



Developing a *Legionella* water management plan

Bureau of Environmental Health and Radiation Protection

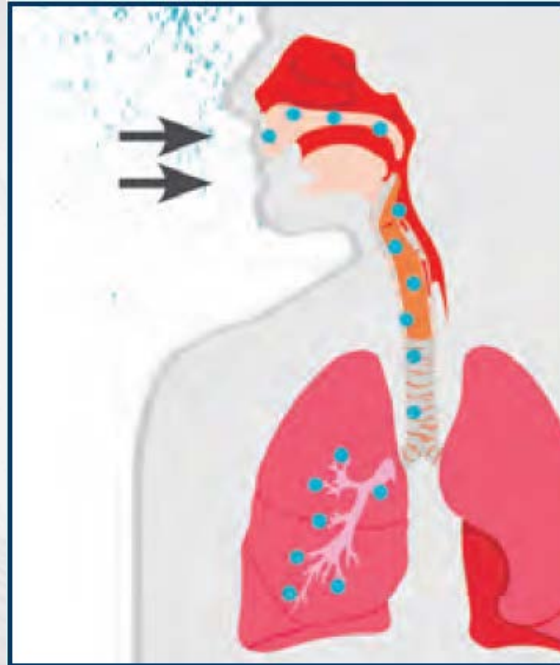
Bureau of Infectious Diseases

Legionella

- Legionnaires' disease is becoming an increasing concern in the United States and worldwide
- Legionnaires' disease is caused by the *Legionella* bacterium.
- *Legionella* is a naturally occurring bacterium that occurs in freshwater lakes and streams, however the quantities in natural water bodies are generally insufficient to cause disease

Legionnaires' Disease

- Infection is caused when contaminated water droplets are inhaled
- *Legionella* is dispersed through aerosolization.



