EVALUATION AND RECOMMENDATIONS OF WATER SYSTEM IMPROVEMENTS

for the

CITY OF Saint Peter
WHERE HISTORY & PROGRESS MEET

Bolton & Menk Project No. M21.040314

October 2008

Prepared by

BOLTON & MENK
Engineers & Surveyors

DESIGNING FOR A BETTER TOMORROW

EVALUATION AND RECOMMENDATIONS OF
WATER SYSTEM IMPROVEMENTS
CITY OF SAINT PETER, MINNESOTA

OCTOBER 2008

M21.040314

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

Signature: ______________________ Typed or Printed Name: Kristopher J. Swanson

Date 10/9/2008 Reg. No. 42626

BOLTON & MENK, INC.
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SECTION 1 - INTRODUCTION

A. EXECUTIVE SUMMARY

The evaluation of Saint Peter's water system has consisted of numerous meetings, research, telephone calls, and discussions representing hundreds of labor hours to develop the recommendations.

A review of these meetings and a well memo from Hydrologists at Barr Engineering can be found in Appendix A. The major conclusions from these meetings and other analysis are as follows:

- Abandon Jefferson WTF and seal wells No. 4 and 5.
- The Mt. Simon aquifer is most likely the only water source with significant quantities available.
- Improve water quality in the City to meet primary and secondary drinking water standards now and in the future.
- Provide option for lower system and upper system redundancy with a water treatment facility located on upper system.
- Provide same water quality throughout City.
- Design year 2030, with incremental cost to expand and decrease treatment capacity.

In the design year 2030, the City's population is projected to reach 15,250 corresponding to a maximum day water usage of 3.35 MGD (2800 gpm pumping rate). To meet this demand and the other characteristics mentioned, additional treatment capacity is required. Additionally, the City's current maximum day demand exceeds the design rated capacities of the existing treatment facilities.

Ground water sources and surface water sources were evaluated and the surface water was eliminated in order to avoid the stringent regulations of treatment for surface water and the resulting increased cost to construct and operate. The ground water supply will be obtained from three aquifers, the Jordan, Franconia-Ironton-Galesville (FIG) and Mt. Simon. The Jordan and FIG aquifer usage will be maximized during construction, while it is expected that the Mt. Simon will provide the bulk of the supply.

To meet the water quality requirements, it is recommended to use reverse osmosis (R.O.) membranes after gravity filtration. The R.O. membranes are an excellent treatment technology for Saint Peter now and provides the ability to meet the anticipated more stringent requirements in the future. To accommodate the wells and treatment technology selected, an additional 2500 gpm gravity filtration facility would be needed. The St. Julien treatment facility would remain and provide 1500 gpm of gravity filtration. This would provide a total treatment capacity of 4000 gpm for iron and manganese. The R.O. treatment would be sized for 3600 gpm feed rate and a permeate flow of 2500 gpm, combined with 400 gpm of non-R.O. water for the design pumping capacity of 2900 gpm. Through well test pumping and value engineering, these flow rates can be modified prior to bid in order to provide the City with the best design at an optimal cost.

To meet these needs, three main treatment facility siting alternatives were evaluated. The first two phases of each alternative is presented in Table 1.1. (All three alternatives include abandoning Jefferson water treatment plant after detailed review of the Jefferson site during review of the draft report.)

Table 1.1
PHASE I & II COSTS FOR THE THREE EVALUATED ALTERNATIVES

1) New WTF at Greenhill with all R.O. and Wells at Broadway	$15,040,000
2) New WTF at Broadway and Add R.O. to St. Julien	$14,000,000
3) New WTF at Sunrise and Add R.O. to St. Julien	$13,790,000

Based on a number of factors, the Broadway alternative was recommended to build a new WTF at the Broadway Avenue water tower site and add reverse osmosis to the St. Julien WTF. The recommended improvements are presented in a sequenced approach to help Saint Peter meet its immediate drinking water needs of having a plant online by 2010.

The project would result in an annual increased cost of approximately $1,317,000 (including PFA debt service and O&M costs). It also includes $100,000 to dispose R.O. reject to the wastewater treatment facility that could be better developed in the future. Based on the water sold in 2006, and the sample rate structure presented in Appendix C, an average customer using 4,500 gallons per month, this would see an increase of approximately $11.12 per month. This cost could be offset by salt savings realized by customers resulting in a net cost change of almost nothing per month for most users.

There would also be an additional savings to the customers by extending the life of water heaters, plumbing and other water using appliances throughout their home.

The City of Saint Peter water supply, well, and treatment plant addition projects have been included on the State's DWRF Intended Use Plan. Under this program, loan money will be available at an interest rate of approximately 2-3%. In order to take advantage of this money, the following critical path (Table 1.2) is recommended for implementation.

The schedule to implement the recommendations is extremely tight. Immediate action is needed to have a new facility on-line by 2010. To meet the schedule and take advantage of funding, we recommend that the City Council authorize Bolton & Menk to begin design by October 15, 2008. Bolton & Menk has designed numerous facilities of this size throughout Minnesota and is prepared to begin design immediately. Details of these facilities can be seen in Bolton & Menk's proposal for this report. As part of this design, a detailed cost opinion will be provided with incremental cost to increase/decrease treatment capacities and options to better help the city in the selection of a final bid package. Also, the value engineering process will be used (similar to the WWTF project) to help provide the city with the best value for their money.

Table 1.2
CRITICAL PATH TO IMPLEMENT RECOMMENDATIONS

Item	Date										
	Oct. 2008	Nov. 2008	Dec. 2008	Jan. 2009	Feb. 2009	* Mar. 2009	Apr. 2009	May 2009	June 2009	2010	2011
Council workshop and approval of this Report	■										
Authorize Bolton & Menk to begin design of Wells and WTF	■										
Tour existing WTF's with City staff	■										
Submit well designs to the Minnesota Department of Health		■									
Bid wells and begin construction			■	■							
Submit plans and specifications for WTF to the City and Minnesota Department of Health for review.					■	■					
Value Engineering and Final Bid Package Approved from Council.							■				
Bid WTF and St. Julien modifications								■			
Finalize PFA funding.									■		
Construction of new WTF.										■	
Start-up of new WTF and St. Julien modifications											■

* PFA Plan Submission Deadline is March 2, 2009.

B. PURPOSE

The purpose of this report is to develop a number of water treatment and source water alternatives for the City of Saint Peter and make recommendations to the City on how to proceed to meet their drinking water needs through 2030. The report was authorized by the City to further develop the recommendations set forth in the October 2007 Water Master Plan.

The goals, as presented in Bolton & Menk's proposal, include:

- Develop a feasible plan to obtain water for treatment;
- Develop a treatment process to meet the City's water quality requirements;
- Select a site(s) for treatment near sources;
- Propose three to five detailed alternatives including cost estimates;
- Make recommendations on the best alternative and develop a critical path to determine when recommendations need to be implemented;
- Summarize new technology to be used in recommended alternative.

As part of this report, four main meetings were held to discuss the issues of this project. The meeting minutes, as well as a memorandum from the hydrogeologist, are presented in Appendix A. This report will serve to organize the recommendations and discussions of the experts who were met with in these meetings.

C. REPORT ORGANIZATION

This report is organized into six main sections and appendices. The next section, Section 2, will review background information including meetings with experts, the Water Master Plan, and water needs. Section 3 will discuss potential water sources and make recommendations as to what sources are feasible. Section 4 will include a discussion on water and wastewater reclamation and re-use. Section 5 will develop the feasible alternatives and cost estimates for each alternative. Section 6 will provide a ranking and recommendation of the best alternative, as well as a critical path to implement this alternative.

SECTION 2 – BACKGROUND INFORMATION

A. REVIEW OF MEETING MINUTES AND MEMORANDUM

As part of this report/project, a series of meetings were held to discuss a wide array of topics relating to the immediate and future needs of the City of Saint Peter potable water system. These meetings were a major part of this evaluation as they served as a time to discuss, question, and come to conclusions regarding many issues that the City faces. Below is a brief summary of each meeting. These items will be built upon throughout the report to develop the final recommendations for the City.

1. April 8, 2008 Kick-off Meeting (Appendix A1)

City staff and Bolton & Menk, Inc. met to discuss the purpose and goals of the project. Personnel involvement and schedules were also decided. Concluded items included:

- Water treatment facility design year would be 2030.
- Provide flexibility of water system for redundancy purposes.
- The City must have one water quality throughout city.

2. April 30, 2008 Meeting with DNR Area Hydrogeologist Leo Getsfried (Appendix A2)

The DNR met with City staff and Bolton & Menk to discuss the hydrogeology of Saint Peter, as well as the most recent Water Emergency and Conservation Plan (WECP) and water appropriations. Significant discussion items included:

- Mr. Getsfried sees no major obstacles for the City to obtain additional groundwater appropriations from any groundwater aquifer including the Mt. Simon. The Mt. Simon appropriations would be especially acceptable to the DNR because the water is primarily for domestic use.
- Long term, if the static water level in Mt. Simon was shown to be dropping, domestic use (such as the City of Saint Peter) would have the priority over industries such as ethanol.
- As of this time, there are no known shortages in the Mt. Simon aquifer.
- The DNR will not be requiring Saint Peter to provide a separate monitoring well or aquifer testing since the water will be used domestically. Only if a major industrial/commercial user comes online would an aquifer test be required.
- Appropriation of water should not be restricted in Saint Peter as long as no aquifer drops are measured and that the City continues to move in the right direction regarding water conservation methods. DNR has no plans at this

time to limit Mt. Simon as is currently done in the seven county metro area.

- Eliminating multi-aquifer wells is desirable by the DNR.
- 10-year appropriations of water is possible for a community if all requirements are met (requirements are provided with meeting minutes in Appendix A2).

3. May 13, 2008 Hydrology Meeting with Brian LeMon of Barr Engineering (Appendix A3)

A meeting with Brian LeMon of Barr Engineering was held to discuss feasible water sources for the City of Saint Peter and to have a preliminary informal evaluation of each source. The main points of discussion were:

- Mt. Simon aquifer is not restricted outside the seven county metro area and no restriction has been proposed. Drawdown of the aquifer is localized to the metro area.
- Summarized potential water sources including three ground water aquifers, Minnesota River, wastewater reclamation, and storm water.
- Discussion on aquifer recharging. At this time, the MDH is not allowing ground water aquifer recharging. No Class 5 injection wells are permitted mainly because there is currently no need in Minnesota.
- Groundwater and wastewater re-use was thoroughly discussed at this meeting and will be developed in Sections 3 and 4 of this report.
- The Minnesota River is not a desirable drinking water source due to the increased regulations with treating surface water.

4. June 3, 2008 Meeting with Panel of Experts to Develop Ideas and Alternatives (Appendix A4)

A list of attendees can be found in the minutes for this all-day meeting. At this meeting, a detailed discussion of all items including water sources, reclamation energy, and treatment was discussed. A number of alternatives were developed during this meeting, but the alternatives require modifications in light of Barr Engineering's July 17, 2008 Memorandum. The information, alternatives, and conclusions from this meeting will be presented and referenced throughout this report.

5. July 17, 2008 Memorandum from Barr Engineering (Appendix A5)

The memorandum from John Greer and Brian LeMon provides a detailed summary of the groundwater sources in Saint Peter based on information from the 1997 and 2008 Wellhead Protection Plans, as well as the 2007 Water Master Plan. The memorandum evaluates potential yield from each aquifer and makes recommendations of expected well yields and drawdowns. The information presented in this memorandum will be summarized in Section 3 of this report and will be incorporated into the development and selection of the alternatives.

6. Memorandum Regarding Jefferson Site and Broadway Options from draft report review (Appendices A6, 7 and 8).

These memos address council questions during the report review. The first memo (A6) evaluated the Jefferson WTF site and how it is cost prohibitive to build at this location. Water use is also reviewed detailing how the City of Saint Peter uses very little water compared to other communities. It further supports the 20-year design life flow of 2,800 gpm. In Appendix A7, the recommended option is presented along with two alternatives to save cost while sacrificing redundancy and operational flexibility. Finally, in Appendix A8, an option to provide a 10-year design, without reverse osmosis is presented for comparison only. This option is not feasible under the current well quality and would only be obtainable if the proper well capacity is obtained with quality better than the existing well.

B. REVIEW OF DRINKING WATER NEEDS

To properly develop the proposed alternatives, information from the Water Master Plan was used to determine the water quantity that is required by the City in 2030. A review of the primary and secondary drinking water standards, as well as a summary from the project meetings, were used to determine the drinking water quality that is needed for the City of Saint Peter.

1. Treatment Capacity

In 2030, the population of Saint Peter is expected to be 15,250 people (Table 2.1 of Master Plan). The corresponding water demand is presented in Table 2.1 below for years 2010-2040. Current population exceeds 10,700.

Table 2.1 PROJECTED AVERAGE DAY AND MAXIMUM DAY WATER DEMAND				
Year	**Avg. Day Demand (MGD)**	**Max. Day Demand (MGD)**	**Max. Day 20-Hr. Pumping Rate (GPM)**	**Population**
2010	1.29	2.58	2150	11,750
2020	1.48	2.97	2475	13,500
2030	1.68	3.35	2792	15,250
2040	1.87	3.74	3117	17,000

Based on the design year decided upon at the April 8 meeting, 2030 flow rates will be used for developing alternatives. At that time, the City will experience a maximum day demand of 3.35 million gallons per day with a 20-hour pumping rate of approximately 2,800 gallons per minute.

The City currently has seven wells that are used to produce potable water. Wells 4 and 5 are multi-aquifer wells drawing water from all three formations found in Saint Peter: the Jordan Sandstone; Franconia-Ironton-Galesville (FIG); and the Mt. Simon Sandstone. Wells 6 and 9 are Jordan wells, Well 7 is a Mt. Simon well, and Wells 8 and 10 are finished in the FIG formation (see Figure 4.3 in the Water Master Plan, Appendix B1 for geology information on aquifers). The two multi-aquifer wells are not desirable to the Minnesota Department of Health due to the chance of cross contamination between aquifers. The Minnesota Department of Health encourages the cities with multi-aquifer wells to seal and abandon these wells. For this reason, the City has decided to seal these wells and abandon the Jefferson Water Treatment Facility. By sealing these wells and abandoning Jefferson, the City was able to obtain additional points for rankings with the Public Facilities Authority (PFA) and making the City eligible to be funded through the Drinking Water Revolving Fund (DWRF) that the PFA administers.

Table 2.2 COMBINED WELL PUMPING RATES					
Well Number	**Current Individual Well Pumping Rate (GPM)**	**Combined Well Pumping Rates (GPM)**			
		Option 1	**Option 2**	**Option 3**	**Option 4**
6	350	275	275	250	260
7	450	300	300	---	260
8	475	---	425	375	340
9	325	250	250	250	250
10	525	425	---	450	360
Total		**1250**	**1250**	**1325**	**1470**

With Jefferson WTF's planned abandonment, the only current WTF capacity will come from the St. Julien facility. This plant currently has capacity to treat 1,500 gpm for iron and manganese removal. Capacity is currently limited by the wells feeding the plant. Table 2.2 shows the combined pumping capacity of various well combinations for Wells 6, 7, 8, 9 and 10 that feed St. Julien.

The firm well pumping capacity at St. Julien is approximately 1,300 gpm. To obtain the full capacity of St. Julien well modifications would be needed to secure 1,500 gpm firm well capacity. To meet the needs of design year 2030, an additional treatment facility is required. The combined output from St. Julien and the new water treatment facility would need to be 2,900 gpm. A summary of the water treatment capacity is shown in Table 2.3.

Table 2.3 SUMMARY OF WATER TREATMENT CAPACITY FOR DESIGN YEAR 2030		
	Firm Capacity	**Firm Capacity w/75% Recovery****
Jefferson WTF*	---	---
St. Julien WTF	1,500 gpm	1,100 gpm
Proposed WTF	2,500 gpm	1,800 gpm
* Abandoned facility. ** 75% recovery of water is a typical percentage used with reverse osmosis/blending water treatment.		

2. Water Quality

The primary concern of most cities water systems is the quality of the drinking water and Saint Peter is no exception. Throughout the development of the Water Master Plan, engineering proposal, meetings, and telephone conversations, the public demand for a high quality drinking water has been brought to the forefront. As detailed in our project meetings, it was confirmed to continue to provide the same water quality throughout the City with R.O. to reduce the contaminants in the drinking water.

To better quantify some of the water quality issues to be addressed in Saint Peter, Table 2.4 is presented summarizing the US EPA secondary drinking water standards. Note, the primary drinking water standards are required to be met by the City of Saint Peter. The primary standards are currently being met and all proposed facilities will continue to meet all primary standards of drinking water.

