Hagensborg Waterworks District

Preliminary Report on Pilot Project

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Background and Purpose

This report should be read in conjunction with the documents entitled “Point-of-Entry Ultraviolet (UV) Disinfection Proposal” dated April 13, 2009, “Technical Review of the Proposed Point-of-Entry Ultraviolet (UV) Disinfection Project” dated October, 2010, “Budget Update” dated April 25, 2011, and other correspondence related to the pilot project including my update letters dated November 12, 2013 and October 12, 2014. The purpose of this report is to provide confirmation of estimated project costs based on current pricing reflecting changes in various input costs since the date of the original reports, and to provide a general update on operating costs, life cycle expectations, and recommendations related to the pilot project.

It should be noted that this report should be considered preliminary. As per VCH requirements in the pilot project construction permit, an independent engineering firm should be engaged to evaluate the results of the pilot project. We await the District’s appointment of an engineering firm and look forward to working with the engineer to prepare the final report for the District’s review. This report will include a more detailed evaluation of all costs. We are pleased to take any role in the preparation of this final report that is desired by the District.

Our assessment of equipment life cycle costs is limited by the fact that the back-up wells are not yet online. We are therefore unable to assess the potential impact on replacement filter costs, and the potential mitigation of turbidity concerns. We consider the use of the back-up wells to be integral to our turbidity management strategy.

General Review of Pilot Project

We are confident that the residential component of the pilot project has achieved its primary objectives:

- Confirmed the viability of POE as an effective treatment option to achieve the objectives set-out in the B.C. Drinking Water Protection Act and Regulations
- Confirmed that the equipment can be operated on a basis which is cost effective
- Obtained sufficient data with respect to the installation costs of the POE systems
- Obtained sufficient data to determine operating cost estimates and equipment life cycles
- Confirmed suspicions that UVT transmittance could be impacted by turbidity events and provided opportunities to assess various options to address such turbidity events

The commercial component of the pilot project cannot be assessed as the final connections have not yet been completed.

Early in the pilot project, it was confirmed that infrequent but recurring and severe turbidity events do indeed occur within the Snootli Creek watershed, and that these events have a significant impact on water quality. While generally brief, these events reduce UV transmittance after pre-treatment to a level that can cause a UV alarm condition at individual POE locations. These events appear to be becoming more frequent, likely due to the fire that occurred in the watershed several years ago or changes in the streambed due to the severe flooding event several years ago.

Managing turbidity will be integral to the success of POE water treatment in Hagensborg. During events whereby turbidity levels spike above about 40 NTU in Snootli Creek, the UV transmittance of the water reaching the UV sterilizers can decline below 75%, triggering an alarm condition. We were able to track numerous turbidity events during the pilot project. Severe events would cause all or nearly all of the POE systems to go into alarm. During lesser events, only some units would reach the alarm threshold. While the frequency of alarms was not high due to the fact that turbidity events may only occur a few times per year, it is impractical for the District to field enquiries from a large number of homeowners as may occur due to alarm conditions caused by a turbidity event. Accordingly, to ensure user satisfaction with their POE

system and to ensure operational practicality, we feel that it is critical that a turbidity management strategy be in place.

Units that alarmed due to the turbidity events were brought back online usually by simply flushing the turbid water out of the UV system. In a small number of cases, cleaning of the UV sleeve and or intensity monitor sensor was required, particularly in homes in the western end of the distribution system. Preventing elevated turbidity from entering the distribution network will eliminate these alarm conditions and the necessity for this maintenance. It will also reduce maintenance required to blow out the distribution lines themselves, thus it is most desirable that the turbidity management strategy include a centralized component.

Turbidity Management Strategy

Several initiatives have been undertaken to address these turbidity events:

- Replacement of the 1 micron absolute pre-filter with a 0.35 micron cartridge filter
- Upgrade of the UVMax Pro10 UV system to include the newly available flow meter which permits full flow-based dose monitoring instead of measuring dose based on full system capacity only
- Drilling of back-up wells to be used during turbidity events

In co-operation with the local federal fish hatchery, remote real-time in-stream turbidity monitoring equipment was installed in Snootli Creek upstream of the Hagensborg water intake. The District's water now receives alerts by email and phone in the event of a significant increase in turbidity in Snootli Creek. Two alert levels have been established, a lower level alert at 40 NTU and an extreme turbidity alert at 100 NTU. These alerts can now be used to determine when the back-up wells should be put in service at the beginning of an event, and when to revert back to the Snootli creek source.