Common sources of exposure



**Water used for showering
(potable water)**



**Cooling towers (parts of large
air conditioning systems)**



Decorative fountains

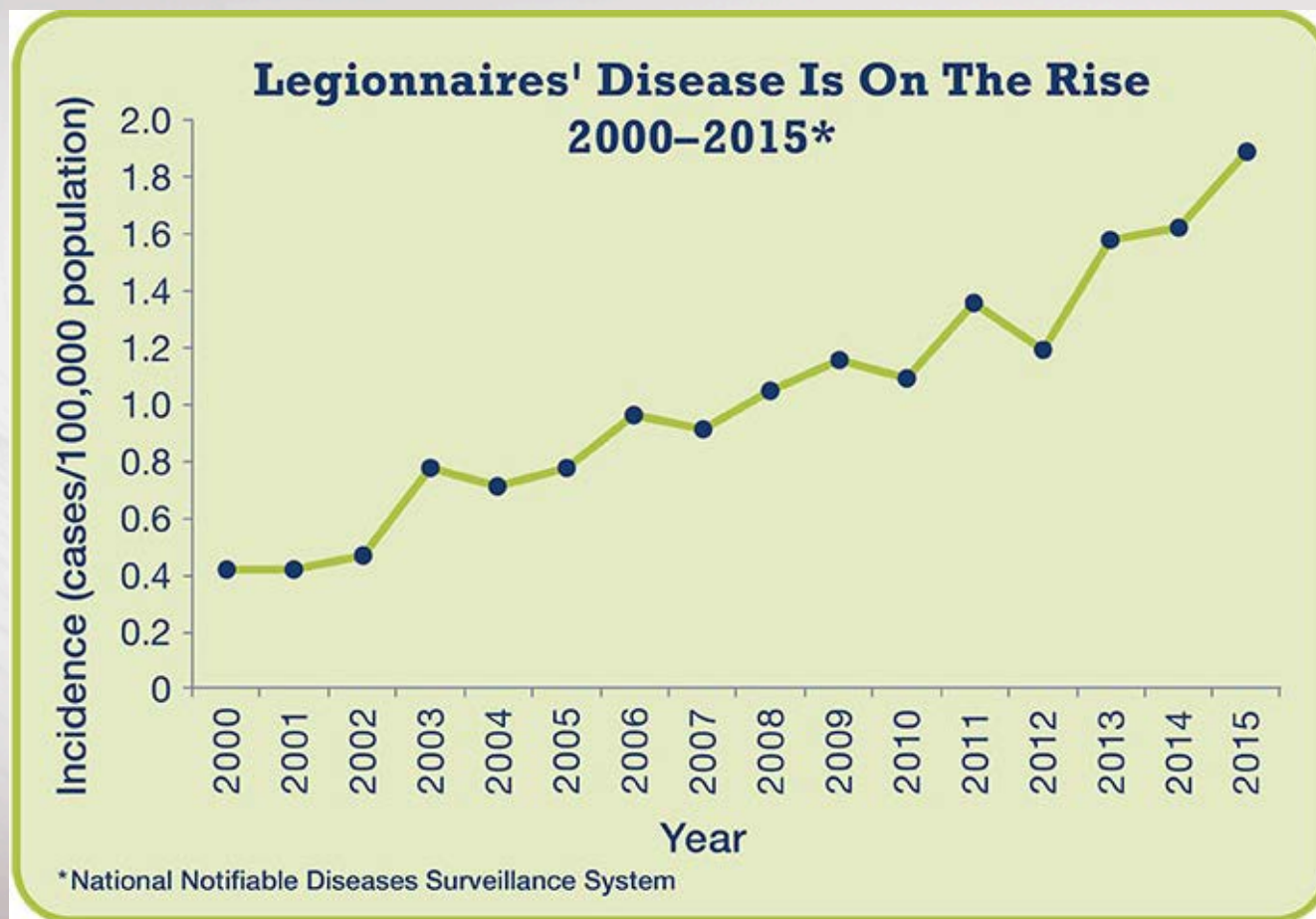


Hot tubs

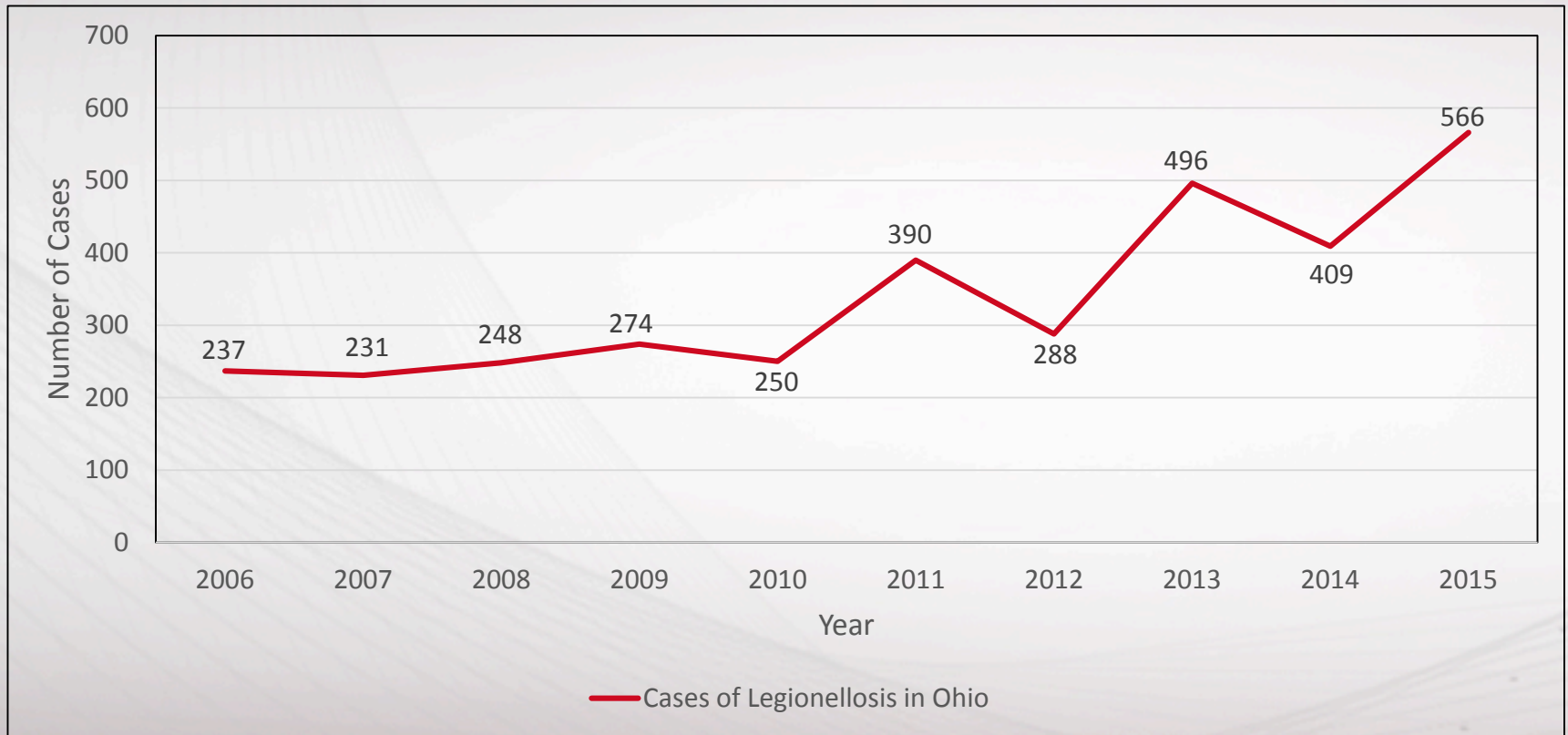
Legionella Growth

- Growth or amplification of *Legionella* can occur under different environments in water systems.
- Conditions that promote amplification:
 - Water stagnation
 - Warm temperatures (25 - 51° C [77° - 124° F])
 - Presence of scale and sediment
 - Presence of organic matter (biofilms)
 - Protozoa
 - Lack of residual disinfectant

Legionnaires' Disease in the US, 2000-2015



Cases of Legionellosis in Ohio



At-risk facilities

- Facilities housing sensitive populations such as hospitals and long-term care facilities
- Buildings with more than 10 stories
- Buildings with cooling towers
- Building with large, complex hot water distribution systems

CDC Investigation of Building –Associated Outbreaks

- The CDC recently identified that common settings for outbreaks include:
 - Hotels
 - Long-term care facilities
 - Hospitals



Garrison LE et al. *MMWR*. 2016;65(22):557–61.

Source: Soda, 2017.

CDC Vital Signs

The image shows the cover of the CDC Vital Signs June 2016 issue. The title 'Legionnaires' Disease' is prominently displayed in large white letters. Below it, a subtitle reads 'Use water management programs in buildings to help prevent outbreaks'. A central graphic features a human silhouette with a glowing chest area. To the left of the silhouette, a blue box contains statistics: '4x' (The number of people with Legionnaires' disease grew by nearly 4 times from 2000-2014), '1 in 10' (Legionnaires' disease is deadly for about 10% of people who get it), and '9 in 10' (CDC investigations show almost all outbreaks were caused by problems preventable with more effective water management). The bottom left corner includes the CDC logo and the text 'Centers for Disease Control and Prevention National Center for Immunization and Respiratory Diseases'. The bottom right corner has the text 'Want to learn more? www.cdc.gov/vitalsigns/legionnaires'.

JUNE 2016

CDC Vital signs™

Legionnaires' Disease

Use water management programs in buildings to help prevent outbreaks

CDC investigated the first outbreak of Legionnaires' disease, a serious lung infection (pneumonia), in 1976. An increasing number of people in the US are getting this disease, which is caused by breathing in water contaminated with *Legionella* germs. About 5,000 people are diagnosed with Legionnaires' disease and there are at least 20 outbreaks reported each year. Most identified outbreaks are in buildings with large water systems, such as hotels, long-term care facilities, and hospitals. *Legionella* grows best in building water systems that are not well maintained. Building owners and managers should adopt newly published standards that promote *Legionella* water management programs, which are plans to reduce the risk of this germ in building water systems.

Building owners and managers can:

- Learn about and follow newly published standards for *Legionella* water management programs. www.techstreet.com/ashrae/products/13337561
- Determine if the water systems in their buildings are at increased risk of growing and spreading *Legionella*.
- Develop and use a *Legionella* water management program as needed. www.cdc.gov/legionella/WMToolkit
- Monitor and respond to changes in water quality.

Want to learn more? www.cdc.gov/vitalsigns/legionnaires

4x
The number of people with Legionnaires' disease grew by nearly 4 times from 2000-2014.

1 in 10
Legionnaires' disease is deadly for about 10% of people who get it.

9 in 10
CDC investigations show almost all outbreaks were caused by problems preventable with more effective water management.

Centers for Disease Control and Prevention
National Center for Immunization and Respiratory Diseases

- Healthcare facilities often have large and complex water distribution system
- Serve sensitive populations

<https://www.cdc.gov/vitalsigns/pdf/2017-06-vitalsigns.pdf>

Legionella Prevention Actions

- Clinical
 - Proactive monitoring of cases
 - Reporting of Legionnaires' disease to local health districts
- Environmental
 - Includes facility assessments, water management plans, environmental controls and monitoring

Environmental Sources

- Common sources in buildings
 - Showers, faucets, ice machines
 - Cooling towers
 - HVAC (Heating, Ventilation, and Air-Conditioning) Systems
 - Hot tubs
 - Decorative fountains
 - Large, complicated cold and hot water systems

Development of Water Management Plans

- Also called Water Safety Plans
- Purpose
 - Prevention of *Legionella* growth
 - Remediation in case of outbreaks
- Means
 - Monitoring of system parameters
 - Remediation measures

Water Management Plans

- Components

1. Establish a water management program team
2. Describe the building water systems using text and flow diagrams
3. Identify areas where *Legionella* could grow and spread
4. Decide where control measures should be applied and how to monitor them
5. Establish ways to intervene when control limits are not met
6. Make sure the program is running as designed and is effective
7. Document and communicate all the activities

