Water Main Repair and Replacement and Physical Integrity of Finished Water Storage Facilities

TCR FACA

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This Meeting's Presentations

Objectives

Provisions

System compliance

Improvement

Research

Water Mains and Storage Research and Information Collection Needs

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Presentation Objectives

- Define the distribution system issues
- Explain why this topic is a concern that may warrant additional research / information collection
- Review the current state of information
- Describe decision-relevant research and information needs
- Identify linkages to related topics and cross-cutting issues

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Water Mains and Storage Facilities Act as Physical Barriers to Contamination

1. How often are these physical barriers breached?

2. What is the likelihood that waterborne pathogens will enter the water main or storage facility during a contamination event?

3. What is the likelihood that a contamination event at a water main or storage facility will affect public health and what is the possible severity of these public health effects?

4. How often are BMPs followed? Does implementation of BMPs need to be more effective?

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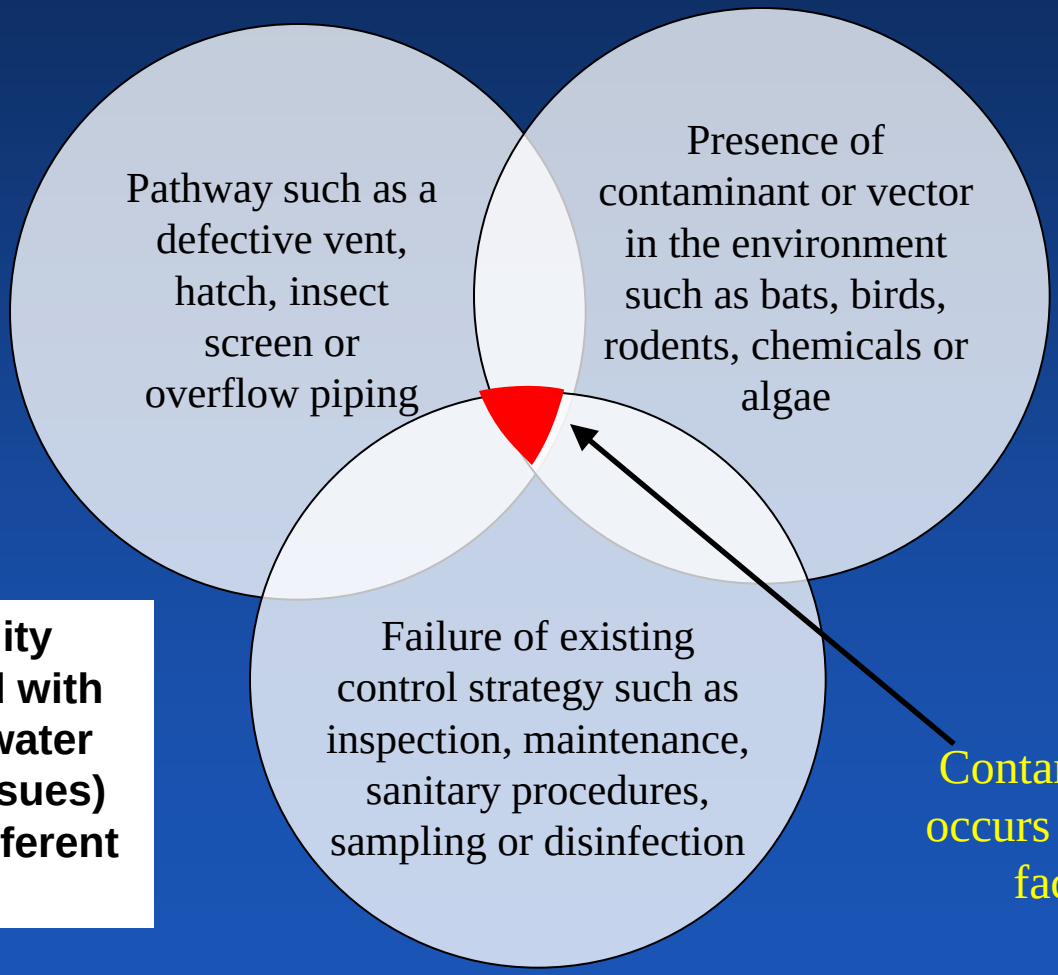
External Contamination of Finished Water Storage Facilities



Contamination only occurs when all three factors exist

Note: Water quality impacts associated with turnover, mixing, water age (i.e., internal issues) are addressed in different presentation

