Building Potable Water Flushing Guidance
Following Periods of Temporary Shut-Down

April 15, 2020

This Building Water Flushing Guidance (for potable water) was developed during the COVID-19 pandemic but could easily apply to multiple situations or general temporary shut-down situations. This guidance is meant to be a quick guide for water systems; however, it does not underscore the need for system operators to know and understand their individual water lines and building layouts and to take additional steps as necessary to ensure top quality water service to their facilities.

Key Points relative to COVID-19 (at the time of this writing)
• COVID-19 has not been detected in drinking water.
• There is no evidence of viable COVID-19 in wastewater systems.
• There is no evidence that COVID-19 survives the disinfection processes of water and wastewater systems.

Objective
• Develop a systematic approach to expel stagnant potable water from buildings and replace it with fresh, quality potable water that mimics pre-shut-down conditions.

Reasons for Building Water Flushing
• Stagnant, aged water within water mains and building water piping systems can have negative impacts, such as:
  – Sediment deposition within the pipes.
  – Protective scale disruption within the pipes.
  – Mild corrosion of the piping and fixtures.
  – Micro-organism growth within the systems, such as *Legionella*.
  – Low or no disinfectant residual within the water.
  – Disinfection byproduct formation within the water.

Quick Guide Approach for Flushing Water Through Temporarily Shut-Down Buildings
• When full water service is re-established and prior to building occupancy, it is recommended to take the following minimum steps, and other site-specific actions as necessary, to ensure the best quality water is being delivered to the previously shut-down facilities.
  – Flush water in a uni-directional manner, starting at the source and flushing to the peripheral ends.
  – Flush the water mains leading to the facilities until fresh water is within the mains.
  – Flush the interior building potable water lines until fresh water is within the building piping.
    ▪ Includes cold and hot water piping and hot water storage tanks.
    ▪ Includes all potable water devices, such as drinking fountains, ice machines, clothes washers, dishwashers, point of use filter devices and other water equipment.
– Disinfect the faucet fixtures, drinking fountain heads, hose bibbs, shower heads, and outlets.
– Flush fixtures.
– Test the water for adequate chlorine residual at the far end of the system.
  ▪ The minimum should be 0.2 mg/L free available chlorine.
– As necessary, a bacteriological test can also be completed; this is particularly important for hospitals and buildings with compromised occupants. Test for e-coli, total coliform, *Legionella* and others as deemed necessary for site specific concerns.
– Restore water service.

**Weekly Flushing and Water Storage Tank Monitoring**

- Depending on the length of time of the shut-down and the water facility components, general weekly flushing and water storage tank monitoring is recommended.
- Stagnant, aged water within large water mains and water storage tanks can lead to the following undesirable conditions:
  - Water stratification within the water storage tank.
  - Aged water with significant loss of chlorine residual.
  - Disinfection byproduct formation.
- Main flushing that engages the water tank storage is recommended.
- Flush from the high point of the system to the low points.
- Flush until adequate chlorine residual (0.2 mg/L) is noticed and clear water is being flushed.

**Reference Materials and Websites** (In addition to the above guidelines, utilize these reference materials)

Attachment 1—World Health Organization (WHO) *Water, sanitation, hygiene, and waste management for the COVID-19 virus.*

Attachment 2—Environmental Science, Policy and Research Institute (ESPRI) *Coronavirus Building Flushing Guidance.*


ASDWA Site: [https://www.asdwa.org/2020/04/13/covid-19-resources-for-building-water-systems/](https://www.asdwa.org/2020/04/13/covid-19-resources-for-building-water-systems/)
Background

This interim guidance supplements the infection prevention and control (IPC) documents by summarizing WHO guidance on water, sanitation and health care waste relevant to viruses, including coronaviruses. It is intended for water and sanitation practitioners and providers and health care providers who want to know more about water, sanitation and hygiene (WASH) risks and practices.

The provision of safe water, sanitation, and hygienic conditions is essential to protecting human health during all infectious disease outbreaks, including the COVID-19 outbreak. Ensuring good and consistently applied WASH and waste management practices in communities, homes, schools, marketplaces, and health care facilities will help prevent human-to-human transmission of the COVID-19 virus.