Water Management Plan or Water Safety Plan

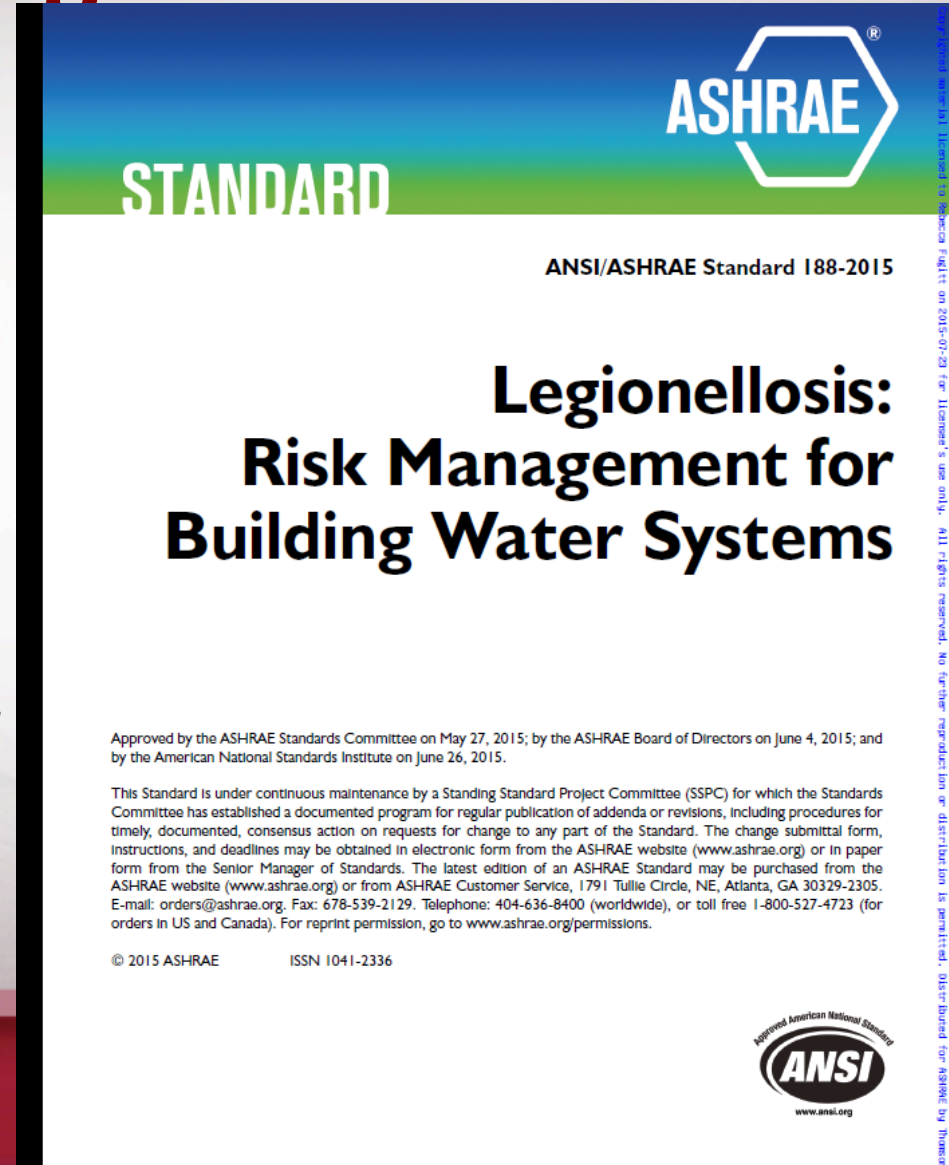
A plan to reduce the risk of growth and spread of *Legionella* in a building water system.

<https://www.cdc.gov/legionella/maintenance/wmp-toolkit.html>

Water Management Plans

Resources

ASHRAE (2015). Standard 188-2015, Legionellosis: Risk Management for Building Water Systems. *American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc., Atlanta, Ga.*



Water Management Plan

CDC (2016). Developing a Water Management Program to Reduce *Legionella* Growth & Spread in Buildings. *Centers for Disease Control and Prevention.*



Key Components

- Actively identify and manage hazardous conditions that support growth and spread of *Legionella*.
- Identify building water systems for which *Legionella* control measures are needed
- Assess how much risk the hazardous conditions in those water systems pose
- Apply control measures to reduce the hazardous conditions, whenever possible, to prevent *Legionella* growth and spread
- Make sure the program is running as designed and is effective

Components of a water management plan

- Identifying Buildings at Increased Risk
- Elements of a Water Management Program
- Establish a Water Management Program Team
- Describe Your Building Water Systems Using Text
- Describe Your Building Water Systems Using a Flow Diagram
- Identify Areas Where *Legionella* Could Grow & Spread
- Control Measures & Corrective Actions: The Basics
- Decide Where Control Measures Should Be Applied
- Decide How to Monitor Your Control Measures
- Establish Ways to Intervene When Control Limits Are Not Met
- Corrective Action Examples
- Contingency Response Examples
- Make Sure the Program Is Running as Designed & Is Effective
- Document & Communicate All the Activities of Your Water Management Program
- Special Considerations for Healthcare Facilities
- Elements of a Water Management Program

Identifying Buildings at Increased Risk

Survey your building (or property) to determine if you need a water management program to reduce the risk of *Legionella* growth and spread.

If you answer **YES to any of questions 1 through 4, you should have a water management program for *that building's* hot and cold water distribution system.**

Healthcare Facilities

- Yes ____ No ____ 1. Is your building a healthcare facility where patients stay overnight or does your building house or treat people who have chronic and acute medical problems[†] or weakened immune systems?
- Yes ____ No ____ 2. Does your building primarily house people older than 65 years (like a retirement home or assisted-living facility)?
- Yes ____ No ____ 3. Does your building have multiple housing units and a centralized hot water system (like a hotel or high-rise apartment complex)?
- Yes ____ No ____ 4. Does your building have more than 10 stories (including basement levels)?

Devices in buildings that can spread contaminated water droplets should have a water management program even if the building itself does not. If you answer **NO to all of question 1 through 4 but **YES** to any of questions 5 through 8, you should have a water management program for *that device*.**

- Yes ____ No ____ 5. Does your building have a cooling tower*?
- Yes ____ No ____ 6. Does your building have a hot tub (also known as a spa) that is not drained between each use?
- Yes ____ No ____ 7. Does your building have a decorative fountain?
- Yes ____ No ____ 8. Does your building have a centrally-installed mister, atomizer, air washer, or humidifier?

If you answer **NO to questions 1 through 8, you should still maintain water systems according to manufacturer recommendations.** On properties with multiple buildings, prioritize buildings that house or treat people who are at increased risk for Legionnaires' disease (see Appendix A to learn who is at increased risk).

Where can *Legionella* grow and/or spread?

Legionella can grow in many parts of building water systems that are continually wet, and certain devices can then spread contaminated water droplets. Examples include:

- Hot and cold water storage tanks
- Water heaters
- Water-hammer arrestors
- Expansion tanks
- Water filters
- Electronic and manual faucets*
- Aerators
- Faucet flow restrictors
- Showerheads* and hoses
- Pipes, valves, and fittings
- Centrally-installed misters*, atomizers*, air washers*, and humidifiers*
- Nonsteam aerosol-generating humidifiers*
- Infrequently used equipment, including eyewash stations*
- Ice machines*
- Hot tubs*
- Decorative fountains*
- Cooling towers*
- Medical devices* (such as CPAP machines, hydrotherapy equipment, bronchoscopes)