By preventing highly turbid water from entering the distribution system, operating costs are expected to be reduced (POE pre-filters as well as labour costs to flush the distribution lines). As noted above, we cannot fully assess the benefit of the back-up wells until they are on line. It is strongly recommended that the District work with the hatchery to implement an automated system to open and close the Snootli intake and activate the back-up wells based on the in-stream monitored turbidity levels. Maintaining this as a manual process creates the potential for human errors or delays that could result in less than optimal operation of the turbidity management strategy.

The 0.35 micron pre filter and the flow meter upgrade were installed at one location each in the fall of 2014. Both appear to have had some success in reducing low UV alarms during turbidity events. The flow meter upgrade, in particular, appears to have been very successful, eliminating UV alarms at the location where it was installed despite the occurrence of several turbidity events over the 2014/15 winter season.

Most NSF-validated UV systems monitor only the UV intensity and assume that the system is always running at maximum capacity when calculating dosage and determining alarm conditions. This results in unnecessary UV alarms during many conditions when actual UV dose is far higher than the safe validation dose due a difference between the actual flow rate and the maximum flow rate capacity. Such alarms often occur due to the heating of water in the chamber during extended no-flow conditions, or due to temporary minor decreases in UV transmittance as a result of sleeve fouling or feed water conditions (turbidity increase due to rain event, etc.). When equipped with the flow meter, the UVMax Pro10 does not assume that the maximum flow capacity is always being used – instead, it uses a flow meter to measure the actual flow rate and uses this and the UVT to calculate the true real-time dose. The true real-time dose is used to trigger the alarm conditions. This technology will therefore allow users to continue to demand fully-treated water at a lower flow rate (having received the validated UV dose) during conditions that would have previously caused alarm conditions and shut-off the water supply completely via the solenoid valve. Is essence, this technology has the capacity to greatly reduce user frustration with conventional monitored UV sterilizers during periods of elevated turbidity.

Equipment Recommendations

We are generally very pleased with the performance of the equipment selected for the pilot project. Below is a brief assessment of each piece of equipment and its performance during the pilot project, and recommendations for the final project.

Pentek Big Blue Filter Housings
No problems with experienced with the cartridge filter housings. No failures were noted. Occasional o-ring replacement was required as part of regular maintenance. We recommend the use of the same housings for the final project due to their NSF-validation, consistent performance, brand name, and good value.

Cartridge Filters
Two cartridge filters were selected for the original pilot project: Pentek DGD-2501-20, and the Harmsco PP-BB-20-1. Both have performed very well with filter life spans significantly longer than originally expected. A third filter featuring 0.35 micron level filtration was tested over the 2014/15 winter season to see if it would help address the low UVT caused by certain turbidity events. It seems to have had some benefit in preventing alarm conditions that otherwise would have occurred during these events. We believe that other turbidity mitigation issues will be more effective in addressing turbidity events, accordingly, we recommend that the original 2 filters be utilized in the POE systems. The lack of available NSF/ANSI 53 cyst validation in a 0.35 micron filter weighs in on this recommendation as well as it may be difficult to obtain VCH approval for the swap of these filters. The two selected cartridges have been widely used on our other POE projects and other regulated applications.

UVMax Pro10 UV Sterilizers
The UVMax UV sterilizers performed well with limited problems. 2 minor equipment failures occurred, a cooling fan which was making a grinding noise, and a ballast, both of which were replaced under the manufacturer's warranty. UV lamp life met expectations of 2 years, which is double the life of the lamps from other manufacturers. A couple of UV sleeves were broken during routine maintenance. While this does occur occasionally due to the fragile nature of the sleeves, with increased experience of the operators, this should occur less often. No failures were noted with the UV intensity monitor sensors.

Low UVT conditions were correctly detected during the turbidity events resulting in alarm conditions and activation of the emergency solenoid shut-off valves. No solenoid valve failures were noted.

The addition of the new flow-based dose monitoring technology will be a major enhancement in reducing alarm conditions during turbidity events were actual UV dose can be maintained at required levels, and is therefore strongly recommended.