Table 2.4 USEPA NATIONAL SECONDARY DRINKING WATER CONTAMINANTS STANDARDS			
Contaminant	**Effects**	**SMCL - mg/L**	**Concern to St. Peter System** **Yes/No**
Aluminum	Colored water	0.05 to 0.2	**No**
Chloride	Salty taste	250	Yes
Color	Visible tint	15 color units	No
Copper	Metallic taste, blue-green stain	1.0	No
Corrosivity	Metallic taste, corrosion, fixture staining	Non-corrosive	
Fluoride	Tooth discoloration	2	No
Foaming Agents	Frothy, cloudy, bitter taste, odor	0.5	No
Iron	Rusty color, sediment, metallic taste, reddish or orange staining	0.3	Yes
Manganese	Black to brown color, black staining, bitter metallic taste	0.05	Yes
Odor	"Rotten egg", musty, or chemical smell	3 Ton	No
PH	Low pH - bitter metallic taste, corrosion; high pH - slippery feel, soda taste, deposits	6.5-8.5	No
Silver	Skin discoloration, graying of the white of the eye	0.10	No
Sulfate	Salty taste	250	No
Total Dissolved Solids (TDS)	Deposits, salty taste, dissolved minerals (contributes to hardness)	500	Yes
Zinc	Metallic taste	5	No

Two of the constituents on this list, iron and manganese, are currently meeting the secondary standard through treatment with gravity filtration. The remaining constituents are typically met through a regiment of blending well water.

The City has expressed two primary goals when considering water quality in the future:

1. Increase the water quality by providing additional treatment beyond gravity filtration, to provide another level of protection against current and future contaminants, which will also provide its residents with more aesthetically pleasing water.

2. Utilize state-of-the-art technology so the treatment process does not become obsolete as new regulations are developed.

In order to meet these goals, the water source and the treatment processes need to be matched to ensure the quality water is produced by the City of Saint Peter. Water sources and treatment processes will be discussed in detail in the following sections. To summarize the water quality that is desirable and will be designed for, Table 2.5 is presented.

Table 2.5
PROPOSED SAINT PETER WATER TREATMENT STANDARDS

Contaminant	Treated Level
Primary Drinking Water Standards	* All Primary Standards will be met
Chloride	Below 250 mg/l
Iron	Below 0.3 mg/l
Manganese	Below 0.05 mg/l
Total Dissolved Solids	Below 500 mg/l
Hardness	Between 4-6 grains (85-100 mg/l)

* Radionuclides, nitrate, radon and disinfection are primary concerns for the City. Obtain nitrate well below 4 mg/l to satisfy future requirements that may arise.

By lowering the levels of the contaminants expressed in Table 2.5, the water will be more aesthetically pleasing to residents and will require less treatment by homeowners. It will also help to minimize plumbing and water heater failures that are commonly seen in Saint Peter.

SECTION 3 – DRINKING WATER SOURCES

The City of Saint Peter has two viable options for drinking water sources in the City, ground water and surface water. The third source of water discussed during this project was reclaimed wastewater, currently reclaimed wastewater is not permitted as a drinking water source in the State of Minnesota. Reclamation will be discussed further in Section 4 as a method to decrease drinking water demand peaks, but for the purpose of this chapter on Drinking Water Sources, the discussion will focus on ground water and surface water.

A. GROUND WATER

The City of Saint Peter has three ground water aquifers available to them: The Jordan, Franconia Ironton-Galesville (FIG), and the Mt. Simon. Each aquifer has positive and negative aspects when using it as a water source. In this section, each aquifer will be summarized and a set of design parameters will be developed to help make recommendations on how to proceed.

1. Jordan Sandstone

A description of the Jordan Sandstone can be found on page 41 of the Water Master Plan in Appendix B1 and further information is found in Appendix B2, the Wellhead Protection Plan. Because the Jordan Sandstone is a relatively shallow aquifer that is quickly recharged through surface water that percolates through the sand plains near Saint Peter, the Jordan Aquifer is considered to be vulnerable to contamination, which could show up in the Saint Peter wells in a relatively short time. This contamination can be seen in the Jordan water quality through the increased nitrate levels. The Jordan Sandstone is lower in hardness and total dissolved solids (TDS) when compared to the FIG and Mt. Simon.

The capacity of the Jordan Aquifer appears to be very limited. According to Barr Engineering's Well Spacing memo dated 7/17/2008 (found in Appendix A5) "the current data (on the Jordan) results in significant and unacceptable drawdowns for the Jordan wells when pumped at 500 gpm." The interference between Jordan wells is great (as currently seen by the City). The depth of the Jordan aquifer formation is also relatively small with only about 35-50' of useable formation. To summarize, the Jordan aquifer is a viable source for potentially one new low capacity (250-500 gpm) well. Due to the nitrate and vulnerability concerns it would be prudent to treat this water with reverse osmosis to provide protection against nitrates or future contaminants that could enter this shallow source.

During the meetings, there was great interest in potentially keeping the Jordan water separate and treating with reverse osmosis. The hope was to use the reject water from the Jordan to irrigate/reuse the water. The reject will contain approximately 1,750 mg/L of TDS, depending on soil types to be irrigated, the large TDS concentration may have a negative impact on plants/soil. According to Metcalf and Eddy, Water Re-use, Copyright 2007, TDS between 450-2000 mg/L has slight to moderate restrictions on irrigation. The sodium concentration in the Jordan water appears to be low enough that, salt concentrations in the reject should not be a problem. As with any irrigation water analysis and land applications of waste streams, the soil would need to be evaluated to better determine the rate and frequency of irrigation with R.O. reject water. The use of R.O. reject water for irrigation would also require permitting through the Minnesota Pollution Control Agency as a waste stream discharge.

2. Franconia Ironton-Galesville (FIG)

A description of the FIG can also be found in Appendices B1 and B2. The FIG appears to be a good source for quality water. The aquifer is confined and deeper than the Jordan and therefore, is not as vulnerable to surface contamination. The water from the FIG has higher hardness and TDS than the Jordan, but lower than the Mt. Simon.

Because the FIG formation is not as porous as other aquifers, large capacity of FIG wells are difficult to obtain. This also increases interference between wells in close proximity. As an example, Barr predicted approximately 34' of drawdown of the FIG a mile away from the well site (when pumped continuously for 2 weeks). However, because the FIG well is deeper, and the static water level higher than a comparable Jordan well, a 500 gpm FIG well should have only a small impact on the existing FIG wells.

In summary, the FIG appears to have adequate capacity and quality to produce at least on additional 500 gpm well in Saint Peter. The level of treatment and technology used will be discussed in Section 5.

3. Mt. Simon Sandstone

The Mt. Simon Sandstone aquifer is also discussed at length in the reports located in Appendix B. The current Mt. Simon Well (Well No. 7) in Saint Peter produces lower quality water, high in hardness, TDS, chlorides, sulfates, iron and manganese. None of these constituents are primary standards, however, most are secondary standards that make the raw water less desirable for drinking and general use. Although, the water quality in Well No. 7 in Saint Peter has a higher level of contaminants, other Mt. Simon wells in the state tend to have a lower level of contaminants. Detailed discussions have occurred trying to determine if the Well No. 7 water quality is an anomaly or is indicative of the Mt. Simon water in Saint Peter.

The Mt. Simon is the deepest aquifer located in Saint Peter with an abundance of water producing capacity. High rate municipal production wells are common in the Mt. Simon Aquifer. For this reason, the Mt. Simon is the best source to obtain high capacity production wells for the City. Even though water quality is high in contaminants, the Mt. Simon water will be required for a new facility to obtain the flow rates of 1,500-2.500 gpm of additional drinking water that will be needed in 2030.

B. SURFACE WATER

Surface water sources can be any lake, river, or stream that has adequate recharge to support the amount of water being pumped for potable treatment. In the City of Saint Peter, the most viable surface water source is the Minnesota River.

Water from the Minnesota River could be pumped utilizing a surface water intake or Ranny wells, which are shallow angled wells. Either method would be considered a surface water source and fall under the more stringent surface water treatment rules. Because surface water treatment is more regulated, additional treatment methods and chemicals are required which quickly push up the cost for treatment. At this time, the

Minnesota River is not a viable option for drinking water treatment. The regulations are much more vast and there are adequate ground water sources that could be treated more efficiently and effectively.

During the meeting on June 3rd, 2008, surface water was eliminated as an option for reasons stated above.

C. SOURCE RECOMMENDATIONS

As stated in the previous sections, each ground water source has pros and cons associated with using it as a drinking water source. However, ground water sources are the preferred water source over surface water in order to avoid a costly surface water treatment facility and the stringent requirements of operating a surface water treatment plant. For these reasons, ground water wells are recommended to supply the City of Saint Peter with its water needs through 2030.

With any well field project, location of the wells is critical. In order to avoid impact on the existing wells that feed the St. Julien WTF, Barr Engineering states:

> "The greatest impact to existing wells would be created by wells installed at the Greenhill Reservoir since it is closest to the existing wells. In addition to proximity, it is also directly up-gradient from the St. Julien plant wells, which make the interference even worse. In general, this site would not be recommended unless all other sites were unavailable. Each well installed at the other locations will create noticeable and, possibly, problematic drawdown at the St. Julien wells. The City may be able to mitigate the interference during the next round of well maintenance at each of the existing wells by dropping the pump set point and possibly increasing the pump and motor size to account for the additional drawdown. These kinds of modifications may not be possible at some wells due to casing or aquifer limitations."

For this reason, the location of the well field (and co-located treatment facility) is best located as far as possible from the St. Julien wells and avoids the area directly west of St. Julien. Additionally, as part of any modifications to the St. Julien treatment plant, well upgrades will be evaluated to ensure the existing wells are not negatively impacted.

To best utilize the ground water sources in the City of Saint Peter, it is recommended to install four to six wells with any new treatment facility. Table 3.1 describes the recommended wells.

Table 3.1 RECOMMENDED NEW WELLS		
Aquifer	**No.**	**Targeted Capacity***
Jordan	11	500 gpm
FIG	12	500 gpm
Mt. Simon	13	1500 gpm
Mt. Simon	14	1500 gpm
* Well capacity could vary with treatment process selected and the interference with the wells at the St. Julien WTP.		

With these well additions and modification to St. Julien's wells, the City of Saint Peter's water needs will be met through the year 2030.

Ground water quality and quantity in an aquifer can vary from site to site; therefore, it is proposed to drill the wells before designing the treatment plant. It is proposed to drill the Jordan well first to determine the water quality, quantity and the interference with the existing wells before drilling the other wells. The same process would be repeated for the FIG wells and the Mt. Simon wells.

SECTION 4 – RECLAMATION

A. POTENTIAL FOR RE-USE

With concerns about water resources and conservation growing, the City of Saint Peter is considering options to reuse some of the municipal water and wastewater sources. Typically, municipal wastewater has two streams – one from the wastewater treatment facility and one from the water treatment facility.

The Minnesota Pollution Control Agency (MPCA) encourages conservation and recycling, if possible, but is continually tightening the rules relating to water treatment facility discharges. Discharges intended for reuse or recycled purposes will be required to meet strict quality and quantity limits and require a separate discharge permit for each discharge location including receiving waters, industry, and irrigation/land application.

Potential recycling types for the water and wastewater treatment facility discharge streams are discussed below.

1. Wastewater

Recent research by the Metropolitan Council has shown potential for recycling municipal wastewater for industrial water use. The wastewater would first be brought to a wastewater treatment/recycling facility and treated before being discharged for reuse. The wastewater treatment/recycling facility in question could be either the City's main wastewater treatment facility (modified to treat water to a level applicable for reuse) or a separate facility constructed for recycling needs. During the meetings for this drinking water study, there has been great interest in potentially reusing wastewater for irrigation of lawns, parks and recreational fields to minimize the peaking factors on the drinking water system. Although, this system is feasible from a technical stand point, economically this type of system would require a second distribution system that would make this project unfeasible. Additionally, permitting of such a system has not been done in the State of Minnesota. Without irrigation demand amounts and location of users, impacts on the water system can not be determined at this time. If the R.O. reject water is not discharged to the WWTP, then it will improve the quality of the wastewater discharge and potential for reuse would increase.

2. Backwash and Reject Stream from WTF

The wastewater stream from the Water Treatment Facility could consist of two parts: gravity filter backwash water and reverse osmosis (R.O.) reject water (pending treatment chosen). Backwash water can be and has been successfully recycled back into the water treatment facility through a reclaim system similar to the system recently installed at St. Julien. The R.O. reject stream may be used for irrigation if certain quality characteristics are met, and the MPCA issues a discharge permit. R.O. reject water typically has all of the contaminants of the raw water being treated multiplied by four. Reusing R.O. reject water in this way is subject to strict quality regulations and detailed analysis of soil and water characteristics to ensure the plants and environment are not negatively affected.

B. POSSIBLE USES AND SAVINGS

As mentioned above, there is potential for wastewater to be recycled or reused for industrial or irrigation purposes. Possible methods and cost savings for each use are discussed below.

1. Recycling for Industrial Water Use

Wastewater from the Wastewater Treatment Facility (WWTF) and from the backwash water at the Water Treatment Facility (WTF) could potentially be recycled for industrial use. For some industrial uses, only a small change to the WWTF's disinfection process would be required. After the change is made and recycled water piping to the appropriate industrial site is constructed, the future costs of this would include only operation and maintenance items. The City would then not be required to treat the water for that industrial facility's use and would save money on overall water treatment costs.

For other industrial uses, further treatment would be required before the recycled wastewater would be able to be used. At a minimum, hardness and excess dissolved solids would need to be removed from the wastewater as well as all TSS, bacteria, and residual BOD. For this scenario, the wastewater would be routed from the WWTF to a treatment facility to be treated for recycling. This could be at the existing WWTF or could be a separate facility constructed for recycling purposes. For either option there would be significant initial costs to provide this type of treatment for recycling. For some industrial water uses, the operation and maintenance costs of this can be competitive with other water supplies. For example, using a reverse osmosis system to remove hardness and TDS would have similar operation and maintenance costs for recycling as treating raw water from a different source using R.O., while actively conserving water. However, for other uses, significant further treatment may be necessary and the ongoing costs may outweigh the costs to provide treated groundwater. The potential for savings increases as the amount of water used by the industry increases. Recycled water systems are most competitive for capacities of 1 MGD or larger. At this time, the City of Saint Peter has no industrial users requiring water at such high capacities.

2. Reuse for Irrigation

As discussed in Section 2 of this report, the City has seven production wells used to produce potable water. Due to the strict water quality requirements for R.O. reject water reuse, only Wells No. 6 and 9 currently have the raw water quality necessary to meet these requirements. Wells No. 6 and 9 draw water from the Jordan aquifer and have comparatively low levels of sulfates, chlorides and total dissolved solids. If the City were to treat the water from these two wells separately through a reverse osmosis system, the reject water from that system would potentially have the quality necessary to be reused for irrigation purposes without further treatment. The R.O. reject water would be permitted to be reused on certain plots of land depending on the chemical nature of the soil, the amount of water required, and the quality of the final reject. The MPCA would carefully examine all of these items before permitting the reuse.

Because this water would not have to be treated further before reuse, the cost of reuse would be limited to the distribution system. Provisions could be made to direct the reject water to the permitted areas during construction of water treatment facilities or other City construction projects. Minimal cost savings could be realized due to the fact that the City will no longer be paying for treatment of the water used for those particular irrigated areas or for treatment of the R.O. reject stream before it is discharged back into nature.

Reclaimed wastewater could also be used in this manner to irrigate grass. Additional treatment and permitting would be required by the MPCA as well as cross contamination protection for the drinking water system. Cost savings would most likely not be realized on any water reuse/reclamation project as stated by Gordon Culp. Most reuse projects are to save water in dry arid regions or as required by a regulation agency.

C. RECLAMATION RECOMMENDATIONS

While the potential for water reuse is present for the City, no options are cost effective. Due to the large construction costs and large operation and maintenance costs of recycling wastewater for industrial use, this option does not appear feasible for Saint Peter at this time. Additionally, there is no data to show that it would reduce water demands either now or in the future.

Reusing R.O. reject water for irrigation purposes is more practical for the City. There is potential for reuse for City properties or private customers, however, data available does not show that this will significantly reduce water demands. Further evaluation of these options is beyond the scope of this report. Additional evaluations and research would need to be conducted to determine the real impact a reuse system could have on drinking water demands. At this time, it is recommended to proceed with a new WTF that includes the required infrastructure to reuse water should it be desired in the future.

SECTION 5 – TREATMENT ALTERNATIVES AND COST

To meet the finished water quality desired by the City of Saint Peter as discussed in Section 2, treatment of the raw well water will be required. The City currently treats the water with aeration, detention, and gravity filtration to remove iron and manganese. This process is the industry standard for the removal of iron and manganese, however, it removes none of the other contaminants that the City would like taken out of the drinking water supply including nitrates, chlorides, sulfate, and hardness. To address some of these contaminants, the following brief descriptions are given about treatment technologies used.

