MWH

BUILDING A BETTER WORLD

October 2, 2013

City Council and Mayor Clinton
City of Bend
710 NW Wall Street
PO Box 431
Bend, OR 97709-0431

Subject: Summary Report from Water Treatment Technical Advisor
Water Treatment Advisory Group

Members of the Council and Mayor Clinton:

MWH is pleased to submit this Summary Report to complete our services as a Technical Advisor in support of the City's Water Treatment Advisory Group (WTAG). In my role as Technical Advisor for the WTAG, I have read numerous reports and other background material, prepared and presented information to the group and attended all meetings. I have also done independent research and analysis. This report and professional recommendation completes MWH's services per the Contract which initiated in June 2013.

The WTAG had a challenging assignment to complete its evaluation in 3 months. There was a multitude of information to try and absorb during this relatively-short period of time and then to determine which treatment method is appropriate from each individual's perspective. Each member took this voluntary assignment seriously and did their homework. While it is clear that the WTAG does not have a unanimous recommendation for either of the two treatment options, this effort should still be considered a valuable addition to the City's understanding of its water supply and treatment issues.

Please let me know if you have any questions, wish to discuss any part of this report, or if I can assist with your decision-making process in any way. Thank you for providing MWH with the opportunity to serve the City in this challenging and important endeavor.

Sincerely,

Peter Kreft

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Technical Advisor

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City of Bend -
Sourcewater Improvements Project

Water Treatment Advisory Group – Summary Report from Water Treatment Technical Advisor

OCTOBER 2, 2013

0 Executive Summary

Based on federal regulations, Bend must treat its surface water supply and is currently deciding whether to use ultraviolet light (UV) disinfection to treat its surface water source or whether to install filtration. Faced with similar decisions, some communities with high-quality surface water have selected UV disinfection due to the lower initial cost compared to filtration while other communities with similar water quality have selected filtration. Each community/water system, including Bend, has unique challenges which need to be carefully considered as part of the decision-making process.

From the perspective of balancing risks and costs, it is our professional opinion that the City should implement membrane filtration for its Bridge Creek supply. The slightly higher rates that customers will pay initially for filtration will provide the greatest benefits and the lowest risks to the community for the next 50+ years. There is a high likelihood of fire in the watershed and, if UV were installed, the existing groundwater supply would require significant upgrades to provide the same level of service which will be achieved with microfiltration (MF) of the surface water. The use of UV would mean that more than 8 billion additional gallons of groundwater would need to be pumped over a 20-year period even if a fire does not happen, which may not be a sustainable practice in the long-term. The UV option would also not provide a long-term guarantee of success to maintain a dual-water supply system. Investing in a MF system now will make the most of the City's investments to the surface water system, provide a robust solution in the very likely event of a fire, ensure the City can maintain a dual source system for the next 50+ years, and is similar in cost if not less expensive, to the installation of UV and an upgrade of the groundwater system.

1 Introduction

These overview comments and independent professional recommendations are provided herein to complete the Technical Advisor Services in support of the Water Treatment Advisory Group (WTAG). MWH was retained by the City in early June 2013 to provide these services which included 1) review of numerous planning and design documents, 2) participation in 5 WTAG meetings (including technical support to the committee members), 3) discussions with multiple parties, and 4) independent research. This has been a challenging assignment for all parties involved. Three months have passed since the initial WTAG site tour/meeting and represents a relatively short time for the volunteer committee members to try and understand all of the technical and non-technical issues associated with Bend's water supply system, as well as the treatment options.

At the heart of this surface water treatment decision is **balancing risks and costs while maintaining a dual-source water supply**. Bend is a unique community which has benefited from using both surface water and groundwater to meet its water demands. The federal and state mandate to treat the Bridge Creek surface water supply to protect against *Cryptosporidium* (LT2) presents opportunities as well as challenges. The recent *Cryptosporidium* outbreak in Baker City and wildfires in multiple parts of the western United States highlight the threats to Bend's water system and to its citizens, which the City must address in a responsible and cost-effective manner.