*These devices can spread *Legionella* through aerosols or aspiration

Factors that increase risk for growth

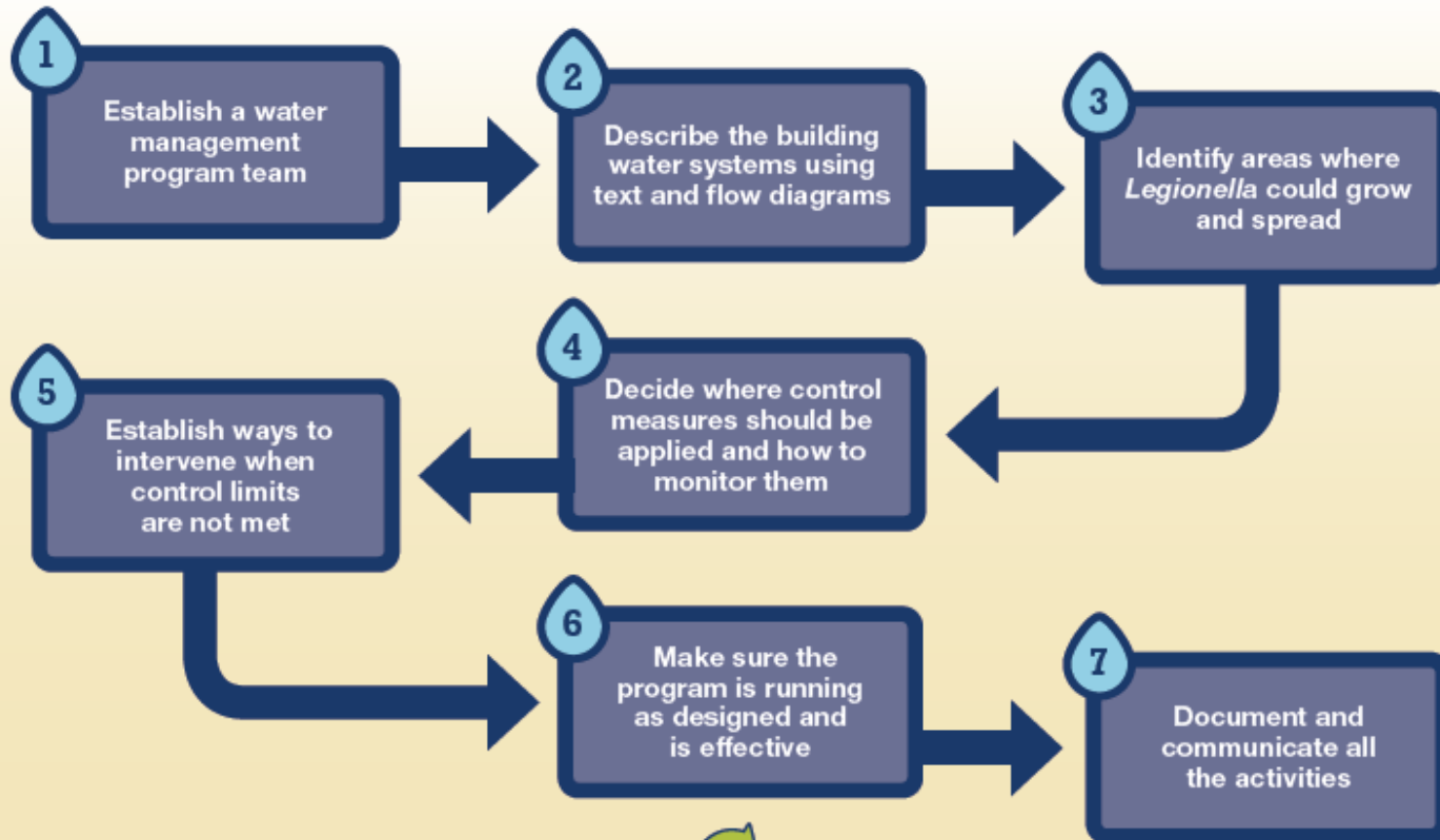
- **Construction:** Vibrations and changes in water pressure can dislodge biofilm and free *Legionella* into the water entering your building.
- **Water main breaks:** Changes in water pressure can dislodge biofilm and free *Legionella* into the water, while dirt and other materials can be introduced into the water and use up disinfectant
- **Changes in municipal water quality:** Changes in water quality can increase sediment, lower disinfectant levels, increase turbidity, or alter pH. Changes in disinfectant type can impact water monitoring.

Internal building factors that increase risk for growth

- Biofilm
- Scale and sediment
- Water temperature fluctuations
- Water pressure changes
- pH
- Inadequate disinfectant
- Water stagnation



Elements of a Water Management Program



Continuous program review (see below)

Program Review

Program Review

- Elements of the program should be **reviewed** at least once per year.
- The program should be reviewed and revised when any of the following events occur:
 - Data review shows control measures are persistently outside of control limits
 - A major maintenance or water service change occurs, such as:
 - New construction
 - Equipment changes (e.g., new hot tub chlorinator pump)
 - Changes in treatment products (e.g., disinfectants)
 - Changes in water usage (e.g., high and low season for hotel)
 - Changes in the municipal water supply
- One or more cases of disease are thought to be associated with the system(s)
- Changes occur in applicable laws, regulations, standards, or guidelines.

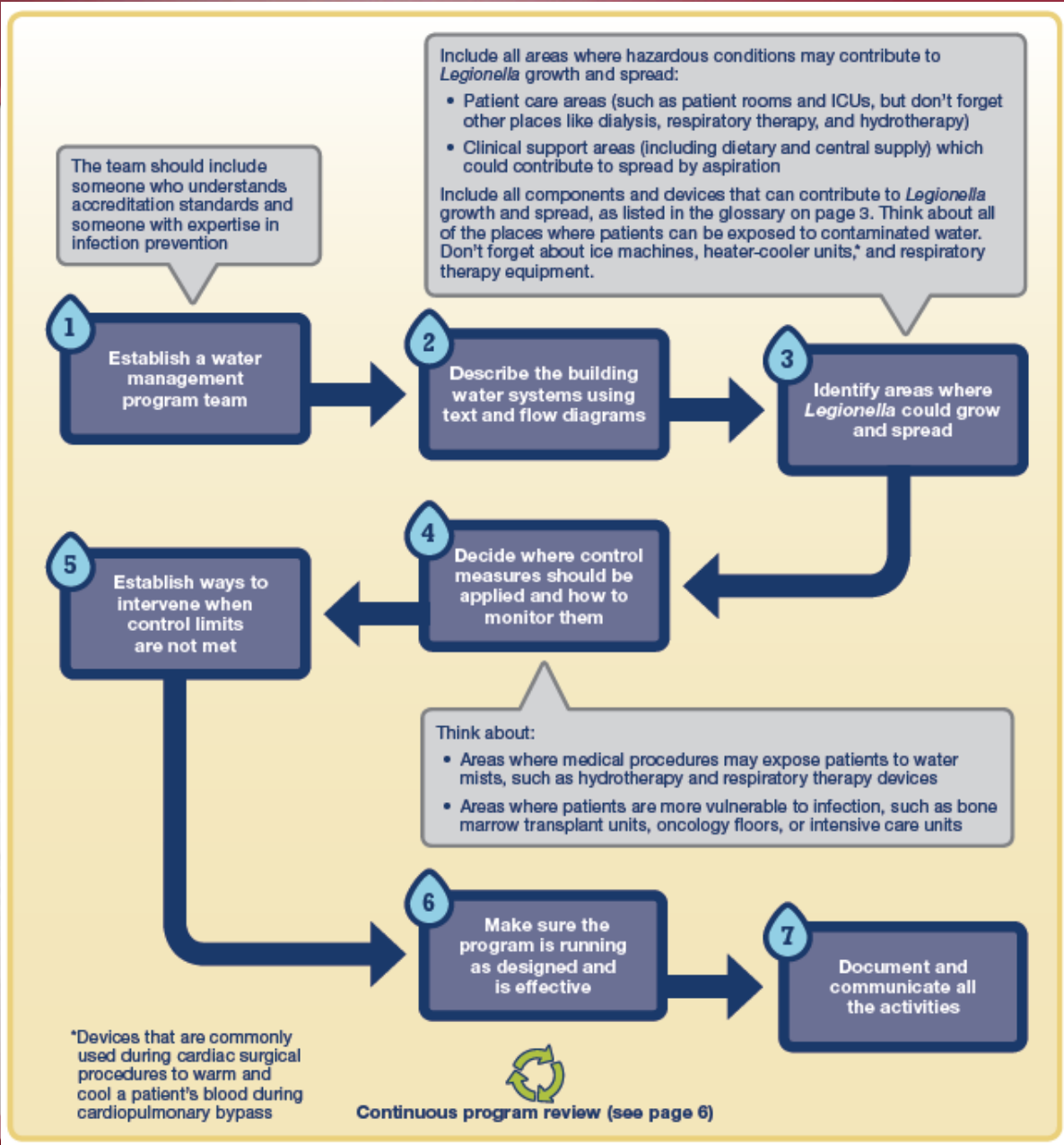
Reference: ASHRAE 188: *Legionellosis: Risk Management for Building Water Systems* June 26, 2015. ASHRAE: Atlanta. www.ashrae.org