A. AVAILABLE TECHNOLOGIES

Since removal of contaminants is a goal of the City, only technologies with ability to remove contaminants will be evaluated.

1. Lime softening

Lime softening in combination with oxidation and filtration can be very effective treatment for both iron and manganese removal as well as reducing hardness of the water to low levels. Lime softening will not remove nitrate, chloride, and sulfate.

Lime softening is currently used in water treatment facilities throughout the country, however, Dr. Delvin DeBoer predicts very few new lime softening facilities will be constructed in the future because of the lime disposal required. Lime softening uses lime to raise the pH of the water to above 10. At a higher pH, calcium and magnesium (the primary constituents of water hardness) will precipitate out of the water and be removed through settling and filtration. In the settling process the precipitate, as well as large volumes of lime, produce a sludge that must be drained off the bottom of the clarifier and disposed of. The sludge is becoming increasingly more difficult to dispose of through land application and land filling it is cost prohibitive. For this reason, Dr. DeBoer believes that only special communities with a need for high pH lime sludge will be able to justify building these facilities.

Based on the sludge disposal and lime softening's inability to remove nitrate, sulfate, and chloride this treatment technology is not feasible or desirable for the City of Saint Peter. This option will not be evaluated further.

2. Ion Exchange

Ion Exchange is a process where the water is passed through a bed of resin media that is charged oppositely of the contaminant that is being removed. The process is the same as used in a home water softener. The resin media can be designed and manufactured differently to effectively de-ionize water, thus removing all of the constituents that are needed to provide Saint Peter with a high quality drinking water.

Ion Exchange is a batch process that over time will exhaust the media and require recharging with a chemical solution. Because of the high levels of ions in Saint Peter's water sources and the large volume of water required by a City, ion exchange is not a practical method of treatment. Chemical costs to recharge resins and physical space required to hold resin beds make this option unfeasible from a capital and O&M cost stand point. Typically, ion exchange is used only when de-ionized water is required. Ion exchange will not be evaluated further for Saint Peter.

3. Reverse Osmosis Membranes

Reverse Osmosis (R.O.) is a process where water is passed through a semi-permeable membrane through the use of pressure. The membrane rejects most contaminants allowing a purified water to pass through it. The reverse osmosis is a process that produces two streams, the permeate which is the clean water and the concentrate reject which is the high mineral content water containing high concentrations of TDS. R.O. can do an excellent job of removing nearly all contaminants in Saint Peter's water including hardness, chloride, sulfate, and nitrate. Iron and manganese removal can also be accomplished with R.O. however, removal of these constituents will cause premature fouling of the membranes and result in frequent membrane replacement. For this reason, it is recommended that aeration detention, and gravity filtration be used prior to R.O. for removal of iron and manganese.

R. O. water is a very pure source of water that contains only small amounts of TDS and other constituents. Without these ions in the water, pure R.O. water tends to be very corrosive to the distribution system and plumbing. To help minimize the corrosiveness of the water, Bolton & Menk has successfully blended the R.O. water with a small portion of the filtered water to both raise the pH and provide alkalinity to minimize the corrosion. Chemical feed is also utilized with blending to raise the pH and add a corrosion inhibitor to meet the State's lead and copper rule.

Based on our meeting discussions, water quality required, raw water quality in the wells and treatment technologies available, reverse osmosis is the clear recommendation to further treat Saint Peter's drinking water. Reverse osmosis is an advanced technology that will not only meet the water quality desired today, it will also create a barrier for future and unknown contaminants such as viruses, bacteria, arsenic and most endocrine disrupters. Regardless of the raw water quality found, R.O. will provide a positive barrier to contaminants.

Because R.O. was the treatment technology selected during the meeting with industry experts, it was decided that raw water quality was not as critical as first believed. Moving ahead with this idea, it was decided not to construct a test well both because R.O. membranes would treat nearly any raw water encountered but also because the Mt. Simon was the only source of water with enough capacity for the City.

One item to design for with any R.O. treatment is the disposal of the reject water. As discussed previously, the reject water from the Jordan aquifer may be able to be used for irrigation if permitted by the MPCA. All other reject (and the Jordan reject during non-irrigation times) will need to be discharged thru the sanitary sewer. A major advantage of softening the drinking water supply with reverse osmosis is the decrease of chlorides and TDS because home water softeners will not be required (or significantly turned down) thus lowering the salt discharged to the sanitary sewer. The following calculation shows the difference between reverse osmosis and home zeolite water softeners for a typical example:

- Raw Well Water Hardness (as $CaCO_3$) 390 mg/l
- Finished Water Hardness (as $CaCO_3$) 80 mg/l
- Hardness Removed 310 mg/l = 18.1 grains/gallon
- Average Daily Water Use 1.7 MGD
- Zeolite Softener Assumptions:
  - Ion Exchange Capacity 25,000 gr/cu ft resin
  - Salt Required for Regeneration 15 lbs salt/cu ft resin
- Estimated Daily Salt Use = 18.1 x 1,700,000 x 1/25,000 x 15 = 18,460 lbs/day
- Annual Salt Discharge to Sanitary Sewer with Home Softeners = 3,400 tons/year
- Annual Salt Discharge with Reverse Osmosis to Soften to the Same Level = 1,490 tons/year (400 gpm Reject Chloride = 1200 mg/l in Reject)

Reverse osmosis treatment will save nearly 2,000 tons per year of chlorides discharged thru the wastewater treatment facility.

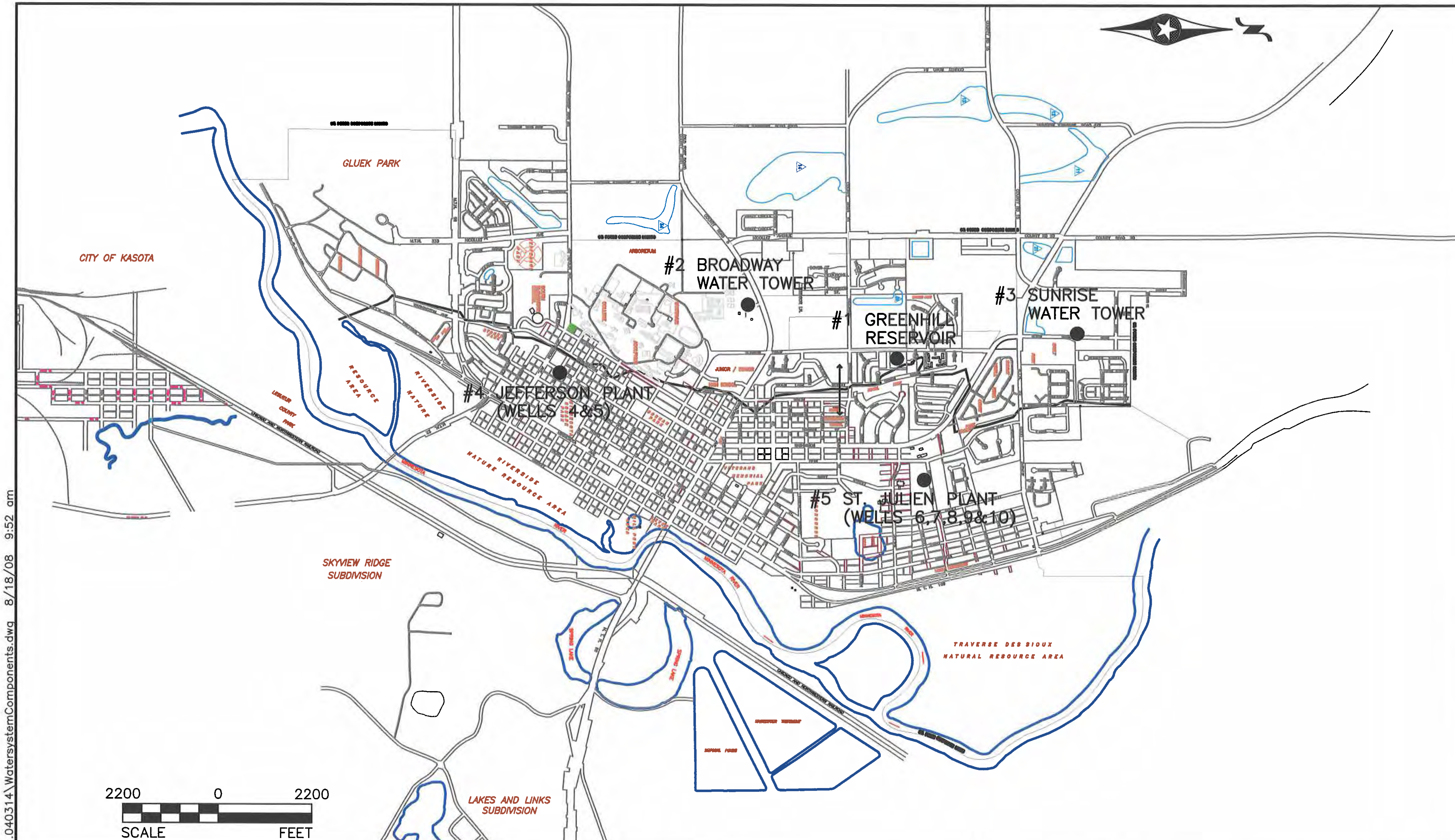
It is recommended that the City proceed with gravity filtration for iron and manganese removal followed by reverse osmosis and blending to meet the finished water quality described in Section 2.

B. PRESENTATION OF ALTERNATIVES

Through out this evaluation, five main sites have been proposed as practical treatment locations.

1. Area near Greenhill Reservoir;
2. Area near Broadway Water Tower;
3. Area near Sunrise Water Tower;
4. Existing Jefferson WTF Site;
5. Existing St. Julien WTF Site.

These five areas can be seen on Figure 5-1, Proposed Water Treatment Locations. The Minnesota Department of Health recommends the multi-aquifer wells at Jefferson WTF be sealed and abandoned; therefore, this site was removed from further consideration. The projects are presented in three phases, however, phases I and II should be completed together. They are separated to show that phase I must be on line before completing phase II for operational purposes.



BOLTON & MENK, INC
CONSULTING ENGINEERS & SURVEYORS
MANKATO, MN FAIRMONT, MN SLEEPY EYE, MN WILLMAR, MN
BURNSVILLE, MN CHASKA, MN AMES, IA LIBERTY, MO

CITY OF SAINT PETER
PROPOSED WATER TREATMENT LOCATIONS

AUGUST, 2008

FIGURE NO. 5–1

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1. Greenhill Reservoir Area (Figure 5-2) (Greenhill Alternative)

A new treatment facility in the location of the Greenhill Reservoir was evaluated for this alternative. At the meeting held on July 3, 2008, four different alternatives were discussed, including a new treatment facility at the Greenhill Reservoir. After that time, a more careful evaluation of future well sites was completed by Barr Engineering, resulting in the Greenhill Reservoir site becoming less desirable than other alternative sites.

The Greenhill site is directly up-gradient of the new production wells at St. Julien. Therefore, any new wells near Greenhill could result in significant capacity lost for the existing wells. Because of this, new wells at Greenhill are not recommended. Any new wells to feed Greenhill would need to come from a well field approximately 1 mile to the north or south of the Greenhill site to help minimize the impact to the existing wells. The distance to the well field will increase the cost of the raw water transmission lines significantly and require a large wellhouse to be built on the well field site.

To help offset some of these increased well costs, this alternative proposes to have all reverse osmosis treatment at Greenhill.

This alternative would provide a 2,500 gpm iron and manganese filtration plant at the Greenhill area. The St. Julien facility will not be changed except to modify the wells and raw water piping to ensure 1,500 gpm iron and manganese removal capacity. The gravity filtration capacity at St. Julien is 1,500 gpm with four wells at this site. Because the existing facilities are in good working order, it is not cost-effective to demolish this infrastructure only to re-build it in a new location. Because of this, it is proposed to rehabilitate the required equipment and processes at the St. Julien WTF. Also, the wells and raw water piping would be refurbished to increase their capacities to allow the full 1,500 gpm to reach the facility. The water from St. Julien will be pumped directly to the new Greenhill treatment facility through the existing dedicated pipeline (and extended to WTF site). The clearwell as Greenhill will be sized for the full 4,000 gpm flow and 3,600 gpm of reverse osmosis capacity. This will provide ease of operation by locating all reverse osmosis equipment and chemical feed at one location. It will also eliminate the need for a new building and clearwell that is required at St. Julien under Options 2 and 3.

As with the next two options, an additional ground storage reservoir could be constructed at the Greenhill site to provide lower system redundancy for the existing Greenhill Reservoir. However, because the raw and pretreated water (from St. Julien) will be coming from some distance, it is not feasible to keep the raw water from the Jordan Aquifer separate for R.O. treatment. Therefore, reuse of the Jordan Aquifer concentrate water for irrigation is not included as part of Option 1.

Because of the wide variation of the improvements and various options available, we would recommend a phased approach to this option, as well as options 2 and 3. These phases could be split up differently; however, the first phase should include the required elements to meet the City's needs in the near future (2010-2012). Below is a summary of the costs for the Greenhill alternative.

Greenhill Alternative Project Costs

Construction Sequence Phase I Treatment Plant and Wells (Eligible for PFA Loan Funding)		
Treatment Plant		
2500 gpm gravity filtration, clearwell & reclaim		$6,200,000
2300 gpm R.O. advanced treatment		3,000,000
	Subtotal	**$9,200,000**
Wells (at Broadway Site)		
Mt. Simon		$500,000
FIG		250,000
Jordan		200,000
Well House		350,000
Raw Water Pipelines		400,000
	Subtotal	**$1,700,000**
St. Julien and Piping Modifications		
Upgrade wells 6, 7, 8, 9, 10		$100,000
Piping connections at Greenhill		350,000
	Subtotal	**$450,000**
	Construction Subtotal	**$11,350,000**
Engineering/Legal/Administration/Contingency (15%)		$1,700,000
Land Acquisition (8 acres @ $40,000/acre)		$320,000
	GREENHILL ALTERNATIVE WTF SUBTOTAL	**$13,370,000**

GREENHILL WTF SITE

AUGUST, 2008

FIGURE 5-2

BOLTON & MENK, INC.
Consulting Engineers & Surveyors

City of Saint Peter

Greenhill Alternative Project Costs (Continued)

Construction Sequence Phase II Lower System Redundancy and Demolition of Jefferson	
250,000 gallon ground storage reservoir	$600,000[a]
Pumps and connection to lower system	120,000[a]
Demolish Jefferson	200,000
Seal wells	30,000
Redundant well (Mt. Simon)	500,000[a]
Construction Subtotal	**$1,450,000**
Engineering/Legal/Administration/Contingency (15%)	220,000
GREENHILL ALTERNATIVE / REDUNDANCY SUBTOTAL	**$1,670,000**
PFA Loan Eligible Cost	$264,500
PFA Loan Non-Eligible Cost	$1,405,500
GRAND TOTAL	**$15,040,000**

Phase III – Not feasible at Greenhill site.

[a] May not be eligible for PFA loan funding.

2. Broadway Tower Area (Figure 5-3) (Broadway Alternative)

The Broadway alternative includes a new treatment facility at the Broadway Tower site. This facility would have the capacity to filter 2,500 gpm for iron and manganese and reverse osmosis capacity for 2,300 gpm (this will keep the finished water hardness between 75-100 mg/L). The site would include three new wells with plans to add a fourth well in the vicinity for redundancy. This plant would be constructed in and connect to the upper system to provide a back-up for the Greenhill pump station. As an option, this facility can be constructed with a ground storage reservoir and a connection to the lower system to provide another reservoir for the lower system. Another option that could be added to this site would be segregation of the Jordan Aquifer reject for irrigation water. This option would require its own separate reservoir to meet the Minnesota Department of Health regulations and permitting by the MPCA.

The facilities would be located just west of the Existing Broadway Avenue Water Tower as shown on Figure 5.3. This location includes many advantages including:

1. City Owned Land;
2. Close proximity to major water mains;
3. Close proximity to Gustavus and the High School athletic fields (if reuse if permitted in the future);
4. Located the longest distance away from existing well field at St. Julien to minimize drawdown;
5. Located in the center of the City which will provide good water mixing/turnover and help increase distribution system performance;

6. Land is available for three wells and area for future wells nearby.

The Broadway site appears to be an excellent location for a new facility, however, in order to provide a connection to the lower system for redundancy, considerable construction along Broadway Avenue will need to occur. A summary of the costs for a new treatment facility near the Broadway Tower is presented below. As in Option 1, a phased approach has been developed to help distribute costs over time and provide needed improvements in a timely manner.

