Summary Information for Sallal Water Association Member Meeting Concerning Chlorination of Drinking Water
October 29, 2020

Section 1: Protecting the water you drink

Presentation Slide 7

State and federal regulations require drinking water utilities to take several steps to protect the quality of water delivered to customers. Given the potential health risks associated with contaminated drinking water, the regulations require a "multi-barrier" approach to drinking water protection. This approach builds in redundant levels of protection to safeguard the quality of water in our aquifers, at our wells, and in the pipes leading to our members' homes and businesses. The drinking water regulations require utilities to ensure adequate protection is in place at each step shown below. The regulations also require utilities to increase their protection efforts if routine monitoring indicates possible problems.

Protecting water in the ground: The first barrier in protecting your drinking water is to protect the water in the ground before it gets to our wells. This includes identifying the land areas where contaminants can potentially enter a groundwater aquifer and working with landowners and government authorities to manage activities in these areas in a way that prevents contamination. Sallal is fortunate that its primary wells are in a groundwater area that is protected from development. This means that there is generally a low risk that our wells will pump water that has been contaminated with dangerous chemicals or pathogens (bacteria, viruses, and parasites).

Protecting water from our wells: The regulations recognize that groundwater protections are often enough to protect the quality of water delivered by a drinking water well. Wells in protected areas often do not required treatment to remove chemicals or pathogens. Unfortunately, contamination can still happen even in areas with a very high level of protection, like we have with the aquifer for wells #1, #2 and future well #4. Because of this, the drinking water regulations require utilities to treat water pumped by a well if water samples indicate possible contamination of the groundwater aquifer. In our case, a positive *E. Coli* test for a water sample taken from well #2 in September 2019 indicated that water pumped by that well may contain pathogens. This test result required Sallal to act immediately to remove this risk by disinfecting water from this well. The regulations require disinfection to remain in place as long as there is a potential risk for pathogens being present. The drinking water standards require disinfection systems to remove 99.99% of viruses that might be present in the well water (referred to as "4-log treatment"). Disinfecting water to this level ensures that the water we send to your home or business is free of harmful viruses, bacteria, and parasites.

Protecting water to your tap: Protecting drinking water quality does not end until the water reaches the meter that connects your home or business to our pipes. We must ensure the water we deliver is safe to drink once it reaches you. This protection often requires a utility to use multiple strategies to prevent contamination. Most drinking water utilities use a combination of the following strategies to protect water in their pipe networks:

- backflow prevention devices at points where drinking water pipes connect to customer pipes to prevent contaminated water from flowing backwards into the drinking water pipe network.

- periodic flushing of pipes and tanks to clean out the system.
- rigorous maintenance of the pipes, tanks, valves, and booster pumps in the distribution network.
- adding a small amount of chlorine to the drinking water to keep pathogens from growing inside the pipes.

Sallal has historically relied on the first three strategies to protect water we deliver. While these strategies were generally successful, past routine monitoring indicated that these steps alone may not provide enough protection. In response to the multiple detections of total coliform and *E. Coli* bacteria at various locations in September 2019, it was necessary for Sallal to begin adding chlorine to the water distribution network to better protect the water we deliver. The drinking water standards require utilities that add chlorine to protect water in drinking water pipes to maintain a minimum residual concentration of 0.2 mg/L (measured as either free chlorine, total chlorine, or combined chlorine) throughout the pipe network. . Our operating standard is to maintain a residual of at least 0.6 mg/L (as free chlorine) in our pipes. This concentration is about seven times lower than the 4 mg/L concentration that the CDC and EPA consider as safe for drinking water.

Section 2: How the state regulates "Pathogens"

Drinking water regulations require utilities to routinely test the water they deliver to homes and businesses for possible presence of "pathogens" – harmful viruses, bacteria, and parasites that can make people sick. Examples of pathogens that could end up in drinking water include *Norovirus*, *Hepatitis* A, *Campylobacter coli*, *E. Coli* O157:H7, *Giardia*, and *Cryptosporidium*. While there are many types of pathogens that can make people sick from drinking water, the most common cause of this type of pollution is fecal contamination, either from animals or humans.

