

# Importance of a Chlorine Residual: Entry Point to Faucet

AWWA PA Section Southeast District **March 2018**



**PHILADELPHIA**  
**WATER**  
— DEPARTMENT —



# PHILADELPHIA WATER

— DEPARTMENT —



## Overview

- 1. Review of PA's New Disinfection Requirements Rule (DRR)**
  - PWD
- 2. What a Chlorine Residual Can & Can Not Do In Premise Plumbing**
  - ESPRI – The Environmental Science, Policy and Research Institute

# DRR – Where did we begin?

## Entry Point Requirements

- **May 2014, PADEP’s Pre-draft “Revised Total Coliform (RTCR) & General Updates”, for the entry point disinfectant residual, proposed:**
  - water systems using free chlorine: *0.50 mg/L*
  - water systems using chloramines: *1.00 mg/L*

# DRR – Where did we begin?

## Distribution System Requirements

- **May 2014, PADEP’s Pre-draft “RTCR & General Updates”, for the distribution system disinfectant residual, proposed:**
  - water systems using free chlorine: *0.30 mg/L*
  - water systems using chloramines: *1.00 mg/L*
  - HPC < 500 counts/mL would not achieve compliance for locations below the requirements

Failure to maintain the above, 100% of the time, would trigger 1-hour notification to PADEP and require Tier 2 public notice (notify public about this within 30 days)

# DRR – Regulatory Review Timeline

- **RTCR was split from “non-RTCR” provisions on April 21, 2015**
  - RTCR
  - Disinfection Requirements Rule
  - Safe Drinking Water General Update
- **Proposed DRR published in PA Bulletin on February 20, 2016**
- **Proposed DRR public comment period closed on April 19, 2016**
- ***PADEP must submit a final-form version of DRR within two (2) years of the close of the public comment period to IRRC, Standing Committees and public commentators (i.e., by April 19, 2018)***
- **PADEP submitted the final-form on January 22, 2018**
- **IRRC unanimously approved the final DRR on February 22, 2018**
- **Expect the DRR to be published in the PA Bulletin any week now!!!**

# DRR – Where are we now?

## Key requirements for free chlorine and chloraminated systems

- **Entry Point = 0.20 mg/L (currently requires 0.2 mg/L)**
  - Extra “0” is tied to meeting CT
  - Continuous monitoring and recording of the entry point disinfectant residual
  - Record the lowest value for each day
  - Record the number of periods each day it is < 0.20 mg/L for more than 4 hours
  - If 0.20 mg/L is not maintained at the entry point for more than 4 hours AND there is a failure to calculate the log inactivation or failure to meet the minimum log inactivation for more than 4 hours, then a violation of the treatment technique requirement for pathogenic bacteria, viruses and protozoan cysts is incurred and Tier 1 PN is required (notify PADEP within 1 hour)

# DRR – Where are we now?

## Key requirements for free chlorine and chloraminated systems

- **Distribution System = 0.2 mg/L (currently requires 0.02 mg/L)**
  - For compliance:
    - 0.15 - 0.2 mg/L will round to 0.2 mg/L;
    - 95% of samples must be  $\geq 0.15$  mg/L over 2 consecutive months;
    - If not, incur a violation of treatment technique requirement – must notify PADEP within 1 hour and issue Tier 2 PN
  - No longer able to use HPC in lieu of a chlorine residual for compliance
    - Currently under PA Ch. 109, HPC  $< 500$  counts/mL achieves compliance for locations registering nondetectable chlorine residual ( $< 0.02$  mg/L)

# DRR Concerns

- **True intent of this rulemaking**
- **Increased DBPs?**
  - PADEP was recommended to evaluate the impact of DBP's as a result of DRR
  - Journal AWWA article by Roth and Cornwell:  
***DBP Impacts From Increased Chlorine Residual Requirements (Feb 2018)***



# DRR – Be Cautious With Online Monitoring

- **During draft final-form DRR discussions, on August 24, 2017, TAC (Small Water Systems Technical Assistance Center) recommended:**
  - *Water systems using continuous analyzers for distribution system disinfection residual measurements as described in their monitoring plan should calculate a daily average to be reported to the Department.*
- **This motion passed, PADEP incorporated the following into DRR:**
  - *A public water system may substitute on-line residual disinfectant concentration monitoring and recording for grab sample monitoring and manual recording if it validates the on-line measurements for accuracy in accordance with 109.304.*
  - *Report to the Department a daily average if on-line monitoring and recording is substituted for grab sample measurements.*

# DRR – Be Cautious With Online Monitoring

- **From PWD's experience, maintaining a network of online distribution system monitoring, at multiple locations, requires significant resources**
- **Some things to Consider:**
  - Are enough proficient staff available for dedicating time to maintaining such instruments?
  - Has baseline monitoring been performed to understand how the instrument compares to grab sample data?
  - Redundant sensors, particularly chlorine (in case one fails)?
  - Ability to view the continuous data in real-time and provide alarms to various users as desired?