The most important information concerning WASH and the COVID-19 virus is summarized here.

- Frequent and proper hand hygiene is one of the most important measures that can be used to prevent infection with the COVID-19 virus. WASH practitioners should work to enable more frequent and regular hand hygiene by improving facilities and using proven behavior-change techniques.
- WHO guidance on the safe management of drinking-water and sanitation services applies to the COVID-19 outbreak. Extra measures are not needed. Disinfection will facilitate more rapid die-off of the COVID-19 virus.
- Many co-benefits will be realized by safely managing water and sanitation services and applying good hygiene practices.

Currently, there is no evidence about the survival of the COVID-19 virus in drinking-water or sewage. The morphology and chemical structure of the COVID-19 virus are similar to those of other human coronaviruses for which there are data about both survival in the environment and effective inactivation measures. This document draws upon the evidence base and WHO guidance on how to protect against viruses in sewage and drinking-water. This document will be updated as new information becomes available.

1. COVID-19 transmission

There are two main routes of transmission of the COVID-19 virus: respiratory and contact. Respiratory droplets are generated when an infected person coughs or sneezes. Any person who is in close contact with someone who has respiratory symptoms (sneezing, coughing) is at risk of being exposed to potentially infective respiratory droplets.\(^1\) Droplets may also land on surfaces where the virus could remain viable; thus, the immediate environment of an infected individual can serve as a source of transmission (contact transmission).

Approximately 2–10% of cases of confirmed COVID-19 disease present with diarrhoea,\(^2,4\) and two studies detected COVID-19 viral RNA fragments in the faecal matter of COVID-19 patients.\(^5,6\) However, only one study has cultured the COVID-19 virus from a single stool specimen.\(^7\) There have been no reports of faecal–oral transmission of the COVID-19 virus.

2. Persistence of the COVID-19 virus in drinking-water, faeces and sewage and on surfaces.

Although persistence in drinking-water is possible, there is no evidence from surrogate human coronaviruses that they are present in surface or groundwater sources or transmitted through contaminated drinking water. The COVID-19 virus is an enveloped virus, with a fragile outer membrane. Generally, enveloped viruses are less stable in the environment and are more susceptible to oxidants, such as chlorine. While there is no evidence to date about survival of the COVID-19 virus in water or sewage, the virus is likely to become inactivated significantly faster than non-enveloped human enteric viruses with known waterborne transmission (such as adenoviruses, norovirus, rotavirus and hepatitis A). For example, one study found that a surrogate human coronavirus survived only 2 days in dechlorinated tap water and in hospital wastewater at 20°C.\(^3\) Other studies concur, noting that the human coronaviruses transmissible gastroenteritis coronavirus and mouse hepatitis virus demonstrated a 99.9% die-off in from 2 days\(^8\) at 23°C to 2 weeks\(^10\) at 25°C. Heat, high or low pH, sunlight, and common disinfectants (such as chlorine) all facilitate die off.

It is not certain how long the virus that causes COVID-19 survives on surfaces, but it seems likely to behave like other coronaviruses. A recent review of the survival of human
coronaviruses on surfaces found large variability, ranging from 2 hours to 9 days. The survival time depends on a number of factors, including the type of surface, temperature, relative humidity, and specific strain of the virus. The same review also found that effective inactivation could be achieved within 1 minute using common disinfectants, such as 70% ethanol or sodium hypochlorite (for details, see Cleaning practices).

3. Keeping water supplies safe

The COVID-19 virus has not been detected in drinking-water supplies, and based on current evidence, the risk to water supplies is low. Laboratory studies of surrogate coronaviruses that took place in well-controlled environments indicated that the virus could remain infectious in water contaminated with faeces for days to weeks. A number of measures can be taken to improve water safety, starting with protecting the source water; treating water at the point of distribution, collection, or consumption; and ensuring that treated water is safely stored at home in regularly cleaned and covered containers.