Frequently, concentrations of pathogens from fecal contamination are small, and the number of different possible pathogens is large. As a result, it is not practical to test for specific pathogens in every water sample collected. The regulations instead focus on testing for the presence of "indicator organisms", such as coliform bacteria. Coliform bacteria are organisms that are present in the environment and in the feces of all warm-blooded animals and humans. While most coliform bacteria are harmless, their presence in a drinking water sample may indicate that the water is contaminated either from an environmental source or from a pollution source that contains feces. A positive coliform test indicates that there is a risk that the water may contain harmful pathogens.

State and federal drinking water regulations require utilities to use the protection strategies described above to reduce the risk of pathogens being in our water. By disinfecting water at the well location, we remove pathogens before they can enter the drinking water system. Maintaining a small residual concentration of chlorine in the pipes connected to your home or business helps to remove pathogens that may have made it past the main disinfection process and protects the water in the pipes from contamination by possible unknown leaks in areas of our system.

Section 3: Monitoring for Pathogens

Presentation Slides 8-10

State and federal regulations require Sallal to perform monthly tests for the presence of pathogens in water samples collected from several locations throughout the pipe network that distributes water from out wells. Sallal collects water samples at several locations each month to test for the presence of "Total Coliform" bacteria. In addition, if a sample tests positive for total coliform, the lab tests the sample again specifically for "E. Coli" bacteria – a sub-set of the larger group of total coliform bacteria. While positive tests may indicate possible environmental contamination, it cannot tell us if the water actually contains harmful pathogens. A positive test only indicates elevated risk.

Based on our service area population, Sallal must test a minimum of seven locations each month to ensure the samples adequately represent the quality of water delivered to our members. We perform all monitoring according to a DOH-approved plan that documents our sampling locations and testing methods. All pathogen monitoring, as well as responses to possible contamination, must comply with requirements in the federal Total Coliform Rule as well as the state's regulations governing Group A Public Water Supplies (WAC 246-290).

The required monitoring first relies on testing for the presence or absence of Total Coliform as an initial screening to determine if there has been a potential risk of contamination by pathogens from an environmental source. If any routine test has a positive result for the presence of Total Coliform bacteria, the regulations require two immediate follow-up actions: we must immediately test the positive sample for E. Coli bacteria and we must also collect repeat samples from the distribution network (minimum of three samples for each positive result). The retesting for E. Coli bacteria is necessary to determine if the potential contamination is from a source that contains fecal mater and the repeat samples are used to help verify whether the initial positive result may have been an error or anomaly. It is important to note that the test methods do not attempt to determine how many bacteria may be in a positive sample – one or one million bacteria in a sample will give the same result. The tests also do not attempt to identify the specific bacteria species present. The tests only generally identify the presence of bacteria in the large group of Total Coliform bacteria or in the smaller sub-group of E. Coli bacteria. The regulations do not require information on quantity or specific bacteria species to assess risk. A positive result for any of the indicator organisms is sufficient to demonstrate that there is a risk of contamination.

In addition to triggering repeat sampling, monitoring that indicates positive results for Total Coliform bacteria also requires the drinking water utility to take corrective follow up actions. The regulations (WAC 246-29-320) contain two levels of action that differ according to the level of risk.

Level 1 Assessment: The regulations require a level 1 assessment in response to events considered "low risk". The following conditions trigger this level of assessment for a system the size of Sallal's:

- Two or more Total Coliform positive samples in the same month. Results that may qualify as "two or more in the same month" include positive results at multiple routine sample sites, or a single Total Coliform positive result at a routine site along with a positive sample at a repeat sample site.

- Failure to take appropriate repeat samples after a single positive Total Coliform result in a routine sample.

