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Title: Cyanotoxins Detection and Treatment Plan for Salem’s water supply.

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Neighborhood(s): All Neighborhoods
Result Area(s): Safe, Reliable, and Efficient Infrastructure.

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Attachments: 1. Geren Island Water System, 2. Turner Water System

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4/22/2019	1	City Council	received and filed	

TO: Mayor and City Council

THROUGH: Steve Powers, City Manager

FROM: Peter Fernandez, PE, Public Works Director

SUBJECT:

Cyanotoxins Detection and Treatment Plan for Salem’s water supply.

Ward(s): All Wards
Councilor(s): All Councilors
Neighborhood(s): All Neighborhoods
Result Area(s): Safe, Reliable, and Efficient Infrastructure.

ISSUE:

Actions and plans taken to detect, treat, and respond to potential cyanotoxins in the City of Salem’s water supply.

RECOMMENDATION:

Information only. Staff will be prepared at the April 22 meeting to provide a brief presentation.

SUMMARY:

The City has a comprehensive cyanobacteria toxin plan for monitoring the watershed, conducting water quality sampling and laboratory testing, optimally operating the Geren Island Treatment Facility during the algal season. The plan includes implementing water distribution stations and home-water delivery if the City is required to issue a water quality health advisory. Another important component is a communication plan that will be used to guide public information prior to and during algal season.

The first short-term investment, implemented last summer, was the addition of a Powdered Activated Carbon (PAC) Treatment Process. Additional short-term investments implemented over the past six months to improve the PAC Treatment process include re-sanding the large roughing filter and adding chlorine reducing facilities so chlorine can be used to treat cyanotoxins.

The long-term solution for removing cyanotoxins is to add an ozone treatment process. Ozone is one of the strongest disinfectants used to treat water and produces no taste or odor in the finished drinking water.

FACTS AND FINDINGS:

Short-term Steps to Treat Algal Toxins

Salem has several methods available to act as barriers to keep cyanotoxins from getting into the drinking water distribution system. When needed, the roughing filter at the Geren Island Water Treatment Facility will be brought into operation and acetic acid will be added to strengthen the slow sand filters. As toxins are detected first in the Detroit Reservoir and then downstream at the Geren Island Intake, the chlorine levels will be increased to act as a disinfectant against the toxins, by oxidizing them, before the chlorine levels are then reduced back to normal before entering the distribution system. If toxin levels increase to the health advisory level at the Geren Island Intake, the PAC system will be activated and will continue to operate until toxin levels drop below health advisory levels. Water quality samples collected at different steps in the treatment process at the plant are called process samples; and they will give operators an indication of how well each treatment method is acting as a barrier against the toxins.

Improve Powdered Activated Carbon (PAC) Treatment Process

In response to the algal toxin advisory last summer, staff developed, tested, and activated a PAC treatment process in approximately three weeks. The method of using PAC to remove algal toxins from the source water involves five steps:

- Step 1. Add PAC to the water in the inlet channel after it has been drawn from the North Santiam River.
- Step 2. Provide sufficient mixing and contact time between the PAC and the water to

- ensure algal toxins are adsorbed.
- Step 3. Provide sufficient time for the PAC to settle before the water enters our filtration system.
- Step 4. Send the PAC-treated water first to the roughing filter, then add acetic acid before pumping the water to the slow sand filters.
- Step 5. Treat the filtered with chlorine, fluoride, and soda ash to keep the water disinfected and at the proper pH throughout the distribution system.

While PAC is a proven technology for removing cyanotoxins, settling the PAC as identified in Step 3 above was challenging in 2018 due to the configuration of the existing facility. Often times too much PAC passed onto the roughing filter and caused it to clog quickly. Last fall and winter staff ran multiple tests of the system and determined that the PAC settling time could be increased from one hour to two hours by reconfiguring the South Basin of the treatment facility. That work is complete and ready for use should PAC treatment become necessary this summer.

Re-sand Large Roughing Filter No. 2

The large roughing filter at the Geren Island Treatment Facility (Attachment 1) consists of a coarse graded sand with larger particles than the fine sand used in the slow sand filtration process. In previous years the roughing filter was used primarily during high turbidity events to filter sediments from the water prior to passing through the slow sand filtration process. In 2018, the filter was used more regularly and developed a biological layer of its own. As tests were taken throughout the treatment plant last summer, it became evident that the roughing filter was significantly reducing cyanotoxin levels, and in combination with the slow sand filters, became a successful treatment process for removing cyanotoxins. Over the past three months contractors have cleaned over 4,400 cubic yards of sand and replenished the roughing filter so it is ready for use this spring.

