

SUPPLEMENT S1
WATER QUALITY SAFETY RISK ASSESSMENT (WQSRA)
Building Water Distribution System (BWDS)

for Academic Institutions or School Settings (Non-Healthcare Settings)

Exemplar for Water Disruptive Events defining Project Categories, Building Occupant Risk Groups, and Risk Mitigation Levels

Disclaimer: This is an example WQSRA document and requires each organization to review its contents for appropriateness and application in conjunction with the organization's water management program and water disruptive event policy and procedures. The user / organization assumes the sole risk and full responsibility for implementation of such practices and consequences of implementation in building environments. The authors make no representations or warranties about the suitability, completeness, reliability, legality, accuracy, or appropriateness of the information provided to reduce the likelihood of waterborne pathogens or water chemistry present in building water distribution systems (BWDS), the disease cases, or deaths that may emerge from such building water systems. Every building water system has unique attributes that can create different results and must be evaluated by the responsible water management program team acting on behalf of the building owner. Modifications will be necessary for local, state, or federal regulatory requirements, as well as any numeric values (ex. temperature, residual oxidant, etc.) within organization's building water management program.

DIAGRAM 1 Instructions: Use the WQSRA Decision Matrix to determine appropriate Risk Mitigation Level (RML). After evaluating the Category (A, B, or C) and the Building Occupant Risk Group (low, medium, or high), determine the appropriate RML (RML - 1, 2, or 3). See Diagram 4 for RML descriptions.

WQSRA Decision Matrix Building Water Distribution System (BWDS) Scope of Work			
	Small scale BWDS, short-duration, and low to modest water age (≤ 7 days)	Moderate to high levels of BWDS disruption, and medium water age (≤ 30 days)	Major BWDS disruption or new construction with high water age (> 30 days)
BUILDING OCCUPANT RISK GROUP	CATEGORY A	CATEGORY B	CATEGORY C
Low Risk	RML - 1	RML - 2	RML - 2 or 3
Medium Risk	RML - 1	RML - 2	RML - 2 or 3
High Risk	RML - 2	RML - 2 or 3	RML - 3

DIAGRAM 2 Instructions: Evaluate the water disruptive event (Category A, B, or C). Categories are defined by the severity of the water disruptive event; the project scope of work to fix the issue; the extent of water age (i.e., stagnation), and the impact on building occupants. Contact the organization's Water Management Program Team or Safety and Risk Manager if any BWDS project activity needs clarification for completing the scope of work evaluation.

CATEGORY A	BWDS Inspection, maintenance/repair, or small scale construction; creates minimal water disruption, and low to modest water age. Includes but not limited to: Replacing fixtures and trim(s) Replacing fixture "in-kind" (i.e., meaning 1:1 or like for like) Replacing or installing fixtures in a localized area and may include work within wall cavities or ceiling areas. Impact and risk is only to building users in the localized area of disruption (room, floor, or department) Disaster event (e.g., inclement weather or leakage) allows containment within a small building area. Water by fixture or area is shut down for ≤ 7 days (low to modest water age/stagnation)
CATEGORY B	Work generates moderate to high BWDS disruption or removal of any fixed BWDS components or assemblies with medium water age. Includes but not limited to: Plumbing work requiring multiple fixtures (existing, replacement or new) Major water system component replacement (boilers, heaters, water main, etc.) Work in wall cavities or ceilings with major disruption to local and downstream occupied areas Change of functional building space program (i.e. moving/changing room or dept. functions) in existing building Disaster event is generally localized within the building yet impacts wide range of building occupants. Water by fixture, component, or area is shut down ≤ 30 days (medium water age)
CATEGORY C	Major BWDS demolition, renovation, infrastructure, and/or new construction projects with high water age. Includes but not limited to: Change in functional building space program (i.e. series of rooms and departments) Catastrophic events (public health disaster, major weather events, or emergency conditions) Tenant improvements (i.e. existing buildings, or tenant space within unoccupied buildings) New shell and core buildings, additions, or expansions on campus (i.e. near existing built environments) New shell and core buildings, additions, or expansions off campus (i.e. future built environments) Acquisition of building with unknown water quality / safety conditions Infrastructure projects connecting to building water systems (i.e. underground piping, utility tunnels, etc.) Water by fixture or area is not active (new start-up) or was shut down > 30 days (high water age)

