

Building Water System COVID-19 Guidance Document Evaluation Tool

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Recommissioning and routine flushing guidance for building plumbing systems are being rapidly developed and disseminated to the public. This document provides an evaluation tool to aid building owners, public health officials, and private sector organizations identify information to consider including in those guidance documents. Information contained in this document can serve as a tool for end users to evaluate the applicability of existing building water system guidance documents for various purposes.

Considerations outlined in this document were synthesized based on our recent paper, “Considerations for Large Building Water Quality after Extended Stagnation” co-authored by 9 plumbing, water quality, and public health experts and conversations with various public health and environmental quality public servants, which can be downloaded here: <https://www.doi.org/10.31219/osf.io/qvj3b>.

How to use this document

For users that are developing or have developed COVID response guidance, this document can be used to inform internal conversations about the scope, applicability, and practicality of documents being disseminated to building owners and the public. We encourage protocol developers to consider revising existing guidance if there are ways to improve it.

For users that are implementing protocols issued by others, this document can serve as an evaluation tool to help identify topic(s) that may be lacking or unclear. Users of this document are encouraged to contact the entity that developed the building water system protocols for clarification. Users of this document can also develop their own protocols that address important considerations of building water safety.

The contents of this document address the clarity and specificity of the following items:

1. A guidance document’s scope and applicability
2. Considerations for routine flushing to keep water moving through plumbing systems
3. Considerations for recommissioning to reduce exposure to health risks that developed during stagnation
4. Considerations for evaluating building water safety
5. Considerations for worker safety
6. Considerations for communication between stakeholders

This document does not replace the value in communicating with local, state, and federal public health officials about what actions are recommended or necessary for specific buildings. Those entities should be contacted directly for clarifications on their documents.

This document does not address pools, spas, cooling towers, water features, sanitary drains, and other equipment and devices located in some buildings. Specialized attention is needed for these systems. This document only addresses the hot and cold water plumbing systems.

This document is not a protocol for maintaining building water safety or returning buildings to safe use. It is a tool to help develop, evaluate, and improve guidance disseminated to the public.

Contact William Rhoads (wrhoads@vt.edu) with questions or comments about this document. If you are developing protocols, the authors can provide assistance.

Scope and Applicability

Guidance issued should clearly state the focus and applicability of the recommendations being issued. Varying building types (e.g., office building, school, high-rise) will required different approaches and level of preventative or remedial actions.

Scope and applicability		
Does guidance...	Reasoning	Technical Notes
Identify and explain the health risk(s) it is intended to minimize?	Recommendations may not apply to all health risks; guidance should specify which health risk(s) it addresses.	Inhalation of aerosolized organisms can be a high risk for water use, but dermal and ingestion exposure routes for organisms and chemicals can be a concern as well. Highest priority concerns will be dependent on water systems design and operation as well as population exposed (children at drinking water fountain/faucets, critically ill in shower). These may include, but are not limited to, organisms such as <i>Legionella</i> , and chemicals such as lead.
Identify the building type(s), size(s), and systems it is intended to cover?	Approach may be dependent on building type/design; systems have specific requirement (e.g., cooling tower vs potable water)	Limiting scope to one building/system type/size may be easier for users to understand and would allow users to determine which guidance is most applicable to their specific needs; may need guidance targeted specifically for buildings with low- or no-occupancy during stagnation, or re-purposing buildings (e.g., for expanded healthcare): will these buildings support the intended purpose within the necessary time frame?
Identify whether it is intended for routine flushing practices, recommissioning, or both?	Guidance for recommissioning is different than for routine flushing	Recommissioning may not be necessary; Routine flushing practices are always recommended to maintain water quality. Consider separating out routine from recommissioning recommendations for clarity. If providing recommendations for both, ensure there are clear criteria to choose which is most applicable
Explain the goal of routine flushing and recommissioning, as applicable?	When users understand the purpose, they can better implement strategies in their systems.	Recommissioning: bring building plumbing back to routine use after non-routine use; Routine flushing: turnover water system to prevent development of water quality issues

Routine Flushing

The goal of routine flushing is to turnover the water system to ensure water does not sit in the plumbing to prevent harmful organisms and chemicals from reaching unsafe levels.

