. Historic and Projected Population and Drinking Water Demand for Washington County Municipal Water Coalition Communities.

City	2012 Population[1]	2040 Projected Population[2]	2012 Municipal Water Use[3] (MGY)	2012 Municipal Well Appropriation[4] (MGY)	2040 Projected Demand[5] (MGY)
Bayport	3,626	3,210	84	173	138
Cottage Grove	35,132	47,000	1,578	1,500	1,884
Lake Elmo	8,536	12,444	165	260	522
Newport	3,464	4,154	101	420	142
Oakdale	27,895	30,200	1,027	1,210	1,187
Oak Park Heights	4,726	5,700	244	291	312
Saint Paul Park	5,354	7,954	207	250	304
Stillwater	18,722	22,800	835	865	1,001
Woodbury	61,961	83,139	3,029	3,267	3,733
Total	169,416	216,601	7,270	8,235	9,223

1. Metropolitan Council historical population data.
2. Metropolitan Council population forecasts (adopted May 28, 2014).
3. Average water use from 2003-2012 of calculated per capita water use, from MCES water use data. 2012 data was the most recent compiled data at the time this report was started.
4. From DNR MPARS data
5. Note that this projection is based on an average per capita water use from 2003-2012 for each community.

Table 1-2. Historic and Projected Total Population and Water Demand for the Washington County Municipal Water Coalition from MCES data and demand projections.

Year	2012	2040
Population	169,416	216,601
Annual Water Usage (MGY)	7,270	9,223
Average Daily Demand (MGD)	20.0	25.3
Maximum Daily Demand (MGD)	48.4	61.6

An important water infrastructure planning criteria is the peak ratio which is the ratio of maximum day water use to average day use. Peak demands occur during warmer months, and are mainly attributed to irrigation and outdoor water use needs. For this study area, 2003 to 2012 water use data from the DNR was used to find the average maximum day to average day ratio. This ratio was applied to the average day demand projected for 2040 to estimate the 2040 maximum day demand. Table 1-3 summarizes the projected 2040 water demands and peak ratios.

Table 1-3. 2040 Average and Maximum Day Demands by Community.

City	Avg. Day[1] 2040 Demand (MGD)	Max. Day[2] 2040 Demand (MGD)	Peak Ratio[3]
Bayport	0.4	1.1	2.7
Cottage Grove	5.2	13.5	2.6
Lake Elmo	1.4	3.1	2.2
Newport	0.4	0.7	1.7
Oakdale	3.3	8.0	2.4
Oak Park Heights	0.9	1.8	2.1
Saint Paul Park	0.8	1.7	2.1
Stillwater	2.7	6.2	2.3
Woodbury	10.2	25.4	2.5
Total	25.3	61.6	2.4

1 Average day demand is defined as the total annual water use for a system dividend by 365 days.
2 Maximum day demand is defined as the largest daily water use over the course of a calendar year. This is an important criterion for the sizing of infrastructure systems for reliable service.
3 Peak Ratio is the maximum day demand divided by the average day demand. Peak ratios are based on the average of DNR water appropriations permit data records for 2003 to 2012. The peak ratio is applied to the 2040 average day demand to obtain the 2040 maximum day demand.

1.6 Existing Water Infrastructure

The water infrastructure is similar for each community in the study area. At least one water tower and/or ground storage tank are present in all cities, and allow for at least 0.3 to 11.0 MG of storage in each community.

Pressure zones across the communities range from a low of 865 feet in Cottage Grove to 1,230 feet in Oakdale. Most communities in the study area utilize treatment at individual wells, which typically consists of chlorination for disinfection, fluoride addition to prevent tooth decay, and the addition of polyphosphates for corrosion control as needed. Polyphosphate addition also helps prevent lead and copper from leaching from service lines and indoor plumbing. Bayport and Oakdale are the only two communities within the coalition that currently have operating treatment plants. Bayport owns and operates an air stripping water treatment plant to remove trichloroethylene (TCE). Oakdale operates a granular activated carbon (GAC) water treatment plant to remove perfluorinated compounds (PFCs). Appendix A provides a summary of each community’s water supply system infrastructure.

There are 58 municipal wells listed within the study area. Of the 58 wells, 55 wells pump groundwater from the Prairie du Chien – Jordan aquifer, the remaining three pump from the Tunnel City-Wonewoc aquifer.

1.7 Water Rates

Table 1-4 summarizes annual residential water bills for each community based on 8,000 gallons per month of water usage.

Table 1-4. Calculated Annual Residential Household Water Bills for Washington County Municipal Water Coalition Communities.

City	Annual Cost[1]
Bayport	$415.32
Cottage Grove	$142.80
Lake Elmo	$331.32
Newport	$626.04
Oakdale	$190.32
Oak Park Heights	$214.56
Saint Paul Park	$270.24
Stillwater	$182.40
Woodbury	$104.28

[1] Rate from MCES Twin Cities Regional Water Billing Analysis, CDM Smith, 2015

1.8 Feasibility Assessment Overview

Preliminary screening identified a core group of alternatives for assessment. This section provides an overview of the alternatives selected. Separate chapters and appendices provide detail on the project components, costs, and other factors to consider for each water sustainability approach.

1.8a Assessment Methods

The development of concept water infrastructure systems for each approach evolved from a preliminary screening phase to a group of alternatives for evaluation. The alternatives selected represent potential projects to achieve water sustainability goals. These are concept level alternatives to serve as a basis of comparison to understand the associated costs, implementation considerations, and environmental benefits of various approaches. This is not an implementation study. The approaches and alternatives have not been placed in any particular order of importance or preference.

Figures and maps have been prepared that show concept level watermain routes and infrastructure locations. These figures are only intended to convey a concept and the infrastructure locations are not final.

The summary information presented in this section is supported by information detailed in appendices:

- Existing infrastructure for each of the Coalition communities, including trunk water main, wells, treatment facilities, and storage is identified in Appendix A.
- A methodology was developed for estimating costs of water main, booster stations, and booster station O&M costs. A summary of the cost estimating approach is included in Appendix B.

1.8b Approach 1 – Use of Treated Effluent from Pollution Containment Wells

Contaminant containment wells owned and operated by 3M on the Woodbury/Cottage Grove border pump approximately 3,000 gallons per minute (gpm) of groundwater that is contaminated with perfluorinated compounds (PFCs) to the 3M Cottage Grove facility where it is treated with granular activated carbon (GAC), used as process water, and discharged to the Mississippi River. Approach 1 alternatives evaluate the feasibility of alternate uses of the contaminant containment water. Table 1-5 summarizes the Approach 1 alternatives.

Table 1-5. Summary of Approach 1 alternatives.

Alternative	Significant Infrastructure Features
1A – Contaminant Containment Water to Valley Creek	GAC WTP, transmission main
1B – Contaminant Containment Water to Northern Tier Refining	GAC WTP, transmission main
1C – Contaminant Containment Water from 3M Cottage Grove Facility to Northern Tier Refining	Utilize existing 3M GAC WTP, transmission main
1D – Contaminant Containment Water to Woodbury Golf Courses and Northern Tier Refining	GAC WTP, transmission main
2A – Potable reuse to Woodbury	RO WTP, transmission main
2B – Potable reuse to Cottage Grove	RO WTP, transmission main
2C – Potable reuse to Woodbury and Cottage Grove	RO WTP, transmission main
3 – Aquifer recharge	Alternative not deemed feasible

1.8c Approach 2 – New Surface Water Treatment Plant – Conjunctive Use

An option for reducing reliance on groundwater for the Coalition is to build a new water treatment facility with a surface water source for conjunctive use with the existing groundwater systems. Approach 2 looks at scenarios with water treatment facilities located on the Mississippi and St. Croix rivers serving various communities. Table 1-6 summarizes the Approach 2 alternatives.

Table 1-6. Summary of Approach 2 alternatives.

Alternative	Communities Served	Significant Features
4A – New Surface WTP on Mississippi River – Conjunctive Use with Groundwater	Cottage Grove, Woodbury	17 MGD Surface WTP, transmission main
4B – New Surface WTP on Mississippi River – Conjunctive Use with Groundwater	Cottage Grove, Woodbury, Lake Elmo, Oakdale, Newport, St. Paul Park	25 MGD Surface WTP, transmission main
5A – New Surface WTP on St. Croix River – Conjunctive Use with Groundwater	Stillwater, Oak Park Heights, Bayport	6 MGD Surface WTP, transmission main
5B – New Surface WTP on St. Croix River – Conjunctive Use with Groundwater	Woodbury, Cottage Grove, Lake Elmo, Oakdale	25 MGD Surface WTP, transmission main

1.8d Approach 3 – Connect to SPRWS – Conjunctive Use

In Approach 3, various subsets of Coalition communities would connect to St. Paul Regional Water Services (SPRWS), a major water utility that receives approximately 90% of its water from the Mississippi River. Portions of the SPRWS system border the Coalition communities. Table 1-7 summarizes the Approach 3 alternatives.

Table 1-7. Summary of Approach 3 alternatives.

Alternative	Communities Served	Significant Features
6A – Connect portion of Woodbury to SPRWS – Not Conjunctive Use	Woodbury	Transmission main, booster station
6B – Connect all of Woodbury to SPRWS – Conjunctive Use	Woodbury	Transmission main, blending station
6C – Connect all of Woodbury, Cottage Grove to SPRWS – Conjunctive Use	Woodbury, Cottage Grove	Transmission main, blending stations, booster station
6D – Connect all of Newport to SPRWS – Conjunctive Use	Newport	Transmission main, blending station
6E – Connect all of Oakdale to SPRWS – Conjunctive Use	Oakdale	Transmission main, blending station, booster station
6F – Connect all of Oakdale and Lake Elmo to SPRWS – Conjunctive Use	Oakdale, Lake Elmo	Transmission main, blending stations, booster stations
6G – Connect portion of Woodbury and all of Newport to SPRWS – Conjunctive Use for Newport	Woodbury, Newport	Transmission main, blending station, booster station

1.8e Approach 4 – New Well Fields

Approach 4 investigates the feasibility of constructing new wells and attempts to identify areas in the region where there are less drawdown or contamination concerns. Table 1-8 summarizes the Approach 4 alternatives.

Table 1-8. Summary of Approach 4 alternatives.

Alternative	Communities Served	Significant Features
7A – New Well Field on Woodbury/Cottage Grove Border	Woodbury, Cottage Grove	New wells, transmission main
7A – New Well Field in Denmark Township	Woodbury, Cottage Grove	New wells, transmission main
7A – New Well Field in Southern Cottage Grove	Woodbury, Cottage Grove	New wells, transmission main

Chapter 2 – Use of 3M Contaminant Containment Water – Alternatives 1-3

One approach for reducing the impact on the local groundwater aquifer is to re-use contaminant containment water from the 3M Woodbury site in conjunction with existing municipal groundwater wells.

2.1 3M Contaminant Containment Water Overview

Groundwater at a former 3M landfill site located on the Woodbury/Cottage Grove border is contaminated with volatile organic compounds (VOCs) and perfluorinated compounds (PFCs). To prevent contamination from migrating offsite, four barrier wells were drilled in the 1960's. The barrier wells are drilled in the Prairie du Chien-Jordan sandstone formations/aquifers. Approximately 3,000 gallons per minute (gpm) of groundwater is pumped continuously from the barrier wells. The contaminant containment water is pumped in a pipeline to the 3M Cottage Grove facility where it is treated in granular activated carbon (GAC) contactor vessels to remove the PFCs. The water is used at the 3M facility as process water and ultimately discharged to the Mississippi River. Appendix C contains additional information on PFC contamination in Washington County.

PFCs are a class of synthetic compounds composed of carbon chains with attached fluorine groups. There are thousands of different types of PFCs. The two most common PFCs are perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS).

Once in the environment, PFCs are very persistent; there are no known biological or chemical reactions that degrade PFCs. PFCs have been detected in a wide variety of environments, including drinking water. There is very little information available on the health effects associated with long term PFC exposure. The United States Environmental Protection Agency (EPA) has placed PFOA and PFOS on the Candidate Contaminant List (CCL) and have set health advisory levels for PFOA and PFOS of 0.07 μg/L (individually and combined). The Minnesota Department of Health (MDH) has also defined health risk levels (HRLs) for PFOA and PFOS each at 0.3 μg/L. MDH has also set HRLs for additional PFCs, including perfluorobutanoic acid (PFBA) and perfluorobutanesulfonate (PFBS) each at 7μg/L. Other PFCs that are being monitored by MDH, with no HRL yet defined include perfluorohexanesulfonate (PFHxS), perfluorohexanoic acid (PFHxA), and perfluoropentanoic acid (PFPeA).

2.2 Alternative 1 – Nonpotable Reuse of Contaminant Containment Water

Various alternatives are investigated to determine if there is a more beneficial use for the 3M contaminant containment water. One approach for utilizing contaminant containment water from the 3M site is to treat the water, then distribute to nearby surface water bodies, businesses or industry for surface water augmentation, non-potable irrigation, or process-related uses. Four alternatives are analyzed:

- Alternative 1A distributes contaminant containment water from the 3M Woodbury site to Valley Creek in Afton
- Alternative 1B distributes contaminant containment water from the 3M Woodbury site to Northern Tier Refining in St. Paul Park
- Alternative 1C distributes contaminant containment water from the 3M Cottage Grove site to Northern Tier Refining
- Alternative 1D distributes contaminant containment water from the 3M Woodbury site to Northern Tier Refining in St. Paul Park and two golf courses in Woodbury

Approximately 4 million gallons per day (MGD) of contaminant containment water could be provided to each of these potential users, consequently reducing the need for non-potable water withdrawal from the aquifer or augmenting a surface water body. Northern Tier Refining could potentially utilize all of the contaminant containment water.

2.2a Treatment

PFCs can be removed from water with GAC contactors (filters). GAC is currently being utilized to treat the 3M Woodbury contaminant containment water at the 3M Cottage Grove facility. GAC is commonly used to adsorb natural and synthetic organic compounds in water. A new GAC water treatment plant at the 3M Woodbury site will be required to treat the contaminant containment water for Alternatives 1A, 1B, and 1D. For Alternative 1C in which water is distributed from the 3M Cottage Grove site, no additional treatment is required due to existing GAC treatment at this location.

2.2b Alternative 1A

Alternative 1A involves treating contaminant containment water from the 3M Woodbury site using a GAC water treatment plant and then distributing the water to Valley Creek in Afton (Figure 2-1). Concerns have been raised about groundwater pumping potentially reducing the base flow in Valley Creek. Augmenting Valley Creek with groundwater from the 3M Woodbury site could alleviate some of the base flow volume concerns. Regulatory approval would be needed for this alternative.

For Alternative 1A, it is assumed that a GAC treatment system capable of treating the water from the containment wells is located at the 3M Woodbury site.

Due to the conceptual nature of this study, a 20% contingency was accounted for in all alternatives. A separate cost estimating memo included in Appendix B describes the method of determining unit costs for construction and materials in both rural and urban areas.

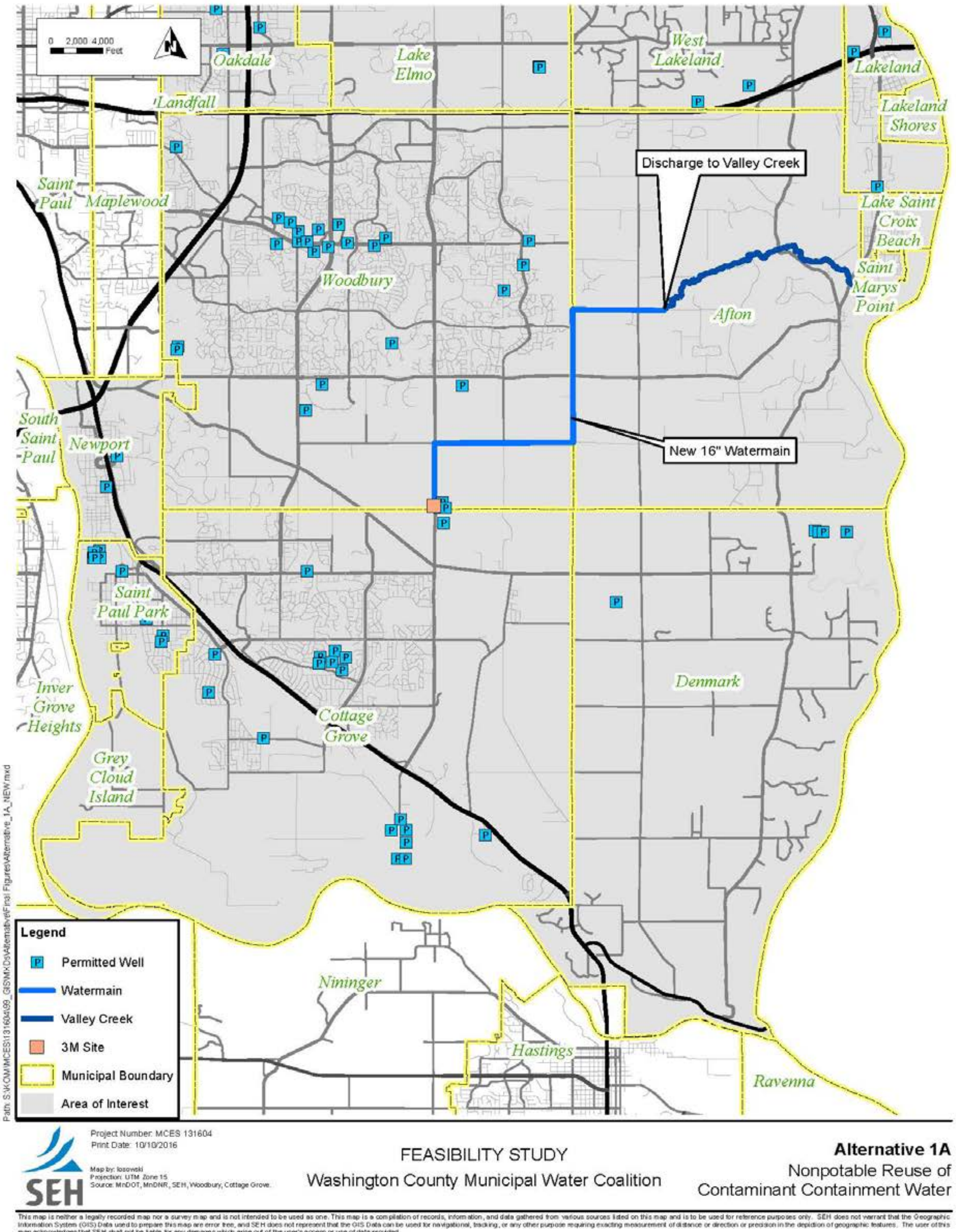
2.2c Alternative 1A – Estimated Costs

Table 2-1 provides a concept level cost estimate for Alternative 1A.

Table 2-1. Cost estimate for nonpotable reuse of contaminant containment water to Valley Creek (Alternative 1A).

Item	Quantity	Units	Unit Cost	Total Cost
Water Treatment Plant				
3,000 gpm GAC Treatment Plant	1	Lump Sum	$4,100,000	$4,100,000
Water Main				
Open Cut 16" DIP (0% in road, rural)	35,000	Feet	$244	$8,500,000
Easements/ Land Acquisitions	175,000	Square Feet	$6	$1,050,000
Environmental	7	Miles	$50,000	$350,000
			Subtotal	**$14,000,000**
			Contingency (20%)	$2,800,000
			Engineering/ Administration/ Legal (15%)	$2,100,000
			Total Alternative 1A	**$18,900,000**

Figure 2-1. Water main alignment for nonpotable reuse of contaminant containment water to Valley Creek (Alternative 1A).



2.2d Alternative 1B

Alternative 1B consists of treating contaminant containment water at the 3M Woodbury site with a GAC water treatment plant, then distributing reuse water to Northern Tier Refining in St. Paul Park via a 16-inch water main (see Figure 2-2). Permit appropriation data provided by the DNR shows that Northern Tier Refining currently has five wells with a total appropriation of 966 MGY. The proposed alternative could provide the entire amount of water currently appropriated to the refinery; thereby eliminating most, if not all, of the groundwater pumping at Northern Tier Refining. The water provided to the refinery from 3M should be similar in water quality to the water the refinery currently pumps from its groundwater wells.

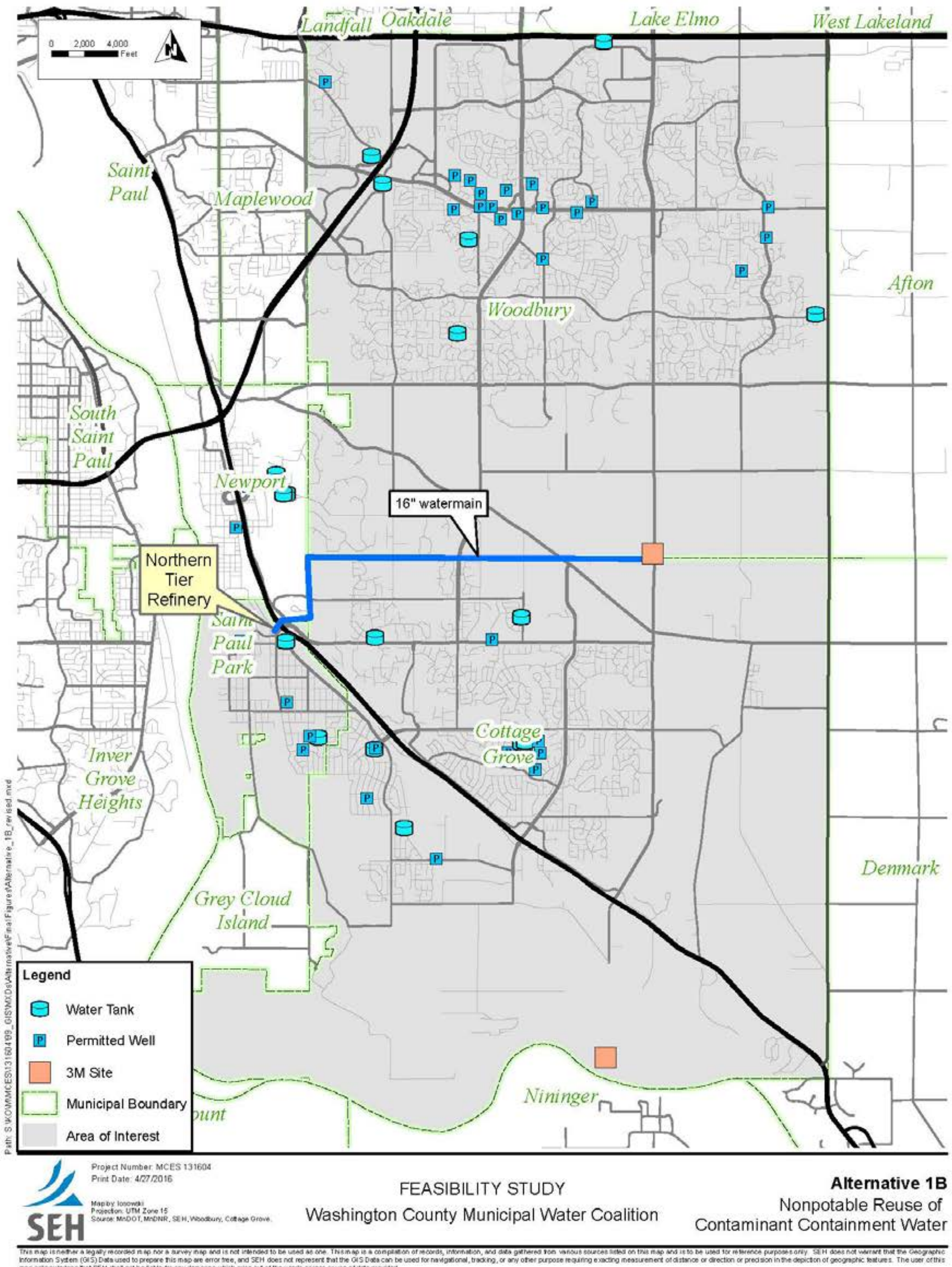
2.2e Alternative 1B – Estimated Costs

Table 2-2 provides a concept level cost estimate for Alternative 1B.

Table 2-2. Cost estimate for nonpotable reuse of contaminant containment water from 3M Woodbury to Northern Tier Refinery in Saint Paul Park (Alternative 1B).

Item	Quantity	Units	Unit Cost	Total Cost
Water Treatment Plant				
3,000 gpm GAC Treatment Plant	1	Lump Sum	$4,100,000	$4,100,000
Water Main				
Open Cut 16” DIP (0% in road, rural)	20,000	Feet	$244	$4,900,000
Open Cut 16” DIP (50% in road, urban)	9,000	Feet	$514	$4,600,000
Easements/ Land Acquisitions	145,000	Square Feet	$6	$900,000
Environmental	6.0	Miles	$50,000	$300,000
			Subtotal	**$14,800,000**
			Contingency (20%)	$3,000,000
			Engineering/ Administration/ Legal (15%)	$2,300,000
			Total Alternative 1B	**$20,100,000**

Figure 2-2. Water main alignment for nonpotable reuse of contaminant containment water from 3M Woodbury to Northern Tier Refinery (Alternative 1B).



2.2f Alternative 1C

Alternative 1C involves distributing contaminant containment water from the Cottage Grove 3M facility to Northern Tier Refining in St. Paul Park (see Figure 2-3). As previously mentioned, the Cottage Grove site already has a GAC water treatment system and therefore would not require additional treatment.

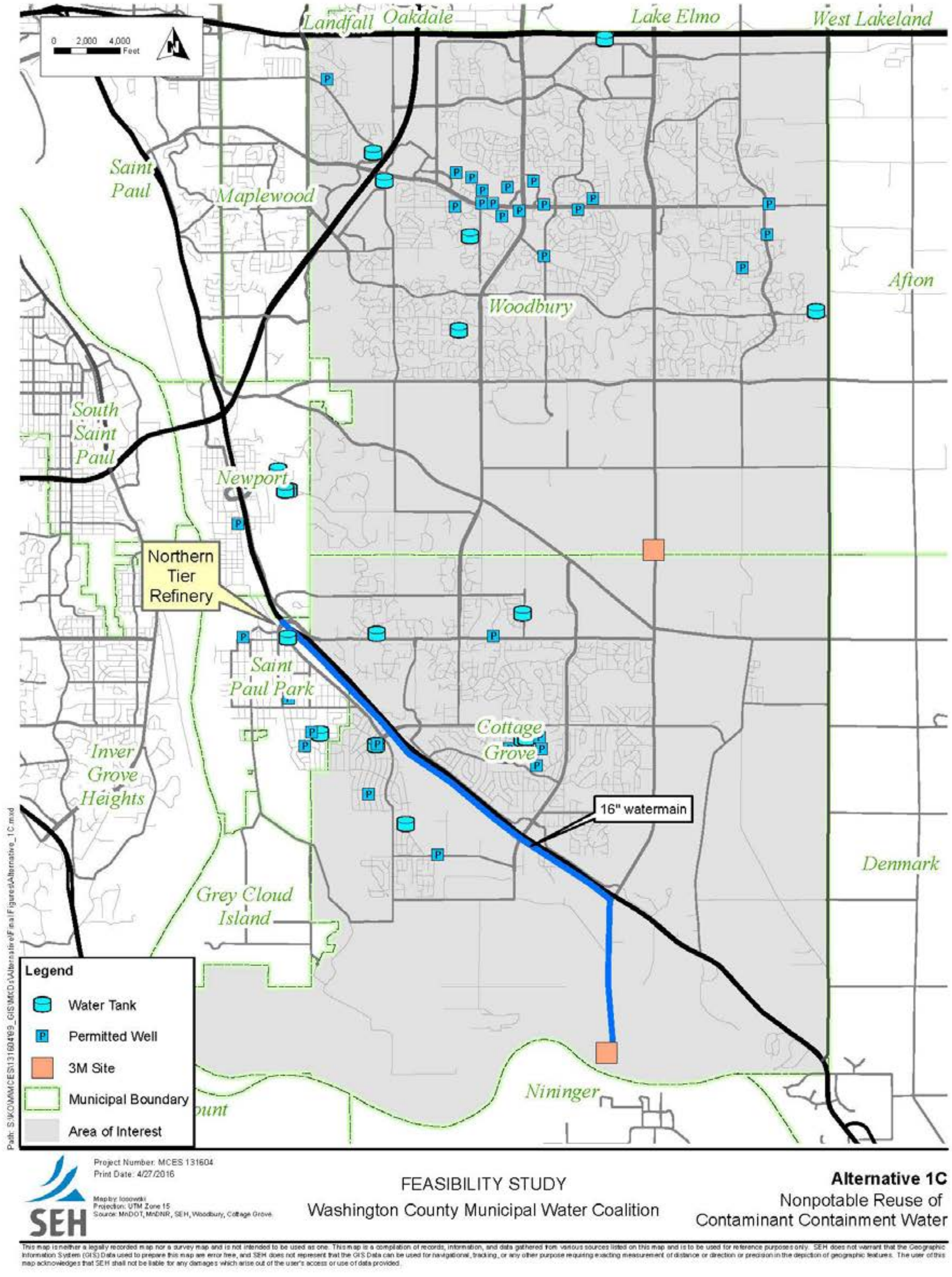
2.2g Alternative 1C – Estimated Costs

Table 2-3 provides a concept level cost estimate for Alternative 1C.

Table 2-3. Cost estimate for nonpotable reuse of contaminant containment water to Northern Tier Refinery from 3M Cottage Grove site (Alternative 1C).

Item	Quantity	Units	Unit Cost	Total Cost
Water Main				
Open Cut 16" DIP (0% in road, rural)	9,000	Feet	$244	$2,200,000
Open Cut 16" DIP (50% in road, urban)	28,000	Feet	$514	$14,400,000
Easements/ Land Acquisitions	185,000	Square Feet	$6	$1,200,000
Environmental	8.0	Miles	$50,000	$400,000
			Subtotal	**$18,200,000**
			Contingency (20%)	$3,700,000
			Engineering/ Administration/ Legal (15%)	$2,800,000
			Total Alternative 1C	**$24,700,000**

Figure 2-3. Water main alignment for nonpotable reuse of contaminant containment water from 3M Cottage Grove to the Northern Tier Refinery (Alternative 1C).



2.2h Alternative 1D

Alternative 1D consists of treating contaminant containment water at the 3M Woodbury site with a GAC water treatment plant, then distributing reuse water to Northern Tier Refining in St. Paul Park via a 16-inch water main (Alternative 1B) and two golf courses in Woodbury (Eagle Valley and Prestwick Golf Courses). The golf courses are currently appropriated 48.3 MGY for irrigation.

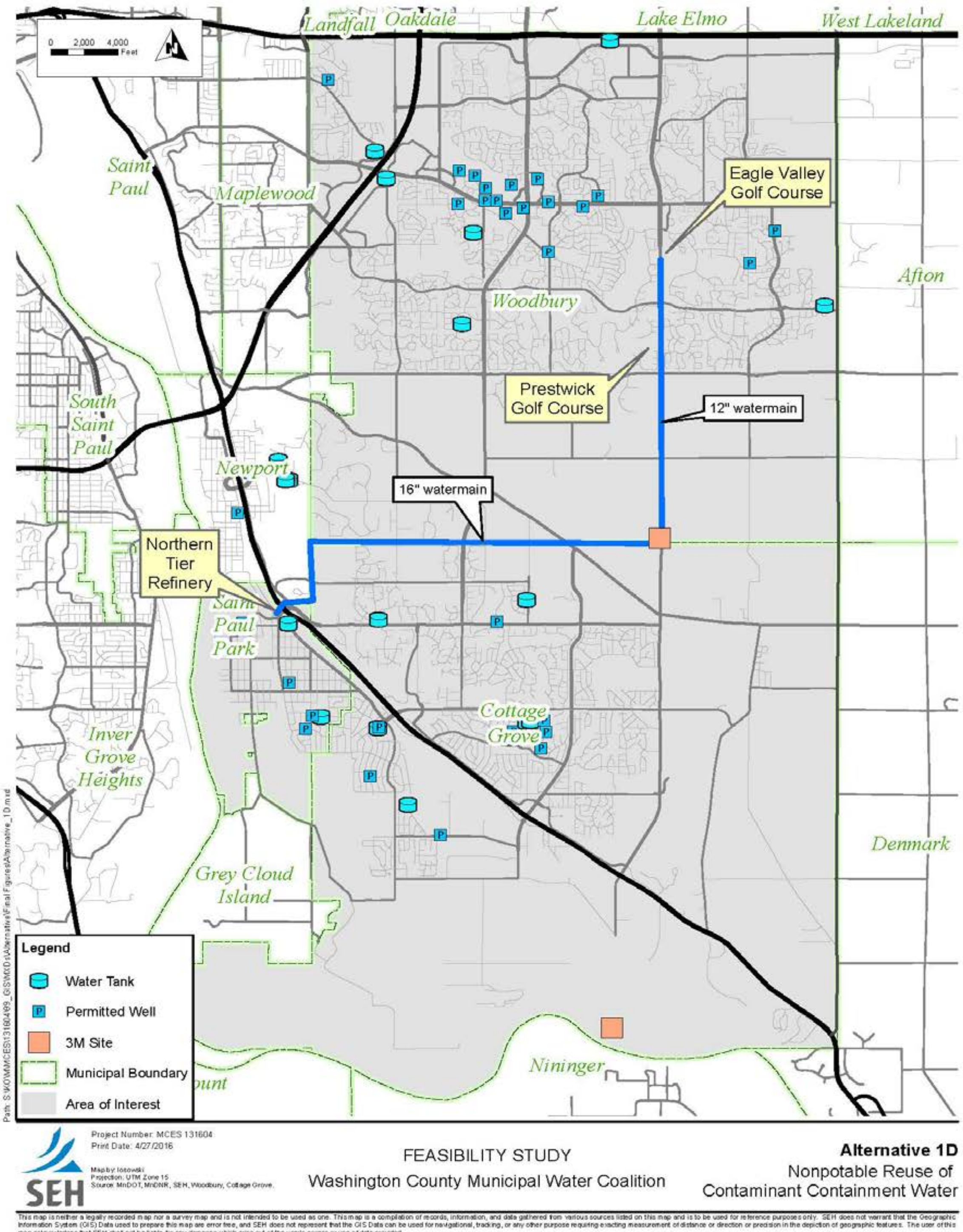
2.2i Alternative 1D – Estimated Costs

Table 2-4 provides a concept level cost estimate for Alternative 1D.

Table 2-4. Cost estimate for nonpotable reuse of contaminant containment water to the Woodbury golf courses and Northern Tier Refinery from 3M Woodbury site (Alternative 1D).

Item	Quantity	Units	Unit Cost	Total Cost
Water Treatment Plant				
3,000 gpm GAC Treatment Plant	1	Lump Sum	$4,100,000	$4,100,000
Water Main				
Open Cut 16” DIP (0% in road, rural)	20,000	Feet	$244	$4,900,000
Open Cut 16” DIP (50% in road, urban)	9,000	Feet	$514	$4,700,000
Open Cut 12” DIP (0% in road, rural)	35,000	Feet	$218	$7,600,000
Easements/ Land Acquisitions	320,000	Square Feet	$6	$1,900,000
Environmental	12.0	Miles	$50,000	$600,000
			Subtotal	**$23,800,000**
			Contingency (20%)	$4,800,000
			Engineering/ Administration/ Legal (15%)	$3,600,000
			Total Alternative 1D	**$32,200,000**

Figure 2-4. Water main alignment for nonpotable reuse of contaminant containment water from 3M Woodbury to the Northern Tier Refinery and the Woodbury golf courses (Alternative 1D).



2.3 Alternative 2 – Potable Reuse of Contaminant Containment Water

A second approach for utilizing the 3M contaminant containment water is to treat the water to potable standards and then distribute to either Woodbury, Cottage Grove, or a combination of the two. Alternative 2 is broken into three sub-alternatives:

- Alternative 2A evaluates sending potable reuse water to Woodbury
- Alternative 2B evaluates sending potable reuse water to Cottage Grove
- Alternative 2C evaluates sending potable reuse water to both Woodbury and Cottage Grove

2.3a Treatment

Because the 3M Woodbury site is a former landfill, it is possible that contaminants besides PFCs exist in the groundwater. To protect against potential unknown contaminants and to remove PFCs, reverse osmosis (RO) treatment would be required. RO provides a high level of protection against contaminants.

The RO process train consists of a screening system, RO membranes, and disinfection prior to distribution. Screening systems typically consist of cartridge filters or micro screens followed by microfiltration membranes. The source water is then fed under high-pressure across the surface of a semi-permeable membrane. Due to the difference in pressure between the feed and permeate sides of the membrane, a portion of the feed stream passes through the membrane. As water passes through the membrane, solutes are rejected and the feed stream becomes more concentrated. Reject water exits via a separate pipe and would be sent to the existing GAC contactors at the 3M Cottage Grove facility for PFC removal. It is assumed that the reject water will be allowed to be discharged into the Mississippi River after the PFCs have been removed. Additional analysis is required to determine if the reject water blended with other 3M discharges will meet their NPDES permit limits.

Permeate from an RO facility is typically approximately 80% of the raw water and the other 20% is reject water. Therefore, approximately 2,400 gpm (or 3.5 MGD) would be available as potable water.

2.3b Alternative 2A

Alternative 2A sends potable reuse water from the RO water treatment plant northwest via a 16-inch water main to an existing 24-inch water main in the southern section of Woodbury's water distribution system (Figure 2-5). The City of Woodbury's projected daily average groundwater pumping rate in 2040 is 10.2 MGD. Therefore the potable reuse water will provide a portion of the drinking water needed and allow for reduced groundwater pumping.

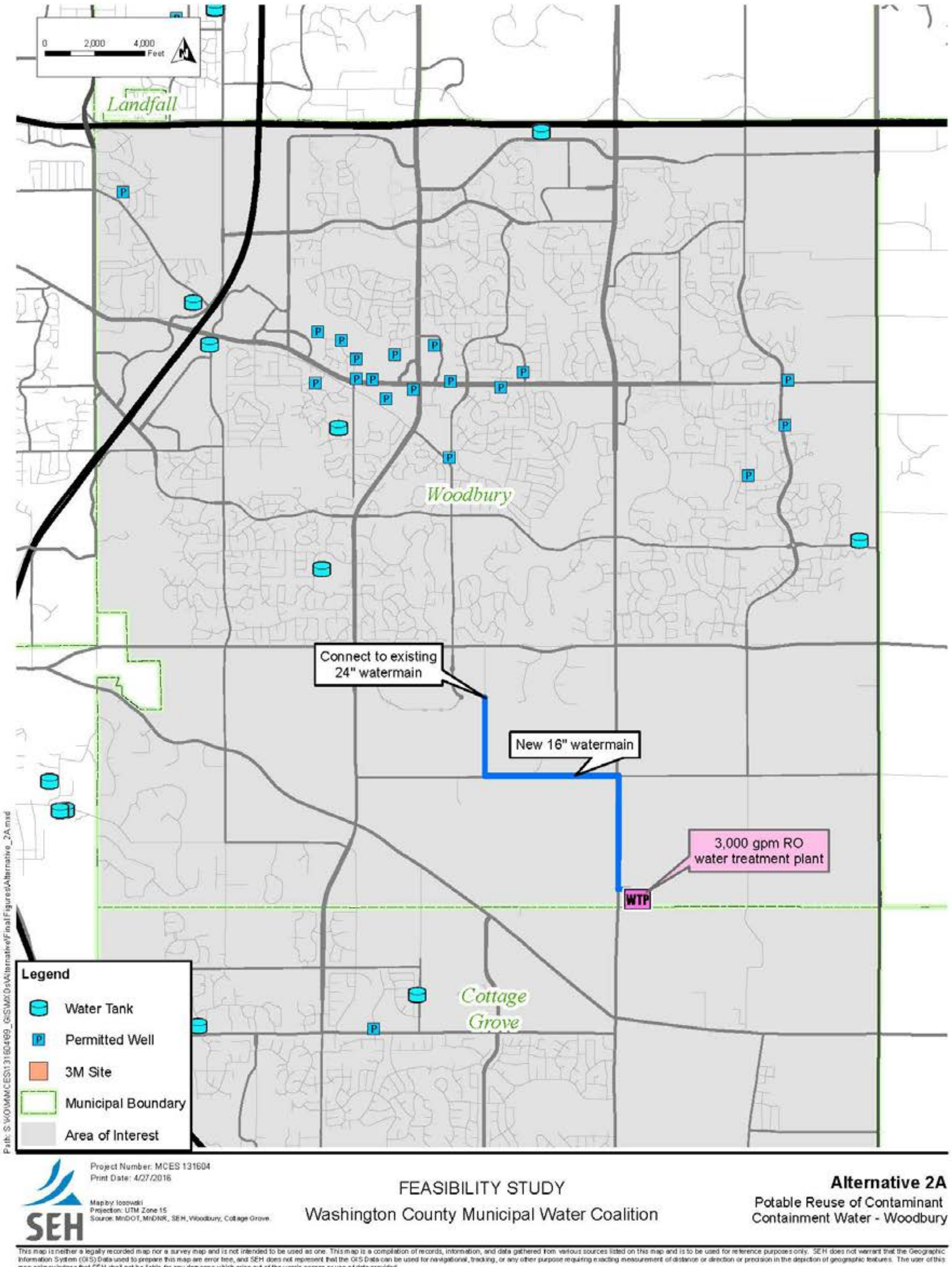
2.3c Alternative 2A – Estimated Costs

Table 2-5 provides a concept level cost estimate for Alternative 2A.

Table 2-5. Cost Estimate for Potable Reuse of Contaminant Containment Water to Woodbury (Alternative 2A).

Item	Quantity	Units	Unit Cost	Total Cost
Water Treatment Plant				
3,000 gpm RO Treatment Plant	1	Lump Sum	$20,000,000	$20,000,000
Water Main				
Open Cut 16" DIP (0% in road, rural)	13,200	Feet	$244	$3,300,000
Easements/ Land Acquisitions	66,000	Square Feet	$6	$400,000
Environmental	3.0	Miles	$50,000	$200,000
			Subtotal	**$23,900,000**
			Contingency (20%)	$4,800,000
			Engineering/ Administration/ Legal (15%)	$3,600,000
			Total Alternative 2A	**$32,300,000**

Figure 2-5. Water main alignment for potable reuse of contaminant containment water connecting to Woodbury (Alternative 2A).



2.3d Alternative 2B

In Alternative 2B, potable reuse water is transmitted southwest via a 16-inch water main to connect to existing 24-inch water main in the northern section of the Cottage Grove distribution system (Figure 2-6). The projected average daily groundwater pumping rate in Cottage Grove in 2040 is 5.4 MGD. The potable reuse water would provide a large portion of the drinking water for the City and allow for reduction of groundwater pumping.

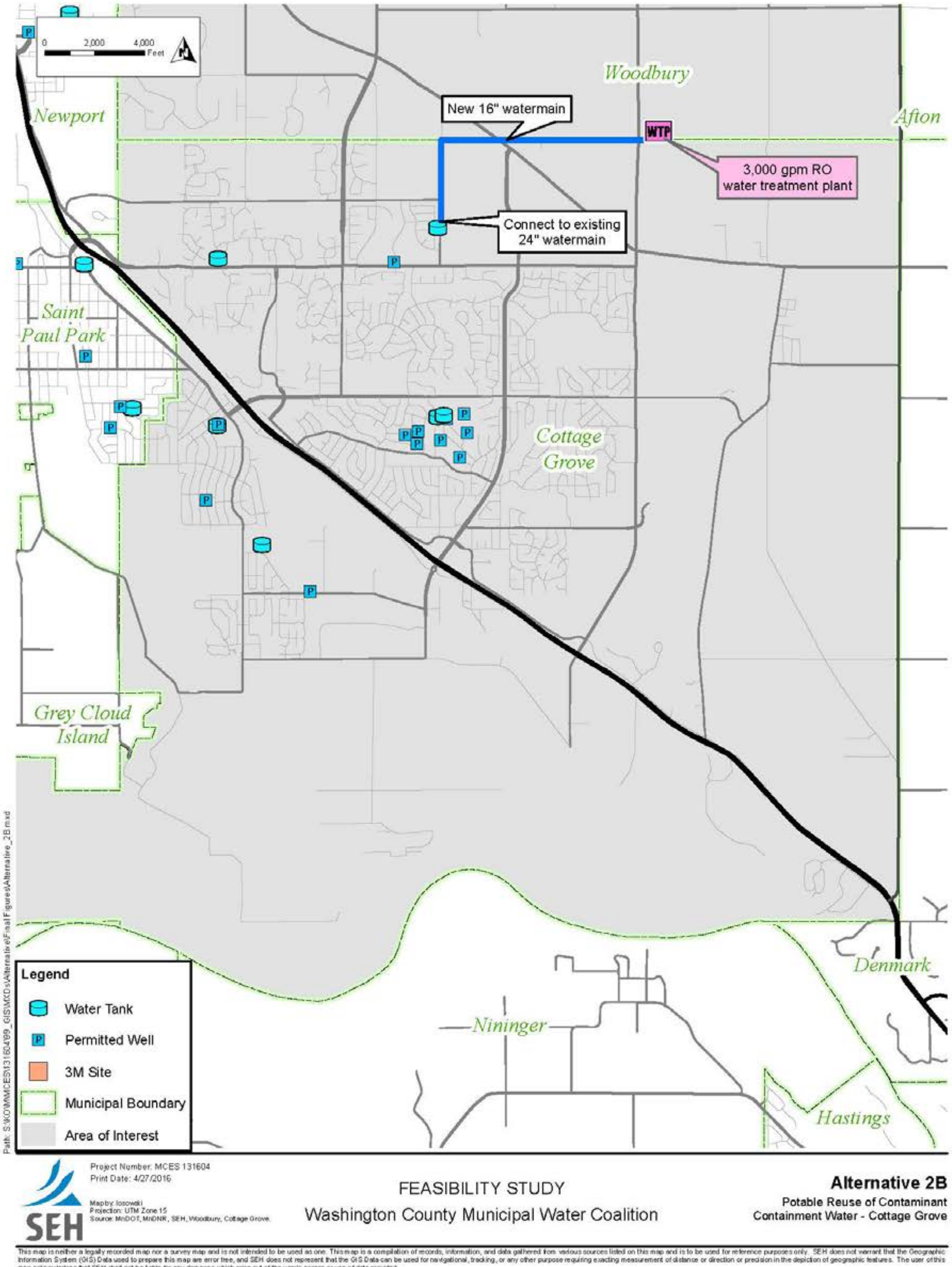
2.3e Alternative 2B – Estimated Costs

Table 2-6 provides a concept level cost estimate for Alternative 2B.

Table 2-6. Cost estimate for potable reuse of contaminant containment water to Cottage Grove (Alternative 2B).

Item	Quantity	Units	Unit Cost	Total Cost
Water Treatment Plant				
3,000 gpm RO Treatment Plant	1	Lump Sum	$20,000,000	$20,000,000
Water Main				
Open Cut 16” DIP (0% in road, rural)	5,800	Feet	$244	$1,400,000
Open Cut 16” DIP (50% in road)	6,000	Feet	$311	$1,900,000
Easements/ Land Acquisitions	60,000	Square Feet	$6	$400,000
Environmental	2.0	Miles	$50,000	$100,000
			Subtotal	**$23,800,000**
			Contingency (20%)	$4,800,000
			Engineering/ Administration/ Legal (15%)	$3,600,000
			Total Alternative 2B	**$32,200,000**

Figure 2-6. Water main alignment for potable reuse of contaminant containment water connecting to Cottage Grove (Alternative 2B).



2.3f Alternative 2C

Alternative 2C sends potable reuse water to both Woodbury and Cottage Grove (Figure 2-7). The combined average daily demand for Woodbury and Cottage Grove in 2040 is 15.4 MGD. The potable reuse water would offset a portion of the water demand and allow for reduction of groundwater pumping.

