GUIDANCE FOR WATER FLUSHING AND SAMPLING DURING COVID-19 /LOW FLOW/OCCUPANCY

OVERVIEW

During a low flow period, where there is low occupancy, and therefore, low water usage, chlorine levels can drop, heavy metals can leach, scale can destabilize and suspend, and if the temperatures are not maintained for hot and cold water, there is a potential for *Legionella* bacteria to grow. The control measure currently in place is daily flushing at the point of use (POU) for both cold and hot water systems. This protocol follows Washington State Department of Health Guidance for Legionella and Building Water System Closures.

While academic institutions experience widespread stagnation annually during summer months, the curtailment of building operations during the COVID-19 pandemic resulted in extended durations of low flow conditions with the potable water systems. The Environmental Health & Safety Department (EH&S) and UW Facilities (UWF) developed a water quality verification sampling protocol for the buildings that have been shut down or in a reduced-to-low water flow condition.

PURPOSE

1. To maintain the quality of the water once it enters the building water system
2. To verify that buildings that have had reduced occupancy meet water quality standards before re-occupancy

SCOPE

This guidance is applicable to all buildings that are owned and managed by UW personnel. Buildings that are leased and managed by a property manager are excluded.

ROLES AND RESPONSIBILITIES

Technician: Conducts flushing and/or sampling, including, but not limited to preparation of samples for analysis. Technician must be trained on this procedure; required to wear safety glasses and disposable gloves when conducting water flushing and sampling. This role can be fulfilled by a third-party vendor or internal staff from the UW, including occupants, EH&S, Regulated Materials Management (RMO), Building Services Department (custodial Services), Facilities and Maintenance Construction (FMC), building coordinators or occupants. A competent Technician plays a critical role in the everyday monitoring of building water systems to ensure they do not become a source of *Legionella* amplification and assists with the investigation of potential sources as needed. Technicians must be trained on the fundamental knowledge of proper sample techniques, water parameter measurement methods, and documentation.

Public health professional (EH&S staff): Anticipate, recognize, evaluate and control *Legionella* exposure in water systems. Responsible for developing Water Management Plan; developing the sampling plan; determining contaminants to be analyzed, including limits, quantity and location of samples; interpreting the results; reviewing periodic water sample analyses, recommending control measures and corrective actions, identify critical control points, assess and validate the effectiveness of water management programs, and recognize the potential impacts of remediation activities, and, if necessary, notifying management and/or the parties needed to make corrections.

Management: Responsible for providing the resources for flushing, oversee the implementation of water management plan, implementing corrective action where sampling results identify the need for it in partnership with the public health professional. This role may be fulfilled by a department head, zone manager, or authorized personnel.

REQUIREMENTS FOR FLUSHING AND SAMPLING

This guidance must be followed under these circumstances or conditions:

- Vacant or curtailed building use
- Buildings closed or under renovation
- New construction (applies to sampling and testing only)

FLUSHING APPROACHES TO ADDRESS STAGNATION

Periodic flushing replaces any stagnant water with high quality water from the city supply. During periods of low occupancy, periodic flushing has been identified as a preventive measure for maintaining the water quality.

A flushing plan should be developed by the building manager, engineer or other qualified personnel. The plan must include the following elements:

- Specific, measurable criteria (flow rate, frequency, and time) to be met during flushing
- Drawings to identify the source of water to the building, building potable water plumbing system, including hot water systems
- Identification of POU flushing locations throughout the building, including the furthest POU outlet
- Flushing procedures
- Qualifications of the personnel assigned to perform the flushing activities

FLUSHING PROCEDURES

Flushing instructions will vary depending on the plumbing design. Follow the key elements of flushing outlined in the Environmental Science Policy Research Institute Flushing Guidance for Periods of Low or No Use guidance.