Broadway Alternative Project Costs

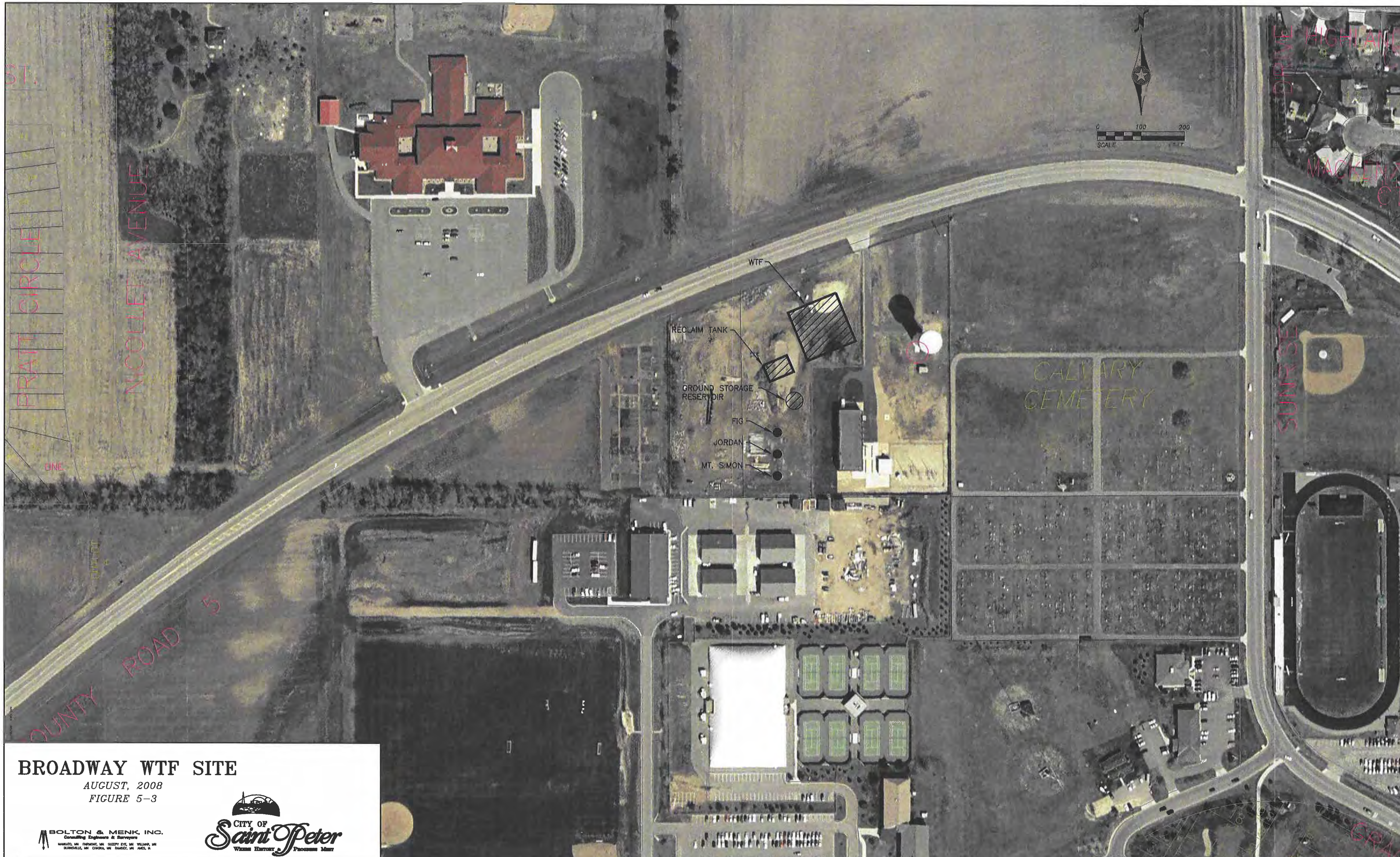
Construction Sequence Phase I Treatment Plant and Wells (Eligible for PFA Loan Funding)

Treatment Plant		
2500 gpm gravity filtration plant		$5,900,000*
2300 gpm R.O. advanced treatment		2,100,000
	Subtotal	**$8,000,000**
Wells (at Broadway Site)		
Mt. Simon		$500,000
FIG		250,000
Jordan		200,000
	Subtotal	**$950,000**
St. Julien Modifications		
Upgrade wells 6, 7, 8, 9, 10		$ 100,000
Add R.O. building and blending clearwell		1,200,000
	Subtotal	**$1,300,000**
	Construction Subtotal	**$10,250,000**
Engineering/Legal/Administration/Contingency (15%)		$1,500,000
Land Acquisition		0
	BROADWAY ALTERNATIVE / WTF SUBTOTAL	**$11,750,000**

- Phase II – Lower System Redundancy, Demolition of Jefferson, Additional Well

- Water System		
250,000 gallon ground storage reservoir		$600,000 [a]
Pumps and connection to lower system		620,000 [a]
Seal wells		30,000
Demolish Jefferson		200,000
Redundant well (Mt. Simon)		500,000 [a]
	Construction Subtotal	**$1,950,000**
Engineering/Legal/Administration/Contingency (15%)		300,000
	BROADWAY ALTERNATIVE / REDUNDANCY SUBTOTAL	**$2,250,000**
	PFA Loan Eligible Cost	$264,500
	PFA Loan Non-Eligible Cost	$1,985,500
	GRAND TOTAL	**$14,000,000**

[a] May not be eligible for PFA loan funding.



BROADWAY WTF SITE

AUGUST, 2008

FIGURE 5-3

BOLTON & MENK, INC. Consulting Engineers & Surveyors

CITY OF Saint Peter

- Phase III –Water Reuse** (Not Eligible for PFA Loan Funding)

- Re-Use Systems**		
50,000 gallon steel tank at Broadway		$230,000
50,000 gallon steel tank at St. Julien		230,000
Pumping facility at Broadway		80,000
Pumping facility at St. Julien		80,000
	Phase III Subtotal	**$620,000**
Engineering/Legal/Administration/Contingency (15%)		100,000
	BROADWAY ALTERNATIVE / PHASE III TOTAL	**$720,000**

* Note this is less than the Greenhill alternative because with this option, high service pumps and clearwell will also be at St. Julien.

** Note re-use system does not include distribution system.

With this alternative and the Sunrise alternative, we are proposing to leave the infrastructure at the St. Julien WTF in place and add reverse osmosis after the gravity filters. The gravity filtration capacity at St. Julien is 1,500 gpm with four wells at this site. Because the existing facilities are in good working order, it is not cost-effective to demolish this infrastructure only to re-build it in a new location. Because of this, it is proposed to rehabilitate the required equipment and processes at the St. Julien WTF. Also, the wells and raw water piping would be refurbished to increase their capacities to allow the full 1,500 gpm to reach the facility. In addition to the rework on the existing systems, a new 1,300 gpm (to maintain hardness between 75-100 mg/L) reverse osmosis treatment system and building would be added, including a new 100,000 gallon reservoir (approximately) for blending of the reverse osmosis permeate and non-R.O. water. Note that the new WTF's would also have a clearwell for blending of the finished water.

Under this option the total gravity filtration capacity would be 4,000 gpm. Assuming an R.O. recovery of 75% (recovery can range between 70-75% typically) and a blend ratio of 85% R.O. to 15% non-R.O., the total finished water pumping capacity would be 2,900 gpm which meets the projected demand and population for the design year 2030.

3. Sunrise Tower Area (Figure 5-4) (Sunrise Alternative)

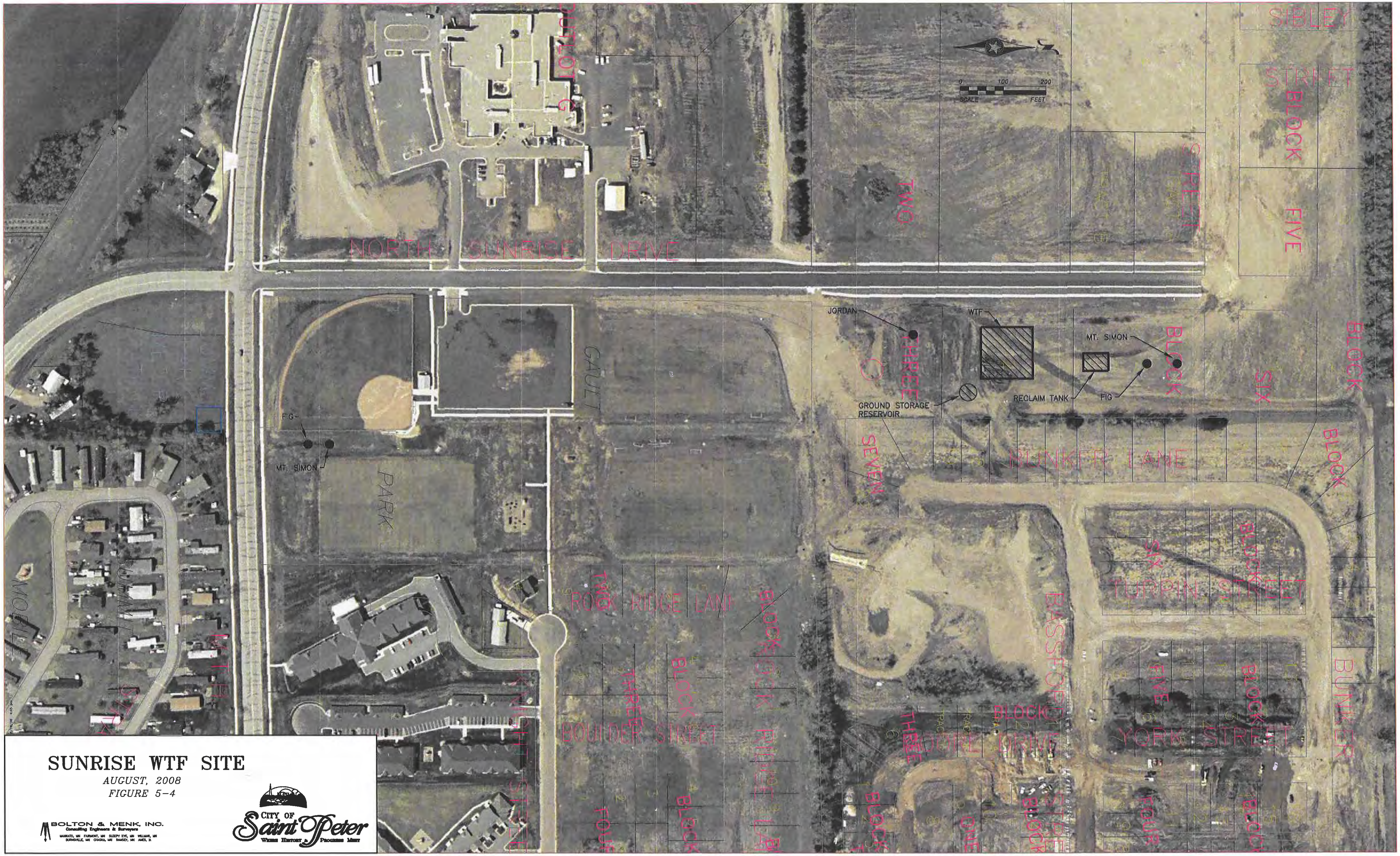
This alternative is nearly identical to the Broadway alternative; however, the new treatment facilities and wells would be near the Sunrise Avenue Water Tower as shown in Figure 5.4. This option would create a new 2,500 gpm treatment facility with reverse osmosis while modifying the St. Julien Facility to add R.O. The Sunrise Tower site would require the purchase of two industrial park lots for the required facilities and wells. The site appears to be a good fit for the following reasons:

1. Located in the upper system;
2. Close proximity to major water mains;
3. The land from the industrial lots as well as the park could be utilized for the new wellfield;
4. Land is available to reuse Jordan concentrate water for irrigation, if permitted;
5. Located west and north of existing wells which will help minimize interferences with the existing wells;
6. Connection to lower system is closer and less costly than Broadway.

A summary of the costs associated with this alternative is presented below. As in previous options, the costs are presented in a phased approach.

Sunrise Alternative Project Costs

Construction Sequence Phase I Treatment Plant and Wells (Eligible for PFA Loan Funding)		
Treatment Plant		
2500 gpm gravity filtration plant		$5,900,000*
2300 gpm R.O. advanced treatment		2,100,000
	Subtotal	**$8,000,000**
Wells (at Broadway Site)		
Mt. Simon		$500,000
FIG		250,000
Jordan		200,000
Seal wells at Jefferson		30,000
	Subtotal	**$980,000**
St. Julien Modifications		
Upgrade wells 6, 7, 8, 9, 10		$ 100,000
Add R.O. building and blending clearwell		1,200,000
	Subtotal	**$1,300,000**
	Construction Subtotal	**$10,280,000**
Engineering/Legal/Administration/Contingency (15%)		$1,500,000
Land Acquisition		200,000
	SUNRISE ALTERNATIVE / WTF SUBTOTAL	**$11,980,000**



SUNRISE WTF SITE

AUGUST, 2008

FIGURE 5-4

BOLTON & MENK, INC.
Consulting Engineers & Surveyors

CITY OF Saint Peter

- Construction Sequence Phase II Lower System Redundancy, Demolition of Jefferson, Water Reuse

- Water System	
250,000 gallon ground storage reservoir	$600,000 [a]
Pumps and connection to lower system	250,000 [a]
Demolish Jefferson	200,000
Seal wells at Jefferson	30,000
Redundant well (Mt. Simon)	500,000 [a]
Construction Subtotal	**$1,580,000**
Engineering/Legal/Administration/Contingency (15%)	230,000
SUNRISE ALTERNATIVE / REDUNDANCY SUBTOTAL	**$1,810,000**
GRAND TOTAL	**$13,790,000**
PFA Loan Eligible Cost	$264,500
PFA Loan Non-Eligible Cost	$1,545,500

- Phase III –Water Reuse** (Not Eligible for PFA Loan Funding)

- Re-Use Systems**	
50,000 gallon steel tank at Broadway	$230,000
50,000 gallon steel tank at St. Julien	230,000
Pumping facility at Broadway	80,000
Pumping facility at St. Julien	80,000
Phase III Subtotal	**$620,000**
Engineering/Legal/Administration/Contingency (15%)	100,000
SUNRISE ALTERNATIVE / PHASE III TOTAL	**$720,000**

* Note this is less than option 1 because with this option, high service pumps and clearwell will also be at St. Julien.

** Note re-use system does not include distribution system.

[a] Not eligible for PFA loan funding.

4. Jefferson WTF Site

Jefferson WTF site was eliminated as an alternative due to lack of area for new wells, staging concerns with construction of a new treatment facility in a small site while maintain operation of the existing WTF, and the location in the lower system. In order to provide redundancy to the Greenhill Reservoir Pump Station, it was decided that the best location for a new treatment facility would be on the upper pressure system. This conclusion is further detailed in Appendix A6.

5. St. Julien WTF Site

The St. Julien WTF facility site was eliminated as an alternative because no additional well capacity was available in the area in addition to space concerns with the land that would be required for approximately 2,500 gpm of gravity filtration. Without land available for a large treatment facility and without well spacing required to minimize drawdown in existing wells, this site was deemed unfeasible.

C. OPERATION AND MAINTENANCE

Operation and maintenance costs between all three alternatives would vary only slightly, and for the purposes of this report would be considered equal. A basic summary of the estimated additional O&M costs is presented in Table 5.1.

Table 5.1
ADDITIONAL OPERATION AND MAINTENANCE COSTS PER YEAR

Membrane Replacement Cost	$ 65,000
Chemical Cost	80,000
Electrical and Natural Gas	120,000
Additional Personnel	80,000
Increased Wastewater O&M Cost	100,000
Miscellaneous Maintenance	20,000
TOTAL YEARLY O&M COST	**$465,000**

A summary of the existing O&M costs per year is presented in Table 5.2.

Table 5.2
EXISTING OPERATION AND MAINTENANCE COSTS PER YEAR*

Wells	$ 73,000
Treatment Facilities	180,000
Distribution & Storage Facilities	385,000
General Administration & Customer Accounts	152,000
TOTAL YEARLY O&M COST	**$790,000**
* These costs do not include Jefferson WTF.	

Based on the additional O&M Costs and subtracting the savings of Jefferson WTF O&M cost, the actual additional cost to the city for operation and maintenance is between $375,000 - $395,000 ($465,000 + $790,000 = $1,255,000 in O&M – Existing O&M of $868,000 = $387,000 additional O&M).

SECTION 6 RECOMMENDATIONS AND CONCLUSIONS

A. RANKING OF ALTERNATIVES

Below is a brief ranking of the three options presented in Section 5 including an explanation of the ranking.

- Greenhill WTF with Remote Wells and all R.O. Treatment
  Rank = 3. This option, although desirable from an O&M standpoint, proved to be a much higher cost.

- Broadway WTF with St. Julien Modifications
  Rank = 1. Because it is centrally located in the city and the greatest distance from the existing wells, this option was ranked first since the cost was so close to option 3.

