



Chlorine Residuals and Compliance Samples in Distribution Systems

Comments to TAC Board
May 26, 2015

AQUASM

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Outline

- Key Points
 - Provide comments to TAC Board and DEP on topics related to most recent pre-draft regulation
 - Focus on disinfectant residual
 - Examine potential impacts to Aqua and our customers
- Outline actions Aqua has taken
- Stress need for on-going technical discussions with water systems

Charles Hertz, a brief introduction

- Representing Aqua Pennsylvania, Inc.
 - Manager, Laboratory and Research
- > 30 years experience in water quality & lab analyses
- Multiple perspectives
 - Commercial laboratory
 - Municipal authority
 - Academic: BS, MS, Ph.D.
 - State regulatory agency, Research Scientist, NJDEP
 - Investor-owned utility, 25 years at Aqua
- AWWA committees
 - Former Chair of WQ Lab Committee
- *Journal AWWA*, Journal Editorial Board, Technical Editor
- Water Research Foundation Committees

Key Points

- General agreement
 - RTCR seeks to improve public health protection
 - *Find & fix* pathways of contamination
 - Embrace concept of continuous improvement
 - Premise plumbing issues are very complex

Key Points

- Setting a minimum disinfectant residual in the distribution system has major impacts, including potential unintended consequences
- Federal RTCR moved away from unnecessary Tier 2 Public Notices
- Frequent PNs may confuse consumers and erode public confidence in safety of water
 - Pennsylvania pre-draft still links minimum disinfectant residual with Public Notice
 - Pennsylvania already leads the nation in violations that trigger PN- mainly M/R violations

Key Points

- Aqua strongly supports an on-going technical discussion about increasing the minimum disinfectant residual.
- Disinfectant residual is just one component in a complex and multi-faceted approach to public health protection.
- Start a technical dialog.
 - Two days of presentations to the TAC Board can only be viewed as a beginning.

Aqua Pennsylvania, Inc.

- 107 water systems
 - Very small to very large
 - Surface water & ground water
 - Secondary disinfectants: free chlorine & chloramines
- 425,000 service connections, state-wide

Aqua Pennsylvania, Inc.

- Southeastern PA

- 23 water systems in 5 counties
- 8 surface water plants, 11 SW sources
- 80 well stations
- 350,000 service connections
- 85 Storage tanks, 170 MG storage
- 80 pressure zones
- 80 Booster stations
- 4,400 miles of distribution system
- 300+ automatic valves

Actions taken by Aqua, SEPA water systems

- Water Quality Work groups formed within Aqua to evaluate increased chlorine residual within distribution systems
 - Storage tanks;
 - Flushing;
 - Hot spots; and
 - Data analysis.

Actions taken by Aqua, SEPA water systems

- Operational control strategies
 - Changes at treatment facilities**
 - Increased chlorine : ammonia ratio at SW plants
 - Chlorine residuals
 - pH
 - Changes in distribution systems**
 - Reduced water age
 - Modified flushing efforts
 - Hydraulic modeling
- Increased WQ monitoring
- Research on chloramine stability

Actions taken by Aqua, SEPA water systems

- Final Costs... to be determined
 - Additional chemicals
 - \$150,000 extra during 2015
 - Booster station permits
 - Mixers in storage tanks
 - Aerators in storage tanks
 - \$320,000 YTD in 2015
 - Mixers in clear well at 1 WTP
 - Monitoring
 - Flushing
 - Consultants

Operational Strategies/Considerations

- Chloramine System Strategies
 - Understanding of chloramine chemistry
 - Nitrification Monitoring and Control
 - Nitrite, free ammonia, also ATP, R2A
 - Chlorine to Ammonia ratio of 5:1 at Entry/Feed points
 - Higher pH promotes Chloramine Stability
 - Aqua has increased pH from 7.0-7.2 to 7.5
 - Higher Chloramine doses at Entry Points
 - Aqua has increased from 1.5 - 2.0 mg/L to 3.0 mg/L
 - Minimize/eliminate blending with free chlorine

Operational Strategies/Considerations

- **No Quick Fix or Silver Bullet**
- Reduce water age
- Storage tank management / turnover
 - Seasonal operation
 - Draining considerations
- Flushing –
 - Localized spot flushing
 - Unidirectional
 - Water loss and discharge considerations