DOH considers a level 1 assessment as a basic evaluation that anyone familiar with the water system can complete. It consists of a review of the administrative and operational practices in place to protect the water in the pipes from contamination. If the review identifies problems, the utility must implement necessary corrective actions before DOH will consider the assessment as complete.

Level 2 Assessment: This level of assessment is required when monitoring results indicate a higher public health risk due to the repeated occurrence of Total Coliform bacteria, or the confirmation of E. coli bacteria in the distribution system. Conditions that trigger a level 2 assessment include:

- Monitoring results Trigger a second level 1 assessment in a rolling 12-month period.
- Any violation of the E. Coli Maximum Contaminant Level (MCL). Any of the following qualify as a violation of the E. Coli MCL:
  1. A total coliform-positive repeat sample follows an E. coli positive routine sample.
  2. An E. coli positive repeat sample follows a total coliform-positive routine sample.
  3. The lab fails to test a total coliform-positive repeat sample for E. coli.
  4. The system fails to take three repeat samples following an E. coli positive routine sample.

DOH considers a Level 2 assessment as a more complex assessment that only a person with specific qualifications can complete. Qualified individuals include licensed engineers working in the field of water system design, DOH-certified distribution system operators at the level of WDM2 or higher, or appropriate staff from state or local health departments. The goal of a level 2 assessment is for the utility to take a comprehensive look at its administrative, operational, and technical practices used to protect the quality of drinking water in its pipes. The results of this assessment should identify potential causes for repeated contamination as well as identify appropriate corrective actions to prevent future problems.

Since revision of the federal Total Coliform Rule in 2016 (and subsequent revision to state regulations), DOH requires any drinking water utility to begin adding chlorine to their distribution system when the utility triggers a second level 2 assessment and the utility cannot find and fix the source of contamination. As part of a meeting in June 2020, members of the Sallal board reviewed our history of bacteria monitoring with DOH staff. This review highlighted that past monitoring demonstrated that Sallal's system has multiple Total Coliform and E. Coli detections in the past. While the monitoring did not violate standards in place at the time, DOH noted that the current Total Coliform Rule would have required Sallal to begin adding chlorine several years ago, had it been in place.

Since 1996, Sallal has detected the presence of Total Coliform in 38 routine samples collected at various locations in our water distribution network. A single detection does not necessarily mean that our monitoring revealed actual contamination since false positives and other errors can occur. Of the 38 routine samples with positive Total Coliform detections, 25 did not have corresponding detections in repeat samples. In most cases these results would not have trigger a level 1 assessment since they did not meet the threshold of "two or more Total Coliform detections in the same month". However, the remaining 13 routine samples with positive results

also corresponded with one or more repeat samples that also tested positive for Total Coliform. These results would have triggered a level 1 assessment. In addition, three routine samples collected in 2004 and 2009 along with six repeat samples (all from 2004) also tested positive for E. Coli. These results would have qualified as E. Coli MCL violations that trigger a level 2 assessment.

Table 1 identifies where past monitoring would have likely triggered a level 2 assessment under the current Total Coliform Rule by either triggering multiple level 1 assessments in a 12-month period, violating the E. Coli MCL, or both. The record indicates that monitoring could have triggered level 2 assessments at least seven times between 2001 and 2017. As shown here, viewing past monitoring results through the lens of the current regulations suggests that monitoring could have triggered a need to add chlorine to our distribution network as early as 2004.

Table 1. Past Monitoring Potentially Qualifying as Level 2 Trigger Events

12- Month Range	Multiple Level 1 Assessment Triggers? (months with 2 or more Total Coliform Detections)	Violation of E. Coli MCL?
May 2001 – April 2002	May (1 routine, 1 repeat) November (1 routine, 2 repeat)	No (positive for TC & Fecal) [1]
July 2004 – June 2005	July (1 routine, 2 repeat) October (2 routine, 6 repeat) June 2005 (1 routine, 3 repeat)	Yes, October – 8 samples
June 2005 - May 2006	June 2005 (1 routine, 3 repeat) January 2006 (1 routine, 1 repeat)	No
October 2009	No	Yes, routine test on 10/14/09 positive for both TC and E. Coli.
September 2010 – August 2011	September (1 routine, 1 repeat) October (1 routine, 0 repeat) November (2 routine, 5 repeat)	Yes, October - 1 sample
November 2014-October 2015	November (1 routine, 1 repeat) March 2015 (1 routine, 1 repeat)	No
August 2016 – July 2017	August (1 routine, 1 repeat) September (2 routine, 0 repeat)	No