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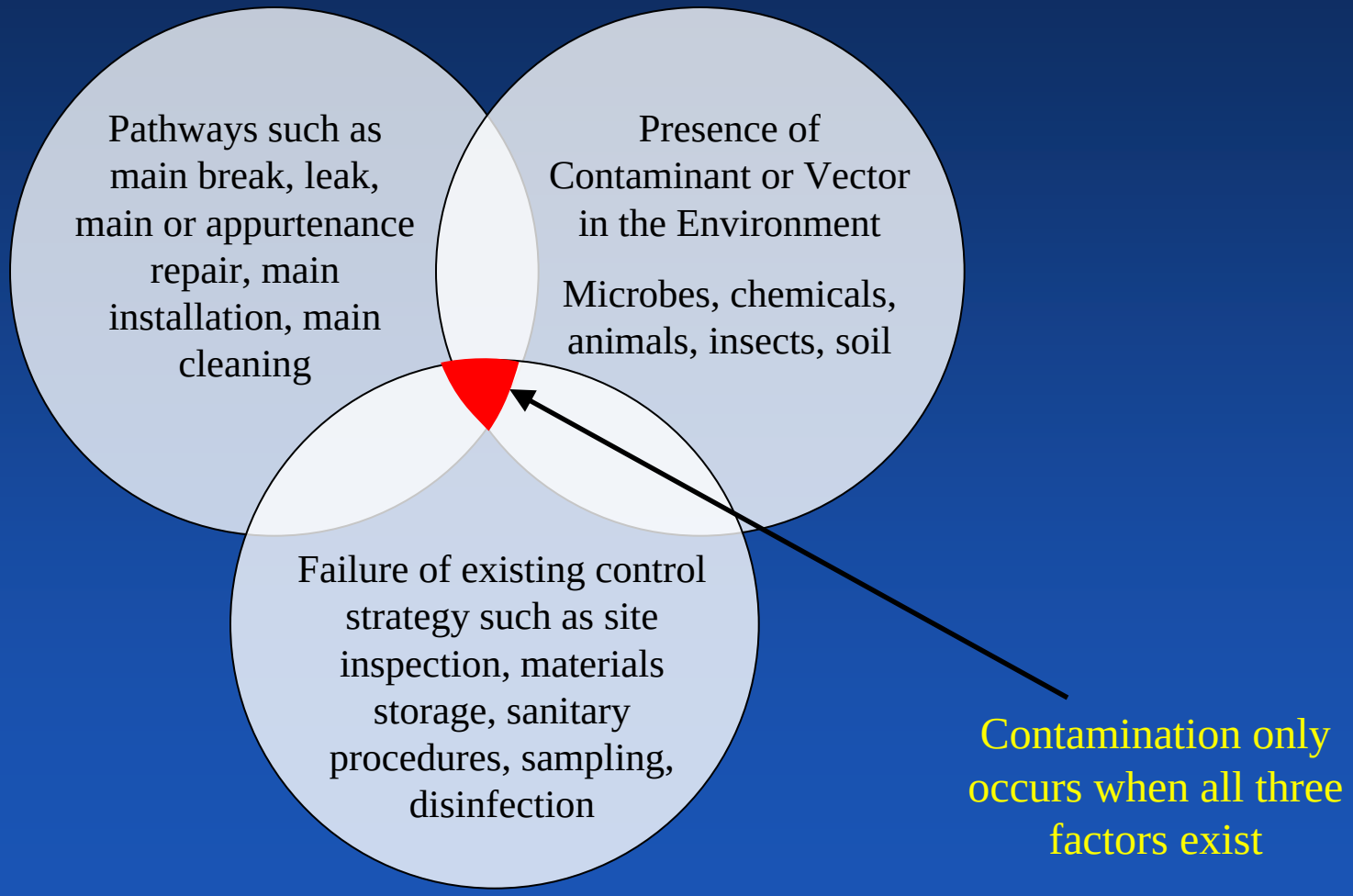
Contamination During Main Installation and Repair



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Reasons for Potential Public Health Concern

- There are more than 150,000 finished water storage facilities in the U.S.
- Several waterborne disease outbreaks have been linked to improper maintenance of storage tanks, water main repair and new main construction.

- Waterborne pathogens have been found in soil and groundwater at water main repair and construction sites (e.g. *Salmonella spp.*, *Campylobacter spp.*).
- Kirmeyer et al (1994) estimated from approx. 880,000 miles of pipe:

  * 237,600 main breaks

  * 13,200 miles new main

  * 4,400 miles main repaired

Water main breaks that can be repaired under pressure do not present the same level of risk as other water main events.

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Mitigation Strategies – State Requirements and Guidelines

- At least 30 States require utilities to follow industry standards regarding design and construction of storage tank vents, hatches, screens, etc.
- At least 13 States have requirements for tank inspection and maintenance.
- Several states require bacteria samples be coliform-free before a storage facility is returned to service after maintenance.
- The Ten State Standards recommends minimum separation distances between water mains and wastewater infrastructure.