DRR – So I am Meeting the 95% requirement, but one location may go below 0.15 mg/L over consecutive months?

- **If a public water system fails to meet the minimum level at any sample location for 2 consecutive month or more, then within 60 days, the public water system must conduct an investigation to determine the cause and appropriate corrective actions and submit a written report to PADEP.**

# DRR – Averaging Grab Sample

## Measurements from the same location

- **During draft final-form DRR discussions, on August 24, 2017, TAC (Small Water Systems Technical Assistance Center) recommended:**
  - *DEP should add language to clarify that multiple grab sample measurements from the same location during the monitoring period will be averaged by DEP into a monthly compliance value for that location*
- **This motion unanimously passed, however PADEP did not incorporate it in DRR**
  - *The recommendation regarding averaging additional grab sample measurements from a sampling location will be included in Department guidance on system monitoring*

# DRR – Averaging Grab Sample Measurements from the same location for compliance?



- **A water system collect samples from the same location weekly**
- **From the above grab data, for chlorine residual:**
  - July average is 0.185 mg/L
  - August average is 0.188 mg/L

# DRR – Averaging Grab Sample Measurements from the same location for compliance?...Will be addressed in DRR Guidance

- **PADEP will address how the “compliance value” will be determined in DRR Guidance**
- **Pay attention to when DRR guidance is issued because PADEP Regional Office Staff will “use guidance to direct and support implementation” of the DRR**
- **Non regulatory agenda (published by PADEP in Feb 2018)**
  - New Draft Lab Reporting Instructions for Disinfectant Residuals (Publish as a draft in Q3 2018)
  - New Draft DRR Guidance (not clear as to when a draft will be published)

# Disinfection Requirements Rule (DRR)

## DRR monitoring plan

- 6 months to develop and submit a monitoring plan to PADEP
- Tie to RTCR locations (monitor at “representative” locations throughout the distribution system )

## Nitrification Control Plan

- Required for systems that chloraminate
  - 1 year to develop plan (not required to submit)

# Disinfection Requirements Rule (DRR)

## What will it will take now to be in compliance

- **Will you be in compliance under current operation practices following the new DRR?**
- **If not, what requirements, upgrades, or changes will be needed?**
  - PADEP's "friendly" Consent Order Agreement/Alternate Compliance Schedule
  - Must submit intent to have this agreement in place within 1 year of the effective date of the final DRR



# The Other Side of the Meter

- ▶ About building water systems
- ▶ What a disinfectant residual can do
- ▶ What it cannot do