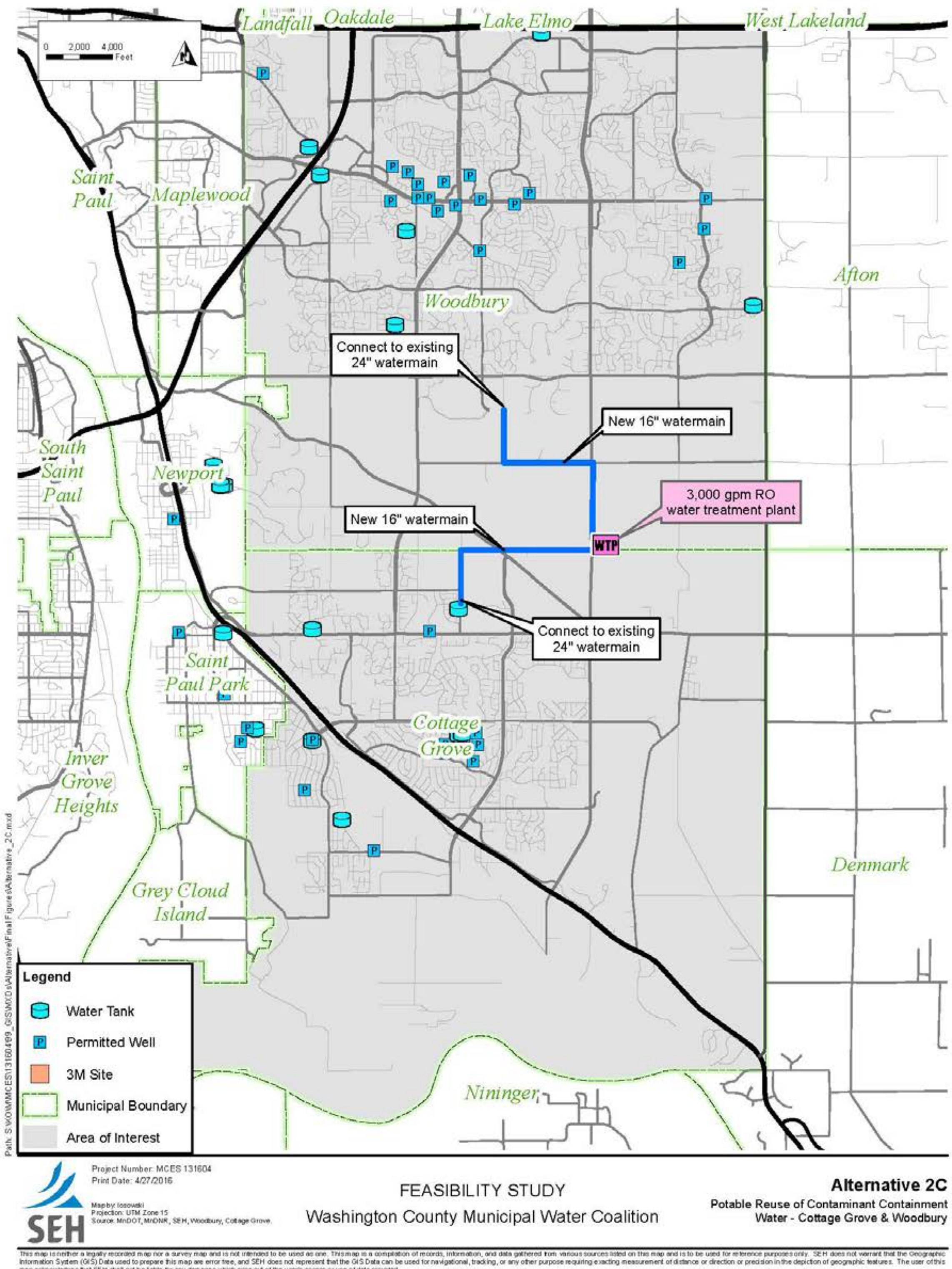
2.3g Alternative 2C - Estimated Costs

Table 2-7provides a concept level cost estimate for Alternative 2C.

Table 2-7. Cost estimate for potable reuse of contaminant containment water to Cottage Grove and Woodbury (Alternative 2C).

Item	Quantity	Units	Unit Cost	Total Cost
Water Treatment Plant				
3,000 gpm RO Treatment Plant	1	Lump Sum	$20,000,000	$20,000,000
Water Main				
Open Cut 16" DIP (0% in road, rural)	19,000	Feet	$244	$4,700,000
Open Cut 16" DIP (50% in road)	6,000	Feet	$311	$1,900,000
Easements/ Land Acquisitions	125,000	Square Feet	$6	$800,000
Environmental	5.0	Miles	$50,000	$300,000
			Subtotal	**$27,700,000**
			Contingency (20%)	$5,600,000
			Engineering/ Administration/ Legal (15%)	$4,200,000
			Total Alternative 2C	**$37,500,000**

Figure 2-7. Water main alignment for potable reuse of contaminant containment water connecting to Cottage Grove and Woodbury (Alternative 2C).



2.4 Alternative 3 – Aquifer Recharge

A third approach for utilizing the 3M contaminant containment water is to treat the water and inject it back into the ground either via deep water injection into a bedrock aquifer or shallow injection into a surficial aquifer.

Because the 3M Woodbury site is a former landfill, it is possible that contaminants besides PFCs exist in the groundwater. To protect against potential unknown contaminants and to remove PFCs, reverse osmosis (RO) treatment would be required to inject the contaminant containment water back into the ground.

Once the water is treated by RO, it would meet potable drinking water standards. At this point, it could be used as drinking water and there would be no reason to pump it back into the ground. Therefore, this alternative is not being considered further.

2.5 Cost Summary

Table 2-8 provides a summary of capital costs for Alternatives 1 and 2. The costs presented include contingency (20%) and engineering/admin/legal (15%).

Table 2-8. Capital cost summary for Alternatives 1 & 2.

Alternative	Capital Cost	Water Provided (MGY)
Alternative 1A – Contaminant containment water from 3M Woodbury to Valley Creek	$18,900,000	1,575
Alternative 1B – Contaminant containment water from 3M Woodbury to Northern Tier Refinery	$20,100,000	1,575
Alternative 1C – Contaminant containment water from 3M Cottage Grove to Northern Tier Refinery	$24,700,000	1,575
Alternative 1D – Contaminant containment water from 3M Woodbury to golf courses and Northern Tier Refinery	$32,200,000	1,575
Alternative 2A – Contaminant containment water to Woodbury	$32,300,000	1,260
Alternative 2B – Contaminant containment water to Cottage Grove	$32,200,000	1,260
Alternative 2C – Contaminant containment water to Woodbury & Cottage Grove	$37,500,000	1,260

2.5a Operation & Maintenance Costs

Operation and maintenance for Alternatives 1A, 1B, 1C, and 1D involve a full change out of the GAC every 18 months (approximately $200,000 per event), labor, and building costs (electricity, heat, insurance, etc.). The total annual O&M for Alternatives 1A, 1B, 1C, and 1D is estimated to be $185,000.

Operation and maintenance for Alternatives 2A, 2B, and 2C include significant pumping costs (due to high pressures), chemical costs, labor, and building costs (heat, insurance, etc.). The total annual O&M cost for Alternatives 2A, 2B, and 2C is estimated to be $2,750,000.

2.5b Annual Costs

Annual costs to use contaminant containment water for nonpotable and potable reuse include annualized payment on capital infrastructure, repair and replacement on capital infrastructure, and treatment plant O&M costs. Table 2-9 depicts a summary of annual costs for Alternatives 1 and 2.

Cost assumptions include:

- 20 year bond, 4% interest
- 1% annual repair and maintenance for new water main
- 2% annual repair and maintenance for water treatment plants
- Repair and replacement for new infrastructure and treatment plant
- O&M and repair and replacement for existing coalition infrastructure is not included

Table 2-9. Annualized costs to reuse 3M contaminant containment water for nonpotable purposes (Alternative 1 & 2).

Alternative	Water Provided (MGY)	Annualized Capital Cost	Repair & Replacement	Annual O&M	Total Annual Cost	Cost per 1,000 gallons
1A	1,575	$1,391,000	$167,000	$185,000	$1,743,000	$1.10
1B	1,575	$1,480,000	$177,000	$185,000	$1,840,000	$1.20
1C	1,575	$1,820,000	$166,000	$185,000	$2,170,000	$1.40
1D	1,575	$2,370,000	$254,000	$185,000	$2,810,000	$1.80
2A	1,260	$2,380,000	$433,000	$2,750,000	$5,560,000	$4.40
2B	1,260	$2,370,000	$433,000	$2,750,000	$5,550,000	$4.40
2C	1,260	$2,760,000	$466,000	$2,750,000	$5,980,000	$4.70

[1] The costs per 1,000 gallons are for relative comparison of Alternatives 1 & 2, and are not meant to represent potential water rates. Cost sharing options are discussed in Chapter 7.

Chapter 3– Conjunctive Use Surface Water Treatment Plant on Mississippi or St. Croix Rivers - Alternatives 4 and 5

An option for reducing reliance on groundwater for the Coalition is to build a new water treatment facility with a surface water source for conjunctive use with the existing groundwater systems.

3.1 Conjunctive Use New Water Treatment Plant Overview

The United States Environmental Protection Agency (US EPA) requires treatment of surface water used for drinking water. A conventional surface water treatment plant (WTP) typically consists of preliminary screening, chemical coagulation, flocculation, sedimentation, sand filtration, and chlorination.

All of the communities in the study area utilize groundwater as their source of drinking water. The intent with Alternatives 4 and 5 is that there is conjunctive use of surface water and groundwater. Conjunctive use is using groundwater and treated surface water in the distribution system at the same time. Alternatives 4 and 5 evaluate options for converting a portion of the drinking water for various communities in the study area from groundwater to treated surface water. The source of the surface water in Alternative 4 is the Mississippi River and the St. Croix River for Alternative 5.

3.2 New Water Treatment Plant

A new surface WTP will need to adhere to the United States Environmental Protection Agency's Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR). The new surface water treatment plants are sized based on the projected 2040 average daily demand of the communities served in each alternative, while municipal groundwater wells will supply peak water demands. A discussion of the LT2ESWTR and potential treatment processes is included in Appendix D.

3.3 Raw Water Quality

A number of water quality parameters monitored in the Mississippi River after the Minnesota River connects at Mendota Heights and in the St. Croix River at Stillwater were evaluated. The water quality criteria for both rivers show that the St. Croix River has lower concentrations of total suspended solids and turbidity when compared to the Mississippi River. The St. Croix River would likely require a lesser degree of water treatment based on the data provided in the latest MCES River Quality Summary. A memo presenting river water quality is included in Appendix E.

3.4 Conjunctive Use

A previous desktop study was conducted to identify water quality impacts associated with delivering treated surface water to groundwater communities and the possibility of conjunctive use of surface water and groundwater. The analysis was qualitative in nature.

A memo discussing the conjunctive use water quality is included in Appendix F. If should be noted that the conjunctive use memo in Appendix F was prepared for a different project; however, the concepts are identical. Preliminary conjunctive use water quality findings are as follows:

- Communities need to switch disinfection methods from chlorine to chloramines with a conversion to conjunctive use surface water.
- Mixing groundwater and surface water is predicted to be feasible.
- Customers in the Coalition can expect taste and odor properties to be different with conjunctive use of surface water. A public education program would be recommended.

- Lead, copper, and iron solution chemistry will be different with a conversion to conjunctive use of surface water. These constituents will need to be monitored closely and practices to control levels may need to be modified, including corrosion control.

3.5 Alternative 4 – Conjunctive Use Surface Water Treatment Plant on Mississippi River Overview

Alternative 4 analyzes only two possible scenarios for conjunctive use of treated surface water and groundwater for potable supply in subsets of communities in the study area. Both scenarios involve surface water treatment plants taking water from the Mississippi River as follows:

- Alternative 4A consists of connecting Cottage Grove and Woodbury to a new surface WTP
- Alternative 4B consists of connecting the communities of Cottage Grove, Woodbury, Lake Elmo, Oakdale, Newport and St. Paul Park to a new surface WTP

3.6 Alternative 4A

Alternative 4A consists of constructing a 17 million gallon per day (MGD) surface WTP located inland of the Mississippi River and a pumping station (Figure 3-1). The WTP location (conceptual in nature) is shown in the southeast portion of Newport. The 2040 average day demand for Woodbury and Cottage Grove is 15.4 MGD.

3.6a Alternative 4A - Trunk Water Main and Booster/Blending Stations

The treated water would be distributed from the new WTP via a 36-inch water main to a point at which the new distribution system sends a portion of the water north to Woodbury via a 30-inch water main and the remaining water southeast to Cottage Grove via a 20-inch water main.

Blending stations located in each distribution system allow suitable mixing of treated surface water with groundwater from municipal wells into the distribution systems. A booster station is also included in Woodbury due to a higher hydraulic grade line (water tower elevation).

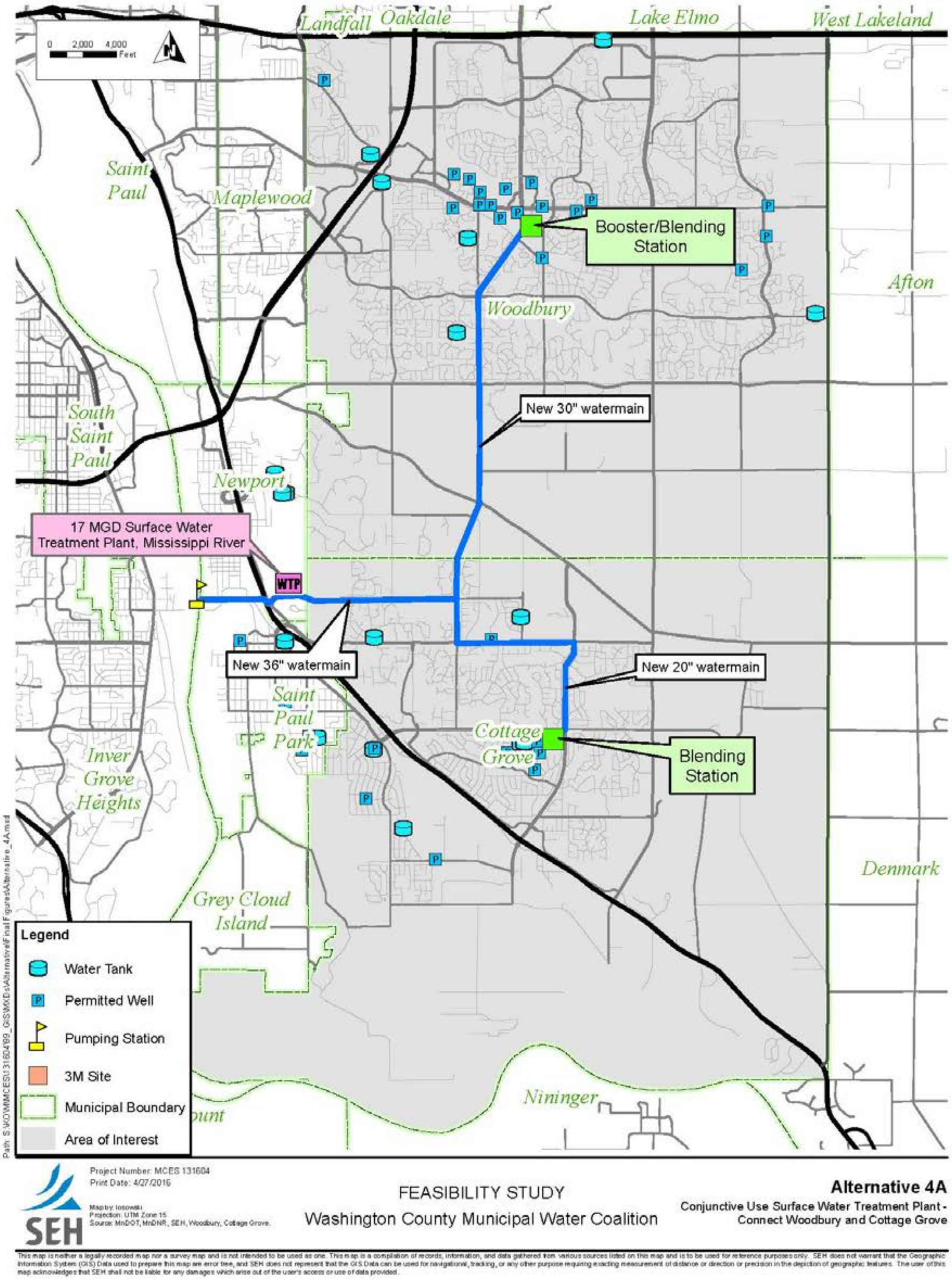
3.6b Alternative 4A – Estimated Costs

Table 3-1 provides a concept level cost estimate for Alternative 4A.

Table 3-1. Cost estimate for conjunctive use of groundwater and surface water connecting Woodbury and Cottage Grove (Alternative 4A).

Item	Quantity	Units	Unit Cost	Total Cost
Water Treatment Plant				
17 MGD Surface WTP	1	Lump Sum	$63,000,000	$63,000,000
Water Main				
Open Cut 36" DIP (0% in road, rural)	16,000	Feet	$421	$6,800,000
Open Cut 20" DIP (50% in road, urban)	15,000	Feet	$544	$8,200,000
Open Cut 30" DIP (50% in road, urban)	11,000	Feet	$622	$6,900,000
Open Cut 30" DIP (50% in road, rural)	13,000	Feet	$419	$5,500,000
Open Cut 12" DIP (0% in road, urban)	10,000	Feet	$272	$2,800,000
Booster/ Blending Station				
Cottage Grove – Blending	1	Lump Sum	$600,000	$600,000
Woodbury – Blending/ Booster	1	Lump Sum	$800,000	$800,000
Easements/ Land Acquisitions	325,000	Square Feet	$6	$2,000,000
Environmental	13.0	Miles	$50,000	$700,000
			Subtotal	$97,300,000
			Contingency (20%)	$19,500,000
			Engineering/ Administration/ Legal (15%)	$14,600,000
			Total Alternative 4A	**$131,400,000**

Figure 3-1. Water main alignment for conjunctive use of groundwater and surface water connecting Woodbury and Cottage Grove (Alternative 4A).



3.7 Alternative 4B

Alternative 4B involves building a 25 MGD surface water treatment plant in the same location as described in Alternative 4A, and adding water main to neighboring communities of Lake Elmo, Oakdale, Newport and St. Paul Park. The 2040 average day demand of the Alternative 4B communities is 21.3 MGD.

3.7a Alternative 4B – Trunk Water Main and Booster/Blending Stations

In addition to the needed infrastructure presented for Alternative 4A, a 20-inch water main (Figure 3-2) is required to distribute water to Oakdale, and a 12-inch water main is required to distribute water to the communities of Lake Elmo, Newport and St. Paul Park.

Similar to Alternative 4A, blending stations are required in each community's distribution system in order to properly mix surface water and groundwater for potable use. Booster stations are required in Woodbury, Oakdale and Lake Elmo due to higher elevations in these communities.

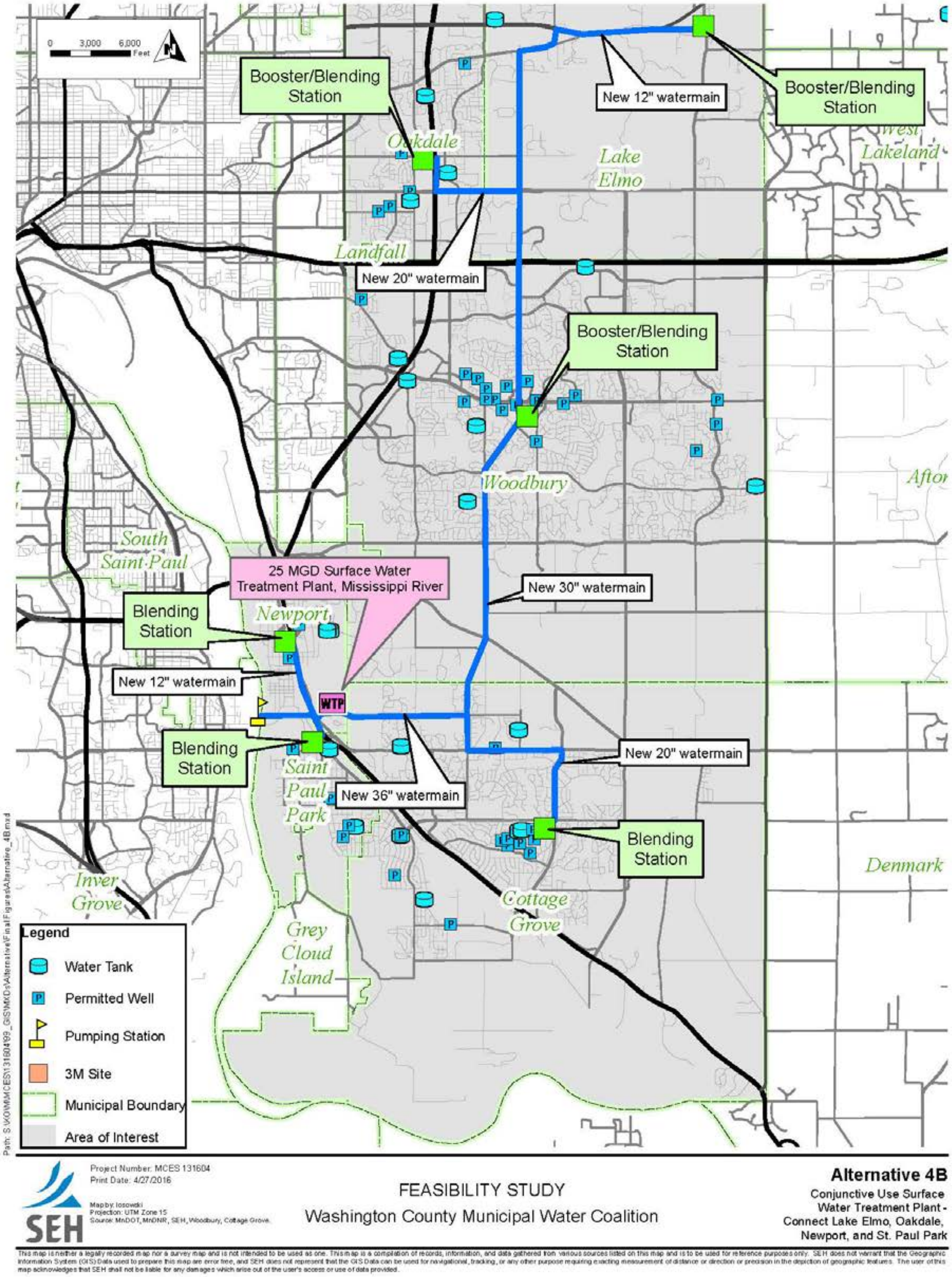
3.7b Alternative 4B – Estimated Costs

Table 3-2 provides a concept level cost estimate for Alternative 4B.

Table 3-2. Cost estimate for conjunctive use of groundwater and surface water connecting Lake Elmo, Oakdale, Woodbury, Cottage Grove, Newport, and St. Paul Park (Alternative 4B).

Item	Quantity	Units	Unit Cost	Total Cost
Water Treatment Plant				
25 MGD Surface WTP	1	Lump Sum	$78,000,000	$78,000,000
Water Main				
Open Cut 36" DIP (50% in road, rural)	16,000	Feet	$488	$7,900,000
Open Cut 30" DIP (50% in road, urban)	10,000	Feet	$622	$6,300,000
Open Cut 30" DIP (50% in road, rural)	10,000	Feet	$419	$4,200,000
Open Cut 12" DIP (50% in road, rural)	20,000	Feet	$285	$5,700,000
Open Cut 20" DIP (50% in road, urban)	36,000	Feet	$544	$19,600,000
Booster/ Blending Station				
Cottage Grove – Blending	1	Lump Sum	$600,000	$600,000
Woodbury – Blending / Booster	1	Lump Sum	$800,000	$800,000
St. Paul Park – Blending	1	Lump Sum	$500,000	$500,000
Newport – Blending	1	Lump Sum	$500,000	$500,000
Oakdale – Blending / Booster	1	Lump Sum	$700,000	$700,000
Lake Elmo – Blending / Booster	1	Lump Sum	$700,000	$700,000
Easements/ Land Acquisitions	460,000	Square Feet	$6	$2,800,000
Environmental	18.0	Miles	$50,000	$900,000
			Subtotal	**$129,200,000**
			Contingency (20%)	$25,900,000
			Engineering/ Administration/ Legal (15%)	$19,400,000
			Total Alternative 4B	**$174,500,000**

Figure 3-2. Water main alignment for conjunctive use of groundwater and surface water serving Woodbury, Cottage Grove, Lake Elmo, Oakdale, Newport, and St. Paul Park (Alternative 4B).



3.8 Alternative 5 – Conjunctive Use Surface Water Treatment Plant on St. Croix River Overview

Alternative 5 analyzes two scenarios for conjunctive use of treated surface water and groundwater for potable supply in subsets of communities in the study area. Both scenarios involve surface WTPs taking water from the St. Croix River as follows:

- Alternative 5A consists of connecting the communities of Stillwater, Oak Park Heights, and Bayport to a new surface WTP
- Alternative 5B consists of connecting the communities of Woodbury, Cottage Grove, Lake Elmo and Oakdale to a new surface WTP

A memorandum prepared by the Minnesota Department of Natural Resources discussing potential permitting requirement to receive appropriation from the St. Croix River is located in Appendix G.

3.9 Alternative 5A

Alternative 5A consists of constructing a 6 MGD surface WTP and pumping station (Figure 3-3). The WTP location (conceptual in nature) is shown in the east portion of Stillwater. A blending station would be located near the new WTP and a second blending station would be located in Oak Park Heights. A final blending station would need to be located in central Bayport near the existing water tank. The 2040 average day demand for the Alternative 5A communities is 4 MGD.

3.9a Alternative 5A – Trunk Water Main and Booster/Blending Stations

The treated water would be distributed from the new treatment plant via a 24-inch water main to a point in which the new distribution system sends a portion of the water to Bayport via an 8-inch water main line.

Blending stations located in each distribution system allow for mixing of treated surface water with groundwater from municipal wells into the distribution systems for potable use. No booster stations are required for this alternative.

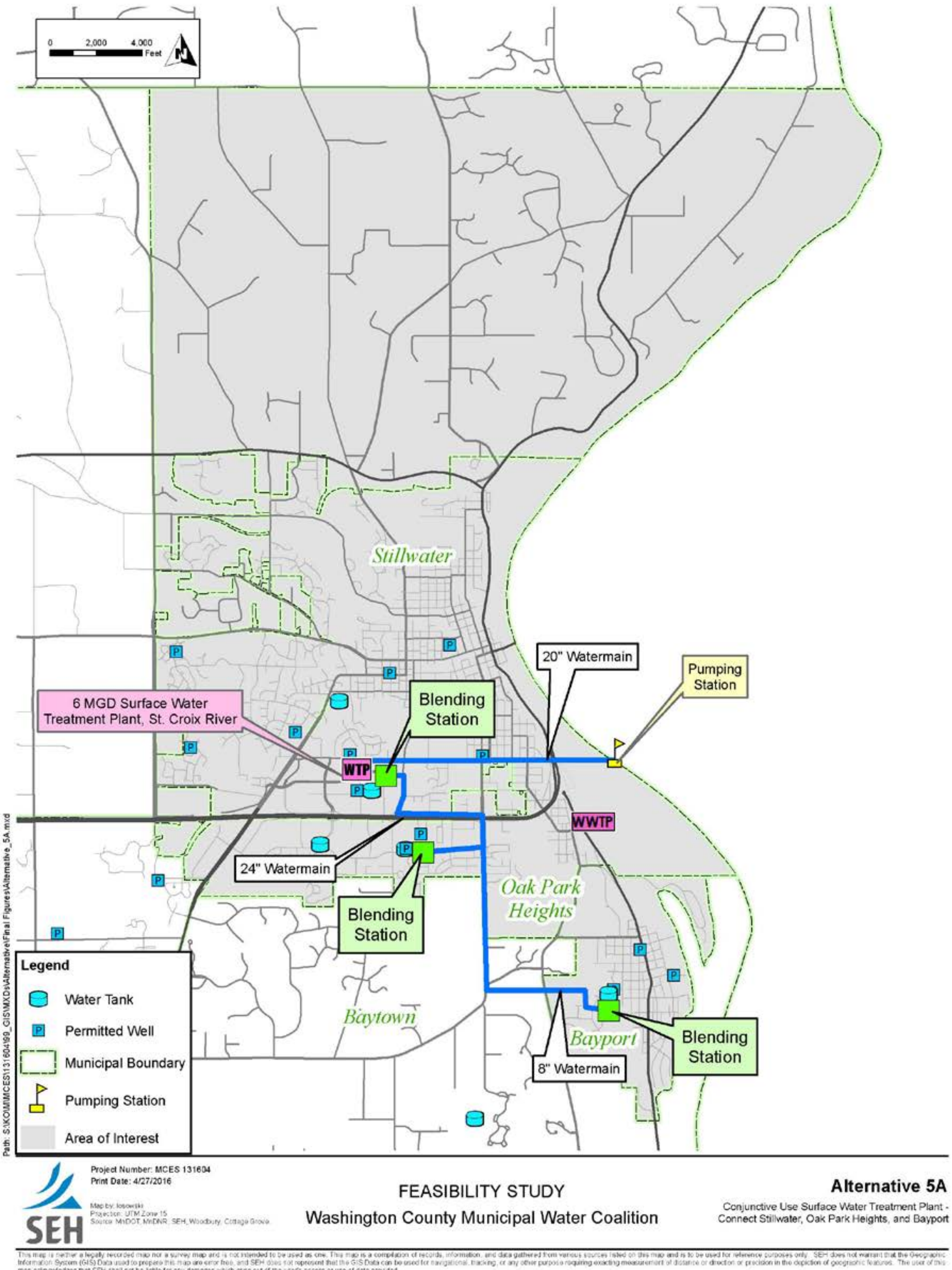
3.9b Alternative 5A – Estimated Costs

Table 3-3 provides a concept level cost estimate for Alternative 5A.

Table 3-3. Cost estimate for conjunctive use of groundwater and surface water connecting Stillwater, Oak Park Heights, and Bayport (Alternative 5A).

Item	Quantity	Units	Unit Cost	Total Cost
Water Treatment Plant				
6 MGD Surface WTP	1	Lump Sum	$35,000,000	$35,000,000
Water Main				
Open Cut 20" DIP (50% in road, urban)	12,000	Feet	$544	$6,600,000
24" Cased, Tunneled Pipe	250	Feet	$2,000	$500,000
Open Cut 24" DIP (50% in road, rural)	10,000	Feet	$370	$3,700,000
Directionally Drilled 8" HDPE	12,000	Feet	$150	$1,800,000
Fusing Pits	25	Each	$15,000	$400,000
Booster/ Blending Station				
Bayport – Blending	1	Lump Sum	$500,000	$500,000
Oak Park Heights – Blending	1	Lump Sum	$600,000	$600,000
Stillwater – Blending	1	Lump Sum	$600,000	$600,000
Easements/ Land Acquisitions	112,000	Square Feet	$6	$700,000
Environmental	5.0	Miles	$50,000	$300,000
			Subtotal	$50,700,000
			Contingency (20%)	$10,200,000
			Engineering/ Administration/ Legal (15%)	$7,700,000
			Total Alternative 5A	**$68,600,000**

Figure 3-3. Water main alignment for conjunctive use of groundwater and surface water connecting Stillwater, Oak Park Heights, and Bayport (Alternative 5A).



3.10 Alternative 5B

Alternative 5B involves building a 25 MGD surface WTP on the St. Croix River in Denmark Township to distribute treated surface water to Woodbury, Cottage Grove, Lake Elmo and Oakdale (Figure 3-4). The 2040 average day demand for the Alternative 5B communities is 20.1 MGD.

3.10a Alternative 5B - Trunk Water Main and Blending/Booster Stations

A 36-inch water main is required from the water treatment plant location to a point in the system in which water is distributed to the communities. A series of 24-inch, 20-inch and 12-inch water mains would then be used to distribute treated water to the blending and boosting stations.

Four new blending stations and three booster stations would be needed to provide the required pressure and mixing for each location.

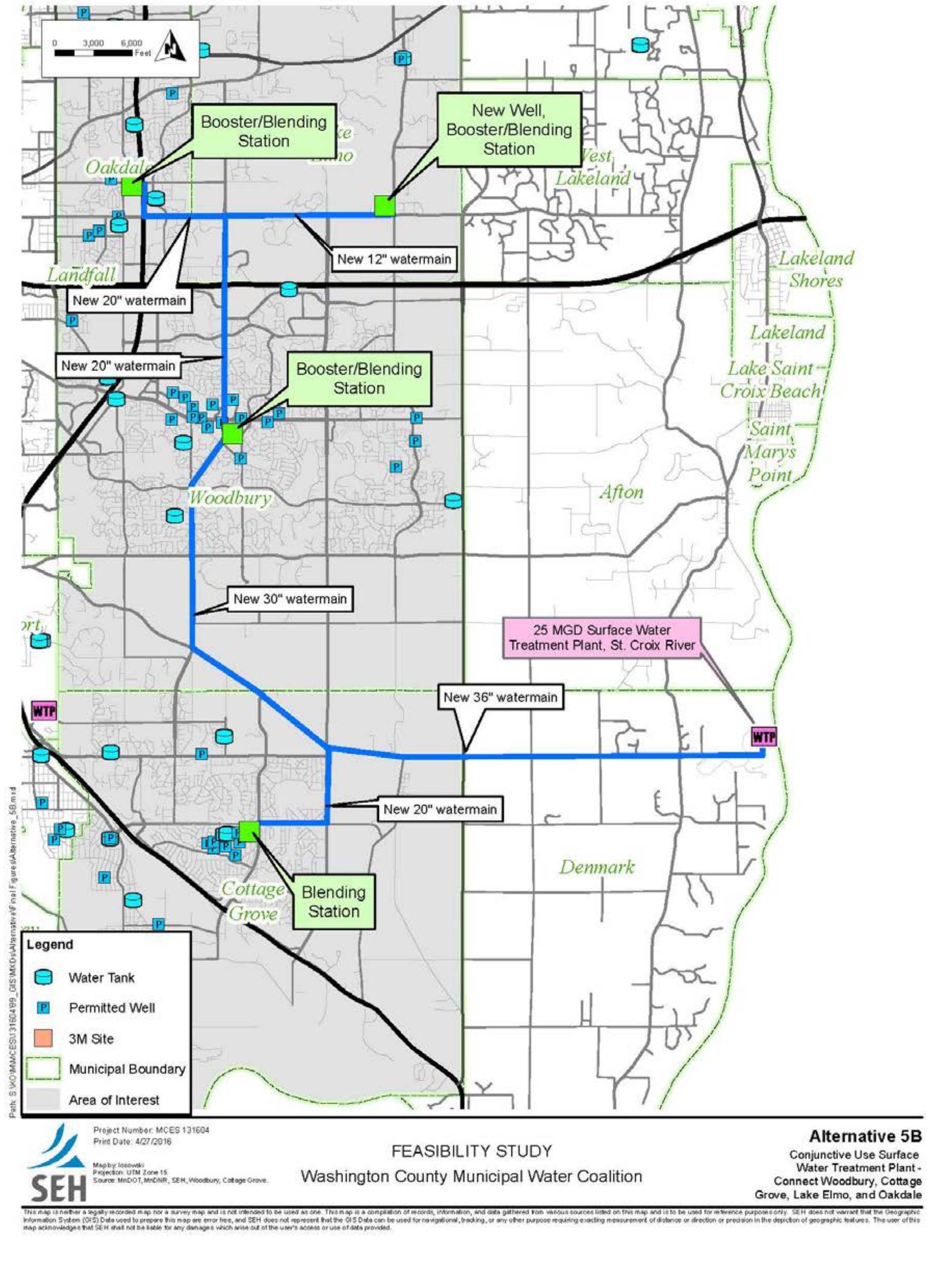
3.10b Alternative 5B – Estimated Costs

Table 3-4provides a concept level cost estimate for Alternative 5B.

Table 3-4. Cost estimate for conjunctive use of groundwater and surface water connecting Woodbury, Cottage Grove, Lake Elmo, and Oakdale (Alternative 5B).

Item	Quantity	Units	Unit Cost	Total Cost
Water Treatment Plant				
25 MGD Surface WTP	1	Lump Sum	$78,000,000	$78,000,000
Water Main				
Open Cut 36" DIP (0% in road, rural)	29,000	Feet	$421	$12,300,000
Open Cut 20" DIP (50% in road, urban)	32,000	Feet	$544	$17,500,000
Open Cut 30" DIP (0% in road, rural)	16,000	Feet	$352	$5,700,000
Open Cut 30" DIP (50% in road, urban)	11,000	Feet	$622	$6,900,000
Open Cut 12" DIP (50% in road, rural)	31,000	Feet	$285	$8,900,000
Booster/ Blending Station				
Cottage Grove – Blending	1	Lump Sum	$600,000	$600,000
Woodbury – Blending / Booster	1	Lump Sum	$800,000	$800,000
Oakdale – Blending / Booster	1	Lump Sum	$700,000	$700,000
Lake Elmo – Blending / Booster	1	Lump Sum	$700,000	$700,000
Easements/ Land Acquisitions	595,000	Square Feet	$6	$3,600,000
Environmental	23.0	Miles	$50,000	$1,200,000
			Subtotal	**$136,900,000**
			Contingency (20%)	$27,400,000
			Engineering/ Administration/ Legal (15%)	$20,600,000
			Total Alternative 5B	**$184,900,000**

Figure 3-4. Water main alignment for conjunctive use groundwater and surface water treatment plant serving Woodbury, Cottage Grove, Lake Elmo and Oakdale (Alternative 5B).



3.11 Cost Summary

Table 3-5 provides a summary of costs for Alternatives 4 and 5. The costs presented include contingency (20%) and engineering/admin/legal (15%).

Table 3-5. Capital Cost Summary of Alternatives 4 and 5.

Alternative	Capital Cost	Water Provided (MGY)
4A – New Surface WTP on Mississippi River, Connect Woodbury, Cottage Grove, Conjunctive Use	$131,400,000	4,900
4B – New Surface WTP on Mississippi River, Connect Woodbury, Cottage Grove, Lake Elmo, Oakdale, Newport, St. Paul Park, Conjunctive Use	$174,500,000	6,680
5A – New Surface WTP on St. Croix River, Connect Stillwater, Oak Park Heights, Bayport, Conjunctive Use	$68,600,000	1,225
5B – New Surface WTP on St. Croix River, Connect Woodbury, Cottage Grove, Oakdale, Lake Elmo, Conjunctive Use	$184,900,000	6,470

3.11a Operation and Maintenance Costs

Operation and maintenance (O&M) costs for major surface WTPs vary considerably with the types of unit processes and water quality characteristics. To develop O&M costs for Alternatives 4 and 5, O&M costs from St. Paul Regional Water Services were used as the basis for this study and proportioned based on the size of the new surface WTPs. The costs include labor, chemicals, electricity, building costs, and administrative costs.

O&M costs for the booster stations needed to connect communities in the Coalition to a new surface WTP were developed based on pumping energy, equipment maintenance, operator costs, building heat, and other miscellaneous costs. The booster station operation and maintenance costs are included in Appendix B. Table 3-6 identifies annual O&M costs for Alternatives 4 and 5.

Table 3-6. Annual operation and maintenance costs for surface WTPs serving Alternatives 4 and 5.

Alternative	Treatment Plant O&M	Booster/Blending Station O&M	Total Annual O&M
Alternative 4A (13 MGD Water Provided)	$5,900,000	$57,000	$5,957,000
Alternative 4B (18 MGD Water Provided)	$8,250,000	$151,000	$8,401,000
Alternative 5A (3.4 MGD Water Provided)	$1,500,000	$55,000	$1,550,000
Alternative 5B (18 MG Water Provided)	$7,950,000	$118,000	$8,068,000

3.11b Annual Costs

Annual costs to connect Coalition communities to a new surface WTP include annualized payments on capital infrastructure, repair and replacement on capital infrastructure, and booster station O&M. The annual costs for each alternative are included in Table 3-7.

Cost assumptions include:

- 20 year bond, 4% interest
- 1% annual repair and replacement for new water main
- 2% annual repair and replacement for water treatment plants and booster stations
- O&M and repair and replacement for existing Coalition infrastructure is not included

Table 3-7. Annual costs for Alternatives 4 and 5 for conjunctive use of surface water and groundwater for potable uses.

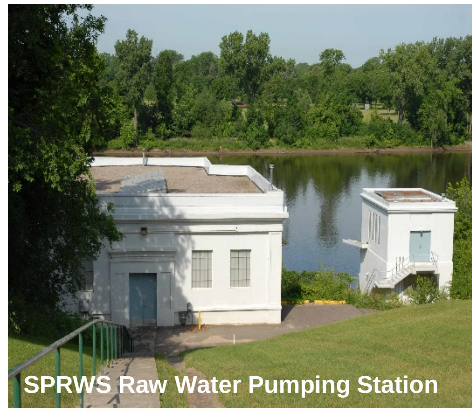
Alternative	Water Provided (MGY)	Annualized Capital Costs	Repair & Replacement	Annual O&M	Total Annual Cost	Cost per 1,000 gallons[1]
4A	4,900	$9,670,000	$1,610,000	$6,000,000	$17,790,000	$3.50
4B	6,680	$12,840,000	$2,150,000	$8,400,000	$23,390,000	$3.50
5A	1,225	$5,050,000	$960,000	$1,550,000	$7,560,000	$6.20
5B	6,470	$13,600,000	$2,180,000	$8,070,000	$23,850,000	$3.70

[1] The costs per 1,000 gallons are for relative comparison of Alternatives 4 & 5, and are not meant to represent potential water rates. Cost sharing options are discussed in Chapter 7.

Chapter 4 - Potable Water Connection to SPRWS – Alternative 6

To reduce reliance on groundwater, select Coalition communities could be connected to St. Paul Regional Water Services (SPRWS) for their drinking water supply. SPRWS operates a major water utility that gets its raw water from the Mississippi River. SPRWS has excess treatment capacity and is in close proximity to the Coalition communities. As previously stated, these alternatives are not meant to be prescriptive, but are meant to provide concept level costs and considerations.

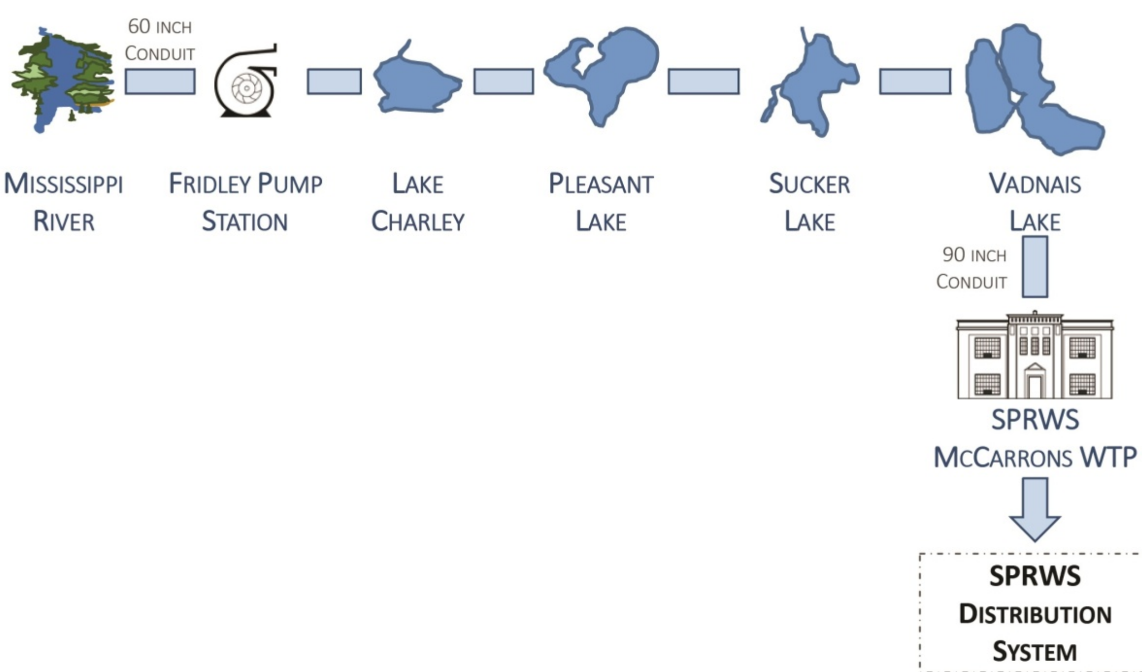
4.1 SPRWS Existing System


SPRWS Raw Water Pumping Station

The SPRWS raw water pumping station is located on the Mississippi River in Fridley, Minnesota (Figure 4-1). The pumping station has a capacity of 80 MGD. The pumping station pumps raw water into two 60-inch cast-in-place concrete pipes. The pressure inside the concrete pipes is regulated by a surge tower located at the pumping station. The overflow elevation of the surge tower is 950 ft.

The raw water conduits are routed east approximately 9 miles and discharge into Lake Charley in the City of North Oaks. Charley Lake is the first lake in a series of lakes that also includes Pleasant Lake, Sucker Lake, and Vadnais Lake. The purpose of the lakes is to act as sedimentation basins to improve the raw water quality ahead of the water treatment plant and provide storage. In addition, oxygen is added to the water in Pleasant Lake and Vadnais Lake to further improve raw water quality. The chain of lakes has an operating storage capacity of 3.56 billion gallons above the McCarrons water treatment facility intakes. A pumping station in Vadnais Lake pumps the raw water into two 90-inch conduits that deliver the water to the SPRWS McCarrons water treatment facility located on Rice Street in St. Paul.

Figure 4-1 Schematic of SPRWS Raw Water and Treatment Infrastructure



Along the two 90-inch conduits, SPRWS has 10 Prairie du Chien – Jordan aquifer wells with a combined capacity of 45 MGD. The wells pump directly into the 90-inch conduits. SPRWS used approximately 1.4 billion gallons of water from the wells in 2012 (3.8 MGD).

The McCarrons water treatment plant (WTP) is a conventional lime softening facility. The treatment process includes chemical addition, flocculation, clarification, recarbonation, settling, filtration, and high service pumping. The lime softening process removes hardness from the water. In 2006, granular activated carbon filters were added to remove objectionable taste and odor constituents from the water. The sustainable maximum day capacity of the water treatment facility is 105 MGD with a peak capacity of 130 MGD.

SPRWS serves approximately 420,000 people in 12 cities. In 2012, the average day demand for the SPRWS system was 45 MGD with a maximum day demand of 77 MGD.

SPRWS has *Retail* customers and *Wholesale* customers. SPRWS owns and operates the water systems of their Retail customers (Maplewood, West St. Paul, etc.). SPRWS sells water to their Wholesale customers, but the Wholesale customers own and operate their respective water systems (Roseville, Little Canada, etc.). Table 4-1 reflects the rates charged to SPRWS Retail customers.

Table 4-1. 2016 Saint Paul Regional Water Services retail water rates.

Type	Retail Customer
Base Rate	$9.00 / quarter
Winter Rate	$3.37 / 1,000 gallons
Summer Rate	$3.50 / 1,000 gallons

4.2 Conjunctive Use Water Quality

As discussed in Section 3.4 and Appendix E, conjunctive use of surface water and groundwater is considered to be feasible. It will require Coalition communities to switch their disinfection method from chlorination to chloramines and potentially modify their stabilization strategies (corrosion control).

4.3 Development of Concept System to Serve the Coalition

All of the communities in the study area utilize groundwater as their source of drinking water. Areas of contamination and potential aquifer drawdown denote potential problems with continued reliance on groundwater. Alternatives 6 A-G evaluate options for converting a portion of the drinking water for various communities in the study area from groundwater to treated surface water from SPRWS. SPRWS provides water to communities bordering the study area to the west. The operating pressures for SPRWS are generally lower than the communities in the Coalition.

Alternative 6 assumes conjunctive use of surface water and groundwater, except for Alternatives 6A and 6F. Conjunctive use systems have a combination of treated surface water and groundwater in the distribution system. SPRWS would provide the communities average day water demand, while municipal groundwater wells will supply peak water demands.

Alternative 6 analyzes seven scenarios for providing treated surface water from SPRWS to subsets of communities in the Coalition as follows:

- Alternative 6A - a portion of Woodbury to SPRWS (not conjunctive use)
- Alternative 6B - all of Woodbury to SPRWS
- Alternative 6C - all of Woodbury and Cottage Grove to SPRWS
- Alternative 6D - Newport to SPRWS
- Alternative 6E - Oakdale to SPRWS
- Alternative 6F - Oakdale and Lake Elmo to SPRWS
- Alternative 6G - a portion of northwest Woodbury and all of Newport to SPRWS (not conjunctive use)

Alternatives 6A through 6G would not require SPRWS to increase the capacity of their treatment or raw water conveyance infrastructure.