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DIAGRAM 3 Instructions: Identify the Building Occupant Risk Group (i.e., students, faculty, staff, visitors, volunteers, or guests, etc.) and affected departmental areas. If more than one building occupant risk group will be affected, select the higher risk group / area of exposure. Contact the organization's Safety and Risk Manager if any risk group needs further clarification for relationships to the BWDS scope of work. The WMP team will need to know of any water reservoirs or fixtures in designated areas and risk from aerosolized water exposure.

EXAMPLE ONLY: Building Occupant Risk Groups must be evaluated and classified by each organization prior to risk mitigation.

Low	Medium	High
Administration areas Classrooms Conference rooms Laboratory (Dry) Lobbies Office areas	Cafeteria areas Canteen/Nourishment Food Prep Areas Nutrition Stations Laboratory (Wet) Laboratory (High-Purity Water)	Areas near cooling tower drift Athletic facilities (student, faculty, coaches) Whirlpools/spas Pools / special exercise equipment Showers Childhood / Pediatric venues childhood development centers daycare centers pediatric or family venues Faculty/Guest overnight stay or lodging Manufacturing or special curriculum Agricultural High Tech Computer Chip Processing Mining Telescopic mirrors Public campus areas with decorative water features shallow pools or bodies of water Simulation/practicum education centers medical simulation centers nursing simulation centers Seasonal venues Athletic stadiums Athletic field house / arena Entertainment / theater / auditoriums Student dormitories Student health and well-being student infirmaries outpatient clinics disability resources

DIAGRAM 4 Instructions: Review, finalize, and implement the selected WQSRA Risk Mitigation Level (RML) determined as appropriate for the BWDS construction activities, scope of work, and building occupant risk group. Contact the the organization's Safety and Risk Manager for clarification on individual hazard controls defined for the project duration.

WQSRA RISK MITIGATION LEVELS *1	
RISK MITIGATION LEVEL	Instructions: Review, finalize, and implement the selected WQSRA Risk Mitigation Level (RML) determined as appropriate for the BWDS water disruptive event, scope of work, and building occupant risk group. Contact the organization's Water Management Program Team and Safety or Risk Manager for clarification on individual hazard controls defined for the project duration.
RML - 1	1) Establish enclosure to prevent aerosolized water (and potential pathogens) from dispersing into the environment. a) close door of area (i.e. designated room door, toilet/shower room door, etc.) b) install non-flammable visqueen or clear plastic sheeting or other approved vapor barrier for protection c) install isolation valve, backflow prevention device, or other piping isolation method 2) Prior to construction activities determine baseline measurements (i.e. temperature, residual disinfectant, pH, or other). 3) Flush fixture (hot) for a minimum 4 minutes; following flushing collect water temperature using digital thermometer; perform the same minimum 4 minute flush (cold) and collect water temperature; record both measurements. 4) Collect residual disinfectant measurements (free or total) using a digital colorimeter instrument and record measurement. 5) Perform repair or replacement of plumbing components (i.e. plumbing fixture, trim, or other).

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DIAGRAM 4 (Continued)