Bend's surface water is currently its backbone/baseline supply and is also the most economical supply due to gravity flow into the distribution system. The existing transmission and distribution system was designed around the gravity-fed surface water supply via the Outback site. The surface water supply is currently not 100% reliable due to occasional/seasonal elevated turbidity events which require the use of groundwater for 40 to 70 days every year to replace surface water (300 to 500 MG of groundwater is pumped annually to replace surface water). Groundwater is also used for approximately 6 months every year to supplement surface water during the peak demand period from May through September. The cost of pumping groundwater is significantly higher than the cost of producing surface water (mostly due to the higher power costs) and this will continue to be the case after the new surface water treatment system is implemented.

When the Surface Water Treatment Rule (SWTR) was promulgated in the early 1990s, the City opted to keep the surface water unfiltered and to use its groundwater system as a "filtration avoidance tool" as well as to help meet peak season demands. The City is now facing a similar decision with respect to 1) implement

filtration, or 2) continue a filtration avoidance strategy and rely on groundwater when the turbidity of surface water is elevated. The threat of a major wildfire in the watershed and other potential "disasters", as well as other potential future changes in water quality and/or regulations, need to be seriously considered as part of the decision-making process to comply with LT2.

Key issues to be considered in terms of risks and benefits include:

- Protecting public health
- Ensuring consumer confidence and satisfaction including reliability of supply
- Environmental stewardship and sustainability
- Weighing short-term vs. long-term financial impacts

This is a generational decision which will impact Bend for the next 50+ years.

2 Review of Options

Two treatment options were initially considered by the WTAG including 1) UV disinfection and 2) membrane filtration. Conventional filtration appears to be slightly more expensive and requires more space than membrane filtration, so this filtration alternative was not considered further. The use of UV requires that the Bridge Creek supply continue to have its filtration waiver approved by OHA. Major differences between UV disinfection and membrane filtration are presented below.

Table 1: Comparison of UV Disinfection and Membrane Filtration

UV Disinfection	Membrane Filtration
Inactivation of pathogens using ultraviolet light transmitted through the sourcewater	Physical removal of pathogens and any other suspended material in sourcewater that is larger than membrane pore size
Investment made will be solely for *Cryptosporidium* inactivation	*Cryptosporidium* will be removed
Will not improve taste/odor/appearance; turbidity/sediment will continue to enter Outback tanks; no aesthetic water quality benefits	Removal of turbidity/sediment will improve taste/odor/appearance; provides aesthetic water quality benefits
Cannot be operated under all sourcewater conditions	Flexibility to treat under all sourcewater conditions
Distributed water quality will be variable during October through April when groundwater replaces surface water	Distributed water quality will be consistent during October thru April since surface water will always be used
Least initial capital cost (roughly half of the initial cost of membrane filtration)	Higher initial capital cost

The Pall MF system selected by the City is a robust treatment process with proven success in treating a wide range of water quality challenges, including regional examples of treating turbidities > 2,000 NTU without pretreatment. This is the best filtration system for current surface water quality, and the design includes the ability to retrofit a pre-treatment system in the case of a significant wildfire or other event that may significantly alter water quality. There is a chance that following such a fire, this pre-treatment may still not be required, but has been designed as a safe-guard. There is little need to install the pre-treatment system at this time ($5M+ cost adder), but may be affordable to the City if the bidding climate is "favorable" to the City. Post-treatment to control tastes and odors can also be added relatively quickly following a major wildfire, if needed, but is not recommended to be constructed initially.

