United States Environmental Protection Agency

Distribution System Water Quality

Protecting Water Quality Through Finished Water Storage Facility Inspection and Cleaning

Finished water storage facilities are used to provide water, equalize pressure under high water demand, and serve as emergency backup supply. Inspecting and cleaning finished water storage facilities helps to maintain water quality in the distribution system and identify repairs needed to maintain infrastructure integrity. Water quality in storage facilities can be affected by corrosion products, biofilms, sediments, and structural breaches that allow contaminant entry. This fact sheet is part of EPA's Distribution System Toolbox developed to summarize best management practices that public water systems (PWSs), particularly small systems, can use to maintain distribution system water quality and protect public health.

Examples of Utility Actions

A PWS serving 9,000 people in the western U.S. experienced a waterborne disease outbreak with more than 400 reported cases of illnesses (approximately 120 laboratory-confirmed) and one fatality. The outbreak was traced to *Salmonella typhimurium* from animal waste contamination in a finished water storage facility. The PWS issued a bottled water advisory, Do Not Use order, and boil water advisory, and then hyperchlorinated the storage facility and the rest of the distribution system prior to bringing them back into service.

A PWS serving 9,500 people in the northeastern U.S. traced coliform bacteria occurrence in the distribution system to two old finished water storage facilities. In response to the microbial threat, the PWS implemented a boil water order, inspected the water storage facilities, removed accumulated sediment, recoated the interior and exterior surfaces, repaired gaps in the roofs, and flushed and disinfected the distribution system. Following these actions, water quality was restored. Later, the outdated storage facilities were replaced with a modern prestressed concrete facility.

Water Quality Risk Factors in Finished Water Storage Facilities

- Storage facilities are susceptible to sanitary risks from nearby contaminant sources (e.g., ambient water, animals) when the integrity of barriers is compromised (e.g., gaps and cracks, open access hatches, broken vent screens).
- Opportunistic pathogens such as *Legionella* occur naturally in supply sources and can thrive in finished water storage facilities under certain conditions.
- Conditions inside storage facilities such as temperature, pH, and the presence of corrosion products, biofilms, and/or sediments can affect pathogen growth.
- High water age in a finished water storage facility can lead to reduced concentrations of disinfectant residuals, encouraging microbial growth, and can also lead to elevated concentrations of disinfection byproducts (DBPs).

Inspection and Sanitary Survey Practices

- Exterior inspections of storage facilities on a regular basis can identify signs of compromised site security, signs of vandalism or storm damage, signs of bird or animal entry, and issues affecting the facility's physical integrity.
- Interior inspections performed on a regular basis can be used to monitor the presence of corrosion products, biofilms, sediments, check the integrity of internal facility structures (e.g., mixers), and check the status of internal and external coatings.
- Due to safety and liability concerns, some PWSs conduct exterior inspections using drones or other machines equipped with cameras rather than requiring staff to climb tall ladders or enter confined spaces.
- Sanitary surveys[1] identify potential risk factors (e.g., contaminant sources, physical gaps in storage facility or components), and follow up on maintenance needs identified in the last inspection.

[1] Sanitary surveys are onsite assessments required by federal drinking water rules (40 CFR Parts 142.14-16, 141.401 and 141.723) and conducted by primacy agencies every 3 to 5 years.

Cleaning Practices

- Storage facility cleaning can include the following:
  - Removing sediment and corrosion products from the facility floor with hoses, shovels, pumps, brooms, and/or pressure washing.
  - Removing biofilm and other debris from facility walls by pressure washing and/or chemical agents.
- The optimal frequency and type of cleaning may vary depending on facility age and condition, inspection results, water quality, and operating conditions.
- Interior inspections and cleaning generally require removing the facility from service and draining. A facility could remain in service, and full of water, if inspection and cleaning are conducted by a diver or a remotely operated vehicle. Cleaning, in this case, may be limited to removal of loose sediment.

Return-to-Service Practices

- If a storage facility is taken out of operation for interior inspection and cleaning, it should be disinfected before it is returned to service.

Checking rooftop appurtenances during a sanitary survey

- Many states require sampling to verify disinfectant residual and the absence of coliform bacteria before a facility is returned to service.
- If coatings are applied to interior surfaces, sampling may be required to demonstrate that the coating is not leaching volatile organics into the finished water.

Table 1. Resources and Guidelines for Storage Facility Inspection and Cleaning

Resource Title and URL	Relevance to Storage Facility Inspection and Cleaning
ASDWA. 2020. Distribution System Survey White Paper https://www.asdwa.org/	Summarizes survey findings on topics that include current state requirements for storage facility inspection and cleaning.
USEPA. 2019. Sanitary Survey Field Reference: For Use When Conducting a Sanitary Survey of a Small Water System. EPA 816-R-17-002 at https://www.epa.gov/dwreginfo/sanitary-surveys.	Reviews common issues connected with the design and operation of finished water storage facilities that can contribute to water quality problems.
AWWA. 2017. M68 Manual of Water Supply Practices. Water Quality in Distribution Systems, 1st Edition. https://www.awwa.org/. Note: There may be a fee associated with obtaining this resource.	Explains how the integrity of storage facilities and related components affects water quality. Describes how inspection and cleaning practices can help maintain water quality.
AWWA. 2013. AWWA Manual M42 Steel Water Storage Tanks https://www.awwa.org/. Note: There may be a fee associated with obtaining this resource.	Describes maintenance practices for steel facilities and related appurtenances, coating systems, and cathodic protection systems. Describes how to inspect facilities during construction.
GLUMRB. 2018. Ten States Standards. https://www.mngovpublications.com/catalog/Default.asp?CatalogID=21656&Provider_ID=1241868 Note: There may be a fee associated with obtaining this resource.	Describes minimum requirements for facility design to accommodate cleaning and maintenance activities, and to provide safe access for inspections and maintenance.

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