[1] While monitoring in 2001-2002 period did not show E. Coli detections, one routine sample in Jan 2002 tested positive for both Total Coliform and Fecal Coliform.

Section 4: DOH requirements for eliminating chlorine

Presentation Slides 12-14

On June 9, 2020, members of the Sallal Board and Sallal's engineering consultant met with representatives from Department of Health's Office of Drinking Water to discuss the steps

required to allow for Sallal to cease using chlorine. DOH representatives confirmed that state and federal regulations could allow Sallal to operate our water system without the use of chlorine. However, they reinforced that we must first demonstrate that other controls are adequate to ensure our water is protected all the way from the aquifer to our members' taps. Since the *E. Coli* detections in September 2019 indicated needs to improve protections for water as it is pumped from well #2 along with protecting water in our distribution pipes, DOH was clear that any steps we take to eliminate the use of chlorine would need to evaluate both protection areas. DOH was also clear that the 2019 event combined with past monitoring meant that reverting to operating practices in place before 2019 was not possible. They will require Sallal make several physical and operational changes to our system before they would approve discontinuing the use of chlorine.

Demonstrating water is protected at our wells Eliminating the use of chlorine for 4-log virus treatment at well #2 requires Sallal to demonstrate that there is little to no risk of the groundwater being contaminated with pathogens. This will include reviewing strategies we use to ensure contaminants do not enter the aquifer from land uses near the well along with examining the well itself to make sure it cannot allow contaminants to enter the water supply. Steps to remove chlorine for disinfection at the well includes:

- Submit a written request to DOH to formally request discontinuing 4-log virus treatment.
- Review the well design and construction to make sure the well complies with the state's construction standards in chapter 173-160 of the Washington Administrative Code (WAC). Prepare and submit documents to DOH to provide evidence of proper construction.
- Review our groundwater source protection area policies to ensure they provide an adequate minimum sanitary control area, as required by chapter 246-290-135 WAC. Prepare and submit documents to DOH to demonstrate that our source control programs are appropriate.
- Complete a minimum of one year of testing of water from well #2 to demonstrate that is does not contain pathogens. Results submitted to DOH must show a minimum of twelve consecutive months of satisfactory tests (no total coliform or *E. Coli*) in water samples taken before any existing treatment. The sampling plan must attempt to capture "worst case" conditions that could lead to a greater risk of environmental contamination.
- Once DOH receives all of the above information, they will conduct a "Special Purpose Investigation" of our facilities. DOH will only approve discontinuing 4-log treatment if they are satisfied that the information we provide demonstrate adequate protection and we correct any significant deficiencies found during the special purpose investigation.

In our meeting, DOH acknowledged that using alternative disinfection methods (UV light or ozone) could allow us to eliminate the use of chlorine for 4-log treatment at well #2 while still providing necessary treatment. However, they advised that neither UV light nor ozone have established track records in the state for use in disinfecting drinking water. This adds considerable uncertainty to the design process that could greatly impact the amount of testing and pre-construction costs we would face in order their approval for either alternative technology.