Conventional, centralized water treatment methods that use filtration and disinfection should inactivate the COVID-19 virus. Other human coronaviruses have been shown to be sensitive to chlorination and disinfection with ultraviolet (UV) light. As enveloped viruses are surrounded by a lipid host cell membrane, which is not robust, the COVID-19 virus is likely to be more sensitive to chlorine and other oxidant disinfection processes than many other viruses, such as coxsackieviruses, which have a protein coat. For effective centralized disinfection, there should be a residual concentration of free chlorine of $\geq 0.5$ mg/L after at least 30 minutes of contact time at pH $<8.0$. A chlorine residual should be maintained throughout the distribution system.

In places where centralized water treatment and safe piped water supplies are not available, a number of household water treatment technologies are effective in removing or destroying viruses, including boiling or using high-performing ultrafiltration or nanomembrane filters, solar irradiation and, in non-turbid waters, UV irradiation and appropriately dosed free chlorine.

4. Safely managing wastewater and faecal waste

There is no evidence that the COVID-19 virus has been transmitted via sewerage systems with or without wastewater treatment. Further, there is no evidence that sewage or wastewater treatment workers contracted the severe acute respiratory syndrome (SARS), which is caused by another type of coronavirus that caused a large outbreak of acute respiratory illness in 2003. As part of an integrated public health policy, wastewater carried in sewerage systems should be treated in well-designed and well-managed centralized wastewater treatment works. Each stage of treatment (as well as retention time and dilution) results in a further reduction of the potential risk. A waste stabilization pond (an oxidation pond or lagoon) is generally considered a practical and simple wastewater treatment technology particularly well suited to destroying pathogens, as relatively long retention times (20 days or longer) combined with sunlight, elevated pH levels, biological activity, and other factors serve to accelerate pathogen destruction. A final disinfection step may be considered if existing wastewater treatment plants are not optimized to remove viruses. Best practices for protecting the health of workers at sanitation treatment facilities should be followed. Workers should wear appropriate personal protective equipment (PPE), which includes protective outerwear, gloves, boots, goggles or a face shield, and a mask; they should perform hand hygiene frequently; and they should avoid touching eyes, nose, and mouth with unwashed hands.

WASH in health care settings

Existing recommendations for water, sanitation and hygiene measures in health care settings are important for providing adequate care for patients and protecting patients, staff, and caregivers from infection risks. The following actions are particularly important: (i) managing excreta (faeces and urine) safely, including ensuring that no one comes into contact with it and that it is treated and disposed of correctly; (ii) engaging in frequent hand hygiene using appropriate techniques; (iii) implementing regular cleaning and disinfection practices; and (iv) safely managing health care waste. Other important measures include providing sufficient safe drinking-water to staff, caregivers, and patients; ensuring that personal hygiene can be maintained, including hand hygiene, for patients, staff and caregivers; regularly laundering bed sheets and patients’ clothing; providing adequate and accessible toilets (including separate facilities for confirmed and suspected cases of COVID-19 infection); and segregating and safely disposing of health care waste. For details on these recommendations, please refer to Essential environmental health standards in health care.

1. Hand hygiene practices

Hand hygiene is extremely important. Cleaning hands with soap and water or an alcohol-based hand rub should be performed according to the instructions known as “My 5 moments for hand hygiene”. If hands are not visibly dirty, the preferred method is to perform hand hygiene with an alcohol-based hand rub for 20–30 seconds using the appropriate technique. When hands are visibly dirty, they should be washed with soap and water for 40–60 seconds using the appropriate technique. Hand hygiene should be performed at all five moments, including before putting on PPE and after removing it, when changing gloves, after any contact with a patient with suspected or confirmed COVID-19 infection or their waste, after contact with any respiratory secretions, before eating, and after using the toilet. If an alcohol-based hand rub and soap are not available, then using chlorinated water (0.05%) for handwashing is an option, but it is not ideal because frequent use may lead to dermatitis, which could increase the risk of infection and asthma and because prepared dilutions might be inaccurate. However, if other options are not available or feasible, using chlorinated water for handwashing is an option.

