

A Perspective From State Drinking Water Programs

Drinking Water Distribution Systems Risks

**Total Coliform Rule / Distribution System Stakeholder
Technical Workshop - January 30 – February 1, 2007**

Distribution System Coliforms

- Where do they come from?
 - ◆ Inadequately treated water
 - ★ Treatment deficiencies
 - ★ Poor performance
 - ◆ System breaches
 - ★ Main breaks
 - ★ Construction and service activity
 - ★ Cross-connections
 - ★ Pressure transients
 - ◆ Internal plumbing problems
 - ◆ Biofilm

Industry Reported Distribution System Issues

- 44% Taste & Odor
- 43% Color & Turbidity
- 5% High HPC Bacteria
- 5% Other
 - ◆ Disinfection Byproducts
 - ◆ Coliform Bacteria
 - ◆ Corrosion
- 3% Loss of Disinfectant Residual

Source *AWWA MainStream* - March 2000
Survey of 160 US & Canadian Utilities

Distribution System Characteristics

- May be a simple or complex network of pipes
- Overall length can vary from several hundred feet to thousands of miles
- Numerous appurtenances e.g., valves, hydrants and service connections
- One mile of 12-inch diameter water main has an internal surface area of 16,588 ft²
- High surface area provides an ideal substrate for chemical and microbial activity

Contaminants of Concern

- Microbial pathogens
 - ◆ Bacteria, viruses, parasites
- Coliform and HPC bacteria
- Chemicals
 - ◆ Naturally occurring
 - ◆ Man-made
 - ◆ Corrosion byproducts
 - ◆ Disinfection byproducts

Risks - EPA White Papers

- Cross Connections (10/18)
- Microbial Growth & Biofilms (9/18)
- New or Repaired Water Mains (8/18)
- Finished Water Storage Facilities (7/18)
- Deteriorating Buried Infrastructure (7/18)
- Nitrification (7/18)
- Permeation & Leaching (5/18)
- Distribution System Transients and Intrusion (3/18)
- Effects of Water Age (3/18)

Risks – State Perspective

- Jurisdictional Issues
- System Integrity
 - ◆ Operation & Maintenance
 - ◆ Aging Infrastructure
- Biofilms
- Best Management Practices
- Cross Connections

Jurisdictional Issues

- Variety of Public Water Systems
- Jurisdictional Boundaries
- Sub-metered Facilities

Public Water Systems (PWS)

- Have 15 service connections AND/OR
- Serve at least 25 people for 60 days

Public Water Systems
PWS
945 Systems
in Utah

Community
(COM)
454 Systems
in Utah

Non-Transient
Non-Community
(NTNC)
61 Systems in Utah

Non-Community
(NC)
430 Systems
in Utah

Variety of Public Water Systems (PWS)

- Community
 - ◆ residential, year round, long term exposure
 - ◆ municipal, districts
- Non-Transient Non-Community
 - ◆ serves the same people for at least 6 months
 - ◆ industry, rural schools
- Non-Community
 - ◆ serves different people
 - ◆ campgrounds, highway rest stops

Jurisdictional Boundaries

- PWS Construction Standards
- Plumbing Codes
- Fire Codes
- No man's land (3 feet outside of structure)
- Changes or Installations made after inspections

Sub-metered Facilities

- Industrial complexes
- Condo complexes
- Trailer parks
- POU/POE treatment devices
- High rise buildings
- Water vending machines

System Integrity

- Leaks and main breaks
- New construction and repairs
- Water storage facilities
- Deteriorating buried infrastructure
- Poorly protected or constructed facilities
- Control of Contractors

Aging and Deteriorating Infrastructure

6-in. Unlined
Cast-iron
Pipe Circa
1913



Poor Protection & Construction

Mobile Home Park - water line passing through collapsed cesspool



Water Quality Deterioration

- Microbial growth & biofilm
- Loss of disinfectant residual
- Internal corrosion
- Particulate matter & discoloration
- Objectionable tastes and odors
- Nitrification (in chloraminated systems)