Demonstrating water is protected to members' taps Regardless of whether Sallal is successful in eliminating the use of chlorine for treatment at well #2, we must still satisfy regulatory requirements to protect our water as it travels through pipes to our members' homes and

businesses. According to DOH, before September 2019 Sallal was the largest drinking water utility in the region to not use chlorine to protect water in its pipe network. Although the regulations allow drinking water utilities to operate their water distribution networks without adding chlorine, DOH advised us that the path discontinuing our use of chlorine in our pipes would be long and challenging. This path will require careful inspection and review of our complete pipe network and may require significant financial investments to replace equipment or to construct improvements. Specific steps on this path include:

- Submitting a formal written request to DOH to discontinue the use of chlorine for protecting our drinking water pipes. According to DOH, they consider this type of request as a proposal to change our system design. Because of this, we will need to work with our engineering consultant to develop an appropriate project submittal.
- We must maintain an appropriate chlorine residual in our pipes for a minimum of twelve consecutive months before DOH will accept our request.
- DOH also expects Sallal to demonstrate that it has clear support from its members to make this change. They strongly recommended developing a survey to gauge member opinion. We must be able to document to DOH that most members support making this type of change.
- As part of our proposal, DOH expects Sallal to review our sampling history and discuss how we addressed all past Total Coliform or *E. Coli* detections. This review must demonstrate to DOH that we have taken appropriate steps correct or mitigate problems that may have allowed contaminants to enter our pipes in the past.
- Our proposal must include a thorough engineering review of all aspects of our drinking water distribution network to identify areas where contaminants might enter our pipes. We must ensure that every valve, booster pump station, pressure regulator, and all other components meet current standards for design and installation. If this effort identifies any issues, we must first correct the problems before we move forward with eliminating chlorine.
- We must also evaluate and, if necessary, improve our cross-connection control program to ensure contaminated water cannot flow backwards into our pipes from a member's home or business.
- Finally, we must closely examine our routine pipeline maintenance program to ensure our maintenance and cleaning practices are sufficient to protect the quality of water we deliver to our members. We must also demonstrate that we will perform any necessary flushing in a way that will not bias our compliance samples.
- Once we have completed the reviews and improvements discussed above to DOH's satisfaction, we must prepare and submit a transitional monitoring plan. This plan provides a detailed description of the water quality monitoring we will do to demonstrate that the water we deliver to our members is safe without the added chlorine. The plan specifically identifies the locations, frequency, and duration of sampling along with the contaminants we will test for in each sample. DOH expects us to provide clear communication with all our members about this monitoring plan. We must also specifically work with schools and restaurants to ensure they understand our *E. Coli* response plan should any sample taken during or after the transition period test positive for *E. Coli*.
- After DOH approves our transition plan, we may begin taking steps to remove chlorine from the water in our distribution pipes.

It's important to note that completing the work described above does not provide any guarantee that DOH will approve Sallal to discontinue using chlorine to protect water in our distribution pipes. DOH may decide at any step that our efforts are not sufficient to protect the health of our members. In addition, any failed test during the transition period could trigger a boil water advisory and require us to immediately return to adding chlorine to our water.

Alternatives for Protecting Sallal's Water from Pathogens

Presentation Slides 15-21

Any strategy for protecting Sallal's water from pathogens requires not only protecting the water that leaves our wells, but also protecting the water as it travels through the miles of pipes that connect the wells to your home or business. In weighing options for protecting the water we drink, it is important to know whether a particular option can provide protection all the way from the well to your tap. Cost estimates shown below were developed by our engineering consultant as part of a preliminary technology review in December 2019. The estimates only reflect costs for adding disinfection to well #2 along with providing a disinfectant residual needed to protect water in our pipes.

Chlorine: Adding chlorine to drinking water, either as a gas or in liquid form as sodium hypochlorite, is recognized as the industry standard for protecting drinking water from pathogens. Chlorine kills microbial pathogens by destroying the cell walls and structures inside the cell. Chlorine reliably achieves a 4-log (99.99%) reduction of viruses when added to water at a well or other drinking water source. It also ensures protection of the water in the pipes connected to homes and businesses. The estimated cost to add chlorine disinfection at well #2 was approximately $300,000. The cost estimate for adding equipment necessary to supply chlorine for the distribution system was $113,000, making the total cost to implement this alternative at $413,000. Completing installation of chlorine disinfection at Sallal's remaining wells will require an additional $100,000.