Functional hand hygiene facilities should be present for all health care workers at all points of care and in areas where PPE is put on or taken off. In addition, functional hand hygiene facilities should be available for all patients, family members, and visitors, and should be available within 5 m of toilets, as well as in waiting and dining rooms and other public areas.
2. Sanitation and plumbing

People with suspected or confirmed COVID-19 disease should be provided with their own flush toilet or latrine that has a door that closes to separate it from the patient’s room. Flush toilets should operate properly and have functioning drain traps. When possible, the toilet should be flushed with the lid down to prevent droplet splatter and aerosol clouds. If it is not possible to provide separate toilets, the toilet should be cleaned and disinfected at least twice daily by a trained cleaner wearing PPE (gown, gloves, boots, mask, and a face shield or goggles). Further, and consistent with existing guidance, staff and health care workers should have toilet facilities that are separate from those used by all patients.

WHO recommends the use of standard, well-maintained plumbing, such as sealed bathroom drains, and backflow valves on sprayers and faucets to prevent aerosolized faecal matter from entering the plumbing or ventilation system, together with standard wastewater treatment. Faulty plumbing and a poorly designed air ventilation system were implicated as contributing factors to the spread of the aerosolized SARS coronavirus in a high-rise apartment building in Hong Kong in 2003. Similar concerns have been raised about the spread of the COVID-19 virus from faulty toilets in high-rise apartment buildings. If health care facilities are connected to sewers, a risk assessment should be conducted to confirm that wastewater is contained within the system (that is, the system does not leak) before its arrival at a functioning treatment or disposal site, or both. Risks pertaining to the adequacy of the collection system or to treatment and disposal methods should be assessed following a safety planning approach, with critical control points prioritized for mitigation.

For smaller health care facilities in low-resource settings, if space and local conditions allow, pit latrines may be the preferred option. Standard precautions should be taken to prevent contamination of the environment by excreta. These precautions include ensuring that at least 1.5 m exists between the bottom of the pit and the groundwater table (more space should be allowed in coarse sands, gravels, and fissured formations) and that the latrines are located at least 30 m horizontally from any groundwater source (including both shallow wells and boreholes). If there is a high groundwater table or a lack of space to dig pits, excreta should be retained in impermeable storage containers and left for as long as feasible to allow for a reduction in virus levels before moving it off-site for additional treatment or safe disposal, or both. A two-tank system with parallel tanks would help facilitate inactivation by maximizing retention times, as one tank could be used until full, then allowed to sit while the next tank is being filled. Particular care should be taken to avoid splashing and the release of droplets while cleaning or emptying tanks.

3. Toilets and the handling of faeces

It is critical to conduct hand hygiene when there is suspected or direct contact with faeces (if hands are dirty, then soap and water are preferred to the use of an alcohol-based hand rub). If the patient is unable to use a latrine, excreta should be collected in either a diaper or a clean bedpan and immediately and carefully disposed of into a separate toilet or latrine used only by suspected or confirmed cases of COVID-19. In all health care settings, including those with suspected or confirmed COVID-19 cases, faeces must be treated as a biohazard and handled as little as possible. Anyone handling faeces should follow WHO contact and droplet precautions and use PPE to prevent exposure, including long-sleeved gowns, gloves, boots, masks, and goggles or a face shield. If diapers are used, they should be disposed of as infectious waste as they would be in all situations. Workers should be properly trained in how to put on, use, and remove PPE so that these protective barriers are not breached. If PPE is not available or the supply is limited, hand hygiene should be regularly practiced, and workers should keep at least 1 m distance from any suspected or confirmed cases.

If a bedpan is used, after disposing of excreta from it, the bedpan should be cleaned with a neutral detergent and water, disinfected with a 0.5% chlorine solution, and then rinsed with clean water; the rinse water should be disposed of in a drain or a toilet or latrine. Other effective disinfectants include commercially available quaternary ammonium compounds, such as cetylpyridinium chloride, used according to manufacturer’s instructions, and peracetic or peroxyacetic acid at concentrations of 500–2000 mg/L. Chlorine is ineffective for disinfecting media containing large amounts of solid and dissolved organic matter. Therefore, there is limited benefit to adding chlorine solution to fresh excreta and it is possible that this may introduce risks associated with splashing.