- Sunrise WTF with St. Julien Modifications
  Rank = 2. Very close alternative to option 2. However, the lower cost was not great enough to outweigh other considerations.

- New Jefferson WTF and Large Gravity Filtration at St. Julien
  Rank = 4 and 5.

B. RECOMMENDED ALTERNATIVE

It is recommended that the City of Saint Peter proceed with Option No. 2, a new treatment facility near the Broadway tower site and an upgrade to the St. Julien WTF. Although this option is slightly higher in cost than the Sunrise site, when considering all phases, the benefits to this site seems to outweigh the cost difference.

- Centrally located (distribution system consideration).
- Greatest distance from existing St. Julien well field.
- Could correct storm water problems when installing watermain along Broadway.
- Close proximity to athletic fields for addition of re-use.

The Broadway water treatment facility would be located directly west of the Broadway water tower on a 5 acre parcel owned by the City of Saint Peter. The well field would consist of 3 new wells and options to add more wells pending results of test pumping.

The treatment plant will be a 2500 gpm gravity filtration plant with reclaim tank to reuse the backwash water. The plant will have a dual chamber clearwell to facilitate backwashing and membrane feed as well as a blending of the R.O. permeate. The reverse osmosis will have a feed rate of 2300 gpm and a permeate flow of 1600 gpm. The facility will contain high service pumps for the upper and lower system. A ground storage reservoir will be designed for this site to provide redundancy of the Greenhill reservoir and for possible irrigation use pending approval from the Minnesota Department of Health.

This project would be sequenced to allow well capacity and quantity information to be obtained prior to finalizing the WTF design. This will allow the city to better evaluate the incremental costs of increasing/decreasing treatment capacity and how these decisions could affect operation and delivery of a safe drinking water supply.

After start-up, testing and permitting of the R.O. reject from the Jordan aquifer, Phase III could be implemented to add an irrigation water system and additional tank, if required, to the facility.

When implemented, the new capital improvements costs the City would incur are approximately $930,017 worth of debt service per year (see Appendix C) and an additional O&M cost of $387,000 per year. This results in an annual cost of $1,317,017 that could be recovered thru an increase in water rates and a monthly base fee. The elimination of Saint Peter's declining block water rates would also help to pay these costs. Eliminating this rate structure will be critical for obtaining permits from the Minnesota Department of Natural Resources to proceed with construction.

Based on annual water sales of 380.4 million gallons in 2006 and the example rates in Appendix C, the increase in cost per 1,000 gallons would be approximately $2.47. Part of this cost increase would be offset by the decrease in softener salt used and the lifetime savings for plumbing, water heaters and water using appliances.

At this time, we recommend the City proceed with the Broadway alternative in order to have the required facilities online by 2010 as presented in paragraph D of this section.

C. SUMMARY OF NEW TECHNOLOGY

The technology to be used in the Saint Peter WTF's is the Reverse Osmosis Membrane Technology. Unlike iron and manganese gravity filtration, reverse osmosis is a new technology that is quickly being expanded to meet the ever changing water regulation as well as increase the available water supply by treating sources that were previously non-potable.

According to the book "Water Treatment Membrane Processes" by the AWWA Research Foundation, Lyonnaise desEaux, and the Water Research Commission of South Africa:

> "Reverse Osmosis is capable of rejecting contaminants or particles with diameters as small as 0.0001 um, whereas Nanofiltration can reject contaminants as small as 0.001 um. Both reverse osmosis and nanofiltration can be described as diffusion-controlled processes in that mass transfer of ions through these membranes is diffusion controlled. Consequently, these processes can remove salts, hardness, pathogens, turbidity, disinfection by-product (DBP) precursors, synthetic organic compounds (SOC's), pesticides, and most all potable water contaminants known today. No process represents universal treatment for all contaminants (Taylor, 1995; Taylor et al., 1990). Most dissolved gases such as hydrogen sulfide and carbon dioxide and some pesticides will pass through RO or NF membranes. However, membrane technology can be used to treat a broader range of potable water contaminants than any other treatment technology."

As stated above, R.O. can treat a broader range of known water contaminants than any other technology. This is the reason why R.O. was selected for Saint Peter. It not only can soften and remove nitrates from the water supply, it can also provide a reliable barrier to future contaminants and potential pathogens thus providing a safe, reliable, and aesthetically pleasing water supply to the City of Saint Peter, now and well into the future.

D. CRITICAL PATH AND CONCLUSION

At the beginning of August 2008, the Public Facilities Authority issued the Drinking Water Revolving Fund (DWRF) 2009 Intended Use Plan. Saint Peter's three projects (additional wells, new WTF, and Rehabilitation of St. Julien) were the last three fundable projects listed for 2008 according to the ranking. This means that the City is eligible for low interest loans (typically 2-3%) through the DWRF to fund all of the items listed in the first phase of the recommended option. The list of fundable projects vary from year to year and because of the low ranking of Saint Peter's projects it would be beneficial to take advantage of PFA funding this year as there are no guarantees in future years if the projects would be funded through DWRF.

In addition to the funding that is available this year, the City staff has indicated that they would like to have a new facility on-line by 2010 to meet Saint Peter's ever growing water demands. These demands are shown in the Water Master Plan. With Saint Peter's growing population, the existing peak treatment capacity from St. Julien WTF and the aging Jefferson WTF will be surpassed shortly after the year 2010.

To meet Saint Peter's water needs and take advantage of DWRF funding, the following critical paths shown in Tables 6.1 and 6.2 should be followed to implement the recommendations found in this project.

Table 6.1
DETAILED DESIGN AND CONSTRUCTION SCHEDULE

October 13, 2008	• Authorization of wells and water treatment facility design, bidding of wells, and construction services for wells.
Week of October 20, 2008	• Complete environmental review and send to State (well project only).
November 2008	• Complete well design. • Submit well plans and specifications to Minnesota Department of Health. • 30 day public comment of environmental review. • Review preliminary layouts of water treatment facility.
December 2008	• Bid wells. • Continue review of water treatment facility ongoing design.
January 2009	• Begin well construction. • 50% design review of water treatment facility improvements. • Environmental review for PFA (water treatment facility project).
February 2009	• Continue well construction. • Finalize plans and specifications for submittal on water treatment facility.
March 2009	• Submit water treatment facility plans and specifications to Minnesota Department of Health (March 2). • Begin test pumping wells.
April 2009	• Value engineering on water treatment facility. • Final design modifications. • Council approval of water treatment facility.

May 2009	• Finish first two wells and continue with others. • Advertise water treatment facility project.
June 2009 (June 30 is PFA deadline for 2009 projects)	• Bid water treatment facility. • Award water treatment facility.
July 2009 – Summer 2011	• Finish all wells. • Construction Sequence 1 – Construct new water treatment facility at Broadway. • Construction Sequence 2 – Start-up new water treatment facility. • Construction Sequence 3 – Provide lower system redundancy. • Construction Sequence 4 – Construct modifications to St. Julien water treatment facility. • Construction Sequence 5 – Start-up St. Julien water treatment facility. • Construction Sequence 6 – Seal multi-aquifer wells and demolish Jefferson water treatment facility.
Fall 2011	• Final project closeout.

The schedule to implement the recommendations is extremely tight. Immediate action is needed to have a new facility on-line by 2010. To meet the schedule and take advantage of funding, we recommend that the City Council authorize Bolton & Menk to begin design on Phase I by October 15, 2008. Bolton & Menk has designed numerous facilities of this size throughout Minnesota and is prepared to begin design immediately. Details of these facilities can be seen in Bolton & Menk's proposal for this report.

Table 6.2
CRITICAL PATH TO IMPLEMENT RECOMMENDATIONS

Item	Date										
	Oct. 2008	Nov. 2008	Dec. 2008	Jan. 2009	Feb. 2009	* Mar. 2009	Apr. 2009	May 2009	June 2009	2010	2011
Council workshop and approval of this Report	■										
Authorize Bolton & Menk to begin design of Wells and WTF	■										
Tour existing WTF's with City staff	■										
Submit well designs to the Minnesota Department of Health		■									
Bid wells and begin construction			■	■							
Submit plans and specifications for WTF to the City and Minnesota Department of Health for review.					■	■					
Value Engineering and Final Bid Package Approved from Council.							■				
Bid WTF and St. Julien modifications								■			
Finalize PFA funding.									■		
Construction of new WTF.										■	
Start-up of new WTF and St. Julien modifications											■

* PFA Plan Submission Deadline is March 2, 2009.

APPENDIX A

Meetings and Memorandums

A1

BOLTON & MENK, INC.
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CITY OF SAINT PETER, MINNESOTA
EVALUATION & RECOMMENDATIONS OF
WATER SYSTEM IMPROVEMENTS

Preliminary Project Meeting Minutes
April 8, 2008 at 1:15 p.m.

Minutes

1. Attendees: Lew Giesking, Pete Moulton, Kris Swanson, Chris Voeltz, Jeff Domras, Bob Brown, Herman Dharmarajah

2. Personnel Involvement
   a. City staff – Lew, Pete and Chris
   b. Lew and Pete will update Todd Prafke on a regular basis.
   c. Engineering and expert staff – Bolton & Menk along with proposed experts

3. Water Evaluation Meeting (Discussion Topics)
   1. Workshops will be with entire council (not just utilities)
   2. Water tables and water quality brainstorming (sources of water). Hydrologist with feel for aquifer information.
      a. Barr Engineering
   3. State Hospital and Gustavus need not be intimately involved, Jeff and Jim from Gustavus may be a good resource
      a. Jeff at Gustavus (Professor of Environmental Services)
      b. Jim from Gustavus (sustainable community)
   4. Distribute copy of Phase I Report from Jeff Domras on wells for an initial source water meeting
   5. Check with Barr Engineering about Met Council drought report
   6. Possible test well(s) to check quality of potential water sources (after VE meeting or as required)
   7. Design year is 2030, or associated water consumption/use
      a. Look at checking population vs. gallons. Correlate water usage and the calendar year closely.
   8. Check with DNR on future restrictions for St. Peter water sources
      a. Preliminary meeting to be arranged

9. Technical water source meeting to brainstorm:
   - ➢ Sources
   - ➢ Quality
   - ➢ Quantity
   - ➢ Schedule meeting for the beginning of May

   a. End of May value engineering meeting to utilize info from source meeting and look at options
10. Flexibility with water sources – Pete may prefer an upper system treatment to provide water by passing Greenhill.
11. Must have one (1) water quality throughout the City.
12. Look at global warming drought areas from NASA if available (Jim Hanson)
13. Public meeting after recommendations when site selection is proceeding.

4. Schedules and Milestones

a. Pre-meeting with DNR in April
b. Information gathering – prior to meeting on water sources
c. Water Sources/Quality meeting – early May
d. Value Engineering meeting – late May early June
e. Conclusions and recommendations – July

5. Action Items

a. Pete – will email Kris Swanson contact information for Jim Dantje and Jeff? (from Gustavus) and let him know who to invite to the water source meeting.
b. Kris – Line meeting up with DNR for April
c. Kris – Line up water source meeting (Tuesdays are good days) for early May
   - ➢ Barr Engineering
   - ➢ Gustavus employees (per action item a.)
   - ➢ Gordon Culp

d. Herman/Jeff Domras/Kris – Gather Information for water source meeting and VE meeting
e. Bob – Will schedule value engineering meeting with technical experts for late May or early June

6. Items from Other Consultants' Proposals the City Would Like Evaluated

a. Construct a 2.6 MGD (1800 gpm) water treatment plant on the empty lot north of the Greenhill Reservoir.
   - ➢ Construct 4 F1G wells as a water supply, 2 at McGill Park, and 2 on the Greenhill property.
   - ➢ Add a 500 gpm RO system to reduce TDS below 500 mg/l.

b. Drill 2 new 900 gpm Mt. Simon wells at Greenhill Reservoir.
   - ➢ Construct new 1.9 MGD – RO treatment plant at Greenhill reservoir. Add RO to the St. Julien water treatment plan. Abandon Jefferson plant.

A2

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CITY OF SAINT PETER, MINNESOTA
WATER SYSTEM EVALUATION

Meeting Minutes
April 30, 2008 at 1:15 p.m.

Minutes

1. Attendees:

a. Leo Getsfried, DNR

b. Lew Giesking, Saint Peter Public Works

c. Pete Moulton, Saint Peter Public Works

d. Kris Swanson, Bolton & Menk

e. Herman Dharmarajah, Bolton & Menk

2. Purposes of Meeting:

a. Determine the requirements for a Mt. Simon well.

b. Has city met all requirements to begin a WTF and wellfield (WECP is completed but not approved)

c. Is the DNR water appropriations for 5 or 10 years

d. When is hydrogeological study/pump test/monitoring wells required?

3. Introductions by Kris Swanson

a. Leo Getsfried.

b. 2nd generation of Saint Peter WECP.

c. Doesn't see any significant obstacles for city with any groundwater aquifers, including the Mt. Simon, now or into the future. Thinks that the City of Saint Peter additional Mt. Simon wells would be especially acceptable because they are using it for domestic use and have no major industrial use.

d. If Mt Simon levels changed due to aquifer changes, domestic would be priority (ethanol and industry would be restricted).

e. No known shortages in the aquifers.

f. Leo stated they are trying to get three wells to monitor Mt. Simon. Hopefully won't show any significant impacts.

g. DNR eliminated cooling water from Mt. Simon in the Twin Cities.

h. DNR won't be looking for a separate monitoring well from St. Peter and does not know of a situation that would require it.

i. Significant domestic use typically won't require aquifer tests. Industrial or commercial uses may

j. Major user coming on line requires an aquifer test.

k. DNR is to protect aquifers and not allow significant drops in levels.

l. Appropriations of water shouldn't be restricted if city is moving in right direction and show domestic need.

m. Appropriations of water are for only 5 years currently. Can be extended for 10 years if certain criteria are met. Leo would send Kris info on this.

n. At this time, nothing further is required from the city after Leo's preliminary review of WECP

4. Other aquifer and area hydrology items to note as discussed by attendees:

a. Mankato is utilizing Ranny Wells (under the direct influence of surface water) (contains nitrates).

b. Central Harvest States uses one thru cooling water almost as much as city of Mankato out of the Mt. Simon aquifer.

c. Eliminating multiple aquifer wells as a positive with DNR and MDH gains points for state revolving fund (DWRF).

d. Self sustainable water sources. Leo has no information and suggests MDH as source for information.

e. MPCA and MDH are contacts for reusing wastewater.

f. As long as city is under 10% unaccounted water, DNR doesn't take a significant look at the unaccounted water.

g. Will state ever require meters to be calibrated once a year? Answer is unknown by Leo. Wisconsin requires once a year calibration.

h. Will DNR impose mandated conservation and/or per capita water use caps? Leo: Not at this time, but future is unknown.

i. Are there any regulations on FIG or Jordan wells? Leo: Nothing at this time.

j. The Jordan aquifer in St. Peter has nitrates (Wells 6 and 9). DNR has no info with water quality.

k. Wells 8 and 10 are FIGS limited production. 50% of water in St. Peter from FIGS.

l. Jefferson WTF Wells come from 25% Mt. Simon / 25% Jordan / 50% FIG as determined from age dating the water a few years back per Pete.

m. Most municipalities in this area are in the deeper aquifers according to Leo.

n. Seven county metro area is limited to 75 gpcd of Mt. Simon water. Originally w as proposed state-wide. Discussion that is probably in the City's best interest to maintain FIGS and Jordan wells (or develop new wells to keep Mt Simon at 75 gpcd or lower).

o. Leo has not heard anything about recharging groundwater aquifers. He will check with state office.

5. Leo was going to get back to Kris with information on recharging groundwater aquifers, requirements that must be met to obtain 10-year water appropriations.

Water Supply Plans and Water Appropriation Permit Approvals

Water Supply Plan (WS Plan) approvals may also include approval for increased water volumes and/or new wells that are planned over the ten year life of the plan. Requesting permit approvals as part of the WS Plan is optional and would most likely benefit growing communities that anticipate large increases in water use or a number of new wells over the next ten years. To qualify for the ten year permit approval certain benchmarks or conservation measures are required along with adequate documentation on the need for increased water volumes and new wells.

Benchmarks and Conservation Measures. Permit approvals will be based on meeting specified benchmarks listed below. If water demands exceed Benchmarks for unaccounted water, residential per capita, and peak demands then permit approval will be contingent on implementation of one or all the listed Conservation Measures or Programs until the benchmark is achieved.