Program Review

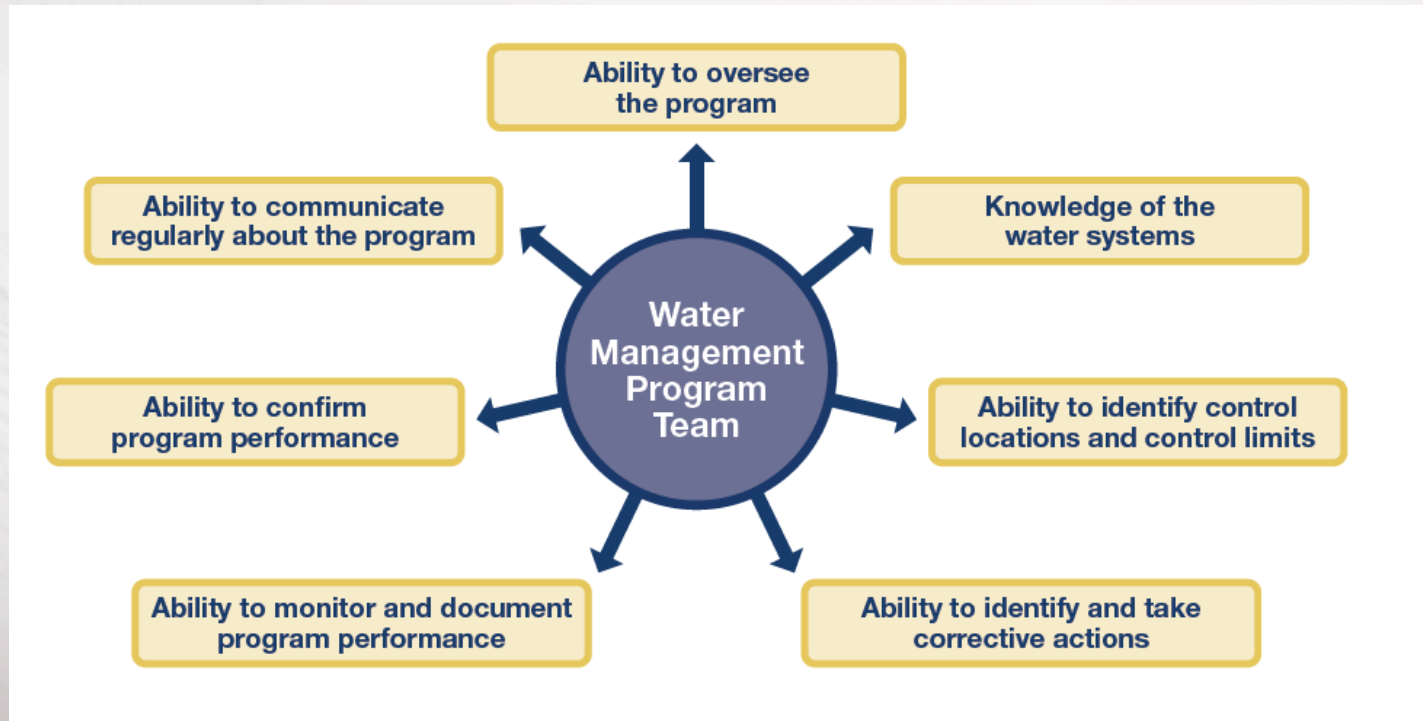
If an event triggers you to review and update your water management program, remember to:

- Update the process flow diagram, associated control points, control limits, and corrective actions
- Update the written description of your building water systems
- Train those responsible for implementing and monitoring the updated program

Water management plans for healthcare facilities



Establish a Water Management Program Team



Suggested Water Management Program Team Members

- Building owner
- Building manager/administrator
- Maintenance or engineering employees
- Safety officers
- Equipment or chemical suppliers
- Contractors/consultants
- Certified industrial hygienists
- Microbiologists
- Environmental health specialists
- State and local health officials

Healthcare Facilities

The team should also include:

- Someone who understands accreditation standards and licensing requirements
- Someone with expertise in infection prevention
- A clinician with expertise in infectious diseases
- Risk and quality management staff

Describe building water system using text

- Write a simple description of the building water system:
- This description should include details like where the building connects to the municipal water supply, how water is distributed, and
 1. Where water is connected to the municipal supply and enters the building
 2. How cold water is distributed
 3. How cold water is heated
 4. How hot water is distributed
 5. How hot, cold, and tempered waste water is discarded
 6. Where pools, hot tubs, cooling towers, and water heaters or boilers are located.
- An existing as-built diagram of the plumbing system and fixtures may be useful in developing this description.

Healthcare Facilities

Be sure to include descriptions of water sources relevant to:

- Patient care areas
- Clinical support areas
- Components and devices that can expose patients to contaminated water

You should also develop an ongoing dialogue with your drinking water provider so that you are aware of changes that may affect your building's water supply.

Example Text Description

1. **Water enters** the basement of the property via a 4-inch main from the municipal water line at Maple Street. Water is immediately drawn off to charge the fire suppression system. The rest of the water is sent through cold water distribution. There is backflow prevention throughout the system, including between the cold water distribution and the city water main and between the cold water distribution and the fire suppression system.
2. **Cold water is distributed** directly to the lit decorative fountain in the lobby, the cooling tower on the roof, the hot tub and pool on the first floor, ice machines on floors 2, 4, 6, 8, and 10, and shower and faucet fixtures in rooms on all 12 floors. All internal plumbing consists of 2-inch copper and polyvinyl chloride (PVC) piping. There is backflow prevention between cold water distribution and the utility lines that serve the cooling tower and hot tub/pool room.