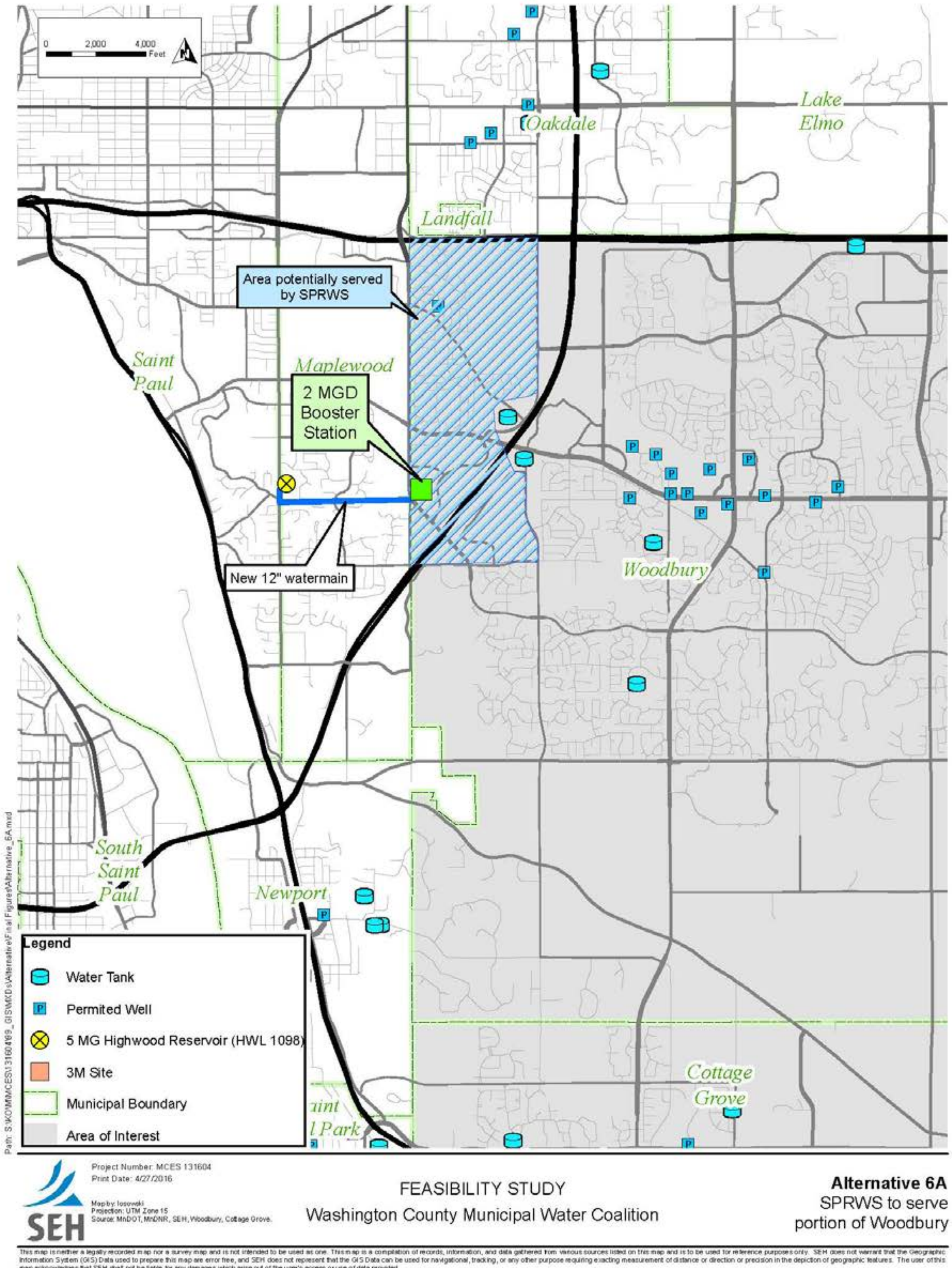
4.4 Altervative 6A

Alternative 6A includes distributing water east from the SPRWS Highwood reservoir in Maplewood to the northwest section of Woodbury (Figure 4-2). This alternative would provide 2 MGD to the northwest section of Woodbury and is intended to be the only source of water for this area (not conjunctive use). A booster station and 12" water main are required. Table 4-2 provides concept level costs for Alternative 6A.

Table 4-2. Cost estimate to connect SPRWS to serve portion of Woodbury (Alternative 6A).

Item	Quantity	Units	Unit Cost	Total Cost
Water Main				
Directionally Drilled 12" HDPE	9,000	Feet	$250	$2,300,000
Fusing Pits	10	Each	$15,000	$200,000
Booster/ Blending Station				
Woodbury – Booster	1	Lump Sum	$600,000	$600,000
Easements/ Land Acquisitions	45,000	Square Feet	$6	$300,000
Environmental	1.0	Miles	$50,000	$100,000
			Subtotal	**$3,500,000**
			Contingency (20%)	$700,000
			Engineering/ Administration/ Legal (15%)	$600,000
			Total Alternative 6A	**$4,800,000**

Figure 4-2. Water main alignment connecting SPRWS to northwest section of Woodbury (Alternative 6A).



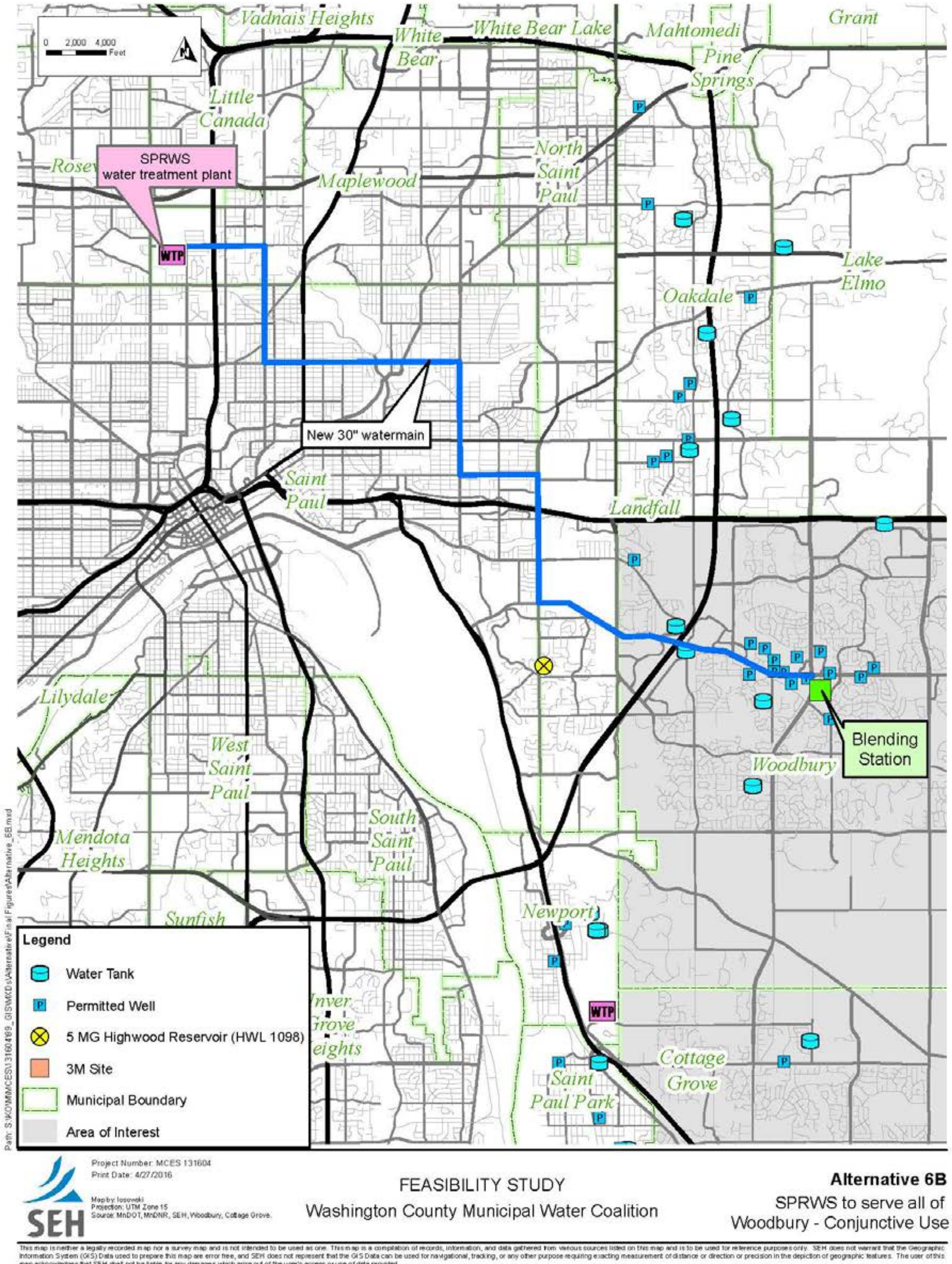
4.5 Alternative 6B

Alternative 6B involves supplying drinking water from SPRWS to meet the City of Woodbury's 2040 average day demands of 10.2 MGD. A new 30" water main would be constructed from the McCarrons WTP to the center of Woodbury's water system (Figure 4-3). A blending station is required to mix the treated surface water and groundwater. Table 4-3 presents the concept level cost estimates associated with Alternative 6B.

Table 4-3. Cost estimate to connect SPRWS to serve Woodbury in conjunction with groundwater (Alternative 6B).

Item	Quantity	Units	Unit Cost	Total Cost
Water Main				
Open Cut 30" DIP (100% in road, urban)	48,000	Feet	$842	$40,500,000
Open Cut 30" DIP (50% in road, urban)	19,000	Feet	$622	$11,900,000
Open Cut 12" DIP (0% in road, urban)	5,000	Feet	$272	$1,400,000
Booster/ Blending Station				
Woodbury – Blending	1	Lump Sum	$700,000	$700,000
Easements/ Land Acquisitions	360,000	Square Feet	$6	$2,200,000
Environmental	14.0	Miles	$50,000	$700,000
			Subtotal	**$57,400,000**
			Contingency (20%)	$11,500,000
			Engineering/ Administration/ Legal (15%)	$8,700,000
			Total Alternative 6B	**$77,600,000**

Figure 4-3. Water main alignment to connect SPRWS to serve Woodbury in conjunction with groundwater (Alternative 6B).



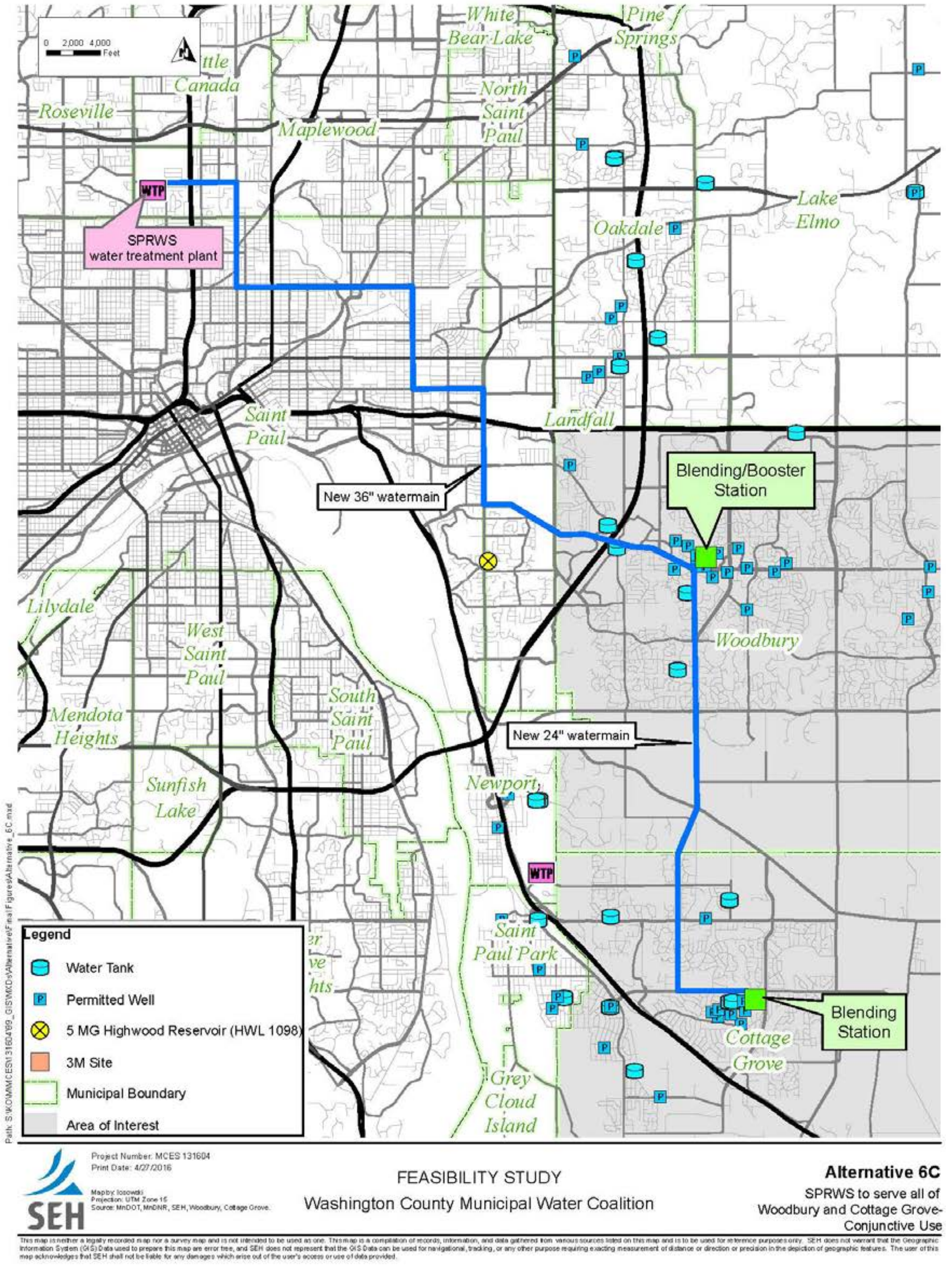
4.6 Alternative 6C

Alternative 6C adds the City of Cottage Grove to Alternative 6B described above. Water will be conveyed to the City of Cottage Grove through a 24-inch water main and includes a blending station (Figure 4-4). A larger 36” water main is also required from SPRWS to the City of Woodbury. Table 4-4 shows the concept level cost estimates for adding the City of Cottage Grove to the previous alternative.

Table 4-4. Cost estimate to connect SPRWS to serve Woodbury and Cottage Grove (Alternative 6C).

Item	Quantity	Units	Unit Cost	Total Cost
Water Main				
Open Cut 36” DIP (100% in road, urban)	48,000	Feet	$911	$43,800,000
Open Cut 36” DIP (50% in road, urban)	19,000	Feet	$691	$13,200,000
Open Cut 24” DIP (50% in road, urban)	5,000	Feet	$573	$2,900,000
Open Cut 24” DIP (0% in road, rural)	11,000	Feet	$304	$3,400,000
Open Cut 12” DIP (0% in road, urban)	10,000	Feet	$272	$2,800,000
Booster/ Blending Station				
Woodbury – Blending / Booster	1	Lump Sum	$1,000,000	$1,000,000
Cottage Grove – Blending	1	Lump Sum	$600,000	$600,000
Easements/ Land Acquisitions	465,000	Square Feet	$6	$2,800,000
Environmental	18.0	Miles	$50,000	$900,000
			Subtotal	**$71,400,000**
			Contingency (20%)	$14,300,000
			Engineering/ Administration/ Legal (15%)	$10,800,000
			Total Alternative 6C	**$96,500,000**

Figure 4-4. Water main alignment to connect SPRWS to serve Woodbury and Cottage Grove in conjunction with groundwater (Alternative 6C).



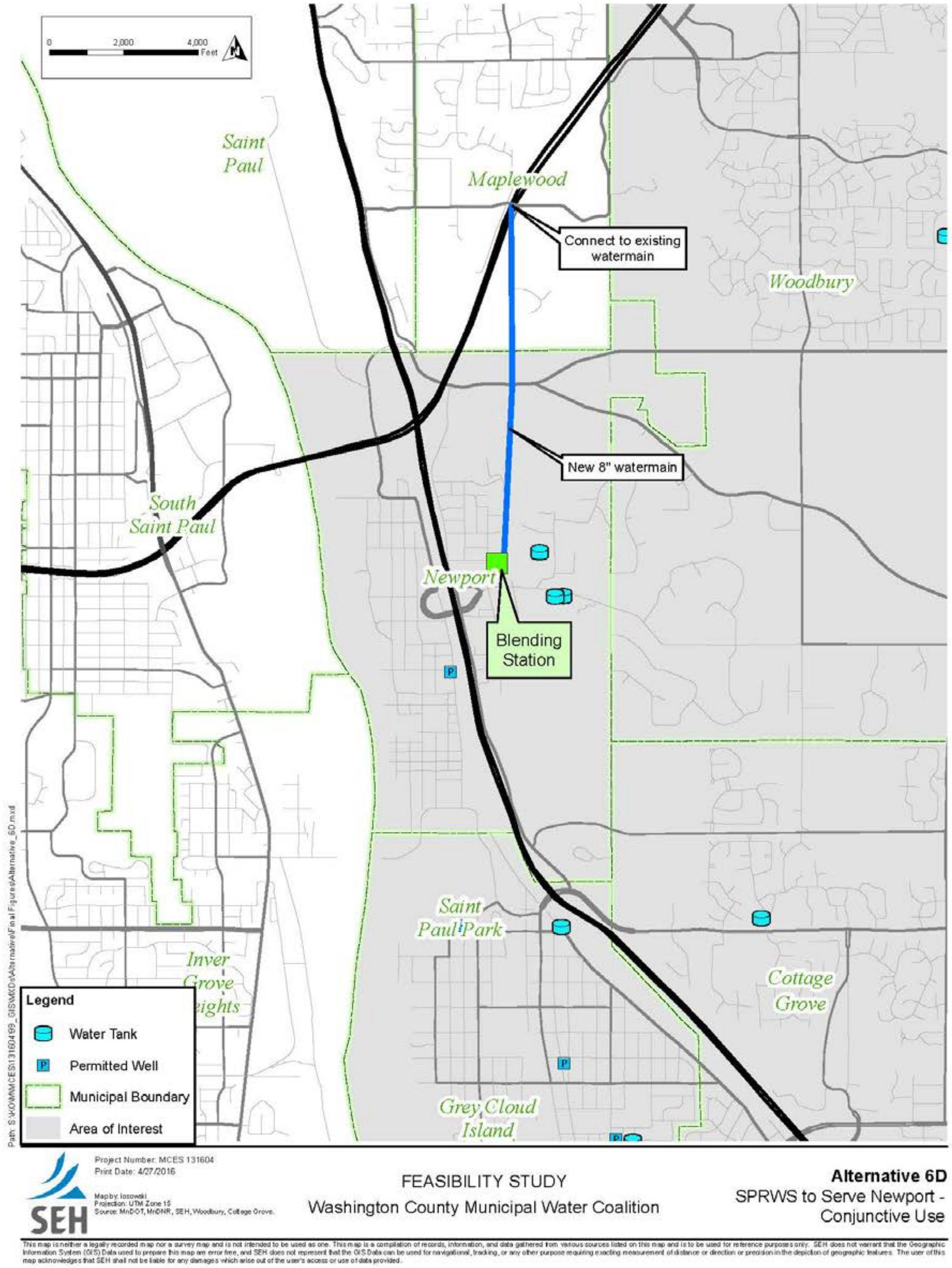
4.7 Alternative 6D

Alternative 6D involves supplying drinking water from the SPRWS to meet the City of Newport's 2040 average day demand of 0.4 MGD. A new 8" water main would be constructed from Maplewood to Newport (Figure 4-5). A blending station is required to mix the treated surface water and groundwater. Although the elevation of Newport's water tower is not known, it is assumed that a booster station is not necessary. Table 4-5 shows the concept level cost estimates associated with Alternative 6D.

Table 4-5. Cost estimate to connect SPRWS and supply potable water to Newport (Alternative 6D).

Item	Quantity	Units	Unit Cost	Total Cost
Water Main				
Directionally Drilled 8" HDPE	10,000	Feet	$200	$2,000,000
Directionally Drilled 12" HDPE	5,000	Feet	$250	$1,300,000
Fusing Pits	15	Each	$15,000	$300,000
Booster/ Blending Station				
Newport – Blending	1	Lump Sum	$500,000	$500,000
Easements/ Land Acquisitions	75,000	Square Feet	$6	$500,000
Environmental	2.0	Miles	$50,000	$100,000
			Subtotal	**$4,700,000**
			Contingency (20%)	$1,000,000
			Engineering/ Administration/ Legal (15%)	$800,000
			Total Alternative 6D	**$6,500,000**

Figure 4-5. Water main alignment to connect SPRWS to serve Newport in conjunction with groundwater (Alternative 6D).



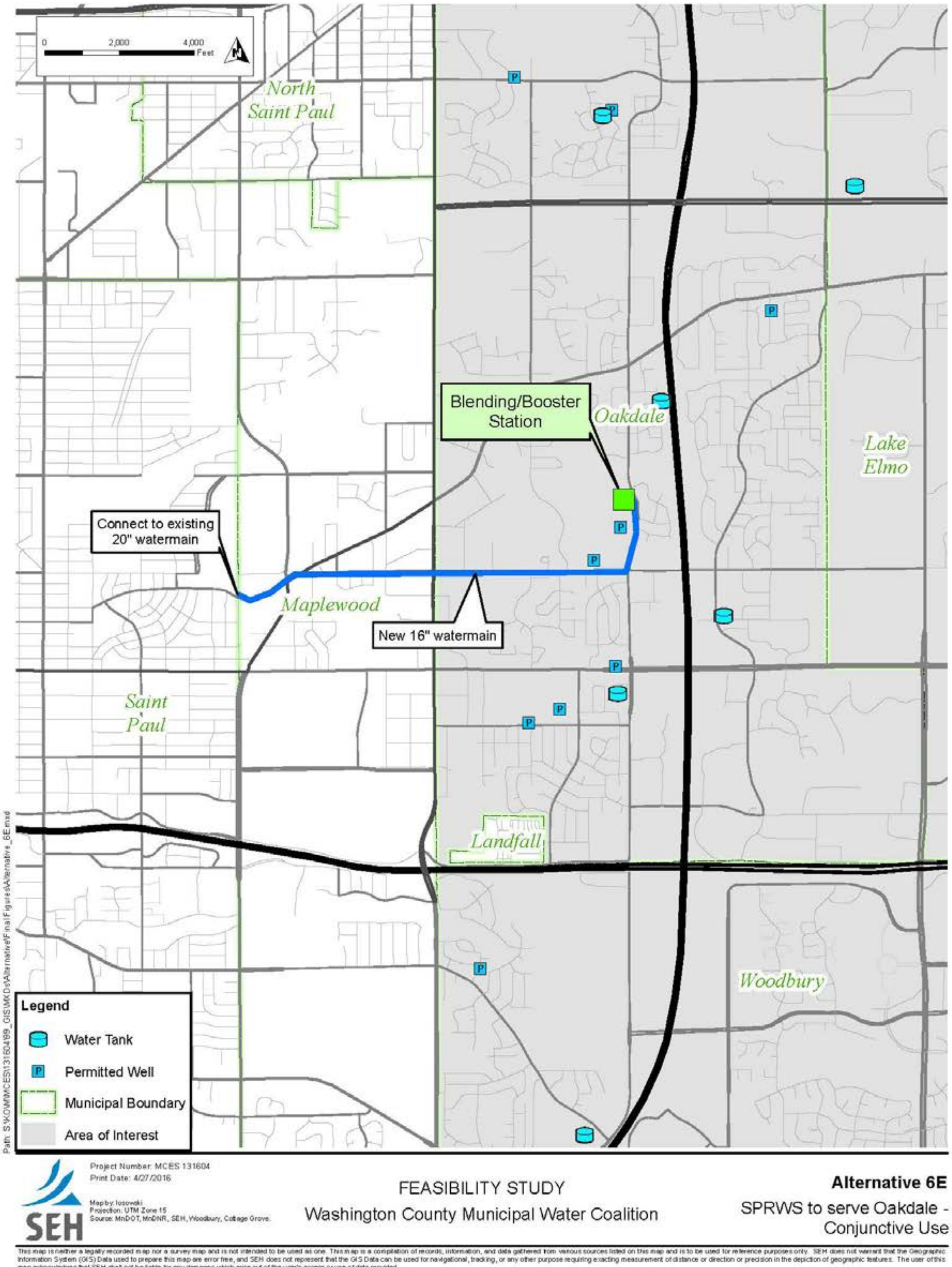
4.8 Alternative 6E

Alternative 6E serves the City of Oakdale from the SPRWS distribution system in Maplewood. A new 16-inch water main will be required to convey potable water to Oakdale (Figure 4-6). A booster station and blending station will be required. Table 4-6 presents the cost estimate for Alternative 6E.

Table 4-6. Cost estimate to connect SPRWS and supply potable water to Oakdale (Alternative 6E).

Item	Quantity	Units	Unit Cost	Total Cost
Water Main				
Open Cut 16" DIP (50% in road, urban)	13,000	Feet	$514	$6,700,000
Open Cut 12" DIP (0% in road, urban)	5,000	Feet	$272	$1,400,000
Booster/ Blending Station				
Oakdale – Blending / Booster	1	Lump Sum	$700,000	$700,000
Easements/ Land Acquisitions	90,000	Square Feet	$6	$600,000
Environmental	3.0	Miles	$50,000	$200,000
			Subtotal	**$9,600,000**
			Contingency (20%)	$2,000,000
			Engineering/ Administration/ Legal (15%)	$1,500,000
			Total Alternative 6E	**$13,100,000**

Figure 4-6. Water main alignment to connect SPRWS to serve Oakdale in conjunction with groundwater (Alternative 6E).



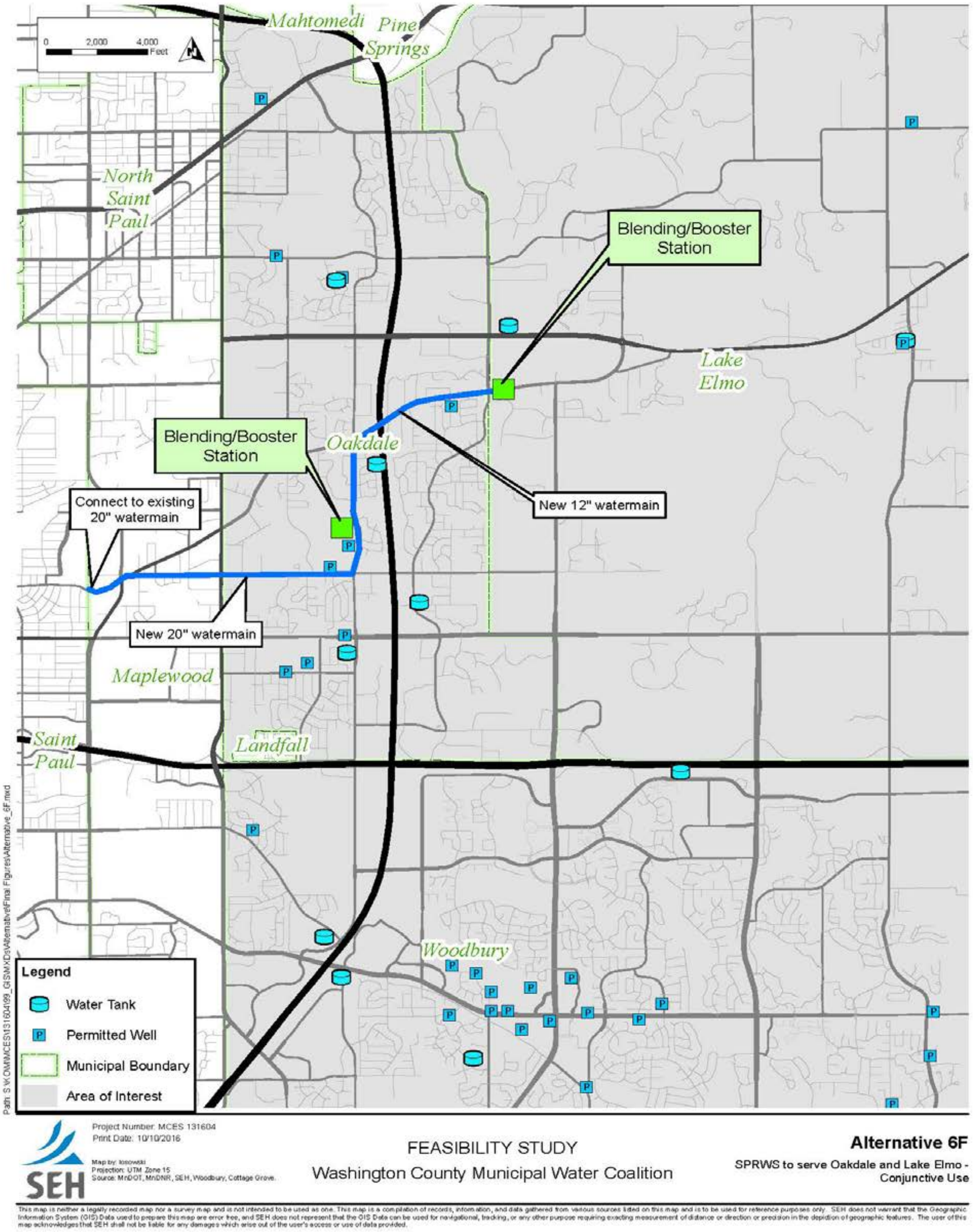
4.9 Alternative 6F

Alternative 6F adds Lake Elmo to Alternative 6E as described above. A new 12-inch water main would convey potable water from the Oakdale blending station east to the northeastern portion of the Lake Elmo distribution system (Figure 4-7). From there, the pressure zones will allow gravity flow to other regions of Lake Elmo. A 20" water main will be required from Oakdale to the SPRWS system in Maplewood. Table 4-7 shows the concept level cost estimates for Alternative 6F.

Table 4-7. Cost estimate to connect SPRWS and supply potable water to Oakdale and Lake Elmo (Alternative 6F).

Item	Quantity	Units	Unit Cost	Total Cost
Water Main				
Open Cut 20" DIP (50% in road, urban)	13,000	Feet	$544	$7,100,000
Open Cut 12" DIP (0% in road, rural)	10,000	Feet	$218	$2,200,000
Booster/ Blending Station				
Oakdale – Blending / Booster	1	Lump Sum	$700,000	$700,000
Lake Elmo – Blending / Booster	1	Lump Sum	$600,000	$600,000
Easements/ Land Acquisitions	170,000	Square Feet	$6	$1,000,000
Environmental	4.0	Miles	$50,000	$200,000
			Subtotal	**$11,800,000**
			Contingency (20%)	$2,400,000
			Engineering/ Administration/ Legal (15%)	$1,800,000
			Total Alternative 6F	**$16,000,000**

Figure 4-7. Water main alignment to connect SPRWS to serve Oakdale and Lake Elmo in conjunction with groundwater (Alternative 6F).



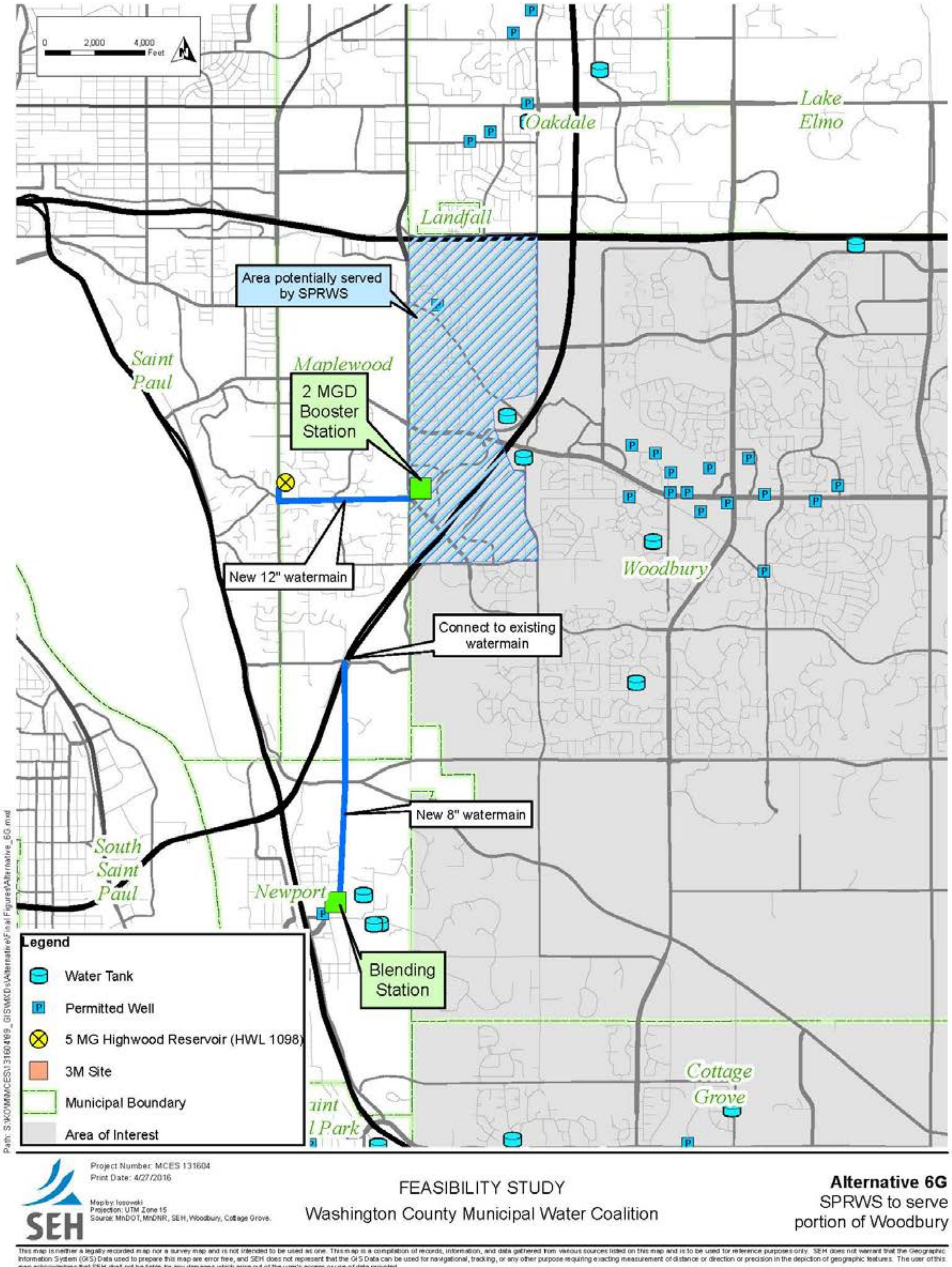
4.10 Alternative 6G

Alternative 6G connects the northwest section of Woodbury as seen in Alternative 6A, as well as the City of Newport from the Highwood Reservoir in St. Paul. In addition to infrastructure in Alternative 6A, new 8-inch water main would connect to existing water main in Maplewood to convey water south to Newport where a blending station would be installed to mix surface and groundwater prior to distribution (Figure 4-8). Table 4-8 presents a concept level cost estimate for Alternative 6G.

Table 4-8. Cost estimate to connect SPRWS and supply potable water to the northwest section of Woodbury and Newport (Alternative 6G).

Item	Quantity	Units	Unit Cost	Total Cost
Water Main				
Directionally Drilled 12" HDPE	14,000	Feet	$250	$3,500,000
Fusing Pits	25	Each	$15,000	$400,000
Directionally Drilled 8" HDPE	10,000	Feet	$200	$2,000,000
Booster/ Blending Station				
Woodbury – Blending / Booster	1	Lump Sum	$600,000	$600,000
Newport – Blending	1	Lump Sum	$500,000	$500,000
Easements/ Land Acquisitions	50,000	Square Feet	$6	$300,000
Environmental	3.0	Miles	$50,000	$200,000
			Subtotal	**$7,500,000**
			Contingency (20%)	$1,500,000
			Engineering/ Administration/ Legal (15%)	$1,200,000
			Total Alternative 6G	**$10,200,000**

Figure 4-8. Water main alignment to connect SPRWS to serve the northwest section of Woodbury and Newport (Alternative 6G).



4.11 Cost Summary

Table 4-9 provides a summary of costs for Alternative 6. The costs presented include contingency (20%) and engineering/admin/legal (15%).

Table 4-9. Capital cost summary for Alternative 6 to connect coalition communities to SPRWS.

Alternative	Capital Cost	Water Provided (MGY)
Alternative 6A – SPRWS Connection to North Woodbury	$4,800,000	730
Alternative 6B – SPRWS Connection to Woodbury	$77,600,000	3,210
Alternative 6C – SPRWS Connection to Woodbury & Cottage Grove	$96,500,000	4,900
Alternative 6D – SPRWS Connection to Newport	$6,500,000	120
Alternative 6E – SPRWS Connection to Oakdale	$13,100,000	1,020
Alternative 6F – SPRWS Connection to Lake Elmo in Addition to 6E	$16,000,000	1,470
Alternative 6G – SPRWS Connection to Newport in Addition to 6A	$10,200,000	842

4.11.a Operation and Maintenance Costs

O&M costs for the booster stations needed to connect communities in the Coalition to SPRWS were developed based on pumping energy, equipment maintenance, operator costs, building heat, and other miscellaneous costs. The booster station operation and maintenance costs are included in Appendix B. O&M costs for Alternative 6 consists only of operating the blending and booster stations. The cost of treating the water is included in the rates charged by SPRWS. Table 4-10 identifies the O&M costs for Alternative 6.

Table 4-10. Annual operation and maintenance costs for Alternative 6.

Alternative	Annual O&M
Alternative 6A	$26,000
Alternative 6B	$23,000
Alternative 6C	$67,000
Alternative 6D	$17,000
Alternative 6E	$31,000
Alternative 6F	$61,000
Alternative 6G	$43,000

4.11.b Annual Costs

Annual costs to connect Coalition communities to SPRWS include annualized payments on capital infrastructure, repair and replacement on capital infrastructure, cost of water from SPRWS, and booster station O&M.

To determine the cost of water charged to wholesale customers, SPRWS would conduct a "Cost of Service" study. In 2014, Roseville, a wholesale customer of SPRWS, currently paid approximately 70% of SPRWS retail rate (plus a base charge). This works out to be approximately $2.44/1,000 gallons in the winter and $2.52/1,000 gallons in the summer, plus a quarterly base rate of $9, for each connection. The total cost for Roseville customers includes this wholesale cost charged by SPRWS plus a City charge for their system infrastructure costs.

For Alternative 6, it is assumed that the wholesale rate from SPRWS would be 75% of the average retail rate ($2.63 per 1,000 gal). This rate is only for alternative comparison purposes in this report. The annual costs for each alternative are included in Table 4-11.

Cost assumptions include:

- 20 year bond, 4% interest
- 1% annual repair and replacement for new water main
- 2% annual repair and replacement for booster stations
- Repair and replacement for new SPRWS infrastructure and treatment plant is included in cost of water
- O&M and repair and replacement for existing Coalition infrastructure is not included

Table 4-11. Annual costs for Alternative 6 for connecting coalition communities to SPRWS for potable purposes.

Alternative	Water Provided (MGY)	Annualized Capital Cost	Repair & Replacement	Cost of Water	Annual O&M	Total Annual Cost	Cost per 1,000 gal[1]
6A	730	$353,000	$35,000	$1,920,000	$26,000	$2,334,000	$3.20
6B	3,210	$5,710,000	$552,000	$8,442,000	$23,000	$14,727,000	$4.60
6C	4,900	$7,101,000	$693,000	$12,890,000	$67,000	$20,751,000	$4.23
6D	120	$478,000	$43,000	$316,000	$17,000	$854,000	$7.12
6E	1,020	$964,000	$95,000	$2,683,000	$31,000	$3,773,000	$3.70
6F	1,470	$1,177,000	$169,000	$3,866,000	$61,000	$5,273,000	$3.59
6G	842	$751,000	$77,000	$2,214,000	$43,000	$3,085,000	$3.66

[1] The costs per 1,000 gallons are for relative comparison of Alternative 6 and are not meant to represent potential water rates. Cost sharing options are discussed in Chapter 7. These costs only account for costs associated with new water infrastructure.

Chapter 5 – Alternative 7 – Optimized Well Fields

All of the communities in the Coalition utilize groundwater as their source of drinking water. Areas of contamination and potential aquifer drawdown are potential problems with continued reliance on groundwater. Alternative 7 investigates the feasibility of constructing new wells and attempts to identify areas in the region where there are less drawdown or contamination concerns.

The intent with Alternative 7 is to investigate the potential area where additional wells could be located, and to create a regional solution by connecting the potable water systems of Woodbury and Cottage Grove. This alternative identifies potential new well locations for Woodbury and Cottage Grove; however the concept could be applied to other subsets of communities in the area.

5.1 Alternative Overview

Alternative 7 analyzes three scenarios for new well field locations for potable supply in the study area. Each scenario involves constructing six new municipal wells and connecting the communities of Woodbury and Cottage Grove as follows:

- Alternative 7A consists of constructing a new well field at the border of Cottage Grove and Woodbury
- Alternative 7B consists of constructing a new well field in Denmark Township
- Alternative 7C consists of constructing a new well field in the southern section of Cottage Grove

5.2 Treatment

Based on information provided in each community's comprehensive plans regarding treatment at the existing wells in these three communities, it is assumed for the purpose of this study that no further treatment is required at the newly constructed well fields.

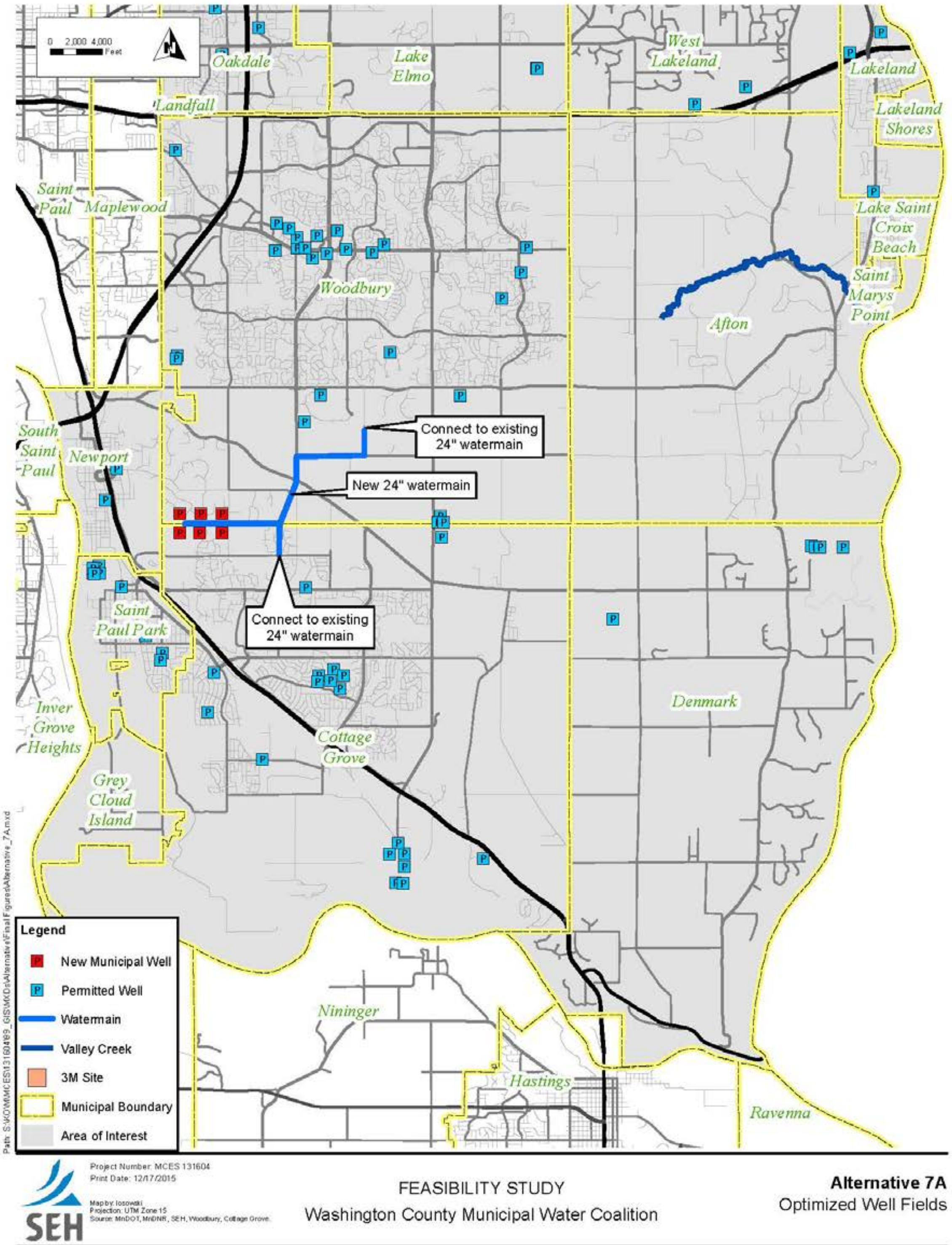
5.3 Alternative 7A

Alternative 7A includes constructing six new municipal wells and connecting the Woodbury and Cottage Grove potable water systems. The proposed well field location is near the border of the two communities. This alternative would provide up to 8.64 MGD of potable water to the two communities. Table 5-1 provides the cost estimate for Alternative 7A.

Table 5-1. Cost estimate to construct new well fields and connect to Woodbury and Cottage Grove (Alternative 7A).

Item	Quantity	Units	Unit Cost	Total Cost
Water Main				
Open Cut 24" DIP (0% in road, rural)	18,000	Feet	$370	$6,700,000
Wells				
New Well Field	6	Lump Sum	$2,000,000	$12,000,000
Easements/ Land Acquisitions	90,000	Square Feet	$6	$600,000
Environmental	3.5	Miles	$50,000	$200,000
			Subtotal	**$19,500,000**
			Contingency (20%)	$3,900,000
			Engineering/ Administration/ Legal (15%)	$3,000,000
			Total Alternative 7A	**$26,400,000**

Figure 5-1. Water main alignment to connect new well fields to Woodbury and Cottage Grove (Alternative 7A).



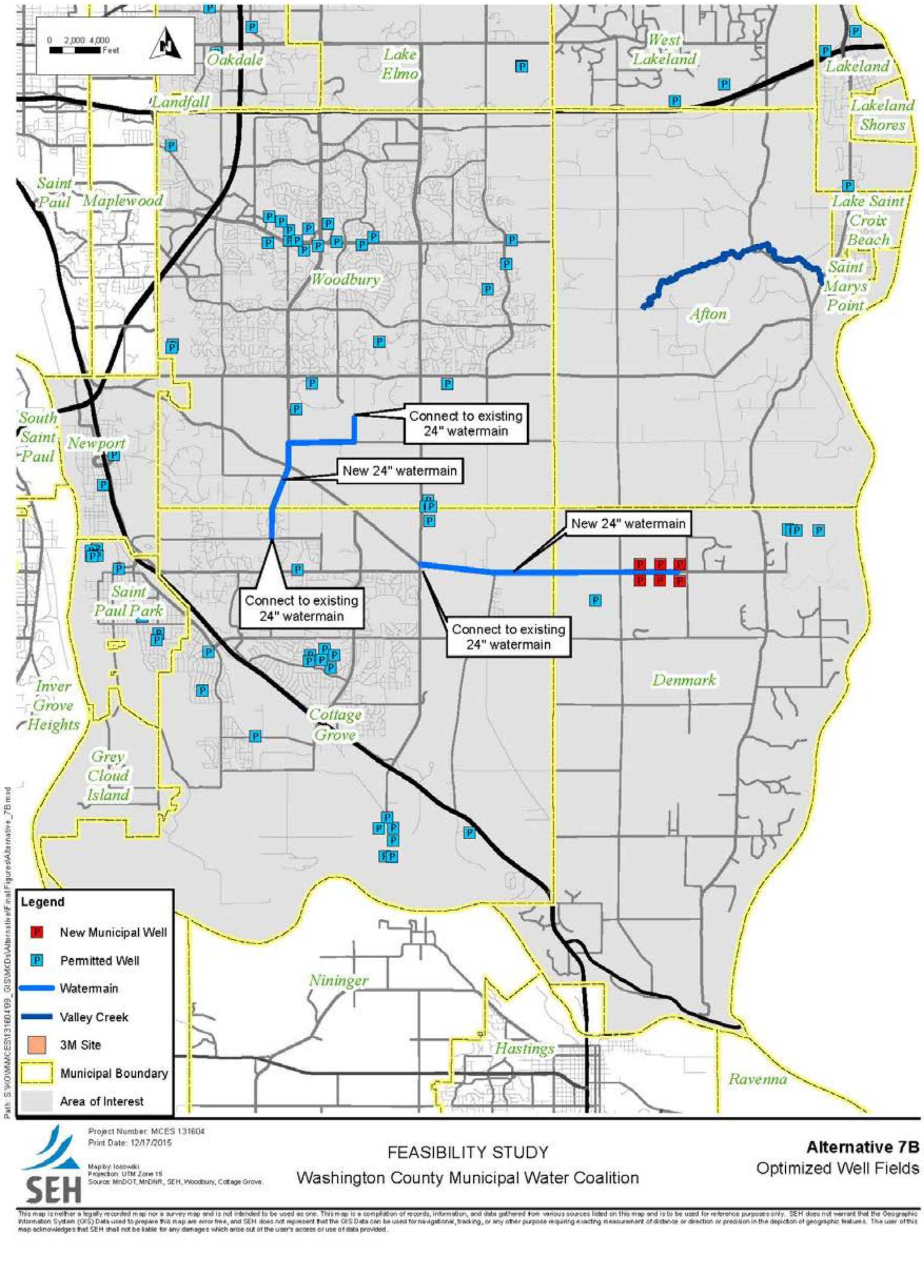
5.4 Alternative 7B

Alternative 7B consists of constructing six new municipal wells in Denmark Township, and connecting these new wells to the municipal water systems of Woodbury and Cottage Grove. This alternative would provide up to 8.64 MGD of potable water to Woodbury and Cottage Grove. According to data provided by the Minnesota Department of Agriculture, the proposed location of the new municipal wells in Denmark Township may have nitrate contamination. Table 5-2 provides the cost estimate for Alternative 7B.