- Make sure each POU tap is opened at least once per day. Some POU taps are used frequently during normal building operation. Others might be used less frequently and may need to be opened intentionally.
- Flushing may need to occur in segments (e.g., floors, individual rooms) due to facility size and water pressure. The purpose of flushing is to replace water inside building piping with fresh water.
- Flush cold and hot water through all points of use (e.g., showers, sink faucets). Flush the cold and hot water separately; cold first and hot second.
- Identify outlets farthest away from the point of entry (the longest plumbing run).
- Flush until the hot water reaches its maximum temperature.
- Identify and locate specialty devices plumbed into the building water system (e.g., ice/coffee/soda machines, drinking fountains, emergency eyewash and shower devices, or other devices serviced by potable water), organized by floor.
- Minimize exposure to aerosols generated during flushing activities (inhalation risk); outlets that generate the most aerosols (e.g., showerheads, sprayer attachments) pose the highest risk for exposure to opportunistic pathogens.
- Where water quality sampling and testing results indicate further flushing, this may include draining water tanks, removing POU screens and filters, and ensuring backwater flow preventers are current with test/inspection requirements.
- Flushing each POU tap should lead to a full building flush once per week during low use. Full building ongoing flushes proceed in the same manner as the initial flush, except water tanks do not need to be drained and hot water flushing times are the same as cold water flushing times. Flush the cold and hot water systems separately; cold first and hot second.

The success of flushing procedures is likely dependent upon meeting the recommended operational settings with respect to cold water residual disinfectants, pH and hot water temperatures (refer to Appendix A: Water Quality Parameters). If these are not met, the following flushing practices are modified and repeated until performance objectives are reached.

SAMPLING PROCEDURES

Building water sampling can occur before reopening a curtailed building after temporary dormancy or shutdown, when a building is newly constructed, during routine water safety

monitoring, post-disaster/outbreak to find contamination, post-intervention to see if a water quality problem still exists, or for general interest.

Building water sampling must be representative of the variety of locations and outlets throughout the building water distribution system and reflect the characteristics of the plumbing design (i.e., how the water is distributed throughout the building), fixture types (e.g., showerhead, sink, water fountain, etc.) and locations (e.g., nearest and farthest outlets from the water supply, highest and lowest floors, etc.). Water use and circulation due to building operational conditions should factor into the decisions about the number and location of samples.

Sample collection for a contract lab

CAUTION: The sample bottle that is provided by the lab has been pre-sterilized. Do not rinse the bottle or touch the inside of the bottle with your fingers or faucet. Sampling containers may contain a preservative. Do not rinse the sampling container prior to sample collection. Do not add preservatives to the sample unless specifically instructed to do so by the laboratory.

1. Coordinate with the laboratory to pick up sampling containers and cooler.
2. Keep sampling bottle closed until it is ready to be filled.
3. Select a faucet in the room for sampling, as discussed with EH&S and/or UWF. Remove any filters or screens from the faucet.
4. Wipe the faucet thoroughly using Clorox wipes or a bleach solution.
5. Open the faucet fully and run cold water for 2-3 minutes.
6. Adjust the water to produce a slow flow.
7. Remove the cap from the sampling bottle and collect the water by holding the bottom of the bottle. Remember not to touch the inside of the bottle or the inside of the cap with the faucet or your finger.
8. Collect only to the fill line. Do not overfill the sample bottle.
9. Place cap back on the bottle and securely fasten.
10. Record the date and time of collection on the bottle label.
11. Deliver sample(s) to the lab for testing in less than 24 hours from the time of collection.
12. It is recommended that drinking water samples be kept cold but not frozen during shipment.