If recommending routine flushing		
Does guidance...	Reasoning	Technical Notes
Specify to start flushing at the building point-of-entry and work toward distal?	Avoid introducing contaminants to the system by removing them step-be-step from the point-of-entry to distal outlets	The goal of routine flushing is to turn over the entire water system; starting at the point-of-entry and mechanical spaces/main branches will make flushing distal lines more efficient
Provide an approach for ensuring cold water is representative of fresh water?	Incomplete flushing may negatively impact efficacy; more flushing than just one pipe volume is likely necessary to achieve turnover	Incomplete flushing may leave dislodged contaminants that pose a health threat in the plumbing; these contaminants may provide surface area and nutrients for pathogen growth, consume disinfectant residual, and pose direct health threat if ingested. Consider recommending testing for chemical disinfectant as best indicator; steady temperature (<0.1 °C or < 0.2 °F change) while flushing can serve as an indicator of fresh water in some geographic locations; Consider recommending building operators reach out to water supplier for information about what users can expect at their location
Provide an approach for ensuring systems are completely turned over?	There are not standard protocols for achieving this; incomplete flushing may negatively impact efficacy; more flushing than just one pipe volume is likely necessary to achieve turnover	If service lines, mechanical room, and main branches are flushing prior to distal lines, this will increase efficiency of the flushing protocol. Starting from the lines closest to the main system and moving toward more distal locations is widely recommended. Special consideration is required for ensuring adequate turnover of hot water storage tank (if present) and recirculating lines. Cold water and hot water outlets need to be flushed until water quality is representative of cold water at the point-of-entry or the hot water set point temperature
Provide information about specific end use devices?	Some buildings contain specialized equipment	e.g., Ice machines, soda dispensers – refer to manufacture recommended routine maintenance as a start point; consider creating list of other special equipment that should be considered
Provide information for how frequently to perform?	There is no standard on how frequently this should be done; there are no one-size-fits all recommendations for all hot and cold-water systems	In healthcare, flushing "unused" or "unoccupied" once per week is a practical recommendation frequently used. Some recommend flushing outlets, particularly those at highest risk for creating aerosols, once per day. Flushing recommendations that are based solely on duration of flushing (e.g., "5 minutes") would not be adequate for all buildings. There is no scientific data to support the efficacy of any recommendation for all situations. Instead, recommendations can consider defining the amount of flushing required in terms of achieving a disinfectant residual and targeting hot water temperature
Recommend validation or confirmation of flushing?	No standard protocol exists	Tracking data can be helpful, but it is often under-utilized by building operators; Which data to collect and how often is usually at the discretion of the building operator and can be prioritized to health risks; if your guidance specifies the need for this, it would be helpful to provide instructions on collection methods, frequency, location, and analysis; success is likely highly dependent on water quality (residual, temperature – see question regarding water management plans below)

Recommissioning

Building plumbing systems are required by plumbing code to be commissioned (i.e., flushed and disinfected) after construction to ensure they are safe for use before they are occupied. Here, “recommissioning” is defined as the process of preparing unoccupied or low-occupancy buildings after prolonged stagnation for normal occupancy. Recommissioning can include thorough flushing and potentially disinfecting the plumbing system.

If recommending recommissioning		
Does guidance...	Reasoning	Technical Notes
Provide decision making for how to choose between recommissioning flushing and disinfection?	There are no standards that stipulate when disinfection is necessary	If disinfection is considered, flushing should be required prior to disinfection; Routine flushing to ensure regular water turnover is recommended after recommissioning; ASHRAE 188 stipulates occupancy should occur within 4 weeks of disinfection in new buildings (but it is unclear how this applies to recommissioning buildings that have technically remained occupied, as with COVID-19 stagnation)
Provide information for occupant safety before recommissioning can be completed?	If occupants are already present, they may be exposed to risk prior to recommissioning or flushing	Can consider temporary application of point of use filters or water use restrictions if building is currently occupied and a significant health risk is identified; If performing disinfection, consideration needs to be given for the safety consumers due to exposure to the levels of disinfectant recommended
Provide information on how to perform recommissioning flush?	There are no standardized protocols or industry standards	Recommissioning flushing aims to thoroughly remove debris and biomass that has accumulated during stagnation and turn over the entire system, typically with high flow rate flushing; One-time flushes are not likely to bring building to normal operation, but can significantly reduce contaminant concentration within plumbing; success is likely highly dependent on water quality (residual, temperature – see question regarding water management plans below)
Provide information about target flow rates to achieve during various steps of the guidance?	Goal of flushing can be to disturb and remove particulate contaminants (sediment, biofilm); Scouring off biofilm and sediments may have impact on plumbing system function	Particulates released during flushing may clog filters, aerators, valves, and mechanical equipment; this may also release bacteria (including harmful organisms) to the water and cause disinfectant residuals to become decrease more rapidly; If recommending high flow rate flushing, consider including criteria to ensure that disturbed contaminants are removed prior to moving on to next step; consider providing information about removing aerators, replacing filters, etc. before/after flushing, as appropriate, as they can become clogged; Consider providing tables of target flow rates to achieve target pipe velocities;
Specify to start flushing at the building point-of-entry and work toward distal?	Avoid introducing contaminants to the system by removing them step-be-step from the point-of-entry to distal outlets	Water mains and services should be explicitly considered if building has been unoccupied or had low occupancy; Turning over service line prior to point of use flushing will help ensure presence of disinfectant residual and make the flushing program more efficient (can flush services lines at high flow rate = less time waiting for fresh water)
Provide an approach for ensuring cold water is	Incomplete flushing may negatively impact efficacy; more flushing than just one pipe	Incomplete flushing may leave dislodged contaminants that pose a health threat in the plumbing; these contaminants may provide surface area and nutrients for pathogen growth, consume disinfectant residual, and pose direct health threat if ingested.