Chlorination System Modifications

Increasing the dosage of chlorine has proven to remove cyanotoxins from drinking water. Chlorine is already added to Salem's drinking water at the Geren Island Treatment Facility to ensure that the water stays disinfected throughout the distribution system. It is typically injected at very low levels to prevent taste, odor, and other health issues. Over the past four months staff have constructed chlorine reduction facilities at Franzen Reservoir and near Aldersgate in the City of Turner (Attachment 2). When in use, these facilities can reduce the levels of chlorine in drinking water by adding National Sanitation Foundation (NSF International) approved chemical compounds. With these facilities in place, operators at the Geren Island Treatment Facility will be able to increase chlorine dosages, if necessary, to treat for cyanotoxins and then reduce the chlorine levels prior to the water entering the distribution system. All of Salem's drinking water will pass through Franzen Reservoir.

Monitoring the North Santiam Watershed

The North Santiam watershed has the potential for algal blooms generally between the months of May through October. The City makes visual observations of water conditions in the Detroit Reservoir throughout the year and conducts water quality samples throughout the year. Testing

occurs at a higher frequency during algal season. A new resource available to the City in 2019 is the algal potential forecast issued weekly from The Prediction Lab out of Oregon State University. The forecasts are based on a combination of many quantitative factors that impact the watershed, and predictions are issued based on probabilities of the potential for harmful algal blooms in the reservoir. The forecasts are another tool that staff can use to monitor the health and condition of the water in Detroit Reservoir.

Water Quality Sampling and Laboratory Testing Program

The City has its own in-house water quality testing capability that utilizes the Enzyme-Linked Immunosorbent Assay (ELISA) analysis equipment. The equipment is located at the Willow Lake Water Pollution Control Facility. The laboratory is currently in the process of becoming the first in the State of Oregon to be certified by the Oregon Environmental Laboratory Accreditation Program (ORELAP) to conduct cyanotoxin analysis. The laboratory can take water quality samples collected from the Detroit Reservoir, North Santiam River, Geren Island Water Treatment Facility, and City water distribution system in the morning and have test results for both Total Microcystins and Cylindrospermopsin cyanotoxins by later that same day. The City reviews the results and makes any necessary operational changes at the Geren Island Treatment Facility. The City will post water quality test results on the City’s website by 12:00 p.m. the day after the samples are collected.

The City’s actions in 2019 will comply with adopted rules (OAR 333-061) from the Oregon Health Authority that apply to Total Microcystins and Cylindrospermopsin. The City has very specific rules to follow regarding water quality sampling, public notification, and entering into and out of a water quality health advisory.

The location and frequency of water quality sampling will depend upon water quality conditions in the Detroit Reservoir, North Santiam River, Geren Island Water Treatment Facility, and the City’s water distribution system. Certain indications will trigger additional sampling:

Normal Conditions	Sample collected 1 day per week from 12 locations
Visual observation of algal bloom in outer reservoir	Samples collected 3 days per week from 7-12 locations
Visual observation of algal bloom in reservoir at dam and/or toxins found in reservoir but not downstream	Samples collected 5 days per week from 9-12 locations
Toxins detected at Geren Island Intake at ½ Health Advisory Level	Samples collected daily from 9-12 locations
Toxins detected at Geren Island Intake above Health Advisory Level but not at Aldersgate entry to water	Samples collected daily from 11-14 locations

distribution system

Toxins detected at Aldersgate entry to the water distribution system

Samples collected daily from 11-18 locations

Issuing a Water Quality Health Advisory

The City of Salem has taken steps to add multiple-barriers to our treatment process to prevent cyanotoxins from entering Salem's finished drinking water. However, no process is 100 percent effective, all of the time. If there are mechanical breakdowns or if the magnitude of incoming toxins are at a high-enough level that our treatment methods are unable to remove enough of the toxins to keep the finished drinking water below health advisory levels, then it may become necessary to issue a water quality health advisory to the community. There are two types of advisories:

Vulnerable People Advisory - If the Total Microcystins level is 0.3 µg/L, but less than 1.6 µg/L, or if the Cylindrospermopsin level is 0.7 µg/L, but less than 3 µg/L, then it is advised that children under age 6, pregnant women, nursing mothers, and those with liver or kidney conditions should not drink the water.

All Persons Advisory - If the Total Microcystins level is 1.6 µg/L or greater, or if the Cylindrospermopsin level is 3 µg/L or greater, then it is advised that all persons, or the total population of the community, should not drink the water.

If early indications from water quality test samples collected in the early morning one day are showing the presence of cyanotoxins exceeding health advisory levels, per the requirements of OAR 333-061-0520, the City would then collect a second, or confirmation sample, from the same location the next day shortly after 12:01 a.m. The purpose of the confirmation sample is to determine that the toxin is present above a health advisory level and is persisting above a health advisory level. The laboratory result from the confirmation sample is anticipated to be available by mid-morning later that day. This means that the confirmation sample result will be available within an estimated 16-18 hours after the initial sample result. If the confirmation sample result exceeds the health advisory limit, the City will notify the Oregon Health Authority and Marion/Polk County Public Health Departments and issue either a Vulnerable People or All Persons Advisory. The Mayor and City Council would be notified prior to the issuance of any water quality health advisory. The City process would provide our water customers an advisory notice more rapidly than any other water provider in the state, and significantly sooner than what is required through Oregon Administrative Rules.