Impact of Current Pre-Draft

Disinfectant residual requirement: chloraminated system

Aqua PA Main System

- Review of 11 years of TCR data: 2004 – 2014

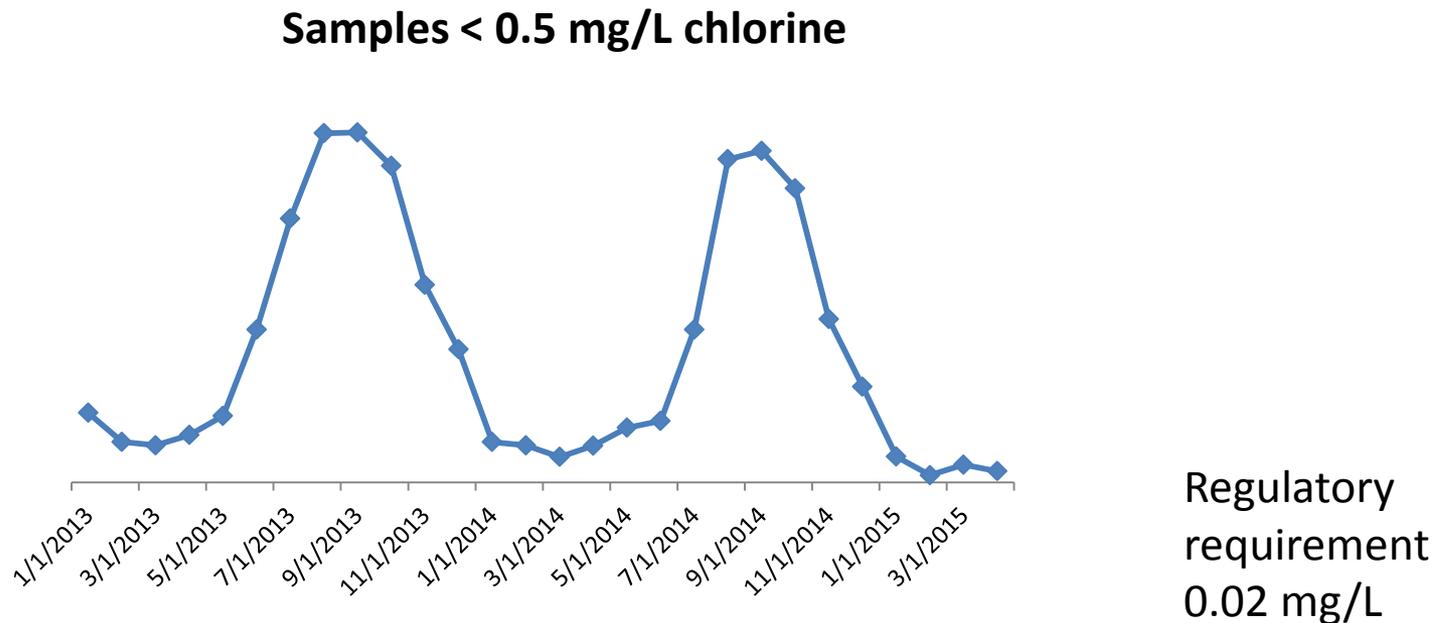
➤ 36,500 samples

17% of samples had chlorine residual < 0.5 mg/L

Regulatory requirement 0.02 mg/L

Distribution System Disinfectant Residuals

- Seasonal trends
- Loss of chlorine worse during summer / fall



Impact of Current Pre-Draft Disinfectant Residual Requirement

Distribution System Chlorine Residuals < 0.5 mg/L January 2013 – April 2015, Three Systems in SEPA*

System	TCR Samples	Number of Samples with Chlorine < 0.5 ppm	Percentage
A	980	62	6 %
B	1,664	361	22 %
C	7,807	1,035	13 %

**Almost all data prior to making changes in 2015*



Potential for 52 Public Notices per month...up to 146 PNs in one month

Regulatory requirement 0.02 mg/L

Summary of *E.coli* Positive Samples...focus of RTCR in the presence of Chlorine Residual

January 2010 – May 2015

System	Year	<i>E.Coli</i>	Chlorine Residual, mg/L
A	2014	Positive	1.4
B	2015	Positive	1.3
C	2015	Positive	1.9
D	2015	Positive	1.5

Note wider date range

Correlation?

Sanitary defect?