Benchmarks	Conservation Measures or Programs
Unaccounted Water (water withdrawals minus sales) Less than 10%	If over 10%, a plan is required that addresses reduction of unaccounted water through universal metering and accounting of water use, routine meter testing and repair, and distribution system leak detection and repair. ➢ Metering of source water and customers. ➢ Accounting for public uses. ➢ Water audits to determine unaccounted water. ➢ A leak detection survey that also includes an inspection of hydrants once each year. ➢ Operational procedures that include an established schedule for repairing leaks within 30 days. ➢ Operational procedures that include an established schedule for meter testing, maintenance and repair.
Residential Gallons Per Capita Less than 75 GPCD	If over 75 GPCD, a plan is required that evaluates and implements measures targeted at reducing residential per capita. ➢ Analyze residential customer use to determine reasons for high per capita use. ➢ Customer education a minimum of four times per year that targets reduction of indoor and outdoor uses. ➢ Contact customers with high volumes and large volume increases and offer home audits and conservation tips. ➢ Incentive programs to reduce per capita use, such as distributing showerheads, aerators, leak detection kits, or soil moisture meters, rebates for washing machines or ULF toilets rebate programs, or other types of incentives.

Peak Demands Maximum Day to Average Day Ratio Less than 2.6	If over a ratio of 2.6, a plan is required to reduce peak demands. ➢ Ordinances for lawn watering including time of day, scheduling (along with information on how often to water) and water wasting (runoff) with adequate enforcement and penalties for non-compliance. ➢ Development approvals with criteria that minimize large open turf areas, require organic soil augmentation for new turf areas on sandy soils, and require one or more trees for new construction. ➢ Customer education/conservation tips during summer peak demands a minimum of four times between May and September of each year. ➢ Conservation Water Rate Structure: Increasing block **or** summer surcharge with 25-cent minimum increments between blocks or normal rates.
Rate Structures - A conservation or conservation neutral rate structure is required that does not include any volume of water in the service or base charge (lifeline exceptions allowed).	
Monitoring Plan – A monitoring plan approved by DNR that includes monthly water level readings in production wells and/or observation that may be required. Monitoring data must be submitted to DNR once each year or upon request.	
Sustainability – All impacts and limits on natural resources and other water users must be satisfied.	

Permit Approval Requests and Process

1) The Water Supply Plan must be approved by DNR.
2) A letter summarizing the permit approvals being requested for new water sources (CIP) and increased volumes (demand projections) for the next 10 years along with documentation that Benchmarks or Conservation Measures and Programs are being implemented.
3) Billing for permit amendment fee.
4) DNR review of permit request, which may require additional information or discussions with the public water supplier.
5) DNR final action on request (approve, approve with limitations, or deny).
6) Compliance reporting by public water supplier.

DNR Waters 8/16/2007

E & C Plan review guidance – What's really important

(Major questions to look at in reviewing Emergency and Conservation Plans)

1. **Are the Demand Projections shown in Table 5 realistic?**
   If they show demand going up faster than population, there is a problem and you should ask for more information. Otherwise, assume it is accurate.

2. **Is groundwater and surface water monitoring adequate?**
   If there are no known groundwater or surface water problems in the area, a monthly check of the static level of at least some of their production wells is adequate. If the Groundwater Unit staff note potential problems, rely on them for advice on minimum monitoring needs. If growth is expected, the supplier should be pressed to add extra monitoring to their plan.

3. **Are natural resource and surface water impacts identified, and is there a system in place to monitor such impacts?**
   Rely on GW Unit staff to decide whether there are potential problems, and whether the proposed monitoring is adequate.

4. **Is the Capital Improvement Plan adequately described?**
   Note that if no new wells or significant volume increase is expected, this section is unimportant and no 10-year permit should be considered. If growth is expected, we will need adequate estimates on numbers of new wells and their proposed location. This information needs to go to the GW Unit staff for review.

5. **Are inter-connections adequately described and are they used where possible?**
   Note that if there are potential problems that might be caused by new wells or increased volumes, they must be pushed to agree to work towards interconnections to meet future needs.

6. **Is unaccounted-for water less than 10% of total volume?**
   If not, the plan must address ways to reduce this percentage by methods such as new meters, leak searching, and better bookkeeping on uses such as hydrant flushing and ice rink filling.

7. **Is the residential gallons per capita demand less than 75 gallons per capita per day (GPCD)?**
   If not, this is a potential sign of excess lawn watering and poor water conserving fixtures. Ordinances, education efforts, rate structure changes and incentives for upgrading water fixtures will be needed. If they exceed 75 GPCD, they should not be given a 10-year permit unless they commit to increased education, a conservation rate structure, and other conservation measures.

(Over)

8. **Is the trend of residential GPCD use going up or down in table 1?**
If trend is going up, there are more conservation measures needed, especially related to rates, ordinances and ordinance enforcement, and water conserving water fixtures. If the trend is going down, this may indicate that the conservation methods being employed are working and no new ones are needed.

9. **Is the peak demand ratio less than 2.6?**
If above 2.6, this is a clear indication of excessive lawn watering, and a commitment to more conservation measures and educational efforts are needed, unless the trend indicates that they may reach 2.6 within the next ten years.

10. **What is the rate structure?**
If it is a "non-conserving structure and if any other indicators are bad, a neutral or conserving rate structure must be required. If their indicators are all below the triggers, then a neutral structure is adequate. A non-conserving rate structure is where water use fees get cheaper per gallon the more you use.

11. **Are their education programs adequate?**
If all indicators are good, and they do at least two education items per year, no changes are needed. If some indicators are bad, they must do more than 2 educational efforts per year.

12. **Do they qualify for a 10-year permit?**
Work toward a 10-year permit only where the supplier plans new wells or indicates that they expect to exceed their currently permitted volume within the next ten years.

The 10-year permit should be processed as a permit amendment and done at the same time as plan approval. The amended permit will include all proposed wells and the volume expected to be used 10 years from now.

Don't bother with a 10-year permit if no new wells are expected and no growth is expected. Also, it may take too much time to develop a 10-year permit for a community that has current and major water supply problems and conflicts.

A3

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CITY OF SAINT PETER, MINNESOTA
WATER SYSTEM EVALUATION

Meeting Minutes (Modified 5/30/2008)
May 13, 2008; 10:00 a.m.
Hydrology Meeting

Minutes

1. Attendees:
   a. Jeff Jerimiason, Gustavus Adolphus College
   b. Kris Swanson, Bolton & Menk
   c. Pete Moulton, Saint Peter Public Works
   d. Jeff Domras, Bolton & Menk
   e. Lew Giesking, Saint Peter Public Works
   f. Bob Brown, Bolton & Menk
   g. Brian LeMon, Barr Engineering
   h. Herman Dharmarajah, Bolton & Menk
   i. Chris Voeltz, Saint Peter Public Works
   j. Todd Prafke, City of Saint Peter (arrived at 10:30 a.m.)

2. Review Meeting Minutes from DNR Meeting on April 30th
   a. Get copy of state law about water rates.
   b. Kris Swanson and Bob Brown summarized meeting with DNR.
   c. Brian LeMon stated drawdown in Mt. Simon is showing localized drawdown in the Twin Cities, so limits were only for the Twin Cities. Border towns are complaining about system (Elk River vs. Ramsey).
   d. Brian – Restricting Mt. Simon in outstate area has not been proposed.
   e. Brian – After jumping thru hoops, Savage was allowed to drill to Mt. Simon for primary water source.

3. Discussion of Aquifers and Other Water Sources
   a. Kris – Summarizing the entire project for Jeff.
   b. Lew – Brought up other sources besides aquifers – wastewater re-use and Minnesota River.

- Bob – Old wastewater lagoons also a potential additional source for storm water.
- Lew – Could look at pumping storm water or wastewater up to sand plains to recharge Jordan. Emphasizes looking past 20 year window.
- Brian – When need becomes greater, recharge of aquifer may be allowed more in MN.
- Brian – Climate change may give us a climate more like Nebraska with less long rains resulting in less ground water recharge. Climate change is not a sure thing 10-20 years in the future. Climate change over 10 years could cause a need for mini dams to be designed to allow large rainfalls more time to recharge aquifer.
- Because city would not need a class 5 injection well, recharging Jordan may be easier to permit.

c. Brian LeMon summarizes aquifers in the area.

- Brian – Wells 6 and 9 have nitrates (Jordan aquifer). Because of sand plains, Jordan is the most vulnerable aquifer to contamination and thus the riskiest to count on long term. Suggests Jordan would be worst aquifer due to high vulnerability to surface contamination.
- FIG aquifer is good water source but pumping capacities are limited to approx. 300-500 gpm per well and wells need to be separated by long distances. North of Metro can get 1000-2000 gpm. Can be more productive in certain areas. FIG may produce more water as we move west because less bedrock is over the top of it.
- Chlorides are present in the Mt. Simon throughout aquifer. City may encounter this again or may not. Mt. Simon also contains radionuclides and radon that can be a concern. Not enough data to determine chlorides, sulfates, radon, radionuclides in this area.
- Good to keep options open with use of all three aquifers. However, multiple aquifer wells are possible source of contamination. (City mentioned that they will be sealed as part of the forth coming project).
- Quantity is not a significant issue in any of the three aquifers. Even in the Twin Cities, the aquifer recharge is not a problem, most drawdown is localized.

d. Well to north of St. Peter in Mt. Simon is a little better but still contains chlorides.

e. Pete – St. Peter says that drawdown always recovers in fall. No significant drawdowns seen in any aquifer in St Peter.

f. Bob suggests to look at using Jordan for all irrigation only. This would help permit recharge and minimize risk for public consumption of using a vulnerable aquifer.

- Jeff J. – Gustavus has no wells of their own. All water used is from city.
- Brian – Farm drain tile is 30+ mg/l in nitrates and essentially dumps right into the Jordan aquifer
- City has worked on rerouting tile thru grants, but has been unsuccessful.

- From public health standpoint, want the cleanest water into system. Since Jordan is most susceptible to contamination, it is a less desirable water source for potable use.
- Brian – Minnesota River also may contaminate Jordan and shallower wells as wells are pumped well.
- Currently, city blends Jordan water with other aquifers to meet nitrates.
- Jeff – Has seen nitrate drops in Minnesota River during the summer over the past few years. Brian – Could check nitrates isotopes to determine source of contamination.
- Brian – Pump setting within the casing should not affect nitrate level. Casing depth could affect nitrate level.
- Lew states he likes Bob's idea of using Jordan for irrigation and non-potable system.

g. Jeff J. – Some water taste complaints at college. It should be noted that sulfide odor should not be an issue in the water supply because the city aerates. May be coming from a softening process at the college.

h. Todd – Brings up wastewater reuse.

- Lew and Kris bring up concerns about future pharmaceutical contaminants with wastewater reuse for drinking water.
- Bob – SMSC is currently working on ground water recharge with the MDH and MPCA.
- Todd – Wants sustainable water source and need to keep wastewater reuse open. Wants to articulate where wastewater reuse could be used and make it a part of this plan.
- Bob – Irrigation and industrial use could reuse wastewater and market the wastewater effluent as source. Infrastructure capital cost is biggest concern with water re-use because it will require a dual distribution system (one for potable and one for non-potable water).
- Brian – Anything city can do to minimize peaks and shave them will conserve water.
- Lew – Look at taking top 10 or 20 irrigation users and how much water would that save. City – Gustavus – High School. Research and plot on map. City will work on figuring out irrigation use and provide that information to Bolton & Menk.
- MPCA won't give a general reuse permit, but it is on a case by case basis.
- Tertiary treatment will be mandatory.
- Todd wants to be the groundbreaking community on wastewater reuse.
- Bob – MPCA is looking at imposing CA Title 22 requirements. Maybe a large infiltration basin. Wastewater plant to sand plains, then use Jordan wells as aquifer for irrigation.

i. Pete – Minnesota River source is not as desirable due to surface water treatment rules.

- Brian – Ranny wells essentially pull off the Jordan aquifer at the Minnesota River. Minnesota River would be mainly non-potable source.
- Kris states if the Minnesota River Ranny wells are the Jordan aquifer, it makes the most sense to not fall under any surface water rules and avoid the river water for a potable use.

j. Pete – Not concerned about water quality of wells, just about finished water quality. What is the easiest way to get water? He thinks Mt. Simon seems easiest water source.

k. Brian & Lew – Well head protection. Only immediate 50' is required to be controlled. The protection area is not required to be owned with city.

l. Lew – What would be the capacity of existing wells if they were maxed out with new pumps? (while sealing the multi-aquifer wells)

- Pete – Appears Jordan wells are at capacity currently.
- Brian – Could look at redeveloping the Jordan well to gain high capacity. 300 gpm is a little low could get up to 1000 gpm if properly developed. However, you always run the risk of losing the well completely with redevelopment.
- FIGS most likely are at capacity (425-500 gpm). High interference between the two wells.
- Multi-aquifer wells (No. 4 and 5) can not be developed further and the aquifers could not be isolated. Decided wells should be sealed to satisfy MDH and minimize potential for contamination between aquifers.
- Mt. Simon well could be increased to the flow rate it was test pumped at (900 gpm-1000 gpm with new pump) with minimal effect on drawdown, based on experience with other Mt. Simon wells. Chlorides and sulfates are an issue in the water supply by increasing the use. The current well will flow approximately 200 gpm with no pumping.

<u>**4.**</u> Summary and Action Items

a. Bob & Brian – FIG and Mt. Simon make a lot of sense for potable. Jordan and wastewater reuse for use as irrigation and industrial.

b. Brian – FIG wells require greater separation due to drawdown issues.

c. Todd – Brings up problem with membrane treatment will increase wastewater discharge.

d. Radium in Mt. Simon is usually an issue and should be planned for.

e. Lew & Herman – Need to determine if increasing existing well capacity, and providing a non-potable irrigation source and distribution system will meet long-term demands or if new wells are still needed.

> ➢ ACTION: City will send Bolton & Menk information on irrigation water use from the top 10-20 irrigation users.

f. Brian – FIG quality and quantity questions. Mt. Simon quality is only question.

g. Todd – Does not believe we can overcome taste perceptions as there will always be someone who doesn't like it.

h. Should city continue to pursue Jordan aquifer wells for potable use?

> ➢ ACTION ITEM: The general consensus was no. From a risk standpoint, Jordan wells are not desirable. Move forward assuming that the city will keep Jordan wells on line but not as potable source.

i. Look at testing Mt. Simon out of the Jefferson WTF multi-aquifer wells.

> ➢ ACTION ITEM: Chris Voeltz will work with St. Peter Well Drilling and Kris Swanson as necessary to obtain sample and provide chlorides and sulfate testing results to the group prior to the June 3 meeting.

j. City needs to look at the interest in wastewater reuse. Are the customers interested?

- Provide Gustavus with a good product and make that the best offer that they can't refuse.

> ➢ ACTION ITEM: City to develop the idea of wastewater re-use desirability and find out if there is a market/need for this.

k. ACTION ITEM: Bolton & Menk to provide a Water quality standard table: Primary – Secondary – Bottled Water, and develop a water quality goal for the city's approval prior to June 3 meeting.

A4

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CITY OF SAINT PETER, MINNESOTA
WATER SYSTEM EVALUATION

Meeting Minutes
June 3, 2008
Development of Options, Costs and Recommendations

1. Attendees:
    a. Rich Valentine, University of Iowa
    b. Lew Giesking, Saint Peter Public Works Director
    c. Pete Moulton, Saint Peter Public Works
    d. Chris Voeltz, Saint Peter Public Works, Water Supt.
    e. Bob Brown, Bolton & Menk
    f. Herman Dharmarajah, Bolton & Menk
    g. Kris Swanson, Bolton & Menk
    h. Jeff Domras, Bolton & Menk
    i. Delvin DeBoer, South Dakota State University (at 10:00 a.m.)
2. Introductions by Bob Brown (and discussion on St. Peter medical system).
    a. City is considering hiring doctors for City clinic – associated with Mayo.
    b. Lew points out City Council is forward thinking and interested in cutting edge technology (as shown by city hiring physicians) and new clinic will be LEED certified.
3. Tornado 1998. (1/2 council from tornado period).
    a. new underground electric
    b. new WWTP
4. Gustavus is part of town and is moving toward sustainable campus.
    a. Gustavus has professor in charge of "self sustaining" campus.
5. 2010 – St. Peter to reduce energy usage by 1.5% per year based on previous 3-year average – for all customers.

Nationwide Water Trends

6. Gordon – reuse doesn't make sense economically – more to produce and sells for less. However, for other reasons, reclamation is still going forward.

7. Reuse

a. groundwater recharge

b. raw supply reservoir

c. industrial use

d. Irrigation

e. no client will accept for potable water, San Diego received poor press "toiled to tap"

f. Scalping reclamation plants interest – track only portion of wastewater for reuse in area of demand.

8. Valentine – Talks about California and the high cost of pumping water from the north to south. Make water reclamation more feasible.

a. Valentine – Distributed treatment, treatment plants small (keep water on site for example an apartment complex).

b. Valentine – European/Asia looking at smaller size water mains to maintain better water quality (less dead ends).