# Good News and a Call to Arms

**Consumers perceive that food microbial risks are lower than chemical risks because**

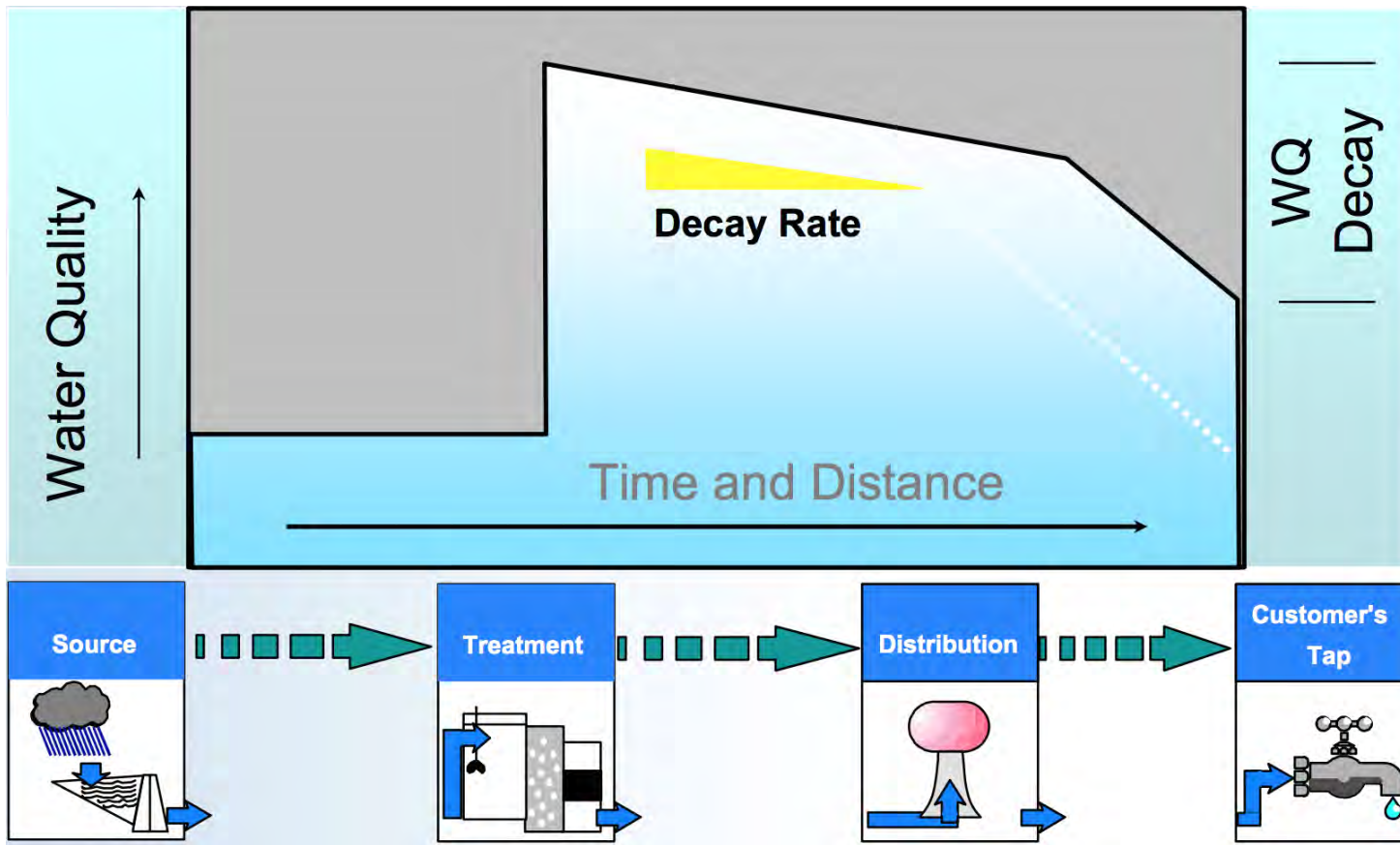
- We are more comfortable with risks we believe we can control
- We have some confidence in the food chain (traceability!)

**Carry-over to drinking water**

- Consumers have tools for controlling the microbial and chemical quality of the water they consume and use
- Drinking water from public water supplies is far more traceable than food from the US food chain

