GUIDANCE FOR BUILDING WATER FLUSHING AND SAMPLING DURING LOW FLOW OR LOW OCCUPANCY

OVERVIEW

Environmental Health & Safety (EH&S) and UW Facilities (UWF) have established a protocol for water quality verification and sampling in University buildings that were temporarily closed, had reduced occupancy, or otherwise experienced low water flow conditions. This protocol addresses the risk of *Legionella* bacteria growth in a building's plumbing system as a result of stagnant or very low water use, which can lead to decreased chlorine levels. A key strategy to mitigate this risk is periodic flushing at the point of use (POU) for both cold and hot water systems in line with the Washington State Department of Health Guidance for *Legionella* and Building Water System Closures.

PURPOSE

1. Maintain the quality of the water once it enters the building water system
2. Verify that buildings with reduced occupancy meet water quality standards prior to being fully reoccupied

SCOPE

This guidance is applicable to all buildings that are owned and managed by University 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 and is required to wear safety glasses and disposable gloves when conducting water flushing and sampling. A third-party vendor or internal staff from the University can fulfill this role, including EH&S, Regulated Materials Office, Building Services Department, Facilities Maintenance & Construction, building coordinators or building occupants.

EH&S Environmental Public Health Professional: 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; recommending measures and corrective actions; and, if necessary, notifying management and/or the parties needed to make corrections.

Management: Responsible for providing the resources for flushing, sampling and analysis; implementing corrective action where sampling results identify the need for it in partnership with the EH&S Environmental Public Health Professional. This is a University representative, such as a unit or department administrator, zone manager, or other individual in a decision-making role.

FLUSHING PROCEDURES

Periodic flushing replaces any stagnant water with high quality water from the city supply. During low flow and low or no occupancy, periodic flushing has been identified as a preventive measure for maintaining the water quality. 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.

- Ensure each point-of-use tap is opened at least once per day. Some POUs are used frequently during building operation, even in decreased occupancy. Others might be used less frequently and may need to be opened intentionally.
- Conducting flushing in segments (e.g., floors, individual rooms) due to facility size and water pressure consideration. The purpose of flushing is to replace water inside building piping with fresh water.
- Sequentially flushing cold and then hot water through at all points of use (e.g., showers, sink faucets). Flush the cold and hot water separately.
- Flush until the hot water reaches its maximum temperature.
- Take measures to minimize splashing and aerosol generation during flushing; avoid creating small droplets or spraying at high pressure
- Where testing requires a Mitigation Plan (described in the Testing and Analysis section), the initial flush after a shut down or low use may include draining tanks, removing screens and filters, and ensuring backwater flow preventers are current with test/inspection requirements.
- Flushing each POU should lead to a full building flush once per week during low use. Full building ongoing flushes proceed the same 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. Still flush the cold and hot water systems separately – cold first and hot second.

SAMPLING PROCEDURES AT POINT OF USE

SAMPLE COLLECTION FOR SENDING TO A LABORATORY

***CAUTION**: The sample container provided by the laboratory has been pre-sterilized. Do **not** rinse the container or touch the inside of the container with your fingers or faucet. Note that 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 the sampling container closed until ready to fill.
3. Identify and prepare a faucet for sampling according to instructions provided by EH&S and/or UW Facilities.
    a) Remove any filters or screens.
    b) Thoroughly cleanse the faucet using Clorox wipes or bleach solution.
4. Fully open the faucet and let cold water run for 2-3 minutes.
5. Adjust the faucet to achieve a slow flow.
6. Remove the cap from the sampling container and collect the water by holding the bottom of the container. Remember not to touch the inside of the container or the inside of the cap with the faucet or your finger.
7. Collect only to the fill line. Do not overfill the sample container.
8. Place cap back on the container and securely fasten.
9. Record the date and time of water collection on the container label.
10. Deliver the collected sample to the laboratory for testing within 24 hours of collection.
11. Ensure water samples are kept cold, but not frozen, during transportation.
12. Fill out COMPLETELY the laboratory form (often called the “Water Sample Information Form”) and sample label. Laboratory forms may vary, but the following information is very important for all:
    a) Water system name (i.e. building name/facility number and room #)
    b) Indicate whether the sample is potable or non-potable
    c) Indicate the purpose of sampling (usually “RC” for routine compliance)
    d) Record the date and time of sample collection, along with the name of the individual who collected it.
    e) Add the chain of custody details.
    f) Include the sample location, including the specific location and/or equipment where the samples were collected.

WASHINGTON STATE DEPARTMENT OF ECOLOGY ACCREDITED LABORATORIES IN THE SEATTLE AREA

Company Name	Contact	Matrix Description	Category
Fremont Analytical	3600 Fremont Ave N, Seattle, WA 98103 (206) 352-3790	Drinking Water	Microbiology
Eurofins Built Environment Testing	7619 6th Avenue NW, Seattle, WA 98117 (206) 781-0155	Drinking Water	Microbiology/ CDC approved for *Legionella* testing
Public Health – Seattle & King County Laboratory	Harborview Medical Center 325 Ninth Ave Seattle, WA 98104 (206) 744-8950	Drinking Water	Microbiology

SAMPLING WITH DIRECT READING INSTRUMENTS

1. Follow the sampling steps 2 through 9 in the section above.
2. Conduct tests for free chlorine, temperature, and pH at cold water outlets.
3. Conduct tests for temperature and pH at hot water outlets.
4. Analyze the samples immediately accordance with the test equipment manufacturer's instructions.
5. Record details such as the building name and facility number, sampling location, description of the fixture or equipment, the date and time of sampling, and the results.