Table 5-2. Cost estimate to construct new well fields in Denmark Township and connect to Woodbury and Cottage Grove (Alternative 7B).

Item	Quantity	Units	Unit Cost	Total Cost
Water Main				
Open Cut 16" DIP (0% in road, rural)	12,000	Feet	$370	$4,500,000
Open Cut 24" DIP (0% in road, rural)	16,000	Feet	$304	$4,900,000
Wells				
New Well Field	6	Lump Sum	$2,000,000	$12,000,000
Easements/ Land Acquisitions	140,000	Square Feet	$6	$900,000
Environmental	5.0	Miles	$50,000	$300,000
			Subtotal	**$22,600,000**
			Contingency (20%)	$4,600,000
			Engineering/ Administration/ Legal (15%)	$3,400,000
			Total Alternative 7B	**$30,600,000**

Figure 5-2. Water main alignment to connect new well fields in Denmark Township to serve Woodbury and Cottage Grove (Alternative 7B).



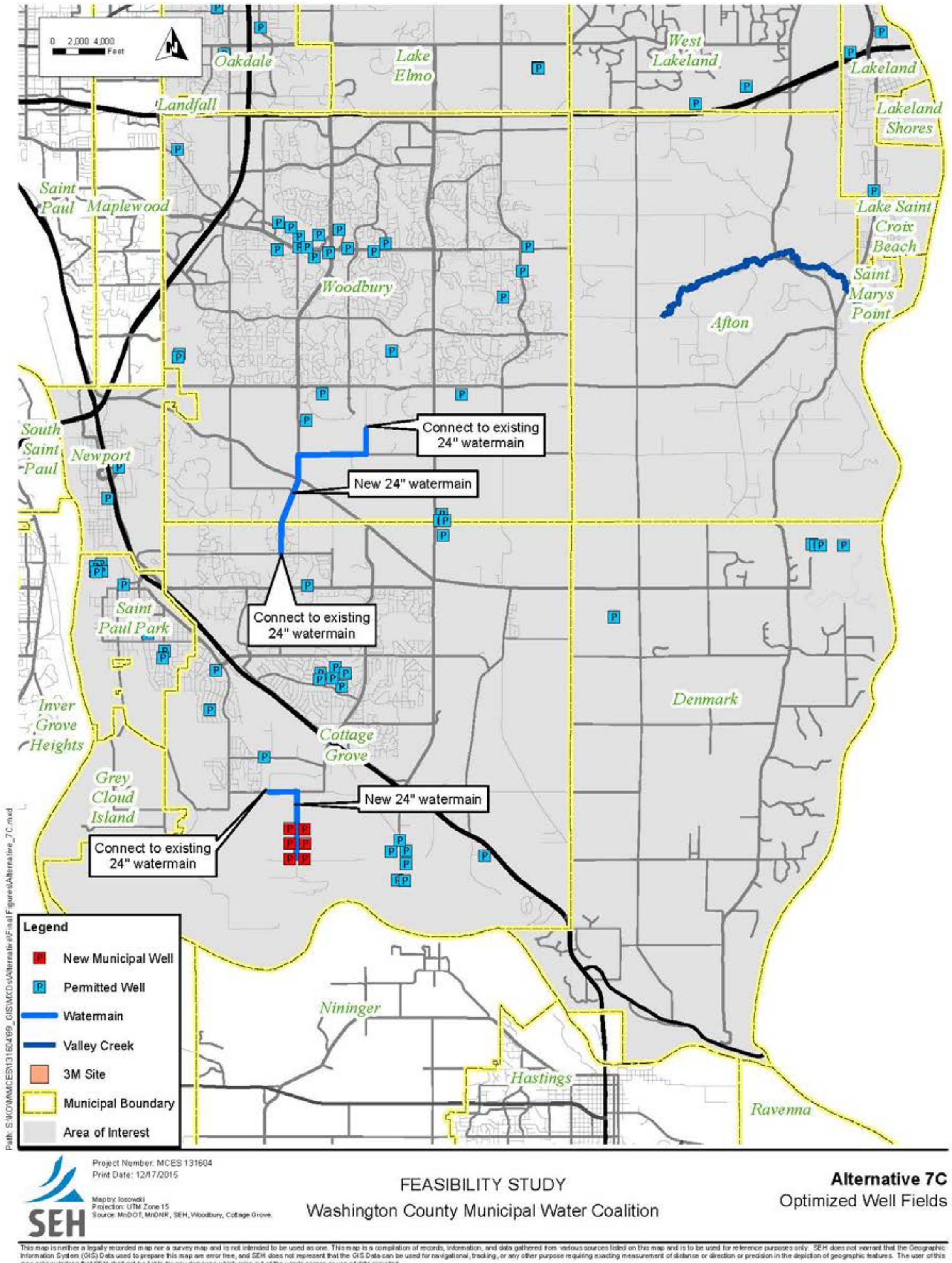
5.5 Alternative 7C

Alternative 7C consists of constructing six new municipal wells in southern Cottage Grove. This alternative would provide up to 8.64 MGD of potable water and would connect the Woodbury and Cottage Grove distribution systems. There is potential for PFC groundwater contamination in southern Cottage Grove. Lower elevation in this area may require additional pumping compared to the other two alternatives. Table 5-3 provides the cost estimate for Alternative 7C.

Table 5-3. Cost estimate to construct new well fields in southern Cottage Grove and connect to Woodbury and Cottage Grove (Alternative 7C).

Item	Quantity	Units	Unit Cost	Total Cost
Water Main				
Open Cut 24" DIP (50% in road, rural)	12,000	Feet	$370	$4,500,000
Open Cut 24" DIP (0% in road, rural)	4,000	Feet	$304	$1,300,000
Wells				
New Well Field	6	Lump Sum	$2,000,000	$12,000,000
Easements/ Land Acquisitions	80,000	Square Feet	$6	$500,000
Environmental	5.0	Miles	$50,000	$200,000
			Subtotal	**$18,500,000**
			Contingency (20%)	$3,700,000
			Engineering/ Administration/ Legal (15%)	$2,800,000
			Total Alternative 7C	**$25,000,000**

Figure 5-3. Water main alignment to connect new well fields in southern Cottage Grove to Cottage Grove and Woodbury (Alternative 7C).



5.6 Cost Summary

Table 5-4 provides a summary of costs for Alternative 7. The costs presented include contingency (20%) and engineering/admin/legal (15%).

Table 5-4. Capital cost summary for Alternative 7.

Alternative	Capital Cost	Water Provided (MGY)
Alternative 7A – Optimized Well Fields for Woodbury and Cottage Grove	$26,400,000	3,150
Alternative 7B – Optimized Well Fields for Woodbury and Cottage Grove	$30,600,000	3,150
Alternative 7C – Optimized Well Fields for Woodbury and Cottage Grove	$25,000,000	3,150

5.6a Operation and Maintenance Costs

Operation and maintenance (O&M) costs for Alternatives 7A, 7B, and 7C were based on relevant O&M costs from existing municipal wells proportioned based on capacity of the new wells. The costs include electricity, labor, and building costs (heat, insurance, etc.). Table 5-5 identifies annual O&M costs for Alternative 7. All three alternatives would provide 8.64 MGD of potable water.

Table 5-5. Annual operation and maintenance costs for optimized well fields serving Alternative 7.

Alternative	Annual O&M
Alternative 7A	$1,200,000
Alternative 7B	$1,200,000
Alternative 7C	$1,400,000

5.6b Annual Costs

Annual costs for a new well field include annualized payments on capital infrastructure, repair and replacement costs on capital infrastructure, and O&M costs. Table 5-6 provides a summary of annual costs for Alternative 7.

Cost assumptions include:

- 20 year bond, 4% interest
- 1% annual repair and maintenance for new water main
- 2% annual repair and maintenance for wells
- Repair and replacement for new infrastructure and treatment plant
- O&M and repair and replacement for existing coalition infrastructure is <u>not</u> included

Table 5-6. Annual costs for Alternative 7 to construct new well fields for potable uses.

Alternative	Water Provided (MGY)	Annualized Payment	Repair & Replacement	Annual O&M	Total Annual Cost	Cost per 1,000 gallons[1]
7A	3,150	$1,940,000	$307,000	$1,200,000	$3,450,000	$1.10
7B	3,150	$2,240,000	$333,640	$1,200,000	$3,770,000	$1.20
7C	3,150	$1,830,000	$297,160	$1,400,000	$3,530,000	$1.10

[1] The costs per 1,000 gallons are for relative comparison of Alternative 7 and are not meant to represent potential water rates. Cost sharing options are discussed in Chapter 7. These costs only account for costs associated with new water infrastructure.

Chapter 6 – Evaluation of Alternatives

The alternatives are evaluated based on capital cost, O&M cost, and cost per million gallons of water treated. In addition, an evaluation of advantages and disadvantages is summarized focusing on water system reliability, reduction in groundwater pumping, implementation obstacles, and potential effects on surface waters. Table 6-1 summarizes the evaluation criteria.

Table 6-1. Alternative evaluation criteria.

Evaluation Criteria	Description
Capital Cost	Identify the capital cost of the alternative.
Capital Cost per Million Gallons of Water Provided	Identify the capital cost of the alternative per million gallons of water provided.
Operation and Maintenance per Million Gallons of Water Provided	Identify the Operation and Maintenance costs per million gallons of water provided. Some alternatives may have a lower capital cost, but have a high operation and maintenance cost.
Reduction in Groundwater Pumping	Identify if the alternative reduces groundwater pumping volume and time.
Water System Reliability	Identify if the alternative adds redundancy to existing water systems.
Implementation Obstacles	Identify items that could make the alternative difficult to implement; potentially including permitting, public opposition, difficult construction, or risk with construction methods.
Advantages and Disadvantages	Identify the advantages and disadvantages that may be unique to that alternative.
Effects on Surface Waters	Identify if the alternative has the potential to help or harm a surface water body.

A summary of the four approaches is as follows:

- Approach 1: Use of Treated Effluent from Pollution Containment Wells
- Approach 2: New Surface Water Treatment Plant (WTP) with Conjunctive Use of Surface Water and Groundwater
- Approach 3: Connection to Saint Paul Regional Water Services (SPRWS) for Conjunctive Use with Groundwater, and
- Approach 4: New Wellfields

The results are summarized in the following sections.

6.1 Approach 1 Alternatives Evaluation

Approach 1 involves alternate uses for the 3M contaminant containment water. Alternative 1 includes non-potable reuse while Alternative 2 includes potable reuse of the contaminant containment water. A brief description of each alternative is as follows:

- Alternative 1A: Non-potable reuse water for augmentation of Valley Creek in Afton
- Alternative 1B: Non-potable reuse water for Northern Tier Refining in St. Paul Park,
- Alternative 1C: Non-potable reuse water from the 3M Cottage Grove site to Northern Tier Refining
- Alternative 1D: Non-potable reuse water for both golf courses in Woodbury and Northern Tier Refining in St. Paul Park
- Alternative 2A:Potable reuse water for Woodbury
- Alternative 2B: Potable reuse water for Cottage Grove
- Alternative 2C: Potable reuse water for both Woodbury and Cottage Grove

Table 6-2. Cost Summary – Approach 1 alternative evaluation.

Alternative	People Served in 2040	Water Provided (MG)	Capital Cost	Capital Cost per MG	O&M Cost	O&M Cost per 1,000 gallons
Alternative 1A	0	1,575	$18,900,000	$12,000	$185,000	$0.12
Alternative 1B	0	1,575	$20,100,000	$12,800	$185,000	$0.12
Alternative 1C	0	1,575	$24,700,000	$15,700	$185,000	$0.12
Alternative 1D	0	1,575	$32,200,000	$20,400	$185,000	$0.12
Alternative 2A	83,139	1,260	$32,300,000	$25,600	$2,750,000	$2.18
Alternative 2B	47,000	1,260	$32,200,000	$25,600	$2,750,000	$2.18
Alternative 2C	130,139	1,260	$37,500,000	$29,800	$2,750,000	$2.18

Advantages of Approach 1

- Alternative 2 provides a more beneficial use of the groundwater (drinking water versus process water).
- Alternative 2 creates water supply reliability by adding a new source of treated water.
- Alternative 2 provides a higher quality drinking water (i.e. softened) than currently experienced by Woodbury and Cottage Grove.
- Alternative 2 would allow for the reduction in existing municipal groundwater pumping, relieving pressure on the aquifer in the well fields. 3M may need to add water supply at its Cottage Grove facility to offset the diverted water.
- Study area communities would retain control over operation of water supply and treatment systems.

Disadvantages of Approach 1

- Approach 1 requires the cooperation of 3M. Diverting the contaminant containment water for other uses could add potential liability and cost making it undesirable to 3M.

- Alternatives 1A and 1D propose using the contaminant containment water for surface water augmentation or irrigation. Given the uncertainty in contaminants that could exist at the 3M landfill site, State regulators (MDH, DNR, MPCA) will likely not allow this water to be used for surface water augmentation or irrigation.
- Alternative 1options that deliver water to Northern Tier Refinery changes the use of the contaminant containment water at significant cost without necessarily providing a more beneficial use.
- Alternative 2 options would require significantly higher costs for potable water than currently charged if outside funding is not provided.

6.2 Approach 2 Alternatives Evaluation

Approach 2 involves alternatives for constructing a new surface water treatment plant on the Mississippi River or St. Croix River and providing conjunctive use of surface water with the existing groundwater systems. A brief description of each alternative is as follows:

- Alternative 4A: New surface WTP on the Mississippi River to serve Cottage Grove and Woodbury
- Alternative 4B: New surface WTP on the Mississippi River to serve Cottage Grove, Woodbury, Lake Elmo, Oakdale, Newport and St. Paul Park
- Alternative 5A: New surface WTP on the St, Croix River to serve Stillwater, Oak Park Heights, and Bayport
- Alternative 5B: New surface WTP on the St, Croix River to serve Woodbury, Cottage Grove, Lake Elmo and Oakdale

Table 6-3. Cost Summary – Approach 2 alternative evaluation.

Alternative	People Served in 2040	Water Provided (MG)	Capital Cost	Capital Cost per MG	O&M Cost	O&M Cost per 1,000 gallons
Alternative 4A	130,139	4,900	$131,400,000	$26,800	$5,960,000	$1.22
Alternative 4B	184,891	6,680	$174,500,000	$26,100	$8,200,000	$1.23
Alternative 5A	31,710	1,225	$68,600,000	$56,000	$1,550,000	$1.27
Alternative 5B	172,783	6,470	$184,900,000	$28,600	$7,910,000	$1.22

Advantages of Approach 2

- Approach 2 alternatives create water supply reliability by adding treated water from a new source.
- Approach 2 alternatives provide a higher quality drinking water than currently experienced by study area communities.
- Approach 2 alternatives provide a significant reduction in groundwater pumping.
- Study area communities would retain control over operation of water supply and treatment systems; including setting their own water rates, and choosing the level of treatment.
- O&M for Approach 2 alternatives are less expensive than Approach 3 per million gallons of water provided.

Disadvantages of Approach 2

- Approach 2 alternatives require large capital investment in water treatment and water main construction.
- Approach 2 alternatives would require significantly higher costs for potable water than currently charged if outside funding is not provided.
- Approach 2 alternatives are major construction projects that would cause disruption to residents.
- Conjunctive use of surface water and groundwater will likely result in taste and odor differences, requiring a public education program and a switch from chlorine to chloramines for disinfection.

6.3 Approach 3 Alternatives Evaluation

Approach 3 involves alternatives for connecting to SPRWS, a major water utility that primarily utilizes surface water from the Mississippi River as its raw water source. Alternative 6 analyzes seven scenarios for providing treated surface water from SPRWS to subsets of communities in the Coalition as follows:

- Alternative 6A – connect a portion of Woodbury to SPRWS (not conjunctive use)
- Alternative 6B – connect all of Woodbury to SPRWS
- Alternative 6C – connect all of Woodbury and Cottage Grove to SPRWS
- Alternative 6D – connect Newport to SPRWS
- Alternative 6E – connect Oakdale to SPRWS
- Alternative 6F – connect Oakdale and Lake Elmo to SPRWS, and
- Alternative 6G – connect a portion of northwest Woodbury and all of Newport to SPRWS (not conjunctive use)

Table 6-4. Cost Summary – Approach 3 alternative evaluation.

Alternative	People Served in 2040	Water Provided (MG)	Capital Cost	Capital Cost per MG	O&M Cost	O&M Cost per 1,000 gallons
Alternative 6A	16,000	730	$4,800,000	$6,600	$1,981,000	$2.79
Alternative 6B	83,139	3210	$77,600,000	$24,200	$9,020,000	$2.81
Alternative 6C	130,139	4900	$96,500,000	$19,700	$13,650,000	$2.79
Alternative 6D	4,154	120	$6,500,000	$54,200	$376,000	$3.13
Alternative 6E	30,200	1020	$13,100,000	$12,800	$2,810,000	$2.75
Alternative 6F	42,644	1470	$16,000,000	$10,900	$4,100,000	$2.79
Alternative 6G	20,154	842	$10,200,000	$12,100	$2,330,000	$2.77

Advantages of Approach 3

- Approach 3 alternatives create water supply reliability by adding treated water from a new source.
- Approach 3 alternatives provide a higher quality drinking water than currently experienced by study area communities.
- Approach 3 alternatives provide a significant reduction in groundwater pumping.
- Alternative 6A, which does not require major water main construction, is more cost effective than most other alternatives.

Disadvantages of Approach 3

- The O&M costs for most of the Approach 3 alternatives are less cost effective that Approach 2 alternatives.
- Approach 3 alternatives require large investments in water main construction.
- Approach 3 alternatives would require significantly higher costs for potable water than currently charged if outside funding is not provided.

- Approach 3 alternatives are major construction projects that would cause disruption to residents.
- Approach 3 would require an agreement with SPRWS as a wholesaler.
- Conjunctive use of surface water and groundwater will likely result is taste and odor differences, requiring a public education program and a switch from chlorine to chloramines for disinfection.
- Study area communities would not retain control over operation of water supply and treatment systems.

6.4 Approach 4 Alternatives Evaluation

Approach 4 investigates three scenarios for new well field locations for potable supply in the study area. Each scenario involves constructing six new municipal wells and connecting the communities of Woodbury and Cottage Grove as follows:

- Alternative 7A consists of constructing a new well field at the border of Cottage Grove and Woodbury,
- Alternative 7B consists of constructing a new well field in Denmark Township, and
- Alternative 7C consists of constructing a new well field in the southern section of Cottage Grove

Table 6-5. Cost Summary – Approach 4 alternative evaluation.

Alternative	People Served in 2040	Water Provided (MG)	Capital Cost	Capital Cost per MG	O&M Cost	O&M Cost per 1,000 gallons
Alternative 7A	130,139	3,150	$26,400,000	$8,380	$1,507,000	$0.48
Alternative 7B	130,139	3,150	$30,600,000	$9,710	$1,534,000	$0.49
Alternative 7C	130,139	3,150	$25,000,000	$7,940	$1,697,000	$0.54

Advantages of Approach 4

- Approach 4 is by far the lowest cost alternative from a capital and O&M cost per million gallons of water provided.
- Approach 4 provides water with the same taste and odor as the water currently being provided.
- Study area communities would retain control over operation of water supply and treatment systems.

Disadvantages of Approach 4

- Approach 4 continues to utilize groundwater in a region with contamination and drawdown concerns.
- Approach 4 does not provide additional water source redundancy.
- Alternative 7A is in a developed area and would cause disruption to residents.
- Alternative 7B is located in an area with potential nitrate contamination in the groundwater.
- Alternative 7B well field is located outside of the City boundaries of Woodbury and Cottage Grove.
- Alternative 7C is located in an area with potential PFC contamination in the groundwater.

Chapter 7 – Cost Sharing

7.1 Cost Sharing Models

This study evaluates the feasibility and costs of several alternative water supply approaches. These include utilizing 3M contaminant containment water to offset existing groundwater uses (potable and non-potable), constructing a new surface water treatment plant on the Mississippi or St. Croix rivers for different subsets of communities, and connecting various subsets of communities to St. Paul Regional Water Services (SPRWS).

An alternative was also developed to identify potential new well fields. Because this alternative does not significantly change the current approach to water supply (groundwater wells), it is not the focus of this section.

Because the costs would be significantly higher to develop an alternative water source for the Coalition communities than traditional groundwater sources, implementation is not likely to occur without incentive, and a mechanism to share the costs amongst a broad range of beneficiaries. The motivation for the reduction in groundwater use is regional in nature – to protect natural resources from the cumulative effects of groundwater use. A single community or a small subset of communities should not bear the cost of regional water sustainability needs. This analysis will consider cost sharing from two perspectives:

- A scenario where only the communities served by the hypothetical alternate water system would pay for the system. This scenario will consider the cost impacts to those communities, and also the degree of outside funding that would be necessary to bring the costs to the individual communities in line with other water systems in the region.
- A scenario where the costs are shared amongst all of the communities in the DNR North and East Metro Groundwater Management Area (GWMA). In this case, the model for ownership and cost sharing will include the creation of a district that would own and operate the alternate water delivery system, with fees paid by all communities within the Groundwater Management Area to promote equity amongst users of the groundwater resource.

There are many examples of similar cost sharing arrangements for water supply across the country. The Metropolitan Council has collected information on case studies as part of its ongoing study, “Regional Feasibility of Alternative Approaches to Water Sustainability.” This study, conducted by HDR Engineering on behalf of the Metropolitan Council, has reviewed three regional water system cost-sharing models. The cost sharing models included the San Jacinto River Authority, Conroe, Texas; West Harris County Regional Water Authority, Houston, Texas; and Woodland-Davis Clean Water Agency, Woodland and Davis, California. The cost-sharing models are summarized below.

San Jacinto River Authority, Conroe, Texas

The San Jacinto River Authority, Conroe, Texas (SJRA) watershed includes approximately 3,200 square miles of land north of the City of Houston. In 2001, the Lone Star Groundwater Conservation District (LSGCD) was created to help Montgomery County manage its dependence on the Gulf Coast Aquifer. The LSGCD studied the aquifer and confirmed that the water levels were declining at an unsustainable rate. The LSGCD calculated the amount of water that the aquifer could yield on a sustainable basis.

To address deficit pumping, the LSGCD required all large-volume groundwater users (LVGUs) to reduce groundwater pumping by 30 percent. In response to this directive, the SJRA created the Groundwater Reduction Plan Division (GRP) to implement a county-wide program to meet the requirements of the LSGCD.

Participation in the GRP was opened to all of the LVGUs that included approximately 200 cities, utilities, and other water users. Of these, 140 water systems joined the GRP. By joining the GRP, the participants are able to achieve cost savings by utilizing a "group compliance" concept in which some of the participants are converted to surface water while other participants continued to use groundwater, while meeting the overall groundwater reduction goal of 30 percent. Cost, proximity to surface water, and demands were used to determine which participants would be converted to surface water. Any LVGUs that did not join the GRP were still required to meet the 30 percent groundwater reduction goal.

The SJRA issued approximately $552 million in bonds between 2009 and 2013 to construct Phase 1 of the project, which included building a surface water treatment plant and transmission system.

One of the challenges in implementing the groundwater reduction plan was defining a rate system that balanced costs between participants, including those that would continue to rely solely on groundwater and those that would be converted to surface water. To balance revenue between the two groups, a groundwater pumpage fee and a surface water rate were calculated. The groundwater pumpage fee and surface water rate developed are $2.25 and $2.44 per 1,000 gallons, respectively.

West Harris County Regional Water Authority, Houston, Texas

In the early 1940s, studies of the Houston/Galveston area located in southeast Texas showed increasing problems due to groundwater extraction from the Chico and Evangeline aquifers causing land subsidence (sinking). In 1975, the Harris Galveston Subsidence District (HGSD) was created to address the impacts of groundwater pumping on land subsidence. In response to the regulatory plans of the HGSD, the West Harris County Regional Water Authority (Authority) was created to transition the area to surface water within a set timeframe.

There are currently 120 municipal water providers within the boundary of the Authority which is managed by a nine-member Board of Directors. The Authority's Groundwater Reduction Plan (GRP) requirements include a 30 percent reduction in groundwater use in 2010, a 60 percent reduction by 2025, and an 80 percent reduction by 2035.

The initial phase of the plan included negotiating a long-term contract with the City of Houston and the construction of numerous transmission projects to supply treated surface water to utility districts within the GRP.

Like SJRA, the Authority has developed a similar rate structure where all water users within the area will pay a share of the costs to build and maintain water delivery infrastructure and for the supply of surface water from the City of Houston system. As of 2014, the groundwater and surface water rates charged to the water providers are $1.90/1,000 gallons and $2.30/1,000 gallons, respectively.

Woodland-Davis Clean Water Agency, Woodland and Davis, California

In September 2009, the neighboring cities of Woodland and Davis, California created the Woodland-Davis Clean Water Agency (WDCWA), a joint powers authority to implement and oversee a regional surface water supply project. Both cities have been dealing with water supply and wastewater discharge issues related to degrading groundwater quality and concluded that a jointly-owned and operated surface water system was the best overall solution.

The Cities of Woodland and Davis have depended on groundwater for water supply since the 1950s. Over time, the quality of the groundwater has declined to the point where the water supply system will not be able to meet state and federal drinking water standards, and the wastewater will not meet anticipated discharge regulations.

The cities identified two possible solutions to address the water quality issues, including developing a higher quality water supply or installing a new wastewater treatment process. It was determined that building a new surface water treatment plant was the most cost effective solution. The system, which will be put into service in 2016, will provide treated surface water from the Sacramento River to the two cities through dedicated service lines. The total capital cost estimate for the project is $228 million. According to the joint powers agreement, the costs to cover the debt service and O&M costs will be divided between the cities based on demand.

7.2 Cost Sharing Examples

For the purposes of demonstrating a potential equitable cost sharing structure, Alternative 4B – connecting Cottage Grove, Woodbury, Lake Elmo, Oakdale, Newport and St. Paul Park to a new conjunctive-use surface water treatment plant will be used as an example. The proposed surface water treatment plant would draw water from the Mississippi River and be located in the City of Newport.

7.2a Existing Water Infrastructure

A new water utility would need to purchase the existing water supply and treatment facilities that would be decommissioned or used as emergency backup as a result of switching to surface water. This includes 44 wells and well houses in the six communities and a water treatment plant in Oakdale. Some wells would be maintained for conjunctive use and emergency backup, but would still be purchased by the proposed utility. For purposes of this cost sharing example, the wells will be valued at $800,000 each and the value of the Oakdale treatment plant is $3 million. Some depreciation was assumed in the existing infrastructure values. The total value of the existing utility infrastructure to be decommissioned with a new surface WTP is estimated to be $38,200,000.

In addition to existing wells and treatment infrastructure, the communities have costs associated with their existing distribution and storage facilities. These costs include operation and maintenance, repair and replacement, and existing debt service. For the purposes of the cost sharing example, it is assumed that the existing storage and distribution O&M and repair and replacement cost is $1.25/1,000 gallons of water. This assumes that approximately half of the existing rates are utilized for water supply and treatment and half are utilized for storage and distribution (based on average water rates among the Coalition communities).

7.2b Cost Sharing Assumptions and Basis

The assumptions used for preparing the cost sharing examples are as follows:

- All costs in 2016 dollars
- Capital cost: $174,500,000 (new facilities) + $38,200,000 (existing utilities) = $217,700,000
- Capital costs amortized over 20 years, 4% interest
- Annual Operation and Maintenance Cost: $8,250,000 for new water treatment plant plus $2,000,000 for groundwater pumped ($1.25 per 1,000 gallons).
- Annual Repair and Replacement Cost: $2,150,000
  - 2% annual repair and replacement for new WTP, booster/blending stations
  - 1% annual repair and replacement for new water main
- Existing Operation and Maintenance: $1.25/1,000 gallons
- 2025 estimated water demands used to project average unit cost over next 25 years
- Selected communities use 6.4 billion gallons of water per year in 2025 (17.6 MGD average day). Approximately 4.8 billion gallons of water will be surface water and 1.6 billion gallons will be groundwater.

- The North and East GWMA will use 29.7 billion gallons of groundwater in 2025 (after Alternative 4B communities convert to conjunctive use surface water). This estimate includes municipal, non-municipal, and private wells.
- The new facilities include a new 25 MGD surface WTP, 17 miles of trunk water main, and blending/booster stations

7.2c Cost Sharing as Water Utility

In a typical water utility, the costs are shared among the member communities based on water usage. Table 7.1 identifies the costs for a potential water utility.

Table 7.1. Potential water utility costs

Item	Annual Cost	Water Used (1,000 gal)	Cost/ 1,000 gal[1]
Annualized Payment	$16,020,000	6,400,000	$2.50
Joint Utility O&M Costs	$10,250,000	6,400,000	$1.60
Repair and Replacement	$2,150,000	6,400,000	$0.34
Cities Existing O&M	$1.25 / 1,000 gal	6,400,000	$1.25
		Total	**$5.69**

[1] The costs per 1,000 gallons are for relative comparison and are not meant to represent potential water rates.

A cost of $5.69 per 1,000 gallons of water would be 78% more than what SPRWS retail customers currently pay at $3.20 per 1,000 gallons. To bring the costs for the Alternative 4B communities down to $3.20 per 1,000 gallons, the utility would need to be subsidized by $2.49 per 1,000 gallons (approximately $16 million per year). If the capital cost of the project ($212,700,000) were covered by another funding source, the estimated cost of water from the new utility would be close to SPRWS' rates. It should be noted that $3.20 per 1,000 gallons is still more expensive than what many of the Coalition communities pay for drinking water.

7.2d Cost Sharing Across North and East GWMA

Instead of sharing costs as a utility, it might be reasonable to share costs across the North and East GWMA for a given approach. Some communities would continue to use groundwater while other communities would be converted to surface water. The communities that would convert to surface water could be determined based on economic feasibility or effects of groundwater use on surface water features. Similar to the water utility cost sharing example, it will be assumed that the Alternative 4B communities will be converted to surface water. As demonstrated in the previous section, if the Alternative 4B communities are charged the same rate as SPRWS customers, it requires that $16 million per year be covered by other funding. If the remaining groundwater users (all municipal, industrial, and private) in the North and East GWMA paid a ***groundwater usage fee* of $0.54 per 1,000** gallons, this would subsidize the 25 MGD regional surface water supply system, so that the six example communities have rates equal to other surface water supply communities.

Chapter 8 – Water Efficiency

Water efficiency has potential to reduce groundwater use thereby reducing demand on the aquifer and connected surface water bodies. Coalition communities have expressed a desire to explore the potential to implement water efficiency practices in order to reduce groundwater use before actively exploring switching their supply source at significant expense.

8.1 Water Use Analysis

To determine the amount of water that could be reduced by efficiency, an analysis of existing water use is required. A community's winter water demand can be compared to the summer water demand. The winter demand typically shows essential water usage for indoor activities such as drinking, cooking, showering, toilet use, and washing clothes. The winter demand would also represent base industrial and commercial uses. The increase in summer water demand typically indicates water use for non-essential needs such as lawn irrigation and car washing. Irrigation during summer months contributes to a large increase in the demand for potable water and puts additional stress on the aquifer. A larger difference in winter and summer demands represents a greater opportunity for reducing water use for nonessential needs. Developing communities are more likely to have higher nonessential water use due to irrigation of new lawns. It should be noted that reducing overall water use would impact a communities water revenues.

Table 8-1 identifies the monthly average winter month demands, average month demands, and average peak month demands for each Coalition community for years 2010 to 2014. Table 8-1 also identifies the non-essential demand which is the difference between the average winter month demand and average month demand.

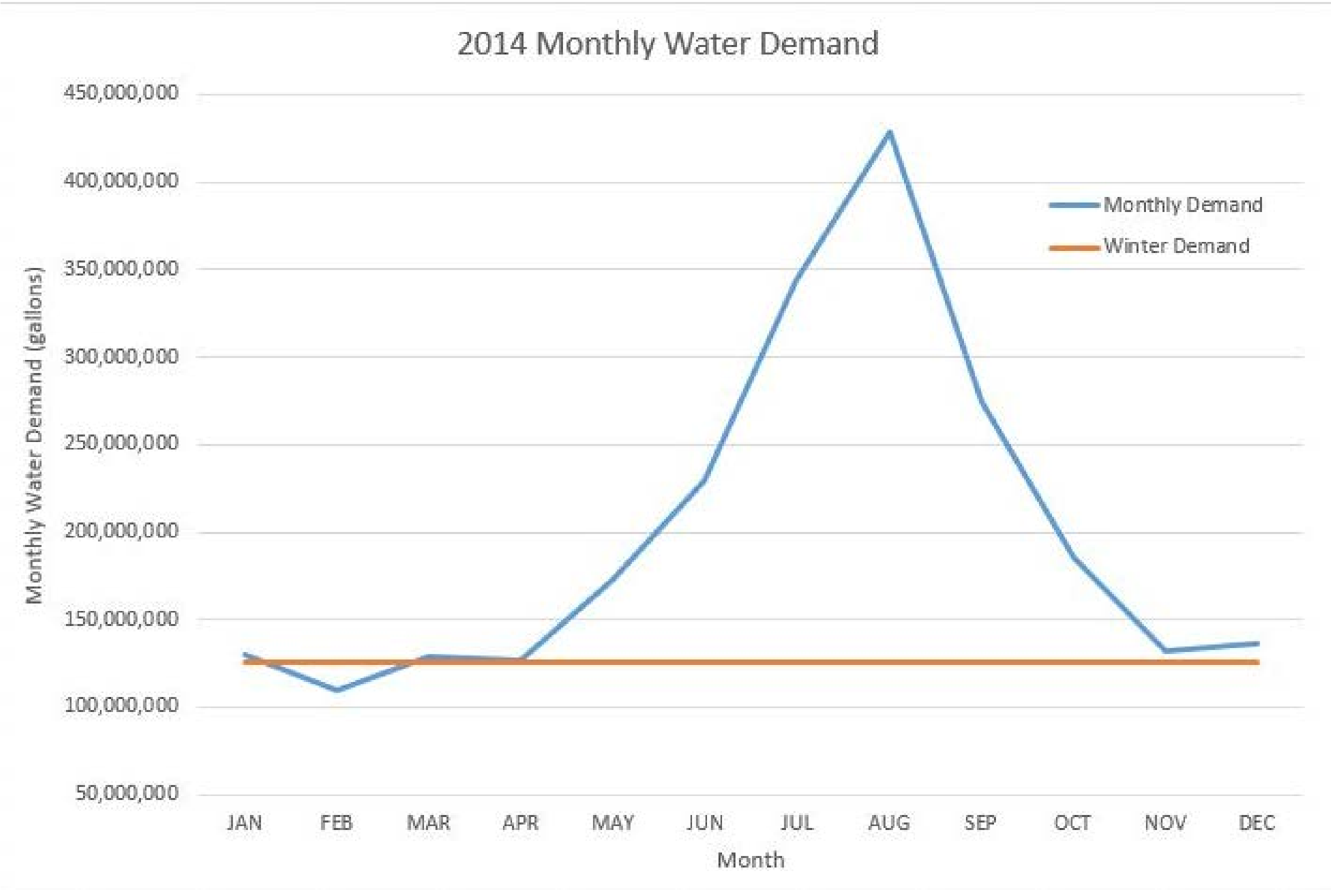
Table 8-1. Washington County Municipal Water Coalition monthly water demand summary from 2010-2014.

City	Winter Month Demand (MG)[1]	Avg. Month Demand (MG)	Peak Month Demand (MG)	Non-Essential Demand (MG/month)
Bayport	5.0	7.0	11.1	2.0
Cottage Grove	66.2	109.9	201.9	43.7
Lake Elmo	6.2	10.3	19.6	4.1
Newport	6.8	8.3	10.7	1.5
Oak Park Heights	14.5	18.7	27.8	4.2
Oakdale	55.5	77.0	123.1	21.5
St. Paul Park	13.0	15.7	21.5	2.7
Stillwater	41.8	60.3	99.2	18.5
Woodbury	125.4	219.6	412.1	94.2
			Total	**192.4**

[1] Average winter demand during winter months of December through February.

To get a sense of the opportunity for water efficiency, monthly water demand data for a typical Coalition community was plotted in comparison to average winter demand. Figure 8-1 demonstrations monthly water demand against the average monthly winter demand from data in 2010-2014. Water demand above the winter demand line on this plot depicts non-essential demand that can be reduced by implementing water efficiency practices.

Figure 8-1. Monthly water demand trends for typical Coalition community.



As indicated in Table 8-1, there is a Coalition wide total estimated 192.4 million gallons per month (2.3 billion gallons per year) of non-essential water use that would be available for efficiency. In addition to non-essential water use, more efficient fixtures and appliances are also available for efficiency of essential water use as discussed in Section 8.3.

8.2 Irrigation Efficiency

Irrigation efficiency applies to residential, commercial, and institutional water users. Irrigation accounts for the majority of non-essential water use and has the greatest opportunity for efficiency. Inefficiencies exist within many irrigation systems including lack of rain sensors, inefficient nozzles and spray patterns, over pressurized irrigation systems, broken sprinkler heads, and soils that do not retain moisture. Opportunities for irrigation water efficiency are discussed in the following sections.

8.2a Irrigation Audits

The irrigation system audit is a thorough examination of each component of the system. The audit tests for proper pressure, reviews zones, cycles and schedules of the control panel and runs the system to evaluate zone efficiency and find parts of the system in need for repair to minimize system losses.

Communities around the Twin Cities Metro Area are creating irrigation efficiency programs in coordination with MCES to help residents, business owners, organizations, and city staff reduce water usage throughout their community. Chanhassen is one example of a local community that utilizes an irrigation audit program. The irrigation audit program is intended to engage the community in water efficiency measures. The City of Chanhassen is offering audits to homeowners associations, new residents, businesses, and other organizations that utilize an irrigation system, free of charge as a water-saving resource.

8.2b Smart Controllers

Many irrigation systems operate on a timer that does not account for environmental conditions. A good example of this is when an irrigation system is operating during, or shortly after a rain event where moisture is already present in the soil and irrigation is not required.

One method to overcome these wasteful events is to install a smart controller system to operate the irrigation system. Smart controller technology available on the market today has the ability to not only sense that rainfall is occurring, but to also measure the amount of rainfall and suspend irrigation completely for that cycle if significant rainfall was recorded. Also incorporated within the smart controller technology are soil moisture sensors that continuously monitor the soil conditions and will initiate operation of the irrigation system only when moisture content is low and irrigation is required. This eliminates overwatering and optimizes water use.

8.2c Sprinkler Nozzle Retrofit

A very common inefficiency found in irrigation systems are leaky or poorly designed sprinkler nozzles. Nozzles can leak water out of the sides and not project water in an efficient manner across the irrigation area. Some sprinkler nozzle manufacturers have created voucher programs allowing homeowners residing in participating water utilities across the country to replace old common nozzles with high efficiency sprinkler nozzles at no charge. These programs state that high efficiency sprinkler nozzles can save up to 1,400 gallons per nozzle each year by eliminating leaks at the nozzle. The programs help users select the proper nozzles for their specific irrigation area, to ensure that water is not being wasted by watering impervious sections of property such as sidewalks and driveways. The nozzles also apply water at a rate closer to the soils ability to absorb water which reduces the likelihood that the water applied runs off the yard and into the gutter.

8.2d Smart Irrigation

New technologies are being developed to provide consumers a smart irrigation system that uses up to 50% less water than conventional systems. This system utilizes a mobile app to map the complex shapes and contours of specific irrigation area, reducing the losses associated with poorly set sprinkler head radius and arc, which is the angle at which the sprinkler head disperses water. By optimizing these parameters, the system only irrigates exactly what is needed, and uses smart controller technology to determine when and for how long the system operates.

8.2e Soil and Sod Types

Along with more efficient irrigation systems, water efficient soil and sod types are being developed to hold moisture for longer periods, thereby requiring fewer watering cycles to flourish. This efficiency approach would be more applicable to new construction projects, and would come at a higher capital cost in comparison to common soils and sod. However the potential is there to save water use by installing water efficient soil and/ or sod types on new construction projects. Further research is needed on such sod and soil types, and substantial outreach and education programs would be required to encourage developers to install more expensive sod types for future water efficiency.

8.3 Residential Water Efficiency

In addition to more efficient lawn irrigation systems, other residential water efficiency opportunities exist. These include low flow toilets, faucet aerators, and energy star washing machines as discussed in the following sections.

8.3a Low Flow Toilets

Toilet use accounts for a large portion of the water demand in residential and commercial buildings. According to the USEPA in 1992, toilet flushing accounted for 41% of the indoor water use (*How We Use Water In These United States*). Prior to 1994, most toilets on the market used a minimum of 3.5 gallons per flush, equating to 20 gallons of water per person per day. All new model toilets by law are required to be low-flow, using no more than 1.6 gallons of water per flush. Encouraging homeowners to replace old toilets with low-flow toilets could save approximately 2 gallons per flush, equating to nearly 11 gallons per person per day.

8.3b Faucet Aerators

Faucet aerators are water-efficient fixtures that help reduce water use in residential and commercial applications. EPA WaterSense-certified faucets and accessories use a maximum of 1.5 gallons per minute, which reduces flow out of the faucet by 30 percent or more from the standard 2.2 gallons per minute faucet. The EPA estimates that replacing old faucets with WaterSense labeled models can save the average family 700 gallons of water per year, equal to the amount needed to take 40 showers.

8.3c Energy Star Washing Machines

Energy Star is an EPA run program that directs engineering research and technology programs to develop, evaluate, and demonstrate non-regulatory strategies and technologies for reducing energy and water use in household products. In addition, the program rates appliances with an Energy Star rating based on energy and water efficiency.

Washing laundry represents a large fraction of residential water use in the average home, accounting for 15-40% of the overall water consumption for a typical family consisting of four people. Before new standards were adopted in 2010, traditional clothing washers used approximately 30 to 45 gallons of water per load. A typical family of four using a standard sized clothes washer will generate more than 300 loads per year. This equates to a regular washing machine consuming approximately 12,000 gallons of water annually. High efficiency Energy Star rated washing machines reduce this water use by more than 6,000 gallons per year by washing clothes more efficiently, requiring less water per load.

8.4 Industrial and Commercial Water Efficiency

The Minnesota Technical Assistance Program (MnTAP) recently completed a water efficiency project in the North and East Groundwater Management Area (GWMA) to identify water efficiency opportunities aimed at industrial water users. The project is supported by MCES with Clean Water Funds focusing on portions of Anoka and Hennepin Counties, as well as all of Ramsey and Washington Counties. The project includes: identification of industrial water users, outreach and awareness of the importance of water efficiency, and one-day assessments of industrial water use with recommendations for improvement by MnTAP staff members. The project supports continuing efforts by MnTAP and MCES in sponsoring summer engineering interns at facilities throughout the Twin Cities metropolitan area, focusing on industrial and commercial water efficiency.

8.5 City Water Metering / Unaccounted Water

Accurate city water metering is crucial to ensure that all of the water being used throughout any particular community is being accounted for. This is important to ensure that consumers are being appropriately billed for water usage, which in turn will create awareness of actual water usage and a sense of accountability for the consumer. If consumers are aware of what the cost is to use all of the water they use on a daily basis, they may be more likely to utilize the efficiency practices listed above.

Aging water infrastructure increases the chance of system losses and water leakage. Leak detection sensors can be installed throughout the distribution system to alert the water utility when a leak is occurring. This allows the water utility to repair the leak in a timely manner and reduce the water loss.

Smart metering technologies, including Advanced Metering Infrastructure (AMI) systems are growing in popularity nationwide and can provide water utilities with real-time readings. These technologies are helpful from a billing standpoint for the utility as well as from an efficiency standpoint to alert users how much water they are actually using and open up opportunities for reducing water demand.

8.6 Water Conservation Toolbox

The MCES website has a dedicated section to water conservation called the "Water Conservation Toolbox." This section of the website can be found at the following link "*http://www.metrocouncil.org/Wastewater-Water/Planning/Water-Supply-Planning/Water-Conservation-Toolbox-Customers.aspx*." Metropolitan Council staff have reviewed a wide range of conservation literature, web sites, and calculation tools to find the most relevant and useful resources for local residents, businesses, water suppliers, communities, and educators. The toolbox is geared towards Minnesota climate and water concerns relevant to the metro area. In the toolbox, you will find answers to common questions such as "Why Conserve?", "How do I compute my water consumption?", and "What can I do to conserve at my home or business?"

The "Residents & Businesses" section of the toolbox is geared towards water consumers and is broken down into three segments, "General Knowledge", "Indoor Water Consumption and Conservation", and "Outdoor Water Consumption and Conservation." The "General Knowledge" segment contains useful information that explains the limitations of local groundwater aquifers, and the interface between groundwater and surface water. The "Indoor Water Consumption and Conservation" segment discusses essential water use in households and businesses in Minnesota and presents water conservation practices and products for essential water demand.

The "Suppliers" water conservation toolbox is geared towards water utilities and discusses the needs and opportunities to conserve water at treatment plants as well as throughout distribution and collection systems. This segment touches on the many sources of water loss throughout distribution systems and current programs being utilized by utilities throughout the region to minimize such losses. The "Communities" water conservation toolbox is geared towards communities in the process of developing the water supply chapters of their comprehensive plans and looking for means of conservation planning. The "Learners" water conservation toolbox is geared towards children and parents to provide education, games and various other tools to learn more about the importance of water conservation and to teach good water use habits.

8.7 Water Efficiency and Infrastructure Needs

As discussed in Section 8.1, the Coalition communities use approximately 2.3 billion gallons of water annually for non-essential uses. This does not include inefficiencies in existing fixtures or losses in the distribution system. Based on the water projections, the non-essential water use in 2040 could be 2.9 billion gallons of water per year.

It is not practical to assume that the non-essential water use can be reduced to zero by efficiency. If the Coalition communities could implement water efficiency practices that would reduce the non-essential water use by half, it would equal almost 1.5 billion gallons of water annually (or 4.1 MGD). At $2 per 1,000 gallons, reducing the non-essential water use by 1.5 billion gallons would save coalition communities approximately $3 million annually.

The largest cost saving benefit that could be realized by water efficiency is by reducing the peak demands. Water systems are constructed to meet peak day demands. As much as half of most communities supply infrastructure is in place to meet maximum day demands due primarily to non-essential water use.

Chapter 9 - Summary of Findings and Implementation Considerations

9.1 Approach 1 – Use of Treated Effluent from Pollution Containment Wells

The feasibility of utilizing treated effluent from the 3M pollution containment wells in Woodbury was evaluated. Key findings are as follows:

- 3M pumps approximately 3,000 gallons per minute from the containment wells in Woodbury to their Cottage Grove facility where it is treated with granular activated carbon (GAC), used as process water, and discharged to the Mississippi River.
- The contaminant containment water is contaminated with PFCs. Given that the site was utilized as a landfill, other unknown contaminants could exist.
- To utilize the water for non-potable uses, it would need to be treated with GAC. Minnesota regulatory agencies (MDH, MPCA, DNR) may not allow the treated water to be used for surface water augmentation or irrigation due to potential unknown contaminants.
- To be utilized for potable water, RO treatment of contaminant containment water would be necessary.

A cost summary of the Approach 1 alternatives is included in Table 9-1.

Table 9-1. Approach 1 cost summary.

Alternative	Water Provided (MGY)	Capital Cost	Annual O&M Cost	Cost per 1,000 gallons
Alternative 1A – Non-potable water to Valley Creek	1,575	$18,900,000	$185,000	$1.10
Alternative 1B – Non-potable water to Northern Tier Refining	1,575	$20,100,000	$185,000	$1.20
Alternative 1C – Non-potable water to Northern Tier from	1,575	$24,700,000	$185,000	$1.40
Alternative 1D – Non-potable to golf courses and Northern Tier Refining	1,575	$32,200,000	$185,000	$1.80
Alternative 2A – Potable reuse to Woodbury	1,260	$32,300,000	$2,750,000	$4.40
Alternative 2B – Potable reuse to Cottage Grove	1,260	$32,200,000	$2,750,000	$4.40
Alternative 2C – Potable reuse to Woodbury and Cottage Grove	1,260	$37,500,000	$2,750,000	$4.70

The non-potable reuse alternatives evaluated do not appear to be feasible. Due to the potential for unknown contaminants, using treated containment water for surface water augmentation or irrigation may not be allowed by regulatory agencies. Sending the water to Northern Tier Refining is technically feasible, but it would be expensive and does not provide any clear benefits over its existing use.

