Who is this relevant to:

- Owner/Manager of properties vacated for long periods such as during the COVID-19 pandemic. This includes office buildings, schools, medical offices, hotels, and other public and private spaces.
- Building occupants especially those with an at risk population (elderly, young children, pregnant women and those with pre-existing health conditions).

About Jacobs

At Jacobs, we’re challenging today to reinvent tomorrow by solving the world’s most critical problems for thriving cities, resilient environments, mission-critical outcomes, operational advancement, scientific discovery and cutting-edge manufacturing, turning abstract ideas into realities that transform the world for good. With $13 billion in revenue and a talent force of more than 55,000, Jacobs provides a full spectrum of professional services including consulting, technical, scientific and project delivery for the government and private sector.

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The properties that sat vacant or underutilized for weeks or months during COVID-19 shelter in place orders may experience water and air stagnation, uncontrolled humidity, and dry sanitary systems that could lead to health risks when occupants return. This brochure focuses on both water and air quality issues within buildings which are not only relevant to building owners and managers of properties but to returning occupants.

Water utilities continue to safeguard the water quality delivered to consumers via the distribution system by maintaining water flows, disinfectant residuals (chlorine or chloramines) and providing water quality that mitigates corrosion and release of metals in premise plumbing (lead and copper for example).

However, safeguarding water quality within the building water systems of properties sitting nearly empty presents additional challenges. These properties are experiencing significantly reduced water flows and prolonged stagnation (weeks or months) that has the potential to deteriorate water quality and create health risks. These issues can impact a number of building water systems including hot and cold potable water used for drinking and washing as well as water used in utility systems such as humidity control for HVAC or cooling towers.

Primary Issues with Prolonged Stagnation in Building Plumbing Systems

- Loss of disinfectant effectiveness within days or weeks.
- Loss of corrosion control effectiveness.
- Changes in water temperature in building services (cold water increase and hot water decrease).

Health-related Risks

- Growth of opportunistic pathogens (Legionella pneumophila, non-tuberculous mycobacteria, Pseudomonas aeruginosa, free-living amoeba), and microbial community shifts.
- Nitrification which further feeds microbial growth.
- Regulated disinfection byproduct concentrations increase.
- Metals (lead, iron, copper) and/or arsenic leaching from plumbing materials into drinking water.
- Water discoloration, taste and odor.

Many building HVAC systems during periods of no occupancy or limited occupancy may have reduced or eliminated outdoor air ventilation and recirculation. During this period of reduced outdoor air ventilation, indoor air pollution has the potential to concentrate as chemicals, including VOC’s, which are released from indoor furnishings, carpets, building materials and cleaners. Humidity levels left uncontrolled can also contribute to mold growth. Each of these can negatively affect occupants respiratory systems.
Building occupants are protected from fumes originating from sanitary waste systems from wetted P traps. During periods of time of little to no use these traps have the potential to dry out leaving an unobstructed path for fumes, vapors and airborne pathogens into the building. According to the World Health Organization (W.H.O.) “It has been suggested that the ‘faecal droplet’ route may have been one of several modes of transmission in Hong Kong during the SARS outbreak in early 2003. In this case, droplets originating from virus-rich excreta in a given building’s drainage system re-entered into resident’s apartments via sewage and drainage systems where there were strong upward air flows, inadequate ‘traps’ and non-functional water seals.”

<table>
<thead>
<tr>
<th>Primary Issues with Poor Indoor air quality</th>
<th>Health-related Risks</th>
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<tbody>
<tr>
<td>Concentration of VOC, chemicals within breathing air</td>
<td>Contributes to the spread of diseases and infections</td>
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<tr>
<td>Excessive moisture contributing to Mold and Mildew growth</td>
<td>Respiratory related issues such as asthma.</td>
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<tr>
<td>Excessive Dust and pollen</td>
<td>Sick Building Syndrome symptoms including throat irritation, runny nose, sneezing, headaches, fever, and dizziness</td>
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<tr>
<td>Airborne pathogens which can be circulated by the Building HVAC systems</td>
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<tr>
<td>Occupant health comfort and work performance</td>
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These are all public health issues that if not addressed could lead to illness in occupants re-entering the properties; and furthermore, lead to loss of confidence or public outcry. For example, both Legionella and poor indoor air quality inside buildings can cause pneumonia and/or flu-like symptoms that could be confused with COVID-19. As such, it is imperative that building owners and operators consult with experts, industry organizations, public health officials and onsite personnel, in developing an action plan for buildings that have sat near empty. Corrective actions can be taken by property managers during the shutdown and before the scheduled re-entry of building tenants and workers.

**Practices to Reduce Impact During Shut Down**

1. Routine inspection and maintenance of buildings is extremely important to identify and correct issues as early as possible. These Inspections should include observation of the building condition with highlighted focus on water leaks or the formation of mold, mildew or unusual odors. Ensuring the building systems integrity and operation during these times is critically important as well.