Some POE site homeowners express some concern with the fact that the initial water demanded from the system after a long period of inactivate water flow (morning), was relatively warm. This is a normal condition in a UV sterilizer. There is an additional device called a Temperature Management Valve that could be used to reduce this effect, however, a drain connection would be required and it would increase the cost of the POE unit by about $100. In mid 2015, the manufacturer is adding a new feature to its units called flow pacing or lamp-dimming. This feature reduces lamp intensity when the flow sensor detects that water is not flowing. This not only reduces heat build-up without sacrificing lamp life and disinfection effectiveness, but it also reduces energy consumption significantly. We feel that the addition of this new feature will red increase homeowner satisfaction.

COMMCenter
To facilitate data gathering and potential troubleshooting during the pilot project, COMMCenters were installed on all of the POE systems. In early 2014, most of the COMMCenters lost communication with their corresponding UV system ballasts/controllers. The contracted operator at the time had initially believed that the COMMCenters had failed and they were gathered up and sent back to HomePlus for testing. Upon arrival, the units were tested and found to be fully operational. They were returned to the community and put back into service. It is suspected that during a power outage, the systems lost the address that is used

to communicate with the UV system controller. The operator was educated as to how to reset the system address if necessary to restore communication between the COMMCenter and UV controller.

It is our opinion that the COMMCenter will not be required on all of the POE systems. Instead, we recommend that the District maintain a small inventory of COMMCenters that it can used for ongoing monitoring at a few locations in the community that would be representative of the overall system. A few additional units could be used for troubleshooting and by service technicians. Eliminating the COMMCenter from each system will result in material cost savings.

Emergency Back-Up Power Units (UPS)
During the pilot project, 2 uninterruptible power supply units were tested. They provided back-up power during short power failures as well as surge protection. After an extended power failure, the low battery warning alarms would sound. This alarm was confused for the UV system alarm by several homeowners. Since these outages could occur at night, the sound of the low battery warning could be a nuisance. We recommend either that the back-up power units be replaced by a dedicated surge protector at substantially lower cost, or a unit with no low-battery warning alarm be selected as an alternative (or one where this alarm can be disabled).

Leak Detection System
No water leaks were detected during the pilot project. The FloodStopper system used in the pilot project applications is no longer available. Alternative equipment is considerably more expensive. We feel that once the main project proceeds, third-party water leak liability insurance would be a more cost effective manner of protecting the District against risks associated with water leaks from the POE systems. Accordingly, we feel that the POE systems should not be equipped with active water leak detections systems. This will result in material cost savings.

Panel Layout
To accommodate the new UVMax system flow sensor, changes to the panel layout are required. We also recommend the addition of a drain to allow for easier draining of the UV chamber for service.

Capital Cost

Since the beginning of 2015, the Canadian dollar has depreciated considerably versus the U.S. dollar. Several components of the proposed POE system are manufactured in the U.S. Accordingly, there have been some minor price increases. Quoted prices are valid for 90 days. In the event that there are significant exchanges in exchange rates, prices could change between now and the beginning of the project.

The new pricing is as follows:

Pro10 Flex Panel POE System, including:
- Pentek Big Blue Housings w/ White Powder Coated Mounting Brackets
- Pentek DGD-2501-20 Sediment Pre-Filter
- Harmsco Poly-Pleat PP-BB-20-1 Validated Cyst Filter
- Pro10S UV sterilizer w/ Flow Meter and Emergency Solenoid Shut-Off
- Pressure Gauges before and after each cartridge
- UV chamber drain port
- Inlet and Outlet Shut-Off
- Flow sensor acrylic guard
- Full-assembly and leak testing

Price: CDN$2,225

Installation parts and labour will vary from location to location. Fpr optimal installation efficiency and to reduce costs, it is highly recommend that the installation be very carefully organized and scheduled. A pre-installation meeting with the homeowner is recommended to:

- Confirm a mutually-acceptable installation
- Sign the service agreement if applicable
- Educate the homeowner about the water treatment system, its capabilities, its limitations, and how to address emergency situations etc.
- To take pre-installation photos so the service contractor knows exactly what fittings, parts, and materials are required for the installation so they can be brought to the site on installation day

Installation labour time is estimated as follows:

Pre-installation site inspection: 30 minutes at $30 per hour.