**Let's partner with customers to maintain water quality all the way to the point of use!**

# Water Quality, from Source to Tap



# Features Making Building Plumbing Unique

**Building plumbing has all of the same WQ issues as the distribution system**

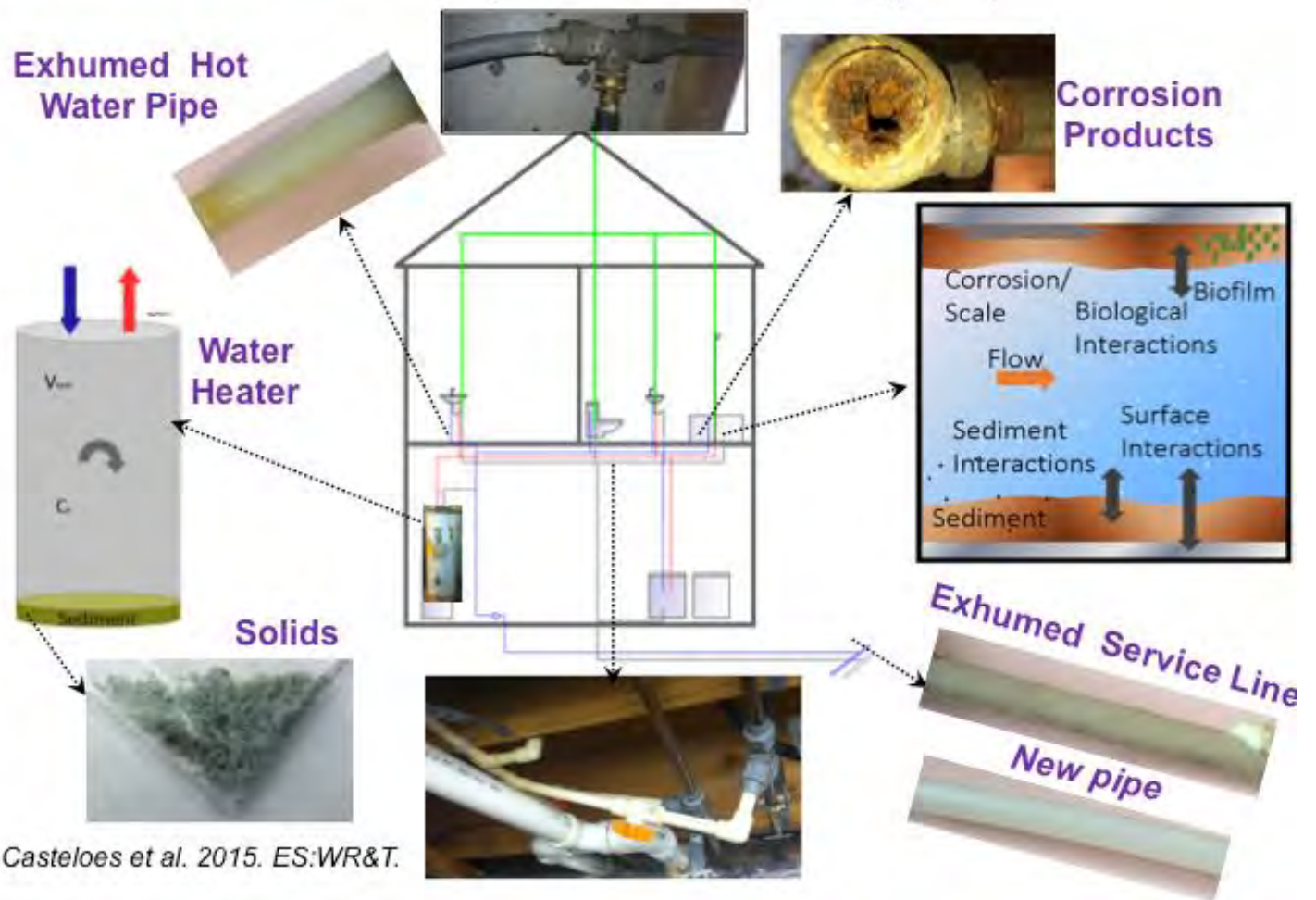
- ONLY TO A GREATER EXTENT
- Nitrification
- Cross connections
- Residual decay and demand
- Water age and dead ends

**Lack of professionals with the knowledge to recognize, prevent or mitigate WQ problems when they arise in building plumbing**

**No U.S. DW regulations that address WQ degradation in building plumbing systems**

- There is no “safe breathing water act” (J Clancy)
- Concerns about what we breathe (not just what we drink)

# Plumbing System Components



Casteloes et al. 2015. ES:WR&T.

Also potentially present

- Appliances
- Systems water treatment
- POU water treatment

# Plumbing System Configurations

Category	Subcategories and considerations
<b>Residences</b>	Single family Multifamily All sizes (row homes to mansions) Different service line lengths
<b>Hotels</b>	Large and small
<b>Commercial buildings</b>	Malls Office buildings Restaurants and food services Industrial facilities
<b>Schools</b>	Preschools, primary and secondary schools Universities (residence halls, food services and other interconnected buildings with specific flushing requirements)
<b>Medical facilities</b>	Hospitals Nursing homes Dialysis units
<b>Correctional facilities</b>	