4. Emptying latrines and holding tanks, and transporting excreta off-site.

There is no reason to empty latrines and holding tanks of excreta from suspected or confirmed COVID-19 cases unless they are at capacity. In general, the best practices for safely managing excreta should be followed. Latrines or holding tanks should be designed to meet patient demand, considering potential sudden increases in cases, and there should be a regular schedule for emptying them based on the wastewater volumes generated. PPE (long-sleeved gown, gloves, boots, masks, and goggles or a face shield) should be worn at all times when handling or transporting excreta offsite, and great care should be taken to avoid splashing. For crews, this includes pumping out tanks or unloading pumper trucks. After handling the waste and once there is no risk of further exposure, individuals should safely remove their PPE and perform hand hygiene before entering the transport vehicle. Soiled PPE should be put in a sealed bag for later safe laundering (see Cleaning practices). Where there is no off-site treatment, in-situ treatment can be done using lime. Such treatment involves using a 10% lime slurry added at 1-part lime slurry per 10 parts of waste.

5. Cleaning practices

Recommended cleaning and disinfection procedures for health care facilities should be followed consistently and correctly. Laundry should be done and surfaces in all environments in which COVID-19 patients receive care (treatment units, community care centres) should be cleaned at least once a day and when a patient is discharged. Many disinfectants are active against enveloped viruses, such as the COVID-19 virus, including commonly used hospital disinfectants. Currently, WHO recommends using:

- 70% ethyl alcohol to disinfect small areas between uses, such as reusable dedicated equipment (for example, thermometers);
- sodium hypochlorite at 0.5% (equivalent to 5000 ppm) for disinfecting surfaces.
All individuals dealing with soiled bedding, towels, and clothes from patients with COVID-19 infection should wear appropriate PPE before touching soiled items, including heavy duty gloves, a mask, eye protection (goggles or a face shield), a long-sleeved gown, an apron if the gown is not fluid resistant, and boots or closed shoes. They should perform hand hygiene after exposure to blood or body fluids and after removing PPE. Soiled linen should be placed in clearly labelled, leak-proof bags or containers, after carefully removing any solid excrement and putting it in a covered bucket to be disposed of in a toilet or latrine. Machine washing with warm water at 60–90°C (140–194°F) with laundry detergent is recommended. The laundry can then be dried according to routine procedures. If machine washing is not possible, linens can be soaked in hot water and soap in a large drum using a stick to stir and being careful to avoid splashing. The drum should then be emptied, and the linens soaked in 0.05% chlorine for approximately 30 minutes. Finally, the laundry should be rinsed with clean water and the linens allowed to dry fully in sunlight.

If excreta are on surfaces (such as linens or the floor), the excreta should be carefully removed with towels and immediately safely disposed of in a toilet or latrine. If the towels are single use, they should be treated as infectious waste; if they are reusable, they should be treated as soiled linens. The area should then be cleaned and disinfected (with, for example, 0.5% free chlorine solution), following published guidance on cleaning and disinfection procedures for spilled body fluids.

6. Safely disposing of greywater or water from washing PPE, surfaces and floors.

Current WHO recommendations are to clean utility gloves or heavy duty, reusable plastic aprons with soap and water and then decontaminate them with 0.5% sodium hypochlorite solution after each use. Single-use gloves (nitrile or latex) and gowns should be discarded after each use and not reused; hand hygiene should be performed after PPE is removed. If greywater includes disinfectant used in prior cleaning, it does not need to be chlorinated or treated again. However, it is important that such water is disposed of in drains connected to a septic system or sewer or in a soakaway pit. If greywater is disposed of in a soakaway pit, the pit should be fenced off within the health facility grounds to prevent tampering and to avoid possible exposure in the case of overflow.

7. Safe management of health care waste

Best practices for safely managing health care waste should be followed, including assigning responsibility and sufficient human and material resources to dispose of such waste safely. There is no evidence that direct, unprotected human contact during the handling of health care waste has resulted in the transmission of the COVID-19 virus. All health care waste produced during the care of COVID-19 patients should be collected safely in designated containers and bags, treated, and then safely disposed of or treated, or both, preferably on-site. If waste is moved off-site, it is critical to understand where and how it will be treated and destroyed. All who handle health care waste should wear appropriate PPE (boots, apron, long-sleeved gown, thick gloves, mask, and goggles or a face shield) and perform hand hygiene after removing it. For more information refer to the WHO guidance, Safe management of wastes from health-care activities.

Considerations for WASH practices in homes and communities.