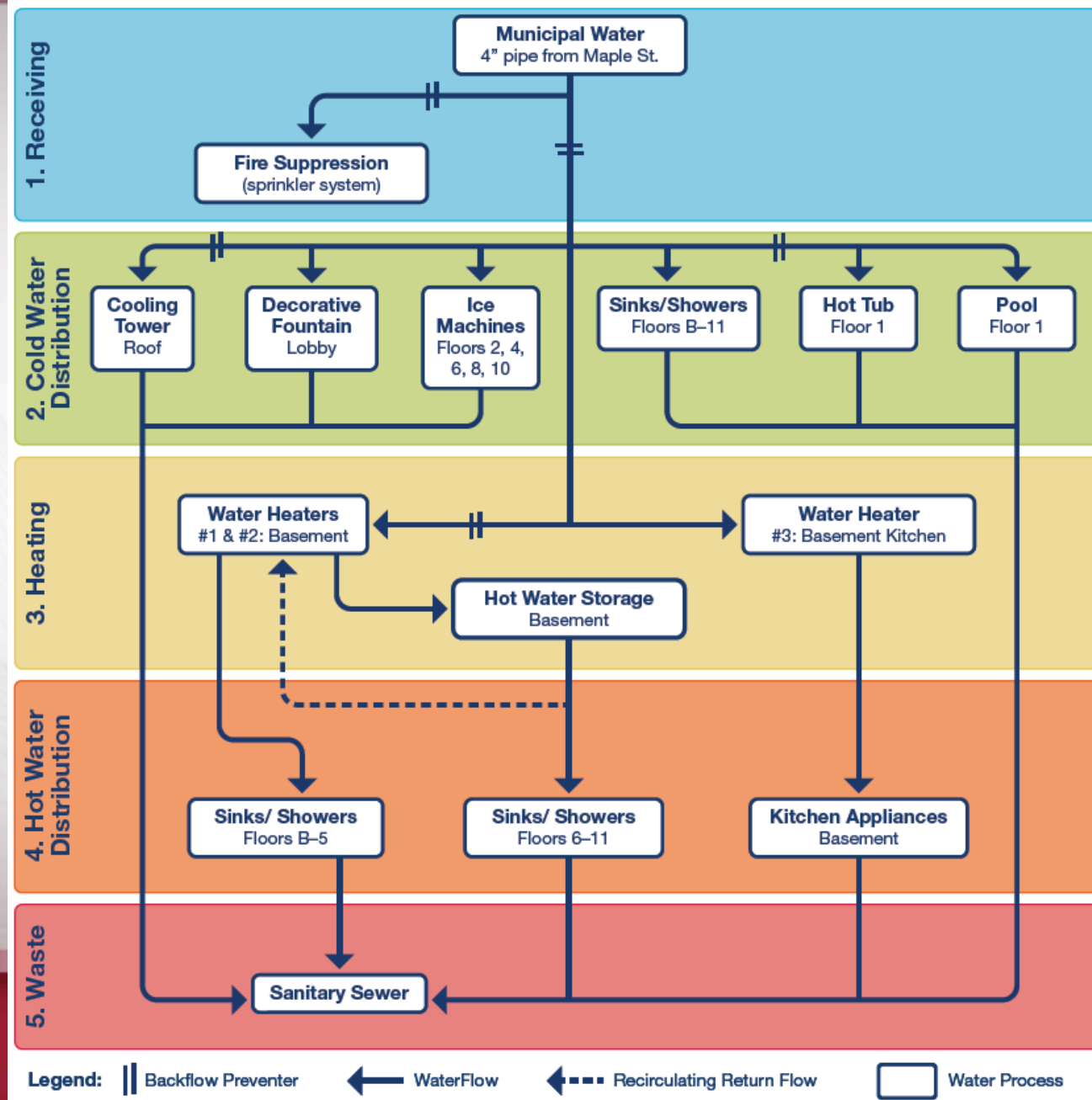
Example text

3. **Cold water is heated** to 140°F by two joined 120-gallon water heaters. The heaters supply a 500-gallon storage tank. Cold water is also delivered to an 80-gallon water heater in the basement that serves the kitchen and staff break room.
4. **Hot water is distributed** to plumbing fixtures in the basement through floor 5 from the joined water heaters in the basement on a direct (non-recirculating) line. Hot water is distributed to floors 6 through 11 from the storage tank with a recirculating line designed to return to the joined water heaters in the basement. Note that hot water is tempered (mixed with cold water) at the fixtures by thermostatic mixing valves.
5. **Hot, cold, and tempered waste water is discarded** through the sanitary sewer line.

Remember to identify if eyewash stations or janitor closets are present, if the building uses recycled or reused water, or rainwater, and the presence of solar water heaters.

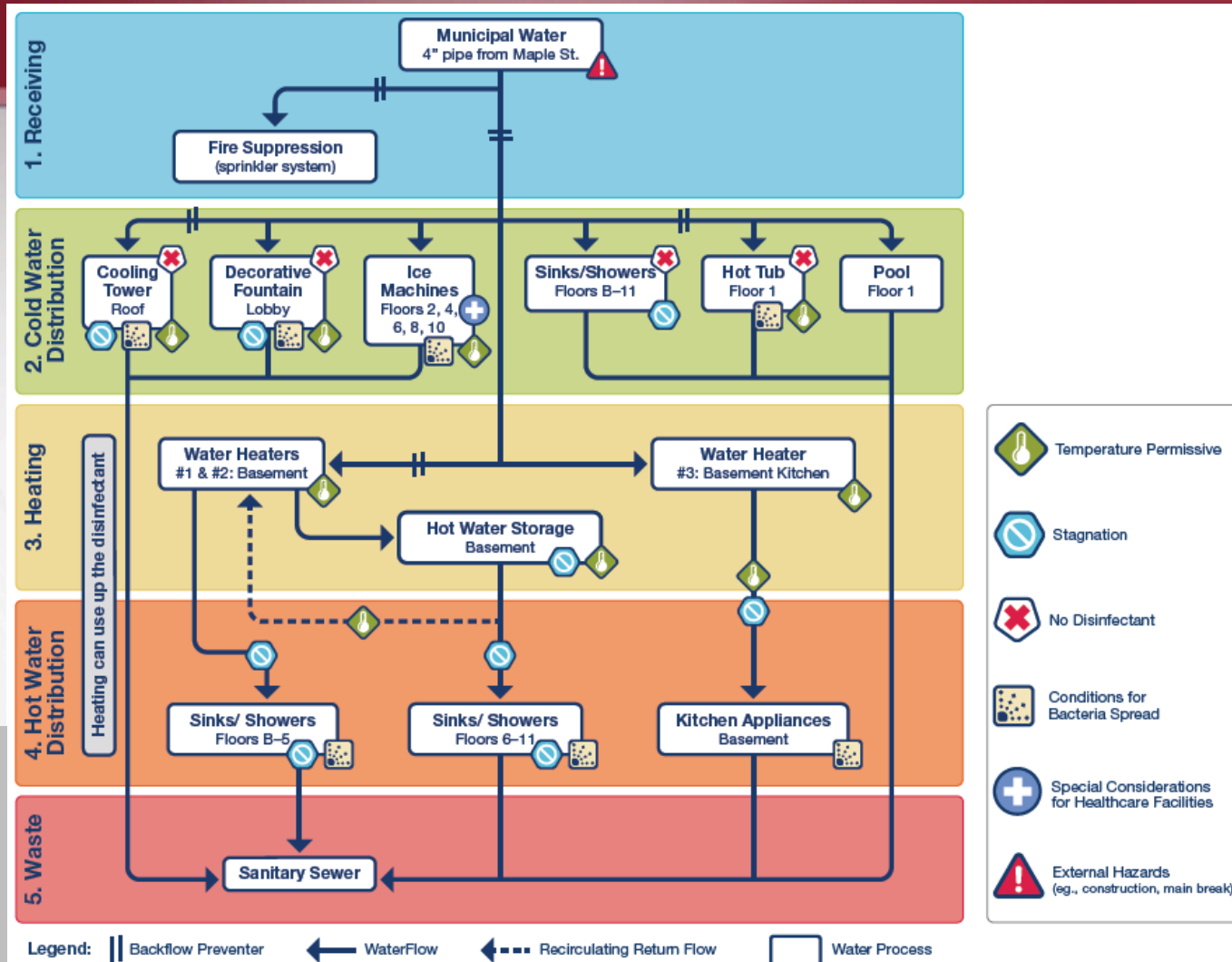
Describe the Building Water System Using a Flow Diagram

Develop a process flow diagram that is easy to understand.



Flow diagram example including identification of hazardous conditions that can promote legionella growth

Each potentially hazardous condition should be addressed individually with a control point, measure and limit



Healthcare Facilities

Think about:

- Areas where medical procedures may expose patients to water droplets, such as hydrotherapy
- Areas where patients are more vulnerable to infection, such as bone marrow transplant units, oncology floors, or intensive care units

In Building A, the ice machine is included to illustrate that patients with problems swallowing may be at increased risk for *Legionella* spread by aspiration.