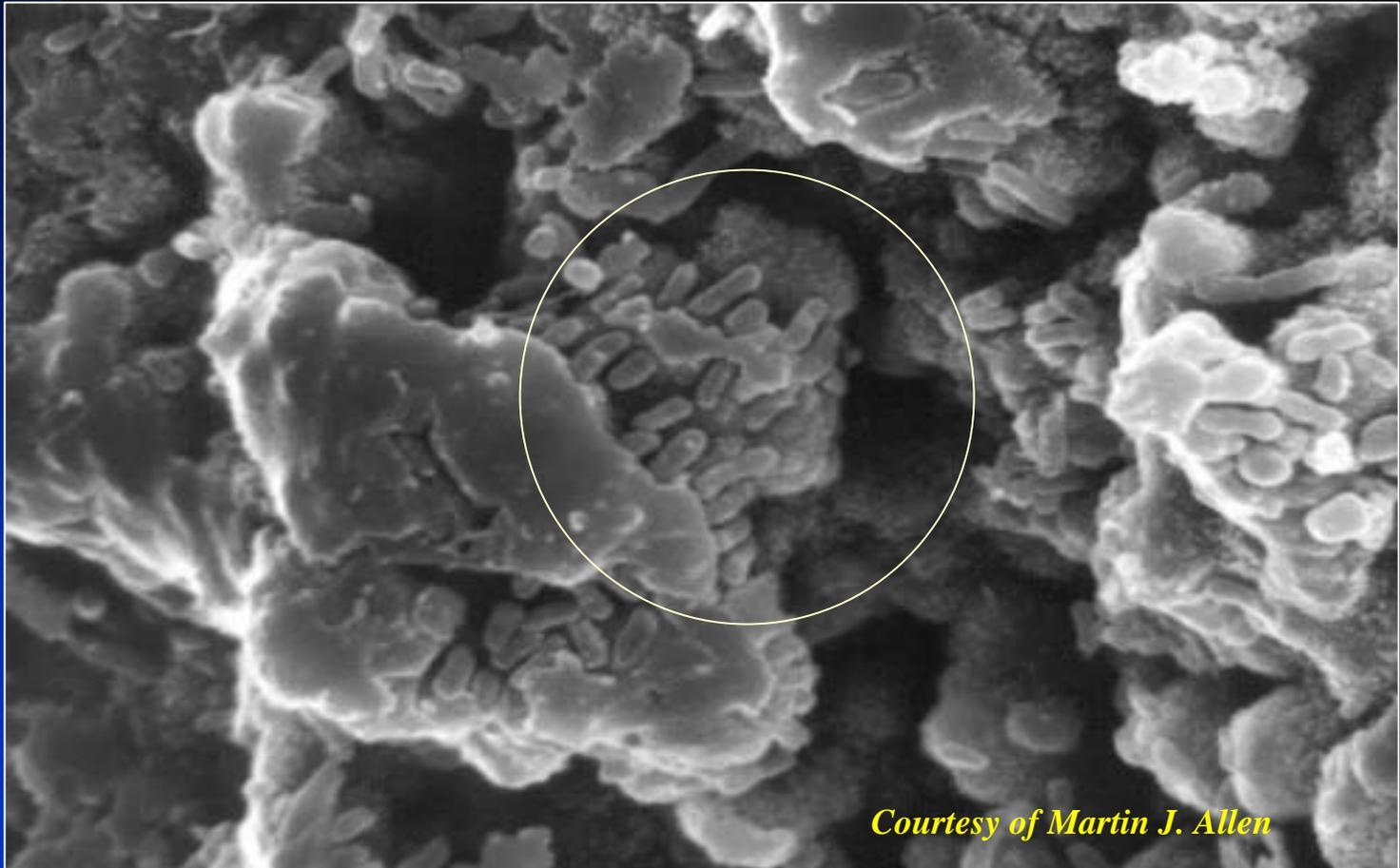
Distribution System Biofilms

- Attached bacteria
 - ◆ Pipe wall
 - ◆ Sediments
 - ◆ Tuberculations
- Attached cells are protected from disinfection
- Present to some degree in all distribution systems
- Total Coliform Rule compliance issues