9. Bob – Discussion on SMSC hurdles with recharging aquifers.

a. Mystic Lake Casino – pilot test for ground water recharge – difficult to get public approval.

City of Saint Peter

10. Jeff & Kris – Gives overview of City layout and aquifers.

a. Aquifers

- Jordan – high potential for contamination – Nitrates
- Franconia-Ironton-Galesville – good quantity
- Mt. Simon – good quantity, but high hardness and radium – Well #7 high Cl, TDS.

b. Greenhill Plant will be in "upper" distribution system.

c. Old WTP – 1950's wells, steel filters, 40 years old.

d. 12,000 acres of ag ground discharge to sand plane in drainage ditches. Jordan aquifer recharge from this ag drainage.

e. Surface water – City does not want to consider due to more regulations.

f. City plans to double population in 30-40 years.

g. North industrial park is close to WWTP for potential water reuse.

h. Twin Cities – MN limited to 75 gpcd well drained from Mt. Simon aquifer. Proposed for entering state, but limited to Twin Cities. Industrial use not allowed in Mt. Simon.

11. Greg – Brings up long term restrictions on aquifers and concerns with ground water sources.

12. Gordon & Bob – Talked about using only FIG wells. Bob mentions that having Mt. Simon wells will be beneficial if State restricts future Mt. Simon (as they have in Twin Cities).
13. Lew – Mentions maybe we shouldn't rule out Jordan aquifer.
    a. Jordan is self sustaining, but poor quality. Mt. Simon withdrawal is being restricted in Twin Cities. FIG – adequate quantity and quality but need several wells and space wells. Strategy – got Mt. Simon wells constructed now to get Grandfather statute in case of future restrictions. FIG has some restrictions in Metro area, but not in St. Peter. Herman – only 1,000 gpm capacity from a cluster of FIG wells.
14. Gordon – Says that if we are looking at R.O. anyway, why not use the Jordan aquifer.
15. City has option of surface water option if required in future.
16. Pete – Regional Treatment Center has 2 wells similar to City wells #4 and #5. Sealed well due to problems with aquifer. Arsenic and CO2 we think were the issues.
17. R.O. brine disposal – Herman said it can go to WWTP. Gordon – concerned about discharge to stream – Greg mentioned anti-degradation issue.
    a. Gordon – evaporation of RO reject doubles cost of RO.
18. Bottled water – how about having City bottled water plant and put same quality of water in distribution systems.

Water Supply

19. 3 sources - each one has issues
    a. cost
    b. quantity
    c. quality
20. Jordan (low cost, suspect quality)
21. FIG (low quantity, med. cost, good quality)
22. Mt. Simon (high quantity, high cost, quality issues)
23. Concern with R.O. brine discharge
    a. What are the chlorides in the wastewater discharge?
    b. Chlorides will be a real issue in wastewater.

BREAK – Del DeBoer joins via video conference at 10:00 a.m.

24. Water Demand:
    a. City does not have irrigation demand data at this time, they have yard meters.
    b. 2030 demand – 1.7 mgd avg.
       3.4 mgd peak day

c. Current plant capacity:

	2.0 mgd	Julian St.
	1.0 mgd	Jefferson Ave.
	3.0 mgd	Total capacity

d. 110 gpcd design demand.

e. City has not promoted wet industries.

f. High wastewater rates may prevent wet industries.

g. Lew – long term industries may come due to modern WWTP,

- Industry may come but may be cooling water.

h. 1.2 mgd wastewater flow per Pete.

25. 3, 100 gpm pumping rate req'd. for 2040.

a. 1,000 gpm/well — Mt. Simon

b. 250 gpm/well — Jordan

c. 450 gpm/well — FIG (1,000 gpm/well field site)

26. Del – suggests trying to get better data from Mt. Simon.

27. Well options:

a. 4 – Mt. Simon wells

b. 79% FIG; 15% Mt. Simon, But Lew raised question about this – doubt this high % FIG. Bonestroo estimate if withdrawal from each of the multi-aquifer wells. Kris – recent tests of multi-aquifer tests which Well #7 is not typical of the other Mt. Simon well quality.

c. City may sample a former Mt. Simon well. Need test well for quality evaluation.

28. FIG wells may require 3 miles of separation between well fields.

Water Quality

29. City water quality has changed since 1990's until now. Went from Jordan water to Mt. Simon aquifer.

30. Customers are most interested in taste and odor (no customer concerns over nitrates at this time)

a. St. Julian plant limit to 5 mg/l Nitrates = _N due to blending.

b. They blend water to ensure nearly same quality at both plants.

31. Taste & Odor

a. Gustavus college says they get a Hydrogen Sulfide odor

b. Customers object to Cl2 odor – at low Cl2 residual

c. Water heater anodes causes H_2S.

32. Water heaters replaced every 5 years typically in St. Peter.

33. Pete wants to meet all primary and secondary (and future MCCs and secondary) water quality standards and reduce solids.

a. Increase water heater life (reduce TDS)

b. Reduce TDS

c. Reduce internal home plumbing problems (faucet, gaskets, wears gaskets) (Gustavus softens water – better corrosion aspect, but poorer taste)

34. Del brings up benefit of reducing salt in wastewater by using R.O. Pete estimates 85% of homes have home softeners.

35. Water quality – soften; 4 mg/l nitrate will not be acceptable in future per Lew.

36. Bromide may be in water supply, appears. 32. Brominated problem in finished water at both plants. Brominated organics much more toxic than chlorinated organics, per Valentine.

37. No triazines detected (or other organics other than THM) in finished water.

Options and Morning Summary

38. Aquifer: Combination of Mt. Simon and FIG now. Option of Jordan in future if restrictions are placed on Mt. Simon. Mt. Simon well spacing can be close together. Put one FIG well field at same site as Mt. Simon.

39. FIGs may not be feasible at Greenhill due to proximity to wells 8 and 10.

40. Del – Jordan aquifer good candidate for nitrate removal with ion exchange due to low anion conc.

41. 2 treatment plants are desirable by city to provide redundancy. Per Lew and Pete, safety and backup are important.

42. Alt – Drill irrigation well in Jordan for Gustavus.

AFTERNOON/LUNCH

43. Conclusions on Aquifers:

a. Test wells for Mt. Simon to find better quality than Well #7.

b. Look at getting zone of influence for FIG wells.

c. Multiple Mt. Simon wells. Perform test well to check quality.

d. Install Mt. Simon wells more if good quality – get Grandfathered for potential future withdrawal limits. Greenhill Reservoir area – per Pete. Land – storm water basin (proposed) area.

e. Park along Church Street is possible location for wells or 40 acres near Greenhill.

f. Jordan aquifer potential future aquifer if Mt. Simon is restricted.

g. Seal wells #4 and #5 – multi-aquifer wells built in 1950's – is draining Mt. Simon to other aquifers. Abandon Jefferson Ave. WTP.

h. Greenhill is only ½ acre.

i. Jefferson WTF site is 500' x 200'.

j. Upper system WTF is desirable to connect to Greenhill for operation.

k. New WTP near Greenhill or further west.

44. Consider St. Julian plant used for wastewater reclamation. Pete says dedicated water main from Julian to Greenhill reservoir could be routed to industrial park for WW reuse.

a. St. Julian used for advanced WWTP – reclaim water to: irrigation, industrial use; recreation pond on edge of town, WWTP utility operation water.

b. May supplement WW with Jordan wells.

c. Irrigation water = 20% of total water sold. (1.2 mgd irrigation during summer). Most used by Gustavus, City parks and high school. Lew said they could serve these on a separate main.

d. City can sell phosphorus TMDL credits.

e. Dual water system for new development areas.

45. Alt. – St. Julian used as Fe/MN removal. Pump to new plant at Greenhill WTP. Blend and membrane process. In future, expand Greenhill WTP and convert St. Julian to water reclamation.

46. Agreed – abandon Jefferson St. wells and WTP.

47. Pete suggested feeding the treatment center from new meter on low pressure side.

48. Lime softening

a. Del – Dairy and beef feedlots use lime softening sludge for yards.

b. Del doesn't expect many more lime softening plants to be built unless there is a good place to dispose lime sludge nearby, very site specific.

49. Take Jordan wells direct to RO at Julian.

a. FIGs to St. Julian Fe/MN removal.

b. R.O. treated Jordan and FIG Fe/MN removed pumped to new plant.

c. New Greenhill Fe/MN removal and R.O. treated – blend with the water from the St. Julian plant.

d. This reduces the reject salts by using Jordan and gets a lot of nitrate removal.

50. Valentine – Expect 80% radium removal from Well #7 – with filtration at St. Julian WTP.

a. Ra+2 removal

b. Aerate to oxidize iron (interferes with Ra+2 adsorption.)

c. Add preformed MnO2 or KMnO4 to water with Mn in water.

d. Ra+2 adsorbs to the MnO2 precip. and remove in filter.

e. 80%± Ra+2 removal expected. Therefore, Well #7 to iron filter will be effective in more complete Ra+2 removal.

f. Pilot study will not show Ra+2 removal because it takes time to establish process. Pilot study used to demonstrate Mn removal.

g. Conclusion – constant % radium removal. Use highest conc. of radium in filter to get max. lbs/d Ra removal.

Option Summary

	Treatment Option	Source Option		
1.	New plant Greenhill	Greenhill well field		
	St. Julian convert to water reclamation	3 – Mt. Simon wells (3, 600 gpm)	2,400	
		2 – FIG wells (1,000 gpm)	1,000	
		Firm	3,400 gpm	
		Abandon St. Julian or use for irrigation.		
2.	New plant Greenhill (smaller)			
	St. Julian renovate & continue to use	Greenhill well field		
	Convert to reclamation in future	3 Mt. Simon (3,600)	2,400	
	Expand Greenhill			
	All R.O. at Greenhill	St. Julian well field (existing)		
3.	New plant Greenhill	Limited now by WTP capacity #7 Mt. Simon		520
	St. Julian pretreat. long term	#8 FIG		520
	All R.O. Greenhill	#10 FIG		520
				1,520
			Firm	3900
4.	New Greenhill plant	Greenhill Well Field		
	Jordan well R.O. at St. Julian direct	#3 Mt. Simon	3,000 gpm	
	Max Ra^{+2} removal Well #7 at St. Julian	St. Julian Well Field		
	Fe/Mn removal	#6 Jordan	350 gpm	
	Blend St. Julian treated w/R.O. at Greenhill	#7 Mt. Simon		520
	Alt – Abandon #7 & use FIG wells (increase	#8 FIG		520
	Jordan well use)	#9 Jordan	325	
		#10 FIG		520
		Jordan	675	1520

51. What happens if we reclaim water?

a. Peak Day Total 3.35 MGD

b. - 50% Irrigation 0.6 MGD

c. Peak Day w/Reuse 2.75 MGD

d. 18% Reduction Plant & Source Capacity

e. Save $2 million approx. at the most

52. Conclusions

a. Rule out all additional treatment at St. Julian due to size constraints.

b. Abandon Jefferson WTF.

c. Greenhill WTF somewhere between County Rd. 20 and Greenhill reservoir.

d. Need test well to determine Mt. Simon water quality.

e. Cost out option to take reclaim water to Gustavus and to industrial park (Sunset).

f. Need to firm up capacity of FIG formation.

53. All options discussed at this meeting included Mt. Simon source

a. Met with Leo Getsfried of DNR and he stated that restrictions not a problem.

54. Mt. Simon Test Well:

a. June 16th workshop.

b. June 23rd to Council.

c. City needs cost estimate for test well and summary of our work. No permitting process. Expedite for water quality data only.

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Memorandum

To: Kris Swanson, Bolton-Menk Inc.

From: John Greer and Brian LeMon

Subject: St. Peter Preliminary Well Spacing Recommendations

Date: July 17, 2008

Project: 23/52 024

The purpose of this memo is to provide preliminary recommendations for well spacing in each of the three aquifers used for water supply in the St. Peter area. The three aquifers considered include the Jordan Sandstone aquifer, the Franconia-Ironton-Galesville aquifer (FIG) and the Mt. Simon Sandstone aquifer. This memo represents only a preliminary look into well spacing and should be used as a preliminary screening tool. We recommend that additional study be done before selecting final well locations for new community water supply wells.

The following reports were briefly reviewed in preparing this memorandum.

- *Wellhead Protection Plan for the City of St. Peter Minnesota* prepared by Bolton & Menk Inc. 1997
- *Water Master Plan for the City of Saint Peter* prepared by Bolton & Menk Inc. October 2007
- *DRAFT City of Saint Peter Wellhead Protection Plan Part I Amended Plan*, prepared by Bonestroo March 2008

While the reports had a significant amount of useful data there were some gaps that limit the accuracy of this investigation. Additional aquifer pumping tests using the existing wells would be beneficial in better characterizing aquifer characteristics and would result in better recommendations regarding well separation. The existing data yielded some aquifer parameters that varied from expected values resulting in higher than anticipated amounts of interference. This is especially true for the Jordan aquifer.

Based on Table 4.2 on page 31 of the *Water Master Plan* (Bolton & Menk, 2007) it appears that the City is not using Wells 4 and 5 in future planning scenarios. This was confirmed in discussions with Kris Swanson of Bolton-Menk. We believe it is reasonable to not use Wells 4 and 5 in future planning since they are multi-aquifer wells and poor water quality is present in some of the aquifers. As a result, there is a risk that Wells 4 and 5 may be pathways for introduction of poor quality water into an aquifer that currently has higher quality water. Table 4.2 also includes four different options showing the rates at which the City's current wells can pump when run together. From these options it is shown that when excluding

Wells 4 and 5 the City has a current total supply of 1,470 gpm and a firm supply of 1,250 gpm. It is assumed that new wells sited in conjunction with this memo would be sited in such a way that they will interfere less and have higher capacities than any of the current wells. Because of this, all current wells are assumed to be in operation for firm supply calculation.

Table 2.10 of the same report shows projected water demands for the City converted to 20-hour peak pumping rates. Combining these data with the current total supply from Table 4.2, the future supply needs for the City are shown in Table 1 of this memo.

Table 1

Future Supply Needs

Year	Projected Max Day 20-Hour Pumping Rate (GPM)	Current Total Supply (GPM)	Firm Supply Needed to Meet Future Needs (GPM)
2010	2,150	1,470	680
2020	2,475	1,470	1,005
2030	2,792	1,470	1,322
2040	3,117	1,470	1,647

Table 1 shows that the City needs to add 680 gpm of firm supply by the year 2010 and 1,647 gpm of firm supply by 2040. Discussions with Kris Swanson of Bolton-Menk indicate that the desired flow rates under consideration are 500 gpm for wells in the Jordan and FIG aquifers and 1,300 gpm for any wells in the Mt. Simon. These rates were used in initial estimates for recommendations of well spacing for the planned wells. Identifying the pumping rates for the proposed wells is needed because the lower the pumping rate of two given wells the closer they can be sited to each other without causing unmanageable interference.

After one round of calculations it became apparent that the current data results in significant and unacceptable drawdowns for Jordan wells when they are pumped at 500 gpm. Available information suggests that a pumping rate of 500 gpm would result in virtually dewatering the Jordan aquifer in teh vicinity of the well after several weeks of continuous pumping. However, without better data we cannot recommend that any Jordan well be pumped at 500 gpm without test data to verify that the aquifer can support this rate. As a result we have modified the Jordan rates to 250 gpm for the final spacing calculations.

Even wells placed at great distances from each other in any of these three aquifers in the St. Peter area will eventually interfere with each other under prolonged pumping. This is especially true of confined aquifers. Available information indicates that the FIG and Mt. Simon aquifers respond to pumping as confined units while the Jordan aquifer responds as an unconfined near Wells 6 and 9 due to its proximity to the surface. Up on the bluff, the Jordan may begin to exhibit confined behavior. Therefore spacing recommendations are not based upon a distance that will result in no interference; rather, they are based upon a distance that will result in a manageable amount of interference that can be accommodated during design. In keeping with this, Table 2 of this memo shows the estimated amount of drawdown that will occur in the static water level produced by a single pumping well, arbitrarily called Well A for discussion purposes, at a distance from that pumping well shown in the table after a period of time, also shown in the table. This would represent the new static water level for a new well, arbitrarily called Well B for discussion purposes, set at that distance from Well A. If Well B is then turned on it will create a drawdown at Well A in proportion to its pumping rate. If it is pumped at the same rate as Well A then it will create the same drawdown or interference in Well A that Well A caused in Well B.

The proposed sites for the new water infrastructure include areas near the Broadway and Sunrise Water Towers and the Greenhill Reservoir. The Broadway and Sunrise Water Towers are approximately 1 mile distant from the St. Julien Plant and associated Wells 6 through 10. The Greenhill Reservoir is just over ½-mile away from the St. Julien Plant and wells. Therefore, Table 2 has been set up to show the preliminary estimated drawdown that would be created at the St. Julien Plant by wells pumping at those distances from the plant. Since wells at the St. Julien plant already interfere with each other and display reduced pumping capacities when pumped together, additional interference induced by new wells placed too close to this location should be scrutinized carefully to preserve the capacity of the existing wells to the extent possible.