SAMPLING PLAN AND ANALYSIS

BUILDING SELECTION

A representative selection of buildings experiencing low flow/occupancy will be sampled to evaluate the effectiveness of the flushing plan.

NUMBER OF SAMPLES AND LOCATIONS

Sampling is required at main points of incoming water to a building and at the point of use. Sampling at both hot and cold lines to fixtures are recommended at the building entry and the most remote location within a specified building.

The number of samples will depend on the number of fixtures and the water use within the building. The EH&S Environmental Public Health Professional will identify the number and locations of samples required for each building.

TESTING AND ANALYSIS

Water quality testing for free chlorine, pH and temperature is required for samples taken at main points of incoming water to a building and at the point of use.

Legionella testing may also be performed based on one or all of the following criteria:

- Buildings with potentially high risk of aerosolization and fixtures that have not been used during shut down, low occupancy periods
- Building closed for a long time (weeks or longer).
- Dental Clinic due to splashing and aerosol-generating procedures
- Buildings that have repeated free chlorine, pH and/or temperature results that are outside of acceptable levels

All sample results will be reviewed and evaluated by the EH&S Environmental Public Health Professional.

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

MITIGATION PLAN

Legionella test results that are more than 1 cfu/ml (colony forming unit per milliliter) indicate conditions that may allow growth; corrective action in the form of a Mitigation Plan must be developed and implemented by management. Follow the guidance below for establishing a Mitigation Plan.

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

Action Thresholds for Potable Water

Reference: 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 perform disinfection in collaboration with the EH&S Environmental Public Health Professional.

>1000	Identify infection sources and disinfect the whole system. Take 2 additional samples throughout the building at the direction of the EH&S Environmental Public Health Professional.

LONG-TERM RISK MANAGEMENT: IMPLEMENT A WATER MANAGEMENT PLAN

To ensure consistently high-quality water in buildings, facility operators should adopt a Water Management Plan that aligns with industry standards, such as ASHRAE 188 (2021) or similar guidelines. This approach is crucial for minimizing infection risks associated with water quality degradation. EH&S is in the process of developing a sample plan, which will be made available once completed.

WATER QUALITY PARAMETERS

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

Chlorine (disinfectant) levels: Maintaining appropriate chlorine levels in the cold water distribution is crucial for effective disinfection. It's important to keep free chlorine residuals at or above 0.2 mg/L (milligrams per liter). This can be measured using an EPA-approved device, ensuring that the disinfectant levels are adequately maintained at the point where water enters the building and at all points of use.

To disinfect using a chemical agent:

1. Add an effective agent such as chlorine.
2. Draw it through to every outlet, then close the outlets.
3. Allow it to remain in contact for a suitable period (known as the contact time).

This method is commonly used when it is necessary to disinfect the cold water storage tanks and the whole system. Free chlorine degrades rapidly at elevated water temperatures, which is a concern for hot water chlorination.

Adding a chemical disinfectant creates a hazard to users through chemical exposure. A risk assessment must be performed prior to starting the disinfection process and safe work practices must be followed throughout the disinfection process.

pH: Chemical disinfectants are optimally effective in pH range of about 6.5 to 8.5. It's important to the measure water pH to ensure the effectiveness of the disinfectant used. Disinfectants work best within a narrow pH range.

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

Temperature: To effectively manage water temperature and prevent *Legionella* growth, it's important to adhere to state regulations and codes for temperature settings in building water systems. The hot water temperature should be maintained at the highest permissible level, preferably at or above 120°F, at the return point. For cold water, temperatures should be kept below 68°F. Inadequate temperature control, with water neither hot enough nor sufficiently cold, can fail to inhibit the growth of *Legionella* bacteria.

To implement thermal disinfection:

1. The process should begin with flushing cold water through each outlet. This step is crucial in ensuring the water system is not conducive to *Legionella* proliferation.
2. Raise the temperature of hot water tanks to between 160 to 170°F and maintain the water temperature at 149°F or higher at outlets during flushing to provide effective disinfection.
3. The optimal flush time varies from 10 to 30 minutes depending on the characteristics of the building plumbing system.

Thermal disinfection works by 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). This method is only applicable to hot water system and is commonly used as a rapid response. It may be less effective than chemical disinfection and may not be practical where the hot water supply is insufficient to maintain a high temperature throughout the system.

Raising the temperature above 140°F creates a scalding hazard to users. A risk assessment must be performed prior to starting the disinfection process and safe work practices must be followed throughout the disinfection process.

Several factors can cause hot water temperature to drop into the range where *Legionella* can grow, including low settings on water heaters, significant heat loss in long pipes, improper mixing of cold and hot water, heat transfer (when cold and hot water pipes are too close together), or heat loss due to water stagnation. In hot weather, cold water in pipes can heat up into the range where *Legionella* can grow.

Legionella bacteria is found in aquatic environments, especially warm water. There have been at least 60 *Legionella* identified species, some of which are associated with human disease. Legionnaires' disease is a serious type of lung infection caused by a person breathing in water (usually airborne droplets) containing *Legionella* bacteria.

Various water systems and devices can amplify and disseminate *Legionella*, which can lead to disease. Common equipment/fixtures in University settings 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
- Ice machines

REFERENCES

- Washington State Department of Health: 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: Reopening Buildings After Prolonged Shutdown or Reduced Operation
- Legionella 2019: A Position Statement and Guidance Document by the Association of Water Technologies