Decision On Control Measures

- Control measures and limits should be established for each control point.
- Control measures need to be monitored to ensure control measures are performing as designed – i.e. regular log of temperatures and chlorine residuals.
- Control limits that include maintaining a chemical or physical, should include a minimum and a maximum value – i.e. temperature or chlorine

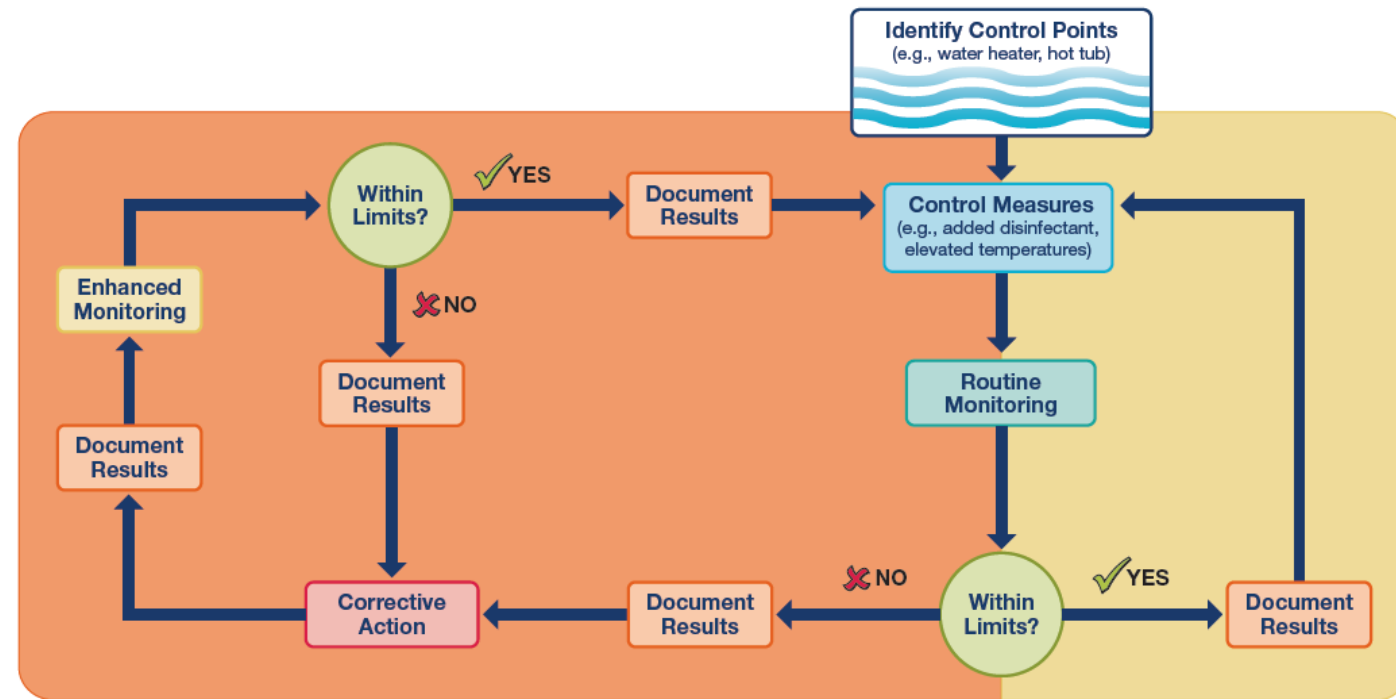
Decisions on Control Measures

- Examples of chemical and physical control measures and limits to reduce the risk of *Legionella* growth:
 - Water quality should be measured throughout the system to ensure that changes that may lead to *Legionella* growth (such as a drop in chlorine levels) are not occurring.
 - Water heaters should be maintained at appropriate temperatures.
 - Decorative fountains should be kept free of debris and visible biofilm.
 - Disinfectant and other chemical levels in cooling towers and hot tubs should be continuously maintained and regularly monitored. Surfaces with any visible biofilm (i.e., slime) should be cleaned.

Control measures & corrective actions

Example:

Predetermined
Acceptable
temperature,
or acceptable
disinfectant
level



Healthcare Facilities

In addition to the steps listed above that you would take in all buildings, if a case of healthcare-associated Legionnaires' disease is discovered in a healthcare facility:

- Make sure the person with expertise in infection prevention on your team is aware
- **Important:** Tell clinicians so they can test patients with healthcare-associated pneumonia for Legionnaires' disease with both culture of lower respiratory secretions and the *Legionella* urinary antigen test
- Report the case to your local and/or state health department; a full investigation may be needed

For more details on identifying and investigating Legionnaires' disease cases in healthcare facilities, see page 24.

Where to apply control measures

Healthcare Facilities

Clinicians should test patients with healthcare-associated pneumonia (pneumonia with onset ≥ 48 hours after admission) for Legionnaires' disease. This is especially important among patients at increased risk for developing Legionnaires' disease (see Appendix B), among patients with severe pneumonia (particularly those requiring intensive care), or if any of the following are identified in your facility:

- Other patients with healthcare-associated Legionnaires' disease diagnosed in the past 12 months
- Positive environmental tests for *Legionella* in the past 2 months
- Current changes in water quality that may lead to *Legionella* growth (such as low chlorine levels)

The preferred diagnostic tests for Legionnaires' disease are culture of lower respiratory secretions on selective media and the *Legionella* urinary antigen test.

Anti-scald Regulation

You should follow local and state anti-scald regulations. However, maximum temperatures allowed by your state may be too low to limit *Legionella* growth. Engineering controls that mix hot and cold water together at or near the point of use can reduce the risk of scalding while allowing water in pipes to remain hot enough to limit *Legionella* growth.