UV alone is not an "apples to apples" comparison with filtration, especially **when the threat/risk of wildfire is considered**. Following a major fire, the Bridge Creek supply will likely lose its filtration waiver and therefore cannot be used without filtration. The existing groundwater system has enough installed capacity to potentially meet all of Bend's needs in case of complete loss of the surface water supply, but **it has never been used as the sole source of supply throughout the year.** There appears to be piping and storage limitations in the existing system, which limits the ability to deliver the required volumes of water to all areas of the City during peak summer demand periods. Also, the groundwater system has proven susceptible to mechanical failure throughout the history of using it. There are multiple risks of using GW as a long-term sole supply following a major fire in the watershed and the chances of an extended curtailment requirement (during the peak demand seasons following a fire) is quite possible due to the existing piping and storage limitations plus the lack of reliability/redundancy of the mechanical well systems. Some baseline improvements to the groundwater system are required with either option, but the scope and urgency to make these improvements is lessened/deferred with filtration.

A more-credible approach with UV would be to install new wells to match the baseline surface water supply capacity (11-13 MGD) to protect against an extended surface water outage (3+ years) due to a major fire. These wells would presumably also serve a long-term purpose to provide additional peaking supply from May through September as growth and water demands increase, but the location of these wells for future growth have not been completely identified to date. The costs to build, operate and maintain wells is significant, as well as the timing and uncertainty to gain regulatory approval (permits) to install new wells. Also, following a major fire, the City would have to build a filtration plant once the filtration waiver is rescinded to allow continued used of the surface water.

Table 2 summarizes the use of groundwater as a backup supply to surface water with both treatment options. This table is based on current water demands and **does not account for future growth in water demands**.

Table 2: Comparison of Groundwater Pumping with UV and MF

	Average Days/year Turbidity > 1.5 NTU	Gallons GW Pumped To Replace Surface Water
UV Pre Fire	54	400 MG/yr (average)
UV Post Fire	365	2,200 MG/yr (for at least 3 years)
Membrane Pre Fire	54	0 MG/yr
Membrane Post Fire	365	360 MG/yr (for first year only; assumes 60 days @ 6 mgd)

The use of groundwater is a significant element of the UV disinfection approach, while it becomes a minor/emergency supply with filtration, in addition to providing peak demands in the summer. Over a 20 year period (not including increased demand due to growth), 8 billion gallons of groundwater will be pumped if UV is implemented; **water which wouldn't be pumped if filtration is used**.

Following a major fire, the UV option requires residential, commercial, and industrial demands to be met year-round with groundwater for multiple consecutive years. Following a fire, the City will be pumping an additional 7 billion gallons of groundwater (not including additional groundwater pumped prior to fire) if UV is implemented, until the surface water system is restored. The volume of groundwater pumped following a major fire with membrane filtration will be a very small fraction (<5%) of the volume pumped compared to UV.

3 Cost Comparison

Table 3 compares the costs of the surface water treatment options to meet LT2. The present worth costs assume that a **major fire does not happen within the next 20 years**. If a fire does occur in the next 20 years, then additional costs would be incurred for the UV options due to the additional costs of pumping groundwater and also because a filtration plant would likely be needed to continue using surface water. **There is no guarantee that the State will allow the Bridge Creek supply to remain unfiltered following a major fire**.

Table 3: Cost Comparison of the Treatment Options

	UV Disinfection	UV Disinfection + 12.5 mgd Wells	Membrane Filtration
Capital	$14M	$35M	$30M
O&M	$390,000	$530,000	$410,000
20 Year PW	$20.3M	$43.5M	$36.5M

The capital costs for the UV system include costs for design and construction inspection, as well as for construction itself. The "UV-only" capital costs do not include upgrades required for the distribution system to improve piping and/or storage to maintain reliable service to all areas following a major fire using groundwater as the sole source of supply for multiple consecutive years. These costs are currently unknown as the City has never analyzed the "groundwater only" supply approach.

The "UV+new wells" option includes $21M to construct 7 new deep wells to provide 12.5 mgd of additional capacity. The capital costs of the new wells includes approximately $5M for the planning, design, construction inspection, and land acquisition (7 acres of property, and permitting), and does not include upgrades required for the distribution system as they are currently unknown. It is understood that completing all 7 new wells at one time during the initial phase of this project is unlikely and/or unfeasible, and that implementation of new wells will likely continue more many years following the startup of the new UV system.