13. Fill out the laboratory form (often called the "Water Sample Information Form") and the sample label **completely**. Laboratory forms may vary, but the following information is very important for all labels:
    - Water system name (i.e. Facnum and room #)
    - Sample potable or non-potable contaminant and sample purpose (usually "RC" for routine compliance)
    - Collection date and time the sample was taken and by whom
    - Chain of custody includes sample location (specific location and/or equipment where the samples were collected)

WASHINGTON STATE DEPARTMENT OF ECOLOGY ACCREDITED LAB CENTERS IN SEATTLE AREA

Company Name	Matrix Description	Category
Fremont Analytical 3600 Fremont Ave N, Seattle, WA 98103 (206) 352-3790	Drinking Water	Microbiology
Lab/Cor, Inc. 7619 6th Avenue NW , Seattle, WA 98117 (206) 781-0155	Drinking Water	Microbiology/ CDC approved for *Legionella* testing
MicroChem Laboratories, Inc. 711 6th Ave N , Seattle, WA 98109 (206) 633-3637	Drinking Water	Microbiology
Seattle-King Co Dept of Public Health Lab, 325 Ninth Ave Seattle, WA 98104 (206) 744-8950	Drinking Water	Microbiology

Sampling with direct reading instruments

1. Follow the sampling instructions in the section above. Test for free chlorine, temperature, and pH on cold water outlets, and test for temperature and pH on hot water outlets.

2. Analyze the samples immediately following the manufacturer's instructions for the test equipment.
3. Record the building name and facnum, sampling location, description of the fixture or equipment, the date and time, and the results.

SAMPLING PLAN AND ANALYSIS

Water quality testing for free chlorine, pH and temperature is required at the main points of incoming water to a building and at the POU. Sampling at both hot and cold lines to fixtures are recommended at the building entry and the most remote location within a specified building.

A representative number of buildings that are in a low flow/occupancy state will be sampled to determine the effectiveness of the flushing plan. The number of samples will depend on the number of fixtures and the water use within the building. The public health professional will identify the number and locations of samples required for each building.

Legionella sampling *may* be selected based on one or all of the following criteria:

- Buildings with potentially high risk of aerosolization and fixtures that have not been used during the University's restricted operations, or rarely used showers (e.g., IMA, ICA, Dental Clinic, and HUB)
- Building closed for a long time (e.g., South Haggett Hall)
- Other buildings that have repeated free chlorine, pH or temperature results that are outside of acceptable levels

Legionella test results that are greater than 1 cfu/ml (colony forming unit per milliliter) indicates conditions may allow bacteria growth; and therefore, corrective action (mitigation plan) must be developed and implemented by management. Follow the American Industrial Hygiene Association (AIHA) guidance below for establishing mitigation plans.

Sampling for *Legionella* will be repeated 48 hours after the mitigations have been implemented to confirm the effectiveness of the corrective measure(s).

All sample results will be reviewed and evaluated by the public health professional.

The sampling records and any respective documentation will be retained in accordance with the EH&S Records Retention Schedule.

Action Thresholds for Potable Water (per American Industrial Hygiene Association AIHA)

Legionella Concentration (cfu/ml)	Remediation

1-9	Continue flushing plan and monitoring chlorine and temperature levels as noted above.
10-1000	Identify infection sources and disinfection in collaboration with the public health professional.
>1000	Identify infection sources and disinfection of the whole system. Take two additional samples throughout the building at the direction of the public health professional.

SPECIFIC END-USE DEVICES

There are end-use devices plumbed directly into building water systems that warrant maintenance per manufacturer's instructions prior to returning these devices to use after curtailment:

- Ice makers/ice machine
- Emergency eyewash and safety showers
- Point of use filters (within outlets, refrigerators, and drinking water fountains)
- Misters/foggers (These devices may exist in a variety of settings, including groceries, restaurants, etc.)

If no documentation is provided by the manufacturer, water lines supplying these devices should be flushed until the water exiting the supply lines matches the temperature of the water that comes from the service supply line entering the building. Any filters or strainers must be cleaned or replaced.

Ice makers require cycling several times and discarding ice from these cycles prior to returning ice makers to service. If an operations manual is not available, develop an ice machine operations and maintenance document as a best practice.

APPENDIX A: WATER QUALITY PARAMETERS

The parameters are important in determining the water quality and for providing verification that *Legionella* controls are in place and effective.