Utilizing the treated contaminant containment water for potable drinking water is a more beneficial use of the water than as process water. However, concept level cost estimates indicate that RO treatment of the water is very expensive from a capital and O&M standpoint, potentially even more expensive than building a surface water treatment plant.

9.2 Approach 2 - New Surface WTP with Conjunctive Use of Groundwater

Conjunctive use of groundwater and surface water from a new treatment plant on the Mississippi or St. Croix Rivers was evaluated. Key findings are as follows:

- The Mississippi River or St. Croix Rivers could be used as a source of surface water. The St. Croix River has better water quality but is further away from the population centers and may be more difficult to get appropriation.
- Conjunctive use of treated surface water and groundwater is possible, but a public education program would need to be adopted for taste and odor changes. Municipalities would need to convert disinfection methods from chlorine to chloramines.

A cost summary of the Approach 2 alternatives is included in Table 9-2.

Table 9-2. Approach 2 cost summary.

Alternative	Water Provided (MGY)	Capital Cost	O&M Cost	Cost per 1,000 gallons
Alternative 4A – Connect Cottage Grove and Woodbury to new surface WTP on Mississippi River	4,900	$131,400,000	$5,960,000	$3.50
Alternative 4B – Connect Cottage Grove, Woodbury, Lake Elmo, Oakdale, Newport and St. Paul Park to new surface WTP on Mississippi River	6,680	$174,500,000	$8,400,000	$3.50
Alternative 5A – Connect Stillwater, Oak Park Heights, and Bayport to new surface WTP on St. Croix River	1,225	$68,600,000	$1,550,000	$6.20
Alternative 5B - Connect Cottage Grove, Woodbury, Lake Elmo, and Oakdale to new surface WTP on St. Croix River	6,470	$184,900,000	$8,070,000	$3.70

Providing treated surface water to Coalition communities via a new WTP would be significantly more expensive than the existing groundwater systems and would require major treatment and conveyance infrastructure. However, if a new water source were needed and groundwater was not available, building a new surface WTP would be feasible and may be a cost effective option.

9.3 Approach 3 – Connect to SPRWS

The feasibility of connecting Coalition communities to Saint Paul Regional Water Services (SPWRS) was evaluated. Key findings are as follows:

- The SPRWS raw water main and pumping are essentially at capacity with existing SPRWS maximum day demands (approximately 80 MGD); however, significant storage exists in the chain of lakes (3.5 BG) to provide additional water to Coalition communities.
- The SPRWS McCarrons Water Treatment Plant currently has approximately 30 MGD of excess capacity.

- The SPRWS Hazel Park pressure zone which is adjacent to Woodbury and Oakdale has limited capacity to provide water to the Coalition communities.
- A new trunk water main that connects to the SPRWS McCarrons Water Treatment Plant is necessary to bring water to the majority of the Coalition communities.

A cost summary to connect selected Coalition communities to SPRWS is included in Table 9-3.

Table 9-3. Approach 3 Cost Summary.

Alternative	Water Provided (MGY)	Capital Cost	Annual O&M Cost	Cost per 1,000 gallons
Alternative 6A – connect portion of Woodbury to SPRWS	730	$4,800,000	$1,981,000	$3.20
Alternative 6B – connect all of Woodbury to SPRWS	3210	$77,600,000	$9,020,000	$4.60
Alternative 6C - connect all of Woodbury and Cottage Grove to SPRWS	4900	$96,500,000	$13,650,000	$4.23
Alternative 6D - connect Newport to SPRWS	120	$6,500,000	$376,000	$7.12
Alternative 6E - connect Oakdale to SPRWS	1020	$13,100,000	$2,810,000	$3.70
Alternative 6F - connect Oakdale and Lake Elmo to SPRWS	1470	$16,000,000	$4,100,000	$3.59
Alternative 6G - connect portion of Woodbury and all of Newport to SPRWS	842	$10,200,000	$2,330,000	$3.66

Providing treated surface water to small subsets of Coalition communities appears to be feasible (Alternatives 6A, 6D, 6E, 6F and 6G). However, once the demand exceeds the capacity of the Hazel Park pressure zone, new trunk water main would be required to the SPRWS McCarrons WTP (Alternatives 6B, 6C). At this point, the alternatives are less cost effective than building a new surface WTP. A switch to SPRWS would result is higher water rates for all of the alternatives.

9.4 Approach 4 – New Well Fields

The feasibility of new well fields in areas less likely to have drawdown or contamination concerns was evaluated. Key findings are as follows:

- PFC contamination exists in the groundwater in large portions of southern Washington County.
- Aquifer drawdown concerns that could potentially impact surface waters exist in eastern Woodbury.
- Nitrate contamination exists in the groundwater in portions of Denmark Township

A cost summary of the Approach 4 alternatives is included in Table 9-4.

Table 9-4. Approach 4 cost summary.

Alternative	Water Provided (MGY)	Capital Cost	O&M Cost	Cost per 1,000 gallons
Alternative 7A – New well field at border of Cottage Grove/Woodbury	3,150	$26,400,000	$1,507,000	$1.10
Alternative 7B – New well field in Denmark Township	3,150	$30,600,000	$1,534,000	$1.20
Alternative 7C – New well field in southern Cottage Grove	3,150	$25,000,000	$1,697,000	$1.10

Drilling new wells is by far the lowest cost Approach for a new water source evaluated in this report. Without an incentive to switch to a new source of water, communities will continue to drill new wells.

Significant areas of contamination (PFCs, TCE, and nitrate) exist in Washington County. In addition, aquifer drawdown could be affecting surface waters in eastern Woodbury.

9.5 Efficiency

The Coalition communities use approximately 2.3 billion gallons of water annually for non-essential uses. This does not include inefficiencies in existing fixtures or losses in the distribution system. Based on the water projections, the non-essential water use in 2040 could be 2.9 billion gallons of water per year.

Significant opportunities exist for Coalition communities to use water more efficiently. These opportunities include more efficient irrigation, low flow toilets, faucet aerators, and Energy Star labeled washing machines. Significant opportunities also exist for industrial and commercial water users. The Minnesota Technical Assistance Program can provide assistance in identifying industrial water efficiency opportunities.

The largest cost saving benefit that could be realized by water efficiency is by reducing peak demand. Water systems are constructed to meet peak day demands. As much as half of the water supply infrastructure is in place to meet maximum day demands due primarily to non-essential water use.

9.6 Implementation Timeframes

The projects included in Approaches 1-4 are significant and would involve lengthy planning, design, and construction timeframes. The major projects (greater than $50,000,000) would take a few years for planning (at a minimum) and design and could take 4 years to construct. On the other hand, a small project ($5,000,000) could be planned, designed, and constructed in 2 years. This assumes that a specific project has been selected and approved by participating municipalities and regulatory agencies, the public involvement and environmental review process has been completed, and all required legislation, community agreements, and funding is in place.

Significant projects can trigger mandatory Environmental Impact Statements (EIS) that can take a year or more to complete. The potential projects in Approaches 1-4 do not appear to trigger a mandatory EIS; however, some form of environmental review would be required.

9.7 Potential Funding Sources

Potential funding sources for the approaches discussed in this report include user rates, State bond money, Drinking Water Revolving Fund (DWRF), or new sources of revenue. These options are discussed below.

User Rates

User rates are the costs paid by the residents for their water. User rates are how most municipalities and water utilities fund projects. As demonstrated in Chapter 7, it would not be equitable to the Coalition communities to fund the projects identified in this report strictly by Coalition user rates.

State Bond Money

State bonds are general obligation bonds issued by the State of Minnesota. Projects that benefit more than one community and are environmentally responsible have received State bond money in the past. It is likely that State bond money would be needed to make one of the approaches identified in this report feasible.

Drinking Water Revolving Fund (DWRF)

The DWRF is a federally funded program used to provide below market-rate loans to municipalities. The DWRF is administered by the Minnesota Public Facilities Authority. The loan rate is based on the financial capability of the municipality. Priority for DWRF loans is based on elements of the project including providing redundancy, exceeding a primary drinking water standard, upgrading disinfection, etc. The criteria for project selection have changed over the years to provide assistance to higher priority needs. The weighting of water sustainability criteria could be modified to provide more incentive for projects that reduce groundwater use. It is important to note that DWRF provides loans, which by definition need to be paid back (not grants).

New Sources of Revenue

A new source of revenue could include a groundwater usage fee spread across an entire area or region benefitting from the resource (e.g., Prairie du Chien – Jordan aquifer). This could be the North and East GWMA or possibly even the entire Metro area. Another source would be specially appropriated grant programs focused on groundwater withdrawal reduction.

Appendix A: Study Area Existing Water Infrastructure

Information Acquisition

Several sources or information were used to compile the community existing water infrastructure summaries:

- Municipal well water usage from 2012 was provided by the MnDNR's "Water Appropriations Permits Program" website. Groundwater wells withdrawing over 10,000 gallons per day (GPD) or 1 million gallons per year (MGY) require an appropriation permit issued by the MnDNR. Multiple wells can be assigned to one permit, and their cumulative withdrawals may not exceed the volume or pumping rate limitation set by the permit. Individual well information is also included in the MnDNR's dataset, including well depth, aquifer, installation ID number, well usage, and in some cases well location. It is important to note that municipal wells do not necessarily serve the entire population within each of the study area communities. Many private wells exist throughout the area, therefore municipal usage is only a subset of the total water usage in the area. The 2012 population numbers that accompany the 2012 municipal water usage data are from MCES data.
- MnDNR data for 2012 was the most recent data available at the time this report was started.
- Projected demands in 2040 were provided by the Metropolitan Council. These demands are based on historical per capita use for each city and projected city populations served by municipal systems.
- Information on infrastructure in each of the study area communities was taken from City Comprehensive Plans as well as GIS files when available. Many of the City's Comprehensive Plans dated back to 2008-2012, and included existing wells and water storage and treatment facilities.
- Water rate structure information was provided to SEH by each study area community, or was taken from available sources.

Bayport

The City of Bayport is located on the St. Croix River between the cities of Afton and Stillwater in eastern Washington County. Municipal water use in 2012 accounted for only 1% of the municipal use in the coalition. Water demand in Bayport is expected to increase by 50% from 2012 to 2040. The City of Bayport is the only community within the coalition in which the projected served population is expected to decrease.

Table 1. Summary of water demand data for Bayport.

Year	2012	2040 (Served)
Population	3,626	3,210
Annual Water Usage (MG)	84	138
Average Daily Demand (MGD)	0.20	0.40
Peak Daily Demand (MGD)	0.50	1.10

Water Supply

Bayport's municipal water system is the only community in the coalition to obtain potable water from the Franconia-Ironton-Galesville (FIG) aquifer (Table 2). These wells have a joint appropriation of 173 MGY, which will meet the Metropolitan Council's 2040 water usage projections. The peak daily water demand to average demand ratio is 2.5:1.

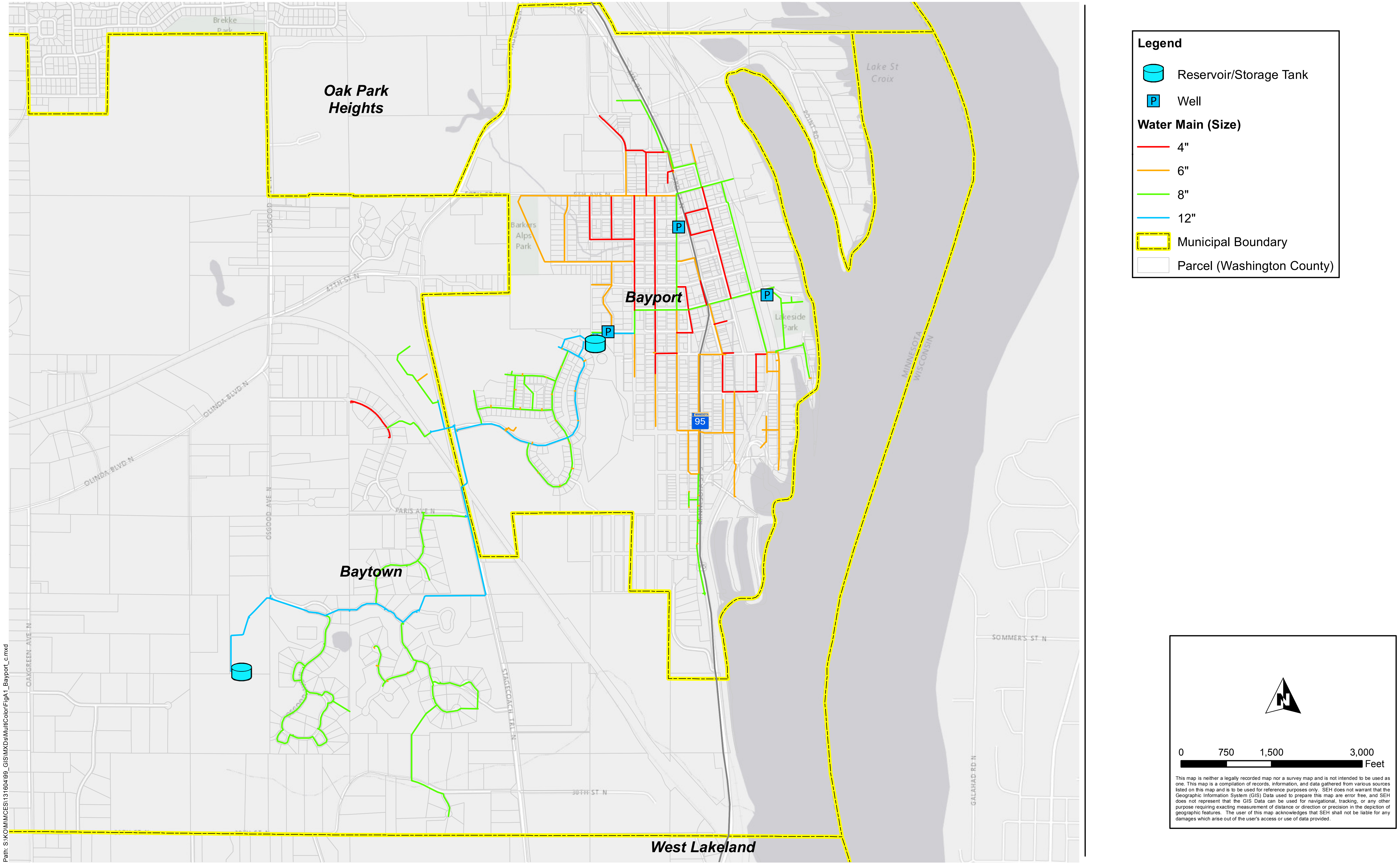
Table 2. Well summary data for Bayport.

Permit No.	Well ID	Installation ID	Permittee	Use Name	Aquifer	Well Depth, ft	2011 Use, MGY	Appropriation, MGY
1964-0526	208795	2	BAYPORT, CITY OF	Municipal Waterworks	FIG	315	34.1	172.8[1]
1964-0526	208796	3	BAYPORT, CITY OF	Municipal Waterworks	FIG	296	17.0	172.8[1]
1964-0526	208797	4	BAYPORT, CITY OF	Municipal Waterworks	FIG	260	16.8	172.8[1]

[1] Combined appropriation amount for all municipal waterworks wells in Bayport.

Water Infrastructure

Bayport operates within two pressure zones, the lowest of which is at an elevation of 898 feet above sea level, where a 300,000 gallon ground reservoir is located. The high pressure zone within the city's water infrastructure houses a 750,000 gallon ground storage reservoir, operated at an overflow elevation of 1,052 feet above sea level. The water distribution system consists of a relatively small network of approximately 17.6 miles of water main, varying in diameter from 4 to 12 inches.



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SEH

Project Number: MCES 131604
Print Date: Print Date: 4/27/2016

Map by: srh
Projection: UTM Zone 15, meter
Source: MnGEO, MnDOT, ESRI, DeLorme, and SEH.

WATER DISTRIBUTION SYSTEM
Bayport, Minnesota

FIGURE A1

Water Treatment

Trichloroethylene (TCE) was detected in Well No. 2; causing the City, in cooperation with the Minnesota Pollution Control Agency (MPCA), to construct an air stripping treatment plant for this well in 2007. In 2015, Well No. 3 was connected to the treatment facility for TCE removal.

Water Rates

Water usage of 8,000 gallons per month would result in an annual water bill of $415.32 based on Bayport's water rates.

Cottage Grove

Cottage Grove is located along the Mississippi River with neighboring Woodbury to the north and Saint Paul Park to the west. Municipal water use in 2012 accounted for approximately 22% of municipal use in the Coalition. Cottage Grove's projected 2040 water demand represents an 83% increase from 2012 usage.

Table 3. Summary of water demand data for Cottage Grove.

Year	2012	2040 (Served)
Population	35,132	47,000
Annual Water Usage (MG)	1,578	1,884
Average Daily Demand (MGD)	4.30	5.20
Peak Daily Demand (MGD)	11.2	13.5

Water Supply

Cottage Grove's municipal water system obtains its drinking water from eleven Jordan aquifer wells in two well fields (Table 4). These wells currently have a joint MnDNR appropriation of 1,500 MGY, which exceeds the 2040 water demand projections. Two dedicated wells are available for irrigating the municipal golf course at a lower appropriation permit amount. Cottage Grove's peak daily water demand to average demand ratio is 2.6:1.

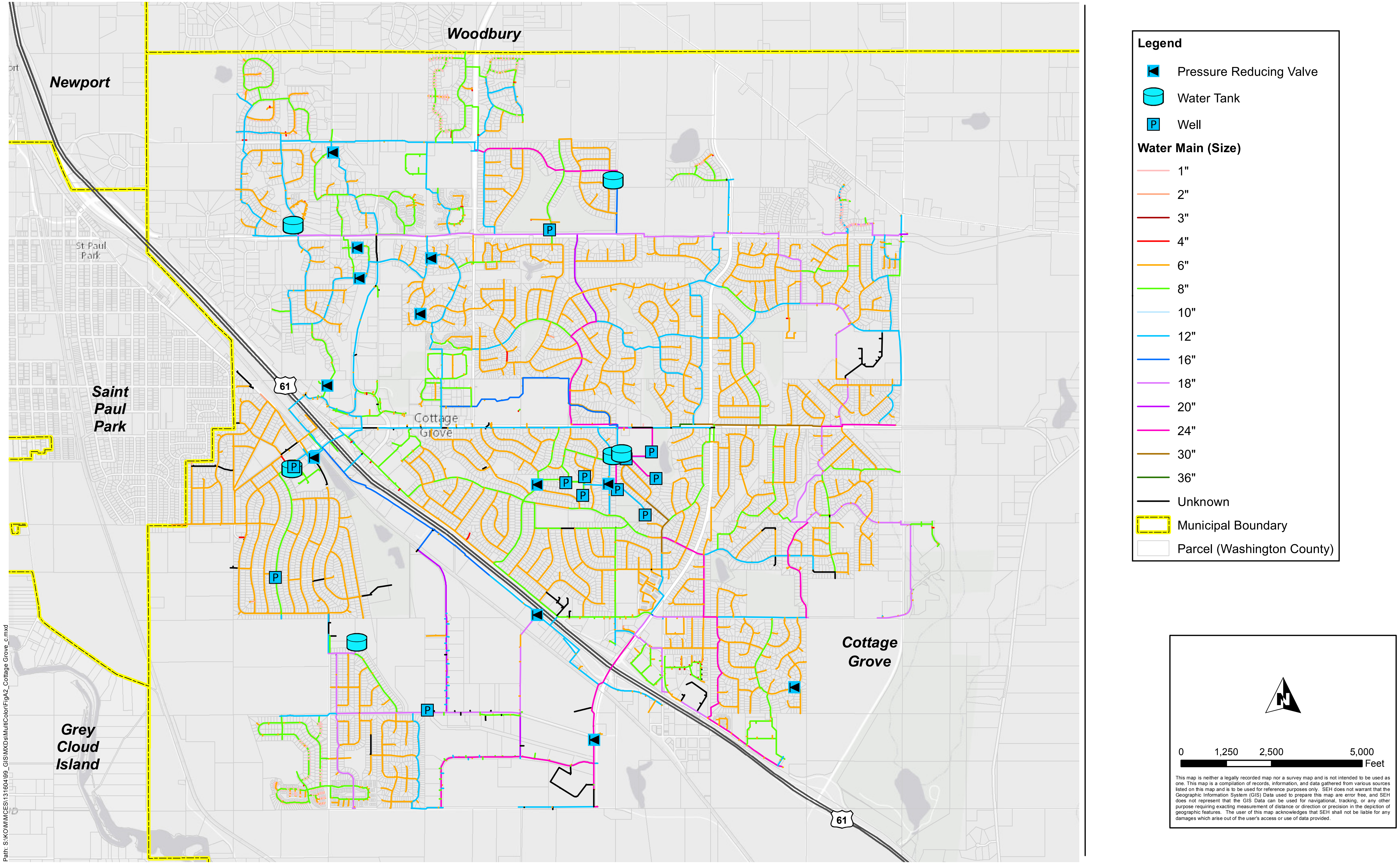
Table 4. High-capacity well summary data for Cottage Grove.

Permit No.	Well ID	Installation ID	Permittee	Use Name	Aquifer	Well Depth, ft	2011 Use, MG	Appropriation, MGY
1977-6349	191904	10	COTTAGE GROVE, CITY OF	Municipal Waterworks	Jordan	284	145.9	1,500[1]
1977-6349	655944	11	COTTAGE GROVE, CITY OF	Municipal Waterworks	Jordan	329	292.5	1,500[1]
1977-6349	208808	1	COTTAGE GROVE, CITY OF	Municipal Waterworks	Jordan	327	61.7	1,500[1]
1977-6349	208809	2	COTTAGE GROVE, CITY OF	Municipal Waterworks	Jordan	350	21.0	1,500[1]
1977-6349	208807	3	COTTAGE GROVE, CITY OF	Municipal Waterworks	Jordan	388	36.2	1,500[1]
1977-6349	208805	4	COTTAGE GROVE, CITY OF	Municipal Waterworks	Jordan	418	141.7	1,500[1]
1977-6349	208806	5	COTTAGE GROVE, CITY OF	Municipal Waterworks	Jordan	358	7.0	1,500[1]
1977-6349	201238	6	COTTAGE GROVE, CITY OF	Municipal Waterworks	Jordan	427	253.9	1,500[1]
1977-6349	201227	7	COTTAGE GROVE, CITY OF	Municipal Waterworks	Jordan	370	103.5	1,500[1]
1977-6349	110464	8	COTTAGE GROVE, CITY OF	Municipal Waterworks	Jordan	396	7.0	1,500[1]
1977-6349	165602	9	COTTAGE GROVE, CITY OF	Municipal Waterworks	Jordan	380	204.3	1,500[1]
1977-6349	420973	1	COTTAGE GROVE, CITY OF	Golf Course Irrigation	Jordan	261	29.9	57
1977-6349	N/A	2	COTTAGE GROVE, CITY OF	Golf Course Irrigation	Jordan	N/A	0	57

[1] Combined appropriation amount for all municipal waterworks wells in Cottage Grove.

Water Infrastructure

The Cottage Grove municipal water system operates under four pressure zones, housing six total water towers with a total usable storage volume of 7.15 million gallons (MG). There are currently no interconnections between communities within the Coalition. The distribution system currently consists of 150 miles of water main. Twelve different pressure reducing valves are distributed throughout the system, ensuring safe and dependable pressures at various elevations throughout the community. The water distribution system utilizes one booster station to convey water from the low pressure zone.



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Project Number: MCES 131604
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Map by: srh
Projection: UTM Zone 15, meter
Source: MnGEO, MnDOT, ESRI, DeLorme, and SEH.

WATER DISTRIBUTION SYSTEM

Cottage Grove, Minnesota

FIGURE A2

Water Treatment

Because Cottage Grove's water source meets all Federal and State drinking water standards, minimal treatment is required. Chlorine and fluoride are added for disinfection and to prevent tooth decay.

Water Rates

Water usage of 8,000 gallons per month would result in an annual water bill of $142.80 based on Cottage Grove's water rates.

Lake Elmo

Lake Elmo is located north of Highway 94, to the west of Bayport and borders Oakdale to the east. The projected 2040 water demand for Lake Elmo represents an anticipated population increase of 69%, the highest projected increase in the coalition. With the large population increase comes a 36% increase in water demand from 2012 to 2040.

Table 5. Summary of water demand data for Lake Elmo.

Year	2012	2040 (Served)
Population	8,536	12,444
Annual Water Usage (MG)	165	522
Average Daily Demand (MGD)	0.50	1.40
Peak Daily Demand (MGD)	1.10	3.10

Water Supply

Two Jordan aquifer wells supply Lake Elmo with its potable water, both of which have a joint appropriation of 260 MGY (Table 6), which falls short of the 2040 projected water use of approximately 620 MGY. During 2010, the annual water usage was less than half of the permit appropriation of one well. However the expected population increase will result in additional water supply needed for the City before 2040. Lake Elmo's peak to average daily water demand ratio is 2.2:1.

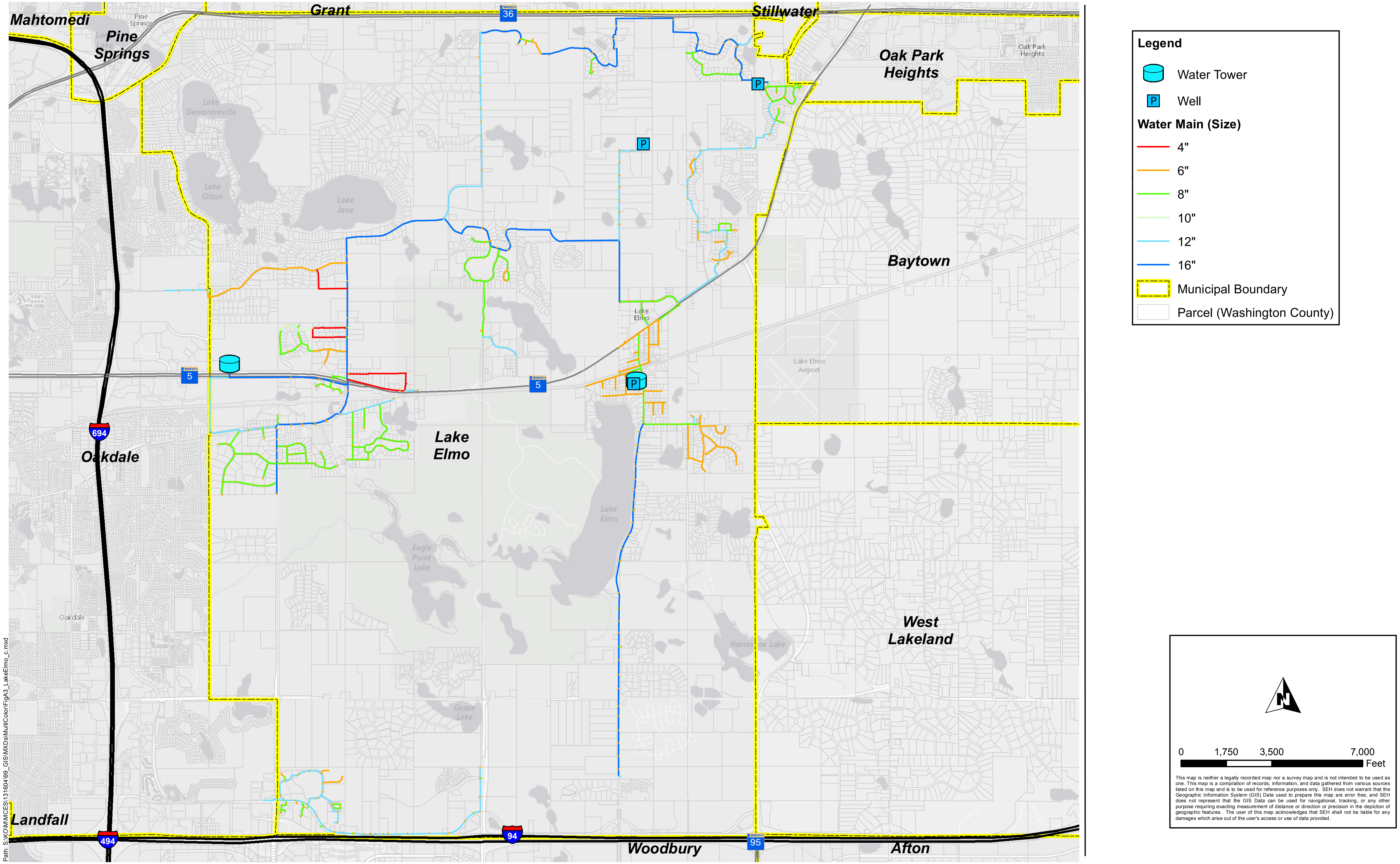
Table 6. Well summary data for Lake Elmo.

Permit No.	Well ID	Installation ID	Permittee	Use Name	Aquifer	Well Depth, ft	2011 Use, MG	Appropriation, MGY
1961-1031	208448	1	LAKE ELMO, CITY OF	Municipal Waterworks	Jordan	805	23.0	260[1]
1961-1031	603085	2	LAKE ELMO, CITY OF	Municipal Waterworks	Jordan	285	89.2	260[1]

[1] Combined appropriation amount for all municipal waterworks wells in Lake Elmo.

Water Infrastructure

The City of Lake Elmo's water system contains two elevated water storage tanks and is interconnected with the neighboring City of Oakdale in two locations. These interconnections allow both communities to back-up their water supply during periods of high demand.



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Map by: srh
Projection: UTM Zone 15, meter
Source: MnGEO, MnDOT, ESRI, DeLorme, and SEH.

WATER DISTRIBUTION SYSTEM

Lake Elmo, Minnesota

FIGURE A3

Water Treatment

Lake Elmo does currently not have a water treatment plant. Because Lake Elmo's water source meets all Federal and State drinking water standards, minimal treatment is required. Chlorine and fluoride are added for disinfection and to prevent tooth decay.

Water Rates

Water usage of 8,000 gallons per month would result in an annual water bill of $331.32 based on Lake Elmo's water rates.

Newport

The City of Newport is a small community located on the Mississippi River to the west of Woodbury and north of Saint Paul Park. The community accounts for a small fraction of only 2% of the total water use in the Coalition.

Table 7. Summary of water demand data for Newport.

Year	2012	2040 (Served)
Population	3,464	4,154
Annual Water Usage (MG)	101	142
Average Daily Demand (MGD)	0.30	0.40
Peak Daily Demand (MGD)	0.50	0.70

Water Supply

Newport obtains drinking water from two Jordan aquifer wells (see Table 8). The Metropolitan Council forecasts water usage in 2040 to be roughly 146 MGY, which will be met with the current joint appropriation amount without modification. The peak to average daily water demand ratio is 1.7:1.

Table 8. Well summary data for Newport.

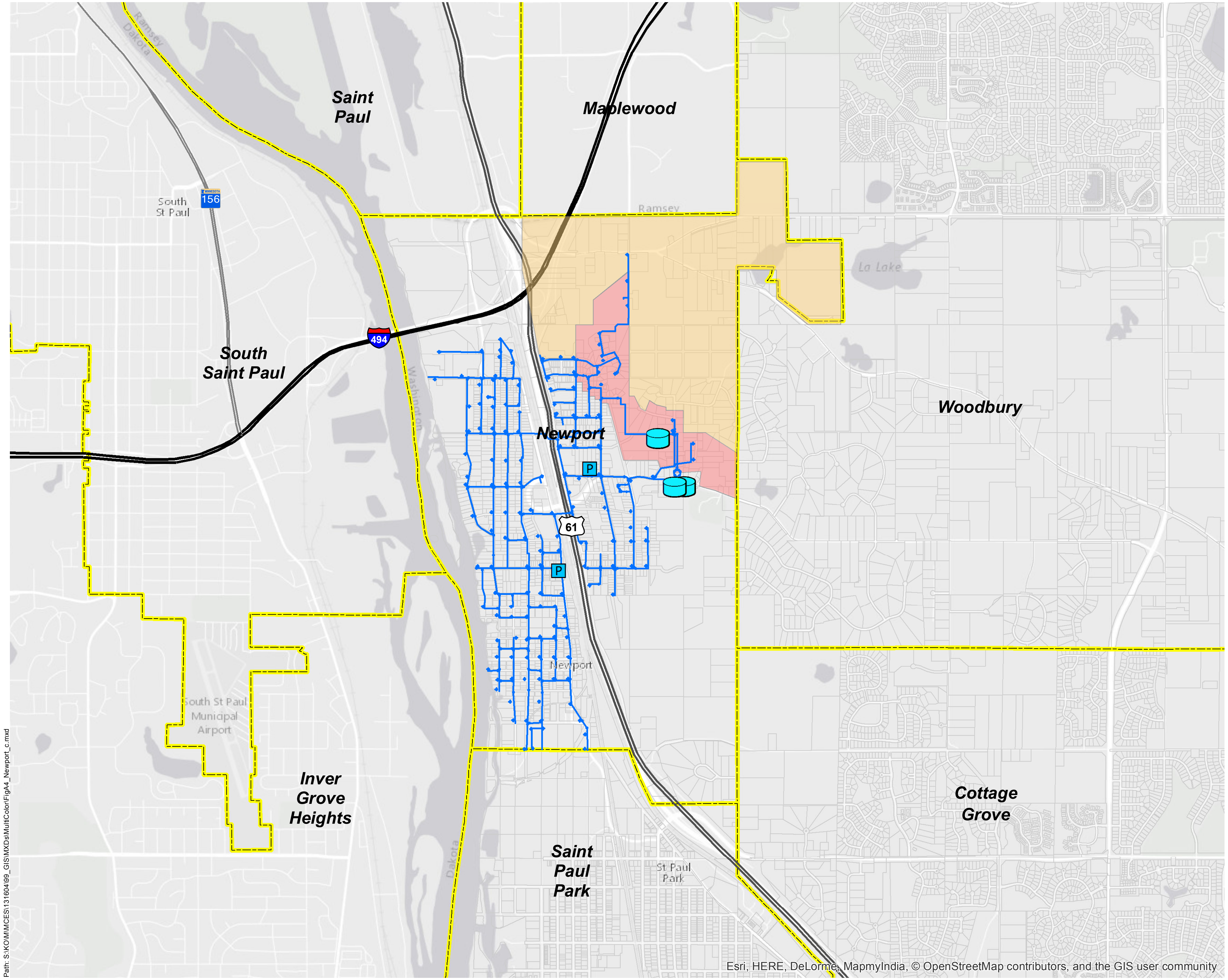
Permit No.	Well ID	Installation ID	Permittee	Use Name	Aquifer	Well Depth, ft	2011 Use, MG	Appropriation, MGY
1972-0851	208353	1	NEWPORT, CITY OF	Municipal Waterworks	Jordan	261	57.4	420[1]
1972-0851	225904	2	NEWPORT, CITY OF	Municipal Waterworks	Jordan	285	38.8	420[1]

[1] Combined appropriation amount for all municipal waterworks wells in Newport.

Water Infrastructure

The City of Newport's water system operates under two pressure zones, with a three storage reservoirs totaling 750,000 gallons. There are currently no interconnections with neighboring communities within the Coalition.

FIGURE A4



Legend

- Reservoir/Water Tower
- Well
- Water Main *
- Future High Pressure Zone Expansion
- High Pressure Zone
- Municipal Boundary
- Parcel (Washington County)

* NOTE:
Water main size was unavailable for this report.

0 1,250 2,500 5,000 Feet

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Print Date: Print Date: 4/27/2016

Map by: srh
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Source: MnGEO, MnDOT, ESRI, and DeLorme, and SEH.

WATER DISTRIBUTION SYSTEM
Newport, Minnesota

Water Treatment

The community does not currently have a water treatment plant. Because Newport's water source meets all Federal and State drinking water standards, minimal treatment is required. Chlorine and fluoride are added for disinfection and to prevent tooth decay.

Water Rates

Water usage of 8,000 gallons per month would result in an annual water bill of $626.04 based on Newport's water rates.

Oak Park Heights

Oak Park Heights is located along the St. Croix River between Stillwater and Bayport. Projected water use in 2040 is approximately 4% of the total Coalition water demand. The water use is estimated to increase 78% from 2012 to 2040.

Table 9. Summary of water demand data for Oak Park Heights.

Year	2012	2040 (Served)
Population	4,726	5,700
Annual Water Usage (MG)	244	312
Average Daily Demand (MGD)	0.70	0.90
Peak Daily Demand (MGD)	1.50	1.80

Water Supply

The Oak Park Heights Water System obtains its water from two Jordan aquifer wells, with a joint appropriation of 291 MGY (Table 10). These wells do not have capacity for the projected 2040 water usage value of 312 MGY. Oak Park Heights' peak daily to average daily water demand ratio is 2.1:1.

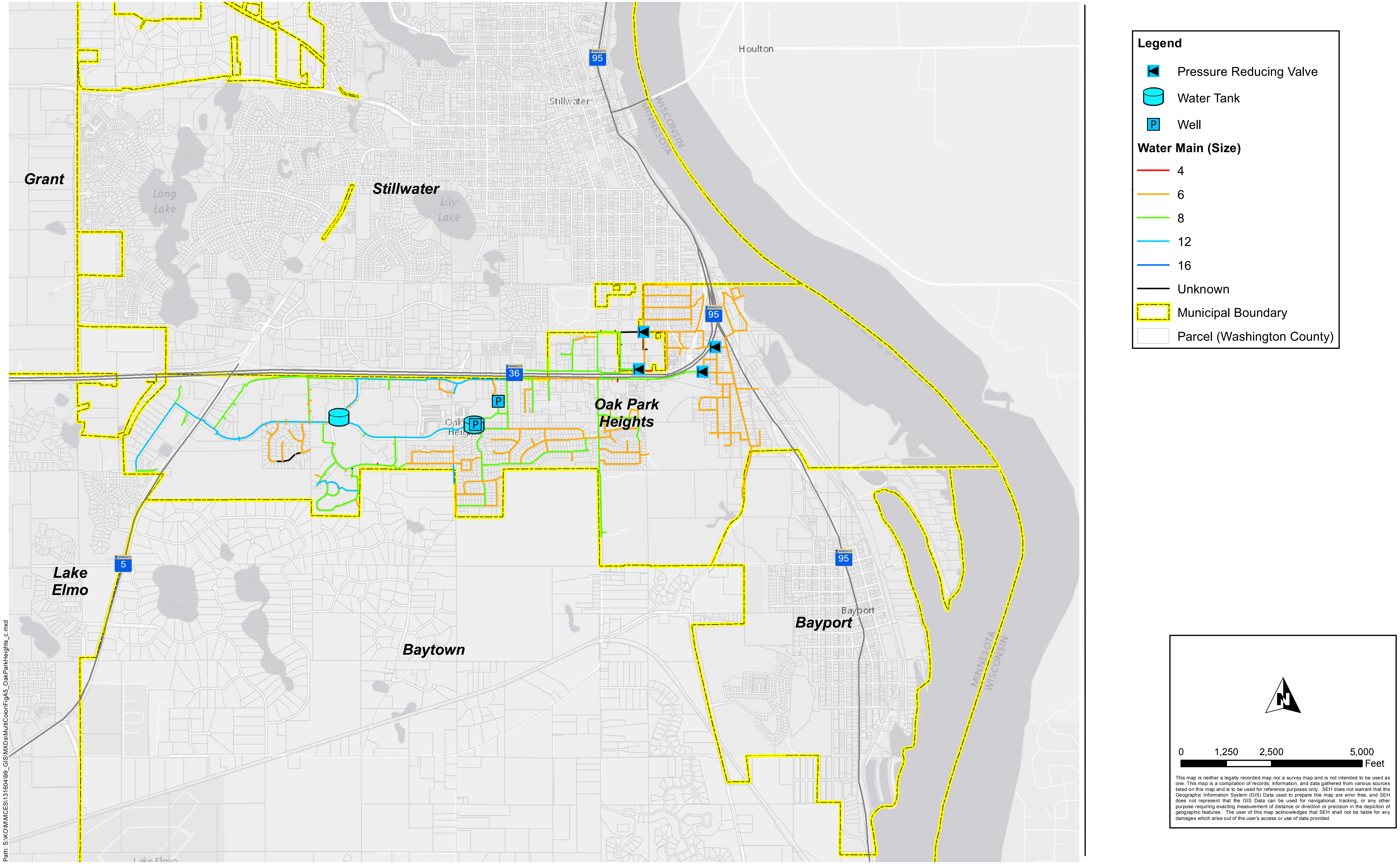
Table 10. Well summary data for Oak Park Heights.

Permit No.	Well ID	Installation ID	Permittee	Use Name	Aquifer	Well Depth, ft	2011 Use, MG	Appropriation, MGY
1975-6123	208794	1	OAK PARK HEIGHTS, CITY OF	Municipal Waterworks	Jordan	310	99.5	291[1]
1975-6123	112205	2	OAK PARK HEIGHTS, CITY OF	Municipal Waterworks	Jordan	290	117.1	291[1]

[1] Combined appropriation amount for all municipal waterworks wells in Oak Park Heights.

Water Infrastructure

The water system at Oak Park Heights consists of three pressure zones with two elevated storage facilities with a total storage capacity of 750,000 gallons. These two reservoirs supply water to the distribution system consisting of water main lines varying in size from 4 to 12 inches in diameter. There are currently no interconnections with neighboring communities within the Coalition.



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Map by: srh
Projection: UTM Zone 15, meter
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WATER DISTRIBUTION SYSTEM
Oak Park Heights, Minnesota

FIGURE A5

Water Treatment
The community does not currently have a water treatment plant. Because Oak Park Height's water source meets all Federal and State drinking water standards, minimal treatment is required. Both wells are equipped with chlorine feed systems for disinfection, but are currently not needed due to water quality.

Water Rates
Water usage of 8,000 gallons per month would result in an annual water bill of $214.56 based on Oak Park Height's water rates.

Oakdale
The City of Oakdale is located in the middle of the coalition, north of Hwy 94 and west of Lake Elmo. The water demand accounts for 14% of the water use for the Coalition. Water demand in Oakdale is expected to increase by almost 85% from 2012 to 2040, which is consistent with projected population increase in the community.

Table 11. Summary of water demand data for Oakdale.

Year	2012	2040 (Served)
Population	27,895	30,200
Annual Water Usage (MG)	1,027	1,187
Average Daily Demand (MGD)	2.80	3.30
Peak Daily Demand (MGD)	6.70	8.00

Water Supply
Oakdale obtains its drinking water from eight municipal wells which have a joint appropriation of 1,210 MGY (Table 12). The appropriation amount provides enough capacity to meet the projected 2040 demand of 1,187 MGY. The Oakdale peak daily to average daily water demand ratio is 2.4:1.

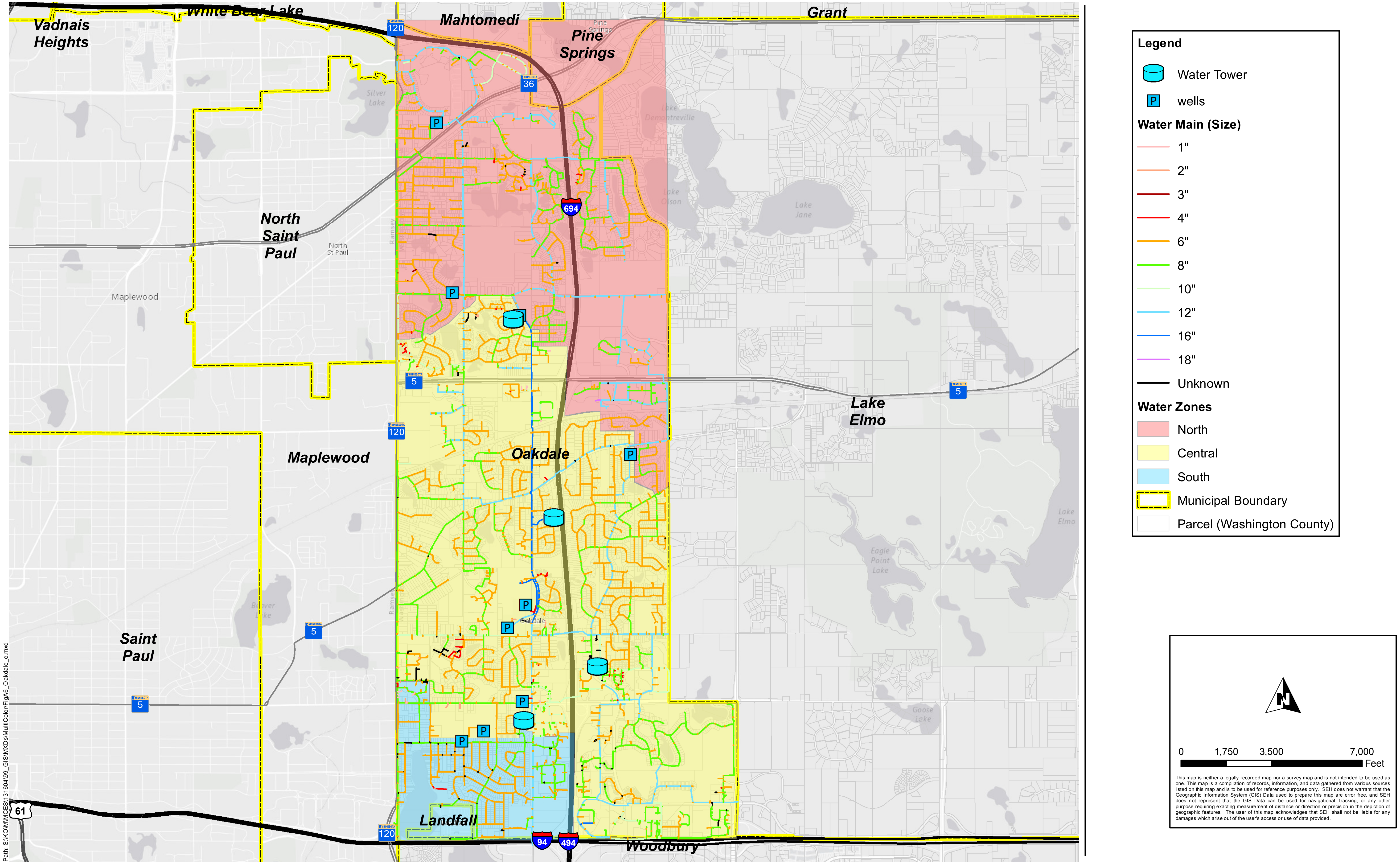
Table 10. Well summary data for Oakdale.

Permit No.	Well ID	Installation ID	Permittee	Use Name	Aquifer	Well Depth, ft	2011 Use, MG	Appropriation, MGY
1978-6197	208462	1	OAKDALE, CITY OF	Municipal Waterworks	Jordan	580	2.6	1,210[1]
1978-6197	208463	2	OAKDALE, CITY OF	Municipal Waterworks	Jordan	542	93.8	1,210[1]
1978-6197	208454	3	OAKDALE, CITY OF	Municipal Waterworks	Jordan	510	34.4	1,210[1]
1978-6197	127287	5	OAKDALE, CITY OF	Municipal Waterworks	Jordan	520	256.8	1,210[1]
1978-6197	151575	6	OAKDALE, CITY OF	Municipal Waterworks	Jordan	471	0	1,210[1]
1978-6197	463534	7	OAKDALE, CITY OF	Municipal Waterworks	Jordan	563	1.7	1,210[1]
1978-6197	572608	8	OAKDALE, CITY OF	Municipal Waterworks	Jordan	463	0.2	1,210[1]
1978-6197	611059	9	OAKDALE, CITY OF	Municipal Waterworks	Jordan	441	205.2	1,210[1]

[1] Combined appropriation amount for all municipal waterworks wells in Oakdale.

Water Infrastructure

The City water system contains four water towers throughout three pressure zones. The system supplies water to neighboring communities including all of Landfall, approximately 40 acres in the City of Lake Elmo, and into the northwest corner of Woodbury.



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Map by: srh
Projection: UTM Zone 15, meter
Source: MnGEO, MnDOT, ESRI, DeLormne, and SEH.

WATER DISTRIBUTION SYSTEM
Oakdale, Minnesota

FIGURE A6

Water Treatment

In 2005, perfluorochemicals (PFCs) were detected in seven of the eight wells. Two of the wells exceeded the Minnesota Department of Health's Health Based Values. A granular activated carbon (GAC) water treatment plant was constructed to remove PFCs from these two wells in 2006.