This document was created by Dr. William Rhoads at Virginia Tech, Dr. Caitlin Proctor, and Dr. Andrew Whelton at Purdue University. Questions about this document can be referred to wrhoads@vt.edu. Input was also provided by various private and public sector organizations.

representative of fresh water?	volume is likely necessary to achieve turnover	Consider recommending testing for chemical disinfectant as best indicator; steady temperature (<0.1 °C or < 0.2 °F change) while flushing can serve as an indicator of fresh water in some geographic locations; Consider recommending building operators reach out to water supplier for information about what users can expect at their location
Provide information about which mechanical equipment should be flushed and how?	Contributes to goal of completely turning over the system; Protocols for bringing equipment out of long-term stagnation likely do not exist	Consider recommending draining storage tanks (e.g., water heaters, pressure tanks, softeners) to ensure turnover; manufacturer protocols for routine maintenance are a good starting point, but are not necessarily designed for long-term stagnation – additional consideration should target ways to remove sediments that may have accumulated and ensure complete water volume turnover; Consider including specific instructions for how to ensure hot water recirculating systems are adequately turned over
Provide an approach for ensuring systems are completely turned over?	There are not standard protocols for achieving this; incomplete flushing may negatively impact efficacy; more flushing than just one pipe volume is likely necessary to achieve turnover	If service lines, mechanical room, and main branches are flushing prior to distal lines, this will increase efficiency of the flushing protocol. Starting from the lines closest to the main system and moving toward more distal locations is widely recommended. Special consideration is required for ensuring adequate turnover of hot water recirculating lines. Cold water and hot water outlets need to be flushed until water quality is representative of cold water at the point-of-entry or the hot water set point temperature
Provide information about specific end use devices?	Some buildings contain specialized equipment	e.g., Ice machines should be cleaned using manufacturer protocol and have at least 3 batches dumped to waste. Consider creating list of other special equipment that should be considered
If recommending disinfection, provide information on how to disinfect or recommend hiring treatment professional?	There are no industry standards; The guidance should specify scope of disinfection – entire system, cold, hot, tanks; Consider deferring guidance to water treatment professionals hired by building owner for disinfectant and protocol approach	Disinfection introduces a biocide to the building plumbing to kill harmful organisms that have established and/or increased to high numbers during stagnation; There are debates among experts regarding what level of disinfection is appropriate; Free chlorine hyperchlorination (at 50 mg/L or 200 mg/L) is stipulated in plumbing codes for new potable water systems (it is unclear how this applies to recommissioning after stagnation); other disinfectants beyond free chlorine can be used as long as their application complies with ANSI 60/61 and are approved for use by EPA; Consider providing a list of pre-disinfection steps to address practical issues (e.g., consider if disinfectant in waste will damage pipes or septic, ensure back flow preventers are functional)
Recommend validation or confirmation of recommissioning?	No standard exists, but user needs to know if their effort water successful and what to do next	If your guidance specifies the need monitoring or validation, it would be helpful to provide instructions; Consider recommending routine flushing after recommissioning is complete

Other considerations

Does guidance...	Reasoning	Technical Notes
Assessing building safety		
Recommend continuous care for critical components of water systems?	Water management plant (WMPs) can help building operators assess the functionality of their system, but can be onerous to implement during emergency situations	Consider highlighting important aspects of WMPs that address critical components of system function, or providing information to help building operators to prioritize actions to taken (e.g., ensure disinfectant residuals are dispersed through cold water plumbing; ensure hot water temperature targets are met and the systems is balanced); Consider recommending that an engineer with building plumbing background leads or is on the team developing WMPs if/when pursued
Recommend testing for contaminants?	There are no standard practices with respect of what, where, how, how often, or when to measure	Testing for specific health risks is the best way to evaluate safety, but interpretation of the results is not always clear. If specific tests are recommended in the guidance, it should also contain instructions for interpretation. At a minimum, water temperature and/or disinfectant residual concentration should be considered.
Worker safety		
Recommend the use of specific personal protective equipment (PPE) or hazards for workers while performing flushing tasks?	WHO and OSHA have specific requirements for PPE	Inhalation of aerosolized harmful organisms can be a high risk for water use, but dermal and ingestion exposure routes can be a concern as well; For remediation, if using high temperatures scaling risk can exist and high biocide doses can pose inhalation, dermal, and ingestion exposure risks; Highest priority concerns will be dependent on water systems design and operation as well as population exposed; define what precautions should be taken and when or defer to other organization specifications
Communication between stakeholders		
Outline various roles and responsibilities with respect to what information building owners can expect from different stakeholders?	Building owners are ultimately responsible, but public health and drinking water utilities have a role to play.	Communication between stakeholders may help guide or enhance building operator responses; define expectations that building owners should have with respect to assistance they can receive from public health and drinking water utilities; provide a list of resources on department of health's pages.
Provide a list of resources to seek more detailed information including contact information for the appropriate public health agency?	Public health guidance needs to be short and to the point. It cannot provide all the details.	Consider the quality of the resources you link and do not provide a link to anything that you do not believe is beneficial to your target audience.
Written in easy-to-understand language and provided in multiple languages, as appropriate for your audience?	Readability is critical for effective public health communication	Guidance should be written at an 8 th grade reading level. This can be done using the Flesch-Kincaid readability tool