Upholding best WASH practices in the home and community is also important for preventing the spread of COVID-19 and when caring for patients at home. Regular and correct hand hygiene is of particular importance.

1. Hand hygiene

Hand hygiene in non−health care settings is one of the most important measures that can prevent COVID-19 infection. In homes, schools and crowded public spaces − such as markets, places of worship, and train or bus stations − regular handwashing should occur before preparing food, before and after eating, after using the toilet or changing a child’s diaper, and after touching animals. Functioning handwashing facilities with water and soap should be available within 5 m of toilets.

2. Treatment and handling requirements for excreta.

Best WASH practices, particularly handwashing with soap and clean water, should be strictly applied and maintained because these provide an important additional barrier to COVID-19 transmission and to the transmission of infectious diseases in general.\(^7\) Consideration should be given to safely managing human excreta throughout the entire sanitization chain, starting with ensuring access to regularly cleaned, accessible, and functioning toilets or latrines and to the safe containment, conveyance, treatment, and eventual disposal of sewage.

When there are suspected or confirmed cases of COVID-19 in the home setting, immediate action must be taken to protect caregivers and other family members from the risk of contact with respiratory secretions and excreta that may contain the COVID-19 virus. Frequently touched surfaces throughout the patient’s care area should be cleaned regularly, such as beside tables, bed frames and other bedroom furniture. Bathrooms should be cleaned and disinfected at least once a day. Regular household soap or detergent should be used for cleaning first and then, after rinsing, regular household disinfectant containing 0.5% sodium hypochlorite (that is, equivalent to 5000 ppm or 1-part household bleach with 5% sodium hypochlorite to 9 parts water) should be applied. PPE should be worn while cleaning, including mask, goggles, a fluid-resistant apron, and gloves;\(^2\) hand hygiene with an alcohol-based hand rub or soap and water should be performed after removing PPE.

References


Contributors

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WHO continues to monitor the situation closely for any changes that may affect this interim guidance. Should any factors change, WHO will issue a further update. Otherwise, this interim guidance document will expire 2 years after the date of publication.

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Coronavirus Building Flushing Guidance

The scientists and engineers at the Environmental Science, Policy & Research Institute (ESPRI) and AH Environmental Consultants, Inc. (AH) developed this brief guidance material to help those who are responsible for maintaining building water systems. We have decades of water quality and treatment experience, including building water quality and operation issues, and wanted to share our insights on this topic.

As buildings have been shut down or used less frequently, building water quality degradation becomes a silent but serious issue. This document is meant as a starting point to bring awareness of the issue of water quality degradation in building plumbing when it is not used, or water use is significantly reduced. We kept this brief and provide it as a general roadmap for how to flush contaminants from the building and get the plumbing system water quality back to pre-stagnation conditions. Each building is different, and flushing will need to be tailored accordingly.

Many thanks to those who reviewed and provided suggestions to this material.

Please feel free to circulate and post this information. And stay well in these challenging times.

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What happened in my building water system while the building was out of use?

- The building water system begins at the meter where water enters the building and includes all plumbing, storage and fixtures to each distal tap.
- When the water was not used, the disinfectant in the water dissipated. Without the disinfectant, microorganisms grew on pipes, fixtures and tanks. Some of these may cause disease if they are consumed or inhaled as droplets (particularly while showering).
- The protective scale on pipes could have destabilized. Without the protective scale, toxic metals like lead can dissolve or shear off as particles and end up in water used for drinking or food preparation.
- Potentially harmful substances such as disinfection byproducts (DBPs) built up.
- Mechanical equipment such as cooling towers, boilers and pumps may not have received any routine maintenance. Backflow preventers may have missed annual test cycles.

How do I prepare the building for re-occupancy?

- The best immediate action is to flush the entire building, including all water-using appliances like ice machines and dishwashers. Flushing clears out the low quality water that accumulated during low use and replaces it with high quality water from the municipal supply. The fresh water will help mitigate the problems (loss of protective scale and biofilm growth) that emerged...
while the water was stagnant. If staff are available to flush, start now. Starting flushing now means less deterioration of water quality in the building and a sooner recovery to normal conditions.

- Inspect mechanical equipment such as cooling towers, boilers, pumps, backflow preventers, etc., and determine if there are any issues regarding their function.