The O&M costs for the "UV+new wells" alternative includes the costs for UV plus the costs to operate/maintain the 7 new wells at an annual cost of $20,000 per well ($140,000/year). The annual O&M cost for UV have been adjusted to $390,000/year compared to $350,000/year presented to the committee in August. It is anticipated that power costs will continue to increase over the next 20 years, and the $390,000 value is estimated to be an average over the next 20 years.

The Present Worth costs of both UV options do not include future costs to design and build a filtration plant following a major fire in the watershed, which is an **unpredictable, but inevitable, event**. The present worth costs of MF are less than UV+new wells assuming that all new wells are constructed in Year 1.

The sunk costs of $4M+ for current MF design cannot be ignored. City staff has invested considerable time and money over the past 5+ years in coming to the conclusion to build an MF plant, with input from multiple consultants and water supply/treatment professionals.

4 Risks and Benefits of Treatment Options

- The main benefit of UV is the lower initial costs. The costs of upgrading the existing distribution system to allow a "groundwater only" supply following a major fire are not known at this time, but could be significant. Without these upgrades, the City would likely need to implement a significant curtailment approach during the peak demand season, following a major fire.
- If wells are to be constructed with the UV option to provide an "apples-to-apples" comparison, then UV will not be as financially attractive compared to MF
- Implementing new wells with the UV option is not a "trivial" task and will take significant time to allow construction to commence. There will be many regulatory and political hurdles and the City would not meet current regulatory deadlines with a significant chance of corresponding actions being taken by regulatory bodies against the City
- If a major wildfire occurs in the next 10-20 years, then the likelihood of building a filtration plant is highly probable to maintain the use of surface water and to allow Bend to maintain a dual-source supply.
- There is a plan in place with MF to address post-fire issues, such as sediments, high turbidity, T&O, etc. MF will allow continued use of SW following a fire, with perhaps short-term outages for worst-case scenarios.
- MF will be on-line in 2016 following completion of design this fall. Construction will be underway when the October 2014 OHA compliance deadline hits. If UV is implemented, the construction will not be underway in October 2014. Political challenges should be considered, including an extended period with public "at risk" of a *Cryptosporidium* outbreak as occurred in Baker City.
- Filtration would allow the Forest Service to accomplish activities in the watershed to reduce fuel load and therefore reduce risks of wildfires
- In addition to the large volumes of groundwater which will need to be pumped with UV, are there concerns about potential contamination of groundwater and/or impacts to stormwater treatment via injection wells, by additional GW pumping?

5 Summary and Conclusions

After taking all of the facts and issues and unknowns into consideration, it is our professional opinion that the City should proceed with a membrane filtration system for the Bridge Creek supply. The City is already making a significant long-term investment in its surface water supply via intake upgrades and a new raw water pipeline, as well as the costs to date for the MF design. The relatively-low incremental rate increase required to implement MF versus implementing UV only (approximately $1000 per customer over a 20-year period based on $4/month higher rate compared to the rate increase for UV only) should be considered as "insurance" to protect the City and its citizens from potentially higher rate increases in the future as a result of wildfires and other unknowns. The Pall MF system selected by the City is a robust treatment process with proven success in treating a wide range of water quality challenges. Increased investment and reliance on groundwater (with the UV option) does not appear to be a sustainable practice for the City to maintain a dual water supply well into the future.

If the Council is truly committed to a dual-source supply for the long-term, installing MF meets this goal better than UV.

- Less risks to the City and its customers
- More certainty in terms of costs and rate impacts with MF
- Benefits of MF outweigh risks of UV and is the best "generational decision"
- Protects City's surface water rights
- Saves further investments in GW for the future if/when demands increase