Equipment installation (2 individuals on site):
Certified installer under contract at $30 per hour labour only
Assistant under contract at $20 per hour labour only
Time on site 2.5 hours

Total cost:
3 hours at $30/hour = $90
2.5 hours x $20/hour = $50
Installation Labour Total = $140

We estimate that one out of every 3 installations will require an electrician to install a power outlet.
We have estimated a cost for this service at $60.

Installation Fittings:

We recommend the use of John Guest style quick connect fittings for as much of the installation as possible. These fittings push-fit to copper and PEX plastic water lines and are available in 3/4 and 1" sizes.

More information: http://www.home-water-purifiers-and-filters.com/john-guest-fittings.php

The exact fittings required for each installation will vary depending on the configuration and materials of the existing plumbing. A small number of locations may require a pressure reducing valve or an insulated exterior cabinet. We believe the average installation will require about $70 in fittings and materials.

Replacement Parts / Maintenance:

The pilot project provided significant insights into the maintenance requirements of the POE equipment. During the pilot project, the POE units were subjected to several significant turbidity events. Accordingly, the sediment loading on the filters was likely significantly higher than will be the case in the future when the back-up wells are put on line during turbidity events.

Pentek DGD-2501-20, replace every 2 years
Harmsco PP-BB-20-1, replace every 2 years
Pentek Big Blue Housing O-Ring, each time the cartridges are replaced
Pentek Big Blue Housing Sump, replace every 10 years
Pro10 Replacement Lamp, replace every 2 years
Pro10 Replacement Sleeve, replace every 5 years
Pro 10 UV Intensity Monitor, replace every 5 years

We are estimating a product life cycle of 12 to 15 years. Beyond this time frame, it cannot be guaranteed that the product line will continue to be supported by the manufacturer and we expect that new technology will be available that may be desirable to implement at such a time.

We have budgeted for general maintenance service and inspection every 12 months. This will include sleeve and sensor window cleaning, a check of filter pressure differential, replacement of the pre-filters if required, a check of UV dose status, and general housekeeping of the unit. Every 2 years, and lamp will be replaced.

We have budgeted $30 per hour for the service technician.

We have budgeted 1 hour of general scheduled maintenance time per year per system. This will require roughly 190 man hours at $30 per hour = $5,700. We have also conservatively budgeted an additional 200 man hours per annum for troubleshooting, materials handling, trailing, and non-scheduled maintenance.

We are concerned about the turnover of service personnel during the pilot project. Retaining a trained technician on a long-term basis is important to the success of the project. Consideration should be given to alternative compensation structures that would encourage a long-term contractor/employee. Ideally, a near full time employee handling the POE system maintenance and other District duties would be ideal, but perhaps not practical.

It will also be critical to have a back-up technician available for emergencies in the event that the primary contractor/service technician is unavailable due to illness or holiday, etc.

Life Cycle Operating Cost

The life cycle cost of each POE system over 15 years is estimated approximately $6,000 or $400 per annum. This includes the original capital cost, installation parts and labour, all scheduled and unscheduled maintenance, and an annual contingency fund for unscheduled parts replacement, particularly after the 5 year ballast warranty ends.

Please see the attached spreadsheet for an overview of our calculations.

Centralized Water Treatment Option

In the event that municipal grant funds can be accessed to modernize the existing water distribution infrastructure, it remains an option to consider a centralized water treatment system for the community. Such a facility would require chlorination which would likely not be popular with residents. Homeowners wishing to remove chlorine at their residence would have the option of installing a POE activated carbon filter. If the community has an interest in further examining this option, please let us know.

Final Report

One of VCH's requirements on the pilot project approval was to have an engineer prepare and review the final pilot project outcome report. We await your instructions regarding the selected engineering firm and proposed involvement of HomePlus in this report. HomePlus would be pleased to be involved to whatever extent is deemed appropriate and desirable by the Board. Our hourly charge-out rate would certainly be significantly lower than that of an engineer, so it may be more cost-effective for us to compile and summarize the majority of the raw data and have the engineering firm provide its opinion thereon. I await your guidance as to the level of involvement that you would like us to have. In any event, you can be assured of our full co-operation with the engineering firm.