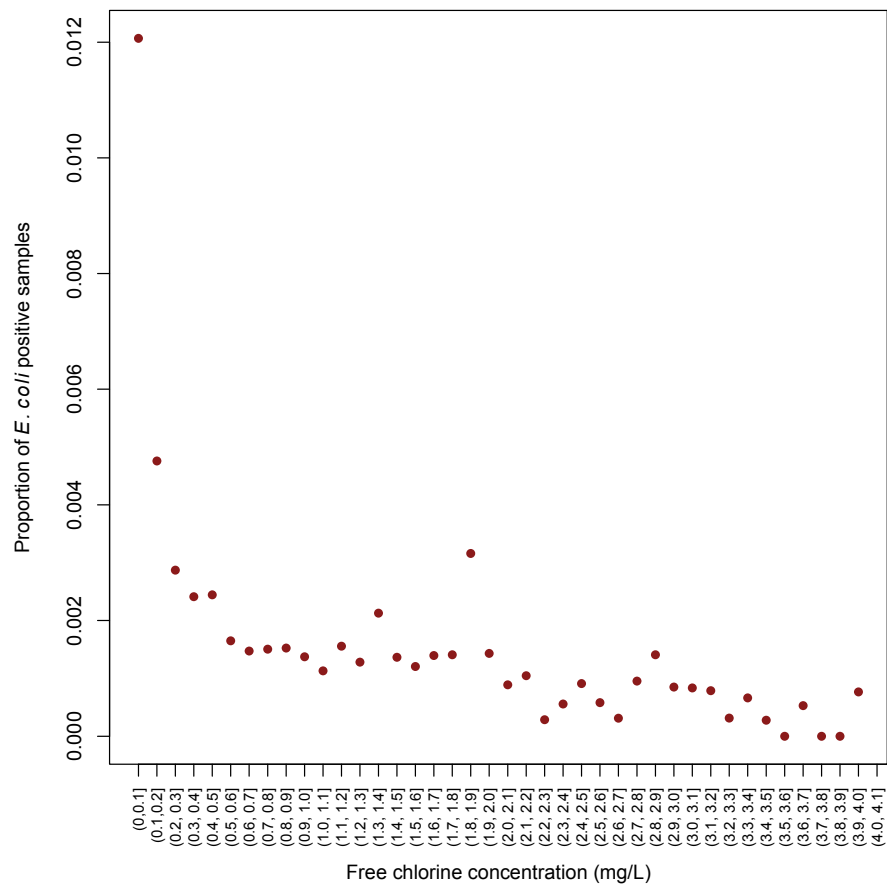
# What Water Providers can do to Help Maintain Good Building Water Quality

**Meet disinfectant residual requirements**

**Maintain distribution system integrity**

**Provide customers solid, scientific information on how to operate their water systems**

# Maintaining a Disinfectant Residual



- The presence of a modest residual has a big impact on coliform regrowth in distributions systems (both free and total chlorine)
- True in building plumbing just as it is in distribution systems
- A residual at the building point of entry does not mean the entire plumbing system is OK (more later)



# Partner with Customers to Maintain Water Quality

## Education

- **CCRs**
- **Turning over water in your system can make a difference**
- **Avoid dead legs**
- **Keep the hot water plumbing hot and the cold water plumbing cold**
- **The origin and meaning of tastes and odors**
- ...

## WRF Flushing Protocol

- **Flush cold first**
- **Avoid running water through endpoint devices until the cold water plumbing has been thoroughly flushed.**
- **Begin by running the cold water faucet closest to the point of entry.**
  - **Progressively, from closest to point of entry to furthest, open all the other cold water fixtures and allow the water to run for at least 20 minutes**
  - **Remove and clean all aerators where possible.**
- **In bathrooms, begin by flushing toilets at least once. If a bathtub has bath tap and shower head, direct flow through the bath tap.**
- **Flush all external spigots for at least 10 minutes.**
- **After flushing all cold taps, re-direct bathtub tap flow to shower head, if applicable.**

# What Water Providers Cannot Do

**Ensure disinfectant residual reaches taps**

**Eliminate Legionnaire's disease and other illnesses associated with organisms that can grow in plumbing systems**

**Dictate how customers operate their plumbing systems**

# Residual in Branches

Measurements conducted at Drexel University (Elrod Owusu-Asumeng)