Chlorine (disinfectant) levels: Maintain cold water distribution free chlorine residuals at or above 0.2 mg/L. Measure it with EPA approved device. Ensure disinfectant levels are detectable where water enters the building and at points of use.

Adding an effective agent such as chlorine, drawing it through to every outlet, then closing the outlets and allowing it to remain in contact for a suitable period (known as the contact time to effectively disinfect the water system). This method is commonly used when it is necessary to disinfect the cold water storage tanks and the whole system. Free chlorine is degraded rapidly at elevated water temperatures, which is a concern for hot water chlorination.

Temperature: There are a number of causes that can result in the hot water temperature to drop into the range where *Legionella* can grow, including low settings on water heaters, heat loss as water travels through long pipes away from the heat source, mixing cold and hot water within the plumbing system, heat transfer (when cold and hot water pipes are too close together), or heat loss due to water stagnation. Maintain hot water temperature at the return at the highest temperature allowable by state regulations or codes, preferably ≥124°F, and maintain cold water temperature at <68°F. Water temperatures that are not hot or cold enough will not prevent growth of *Legionella*. In hot weather, cold water in pipes can heat up into this range.

For thermal disinfection, start by flushing the cold water from each outlet. This method involves raising the temperature of hot water tanks to between 160 to 170°F; maintaining the water temperature at 149°F or higher at outlets during flushing is important to provide effective disinfection. The optimal flush time varies from 10 to 30 minutes depending on the characteristics of the premise plumbing system. Raising the hot water system temperature to a level at which *Legionella* will not survive, drawing it through to every outlet, and then flushing at a slow flow rate to maintain the high temperature for a suitable period (the contact time to effectively disinfect the water system). This method is only applicable to hot water systems and is commonly used as a rapid response. It may be less effective than chemical disinfection and may not be practicable where the hot water supply is insufficient to maintain a high temperature throughout.

Adding disinfectant or raising the temperature above 140 °F creates a hazard to users through chemical exposure or scalding. A risk assessment must be carried out and safe procedures must be in place throughout the disinfection process.

pH: Disinfectants are most effective within a narrow pH range (approximately 6.5 to 8.5). Measure the pH of your water to determine whether the disinfectant used in your building will be effective. Disinfectants work best within a narrow pH range. The bactericidal action

of the chlorine is enhanced at higher temperatures and at lower pH levels. The anti-microbial efficacy of chlorine declines as pH increases >7.

Legionella: is the name of a genus of bacteria. *Legionellae* (the plural, referring to more than one *Legionella* bacterium) are aerobic, non-spore-forming, rod-shaped, typically flagellated, gram-negative bacteria. They are common to aquatic environments, especially warm water, and are found in some muds and soils. There have been at least 60 *Legionella* species identified, with approximately half being linked to human disease.

Many different types of water systems and devices serve as *Legionella* amplifiers and (aerosol) disseminators— and have been associated with disease. Common equipment/fixtures at the University include:

- Potable/domestic hot water systems via tap faucets, showerheads, and aerators
- Cooling towers and evaporative condensers
- Recreational pools, spas, hot tubs, and whirlpools
- Humidifiers and misters
- Water fountains and decorative water features
- Water reservoir misters
- Respiratory therapy/CPAP equipment
- Dental hygiene equipment
- Emergency eye wash and safety showers
- Point of use filters (within outlets, refrigerators, and drinking water fountains)
- Misters/foggers (These devices may exist in a variety of settings, including groceries, restaurants, etc.)
- Ice machines

REFERENCES

WA DOH Guidance for Legionella and Building Water System Closures

Building Water Quality and Coronavirus: Flushing Guidance for Periods of Low or No Use

NIOSH Preventing Occupational Exposure to *Legionella*

CDC Water Management Program

CDC Guidance for Reopening Buildings After Prolonged Shutdown or Reduced Operation

Legionella 2019: A Position Statement and Guidance Document

AWWA Responding to Water Stagnation in Buildings with Reduced or No Water Use