Water Distribution Plan

If a Vulnerable People Water Quality Health Advisory is issued, the City will begin water distribution efforts utilizing up to eight bulk water distribution sites and a home-water delivery system for those who are home-bound or not ambulatory. The bulk water sites will be spread throughout the community, similar to the 2018 advisory, with three sites open 24 hours per day and the others open 14 hours per day. The City can dispense up to 18,000 gallons of water at these sites using its own internal water distribution vehicles and equipment. These sites can be operational within two to four

hours after the advisory is issued.

If an All Persons Water Quality Health Advisory were issued, the City would immediately coordinate its efforts through Marion/Polk County Offices of Emergency Management, the Oregon Office of Emergency Management, Salem-Keizer School District, and our Oregon Water/Wastewater Agency Response Network (ORWARN) partner agencies to mobilize all available potable water distribution assets in the state to provide additional bulk water distribution sites. An expanded home water delivery program would be implemented. The goal would be for public agencies to provide up to half of the 300,000 gallons of drinking water needed per day by the community. The other half would be provided through retail sales and donations of bottled water from the private sector.

Strategic Communication Plan

The dissemination of accurate and timely information to the public is just as important to the community as all the technical process improvements made by the City. A team of public information officers from across City Departments has been working to implement a *Strategic Communication Plan* in advance of the algal season to improve public awareness of what measures the City has been taking to protect the drinking water supply from cyanotoxins. The Plan also encourages the public to prepare for a possible water quality health advisory by having personal water storage on-hand in their household. The City has also updated its *Crisis and Emergency Risk Communication Plan* for use during an emergency, such as a water quality health advisory. The City will be ready, if needed, to implement a Joint Information Center (JIC) that will combine the public information efforts of all involved government agencies involved in the event, across the spectrum of print, broadcast, Internet, and social media.

Long-term Water System Improvements

Ozone Treatment

The long-term solution for removing algal toxins is adding an ozone treatment process at the Geren Island Treatment Facility. Ozone is one of the strongest disinfectants used to treat water and has been used in the U.S. since the 1940s. Ozone is an oxygen gas with an extra oxygen atom and treats water through a process called oxidation. Ozone treatment at the Geren Island Treatment Facility will likely occur prior to the slow sand filtration process. The general steps in an ozone treatment process are as follows:

- Step 1. Liquid oxygen is heated in a vaporizer to form oxygen gas.
- Step 2. Oxygen gas passes through an ozone generator where electrical energy is used to produce ozone from the oxygen gas.
- Step 3. Ozone is dissolved into the drinking water source where it oxidizes algal toxins and microorganisms.
- Step 4. Any remaining ozone gas is destructed.

Carollo Engineers has begun designing the ozone treatment system. In order to construct the system as quickly as possible, staff is recommending that an alternative form of project delivery,

known as Construction Manager/General Contractor (CM/GC) be used for the project. Construction of the facility is scheduled to be complete by March 2021. In the meantime, operators at the Geren Island Treatment Facility will rely on the interim treatment processes identified above.

Alternate Water Sources

In addition to adding an ozone treatment process at the Geren Island Water Treatment Facility, design work is already underway to investigate and develop ground water wells on the island. It is estimated that approximately ten to twenty million gallons per day of ground water can be produced. Additionally, staff are evaluating improvements at our Aquifer Storage and Recovery site that will allow Salem to better utilize the facility during peak water demand seasons. Well sites in town are also being evaluated to provide additional groundwater into the system. Up to five million gallons of water per day could potentially be added to the system with additional wells.

BACKGROUND:

Salem's water treatment facility on Geren Island has served Salem residents with quality drinking water since 1937. Surface water from the North Santiam River is treated with a biological slow sand filtration process to produce Salem's drinking water. In May and June 2018 low concentrations of cyanotoxins passed through the treatment facility and were detected in Salem's water distribution system. As a result of those detections, the City took immediate steps to purchase testing equipment and develop algal toxin treatment systems through a combination of short-term and long-term investments.

Overview of the Salem Water System

Salem's drinking water originates in the Mount Jefferson watershed on the western slopes of the Oregon Cascades. The water is stored behind Detroit Dam and Big Cliff Dam and then released into the North Santiam River. We draw our source water from the river, treat it at our plant on Geren Island, located east of Stayton, and transmit the finished water to customers in Salem, Turner, Orchard Heights, and Suburban East Salem Water District. Because the water in the North Santiam River is typically of very high quality, we use a water treatment process called Slow Sand Filtration. This process involves passing the water through a biological layer (also called a "schmutzdecke") that rests on top of a layer of sand. The biological layer consists of bacteria, fungi, protozoa, and other components that removes particles, organic material, and other contaminants. After passing through the biological layer, the water infiltrates through the sand layer where it is collected, treated with chlorine, fluoride, and soda ash to keep the water disinfected and at the proper pH and sent through transmission pipelines to our customers.

Brian Martin, PE, City Engineer
Mark Becketl, Public Works Operations Manager

Attachments:

1. Geren Island Water System
2. Turner Water System