Water Rates

Water usage of 8,000 gallons per month would result in an annual water bill of $190.32 based on Oakdale's water rates.

Saint Paul Park

Saint Paul Park is located along the Mississippi River to the west of Cottage Grove and south of Newport. Current water use accounts for only 3% of the water demand in the Coalition. Water demand in Saint Paul Park is expected to increase by 75% from 2012 to 2040.

Table 13. Summary of water demand data for Saint Paul Park.

Year	2012	2040 (Served)
Population	5,354	7,954
Annual Water Usage (MG)	207	304
Average Daily Demand (MGD)	0.60	0.80
Peak Daily Demand (MGD)	1.30	1.70

Water Supply

Saint Paul Park obtains its drinking water from three municipal wells in the Jordan aquifer, one utilized primarily for emergency backup (Table 14). Current appropriations of the three wells in Saint Paul Park will not provide sufficient capacity for anticipated water usage value of 304 MGY in 2040. Current residential water use averages about 72% of the total water use in the City. The peak to average daily ratio in Saint Paul Park is 2.1:1.

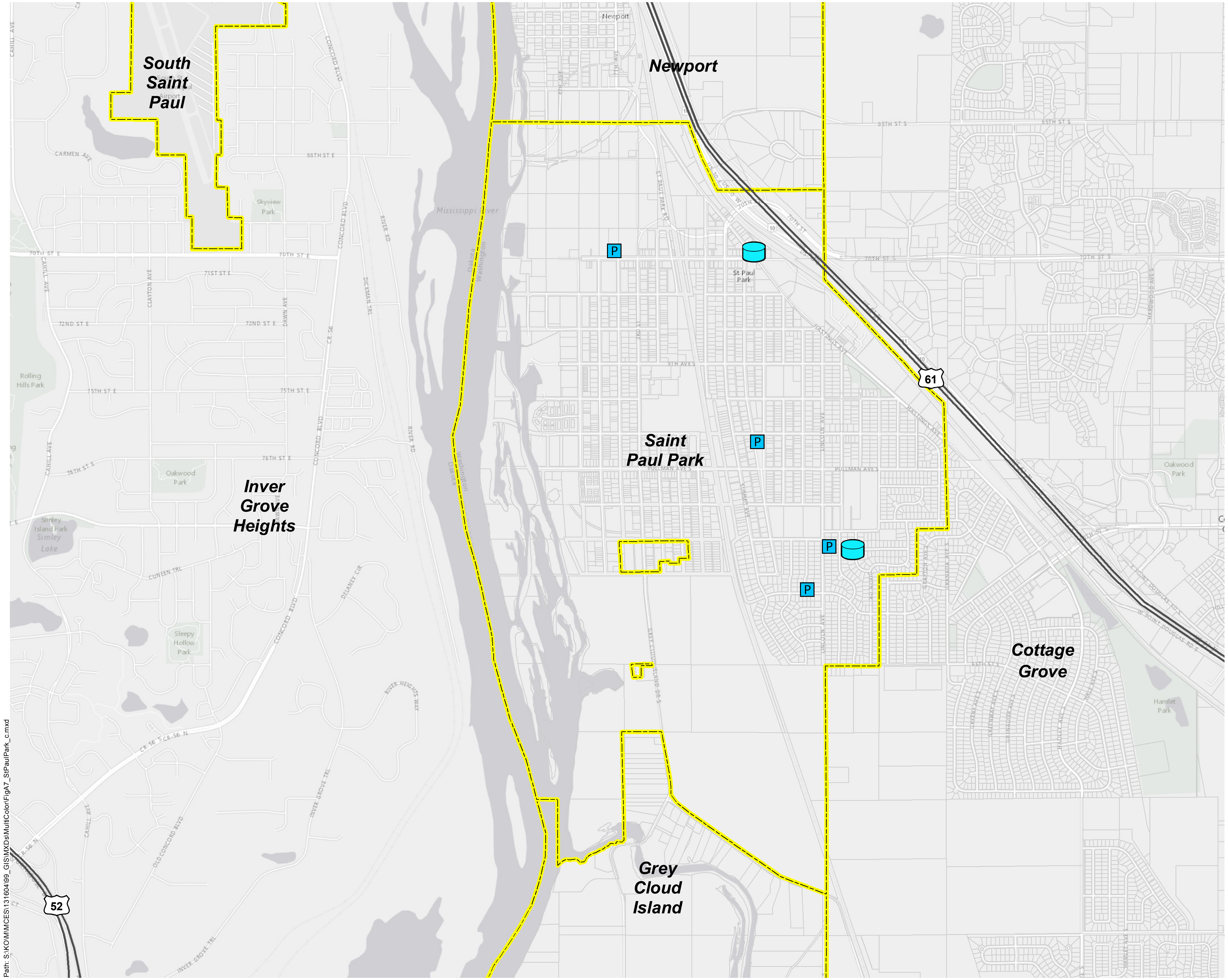
Table 14. Well summary data for Saint Paul Park.

Permit No.	Well ID	Installation ID	Permittee	Use Name	Aquifer	Well Depth, ft	2011 Use, MG	Appropriation, MGY
1963-0913	208418	2	SAINT PAUL PARK, CITY OF	Municipal Waterworks	Jordan	325	90.5	250[1]
1963-0913	208804	3	SAINT PAUL PARK, CITY OF	Municipal Waterworks	Jordan	338	71.9	250[1]
1963-0913	431603	4	SAINT PAUL PARK, CITY OF	Municipal Waterworks	Jordan	360	24.1	250[1]

[1] **Combined appropriation amount for all municipal waterworks wells in Saint Paul Park.**

Water Infrastructure

The City water system contains two water towers and 25 miles of watermain to distribute potable water the community. There are currently no interconnections between Saint Paul Park and neighboring communities.



* NOTE:
Water main line data was not available for this report.

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Map by: srh
Projection: UTM Zone 15, meter
Source: MnGEO, MnDOT, ESRI, DeLormne, and SEH.

WATER DISTRIBUTION SYSTEM
St. Paul Park, Minnesota

FIGURE A7

Water Treatment

The community does not currently have a water treatment plant. Because Saint Paul Park's water source meets all Federal and State drinking water standards, minimal treatment is required. Fluoride is added to prevent tooth decay.

Water Rates

Water usage of 8,000 gallons per month would result in an annual water bill of $270.24 based on St. Paul Park's water rates.

Stillwater

The City of Stillwater is located along the St. Croix River in the northeast corner of the coalition. The City's 2012 water use accounted for 12% of the total water usage in the study area. There is an estimated increase of 85% in water demand from 2012 to 2040.

Table 15. Summary of water demand data for Stillwater.

Year	2012	2040 (Served)
Population	18,722	22,800
Annual Water Usage (MG)	835	1,001
Average Daily Demand (MGD)	2.30	2.70
Peak Daily Demand (MGD)	5.30	6.20

Water Supply

Stillwater obtains its drinking water from seven Jordan aquifer municipal wells; an eighth well is available for backup as needed and an additional well is available for temporary water level maintenance when needed. The municipal wells have a joint appropriation of 865 MGY (Table 16). This appropriation limit will not be able to accommodate the projected 2040 demand of 1,001 MGY. The peak to average daily water demand ratio in Stillwater is 2.3:1.

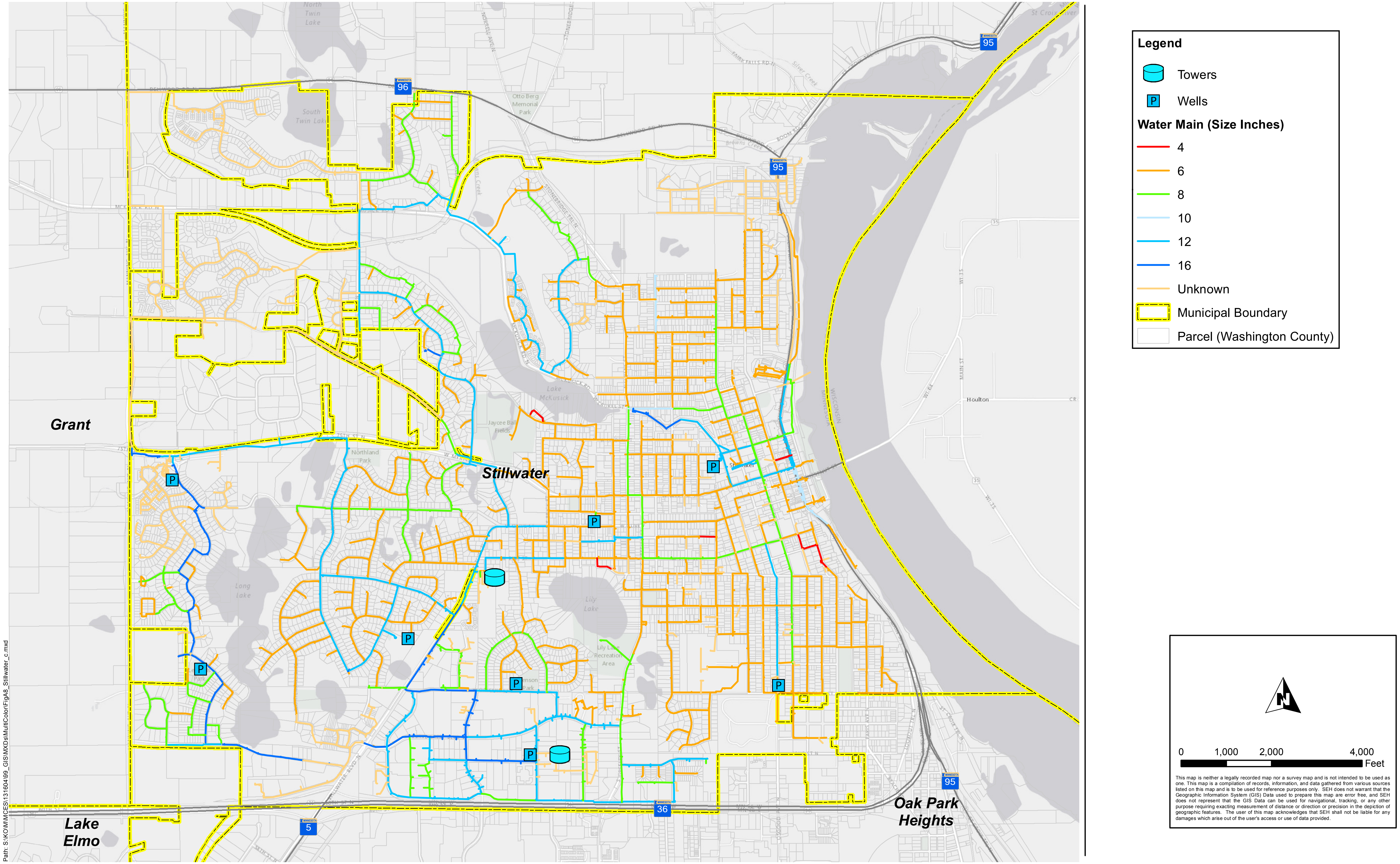
Table 16. Well summary data for Stillwater.

Permit No.	Well ID	Installation ID	Permittee	Use Name	Aquifer	Well Depth, ft	2011 Use, MG	Appropriation, MGY
1975-6207	481662	10	STILLWATER, CITY OF	Municipal Waterworks	Jordan	300	61.0	865[1]
1975-6207	580338	11	STILLWATER, CITY OF	Municipal Waterworks	Jordan	200	285.0	865[1]
1975-6207	208785	1	STILLWATER, CITY OF	Municipal Waterworks	Jordan	255	20.0	865[1]
1975-6207	686297	12	STILLWATER, CITY OF	Municipal Waterworks	Jordan	245	54.9	865[1]
1975-6207	208786	5	STILLWATER, CITY OF	Municipal Waterworks	Jordan	220	12.5	865[1]
1975-6207	208787	6	STILLWATER, CITY OF	Municipal Waterworks	Jordan	269	205.6	865[1]
1975-6207	224608	8	STILLWATER, CITY OF	Municipal Waterworks	Jordan	242	30.1	865[1]
1975-6207	127284	9	STILLWATER, CITY OF	Municipal Waterworks	Jordan	305	10.5	865[1]
1975-6207	N/A	1	STILLWATER, CITY OF	Municipal Waterworks	Jordan	N/A	N/A	1.3

[1] **Combined appropriation amount for all municipal waterworks wells in Stillwater.**

Water Infrastructure

The City's water system consists of a total storage capacity of 3.25 million gallons. There is one elevated storage tank with a capacity of 0.5 million gallons, two ground storage reservoirs with a combined storage capacity of 2.0 million gallons and one stand pipe with a storage capacity of 0.75 million gallons. There are currently no interconnections between Stillwater and neighboring communities in the Coalition.



Project Number: MCES 131604
Print Date: Print Date: 4/27/2016

Map by: srh
Projection: UTM Zone 15, meter
Source: MnGEO, MnDOT, ESRI, DeLorme, and SEH.

WATER DISTRIBUTION SYSTEM
Stillwater, Minnesota

FIGURE A8

Water Treatment

The community does not currently have a water treatment plant. Because Stillwater's water source meets all Federal and State drinking water standards, minimal treatment is required. Chlorine and fluoride are added for disinfection and to prevent tooth decay.

Water Rates

Water usage of 8,000 gallons per month would result in an annual water bill of $182.40 based on Stillwater's water rates.

Woodbury

The City of Woodbury is the largest of the communities in coalition and is located in the middle of the study area with Lake Elmo to the north and Cottage Grove to the south. Woodbury is the largest water user in the Coalition, making up for 42% of the total water use.

Table 17. Summary of water demand data for Woodbury.

Year	2012	2040 (Served)
Population	61,961	83,139
Annual Water Usage (MG)	3,029	3,733
Average Daily Demand (MGD)	8.30	10.2
Peak Daily Demand (MGD)	20.8	25.4

Water Supply

Woodbury obtains its drinking water from seventeen municipal wells in two well fields within one pressure zone (Table 18). Along with municipal wells, the City has wells for landscaping, and golf course irrigation. The joint appropriation for all of the municipal wells is 3,267 MGY, falling short of the projected annual water usage in 2040 of 3,733 MGY. Woodbury's peak daily to average daily water demand ratio of 2.5:1.

Table 18. High-capacity well summary data for Woodbury.

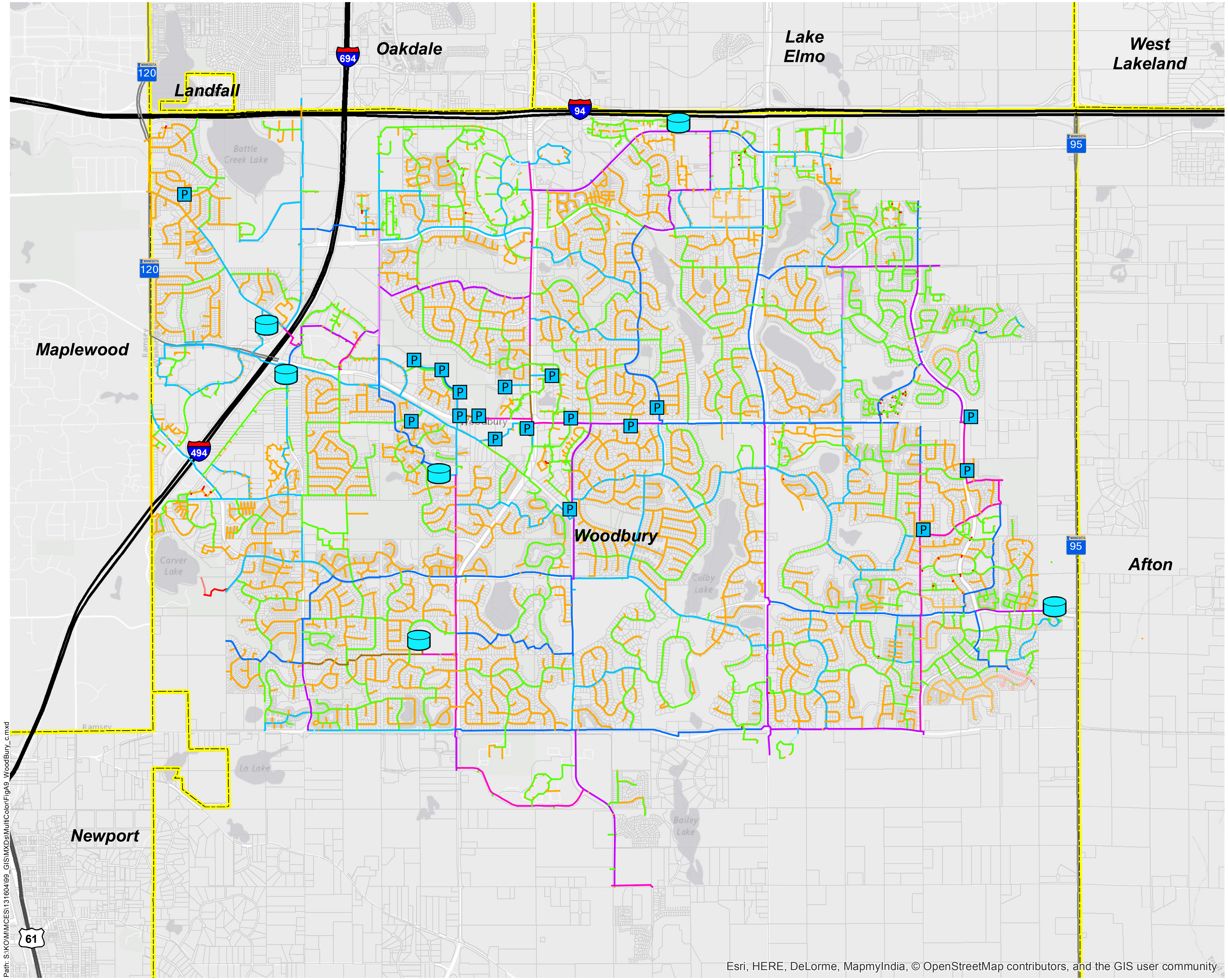
Permit No.	Well ID	Installation ID	Permittee	Use Name	Aquifer	Well Depth, ft	2011 Use, MG	Appropriation, MGY
1969-0215	541763	10	WOODBURY, CITY OF	Municipal Waterworks	Jordan	460	223.0	3,267[1]
1969-0215	563000	11	WOODBURY, CITY OF	Municipal Waterworks	Jordan	488	214.5	3,267[1]
1969-0215	596646	1	WOODBURY, CITY OF	Municipal Waterworks	Jordan	517	1.0	3,267[1]
1969-0215	593657	12	WOODBURY, CITY OF	Municipal Waterworks	Jordan	490	225.9	3,267[1]
1969-0215	611094	13	WOODBURY, CITY OF	Municipal Waterworks	Jordan	465	136.8	3,267[1]
1969-0215	676415	14	WOODBURY, CITY OF	Municipal Waterworks	Jordan	460	142.4	3,267[1]
1969-0215	706811	15	WOODBURY, CITY OF	Municipal Waterworks	Jordan	405	265.9	3,267[1]
1969-0215	759572	16	WOODBURY, CITY OF	Municipal Waterworks	Jordan	471	278.6	3,267[1]
1969-0215	208422	17	WOODBURY, CITY OF	Municipal Waterworks	Jordan	540	186.8	3,267[1]
1969-0215	208423	2	WOODBURY, CITY OF	Municipal Waterworks	Jordan	481	37.5	3,267[1]
1969-0215	208005	3	WOODBURY, CITY OF	Municipal Waterworks	Jordan	512	97.5	3,267[1]
1969-0215	150353	4	WOODBURY, CITY OF	Municipal Waterworks	Jordan	480	101.4	3,267[1]
1969-0215	151569	5	WOODBURY, CITY OF	Municipal Waterworks	Jordan	505	92.4	3,267[1]
1969-0215	433281	6	WOODBURY, CITY OF	Municipal Waterworks	Jordan	495	116.2	3,267[1]
1969-0215	509051	7	WOODBURY, CITY OF	Municipal Waterworks	Jordan	494	142.6	3,267[1]
1969-0215	463539	8	WOODBURY, CITY OF	Municipal Waterworks	Jordan	494	191.6	3,267[1]
1969-0215	N/A	9	WOODBURY, CITY OF	Municipal Waterworks	Jordan	N/A	124.5	3,267[1]

Permit No.	Well ID	Installation ID	Permittee	Use Name	Aquifer	Well Depth, ft	2011 Use, MG	Appropriation, MGY
1969-0215	N/A	1	WOODBURY, CITY OF	Temporary Pollution Containment	Jordan	N/A	0	275
1969-0215	N/A	2	WOODBURY, CITY OF	Temporary Pollution Containment	Jordan	N/A	0	275
1969-0215	N/A	1	WOODBURY, CITY OF	Temporary Construction	Jordan	N/A	0	3.5
1969-0215	N/A	1	WOODBURY, CITY OF	Temporary Water Level Maintenance	Jordan	N/A	0	1.5
1969-0215	562977	1	WOODBURY, CITY OF	Golf Course Irrigation	Jordan	295	39.1	48.3
1969-0215	N/A	1	WOODBURY, CITY OF	Lake Level Maintenance	Jordan	N/A	0	21.5
1969-0215	759570	1	WOODBURY, CITY OF	Landscaping	Jordan	295	22.2	40.0

[1] Combined appropriation amount for all municipal waterworks wells in Woodbury.

Water Infrastructure

The City's large water infrastructure consists of three 2 MG ground storage tanks, one 1 MG stand pipe, one 3 MG ground storage reservoir, as well as a 0.5 MG tank at Woodlane Drive. There are emergency interconnections currently with Oakdale and Maplewood.



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/Water Tank

e)

Boundary

Washington County)

50 3,500 7,000 Feet

ally recorded map nor a survey map and is not intended to be used as ilation of records, information, and data gathered from various sources to be used for reference purposes only. SEH does not warrant that the System (GIS) Data used to prepare this map are error free, and SEH the GIS Data can be used for navigational, tracking, or any other ng measurement of distance or direction or precision in the depiction of e user of this map acknowledges that SEH shall not be liable for any of the user's access or use of data provided.

SEH

Project Number: MCES 131604
Print Date: Print Date: 4/27/2016

Map by: srh
Projection: UTM Zone 15, meter
Source: MnGEO, MnDOT, ESRI, LeLorme, and SEH.

WATER DISTRIBUTION SYSTEM

Woodbury, Minnesota

FIGURE A9

Water Treatment

The community does not currently have a water treatment plant. Because Woodbury's water source meets all Federal and State drinking water standards, minimal treatment is required. Chlorine and fluoride are added for disinfection and to prevent tooth decay. Polyphosphate is added at Wells 14 and 15 to prevent iron and manganese particles from settling out and causing discolored water complaints.

Water Rates

Water usage of 8,000 gallons per month would result in an annual water bill of $104.28 based on Woodbury's water rates.

Appendix B: Unit Cost Development Memo

TECHNICAL MEMORANDUM

TO: Christopher Larson, PE

FROM: Noah Johnson, PE

DATE: April 28, 2016

RE: Unit Cost Development for the Feasibility Assessment of Approaches to Water Sustainability for the Washington County Municipal Water Coalition

Cost estimating for projects under an urban roadway are difficult to estimate at a study phase level, for the purpose of this study several assumptions are needed. A tool was developed to calculate these costs, titled “MCES_WC_FeasibilityStudy_UnitPrices”. The easily definable cost estimates for pavement removal, trench excavation and backfill, pipe and installing costs, and pavement replacement are quantifiable based on 2014 MNDOT published costs. These costs are developed on sheet “Piping and Pavement” of the tool. These cost typically represent 25-35% of a project. The general assumptions that were used to determine the defined costs are:

- A 40 foot wide section of roadway would be removed and replaced
- The curb, gutter and sidewalks would also be removed and replaced
- Some of the pipe would not be under the roadway and a portion of the pavement costs were not included based on the proposed alignments
- The pipe would be buried 8 feet deep and the excavation would have a side slope of 1:1
- No excavation protection was assumed

Several other undefined costs associated with working in the roadway exist and are not easily determined. These costs include water main structures and pipe fittings, other trenching or dewatering costs, other pavement removal and replacement costs, conflicts with the proposed alignments, allowances, and construction activity costs. These costs make up the majority of the project costs and are unknown without a significant effort. In order to estimate these costs a similar project that was just bid in 2014 was reviewed, sheet “SLP” of the tool. Each item was reviewed and the prices were removed from the project if they were accounted for in the defined costs listed above. The remaining bid items were grouped based on the cost item in the following groups:

- Pipe Fittings
- Other Trenching Costs
- Water main Structures

- Other Pavement Costs
- Allowances
- Construction Costs
- Stormwater Protection
- Utility Conflicts

These undefined costs were then divided by the total amount of roadway that was removed and replaced in the similar project. This method provided a unit price per foot for each group of undefined cost. These costs are totaled in the “Undefined Costs” sheet in the tool.

To determine the basis for the final projected unit costs, the proposed alignments were considered. Three unit costs for each pipe diameter were developed based on the percentage of the pipe alignment under the roadway. The pavement costs were adjusted based directly on the amount of pavement that would be removed and replaced, identified in the “Percent Under Road” column of the “Piping and Pavement” sheet. The undefined costs were not directly adjusted by the same amounts, these were adjusted based on the potential to encounter the undefined costs identified in the “Multiplier” cells of the “Undefined Costs” sheet. The undefined costs were further refined based on the diameter of the pipe to be installed. The undefined costs were scaled down linearly based on pipe diameter, 60” pipe assumed 100% of the undefined costs down to 24” pipe which assumed 60% of these costs. With a range of unit prices, the final proposed alignments can be evaluated and a final total cost can be calculated. The following tables outline the assumptions made to determine the unit costs and the final unit costs for each pipe diameter.

Table 1. Unit Cost Adjustments Based on the Proposed Alignments

Percentage of the alignment under the roadway	Percentage of pavement costs included in the unit cost	Percentage of undefined costs included in the unit cost
100%	100%	100%
50%	50%	50%
0%	0%	25%

Table 2. Washington County Municipal Water Coalition Water Supply Feasibility Study Unit Cost Summary

Pipe Diameter (in)	Percent in Roadway	Defined Costs per Foot	Urban Undefined Costs per Foot	**Urban Total Costs per Foot**	Rural Undefined Costs per Foot	**Rural Total Costs per Foot**
12	0%	$108	$164	**$272**	$110	**$218**
12	50%	$160	$328	**$488**	$125	**$285**
12	100%	$212	$497	**$709**	$167	**$379**
16	0%	$134	$164	**$298**	$110	**$244**
16	50%	$186	$328	**$514**	$125	**$311**
16	100%	$237	$497	**$734**	$167	**$404**
20	0%	$164	$164	**$328**	$110	**$274**
20	50%	$216	$328	**$544**	$125	**$341**
20	100%	$267	$497	**$764**	$167	**$434**
24	0%	$194	$164	**$358**	$110	**$304**
24	50%	$245	$328	**$573**	$125	**$370**
24	100%	$297	$497	**$794**	$167	**$464**
30	0%	$242	$164	**$406**	$110	**$352**
30	50%	$294	$328	**$622**	$125	**$419**
30	100%	$345	$497	**$842**	$167	**$512**
36	0%	$311	$164	**$475**	$110	**$421**
36	50%	$363	$328	**$691**	$125	**$488**
36	100%	$414	$497	**$911**	$167	**$581**

Many of the alternatives presented for the Coalition comminutes will utilize a booster or blending station to provide the required system water pressure. It is more cost effective to transport water at low pressure and boost the pressure at each township. In order to estimate the costs of each of the needed booster stations a cost development tool was created titled MCES_WC_FeasibilityStudy_BoosterStationEstimate". Before the tool can be used, the demand of each township and the pressure zone at which the water will be delivered to each booster station must be known. The "Demand Summary" sheet is used for these inputs. The "Motor Hp" and "# of Duty Pumps" are direct inputs based on the review of possible pump curves and horsepower that may be used for each application. These direct inputs are used for the basis of each booster station cost estimate.

It is assumed vertical turbine pumps will be used at each booster station. These costs are determined on sheet "Pumps Pipes and Valves" of the tool. Factors were applied to the pump costs for piping, valves and installation costs based on similar projects and design experience. A stand-by pump was included in order to determine the total costs for the pumps detailed in the following table.

Table 3. Booster Pump and Piping Costs

Alt.	Township	Blending/ Booster	Pumps	Hp	Cost per Pump	Piping Costs	Total
4A	Cottage Grove	Blending	0	0	$0	$121,703	$121,703
4A	Woodbury	Both	2	40	$86,000	$128,853	$300,853
4B	Cottage Grove	Blending	0	0	$0	$121,703	$121,703
4B	Woodbury	Both	2	40	$86,000	$128,853	$300,853
4B	St Paul Park	Blending	0	0	$0	$67,734	$67,734
4B	Newport	Blending	0	0	$0	$67,734	$67,734
4B	Oakdale	Both	2	25	$83,000	$60,017	$226,017
4B	Lake Elmo	Both	2	25	$83,000	$34,041	$200,041
5A	Bayport	Blending	0	0	$0	$67,734	$67,734
5A	Oak Park Heights	Blending	0	0	$0	$185,556	$185,556
5A	Stillwater	Blending	0	0	$0	$121,703	$121,703
5B	Cottage Grove	Blending	0	0	$0	$121,703	$121,703
5B	Woodbury	Both	2	40	$86,000	$128,853	$300,853
5B	Oakdale	Both	2	25	$83,000	$60,017	$226,017
5B	Lake Elmo	Both	2	25	$83,000	$34,041	$200,041
6A	Woodbury	Booster	2	15	$77,000	$34,041	$188,041
6B	Woodbury	Blending	0	0	$0	$264,813	$264,813
6C	Woodbury	Both	3	50	$89,000	$157,247	$424,247
6C	Cottage Grove	Blending	0	0	$0	$185,556	$185,556
6D	Newport	Blending	0	0	$0	$67,734	$67,734
6E	Oakdale	Both	2	25	$83,000	$50,919	$216,919
6F	Oakdale	Both	2	30	$84,000	$60,017	$228,017
6F	Lake Elmo	Both	2	20	$77,000	$34,041	$188,041
6G	Woodbury	Both	2	15	$77,000	$34,041	$188,041
6G	Newport	Blending	0	0	$0	$67,734	$67,734

The booster stations will range between a total of 2 or 3 pumps based on water demand. Structure costs were then developed which provided an appropriate footprint and building size for each station. General structural costs and installation multipliers are developed for the 2 or 3 pump stations in sheets “2 Pump Bldg” and “3 Pump Bldg”. Building mechanical estimated costs are based on similar projects and detailed in sheet “Mechanicals” of the tool. The “Yard Piping” sheet details costs for various diameters of pipe, these costs are based on 200 feet of pipe, and fittings needed to bring water into the booster station and to connect to the service line or water tower. The summary sheet tabulates the costs developed in the tool sheets plus electrical and generator costs. The electrical cost is an estimate based on experience and current costs. This estimate is 13% of the pump, structure and mechanical costs. The generator cost is developed based on the size and number of duty pumps needed for each station. It is assumed natural gas generators will be used. The following table outlines the total estimated cost for each booster station in year 2014 dollars, ENR 9800.

Table 4. Booster/Blending Station Total Costs

Alt	Location	Blending/ Boosting	Pipe Size	Pumps, Pipes, Valves Cost	Bldg	Electrical	Total Cost1
4A	Cottage Grove	Blending	20	$121,703	$199,442	$66,014	$513,000
4A	Woodbury	Both	30	$300,853	$199,442	$98,261	$724,000
4B	Cottage Grove	Blending	20	$121,703	$199,442	$66,014	$513,000
4B	Woodbury	Both	30	$300,853	$199,442	$98,261	$724,000
4B	St Paul Park	Blending	12	$67,734	$199,442	$56,300	$449,000
4B	Newport	Blending	12	$67,734	$199,442	$56,300	$449,000
4B	Oakdale	Both	20	$226,017	$199,442	$84,791	$636,000
4B	Lake Elmo	Both	12	$200,041	$199,442	$80,115	$605,000
5A	Bayport	Blending	12	$67,734	$199,442	$56,300	$449,000
5A	Oak Park Heights	Blending	24	$185,556	$199,442	$77,508	$588,000
5A	Stillwater	Blending	20	$121,703	$199,442	$66,014	$513,000
5B	Cottage Grove	Blending	20	$121,703	$199,442	$66,014	$513,000
5B	Woodbury	Both	30	$300,853	$199,442	$98,261	$724,000
5B	Oakdale	Both	20	$226,017	$199,442	$84,791	$636,000
5B	Lake Elmo	Both	12	$200,041	$199,442	$80,115	$605,000
6A	Woodbury	Booster	12	$188,041	$199,442	$77,955	$591,000
6B	Woodbury	Blending	30	$264,813	$199,442	$91,774	$682,000
6C	Woodbury	Both	36	$424,247	$249,007	$129,394	$928,000
6C	Cottage Grove	Blending	24	$185,556	$199,442	$77,508	$588,000
6D	Newport	Blending	12	$67,734	$199,442	$56,300	$449,000
6E	Oakdale	Both	16	$216,919	$199,442	$83,153	$625,000
6F	Oakdale	Both	20	$228,017	$199,442	$85,151	$638,000
6F	Lake Elmo	Both	12	$188,041	$199,442	$77,955	$591,000
6G	Woodbury	Both	12	$188,041	$199,442	$77,955	$591,000

1) Each total cost includes $45,600 in mechanical equipment and $80,000 for a generator.

Yearly operation and maintenance costs are determined on tab “O&M Costs”. Based on previous project experience, 3% of the capital costs for the pumping equipment is used to determine the costs in the “Equipment Maintenance” totals to cover items such as pump seal replacement or other typical equipment upkeep costs. A general amount of $2,000 was assumed for heating the building and another $2,000 was identified for other miscellaneous building costs. The “Operator Costs” are based on an assumed 4 hours per week of time and an hourly cost of $50. The pumping energy costs assumed the pumps were 60% efficient at pumping the average daily flow and a KW-hr cost of $0.072. The following table outlines the probable costs of operation and maintenance in 2014 dollars.

Table 5. Booster/Blending Station Yearly Operation and Maintenance Costs

Alt	Location	Boosting/ Blending	Equipment Maintenance	Operator Costs, Heating, and Misc	Pumping Energy Costs	Total
4A	Cottage Grove	Blending	$3,651	$14,400	$0	$18,051
4A	Woodbury	Both	$9,026	$14,400	$15,319	$38,744
4B	Cottage Grove	Blending	$3,651	$14,400	$0	$18,051
4B	Woodbury	Both	$9,026	$14,400	$15,319	$38,744
4B	St Paul Park	Blending	$2,032	$14,400	$0	$16,432
4B	Newport	Blending	$2,032	$14,400	$0	$16,432
4B	Oakdale	Both	$6,781	$14,400	$9,574	$30,755
4B	Lake Elmo	Both	$6,001	$14,400	$9,574	$29,975
5A	Bayport	Blending	$2,032	$14,400	$0	$16,432
5A	Oak Park Heights	Blending	$5,567	$14,400	$0	$19,967
5A	Stillwater	Blending	$3,651	$14,400	$0	$18,051
5B	Cottage Grove	Blending	$3,651	$14,400	$0	$18,051
5B	Woodbury	Both	$9,026	$14,400	$15,319	$38,744
5B	Oakdale	Both	$6,781	$14,400	$9,574	$30,755
5B	Lake Elmo	Both	$6,001	$14,400	$9,574	$29,975
6A	Woodbury	Booster	$5,641	$14,400	$5,744	$25,786
6B	Woodbury	Blending	$7,944	$14,400	$0	$22,344
6C	Woodbury	Both	$12,727	$14,400	$19,148	$46,276
6C	Cottage Grove	Blending	$5,567	$14,400	$0	$19,967
6D	Newport	Blending	$2,032	$14,400	$0	$16,432
6E	Oakdale	Both	$6,508	$14,400	$9,574	$30,482
6F	Oakdale	Both	$6,841	$14,400	$11,489	$32,729
6F	Lake Elmo	Both	$5,641	$14,400	$7,659	$27,700
6G	Woodbury	Both	$5,641	$14,400	$5,744	$25,786

Appendix C: PFC Assessment Memo

Building a Better World for All of Us®

TECHNICAL MEMORANDUM

TO: Brian Davis, P.E., PhD

FROM: Christopher Larson, PE

DATE: May 8, 2015

RE: PFC Assessment - Washington County Municipal Water Coalition Water Supply Feasibility

Introduction

Perfluorinated compounds (PFCs) are a class of synthetic compounds composed of carbon chains with attached fluorine groups. There are thousands of different types of PFCs. The two most common PFCs are perfluorooctanoic acid (PFOA) and plerfluorooctane sulfonate (PFOS).

Background

Once in the environment, PFCs are very persistent; there are no known biological or chemical reactions that degrade PFCs. PFCs have been detected in a wide variety of environments, including drinking water. There is very little information available on the health effects associated with long term PFC exposure. The United States EPA has placed PFOA and PFOS on the Candidate Contaminant List (CCL) and have set a Health Advisory level for PFOA and PFOS of 0.07 μg/L (individually and combined). The Minnesota Department of Health (MDH) has also defined HRLs for PFOA and PFOS each at 0.3 μg/L. MDH has also set HRLs for additional PFCs, including perfluorobutanoic acid (PFBA) and perfluorobutanesulfonate (PFBS) each at 7μg/L. Other PFCs that are being monitored by MDH, but no HRL has been defined include perfluorohexanesulfonate (PFHxS), perfluorohexanoic acid (PFHxA), and perfluoropentanoic acid (PFPeA).

Oakdale Water Treatment System

PFC contamination from the Oakdale 3M disposal site has impacted the City of Oakdale's Water Supply. PFCs have been detected in all of the City of Oakdale's municipal wells. Well No. 5 and Well No. 9 are the wells most directly impacted by PFC contamination. Granular activated carbon (GAC) contactors have been constructed for the City of Oakdale by 3M to treat the potable water produced from Well No. 5 and Well No. 9. PFOA, PFOS, PFBA, PFBS, PFHxA and PFPeA are monitored monthly by MDH at Well No. 5, Well No. 9 and at the Water Treatment Plant. PFC monitoring occurs on an annual basis at the remaining City wells.

Figures 1 through 5 display the PFC removal efficiencies of the Oakdale GAC contactor. Based on this information, GAC treatment appears to be effective at reducing the concentration of PFCs below the HRLS set by MDH.

Comparison of these figures indicates that some PFCs have stronger affinity towards the activated carbon than others. In general, the longer chain PFCs (i.e. PFOS, PFOA) are more hydrophobic than the shorter chain PFCs (i.e. PFBA, PFHxA). The increase hydrophobicity of the longer chain PFCs increases the affinity of the PFC towards the activated carbon surface. When sorption sites on the activated carbon become occupied, longer chain PFCs have an affinity towards the activated carbon surface that is sufficiently higher than shorter chain PFCS to replace the shorter chain PFCs that are already adsorbed to the activated carbon. This is particularly evident when examining PFBA (Figure 1). PFBA concentrations in the effluent of the GAC contactors exceed the influent concentrations from the wells. This effect can be further seen in Figure 6, which displays the concentrations of PFCs (excluding PFBS) in the effluent of the GAC contactors. The adsorption affinity in of PFCs in the Oakdale GAC WTP can be described by the following trend.

PFBA<PFHxA<PPeA<PFOA<PFOS

PFOS and PFOA have the highest removal efficiency and the least amount of observed desorption from the activated carbon surface.

Woodbury 3M Disposal Site Barrier Well Assessment

There are four barrier wells located at the Woodbury 3M disposal site that help to prevent the flow of PFC contaminated groundwater out of the contamination plume. The barrier wells pump approximately 3,300 gpm from the Woodbury Disposal site to the Cottage Grove 3M plant. The capacities of each of the barrier well pumps and the 2010 to 2011 average PFC concentrations can be seen in Table 1. Using the pump capacities as a weighting factor and the average concentration of each PFC in each well, the total combined discharge from the barrier wells can be estimated.

Table 1. Woodbury site barrier well pump capacity and 2010 to 2011 barrier well average PFC concentrations.

	Barrier Well B1	Barrier Well B2	Barrier Well B3	Barrier Well B4
PFBA (µg/L)	1.3	0.5	0.8	1.3
PFOA (µg/L)	1.0	0.0	0.2	1.7
PFOS (µg/L)	0.0	0.0	0.2	1.7
Well Capacity (gpm)	960	150	770	1,400

The estimated barrier well discharge and 2006-2015 average PFC concentration in the City of Oakdale Wells No. 5 and No. 9 can be seen in Table 2.

Table 2. City of Oakdale raw water barrier well weighted average PFC concentrations.

	Oakdale Well 5	Oakdale Well 9	Barrier Well Weighted Avg.	MDH HRL
PFBA (µg/L)	1.3	1.5	1.2	7.0
PFOA (µg/L)	0.5	0.5	1.0	0.3
PFOS (µg/L)	0.8	0.5	0.8	0.3

Concentrations of PFBA and PFOS in the Woodbury Site barrier wells are similar to those observed in the City of Oakdale's wells. The PFOA concentration in the barrier wells is approximately twice what is observed in the City of Oakdale's wells.

Assuming there are no additional compounds present in the barrier well water that would compete for sorption sites, activated carbon appears to be viable treatment technology to provide potable water with PFC concentrations below the MDH defined HRLs. PFOA and PFOS concentrations in the barrier wells exceed the MDH HRLs; however, these compounds are effectively removed by GAC.