- Advantages
    - Reliably disinfects drinking water to achieve 4-log virus reduction.
    - Provides a disinfectant residual needed to protect the water as it travels to your home or business.
    - Industry standard for disinfection with well know dosing and design requirements.
    - High level of acceptance by regulators.
    - Simple system to operate and maintain.
- Disadvantages
    - Chorine disinfection is a slower process than the other alternatives. Therefore, this option requires more space for the pipe needed to provide sufficient contract time before sending the water towards your home or business.
    - Chlorine reacts with naturally-occurring organic matter that may be present in drinking water to form Disinfection Byproducts (DPBs). Some DBPs are harmful to humans. Since the groundwater Sallal pumps does not contain significant amounts of organic matter, the risk for DBPs in the water we supply is low. Despite the low risk, utilities that use chlorine are required to do additional testing for DBPs in the water they deliver.

- Chlorine gas and liquid sodium hypochlorite are dangerous chemicals that requires safe storage and use of protective equipment by a certified operators.
- Chlorine can produce a noticeable unpleasant taste and odor at low concentrations.

Ultraviolet Light: You may know that prolonged exposure to ultraviolet light from the sun can damage your skin and can cause skin cancer. This damage occurs from exposure to light in the UV-A and UV-B ranges. Exposing microorganisms to a different range of ultraviolet light, the UV-C range, can damage the organism's DNA and stops it from reproducing. Because of this, UV light provides an effective way to remove pathogens from water without the use of chemicals. While a properly designed UV light system can provide 4-log virus reduction in water from a well, it does not produce a long-lasting residual needed to protect water as it travels through the distribution system. The estimated cost to add UV disinfection at well #2 was approximately $500,000.

- Advantages
  - UV disinfection is capable of reliably achieving 4-log virus reduction in drinking water from wells.
  - Process relies on light and does not add chemicals to water.
  - Disinfection process is faster than chlorine and requires less space for the treatment system.
  - The groundwater Sallal pumps does not contain minerals or solids that can impact UV effectiveness. This makes our water a good match for this technology.
- Disadvantages
  - UV disinfection does not provide a residual disinfectant needed to protect water in the pipes connected to your home or business. Sallal cannot comply regulatory requirements with UV alone.
  - Significantly higher cost than a chlorine system.
  - Equipment used to generate the UV light is sensitive to power interruptions & fluctuations. Even a brief power outage can cause a loss of disinfection.
  - The lamps used in UV systems contain small amounts of mercury, which requires specialized training for safely handling and disposal.
  - While technology is commonly used to disinfect treated wastewater before disposal, it is not commonly used in drinking water facilities. No groundwater purveyors in Washington currently use this technology.
  - Technology requires extensive testing to demonstrate it provides 4-log virus reduction before DOH will allow it use for disinfection.
  - Requires additional operator training & certification

Ozone: Ozone is an unstable molecule comprised of three oxygen atoms. It's a strong oxidizer that that can kill microorganisms by damaging their cell walls and constituents of their nucleic acid. As an unstable form of oxygen, ozone quickly decomposes into harmless compounds. While ozone is highly effective at killing pathogens to meet a requirement for 4-log virus reduction, it does not produce a long-lasting residual needed to protect water as it travels through the distribution system. The estimated cost to add ozone disinfection at well #2 was approximately $520,000.