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Mitigation Strategies – AWWA Standards Provide BMPs

- C600 – Installation of Ductile Iron Water Mains and Their Appurtenances
- C651 – Disinfecting Water Mains
- C652 – Disinfection of Water Storage Facilities
- D130 – Flexible Membrane Lining and Floating Cover Materials for Potable Water Storage
- G200 – Distribution System Operation and Management

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Other Mitigation Strategies

- Utility inspections of construction activities
- Training of utility personnel and contractors using AWWA publications, web casts and videos
- On-going improvement to BMPs using latest industry research findings and guidelines

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Implications for Different Systems

- Small / NCWSs may lack capacity and training, for example:
  - Small systems may rely on consultants/contractors to do all work on main repairs and installations, including inspections.
  - Small systems need to hire contractors to inspect and maintain storage facilities.
  - Small systems do not have the engineering or testing staff to closely oversee these needs.

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State of Current Knowledge: Finished Water Storage Facilities

- >150,000 storage facilities in U.S.
- Birds are known carriers of waterborne pathogens
- Contaminant pathways include insect screens, vents, roof hatch systems, holes
- Contamination is most often due to design defect or deterioration of materials
- Based on survey data collected in response to Gideon outbreak (Missouri 1991-1994):
  - 25% to >50% had evidence of contamination
  - 85% had some type of sanitary defect
  - 50% of tanks had a serious sanitary defect
  - 30 – 40% had minor sanitary defects

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State of Current Knowledge: New and Repaired Mains

- Number of events has been estimated by several researchers.
- Waterborne pathogens have been found in soil and groundwater at water main repair and construction sites (e.g. *Salmonella spp., Campylobacter spp.*).
- Research has documented a low level of contamination that occurs with new main installation and repairs.
- While standards exist for inspection and sanitary practices, these are not adhered to 100% of the time. National survey data on effective use of control strategies:
  - 30-35% inspectors trained on AWWA standards and utility specifications
  - 70-75% use disinfection BMPs
  - 20% maintain water quality data for new/repaired mains

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Research/Info Gaps for Storage Facilities	Exposure / Vulnerability	Health Effect / Risk	Mitigation Strategy
Analytical framework to determine the potential occurrence of contamination.	++ 1-5 yrs		
Design and operation and maintenance characteristics that lead to introduction, growth and retention of waterborne pathogens	++ 1-5 yrs		
National characterization of waterborne pathogens and vectors that can occur at finished water storage facilities.	+++ 1-5 yrs		
Relationship between indicators and microbial contaminants in storage facilities.	++++ 5-10 yrs		
National characterization of barriers to implementation of BMPs including tank inspection and maintenance			+++ 1-5 yrs
National characterization of occurrence of deficiencies in storage facilities.	++++ 1-5 yrs		
Public health records that determine endemic rates or national risk associated with tank contamination.		++++ 5-10 yrs	
National characterization of use and effectiveness of best management practices to mitigate contaminants of concern.			+++ 1-5 yrs

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Research/Info Gaps for Water Main Repair and New Main Installation	Exposure / Vulnerability	Health Effect / Risk	Mitigation Strategy
Analytical framework to determine the potential occurrence of contamination.	++ 1-5 yrs		
Design and operation and maintenance characteristics that lead to introduction, growth and retention of waterborne pathogens and chemicals	++ 1-5 yrs		
National characterization of waterborne pathogens and chemicals that can be found at water main repair and new construction sites.	+++ 1-5 yrs		
Relationship between indicators and contaminants in water main repairs and installation.	++++ 5-10 yrs		
National characterization of barriers to implementation of BMPs in repair and installation.			+++ 1-5 yrs
National characterization of number and types of main breaks, repairs and new installations	++ 1-5 yrs		
National characterization of use and effectiveness of best management practices.			+++ 1-5 yrs

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Summary of Research Gaps

- Why are answers to research gaps critical?
  - Breaches in physical integrity allow pathways for external contaminants into the water distribution system and can potentially affect public health. Closing these research gaps will help characterize on a national level the severity and expected frequency of external contamination, and will help improve control measures to minimize these risks.
  - Research findings will support the SDWA process to determine if Federal regulation is appropriate.

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Cross-Cutting Issues

- Research needs and information needs address multiple issues such as state of infrastructure, and the potential severity and likelihood of public health risks.
- There is a link to the deteriorating infrastructure issue: deteriorated mains have higher frequency of breaks and repairs; deteriorating storage facilities are more susceptible to contamination.
- Main breaks can cause loss of pressure and/or pressure transients, which may lead to intrusion or backflow.
- Main breaks can cause sudden changes in flow, which can entrain scales, sediments, biofilm, etc.
- Storage facilities and new mains have been linked to permeation and leaching of chemical contaminants.
- Corrosion control benefits the reduction of water main breaks and repairs.
- Storage tanks have been linked to water age management, nitrification and biofilm issues.
- Is the stored water's disinfectant residual adequate to control contaminants that enter the tank?

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