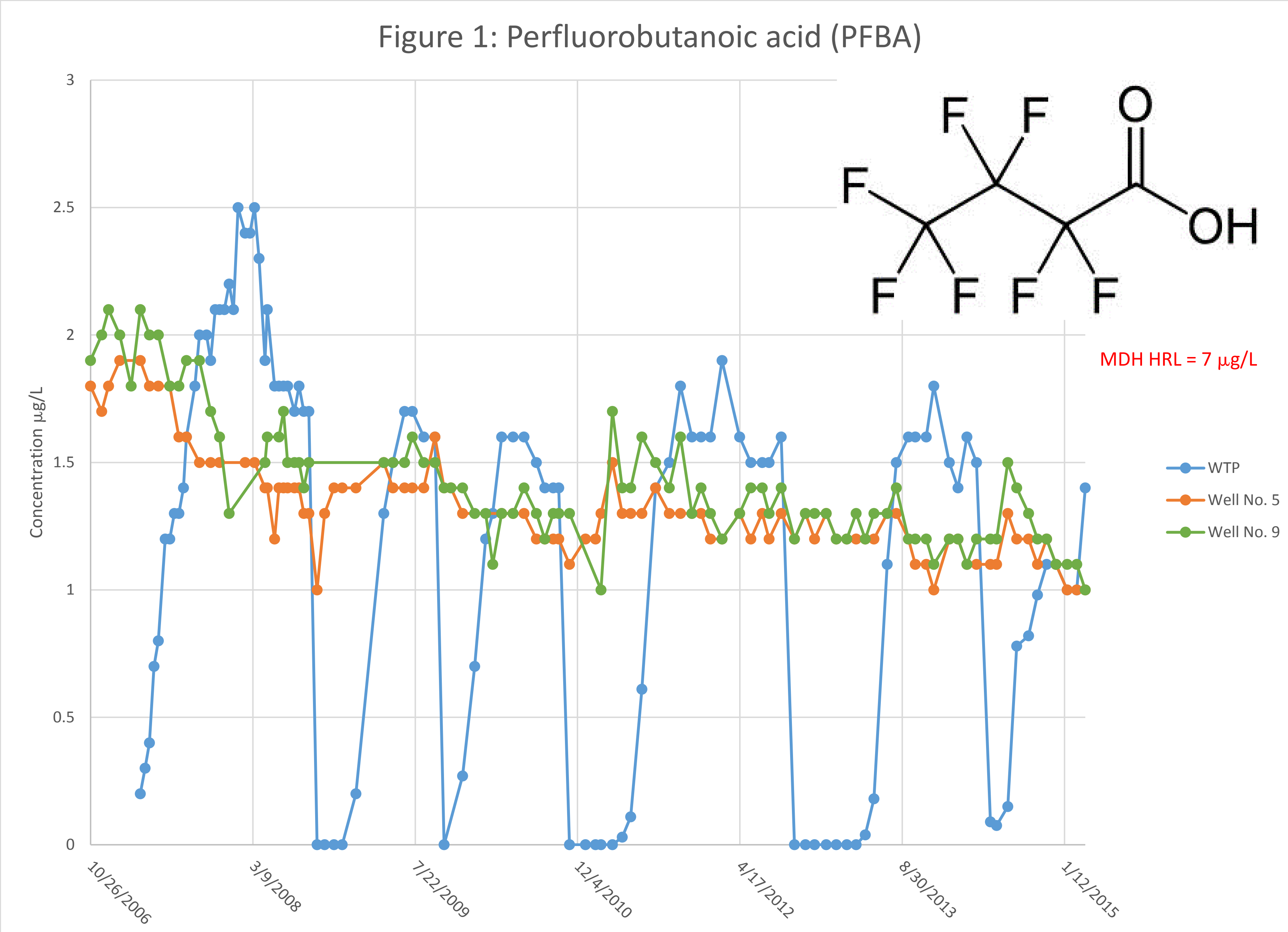


Figure 1: Perfluorobutanoic acid (PFBA)
Concentration µg/L
3
2.5
2
1.5
1
0.5
0
10/26/2006
3/9/2008
7/22/2009
12/4/2010
4/17/2012
8/30/2013
1/12/2015
F F O
F
OH
F F F F
MDH HRL = 7 µg/L
WTP
Well No. 5
Well No. 9

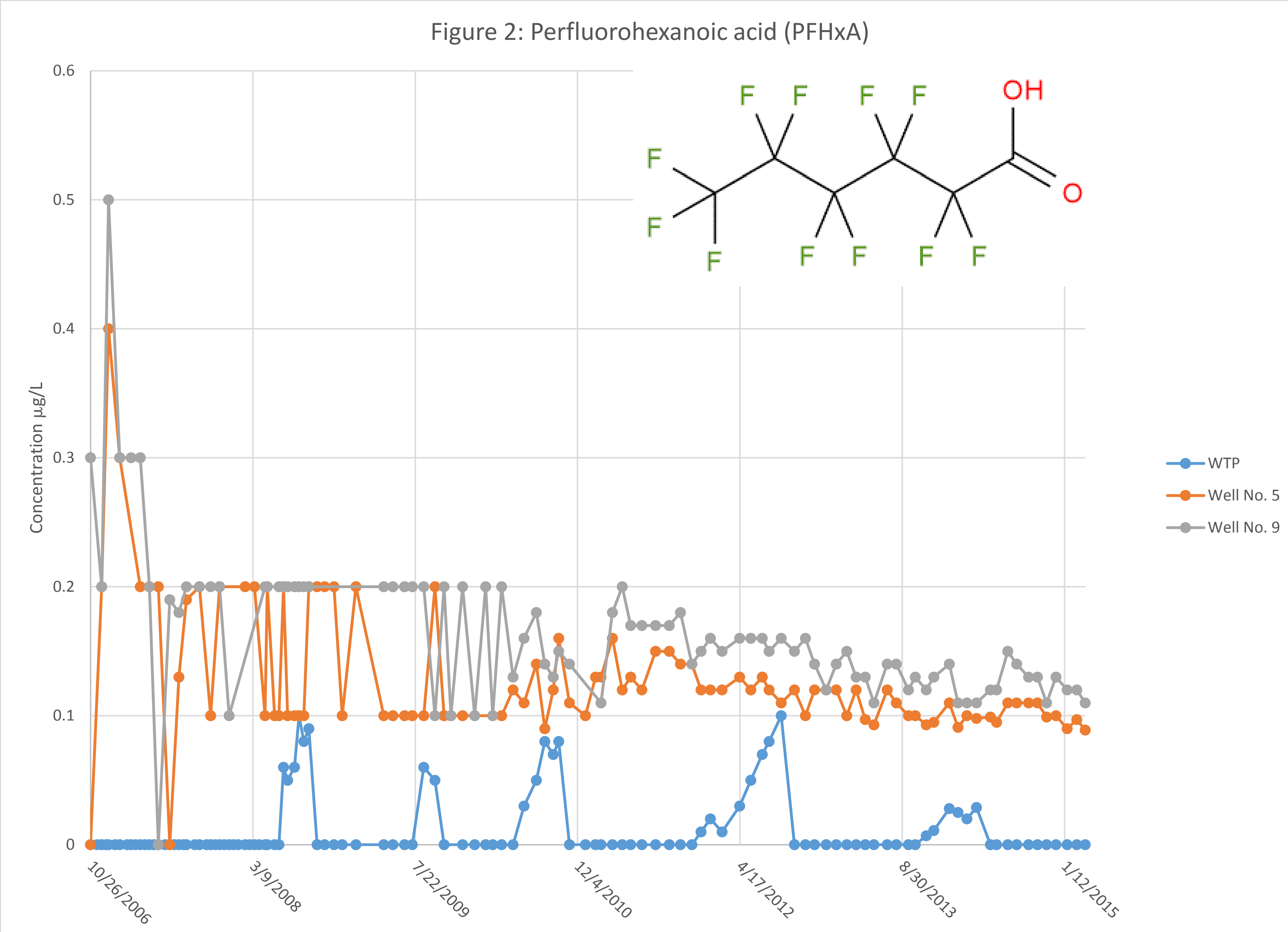


Figure 2: Perfluorohexanoic acid (PFHxA)
Concentration µg/L
0.6
0.5
0.4
0.3
0.2
0.1
0
10/26/2006
3/9/2008
7/22/2009
12/4/2010
4/17/2012
8/30/2013
1/12/2015
WTP
Well No. 5
Well No. 9
F
OH
O

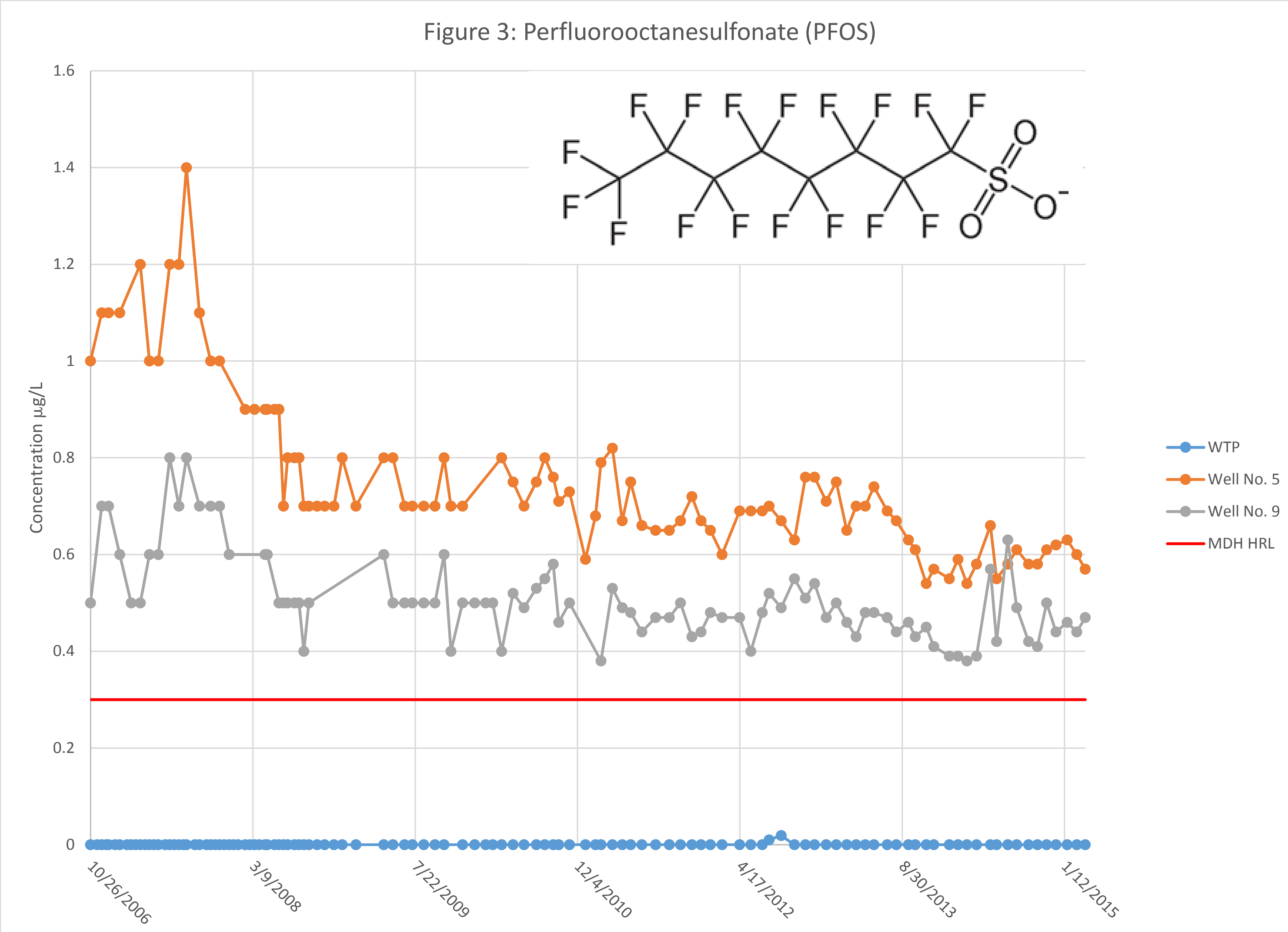


Figure 3: Perfluorooctanesulfonate (PFOS)
Concentration µg/L
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
10/26/2006
3/9/2008
7/22/2009
12/4/2010
4/17/2012
8/30/2013
1/12/2015
WTP
Well No. 5
Well No. 9
MDH HRL

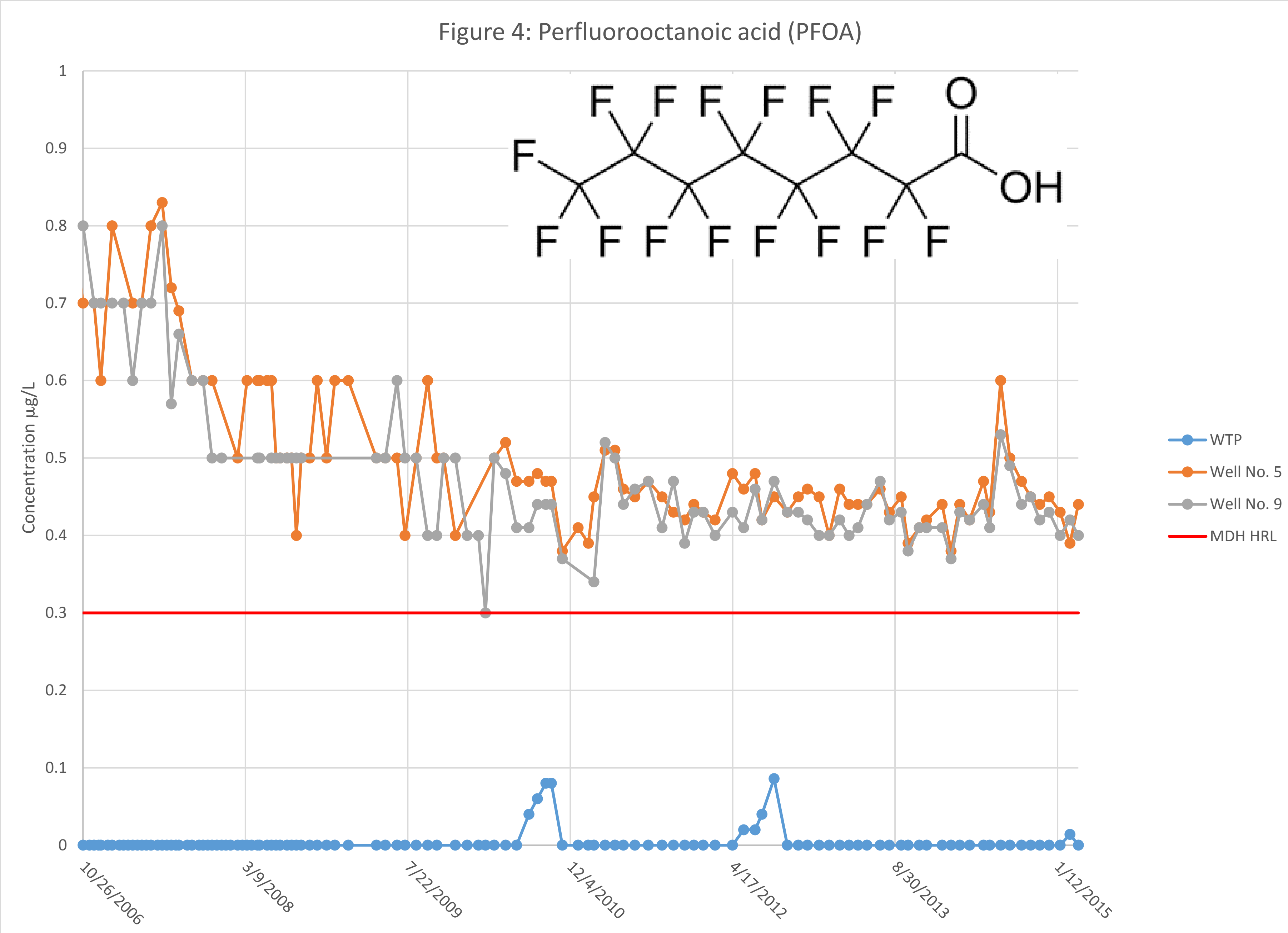


Figure 4: Perfluorooctanoic acid (PFOA)
Concentration µg/L
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
10/26/2006
3/9/2008
7/22/2009
12/4/2010
4/17/2012
8/30/2013
1/12/2015
WTP
Well No. 5
Well No. 9
MDH HRL
F
O
OH

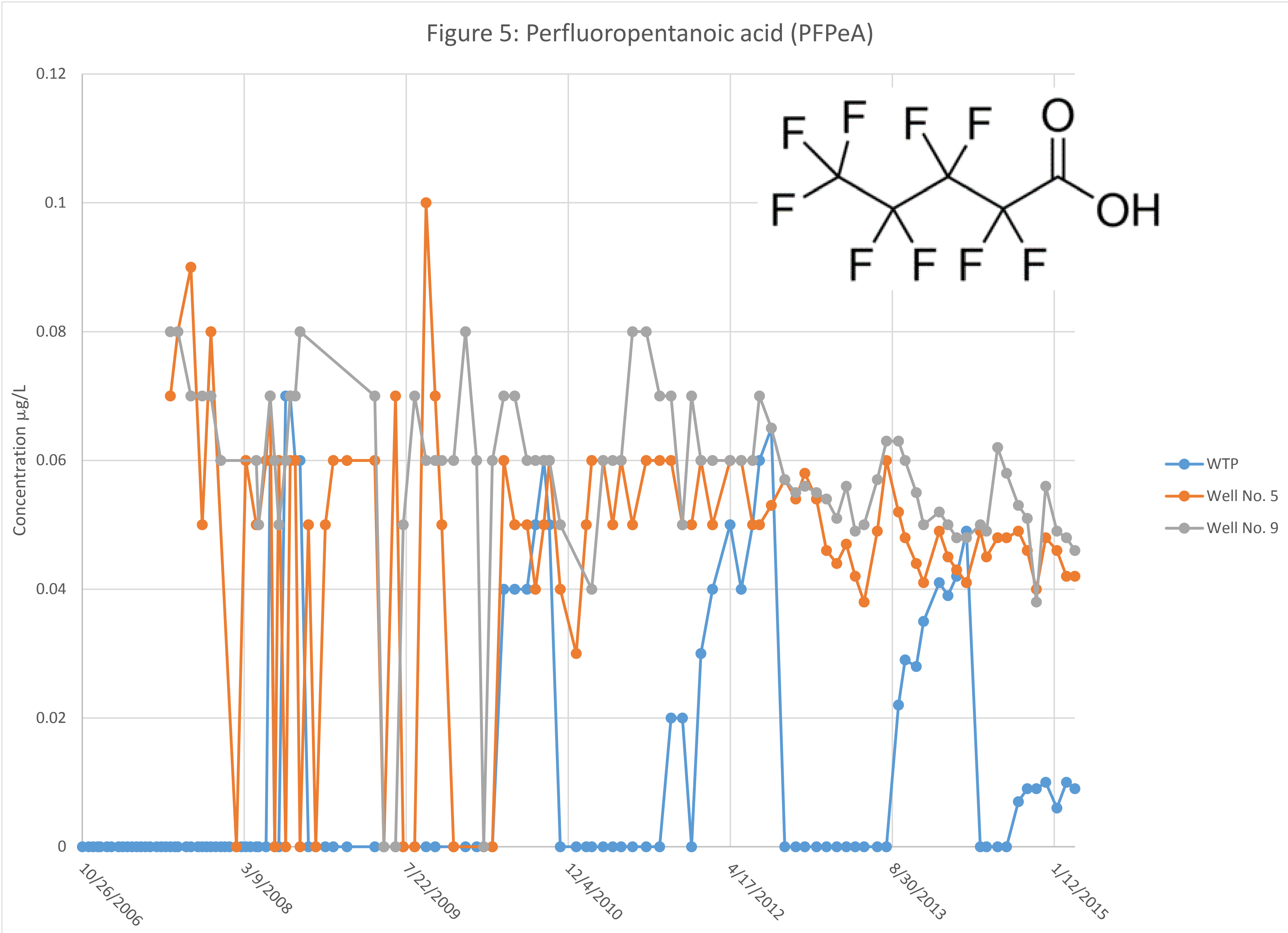


Figure 5: Perfluoropentanoic acid (PFPeA)
Concentration µg/L
0.12
0.1
0.08
0.06
0.04
0.02
0
10/26/2006
3/9/2008
7/22/2009
12/4/2010
4/17/2012
8/30/2013
1/12/2015
WTP
Well No. 5
Well No. 9

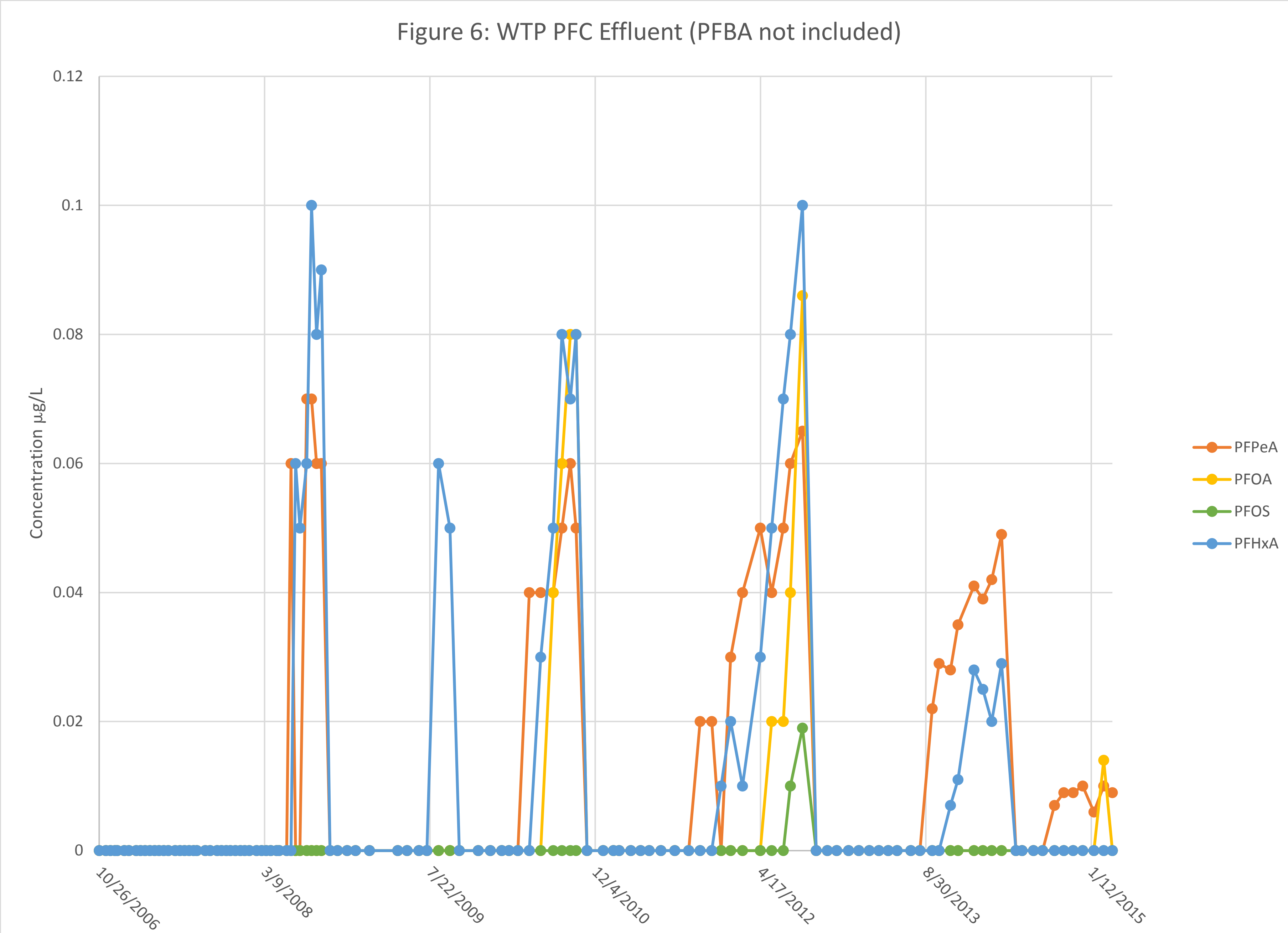


Figure 6: WTP PFC Effluent (PFBA not included)
Concentration µg/L
0.12
0.1
0.08
0.06
0.04
0.02
0
10/26/2006
3/9/2008
7/22/2009
12/4/2010
4/17/2012
8/30/2013
1/12/2015
PFPeA
PFOA
PFOS
PFHxA

Appendix D: Surface Water Treatment Rule and Process Train

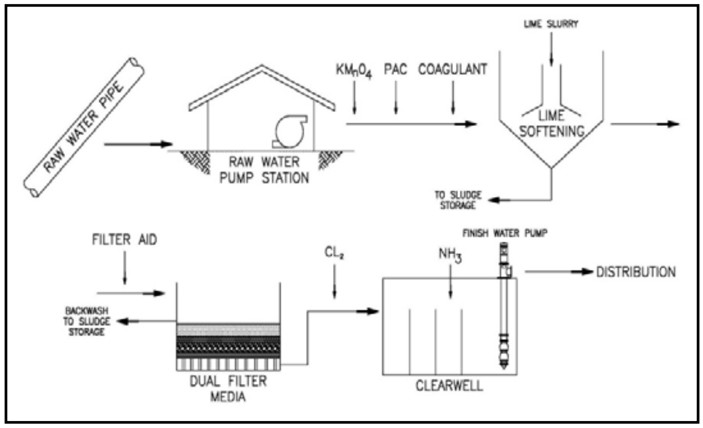
The purpose of the Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR) is to reduce illness associated with the contaminant Cryptosporidium and other disease-causing microorganisms in drinking water. Pathogens, such as Giardia and Cryptosporidium, are often found in water, and can cause gastrointestinal illness (e.g., diarrhea, vomiting, cramps) and other health risks. In many cases, this water needs to be disinfected through the use of additives such as chlorine to inactivate (or kill) microbial pathogens.

Cryptosporidium is a significant concern in drinking water because it contaminates surface waters used as drinking water sources, it is resistant to chlorine and other disinfectants, and it has caused waterborne disease outbreaks. Consuming water with Cryptosporidium, a contaminant in drinking water sources, can cause gastrointestinal illness, which may be severe in people with weakened immune systems (e.g., infants and the elderly) and sometimes fatal in people with severely compromised immune systems (e.g., cancer and AIDS patients).

The rule is intended to supplement existing regulations by targeting additional Cryptosporidium treatment requirements to higher risk systems. LT2ESWTR has the following major components:

- Source water characterization of Cryptosporidium concentrations based on a two-year long, monthly source water monitoring program for Cryptosporidium, E-Coli, and turbidity. The highest running annual average of the monitoring data will determine the bin classification for compliance.
- Bin classification for treatment requirements are shown in the Table below.
- Requirements presume that conventional treatment obtains 3.0 log removal and direct filtration obtains 2.0 log removal/inactivation of Cryptosporidium.
- Treatment requirements range from 0 to 2.5 log additional removal/inactivation of Cryptosporidium for systems utilizing conventional treatment resulting in 3.0 to 5.5 log total removal/inactivation of Cryptosporidium.
- Additional log removal credits may be achieved by utilizing multiple tools. The following list summarizes alternatives that may be implemented:
  - Watershed Control
  - Alternative Source
  - Pretreatment
  - Improved Treatment
  - Improved disinfection: Chlorine dioxide, ozone, UV
  - Peer review validation of system performance

Bin Classification	Crypto Concentration (oocysts/L)	Additional Treatment Requirements for Systems with Conventional Treatment
1	< 0.075	No Additional Treatment
2	From 0.075 - < 1.0	1 log of Additional Treatment (90%)
3	From 1.0 - < 3.0	2 log of Additional Treatment (99%)
4	≥ 3.0	2.5 log of Additional Treatment (99.7%)



The preliminary treatment process proposed for NE Metro assumes that the surface water supply will be classified as Bin 1. If additional treatment is required, a future UV and potential for chlorine dioxide addition can be implemented to assist in meeting additional treatment requirements.

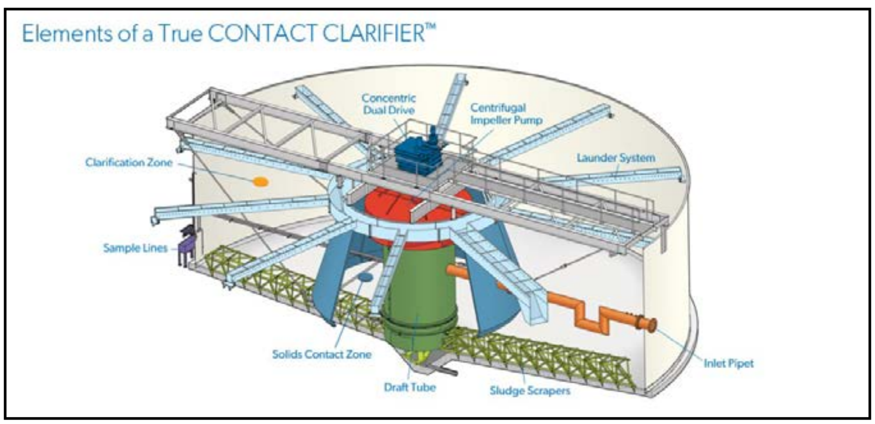
Process Train

As depicted in the process diagram, a potential process train to treat raw surface water from SPRWS includes raw water pumping, chemical addition, lime softening, filtration, and finished water pumping.

This process is very similar to other major surface water treatment plants in Minnesota including SPRWS, the City of Minneapolis, and the City of St. Cloud.

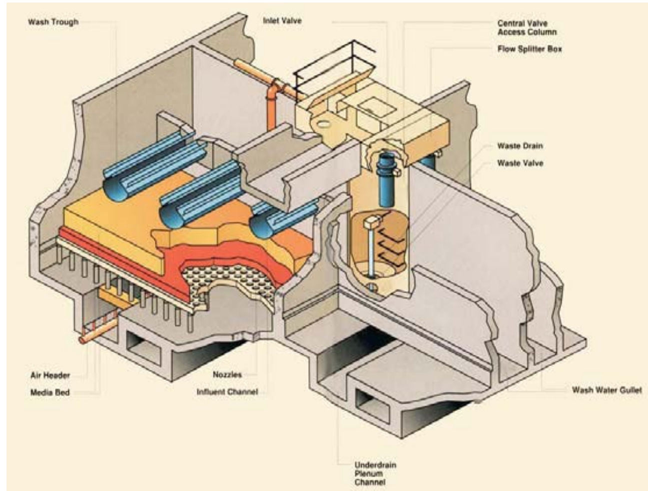
Chemical addition includes potassium permanganate ($KMnO_4$) for oxidation, powdered activated carbon (PAC) for taste and odor, and coagulant to help with floc production.

Lime Softening



Lime softening is used to reduce hardness of water prior to filtration. In addition to removal of hardness from a drinking water supply, lime softening can also remove constituents including arsenic, barium, beryllium, chromium III, copper, fluoride, lead, mercury, cadmium, nickel and radionuclides. The softening step includes the addition of quick lime (CaO) which combined with water forms hydrated lime slurry ($Ca(OH)_2$). Hydrated lime can also be used if desired. The lime slurry reacts with CO_2 to form a calcium carbonate ($CaCO_3$) precipitate. The optimum pH is around 10.3. Magnesium precipitation in the form of magnesium hydroxide ($Mg(OH)_2$) requires a pH of 11-11.3. The solids contact clarifiers (SCC) combine mixing, flocculation and sedimentation in a single basin and is typically used for lime softening. The water then passes through zones where flocculation occurs followed by clarification. Clarified water is collected in radial effluent launders which direct flow to an effluent discharge pipe. After softening, water is recarbonated to “stabilize” the water. A portion of the solids collected at the bottom of the clarifier is recirculated and serves as a seed for coagulation/precipitation process with the raw water in the contact zone.

Conventional Filtration (Conv)



Conventional filtration is considered for reduction of suspended particulates. Typical conventional filters used in water treatment are rapid, deep bed, dual media, gravity filters that utilize layers of both sand and anthracite for media. Typical depths are 12” sand and 24”-36” anthracite. Underdrains and or gravel provide the support necessary for the media. Some particles are removed simply by the mechanical process of interstitial straining. However, the filters are capable of removing particulates smaller than the interstices between filter particles. These particles are brought close enough to the surface of the media grains that inter-particle forces attach them to the media. The filter media arrangement allows for the larger particulates to be removed near the top of the media bed with the smaller particulates being retained deeper within the media bed. Typical loading rates range from 2 gpm/ft^2 to 4 gpm/ft^2. Gravity media filters require periodic backwashing depending on the pressure differential across the media. Typical backwash rates range from 12 gpm/ft^2 to 15 gpm/ft^2. The particulates removed in conventional filtration include microbial contaminants, turbidity, THM precursors, as well as those precipitates formed in pretreatment processes.

Appendix E: Evaluation of Surface Water Quality Memo

TECHNICAL MEMORANDUM

TO: Christopher Larson, PE

FROM: Brendan Wolohan, EIT

DATE: June 30, 2015

RE: Evaluation of Water Quality for Mississippi and St. Croix Rivers – Washington County Municipal Water Coalition Feasibility Assessment

The purpose of this memo is to describe the differences in water quality between the Mississippi and St. Croix Rivers and to determine an ideal location for a new surface water treatment plant within the communities that make up the Washington County Municipal Water Coalition. A large factor to consider is the raw water quality of the source water from which the proposed water treatment plant would draw from.

Water quality monitoring results were taken from the latest available Metropolitan Council Environmental Services (MCES) River Monitoring Program in 2013. A number of important water quality parameters were monitored in the Mississippi River after the Minnesota River connects at St. Paul and in the St. Croix River at Stillwater. These parameters include: turbidity, total suspended solids (TSS), E. coli, dissolved oxygen (DO), total phosphorus (TP), nitrate – nitrogen (NO_3), and chloride (Cl).

Turbidity and TSS measurements provide a representation of the amount of particulate matter in the water that will require filtration for human consumption in the water treatment process. Both TSS and turbidity concentrations in the St. Croix River are approximately half of that measured in the Mississippi River in 2013. E. coli bacteria levels indicate the presence of potentially dangerous pathogens in the water that require disinfection in the water treatment process. The presence of E. coli in the Mississippi River was more common than in the St. Croix River. Nitrogen and Phosphorus are essential nutrients for plant growth, however excess concentrations of these nutrients can lead to algae blooms and oxygen depletion. The St. Croix River has low concentrations of both TP and NO_3, again approximately half of that measured in the Mississippi River. The chloride standard for these water bodies must not exceed a 4 day average of 230 mg/L. The chloride concentrations measured in both rivers were well under the State standard, though the St. Croix River's annual average concentration of 6 mg/L is lower than the 30 mg/L concentration measured in the Mississippi River.

The water quality criteria as described above for both rivers shows that the St. Croix River has lower concentrations of key water quality parameters when compared to the Mississippi River.

Appendix F: Conjunctive Use Memo

Date: June 6, 2014

To: Chris Larson - SEH
Colin Fitzgerald - SEH

From: Greg Harrington

Re: Evaluation of water quality issues for the Northeast Metro Water Supply Feasibility Assessment

The purpose of this memo is to provide you with my conclusions on the water quality aspects of delivering water from St. Paul Regional Water Services to the suburban communities in the northeast Twin Cities metro area. This is qualitative in nature.

Water quality issues will be driven by a number of factors, including the manner in which SPRWS water is delivered to the communities. The following are possible alternatives

- Abandonment of existing wells with complete conversion to water from SPRWS, or placement of existing wells onto a status of emergency use only.
- Mixing of existing well water with water from SPRWS prior to delivering SPRWS water into the distribution system. This memo only focuses on the water quality aspects of this approach, without covering how this would be done from a hydraulics or construction perspective, and without quantifying costs.
- Retaining existing wells and their entry points while introducing SPRWS water into the distribution system at a separate entry point. This memo does not attempt to identify the most plausible entry point of SPRWS water to each community's distribution system.

As noted later, the communities are strongly encouraged to implement the same distribution system disinfection strategy as SPRWS, which is likely to be chloramination for an extended period of time. For communities that switch from chlorination to chloramination, all three of these alternatives are technically feasible for reaching acceptable water quality targets and the best approach can be decided on a community-by-community basis. For example, those communities with existing treatment facilities for their groundwater sources may find the second option more feasible because they would give up a substantial capital investment to implement the first and third of the above alternatives and they have a potential centralized location to implement the second of the above alternatives. The distance of the community treatment plant from the SPRWS system may influence the decision as well. Those communities without existing treatment facilities may find the first and third options more feasible, due to the cost of reaching a centralized location for the second option.

All of the above could be performed by purchasing treated water from SPRWS or by purchasing untreated water from SPRWS and building a new water treatment plant. For purposes of this assessment, it was assumed that a new water treatment plant would have a similar set of treatment processes as the current SPRWS facility and, therefore, would produce water of similar quality to the existing treatment plant. Thus, this memo assumes that the water quality issues will be independent of the entity providing treated water from the chain of lakes. There are some implications to this assumption. For example, it assumes that SPRWS' ten wells, which are fed into the raw water pipeline between Vadnais Lake and the McCarron WTP, are included in both scenarios.

The remainder of this memo will cover water quality issues on a parameter-specific basis, giving consideration to the three alternative approaches noted above.

Waterborne Pathogens, Disinfection Byproducts and Disinfection

For all three alternatives noted above, the northeast metro communities will transition from rules focused on enteric viruses to rules focused on *Cryptosporidium*, *Giardia*, *Legionella*, *E. coli*, and enteric viruses. Most of the effort needed to manage these water quality concerns is done at the surface water treatment plant, so it is unlikely that the northeast metro communities will be directly involved in this aspect of regulatory compliance. However, the northeast metro communities will transition to a new water supply that has significant potential to form trihalomethanes (THMs) and haloacetic acids (HAAs) when free chlorine is used as a disinfectant. The northeast metro communities will need to continue the maintenance of a disinfectant residual in the distribution system. However, SPRWS meets these standards with chloramines as their distribution system disinfectant while the northeast metro communities currently use free chlorine as their distribution system disinfectant.

The difference in disinfectant raises a number of potential issues for the northeast metro communities. The first of these to consider is breakpoint chemistry, which accounts for the interaction between free chlorine, free ammonia, and chloramines. This chemistry will be explained in more detail in a follow-up report. For the purposes of this memo, this chemistry has implications for the blending of chloraminated SPRWS water with chlorinated water and the implications depend on the approach used to incorporate SPRWS water into the water supply:

- If the wells are abandoned or placed off-line for emergency purposes only, then the northeast metro communities are committing to a conversion from free chlorine to chloramines. With respect to breakpoint chemistry, there will be a short and temporary loss of disinfectant residual at locations in the distribution system. For a location that is one day of residence time downstream of the SPRWS entry point, this loss of residual would likely occur at approximately one day after the SPRWS water is turned on.
- If chloraminated SPRWS water is blended with chlorinated well water prior to distribution system, some loss of disinfectant will occur in the blending tank. To avoid this, it is strongly recommended that well water be introduced to the blending tank with no disinfectant applied upstream of the blending tank. Chlorine and ammonia should be added to the blending tank at a ratio needed to achieve a chloramine residual sufficient to survive the entire residence time of the distribution system.
- If chloraminated SPRWS water is introduced via a separate entry point from chlorinated well water, then there will be areas of the distribution system with little to no disinfectant residual. This will be a permanent issue, unlike the temporary issue associated with the first alternative. Although there are some utilities, notably in southern California, that follow this approach while complying with regulatory standards, it is strongly recommended that the northeast metro communities avoid this by converting to chloramines at the wells. Compliance monitoring for disinfectant residuals and coliform presence does not produce a sufficient number of samples to adequately capture the nature of the problem. Conversion to chloramines would require the installation of an ammonia feed system at each entry point to the distribution system.

As noted above, the northeast metro communities are advised to switch to chloramine disinfection once SPRWS water is introduced to the distribution system, regardless of approach used to implement SPRWS water. Of the three alternatives, the first would require less monitoring, offer easier control of chloramine residuals, and require the operation and maintenance of fewer chemical feed systems. However, all three are technically feasible and the best approach can be decided on a community-by-community basis.

Conversion to chloramines raises some additional water quality issues, to include but not be limited to the following:

- **Nitrification.** Nitrification is the conversion of free ammonia to nitrite by ammonia oxidizing bacteria (AOB). Although AOB are not pathogenic, the nitrite they produce can deplete the chloramine residual. This requires careful monitoring of disinfectant residuals, free ammonia residuals, and areas of the distribution system with long residence times. Data from SPRWS suggest that residence times of 10 days or longer are a significant concern. Implementation of distribution system hydraulic models can help identify areas of concern. Minimizing thermal stratification in storage tanks is an important strategy for managing nitrification events, and the communities will want to consider alternatives for doing this.
- **Microbial counts.** Conversion to chloramines can potentially introduce relatively high disinfectant residuals to areas of the distribution system having historically low disinfectant residuals. This may produce a temporary increase in microorganism counts as the system re-equilibrates to the new disinfectant. Again, careful monitoring is needed to manage this issue.
- **Corrosion chemistry.** The pipe surfaces in the distribution system will need to re-equilibrate to the new redox potential and this could lead to changes in corrosion of lead, copper, and iron pipe materials. Changes are difficult to predict. Although Washington DC was infamous for an increase in lead concentrations after converting from chlorine to chloramines, other utilities have made the conversion without such an issue. Careful monitoring will be needed to understand what changes take place and what control strategies are best implemented, with the understanding that time to equilibration may be more than a year.

- **Toxicity to fish.** The free ammonia present in chloraminated systems is of concern for residents with aquariums containing fish that are sensitive to free ammonia. The communities will need to implement a public education campaign to manage this concern.

Chloramination can be avoided if steps are taken at the treatment plant to remove more natural organic matter (NOM) that is present in the surface water. A sufficient amount of removal would be needed to keep THMs and HAAs below regulatory limits while using free chlorine as the distribution system disinfectant. This would require technologies at a significantly higher cost than currently used to achieve THM and HAA compliance. Implementation of this alternative would require regional cooperation on expectations for water quality and willingness to pay for that water quality.

Lead, Copper and Iron from Pipe Corrosion

As noted above, conversion from free chlorine to chloramines is expected to have some impact on lead, copper, and iron release from pipe corrosion. The concentration of these metals is also dependent on pH, alkalinity, hardness, sulfate concentration, and chloride concentration. For the northeast metro communities, a switch to water from SPRWS will come with a reduction in alkalinity and hardness, but with increased pH as well as increased sulfate and chloride concentrations.

As with the change in disinfectant, changes in these parameters are likely to have site-specific effects on the concentrations of lead, copper, and iron. A study in the Tampa Bay area showed that decreased alkalinity was associated with more iron release but with less lead and copper release. The same study showed that increased sulfate concentration was associated with increased iron release but decreased lead release.

These conflicting concerns suggest that utilities serving the northeast metro communities may wish to participate in some water quality monitoring and testing projects prior to implementation of SPRWS water. This could help utilities anticipate needed changes to corrosion control programs, especially the polyphosphate approach used by ten of the communities. It is important to note that equilibration may take more than a year for precipitation/dissolution processes like those encountered in metals release from pipe surfaces.

As noted earlier, the strategy employed for implementation of SPRWS water will influence changes in water quality. For example, abandonment of existing wells or blending of groundwater with surface water at the entry point to the distribution system will produce a change in water chemistry throughout the distribution system. Using separate entry points for surface water and groundwater will mitigate the widespread nature of the change, but will make changes more difficult to monitor and predict.

Hardness, Iron and Manganese from Source

At the present time, four communities provide oxidation and filtration for iron and manganese removal from their groundwater source and two of these also provide facilities for hardness removal. Eight communities use sequestration to limit iron and manganese precipitation in the distribution system. SPRWS water contains less hardness, iron and manganese than the groundwater sources at the northeast metro communities, which should benefit from this change.

Abandonment of existing wells or blending of groundwater with surface water at the entry point to the distribution system will allow communities using sequestration to abandon or reduce the need for that treatment strategy. A similar statement can be made for those communities using oxidation and filtration, although the costs of doing so may not be practical. Using separate entry points for surface water and groundwater will also reduce the costs of treating the groundwater source by oxidation/filtration or by sequestration.

Taste and Odor

Customers in the northeast metro communities can expect taste and odor properties to change for two reasons. First, many customers will detect a change in taste and odor due to the change in disinfection strategy. Second, there is a possibility that customers will notice the naturally-occurring tastes and odors associated with the surface water supply. The primary culprits for the latter are geosmin and methylisoborneol (MIB). SPRWS has done an extensive amount of work to reduce complaints associated with geosmin and MIB, with granular activated carbon as a key component of the treatment plant. Nevertheless, the communities will likely need to invest in a public education campaign to educate their customers about the change.

Conclusions and Recommendations

At this time, the primary conclusions and recommendations for implementing SPRWS water in the northeast metro communities are as follows:

- Blending chloraminated SPRWS water with chlorinated groundwater will create loss of total chlorine residual. The northeast metro communities are strongly encouraged to switch to chloramination for distribution system disinfection. Public education programs should be implemented to manage concerns with changing taste and odor properties of the water and with aquarium owners.
- Blending SPRWS water with groundwater will change the chemistry of the bulk water in the distribution system, and is expected to change release of lead, copper, and iron from pipe materials. The northeast metro communities are encouraged to participate in treatment studies that elucidate potential changes prior to implementation of SPRWS water.
- There are several alternatives for incorporating SPRWS water at each community:
    - Complete switch to SPRWS water
    - Blending groundwater with SPRWS water prior to the distribution system entry point.
    - Introducing SPRWS water and groundwater at separate entry points to the distribution system.
- The above alternatives should be considered on a case-by-case basis for each community, taking costs into consideration. All are capable of meeting accepted water quality targets, provided that the communities convert to chloramines.

Appendix G: Potential Saint Croix River Appropriation Permitting Requirements

STATE OF MINNESOTA

Office Memorandum

MNDNR

DEPARTMENT: Natural Resources – Division of Ecological and Water Resources

DATE: August 4, 2015

TO: N&E Metro GWMA Project File

FROM: Paul F. Putzier, DNR

SUBJECT: Draft Notes on Potential Permitting & Reviews required for water appropriation from the Lower St. Croix River.

DNR has been asked during the course of public open houses for the N&E Metro GWMA and from interested individuals whether water could be appropriated from the Minnesota side of the Lower St. Croix River (LSCR) to be used as a public water supply source, and if so what permits would be needed. The answer to the question is highly dependent on the specifics of the project (location, amounts requested, structures, etc.). However, based on information from several sources in the DNR and individuals outside the DNR, the current regulatory environment does not preclude the appropriation of water from the LSCR, but there are a number of permits that would be required, and a number of agencies that would need to review and approve the proposed projects, potentially including state and federal environmental reviews (e.g. EAW, EIS). In general the consensus is that there would be a "high bar" to get an appropriation approved, but it is possible depending on the project specifics.

The following notes are not complete, but may provide a starting place for individuals with more specific questions or projects. These notes reflect a project proposed for the Minnesota side of the river. Wisconsin may have additional requirements.

Contacts/Organizations:

These are some miscellaneous contacts or organizations that will have some information about appropriation permitting and applicable land use regulations on the Lower St. Croix River.

- Joe Richter, DNR Appropriation Permitting Specialist, Joe.Richter@state.mn.us, 651-259-5877
- Jen Sorensen, DNR Area Hydrologist, jenifer.sorensen@state.mn.us, 651-259-5754
- Jennifer Shillcox, DNR Land Use Programs Supervisor, jennifer.shillcox@state.mn.us, . 651-259-5727
- Randall Doneen, DNR Environmental Review Supervisor (EIS), Randall.Doneen@state.mn.us, 651-259-5156
- John Gleason, DNR Public Waters Hydrologist, john.gleason@state.mn.us, 651 259-5725
- Rich Baker, DNR Endangered Species Coordinator, richard.baker@state.mn.us, 651-259-5073
- Randy Ferrin, St. Croix River Association, rsferrin@frontiernet.net
- Jill Medland, National Park Service, jill_medland@nps.gov, 715-483-2284. Also with Lower St. Croix Management Commission
- Corp of Engineers
- US Fish & Wildlife

- Washington Conservation District, Jay Riggs, jay.riggs@mnwcd.org
- Local Watershed Districts
- Local Municipal Governments (county, city & township)

Selected Permit History

Active Permit

There is currently only one active, permitted appropriation from the LSCR on the Minnesota side – that is for the Xcel King Plant in Bayport. It is permit #1964-0865. There is nothing in the file that points to others that might be involved in permitting review. This is a 'non-consumptive use' permit originally from the 1960s.

Inactive Permits

Older, inactive appropriation permits for the Lower St. Croix River include:

- 1975 – Sod farm in Chisago Co.
- 1973 – Crop irrigation in Washington County
- XX – Unnamed Corporation. No additional information in MPARS.
- XX – Agricultural use in Washington Co. No additional information in MPARS.

Potential Permitting Issues

DNR

- A water use (appropriation) permit from DNR Waters is required for all users withdrawing more than 10,000 gallons of water per day or 1 million gallons per year. (MS 103G). http://www.dnr.state.mn.us/waters/watermgmt_section/appropriations/permits.html

- A DNR public waters work permit would be required because of changes in course, current and cross-section. The Conservation Assistance and Regulations (CAR) Section oversees the administration of the Public Waters Work Permit Program. This program, begun in 1937, regulates water development activities below the ordinary high water level (OHWL) in public waters and public waters wetlands. These areas are identified on maps available for viewing at numerous locations, including the DNR web page. Examples of development activities addressed by this program include construction of water intake structure, filling, excavation, shore protection, bridges and culverts, structures, docks, marinas, water level controls, dredging, and dams. Field staff serve as the primary contacts for this program, and most activities can be authorized at either DNR regional offices. http://www.dnr.state.mn.us/waters/watermgmt_section/pwpermits/index.html

- DNR Endangered Species Permits: Minnesota's endangered species law (MS 84.0895) and associated rules (Chapter 6212.1800 , 6212.2300 and 6134) impose a variety of restrictions, a permit program, and several exemptions pertaining to species designated as endangered or threatened. http://www.dnr.state.mn.us/nhnrp/endangered_permits.html

Other Potential Permits & Reviewers

- Corp of Engineers (permit for in water activity)
- Washington County or Chisago County
- Particular Watershed Districts (review)
- MDH: water treatment plant review, and 100-year flood
- National Park Service (review and could request Federal environmental review)
- US Fish & Wildlife Service (review and could request Federal environmental review)
- Washington Conservation District
- Local Municipal Governments (county, city & township)
- St. Croix Basin Team, the Lower St. Croix Management Commission (LSCMC), and the Technical Committee and Partnership Team.

Initial Comments

These are some initial comments from several experts about what might be involved in permitting and review of a water appropriation project from the Lower St. Croix River.

Randy Ferrin, St. Croix River Association, rsferrin@frontiernet.net

Randy was Vice-President of the St. Croix River Association from 2005 and President in 2007. He formerly served on the Board of Trustees of Standing Cedars Community Land Conservancy, and as a Commissioner on the Washington County Parks and Open Space Commission. He is retired after nearly 33 years of service with the National Park Service and the U.S. Forest Service. His last assignment was the Chief of the Natural Resources Division for the St. Croix National Scenic Riverway, where he worked from 1994 to 2005. While in this position he chaired the interagency St. Croix Basin Water Resources Planning Team from 1995 until his retirement and he continues his involvement with the Basin Team today.

His notes: Because getting water out of the river would require work on the banks and bottom of the river for the intake structure and pipeline, the National Park Service and the Corps of Engineers would be involved. The Corps for a permit, and the NPS for evaluation of the project's potential direct and adverse impacts to the river, under Section 7(a) of the Wild and Scenic Rivers Act. The US Fish and Wildlife Service would also be consulted because of the potential impacts to endangered species (primarily mussels). The local NPS contact is Jill Medland at the St. Croix National Scenic Riverway office in St. Croix Falls. She can also direct you to the proper person at the Corps and the US Fish and Wildlife Service, and if appropriate, with someone at the NPS Water Rights Branch. I'm sure the NPS Water Rights Branch (Fort Collins, CO) would also weigh in on an application. The Water Rights Branch provides consulting to NPS across the nation on issues related to water use in the parks.

My understanding of the river's water quality is that the high dissolved organic carbon makes it unlikely for use as a drinking water source because of the high cost of treatment.

Other entities that would probably be involved: the local Watershed District or Watershed Management Organization, and your own agency for a permit for work on the banks and bottom (besides the appropriation permit itself).

Jennifer Shillcox, DNR Land Use Section Supervisor

Jen Sorensen, the Area Hydrologist who works with the LSCR communities on water permitting issues is most likely be able to help you with this question. There is a 2002 cooperative management plan for the LSCR developed by MN DNR, WI DNR, and NPS; the focus of the plan is on land use and to a lesser extent water surface use; I don't believe there are any management/multi-agency oversight provisions for water appropriation permitting in the plan, but I could be wrong on that.

You may also want to check with Randall Doneen (DNR) to see if federal or state wild and scenic river designation triggers a mandatory EIS for water appropriations; I don't think so, but he would know for sure.

Molly Shodeen, Retire DNR Area Hydrologist

This discussion came up once when Afton Alps was looking at possibly taking water for snow making, but the tannin makes it undesirable. As far as appropriation from rivers for water supply, I am only aware of the St.Paul and Mpls intake permits for the regional water works, not sure if it would trigger environmental review or not. The structures would need Corps and DNR permits for sure, maybe watershed. I'm not aware of any specific additional requirements because it is wild and scenic. I'm sure the rules never anticipated or contemplated such a possibility. Our mussel people would be part of the review of public water permits but not appropriation unless specifically asked for some reason, such as the taking/moving of infested water which might need a separate permit. For the list of contacts, I would also add the St. Croix River Association. It also could happen in Chisago County, so you would need that conservation district contact too. I would add the St. Croix Basin Team, and the Lower St. Croix Management Commission, Technical Committee and Partnership Team if it ever came to fruition. The LSCMC and Technical Committee meet on call, approximately annually.

Randy Doneen, DNR Environmental Review Supervisor

There do not appear to be requirements for a mandatory EAW. However, there are several ways that an EAW or EIS could be triggered for such a project on the Lower St. Croix River. EAW Triggers that might apply (Minnesota Administrative Rule 4410.4300, Environmental Review) include:

- Wetland Impacts related to change in course, current or cross sections for disruption of wetland along shore line.
- Also, when changes in course, current, cross section within designated Wild and Scenic River.
- Work within waterway exceeding an acre.

- Water Appropriations
    - When new appropriation for commercial/industrial use exceeds 30 MGD. This could apply for larger cities.
- Discretionary EAW could be triggered by:
    - Citizens petition
    - RGU can decide to order/request an EAW
    - Project proposers can request an EAW
- Federal NEPA may apply
    - For any projects requiring a federal permit, or on federal land, a Federal EIS may be required.
    - Permits could include those by COE, National Park Service, Fish & Wildlife Service
    - The need to complete a federal environmental review is often a 'judgement call' by the agencies.

Rick Baker, DNR Endangered Species Coordinator

Two federally listed endangered mussel species and over 20 mussel species listed by Minnesota as threatened or endangered means a review would be required, and depending on the project specifics, might require a DNR Endangered Species Permit.

If a Corp of Engineers permit is required, the US Fish & Wildlife Service may also require a Federal Endangered Species permit, and/or and environmental review.

Jill Medland, Chief of Resource Management (Acting), St. Croix National Scenic Riverway
401 Hamilton St., St. Croix Falls, WI 54024. 715-483-2284. jill_medland@nps.gov

For a city to appropriate water from the Lower St. Croix would require, at minimum, a permit from the Corps of Engineers, a Section 7(a) evaluation and determination under Section 7(a) of the Wild and Scenic Rivers Act (WSRA) from the NPS, and consultation with the US Fish and Wildlife Service under Section 7 of the Endangered Species Act.