- Other actions you could take are:
  - Clean showerheads, faucets and other fixtures that can produce aerosols that people could inhale,
  - Develop a water safety plan, a long-term plan for keeping water quality high and protecting building occupants and visitors, and
  - Collect water samples for analysis at a qualified laboratory (only recommended for buildings with specific at-risk populations like children in childcare and elderly people).

- Disinfecting buildings water systems with concentrated chlorine should be considered when there is a strong reason to believe the building is contaminated with pathogens like *Legionella pneumophila*, the bacterium that causes Legionnaires’ disease, and/or the people who use the building are particularly susceptible to infections like Legionnaires’ disease. Disinfectants (chlorine) are dangerous to handle and can cause serious damage to plumbing system components if used improperly. In most cases, flushing buildings with water that has normal amounts of chlorine (the chlorine already in the building water supply) is sufficient for cleaning the water system.

**How do I flush a residence or small building?**


“Note that many homes have maintained service or even increased water use as we stay and work at home and do not need to be flushed.

- When homes are returned to service after an extended period of discontinued service (e.g., weeks or months), an adult should be present in the home to ensure that the meter works, leaks are minimized, wastewater piping is intact, and the building’s plumbing is flushed. A thorough flushing process is appropriate in such situations.

  Note: Social distancing protocols will need to be considered when engaging residents about customer assistance programs, managing lead, and other steps in returning service to the home.

Flushing instructions provided to occupants will vary depending on the structure. This is an area of active research. However, key elements of existing protocols include:

1. Remove or bypass devices like point-of-entry treatment units prior to flushing.
2. Take steps to prevent backflow or the siphoning of contaminants back into plumbing (e.g., close valves separating irrigation systems from home plumbing, disconnect hoses attached to faucets, etc.).
3. Organize flushing to maximize the flow of water (e.g. opening all outlets simultaneously to flush the service line and then flushing outlets individually starting near where the water enters the structure).
4. Run enough water through all outlets (e.g., hose bibs, faucets, showerheads, toilets, etc.), removing aerators when possible. Typical durations in existing protocols range from 10 to 30 minutes for each outlet (duration varies based on outlet velocity).
5. Flush the cold water lines first, and then the hot water lines. Note: the hot water tank can be drained directly; it can require roughly 45 minutes to fully flush a typical 40-gallon hot water tank.
6. Replace all point-of-use filters, including the filter in refrigerators.
7. Additional precautions may be warranted if there is excessive disruption of pipe scale or if there are concerns about biofilm development. Actions that might be warranted include continued use of bottled water, installation of a point-of-use device, or engaging a contractor to thoroughly clean the plumbing system.

Residents should be reminded that if point-of-use devices are installed, POU devices should be properly installed and adequately maintained.”

How do I flush a larger building?
Based on the experience of AH and ESPRI, a single flush cannot bring the building water system back to normal operation and re-establish good water quality. Flushing requires an initial flush to get out low quality water and contaminants and then follow-up flushes that may bring the building back to pre-COVID water quality. Ongoing flushing draws particles through and out of the system and brings in disinfectant from the municipal system that can help control biological growth. The longer service is interrupted, the more the required level of effort for restoration.

Experience in flushing and maintaining buildings has shown that there are some general principles for an effective flushing strategy. In general,

- Flushing should proceed uni-directionally, that is from the service entrance to the periphery of the plumbing system (distal points).
- Some buildings have water treatment systems like filters and water softeners at the building water supply. Those treatment systems were installed for a reason and should not be bypassed. Those treatment systems need to be cleaned, flushed and maintained as part of bringing the building back into use.
- Building water systems have a variety of places where water is stored. At a minimum, they should all be identified, drained, and flushed with clean cold water, after the building cold water service is properly restored. These include, but are not limited to:
  - Hot water storage (some buildings have more than one type of heating system and hot water storage),
  - Hot water recirculating loop(s),
  - Humidifiers,
  - Ice machines,
  - Dishwashers,
  - Cooling towers,
Ultrapure water storage (membrane filtration).