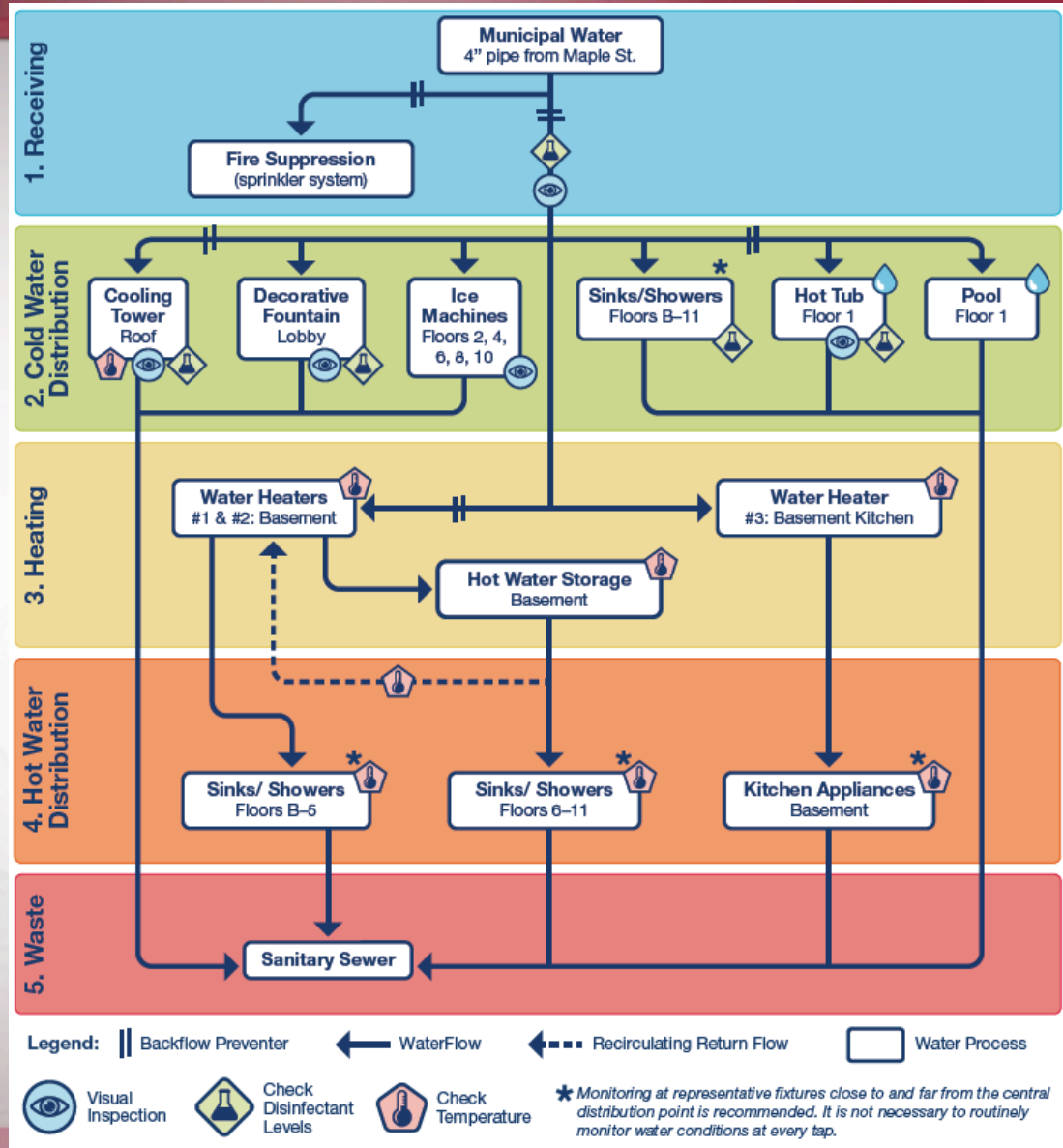


Other Considerations for Control Measures

- Additionally, certain commonly-encountered changes in building water system design or management might require increasing the extent and frequency of monitoring.
- Anticipate additional hazardous conditions that could be associated with scheduled or unanticipated changes in water quality, such as:
 - System start up
 - System shut down
 - Regularly scheduled maintenance
 - Renovations, construction, and installation of new equipment on your property
 - Equipment failure
 - Water main break or other service interruptions

Decide how to monitor control measures

- Follow all state/local regulations for plumbing and aquatic facilities (pools/hot tubs)



Establish Intervention Process When Control Measures are Not Met

- Building water systems are dynamic and change happens
- Monitoring results will vary over time
- Be prepared to take corrective actions in response to systems performing outside of control limits.

Corrective action examples

Scenario 1 – Biofilm in decorative fountain

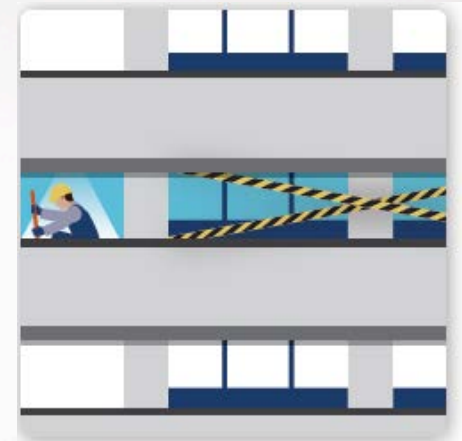
- Shut off, drain, and scrub fountain
- Refill the fountain and check the residual disinfectant levels
- Document observations and corrective actions



Corrective action examples

Scenario 2 – Unoccupied floor

- Flush unused hot and cold faucets daily
- Increase frequency of temperature and disinfectant residual measurement to daily
- Document method and duration of flushing and measurements taken



Corrective action examples

Scenario 3 – Debris in cooling tower, due to dislodged panel

- Replace the panel
- Skim out the debris
- Measure disinfectant levels and perform heterotrophic plate count
- Document actions and measurements



Contingency response

- Adjustment to the system when it is not functioning effectively or conditions change
- Be prepared to respond to unexpected problems, based on knowledge of building water system and how Legionella grows and spreads
- Response may require several steps
- Often requires follow up
- Always required when a case of Legionnaires' disease have been associated with the building

Contingency response examples

Scenario 1 – Multiple occasions of biofilm growth in fountain

- Identify the problem (in this example, the growth is around an incandescent lightbulb)
- Replace with LED bulbs that produce less heat
- Monitor to see if the action eliminates the need for interim cleaning
- Inspect routinely for 3 months for effectiveness
- Document and update the water management plan

Contingency response examples

Scenario 2 – Water main break

- Notify occupants to limit water use
- Flush water at multiple sites until the water meets acceptable parameters
- Measure disinfectant levels daily
- Document actions and measurements

Contingency response examples

Scenario 3 – Broken hot tub chlorinator

- Close the hot tub
- Call the pool contractor
- Contractor repairs or replaces the unit
- Document action
- Follow protocol to restart the hot tub

Evaluate your water management program

Verification: Are we doing what we said we would do?

- Program teams should establish procedures to confirm, both initially and on an on-going basis that the water management plan is being implemented as designed.

Validation: Is the program working?

- Procedures to confirm effectiveness of plan to confirm initially and on an on-going basis, that effective control of hazardous conditions throughout the building water system
- Environmental testing for *Legionella* can be useful to validate the effectiveness of control measures. The program team should determine if environmental testing for *Legionella* should be performed and, if so, how test results will be used to validate the program.

Validation: Is the program working?

- Factors that might make testing for *Legionella* more important include:
 - Having difficulty maintaining the building water systems within control limits
 - Having a prior history of Legionnaires' disease associated with the building water systems
 - Being a healthcare facility that provides inpatient services to people who are at increased risk for Legionnaires' disease (see Appendix B)
- If the program team decides to test for *Legionella*, then the testing protocol should be specified and documented in advance.
- Be familiar with and adhere to local and state regulations and accreditation standards for this testing.

Healthcare Facilities

Water management program teams that include infection control staff may also choose to use their facility's routine surveillance for healthcare-associated Legionnaires' disease to validate their program. To look for healthcare-associated cases, histories for all patients with diagnosed Legionnaires' disease should be reviewed for possible healthcare exposures and certain patients with healthcare-associated pneumonia (see gray box on page 13) should be tested for Legionnaires' disease.

CDC Resources for Environmental Testing

- CDC Sampling Procedure and Potential Sampling Sites
- Sample Data Sheet
- Environmental Investigation Videos
- Considerations when working with *Legionella* Consultants
- <https://www.cdc.gov/legionella/health-depts/inv-tools-cluster/environmental-inv-tools.html>

Documentation

Document the water management plan. The written program should include:

- Program team description including names, titles, contact information and roles.
- Building description – location, age, use, occupants
- Water system description – general summary and use, aerosol-generating devices, process flow diagrams
- Control measures including points in the system where critical limits can be monitored and where control can be applied
- Confirmatory procedures, including verification steps to show that the program is being followed as written and validation to show the program is effective
- Document collection and transport methods and labs that will be performing environmental testing – CDC sampling

Communication

- Communicate the presence of the plan to occupants
- Communicate regularly about the plan to employees
- Use communication as an opportunity to improve the plan and the water system

Contact Information

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