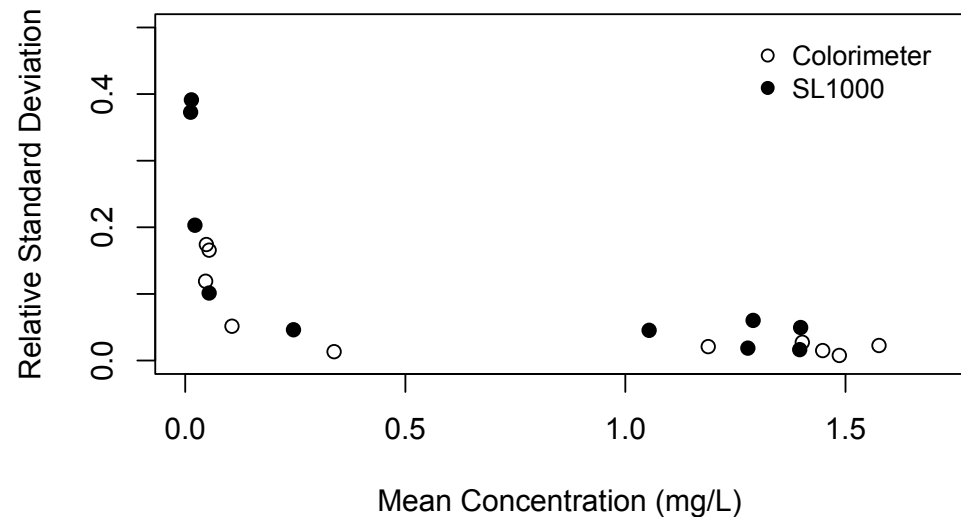
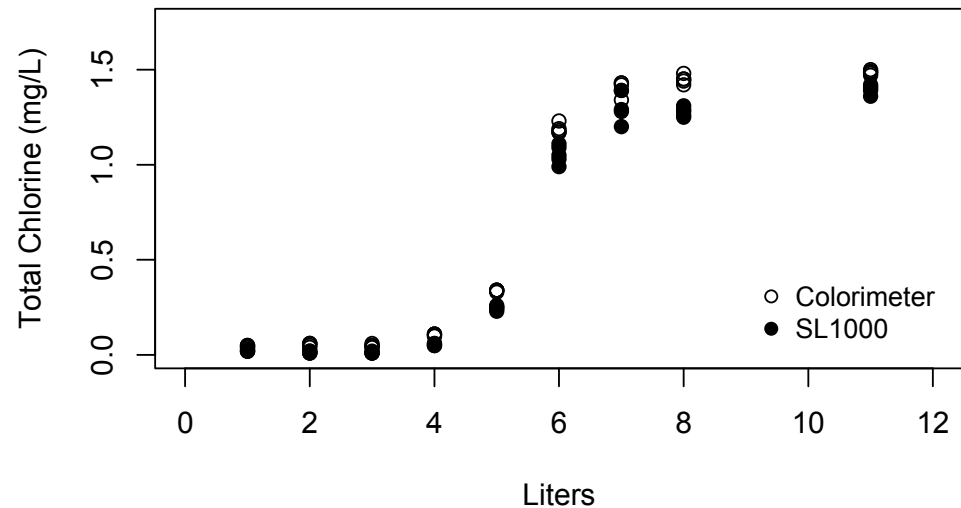
Each liter of water collected from a seldom-used branch of the main building building water system

5 rep measurements for total chlorine for each L

- Hach SL1000
- Hach Pocket Colorimeter II

Plots show profiles of

- Residual concentration
- Relative standard deviation (RSD;  $\sigma/\mu$ )



# Residual at the Building Entry Point does not Mean Residual at the Point of Use

## Primary loss mechanisms

### Decay

- Bulk water
- Pipe walls
- Stagnant legs

### Water heaters

- Higher temperature increase decay rates
- Demands from sediments
- Long residence times

## Other loss mechanisms

### Demand from new copper pipe

### Nitrification

### Demand

- New organic carbon drawn into the plumbing
- “Old” carbon in the form of biofilm and cells

# Legionella Control

## Analysis of data from 50 hospital outbreaks

Case-hospitals were more likely than control-hospitals to be supplied with water containing free chlorine as a residual disinfectant

### Not significant:

- Time of outbreak
- Population supplied by the water plant,
- Amount of water produced by the plant,
- Type of initial (primary) disinfection,
- Type of source water (surface or ground),
- ***Concentration of the residual disinfectant***
- Others

## Locations and disinfectants from Kool et al., 1999 study

# Summary

**In PA, new disinfectant residual requirements (section 109) are coming**

- **Result of a multi-year process**
- **Replaces 0.02 mg/L as a “detectable” minimum**
- **Original intent was public health benefit through *Legionella* control**
- **No doubt about it – a disinfectant residual has benefits**

**Alone, drinking water providers cannot get high quality all the way to the tap**

- **Partnership with customers for *Legionella* control and to address other building water issues**
- **Partnership can involve education, research, expertise sharing and more**