- Advantages
    - More effective than chlorine in destroying pathogens
    - Rapid disinfection process that requires a short contact time and less space than chlorine.
- Disadvantages
    - Ozone decomposes quickly and does not provide a residual disinfectant needed to protect water in the pipes connected to your home or business. Sallal cannot comply regulatory requirements with ozone alone.
    - Highest cost of all three alternatives.
    - Ozone is an unstable gas that must be generated on site with energy-intensive equipment.
    - Ozone can react with naturally-occurring organic matter and other compounds in drinking water to form DBPs. While ozone does not form the same DBPs as those formed by chlorine, ozone DPBs can be harmful to humans. This alternative requires additional testing to see if DPBs are present.
    - Ozone is very reactive and corrosive.
    - Ozone is extremely irritating and possibly toxic, which requires operators to take special precautions when operating and maintaining equipment.
    - Requires additional operator training & certification

UV or Ozone with Chlorine: Pairing UV or ozone with chlorine can provide an effective means of achieving 4-log virus reduction needed to protect water at a well source while producing a residual disinfectant needed to protect water in the distribution pipes. As noted above, the estimated cost to add UV or ozone disinfection at well #2 was approximately $500,000-$520,000. The cost estimate for adding equipment necessary to supply chlorine for the distribution system was $113,000. The total cost of this alternative is up to $633,000.

- Advantages
    - Combining UV or ozone with chlorine potentially provides a more effective means of achieving 4-log virus reduction than chlorine alone.
    - This alternative can comply with regulatory requirements to protect water in the pipes connected to your home or business with a reduce amount of chlorine.
    - Can help reduce chlorine odor and taste issues
- Disadvantages
    - Previously stated disadvantages still apply.
    - Significantly more expensive strategy to fully protect our water system than chlorine alone.
    - Adds higher level of operating complexity and requires additional operators to be trained and certified on multiple systems.

Enhanced Inspection & Maintenance: In theory, DOH can approve Sallal to operate its water system without the use of disinfection barriers, such as using chemicals or UV at the wells and adding chlorine to our pipe network. To do so, Sallal must demonstrate that it uses other technical and administrative practices that provide equal public health protection to the alternatives described above. For a complete explanation of these requirements, please refer to the section titled "DOH Requirements for eliminating chlorine". At present, complete costs to

make necessary improvements to fully eliminate the use of chlorine is unknown. However, we anticipate that this endeavor would likely require engineering reviews that would cost $100,000-$200,000 or more and could result in millions of dollars in improvement projects. There is also considerable uncertainty about whether the improvements would ultimately be sufficient to gain DOH's approval to eliminate chlorine.

- Advantages:
  - Eliminates the use of chemical disinfectants in our water system
  - No additional operator training requirements
- Disadvantages:
  - No certainty of success
  - Impossible to prevent all contamination events
  - Significant engineering review & system redesign
  - Likely highest capital & operational cost

Section 5: Additional Recommended Resources

Regulation: Washington's Group A Public Water Supplies (WAC 246-290) – https://app.leg.wa.gov/wac/default.aspx?cite=246-290

Disinfecting water with chlorine:

- General information from the Center for Disease Control and Prevention – https://www.cdc.gov/healthywater/drinking/public/chlorine-disinfection.html
- General information from DOH – https://www.doh.wa.gov/communityandenvironment/drinkingwater/disinfection/chlorinationofdrinkingwater
- Information from DOH on alternative disinfection methods – https://www.doh.wa.gov/portals/1/Documents/pubs/331-252.pdf
- Information on Point of Use water treatment to remove chlorine – "Chlorine Filter Information" written by Sallal member Stephen Kangas, Nov 2019 – https://sallal.com/chlorine-filter-information/

2016 Revised Total Coliform Rule:

- Information from EPA – https://www.epa.gov/dwreginfo/revised-total-coliform-rule-and-total-coliform-rule
- Information from DOH – https://www.doh.wa.gov/CommunityandEnvironment/DrinkingWater/Contaminants/Coliform/RevisedTotalColiformRuleRTCR

Pathogens in drinking water:

- General information from DOH on Coliform bacteria in drinking water – https://www.doh.wa.gov/CommunityandEnvironment/DrinkingWater/Contaminants/Coliform

- Chapter on "Microbial Aspects" World Health Organization's 2017 Guidelines for Drinking Water Quality (Fourth Edition) – http://www.who.int/water_sanitation_health/publications/2011/9789241548151_ch07.pdf?ua=1