2. Building Water Management Plan (CDC Toolkit). If a Building Water Management Plan is in place, this should include information on management of the water system and should be followed to reduce risk. The plan will commonly include an overview of the building water system, regular flushing and draining protocols, thermal regulation, and water quality testing.

3. Periodic flushing. Replacing stagnant water in the building water system with water from the main will help to prevent water quality deterioration. Flushing locations, frequency and duration should be determined based on system design and piping configuration with considerations for the most remote use point within the building as well as the length of the service line into the building.

4. Maintain intermittent operation of the HVAC system ensuring humidity levels are not allowed to rise excessively. Disable demand control ventilation features ensuring adequate ventilation during periods of no use.

5. Re-wet P traps ensuring isolation of sanitary sewer gases and fumes at least monthly depending on trap type and indoor conditions.
## Considerations Before Building Re-entry

<table>
<thead>
<tr>
<th>Plan and Assess</th>
<th>Communicate</th>
<th>Execute</th>
<th>Ready for Re-entry</th>
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</thead>
<tbody>
<tr>
<td>- Is there a Building Water Management Plan in place?</td>
<td>- How and when are building tenants informed about ongoing water quality issues or mitigation strategies?</td>
<td>- For Building Water systems understand and evaluate the risk, susceptibility and current state of each system.</td>
<td>- Confirm compliant operation of systems including both water and air quality. This includes ensuring the system safety features and interlocks are operational.</td>
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<td>- Are there schematics of the building water system available to understand the number of systems and complexity of the piping network?</td>
<td>- Do stakeholders include “at risk populations” (elderly, sick, or children)?</td>
<td>- Determine appropriate strategy which could include flushing and/or disinfection strategy. These strategies would need to consider the following:</td>
<td>- Water and indoor air quality testing before and after corrective actions.</td>
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<td>- Is there an understanding of which building water systems are potentially at risk such as domestic hot and cold water (potable water), service water (non-potable water), tepid water systems (safety showers) evaporative cooling water systems, cooling tower systems, water fountains? Is a subcontractor required for this?</td>
<td>- Do regulatory agencies require notification, or can they provide guidance?</td>
<td>- The system complexity including fixtures and equipment, dead ends, piping configuration, and ways to maximize flows (pipe velocities)</td>
<td>- Include time for samples to be processed and reported by lab (minimum of 1 week).</td>
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<td>- Are the building hot potable water systems recirculating systems? Older buildings may have been designed without hot water recirculation and are more vulnerable with lack of use.</td>
<td>- Are there legal or financial implications?</td>
<td>- Volume of fresh water required, duration of flush, and pipe velocities?</td>
<td>- Notifications to health department, tenants, and stakeholders.</td>
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</table>
| - When was the last time the system ran at higher capacities? If it has been more than 3-4 weeks, flushing is likely necessary. | - Are there special health and safety considerations for staff or subcontractors implementing corrective actions? | - Type of disinfectant, concentration and duration of exposure, compatibility with piping materials of construction. | |}

- Is flushing required after disinfection? When and where to verify water quality.
- For potable water systems, corrective actions may include flushing with fresh water and/or disinfection (typically shock chlorination).
- For non-potable water systems, verify continuous disinfection systems are maintaining desired water quality. This would apply to cooling towers and water fountains as an example.
- For HVAC systems follow ASHRAE recommendations for commercial buildings which would include:
  - Increase filtration to Merv 13 or better ensuring tight fit around filter ensuring air flow rates are adequate to maintain design conditions.
  - Ensure systems are balanced in each operating mode and the outside air meets minimum requirements per current standards.
  - Operate building humidity between 40-60% RH adding humidification if required.
  - Operate HVAC systems continuously, increasing outside air to maximum while maintaining interior conditions.
  - Systems can be operated on minimum outdoor air settings when the building is not occupied. Operate systems at maximum outdoor air for 2 hours before and 2 hours after occupied mode.
  - Add UVGI ultraviolet germicidal irradiation to recirculating HVAC units.
  - Disable demand control ventilation when building is occupied.
- For Drainage systems ensure all P-traps are wetted. In some cases, sanitization of the trap may be recommended.
- Allocate enough time to complete procedure depending on the size and complexity of the building systems.
- Strategy development may require support from regulators, engineers and subcontractors.
- A plan may be required to ensure that corrective actions have been completed for each component of each system.
- Understand your building occupancy levels during these efforts and any required notifications.

Each building water system must be recommissioned to ensure safe operational performance. For potable water systems, this could include disinfection in accordance with local building codes and water quality regulations. In addition the following may provide some guidance for the current situation as detailed below:

**Additional Resources:** AWWA, WaterRF, CDC, ASHRAE, Purdue University Center of Plumbing Safety, EPA