Biofilm Factors

- Favored environment
 - ◆ Tuberculated cast-iron pipe
 - ◆ Sediments & particulate matter
- High disinfectant demand at pipe wall
- Long detention times
 - ◆ Low turnover in storage tanks
 - ◆ Dead ends
- Excessive nutrient levels (biodegradable organic carbon)
- Lack of system maintenance
- Inadequate corrosion control

Biofilm Bacteria On Tubercle Surface 4000X



Courtesy of Martin J. Allen

Distribution System Best Management Practices

- Maintain residual disinfectant throughout the entire system
- Maintain positive pressure, eliminate transients
- Routine flushing
- Corrosion control
- Maintain storage tanks
- Rehabilitate or replace old pipe
- Leak detection program
- Minimize detention time

Distribution Flushing



- 1. Boosts disinfectant residuals**
- 2. Eliminates sediment**
- 3. Increases circulation**
- 4. Aids in the removal of microbes**

Rehabilitation Cement Lining Old Cast-iron Pipe



Storage Tank Maintenance



- Proactive inspection and cleaning
 - ◆ Remove sediment
 - ◆ Check integrity of internal coating
 - ◆ Look for signs of corrosion
 - ◆ Repair broken or damaged parts



Contractors can trash a Distribution system



Cross Connection Control

- All States recognize the public health risks of cross connections and backflow
 - ◆ Every connection poses a risk
 - ◆ Contaminant can be anything
 - ◆ Transitory connections (garden hoses)
 - ◆ Not generally detected in Routine monitoring
 - ◆ Chlorine residual may or may not offer protection

State Program Survey Results

Program Elements

- Majority of States require: Authority to implement, Inventory records, some types of Record keeping and Backflow Assemblies (listing/approval)
- A third require Hazard assessment surveys

State Variability

- Varying levels of Program requirements
- Varying levels of Enforcement of requirements
- Location of State Drinking Water Program in State Governmental Structure
- “Complex state and local interaction upon which existing state programs depend. Federal involvement could disrupt the program that is working well and protecting the public”
- “One state’s attempt at a cross connection control program was watered down by the legislature and did not provide what the state drinking water program intended.”

Common Cross Connections



Garden Hose Incident

- Initial samples showed results above the MCLs and Health Advisory levels
 - ◆ 2,4 D 638 ppm & Dicamba 64.8 ppm
 - ◆ 2,4 D 1 day HA 1 ppm, 10 day 0.3 ppm, MCL .07 ppm
 - ◆ Dicamba 1 & 10 day HA 0.3 ppm
- Area of system affected contains residential, rentals, daycare, & nursing home facility

Internal Plumbing Incident

- Call Received
 - ◆ Rotten egg smell to the water
 - ◆ Burns slightly as you swallow
- Facility is a major regional children's hospital
- Facility's HVAC system uses sulfuric acid
- Facility is only 6 months old

Occurrence Data

- Water System Survey Results
- Total Number of Hazard Assessment Surveys - 213,158
- Total Number of Cross Connections found - 90,171
- 42% of all surveys conducted find a cross connection (cross connections found / number of hazard assessment surveys)

Other Risks

- Pressure transients
 - ◆ Presentation by Mark LeChevallier, Wednesday 10:15 am
- Permeation and Leaching
 - ◆ Not considered a priority at this time by most State Administrators

Large System vs Small System Issues

- Cost
- Volunteer vs Full time operator

Distribution System Risk Reduction

- Good quality source water
- Effective treatment
- Water quality monitoring
- Cross-connection control
- Attending to aging infrastructure
- Approved materials & construction techniques
- Proactive distribution system maintenance

State Perspective on Regulation Development

- 1. Early state input and participation in the development process.**
- 2. Recognize state and water system costs.**
- 3. Clear and well articulated rule proposal and request for comments.**
- 4. Adequate state primacy and water system compliance timeframe.**

State Perspective on Regulation Development

5. Consider during rule development the impact on implementation of :
 - a. Analytical methods
 - b. Laboratory capacity
 - c. Data management
 - d. Guidance and training

Derived from the Guiding Principles for Rule Development (2002)