Section 7(a) states that no federal agency can give a permit if permit results in direct and adverse effects on the protected values. If the NPS review found that direct & adverse effects would result, the COE could not issue the needed permit. Values include protected mussel populations and recreational use, and others.

NPS would take a very hard look at any proposal to appropriate water from the Lower St. Croix River. It is likely the NPS would steer the COE toward conducting an EIS.

I'm glad to hear that MnDNR is already considering the need for an EIS as any such proposal would be precedent setting and controversial. The NPS would need to be closely involved in any EIS for a water appropriation because of our jurisdiction by law under Section 7(a) of WSRA.

SECTION 7. Wild & Scenic Rivers Act
(a) The Federal Power Commission shall not license the construction of any dam, water conduit, reservoir, powerhouse, transmission line, or other project works under the Federal Power Act (41 Stat. 1063), as amended (16 U.S.C. 791a et seq.), on or directly affecting any river which is designated in section 3 of this Act as a component of the national wild and scenic rivers system or which is hereafter designated for inclusion in that system, and no department or agency of the United States shall assist by loan, grant, license, or otherwise in the construction of any water resources project that would have a direct and adverse effect on the values for which such river was established, as determined by the Secretary charged with its administration. Nothing contained in the foregoing sentence, however, shall preclude licensing of, or assistance to, developments below or above a wild, scenic or recreational river area or on any stream tributary thereto which will not invade the area or unreasonably diminish the scenic, recreational, and fish and wildlife values present in the area on the date of designation of a river as a component of the National Wild and Scenic Rivers System. No department or agency of the United States shall recommend authorization

Stephanie Souter, Planner, Washington County Public Health & Environment. 651-430-6701, stephanie.souter@co.washington.mn.us

For the category of "Local Municipal Governments (city & township)" or "Local municipal zoning & building" depending on where an intake and structure might be located, the county could be the regulatory entity for shoreland and/or Lower St. Croix National Riverway District permitting. County public works/land management are responsible for implementing shoreland and/or Lower St. Croix National Riverway rules in the townships, in partnership with the townships.

Permits

This is a partial list of potential permits required to obtain water and build structures in the Lower St. Croix River:

- Standard DNR appropriation permit
- DNR Public Waters Work permit
- DNR Endangered Species Permits
- Corp of engineers permit for any in-water structures. Could request an EIS.
- Local municipal zoning & building (county, city, township)

Reviews

- EIS - Not triggered automatically, but could be required depending upon the project specifics.
- NPS (Rivers Branch and SRCNSW)
- NEPA – Federal EIS may be required

- Washington Conservation District
- Local Watershed Districts/WMOs
- Local Municipal Governments (county, city & township)
- USFWS – protected clams and wildlife

Reference Materials

- 103F.351 Lower Saint Croix Wild and Scenic River, state designation.
- 103G: Work Affecting Public Waters; Water Diversion and Appropriation
- Cooperative Management Plan, Lower Saint Croix National Scenic Riverway, January 2002 (http://www.rivers.gov/documents/plans/lower-st-croix-plan.pdf)
- Federal Wild & Scenic Rivers Act. http://www.ferc.gov/legal/fed-sta/wsr-act.pdf

Appendix H: TAC Comments

Contributor	Comment	Response
City of Lake Elmo	From our review we would like to communicate the following technical correction for the study. Alternative 6F proposes to add Lake Elmo to SPRWS in conjunction with alternative 6E. The study identifies a blending station to be located in Lake Elmo in the Old Village area. The blending station needs to be located near the intersection of 27th Street North and CSAH 13 (Ideal Avenue). This location will lower the infrastructure costs required for this alternative.	This comment has been incorporated.
City of Oak Park Heights	I believe it generally represents the conversations held to explore a very large broad picture – and very early preliminary concepts for options for alternative water sources – other than the Jordan (or other) aquifer.	No response required.
City of Oak Park Heights	The document is missing an “executive summary” and should be crafted and inserted.	An executive summary has been included.

Contributor	Comment	Response
City of Oak Park Heights	As expected the document can only begin to make some broad generalizations on costs, funding sources and rate impacts. None of which are meant at this stage to be directive of a specific policy and/or represent approval by those entities that participated in the study. Perhaps I missed it, but I would like a clear statement that says no particular proposal that may be included in the document is advocated, supported nor is advanced with this study.	The following statement is included in the report "This study is not meant to provide prescriptive solutions to be implemented. It is meant to provide communities concept level costs and considerations for various water supply approaches."
City of Oak Park Heights	The document does not provide a detailing or a deep explanation of the so-called "problem" it is meant to address. While the STUDY OBJECTIVES seem fairly stated, however, there is not a clear antecedent to why this study was undertaken. This should be better explained and included.	A "problem statement" has been added.
City of Oak Park Heights	The document should include a clear statement that the State nor any other entity with such authority has not provided clear targets for ground water use and accordingly the application of any of the included alternatives - regardless of who funds these - would have an unknown impact towards the current levels of the aquifers in question – what is sustainable? There is a short nod to that concept on Page 2, but is the crux of the issue and needs to be answered in a clear fashion.	Comment noted.

Contributor	Comment	Response
City of Oak Park Heights	On page 2, the following statement is unsubstantiated and or is unclear: "In addition, communities participating in this study are interested in implementing more active conservation programs. Other investigations are being considered to assess the potential for conservation to reduce future groundwater use and decrease the aquifer drawdown."	This statement has been modified slightly to indicate that "some" of the Coalition communities have expressed an interest in more active conservation programs.
City of Oak Park Heights	On page 4, HOW do you know this..provide documentation and support for this statement: "Future water demands may not be met by current groundwater appropriations."	Water projections indicate that existing appropriations will not be sufficient to meet future demands for some of the communities.
City of Oak Park Heights	Section 9.5 is so critical…yet it seems relegated to an afterthought…This section needs more work and highlight.	Water conservation was not included in the original scope of this report.

Contributor	Comment	Response
City of Pak Park Heights	Section 9.6: These timeframes are unrealistic, especially for use of St. Croix River water. Permitting and public engagement alone would be 3-5 years. Not to mention funding and construction. Revise to be more pragmatic.	This paragraph was modified slightly to be more pragmatic.
City of St. Paul Park	**<u>Alternative 4B (Page 35) – Conjunctive Use of Ground Water and Surface Water with 25 MGD Mississippi River Surface Water Treatment Plant to Serve St. Paul Park</u>** 1. The City currently controls its water quality. Obtaining water from a coalition operated surface water treatment plant would relinquish this control to the entire coalition while the City would not be able to address water quality changes like it currently does with its existing groundwater supply water system. As stated in the report, conjunctive use of surface water and groundwater will likely result is taste and odor differences, requiring a public education program and a switch from chlorine to chloramines for disinfection. The costs of this program and switch should be addressed and included in the study. In addition, drinking water produced from a surface water treatment plant water treatment plant would likely contain higher levels of disinfection byproducts (Haloacetic Acids, Total Trihalomethanes, etc.) which is a concern to the City.	Comment noted.

Contributor	Comment	Response
City of St. Paul Park	**Alternative 4B (Page 35) – Conjunctive Use of Ground Water and Surface Water with 25 MGD Mississippi River Surface Water Treatment Plant to Serve St. Paul Park** 2. Surface waters, such as the Mississippi River, commonly contain emerging contaminants' which could pose a water quality concern if the EPA establishes MCLs for these constituents within the water. For example, pharmaceuticals are currently being studied by the EPA and could possibly require further treatment in the future for drinking water that stems from a surface water supply. How would the proposed surface water treatment plant treat emerging contaminants and how would this additional treatment affect the current estimated costs?	Comment noted.

Contributor	Comment	Response
City of St. Paul Park	**<u>Alternative 4B (Page 35) – Conjunctive Use of Ground Water and Surface Water with 25 MGD Mississippi River Surface Water Treatment Plant to Serve St. Paul Park</u>** 3. St. Paul Park's water utility rates include a minimum charge of $27.32/quarter for the first 9,000 gallons used, $2.48 per 1,000 over 9,000 gallons, $2.75 per 1,000 over 25,000. The estimated unit cost for Alternate 4B is $3.60 per 1,000 gallons which does not include maintenance of the existing coalition's infrastructure. Since the City's water supply costs to pump groundwater are minor with respect to the cost of maintaining the City's overall water distribution system, the City would likely need to charge close to its current water rates in order to maintain its existing distribution system. Therefore, the City anticipates that its water rates would be increased to approximately $6 per 1,000 gallons after figuring in the report's estimated unit cost of $3.60 to operate and maintain the surface water treatment plant. This water rate would be one of the highest, if not the highest water rate in Minnesota which is a major concern to the City. In addition, the example cost sharing model on Page 82 estimated a unit cost of $5.64 per 1,000 gallons of water for Alternative 4B which would be 76% more than what St. Paul Regional Water Services (SPRWS) currently charges its retail customers. SPRWS customers currently pay $3.20 per 1,000 gallons. To bring the costs for the Alternative 4B communities down to $3.20 per 1,000 gallons, the report states that the utility would need to be subsidized by $2.44 per 1,000 gallons (approximately $16 million per year). The report further states that if the capital cost of the project ($212,700,000) were covered by another funding source, the estimated cost of water from the new utility would be close to SPRWS' rates. What other funding sources would be available to cover these additional costs and what is the likelihood that funding would be obtained by the coalition to avoid major water rate increases for each City?	Comment noted.

Contributor	Comment	Response
City of St. Paul Park	**Alternative 4B (Page 35) – Conjunctive Use of Ground Water and Surface Water with 25 MGD Mississippi River Surface Water Treatment Plant to Serve St. Paul Park** 4. The potential exists for hazardous materials to spill into the Mississippi River, either from tanker trucks, rail cars, storm sewers or other sources along the river. How would the proposed surface water treatment plant prevent these hazardous chemicals from entering the plant after a spill occurs? What would happen if contaminants from a spill entered the plant and how would the surface water treatment plant treat these contaminants?	Comment noted.
City of St. Paul Park	**Alternative 4B (Page 35) – Conjunctive Use of Ground Water and Surface Water with 25 MGD Mississippi River Surface Water Treatment Plant to Serve St. Paul Park** 5. The draft report incorrectly states that St. Paul Park chlorinates it's water supply. Only fluoride is added at the water production well house locations.	This correction has been incorporated.

Contributor	Comment	Response
City of St. Paul Park	**<u>Alternative 4B (Page 35) – Conjunctive Use of Ground Water and Surface Water with 25 MGD Mississippi River Surface Water Treatment Plant to Serve St. Paul Park</u>** 6. The City has an aging water distribution system with an approximate average age of 50+ years and cast iron pipe, and the estimated cost of future replacement needs already far outweighs existing or any projected available funding. A change of water chemistry as proposed with the coalition plan, including the addition of chlorine that is currently not present, is concerning to the City as it may adversely affect existing pipes and lateral pipe services, release chemical deposits on existing pipes into the water supply, and advance deterioration or decay of existing infrastructure. There is no additional funding or financial consideration included in the study to account for pipe replacement, lateral service replacement, or other infrastructure replacement of St. Paul Park's existing water distribution system that may be made necessary or advanced in schedule as a result of the coalition plan included in the study. How is this proposed to be addressed by the proposed coalition plan?	Comment noted.
City of St. Paul Park	**<u>Alternative 4B (Page 35) – Conjunctive Use of Ground Water and Surface Water with 25 MGD Mississippi River Surface Water Treatment Plant to Serve St. Paul Park</u>** 7. The draft report incorrectly states the number of active municipal wells in St. Paul Park. Well No. 1 was sealed in 2011.	This correction has been incorporated.

Contributor	Comment	Response
City of St. Paul Park	**<u>Alternative 4B (Page 35) – Conjunctive Use of Ground Water and Surface Water with 25 MGD Mississippi River Surface Water Treatment Plant to Serve St. Paul Park</u>** 8. In a regional context, St. Paul Park's municipal water supply wells lie close to the Mississippi River. What modeling or other hydrogeological study information supports the implication that including St. Paul Park in the water supply coalition in Alternative 4B has any impact on groundwater sustainability? Groundwater sustainability is a concept that St. Paul Park supports,, locally, and also at a regional and more global level. However, the feasibility of regional goals for groundwater sustainability as examined in the draft study, including the financial feasibility for capital investment and long term operation and maintenance costs, must be supported those changes and investments also at the local level. Without study to show otherwise, any groundwater not pumped to serve the highest and best use of municipal water supply prior to flowing into the Mississippi River, is potentially lost to downstream uses, out of the groundwater study region, and potentially out of the State of Minnesota. St. Paul Park's municipal pumping of groundwater is insignificant in comparison to other developing communities within the study area much further away from the Mississippi River, and insignificant in comparison to other industrial groundwater appropriations not included in the study. These items should be more thoroughly addressed, compared, and contrasted in the study to support the costs and negative impacts that can go along with the coalition proposition.	Comment noted.

Contributor	Comment	Response
Washington County	General: The final Report should include an executive summary which provides background information and highlights from each of the alternatives studied. The executive summary should make use of Plain Language principles, where possible, so that elected and appointed officials, along with the general public, can better understand the objectives and results of the study.	An executive summary has been included.
Washington County	General: The executive summary, along with the full report, should also include a more comprehensive description of the problem itself – that is, why the report is being done in the first place. Though the Report evaluates various alternatives, it should also be made clear that the Report itself is not advocating for a particular solution, at this point and time	A "problem statement" paragraph has been added to the executive summary and the report. The following statement is included in the report "This study is not meant to provide prescriptive solutions to be implemented. It is meant to provide communities concept level costs and considerations for various water supply approaches."
Washington County	General: The Council should also consider a disclaimer statement regarding maps contained within the Report, that the locations of any lines, structures or other proposed infrastructure are approximations and do not reflect final or absolute locations.	A disclaimer has been added to the Assessment Methods paragraph in Chapter 1.

Contributor	Comment	Response
Washington County	Chapter 1: There should be a statement that clarifies the approaches and alternatives are not placed in any particular order of importance or preference, in how they are numbered. In addition, there should be a clear statement that	A disclaimer has been added to the Assessment Methods paragraph in Chapter 1.
Washington County	Chapter 1: According to the DNR website, their management plan for the North and East Metro is published and is currently being implemented, and is no longer “in development.” Consider revising this section to match the current state of the plan and implementation.	This correction has been incorporated.
Washington County	Chapter 2: Table 2-8 description should be revised to state that it provides a summary of capital costs.	This correction has been incorporated.

Contributor	Comment	Response
Washington County	Chapter 2: In addition, the TAC meeting in July discussed removing the golf course irrigation option and including an option to used contaminant containment water to augment a surface water body, namely Valley Creek. If this recommendation is included in the final report, the Council should notify both the DNR and Valley Branch Watershed District prior to releasing a final report, to get their input.	This comment has been incorporated.
Washington County	Chapter 6 At the beginning of this chapter, add in the table which describes the criteria used to evaluate each of the alternatives, as was included in earlier documents and in the presentation to the TAC in July. This important piece of information is missing.	This comment has been incorporated.
Washington County	Chapter 6: For approach 2, consider removing the second bullet under “advantages” and restating it as just “water quality (softened). You may also include *change* in water quality as a disadvantage, since some residents and/or cities may consider the taste of surface water to be different and less desirable. In addition, consider adding a statement about changes to water chemistry and more specifically corrosivity, and how that may impact current infrastructure.	This change has been incorporated. Potential taste and odor changes was already included as a disadvantage.

Contributor	Comment	Response
Washington County	Chapter 7: Consider adding a statement that acknowledges, in this section, that while SPRWS rates were used as a base for what might be charged under a new system, even the SPRWS rates of $3.20 per gallon are substantially higher than what most Coalition cities currently charge their water. That difference would likely be passed on to the customer. Consider adding a table that would should the difference between a normalized rate of $3.20 per gallon compared with current rates in cities, and what that difference would look like to a typical household.	This comment was partially incorporated. A table comparing potential rates was not included.
Washington County	Chapter 8: Consider using the term water efficiency in place of water conservation.	This comment has been incorporated.
Washington County	Chapter 8: Consider revising the sentence which appears at the beginning of Chapter 8 as follows: Coalition communities have expressed a desire to explore the potential to implement water conservation practices in order to reduce groundwater use before *actively exploring* switching their supply sources at significant expense.	This comment has been incorporated.

Contributor	Comment	Response
Washington County	Chapter 8: For all of the technology options identified in chapter 8, including water audits, at a minimum, include the estimated cost to install said technology in a home or business. As discussed in our July TAC meeting, additional analyses that would look at the overall cost to implement these types of practices at a community, coalition, or even county scale, would be very valuable in terms of comparing cost effectiveness of implementing widespread water efficiency practices, as compared with investing significant resources in alternate supplies. While this level of analysis may be beyond the scope of this Report, the county would encourage the Council to conduct this additional analysis in the near future, given the very large potential to reduce current and future water use.	Water conservation was not included in the scope of this report. Additional water efficiency studies are being considered by the Coalition.
City of Woodbury	The City of Woodbury TAC members express their position that there is a need and desire to further explore the options, impact, cost and the like of water efficiency improvements within the sub region covered by the study and the impact efficiency improvements will have on minimizing/eliminating growth in water demand, maintaining aquifer elevations, and alleviating or reframing the need for alternative water source(s) now and into the future. While water efficiency/conservation is discussed in the current report, it is Woodbury's position that significant further analysis and study is necessary and supported.	Water conservation was not included in the scope of this report. Additional water efficiency studies are being considered by the Coalition.
City of Woodbury	Though a range of options were evaluated and presented in the final study document, the study was not all encompassing. City of Woodbury TAC members acknowledge the efforts by Met Council and SEH in this endeavor. The City Woodbury has no preference towards or a preferred option discussed herein. Woodbury notes with any option or approach presented in the report or otherwise, substantial additional analysis, study, discussion and the like are required in the event the situation arises in the future that an alternative water source option may be necessary.	Comment noted.

Contributor	Comment	Response
City of Woodbury	The City of Woodbury TAC members note that all alternatives evaluated in the report are to be viewed as examples. No alternative in the report is to be viewed or construed as a preferred method or solution to real or perceived potable water supply concerns now or in the future.	This is stated in the report in several locations.
City of Woodbury	I believe the TAC discussed and/or the City of Woodbury did directly with Met Council the benefit of an executive summary which currently is not included.	An executive summary has been added.
City of Woodbury	Page 2, 3rd paragraph. Change “In addition, communities participating in….” to “In addition, several communities participating in this…….”. Also consider substituting “water efficiency improvement programs” for conservation programs.	This comment has been incorporated.

Contributor	Comment	Response
City of Woodbury	Page 12, 2.1 3rd paragraph. Recommend updating EPA MCL for PFOS and PFOA to 2016 updated health advisory levels.	This comment has been incorporated.
City of Woodbury	Page 18, 2.2d. Add at end of paragraph…"therefore would eliminate most if not all pumping of groundwater from Northern Tier Refinery.	This comment has been incorporated.
City of Woodbury	Page 29, 2.5 Table 2-8. Recommend updating table with a foot note on Alternative 1A further explaining under the option only approximately 100 million gallons of water could be utilized.	This alternative was changed to pumping water to Valley Creek.

Contributor	Comment	Response
City of Woodbury	Page 30, 2.5b Table 2-9. Recommend updating table with a foot note on Alternative 1A reflecting again only approximately 100 million gallons of water could be utilized and costs would be significantly different based on 100 million number.	This alternative was changed to pumping water to Valley Creek.
City of Woodbury	Page 75, Table 6-1. Recommend updating table with foot note on Alternative 1A further explaining under the option only approximately 100 million gallons of water could be utilized.	This alternative was changed to pumping water to Valley Creek.
City of Woodbury	Page 83, consider utilizing “Water Efficiency” vs Water Conservation throughout chapter and document.	This comment has been incorporated.

Contributor	Comment	Response
City of Woodbury	Page 84, remove reference to Woodbury. It is requested that the section be reworded making it a neutral non-community specific presentation and in context with population. Alternatively, two other communities, based on data in report, have a greater peaking factor than Woodbury and may provide a better example of opportunity.	This comment has been incorporated.
City of Woodbury	Appendix A and perhaps early in report, include comment on data used through 2012 and its limitation, potential impact new water use data (2013, 2014, 2015…)may have on peaking numbers, aquifer draw numbers, per capita numbers going forward.	This comment has been incorporated.

Sarah Taylor
294 North Third Street
Bayport, MN 55003

August 12, 2016

Dear Technical Advisory Committee (TAC) Member:

Please find enclosed your community's copy of the draft report of the Washington County Municipal Water Coalition (the Coalition, or WCMWC) Water Feasibility Assessment.

The report can also be found online at https://db.tt/MewhULWc

Per the language in the project contract between the Coalition, the Metropolitan Council, and SEH, Inc.:

During and upon completion of the study, the TAC will be provided opportunity by the Metropolitan Council to review the study results and provide comment that will be included as part of the final record of the study. The TAC shall consist of representatives of each municipality in the study group. The TAC shall make recommendations and findings to the full WCMWC during study activities and at its completion.

This is your community's opportunity to provide comments to the Metropolitan Council on the draft report.

Please check the appropriate box below:

☐ The City of Bayport has included comments regarding the draft report on the attached sheets, or has emailed its comments to *brian.davis@metc.state.mn.us*

X The City of Bayport has no comments on the draft report.

TAC Member Signature: Sara Taylor SARA TAYLOR

Please complete the review of the draft report, sign and mail/email this form and your comments if any by 5:00 PM on Wednesday, August 31st, 2016 to *brian.davis@metc.state.mn.us*

Please call me at 651-602-1519 if you have any questions.

Thank you.

Brian M. Davis

Brian M. Davis, Ph.D., P.G, P.E.
Senior Engineer

Jennifer Levitt
12800 Ravine Parkway S
Cottage Grove, MN 55016

August 12, 2016

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This is your community's opportunity to provide comments to the Metropolitan Council on the draft report.

Please check the appropriate box below:

☐ The City of Cottage Grove has included comments regarding the draft report on the attached sheets, or has emailed its comments to *brian.davis@metc.state.mn.us*

X The City of Cottage Grove has no comments on the draft report.

TAC Member Signature: Jennifer Levitt

Please complete the review of the draft report, sign and mail/email this form and your comments if any by 5:00 PM on Wednesday, August 31st, 2016 to *brian.davis@metc.state.mn.us*

Please call me at 651-602-1519 if you have any questions.

Thank you.

Brian M. Davis

Brian M. Davis, Ph.D., P.G, P.E.
Senior Engineer

Brian,

This is our only comment:

From our review we would like to communicate the following technical correction for the study. Alternative 6F proposes to add Lake Elmo to SPRWS in conjunction with alternative 6E. The study identifies a blending station to be located in Lake Elmo in the Old Village area. The blending station needs to be located near the intersection of 27th Street North and CSAH 13 (Ideal Avenue). This location will lower the infrastructure costs required for this alternative.

Thanks,
Kristina

Kristina Handt
City Administrator, City of Lake Elmo
khandt@lakeelmo.org
651.747.3905

City of Oak Park Heights

14168 Oak Park Blvd. N • Box 2007 • Oak Park Heights, MN 55082 • Phone (651) 439-4439 • Fax (651) 439-0574

8-31-16

Mr. Brian Davis, Ph. D, P.G., P.E.
Senior Engineer, Water Supply Planning
METROPOLITAIN COUNCIL
390 Robert Street
St. Paul, MN 55101-1805

RE: Draft Document - Water Coalition Draft Report TAC

Dear Brian,

First off, thank you to you and Chris Larson for working hard on this document. It is a complex issue with no easy answers. I would believe you will find much of my commentary below generally reflects my statements at the various meetings over the past year or so.

I have the following comments on the document:

1. I believe it generally represents the conversations held to explore very large broad picture – and very early preliminary concepts for options for alternative water sources – other than the Jordan (or other) aquifer.

2. The document is missing an "executive summary" and should be crafted and inserted.

3. As expected the document can only begin to make some broad generalizations on costs, funding sources and rate impacts. None of which are meant at this stage to be directive of a specific policy and/or represent approval by those entities that participated in the study. Perhaps I missed it, but I would like a clear statement that says no particular proposal that may be included in the document is advocated, supported nor is in advanced with this study.

4. The document does not provide a detailing or a deep explanation of the so-called "problem" it is meant to address. While the STUDY OBJECTIVES seem fairly stated, however, there is not a clear antecedent to why this study was undertaken. This should be better explained and included.

5. The document should include a clear statement that the State nor any other entity with such authority has not provided clear targets for ground water use and accordingly the application of any of the included alternatives – regardless of who funds these – would have an unknown impact towards the current levels of the aquifers in question -what is sustainable? There is a short nod to that concept on Page 2, but is the crux of the issue and needs to be answered in a clear fashion.

6. I have excerpted out additional pages with some notes and thoughts, not necessarily verbiage edits. These are attached.

I would be curious as to the other comments received, if these could be shared with the group it would be appreciated. When the revised document is available I would be interested in seeing such document prior to any final version be released and/or approved. Again, I as well as others in the Coalition, appreciate the work associated with this effort!

Kind Regards:

Dr. Eric Johnson, AICP
City Administrator

CC: TAC - Coalition Members
Weekly Notes.

communities in Anoka, Ramsey, and Washington counties. This study evaluates the potential of using alternative approaches to reduce impacts to lakes, aquifers, and to address other identified water sustainability issues within the Groundwater Management Area.

2. The DNR is completing a management plan for the North and East Metro Groundwater Management Area. This plan is currently in development and could impact future groundwater appropriations, groundwater monitoring activities, and the assessment of water use sustainability in the area.

The results of these activities will provide supporting information to help chart the course for water resource sustainability practices for the study area. In addition, communities participating in this study are interested in implementing more active conservation programs. Other investigations are being considered to assess the potential for conservation to reduce future groundwater use and decrease the aquifer drawdown.

This statement is unsubstantiated and or is unclear.

1.2 Feasibility Assessment Process

This study defines concept level water infrastructure systems to deliver the approaches to water sustainability identified in the study objectives. The basic elements of the assessment include:

1. Description of concept system alternatives
2. Planning level cost estimates
3. Considerations for implementation
4. Comparison of potential benefits of alternative / approach combinations to the sustainability of water resources and system reliability in the study area

The assessment for each approach followed a similar method: preliminary screening of options, followed by secondary evaluation of options with more detailed analysis. For approaches related to drinking water supplies, different alternatives were developed for sets of communities at varying scales.

This study is not meant to provide prescriptive solutions to be implemented. It is meant to provide communities concept level costs and considerations for various water supply approaches.

1.4 Water Demand

Current municipal well appropriations for individual cities in the study area range from 1 gallons per year (MGY) to 3.27 billion gallons per year (BGY), and total 8.24 BGY withi Table 1-1 shows the relationship between groundwater withdrawals from municipal wel cities within the study area from 2012 and the associated appropriation limits.

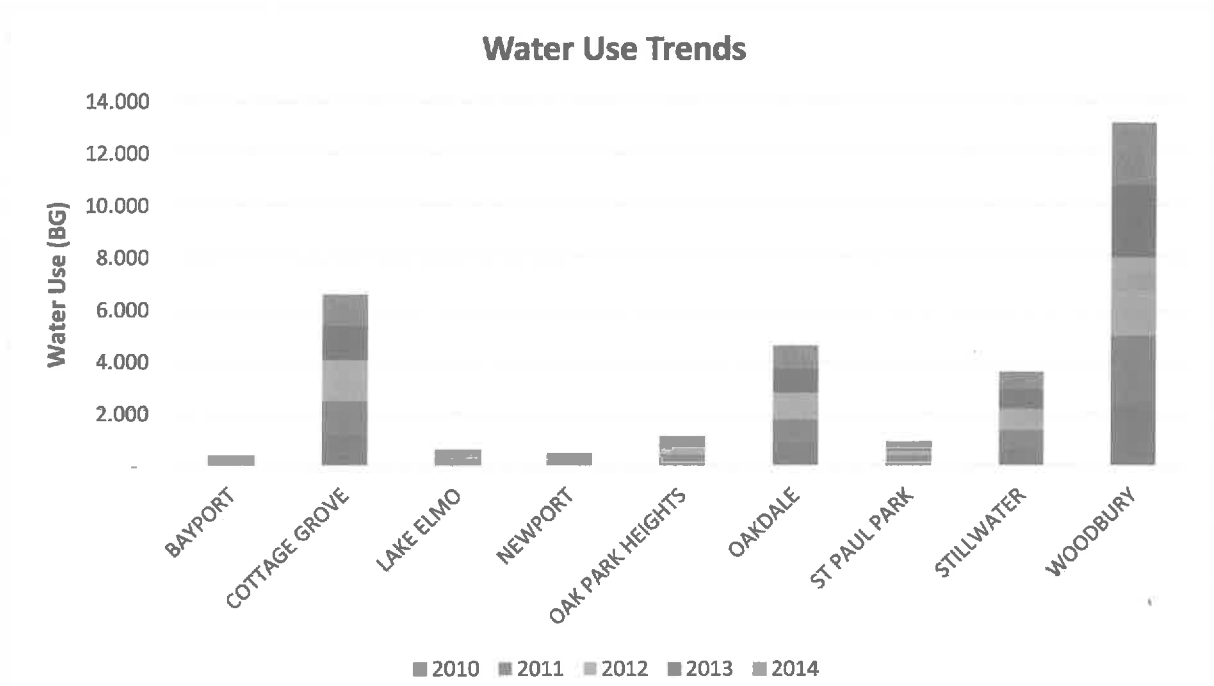
HOW do you know this.. provide documentation and support for this statement.

Projected 2040 water demands for each of the study area communities are also presen Projected average daily water use for the entire study area is estimated to be 25.3 milli day (MGD), while maximum day water demand is expected to be 61.6 MGD, as summarized in Table 1-2. Annual water use in 2040 is expected to be 9.2 BGY.

Total study area demand is expected to grow by about 27% from 2012 to 2040. The 2040 projected water demands for the majority of the communities in the study area exceed the 2012 permit appropriations. Future water demands may not be met by current groundwater appropriations.

A graph showing water use trends for each Coalition community from 2010 through 2014 is presented in Figure 1-2.

Figure 1-2. Map of study area.



This section is so critical... yet it seems relegated to an afterthought... This section needs more work and highlight

t summary.

	Water Provided (MGY)	Capital Cost	O&M Cost	Cost per 1,000 gallons
ew well field at Grove/Woodbury	3,150	$26,400,000	$1,507,000	$1.10
Alternative 7B – New well field in Denmark Township	3,150	$30,600,000	$1,534,000	$1.20
Alternative 7C – New well field in southern Cottage Grove	3,150	$25,000,000	$1,697,000	$1.10

Drilling new wells is by far the lowest cost Approach for a new water source evaluated in this report. Without an incentive to switch to a new source of water, communities will continue to drill new wells.

Significant areas of contamination (PFCs, TCE, and nitrate) exist in Washington County. In addition, aquifer drawdown could be affecting surface waters in eastern Woodbury.

9.5 Conservation

The Coalition communities use approximately 2.3 billion gallons of water annually for non-essential uses. This does not include inefficiencies in existing fixtures or losses in the distribution system. Based on the water projections, the non-essential water use in 2040 could be 2.9 billion gallons of water per year.

Significant opportunities exist for Coalition communities to conserve water. These opportunities include more efficient irrigation, low flow toilets, faucet aerators, and Energy Star labeled washing machines. Significant opportunities also exist for industrial and commercial water users. The Minnesota Technical Assistance Program can provide assistance in identifying industrial water conservation opportunities.

The largest cost saving benefit that could be realized by water conservation is by reducing peak demand. Water systems are constructed to meet peak day demands. As much as half of the water supply infrastructure is in place to meet maximum day demands due primarily to non-essential water use.

9.6 Implementation Timeframes

The projects included in Approaches 1-4 are significant and would involve lengthy planning, design, and construction timeframes. The major projects (greater than $50,000,000) would take a few years for planning and design and could take 4 years to construct. On the other hand, a small project ($5,000,000) could be planned, designed, and constructed in 2 years. This assumes that a specific project has been selected and approved by participating municipalities and regulatory agencies, the public involvement and environmental review process has been completed, and all required legislation, community agreements, and funding is in place.

These timeframes are unrealistic, espcially for use of ST. Croix River water. Permitting and public engagement alone would be 3-5 years. Not to mention funding and construction. Revise to be more pragmatic.

Brian Bachmeier
1584 Hadley Avenue N
Oakdale, MN 55128

August 12, 2016

Dear Technical Advisory Committee (TAC) Member:

Please find enclosed your community's copy of the draft report of the Washington County Municipal Water Coalition (the Coalition, or WCMWC) Water Feasibility Assessment.

The report can also be found online at https://db.tt/MewhULWc

Per the language in the project contract between the Coalition, the Metropolitan Council, and SEH, Inc.:

During and upon completion of the study, the TAC will be provided opportunity by the Metropolitan Council to review the study results and provide comment that will be included as part of the final record of the study. The TAC shall consist of representatives of each municipality in the study group. The TAC shall make recommendations and findings to the full WCMWC during study activities and at its completion.

This is your community's opportunity to provide comments to the Metropolitan Council on the draft report.

Please check the appropriate box below:

☐ The City of Oakdale has included comments regarding the draft report on the attached sheets, or has emailed its comments to *brian.davis@metc.state.mn.us*

X The City of Oakdale has no comments on the draft report.

TAC Member Signature: ______________________________

Please complete the review of the draft report, sign and mail/email this form and your comments if any by 5:00 PM on Wednesday, August 31st, 2016 to *brian.davis@metc.state.mn.us*

Please call me at 651-602-1519 if you have any questions.

Thank you.

Brian M. Davis

Brian M. Davis, Ph.D., P.G, P.E.
Senior Engineer

Kevin Walsh
600 Portland Avenue
St. Paul Park, MN 55071

August 12, 2016

Dear Technical Advisory Committee (TAC) Member:

Please find enclosed your community's copy of the draft report of the Washington County Municipal Water Coalition (the Coalition, or WCMWC) Water Feasibility Assessment.

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This is your community's opportunity to provide comments to the Metropolitan Council on the draft report.

Please check the appropriate box below:

☒ The City of St. Paul Park has included comments regarding the draft report on the attached sheets, or has emailed its comments to brian.davis@metc.state.mn.us

☐ The City of St. Paul Park has no comments on the draft report.

TAC Member Signature: ______________________

Please complete the review of the draft report, sign and mail/email this form and your comments if any by 5:00 PM on Wednesday, August 31st, 2016 to brian.davis@metc.state.mn.us

Please call me at 651-602-1519 if you have any questions.

Thank you.

Brian M. Davis, Ph.D., P.G, P.E.
Senior Engineer

Brian,

Attached please find signed cover, and below are St. Paul Park's comments on the Washington County Municipal Water Coalition Draft Report. If you have any questions on these comments, please feel free to contact me directly, or contact St. Paul Park City Administrator Kevin Walsh, in copy to this email.

Thank you for the opportunity to review and comment on the draft report.

Morgan Dawley
St. Paul Park City Engineer

Alternative 4B (Page 35) – Conjunctive Use of Ground Water and Surface Water with 25 MGD Mississippi River Surface Water Treatment Plant to Serve St. Paul Park

1. The City currently controls its water quality. Obtaining water from a coalition operated surface water treatment plant would relinquish this control to the entire coalition while the City would not be able to address water quality changes like it currently does with its existing groundwater supply water system. As stated in the report, conjunctive use of surface water and groundwater will likely result is taste and odor differences, requiring a public education program and a switch from chlorine to chloramines for disinfection. The costs of this program and switch should be addressed and included in the study. In addition, drinking water produced from a surface water treatment plant water treatment plant would likely contain higher levels of disinfection byproducts (Haloacetic Acids, Total Trihalomethanes, etc.) which is a concern to the City.

2. Surface waters, such as the Mississippi River, commonly contain emerging contaminants' which could pose a water quality concern if the EPA establishes MCLs for these constituents within the water. For example, pharmaceuticals are currently being studied by the EPA and could possibly require further treatment in the future for drinking water that stems from a surface water supply. How would the proposed surface water treatment plant treat emerging contaminants and how would this additional treatment affect the current estimated costs?

3. St. Paul Park's water utility rates include a minimum charge of $27.32/quarter for the first 9,000 gallons used, $2.48 per 1,000 over 9,000 gallons, $2.75 per 1,000 over 25,000. The estimated unit cost for Alternate 4B is $3.60 per 1,000 gallons which does not include maintenance of the existing coalition's infrastructure. Since the City's water supply costs to pump groundwater are minor with respect to the cost of maintaining the City's overall water distribution system, the City would likely need to charge close to its current water rates in order to maintain its existing distribution system. Therefore, the City anticipates that its water rates would be increased to approximately $6 per 1,000 gallons after figuring in the report's estimated unit cost of $3.60 to operate and maintain the surface water treatment plant. This water rate would be one of the highest, if not the highest water rate in Minnesota which is a major concern to the City. In addition, the example cost sharing model on Page 82 estimated a unit cost of $5.64 per 1,000 gallons of water for Alternative 4B which would be 76% more than what St. Paul Regional Water Services (SPRWS) currently charges its retail customers. SPRWS customers currently pay $3.20 per 1,000 gallons. To bring the costs for the Alternative 4B communities down to $3.20 per 1,000 gallons, the report states that the utility would need to be subsidized by $2.44 per 1,000 gallons (approximately $16 million per year). The report further states that if the capital cost of

the project ($212,700,000) were covered by another funding source, the estimated cost of water from the new utility would be close to SPRWS' rates. What other funding sources would be available to cover these additional costs and what is the likelihood that funding would be obtained by the coalition to avoid major water rate increases for each City?

4. The potential exists for hazardous materials to spill into the Mississippi River, either from tanker trucks, rail cars, storm sewers or other sources along the river. How would the proposed surface water treatment plant prevent these hazardous chemicals from entering the plant after a spill occurs? What would happen if contaminants from a spill entered the plant and how would the surface water treatment plant treat these contaminants?

5. The draft report incorrectly states that St. Paul Park chlorinates it's water supply. Only fluoride is added at the water production well house locations.

6. The City has an aging water distribution system with an approximate average age of 50+ years and cast iron pipe, and the estimated cost of future replacement needs already far outweighs existing or any projected available funding. A change of water chemistry as proposed with the coalition plan, including the addition of chlorine that is currently not present, is concerning to the City as it may adversely affect existing pipes and lateral pipe services, release chemical deposits on existing pipes into the water supply, and advance deterioration or decay of existing infrastructure. There is no additional funding or financial consideration included in the study to account for pipe replacement, lateral service replacement, or other infrastructure replacement of St. Paul Park's existing water distribution system that may be made necessary or advanced in schedule as a result of the coalition plan included in the study. How is this proposed to be addressed by the proposed coalition plan?

7. The draft report incorrectly states the number of active municipal wells in St. Paul Park. Well No. 1 was sealed in 2011.

8. In a regional context, St. Paul Park's municipal water supply wells lie close to the Mississippi River. What modeling or other hydrogeological study information supports the implication that including St. Paul Park in the water supply coalition in Alternative 4B has any impact on groundwater sustainability? Groundwater sustainability is a concept that St. Paul Park supports,, locally, and also at a regional and more global level. However, the feasibility of regional goals for groundwater sustainability as examined in the draft study, including the financial feasibility for capital investment and long term operation and maintenance costs, must be supported those changes and investments also at the local level. Without study to show otherwise, any groundwater not pumped to serve the highest and best use of municipal water supply prior to flowing into the Mississippi River, is potentially lost to downstream uses, out of the groundwater study region, and potentially out of the State of Minnesota. St. Paul Park's municipal pumping of groundwater is insignificant in comparison to other developing communities within the study area much further away from the Mississippi River, and insignificant in comparison to other industrial groundwater appropriations not included in the study. These items should be more thoroughly addressed, compared, and contrasted in the study to support the costs and negative impacts that can go along with the coalition proposition.

Morgan Dawley, PE
Municipal Senior Project Manager
d: 763-287-7173 | c: 612-670-3132
WSB & Associates, Inc. | 701 Xenia Avenue South, Suite 300 | Minneapolis, MN 55416

Robert Benson
204 Third Street N
Stillwater, MN 55082

August 12, 2016

Dear Technical Advisory Committee (TAC) Member:

Please find enclosed your community's copy of the draft report of the Washington County Municipal Water Coalition (the Coalition, or WCMWC) Water Feasibility Assessment.

The report can also be found online at https://db.tt/MewhULWc

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This is your community's opportunity to provide comments to the Metropolitan Council on the draft report.

Please check the appropriate box below:

☐ The City of Stillwater has included comments regarding the draft report on the attached sheets, or has emailed its comments to *brian.davis@metc.state.mn.us*

☒ The City of Stillwater has no comments on the draft report.

TAC Member Signature: Robert G. Benson

Please complete the review of the draft report, sign and mail/email this form and your comments if any by 5:00 PM on Wednesday, August 31st, 2016 to *brian.davis@metc.state.mn.us*

Please call me at 651-602-1519 if you have any questions.

Thank you.

Brian M. Davis

Brian M. Davis, Ph.D., P.G, P.E.
Senior Engineer

Washington County

Department of Public Health and Environment

Lowell Johnson
Director

David Brummel
Deputy Director

MEMORANDUM

To: Brian Davis, Metropolitan Council

From: Stephanie Souter, Washington County Department of Public Health and Environment

RE: Technical Advisory Committee (TAC) comments on the draft report of the Washington County Municipal Water Coalition Water Feasibility Assessment

Thank you for the opportunity for Washington County to review and provide formal comments on the draft report Washington County Municipal Water Coalition Water Feasibility Assessment (Report). Below I've provided some general and specific comments on report content.

General

The final Report should include an executive summary which provides background information and highlights from each of the alternatives studied. The executive summary should make use of Plain Language principles, where possible, so that elected and appointed officials, along with the general public, can better understand the objectives and results of the study.

The executive summary, along with the full report, should also include a more comprehensive description of the problem itself – that is, why the report is being done in the first place. Though the Report evaluates various alternatives, it should also be made clear that the Report itself is not advocating for a particular solution, at this point and time.

The Council should also consider a disclaimer statement regarding maps contained within the Report, that the locations of any lines, structures or other proposed infrastructure are approximations and do not reflect final or absolute locations.

Chapter 1

- There should be a statement that clarifies the approaches and alternatives are not placed in any particular order of importance or preference, in how they are numbered. In addition, there should be a clear statement that
- According to the DNR website, their management plan for the North and East Metro is published and is currently being implemented, and is no longer "in development." Consider revising this section to match the current state of the plan and implementation.

Government Center • 14949 62nd Street North — P.O. Box 6, Stillwater, Minnesota 55082-0006
Phone: 651-430-6655 • Fax: 651-430-6730 • TTY: 651-430-6246
www.co.washington.mn.us

Chapter 2
Table 2-8 description should be revised to state that it provides a summary of capital costs.

In addition, the TAC meeting in July discussed removing the golf course irrigation option and including an option to used contaminant containment water to augment a surface water body, namely Valley Creek. If this recommendation is included in the final report, the Council should notify both the DNR and Valley Branch Watershed District prior to releasing a final report, to get their input.

Chapter 6
At the beginning of this chapter, add in the table which describes the criteria used to evaluate each of the alternatives, as was included in earlier documents and in the presentation to the TAC in July. This important piece of information is missing.

For approach 2, consider removing the second bullet under “advantages” and restating it as just “water quality (softened). You may also include *change* in water quality as a disadvantage, since some residents and/or cities may consider the taste of surface water to be different and less desirable.
In addition, consider adding a statement about changes to water chemistry and more specifically corrosivity, and how that may impact current infrastructure.

Chapter 7
Consider adding a statement that acknowledges, in this section, that while SPRWS rates were used as a base for what might be charged under a new system, even the SPRWS rates of $3.20 per gallon are substantially higher than what most Coalition cities currently charge their water. That difference would likely be passed on to the customer. Consider adding a table that would should the difference between a normalized rate of $3.20 per gallon compared with current rates in cities, and what that difference would look like to a typical household.

Chapter 8
Consider using the term water efficiency in place of water conservation.

Consider revising the sentence which appears at the beginning of Chapter 8 as follows: Coalition communities have expressed a desire to explore the potential to implement water conservation practices in order to reduce groundwater use before *actively exploring* switching their supply sources at significant expense.

For all of the technology options identified in chapter 8, including water audits, at a minimum, include the estimated cost to install said technology in a home or business. As discussed in our July TAC meeting, additional analyses that would look at the overall cost to implement these types of practices at a community, coalition, or even county scale, would be very valuable in terms of comparing cost effectiveness of implementing widespread water efficiency practices, as compared with investing significant resources in alternate supplies. While this level of analysis may be beyond the scope of this Report, the county would encourage the Council to conduct this additional analysis in the near future, given the very large potential to reduce current and future water use.

Jim Westerman
8301 Valley Creek Road
Woodbury, MN 55125

August 12, 2016

Dear Technical Advisory Committee (TAC) Member:

Please find enclosed your community's copy of the draft report of the Washington County Municipal Water Coalition (the Coalition, or WCMWC) Water Feasibility Assessment.

The report can also be found online at https://db.tt/MewhULWc

Per the language in the project contract between the Coalition, the Metropolitan Council, and SEH, Inc.:

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This is your community's opportunity to provide comments to the Metropolitan Council on the draft report.

Please check the appropriate box below:

- [x] The City of Woodbury has included comments regarding the draft report on the attached sheets, or has emailed its comments to brian.davis@metc.state.mn.us

- [ ] The City of Woodbury has no comments on the draft report.

TAC Member Signature: J. W. Westerman

Please complete the review of the draft report, sign and mail/email this form and your comments if any by 5:00 PM on Wednesday, August 31st, 2016 to brian.davis@metc.state.mn.us

Please call me at 651-602-1519 if you have any questions.

Thank you.

Brian M. Davis

Brian M. Davis, Ph.D., P.G, P.E.
Senior Engineer

City of Woodbury final technical advisory committee comments for the Washington County Municipal Water Coalition Water Supply Feasibility Assessment August 31, 2016 submittal deadline.

- The City of Woodbury TAC members express their position that there is a need and desire to further explore the options, impact, cost and the like of water efficiency improvements within the sub region covered by the study and the impact efficiency improvements will have on minimizing/eliminating growth in water demand, maintaining aquifer elevations, and alleviating or reframing the need for alternative water source(s) now and into the future. While water efficiency/conservation is discussed in the current report, it is Woodbury's position that significant further analysis and study is necessary and supported.

- Though a range of options were evaluated and presented in the final study document, the study was not all encompassing. City of Woodbury TAC members acknowledge the efforts by Met Council and SEH in this endeavor. The City Woodbury has no preference towards or a preferred option discussed herein. Woodbury notes with any option or approach presented in the report or otherwise, substantial additional analysis, study, discussion and the like are required in the event the situation arises in the future that an alternative water source option may be necessary.

- The City of Woodbury TAC members note that all alternatives evaluated in the report are to be viewed as examples. No alternative in the report is to be viewed or construed as a preferred method or solution to real or perceived potable water supply concerns now or in the future.

City of Woodbury report review comments.

- I believe the TAC discussed and/or the City of Woodbury did directly with Met Council the benefit of an executive summary which currently is not included.
- Page 2, 3rd paragraph. Change "In addition, communities participating in…." to "In addition, several communities participating in this…….". Also consider substituting "water efficiency improvement programs" for conservation programs.
- Page 12, 2.1 3rd paragraph. Recommend updating EPA MCL for PFOS and PFOA to 2016 updated health advisory levels.
- Page 18, 2.2d. Add at end of paragraph…"therefore would eliminate most if not all pumping of groundwater from Northern Tier Refinery.
- Page 29, 2.5 Table 2-8. Recommend updating table with a foot note on Alternative 1A further explaining under the option only approximately 100 million gallons of water could be utilized.
- Page 30, 2.5b Table 2-9. Recommend updating table with a foot note on Alternative 1A reflecting again only approximately 100 million gallons of water could be utilized and costs would be significantly different based on 100 million number.
- Pate 75, Table 6-1. Recommend updating table with foot note on Alternative 1A further explaining under the option only approximately 100 million gallons of water could be utilized.
- Page 83, consider utilizing "Water Efficiency" vs Water Conservation throughout chapter and document.
- Page 84, remove reference to Woodbury. It is requested that the section be reworded making it a neutral non-community specific presentation and in context with population. Alternatively, two other communities, based on data in report, have a greater peaking factor than Woodbury and may provide a better example of opportunity.
- Appendix A and perhaps early in report, include comment on data used through 2012 and its limitation, potential impact new water use data (2013, 2014, 2015…)may have on peaking numbers, aquifer draw numbers, per capita numbers going forward.

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Saint Paul, MN 55101-1805

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metrocouncil.org

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youtube.com/MetropolitanCouncil