Before flushing, sketch out the building water system to the best of your ability and identify:

- the water supply,
- zones or branches with a common water supply (e.g., a branch to a wing of a building or a set of branches served by the same riser),
- the faucet nearest the starting point of the zone and the most distant faucet or use for each zone,
- water heaters and recirculating heated water loops, and
- appliances and water-using features (e.g., hot tubs).

Parts of the water system that are most important to flush because they have the greatest opportunity to make people sick include:

- faucets used for drinking water or food preparation,
- drinking fountains,
- ice machines and refrigerators with ice makers,
- showers,
- kitchen sink sprayers,
- water features that generate aerosols (fountains, spas, etc.),
- parts of the water system that are used by children, and
- components of the water system used by elderly people and susceptible people.

However, it is also important to identify and flush as many other water outlets as possible - utility sinks, hose taps, piping in place to serve any future installations, removed water taps - to remove contamination in the piping.

**Initial flushing and cleaning.** The initial flush clears out contaminants that accumulated during stagnation and draws in fresh, high-quality water to the piping. Cleaning of fixtures removes contaminants from the complex internal structures at the point of discharge. Complete the initial flushing and cleaning steps before resuming normal building operation:

- Clean fixtures.
  - Clean showerheads.
  - Replace/maintain point of use filters.
- Flush zone-by-zone. Zones are branches of the building water system with a common source or parts of the building water system served by a common riser.
- The first zone to flush is the one nearest the building supply. Flush zones progressively outward from the supply.
- In each zone, flush the cold water plumbing first and hot water second.
- Begin flushing at the point of use (POU) nearest to the origin of the zone. Aerators and other flow restrictors are removed at the POU nearest the beginning of the zone and the tap is opened wide.
- Open other taps on the same branch, moving from the faucet nearest the origin to the most distant POU tap. Continue flushing until the final POU tap is flushed for at least 5 minutes AND the cold water temperature at the final POU tap is steady.
Drain hot water tanks on the first flush after resumption of flow. If draining is not possible, hot water flushing time depends upon the size of water heater tank. Maintain the water heater temperature. DO NOT turn the heater off as water temperature is critical to prevent microorganisms from growing in the heater and being disseminated in aerosols.

**Ongoing flushes.** Ongoing flushing can repair destabilized scale and control biofilms. Re-stabilizing scale and controlling biofilms is an ongoing process. In the best case, ongoing flushing is conducted for about 12 weeks – the duration needed for protective scale to re-stabilize and for lead borne on particles to be thoroughly washed from the plumbing system. This is the duration recommended in an industry standard (AWWA) on flushing related to lead. In some cases, longer flushing duration might be required. Monitoring for problematic organisms like *Legionella pneumophila*, the bacterium the causes Legionnaires’ disease, for lead and for disinfectant are the best ways to assess whether flushing is working and how long it should continue. Even when the building water system has recovered from a lengthy stagnation, flushing is a best practice, is easy and it has proven water quality benefits. Recommendations for ongoing flushing include:

- **Make sure each POU tap is opened at least once per day.** Some POUs are used frequently during normal building operation. Others might be used less frequently and might need to be opened intentionally.
- **Flush the full building once per week during ongoing flushing.** 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.
- **During ongoing flushing, it is a good idea to measure the water quality of water coming into the building and at some taps in the building.** Many building operators will not have the equipment or the ability to make measurements. **Even if operators cannot measure water quality, they should still flush the building.**
  - For those who can measure water quality, the most important measurements to make are the concentration of disinfectant (chlorine) in the building supply and the concentration of disinfectant in the cold water of the most distant tap of each zone after that tap is fully flushed. By comparing the disinfectant in the distant taps to the disinfectant in the building supply, you can tell whether the disinfectant is protecting the whole plumbing system. There is no benefit to measuring the disinfectant in the hot water system. At elevated temperature, disinfectant dissipates.
  - There are many other water quality measurements you can make. We do not recommend making those measurements, other than for chlorine, unless there is a compelling reason and unless you can understand what the results mean and what to do about them.

**Long-Term Risk Management: Implement a Water Management Plan (WMP)**

- To maintain high quality water in a building at all times, building owners and operators should implement a WMP that follows industry recommendations, such as ASHRAE 188 (2018) or similar to continually reduce the risk of infections due to water quality degradation.