RML - 1 (continued)	<p>6) When water disruption activities are complete, and area is ready to return to service, flush the fixture for a minimum of 4 minutes hot, then 4 minutes cold. Take corresponding temperature and residual disinfectant measurements. Repeat steps until measurements are the same or better than pre-existing conditions.</p> <p>a) Temperature: Hot water range [113°F (45°C) to 120°F (48.9°C)] and Cold water range [≤ 77°F (25°C)].</p> <p>b) Residual disinfectant range: Hot water = 0.20 ppm to 4.0 ppm and Cold water range = 0.20 ppm to 4.0 ppm.</p> <p>7) Report any odor, discolored water, flecks or floating debris at baseline or at work completion; none should be present.</p> <p>8) Record information on organization's flushing form or in the project information system.</p> <p>9) Facility/Construction staff to:</p> <p>a) leave barriers in place until all BWDS plumbing work is complete including flushing activities</p> <p>b) thoroughly clean and dry area(s) upon completion of project work</p> <p>c) remove barriers or seals in place</p> <p>10) Environmental or construction cleaning services to perform routine cleaning before the area is occupied.</p>
RML-2	<p>Review and/or perform ALL of RLM-1 risk mitigations and adjust for scale of project and:</p> <p>11) Calculate water volumes for area of piping within building water distribution system under construction.</p> <p>12) Perform flushing protocol [____ min. per day/ ____ days per week] on [circle day(s)] M, T, W, TH, F @ ____ fixtures in <i>occupied</i> areas adjacent to the construction zone. Report on flushing form.</p> <p>13) Perform flushing protocol [____ min. per day/ ____ days per week] on [circle day(s)] M, T, W, TH, F @ ____ fixtures in <i>unoccupied</i> areas within or adjacent to the construction zone. Report on flushing form.</p> <p>14) Obtain residual disinfectant and temperature readings post flushing activities 1 day per week in unoccupied and occupied areas at ____% of designated fixture locations as representative sample of fixtures to maintain adequate temperature and residual oxidant levels. Report on fixture analysis form.</p> <p>15) Review any disinfection (i.e. hyperchlorination) procedures to be performed with the Owner's Representative including location(s), method, schedule, and date establishing public BWDS potable water usage. Provide any reports of disinfection activities involving building water main (i.e. point-of-entry), or BWDS for hot and cold water lines.</p> <p>16) If necessary, provide any temporary inline or point-of-use filtration for designated sinks, showers, or other fixtures or piping lines to reduce risk of exposure.</p> <p>17) If necessary, provide any temporary auto-flushing devices at fixtures (i.e. sinks or toilets) at distal locations to pull water through system; set timing devices for [____ min. per hour / ____ times per day / ____ days per week]</p> <p>18) Review installation for equipment with water reservoirs (i.e. ice machines or other) on the project and preventative maintenance prior to occupant start up.</p> <p>19) Review options and finalize decision to perform analytical laboratory sampling for water quality contaminants (e.g., metals, general bacteria, or pathogens of interest). Use the risk of building occupants, baseline sampling, historical BWDS performance, regulatory requirements, or records from water management program as consideration.</p>
RML- 3	<p>Consider using any RLM- 1 and 2 risk mitigation strategies and prepare a project specific WMP plan:</p> <p>20) Contact the Building Owner's Representative for preparing a water commissioning project analysis</p> <p>21) Conduct a project specific BWDS review of hazardous conditions associated with the water disruptive event.</p> <p>See Supplement S2: WQSRA Pre-Project Checklist.</p> <p>a) review site /civil construction or water disruption activity risk factors.</p> <p>b) review building design and construction or water disruption activity risk factors.</p> <p>22) Based upon the Pre-project checklist prepare a project specific WMP plan for the BWDS per ANSI/ASHRAE 188 risk management process for WMPs.</p> <p>a) establish a WMP plan with scheduled milestones starting from the date of water disruption through water activation and toward a first-day of building operations.</p> <p>b) implement/operationalize project specific controls (i.e. protocols for flushing, temperature, and residual disinfectant readings).</p> <p>c) confirm WMP plan & operations with verification and validation.</p> <p>23) Obtain Building Owner's Project Representative approval of the WMC plan, process, and documentation.</p> <p>24) Implement the agreed upon WMP Plan for commissioning water quality and safety.</p> <p>25) Obtain any authorities having jurisdiction (AHJs) and Building Owner's approval before initiating building occupant operations.</p>

Footnote*1 All mitigation measures (hazard controls) and associated numeric values (i.e., temperature, residual disinfectant, pH, or other) need to be reviewed, coordinated and implemented in context with the organization's on-going water management program.

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