The greatest impact to existing wells would be created by wells installed at the Greenhill reservoir since it is closest to the existing wells. In addition to proximity, it is also directly upgradient from the St. Julien plant wells, which makes the interference even worse. In general this site would not be recommended unless all other sites were unavailable. Even wells installed at the other locations will create noticeable and, possibly, problematic drawdown at the St. Julien wells. The City may be able to mitigate the interference during the next round of well maintenance at each of the existing wells by dropping the pump set point and possibly increasing the pump and motor size to account for the additional drawdown. These kinds of modifications may not be possible at some wells due to casing or aquifer limitations. It is beyond the scope of this memo to investigate these issues at this time.

Of particular note is the fact that the pumping water levels being generated in the Jordan aquifer appear to be dropping the water level below the top of the aquifer. This creates unconfined pumping conditions. In order to obtain data that can be used to more accurately estimate the impacts of long term pumping in this aquifer a pumping test designed to evaluate the response of an unconfined aquifer is needed. We were not able to obtain such data for this round of analysis and, therefore, recommendations related to the Jordan aquifer are considered less reliable than those for the other two aquifers.

Table 2 is based on preliminary calculations and not a groundwater model. These calculations may be conservative but time did not allow the creation of a model to more accurately estimate drawdown and interferences. With additional time and access to the groundwater model used in the St. Peter Wellhead Protection Plan more accurate estimates of interference can be generated.

Table 2

Estimate Drawdown Created by a Pumping Well

	Q (gpm)	Distance from Pumping Well (ft)	2-Week Drawdown (ft)	6-Week Drawdown (ft)
Jordan SS	250	2500	40.4	42.0
		5000	38.3	39.9
FIG	250	2500	21.1	23.2
		5000	18.4	20.5
	500	2500	42.1	46.4
		5000	36.7	41.0
Ironton-Galesville	250	2500	26.3	33.8
		5000	17.1	24.4
	500	2500	52.7	67.5
		5000	34.3	48.8
Mt. Simon SS	650	2500	34.6	37.7
		5000	30.6	33.8
	1,300	2500	69.2	75.5
		5000	61.2	67.5

Table 2 Notes:
1) Drawdown estimates done using Theis Method assuming confined conditions
2) Available information suggests assumption of confined conditions may not be accurate for all areas of the Jordan SS
3) Drawdown estimates based on T and S values in St. Peter 1997 Wellhead Protection Plan.
4) T for the Jordan SS from aquifer test in the St Peter #9
4) T for FIG aquifer based on aquifer test in well 452667. CWI has no stratigraphy information for this well. It was assumed that the well penetrates the full thickness of the FIG aquifer.
5) FIG aquifer = Franconia Fm + Ironton SS + Galesville SS
6) T for Ironton-Galesville aquifer based on test in St Peter #10 (un. no. 473640)

As can be seen in Table 2 prolonged continuous pumping of any of the aquifers would result in significant interference. In the case of the Jordan the aquifer would likely be partially dewatered which would result in a reduction in the volume of water that could be pumped from the aquifer. In the Jordan aquifer there is little additional drawdown available without actually drying out the unit at the well. In the case of the FIG and the Mt. Simon there is additional drawdown available to allow management of the interference that would be created by locating wells close to each other.

As a result of the data shown above, we would recommend that additional hydrogeologic investigation be done to better quantify the interference that will be created by installing new wells in the St. Peter area. This will help in selecting better test well sites needed to gather accurate data. For preliminary screening purposes new wells should be located more than a mile away from the existing St. Julien well field, if possible. Spacing wells closer than this may be possible but additional study is needed to verify that the aquifers can support the closer distance. Spacing between new wells is a matter of managing the interference. Additional discussion is needed before final recommendations can be made regarding this item. New wells in the Jordan aquifer should be scrutinized more than wells in the other aquifer as they have less margin for error.

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MEMORANDUM

Date: September 19, 2008

To: Lewis Giesking, City of Saint Peter

From: Kris Swanson, P.E., Bolton & Menk, Inc.

Subject: Water System Evaluation
City Council Questions and Discussions

Lew,

This memorandum contains a brief summary of the numerous items that were discussed at the Council Workshop on Monday night with an evaluation of each item.

1. **Evaluate 75 percent plant capacity if Saint Peter water usage would go down.**

   After researching other City's residential water usage it was found that the City of Saint Peter is already on the low end of residential usage.

Table 1

City	Residential Usage (gpcd)	Total Use (gpcd)
Saint Peter	49-55	103-112
Jordan	66-91	101-110
Windom	98-115	230-251
Waconia	65-79	102-136
Winnebago	65-100	107-138

   Based on the information shown in Table 1, depicting water usage in the area and based off good engineering design practice, Bolton & Menk does not recommend varying from the projected demand as laid out in the 2007 Water Master Plan.

   Based on this information, a decrease in the system pumping capacity of 75 percent (3000 gpm * 75%) would yield a capacity of 2250 gpm which would only serve the population until approximately 2013-2014. The cost of a new 850 gpm treatment plant with R.O. would be approximately $4.2 million dollars. This system with the St. Julien upgrade, engineering, contingency, and wells would have a total cost of about $8,000,000 - $8,500,000 and last approximately 2-3 years after it is on line.

2. **Jefferson Treatment Option**

   A. **2,500 gpm Treatment Plant at Jefferson**

   Enclosed is a site layout for a new treatment plant at the Jefferson site. Because this facility is on a hill, I included an additional $100,000 for concrete wall thicknesses. Because the existing Jefferson plant must stay on line until the new facility is built, the entire block must be purchased to provide minimal space required. Below is the cost estimate for this facility.

Jefferson Alternative Project Costs

- Phase I – Treatment Plant and Wells (Eligible for PFA Loan Funding)

Treatment Plant		
2500 gpm gravity filtration plant		$6,000,000*
2300 gpm R.O. advanced treatment		2,100,000
	Subtotal	**$8,100,000**
Wells (at Jefferson Site)		
Mt. Simon		$500,000
FIG		250,000
Jordan		200,000
	Subtotal	**$950,000**
St. Julien Modifications		
Upgrade wells 6, 7, 8, 9, 10		$ 100,000
Add R.O. building and blending clearwell		1,200,000
	Subtotal	**$1,370,000**
	Phase I Construction Subtotal	**$10,350,000**
Engineering/Legal/Administration/Contingency (15%)		$1,150,000
Land Acquisition (3 homes, 2 townhomes)		0
	JEFFERSON ALTERNATIVE / PHASE I TOTAL	**$1,500,000**

- Phase II – Upper System Redundancy, Additional Well

- Water System		
250,000 gallon ground storage reservoir		$600,000 [a]
Pumps and connection to upper system		1,500,000 [a]
Seal wells		30,000
Demolish Jefferson		200,000
Redundant well (Mt. Simon)		500,000 [a]
	Phase II Subtotal	**$1,830,000**
Engineering/Legal/Administration/Contingency (15%)		300,000
	JEFFERSON ALTERNATIVE / PHASE II TOTAL	**$2,130,000**
	PFA Loan Eligible Cost	$264,500
	PFA Loan Non-Eligible Cost	$1,865,500

[a] Not eligible for PFA loan funding.

- Phase III – Cannot be accomplished since large parcels for irrigation are not close by.

B. **Utilize 1,000 gpm Steel Filter on Jefferson Site.**

Based on information asked by the Council, an option to utilize a 1,000 gpm steel filter at Jefferson has been briefly evaluated. The system would provide up to 2,625 gpm firm pump capacity but would require two additional wells over the Broadway option to ensure adequate supply. This system would last until approximately 2025 and cost approximately $11,760,000.

This savings of $2,330,000 for a system with much less flexibility, 400 gpm less pumping capacity, and on a site that cannot be expanded.

Overall the Jefferson site is not a feasible option for the following reasons:

- No future well field expansion
- Depending on Jordan Aquifer, not a good option since yield is suspect at best.
- No treatment plant on upper system.
- Residential area
- Purchase of homes required.
- Minimal savings with decreased capacity/increased cost with same capacity.
- Requires two more wells that other option.
- Construction into a side hill.
- Steel filters with decreased life.
- Irrigation land not readily available.
- Future expansion of treatment plant not available.

3. Recap of Water Quality, Critical Path and Recommendation

Based on the original and current findings, a new 2,500 gpm treatment facility with R.O. is recommended at the Broadway site with upgrades to St. Julien to add R.O. This treatment option will provide a high quality water addressing chlorides, sulfates, nitrates, iron, and manganese in Saint Peter's water. It will also provide a positive barrier for future contaminants as the Minnesota Department of Health continue to set more stringent requirements. Additionally, the effluent quality at the wastewater plant will significantly improve with the removal of salts from home water softeners.

In order to take advantage of the low interest financing available through the PFA plans and specifications must be submitted by March 2, 2009 to the Minnesota Department of Health. For this reason, design of the facility should be authorized by mid-October 2008. We should also start working the regulatory agencies to ensure approvals are granted in the time allotment required.

I look forward to discussing this memo with you and answering your questions.

JEFFERSON WTF SITE

A7

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MEMORANDUM

Date: September 26, 2008

To: Lewis Giesking, City of Saint Peter

From: Kris Swanson, P.E., Bolton & Menk, Inc.

Subject: City of Saint Peter, Minnesota
Water Treatment Facility Options
City Council Workshop Discussion on 9/29/2008

Lew,

Based on our detailed discussions from earlier this week, it is my understanding that the Broadway Tower site has been finalized as the location of the new well field and treatment facility. This new site coupled with modifications to the St. Julien WTF will supply Saint Peter with their existing and future water needs.

To better help the City understand some of the financial impacts of the treatment options, I have prepared the cost information of the proposed option below along with a couple of items that could be phased in at a later date, if desired.

Broadway Alternative Project Costs

Treatment Plant		
2500 gpm gravity filtration plant		$5,900,000
2300 gpm R.O. advanced treatment		2,100,000
	Subtotal	**$8,000,000**
Wells		
Mt. Simon (one production and one back-up)		$1,000,000
FIG		250,000
Jordan		200,000
Seal multi-aquifer wells		30,000
	Subtotal	**$1,480,000**
St. Julien Modifications		
Upgrade wells 6, 7, 8, 9, 10		$ 100,000
Add R.O. building and blending clearwell		1,200,000
	Subtotal	**$1,300,000**
Demolish Jefferson	**Subtotal**	**$ 200,000**
Lower System Redundancy		
250,000 gallon ground storage reservoir		$600,000
Pumps and connection to lower system		620,000
	Subtotal	**$1,220,000**
	Construction Total	**$12,200,000**
Engineering/Legal/Administration/Contingency (15%)		$1,800,000
Land		0
	TOTAL	**$14,000,000**

This option has a full 20-year design life that meets the expected Saint Peter growth. In the future, water re-use may be added to re-use reject water from the Jordan aquifer if permitted. Below are a couple of items that could be phased in to reduce current capital expense.

1. Delete Lower System Redundancy, Reduce cost by $1,400,000

   By eliminating redundant systems should a well or a tank fail the City may not be able to supply drinking way to its residents. Specifically, if there is problem at Greenhill Reservoir without a redundant system, the entire lower distribution system will be without water while corrections are made.

2. Delete Demolition of Jefferson, Reduce cost by $230,000

   The building could remain on the current site and not be used.

I look forward to discussing this and other items with you and the Council on Monday night.

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Treatment Option to Match Existing Water Quality with New Broadway Site

51% FIG
33% Jordan (due to nitrates)
16% Mt. Simon (due to salts)

The above percentages are required to match the existing water quality and meet the MDH primary and secondary drinking water standards. Based on these ratios, the FIG well will be the limiting factor. Assuming the FIG well can be maximized for 500 gpm, the following capacity water treatment facility could be constructed.

500 gpm FIG (it is questionable if this capacity can be attained)
320 gpm Jordan
160 gpm Mt. Simon
980 gpm capacity

WTF	
980 gpm gravity filtration	$3,000,000
Wells	
2 Jordan (360 gpm each)	$400,000
2 FIG (500 gpm each)	500,000
2 Mt. Simon (160 gpm each)	700,000
	$1,600,000
St. Julien	
Add redundant wells	$750,000
Land availability?	?
	$750,000
15% Engineering/Legal/Admin./Contingency	$800,000
TOTAL	$6,150,000

This would add about 200 gpm more than the existing capacity and have a 10-year design life. This option also assumes that the FIG and Jordan capacity is available which will require test pumping and drawdown tests to finalize information.

Overall, the concept to use Mt. Simon water to provide a stable, high capacity source to meet the city's needs is more feasible since the desired pumping rates can be obtained. However, this source is high in salts and will require R.O. treatment.

APPENDIX B

Site Selection Matrix

CITY OF SAINT PETER

WATER SYSTEM EVALUATION

RANKING MATRIX FOR WATER TREATMENT PLANT LOCATION (August 2008)

8/25/2008

Weighted Percentage	10%		15%		1%		10%		19%		15%		15%		15%		Total 100%
	1		2		3		4		5		6		7		8		
Site Location	Wellfield Site Size (0.0 - 1.0)	Weighted Value	System Operation (0.0 - 1.0)	Weighted Value	Lower System Connection Cost (0.0 - 1.0)	Weighted Value	Distance of Wells to Treatment Plant (0.0 - 1.0)	Weighted Value	Site and Construction Cost (0.0 - 1.0)	Weighted Value	Lower System Redundancy (Yes/No)	Weighted Value	Upper System Redundancy (Yes/No)	Weighted Value	Potential to Incorporate Water Re-Use Effectively (Yes/No)	Weighted Value	Total
Option 1 - Near Greenhill Reservoir	0	0	0.75	0.1125	$120,000	0.01	0.1	0.01	$13,070,000	0.1669	Yes	0.15	Yes	0.15	No	0	0.599
Option 2 - Near Broadway Tower	1	0.1	1	0.15	$620,000	0.0019	1	0.1	$11,480,000	0.19	Yes	0.15	Yes	0.15	Yes	0.15	0.992
Option 3 - Near Sunrise Tower	1	0.1	0.75	0.1125	$250,000	0.0048	1	0.1	$11,680,000	0.1867	Yes	0.15	Yes	0.15	Yes	0.15	0.954
Upgrade St. Julien	0	0	0.25	0.0375	$120,000	0.01	0	0	0	0	Yes	0.15	No	0	No	0	0.198

NOTE: The closer the total is to 1.0, the higher ranked is the site location.

CATEGORY DESCRIPTION

1 Represents the Availability of Land for Construction of a New Well Field

2 Overall System Chlorine Residual and Flow Characteristics Given Jefferson Water Treatment Plant is Demolished and High Volume Users are on South End of Town

3 Cost to Connect New Upper System Ground Storage Tank to Lower System for Lower System Redundancy if Greenhill Reservoir is out of Service (Cost for Ground Storage Tank Not Included)

4 Distance of New Wells to New Treatment Plant Based on Possible Wellfield Locations

5 Cost to Construct New RO Water Treatment Facility (Includes New Wells, New Treatment Facility, Land Costs, Upgrades to St. Julien Plant and Engineering/Legal/Administrative/Contingency) (Does not Include Cost of Ground Storage Tank or Connection to Lower System)

6 Is the Site Location Capable of Providing Lower System Redundancy for times when Greenhill Reservoir is Out of Service?

7 Is the Site Location Capable of Providing Upper System Redundancy for times when the St. Julien Water Treatment Facility is Out of Service?

8 Is the Site Location Capable of Effectively Utilizing RO Backwash and Reject Water for Irrigation Purposes? Current Large Volume Irrigation Users are GAC, SPHS and City of Saint Peter Parks

APPENDIX C

Example Rate Structure

FUNDING AND RATES (Estimated based on total project)

Total Capital Cost $14,000,000
$12,014,500 @ 2.5% for 20 years
$1,985,500 @ 5.0% for 20 years
= $930,017 per year

Current Pop. = 10,700
20 year pop. = 15,250
1,820 new customers or 90 new customers per year

Conservatively use Master Plan's 70 customers/year

70 customers * WAC of $3,000 = $210,000/year

Annual principal and interest capital = $930,017/year
Less water access charge = $210,000/year
Less Saint Julien principal and interest = $170,000/year (bond retired in 2008)

Annual net cost = $550,017/year or $1.45 per 1,000 gallons of water sold

Annual O & M Cost = $387,000/year or $1.02 per 1,000 gallons of water sold

Total cost = $2.47 per 1,000 gallons of water sold

Average customer uses 4,500 gallons per month (residential) resulting in an increase in cost of $11.12/month or $133.00 per year (offset by savings)