Aqua's Chloramine Stability Studies

- Purpose: to determine decrease in chlorine residual under ideal conditions
- Baseline studies, effect of:
 - **pH increase**
 - *pH affects chloramine stability*



- **Chlorine residual increase**
 - *Response to pre-draft changes in Chapter 109*

Chloramine Stability Studies

Series of 10 sterilized bottles

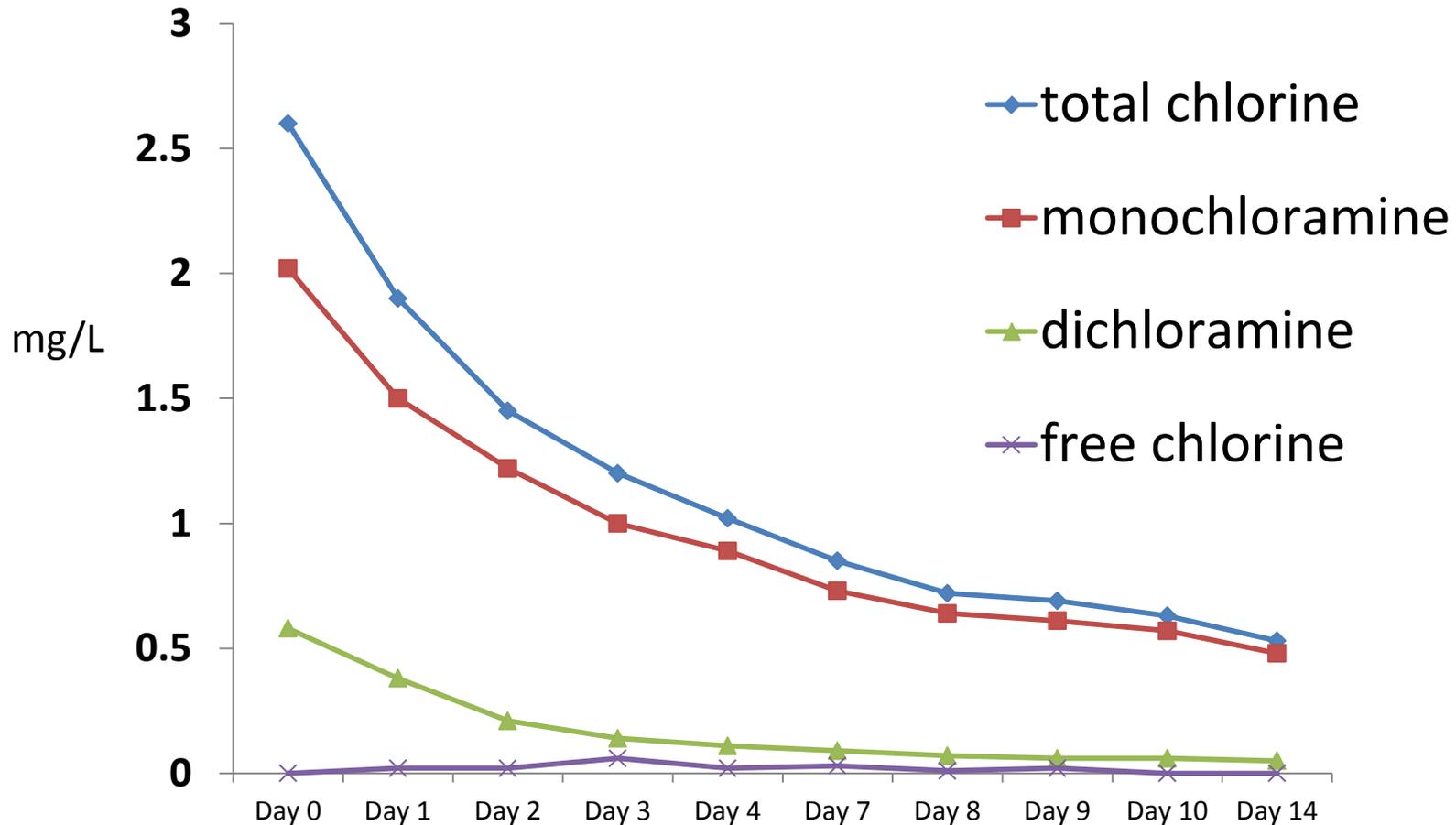
- Parameters tested

- Chlorine speciation: total chlorine, monochloramine, dichloramine, free chlorine
- Ammonia, free & total
- Nitrite & nitrate
- pH, Alkalinity
- THMs

- ATP, HPC with R2A agar
- TOC
- UV₂₅₄

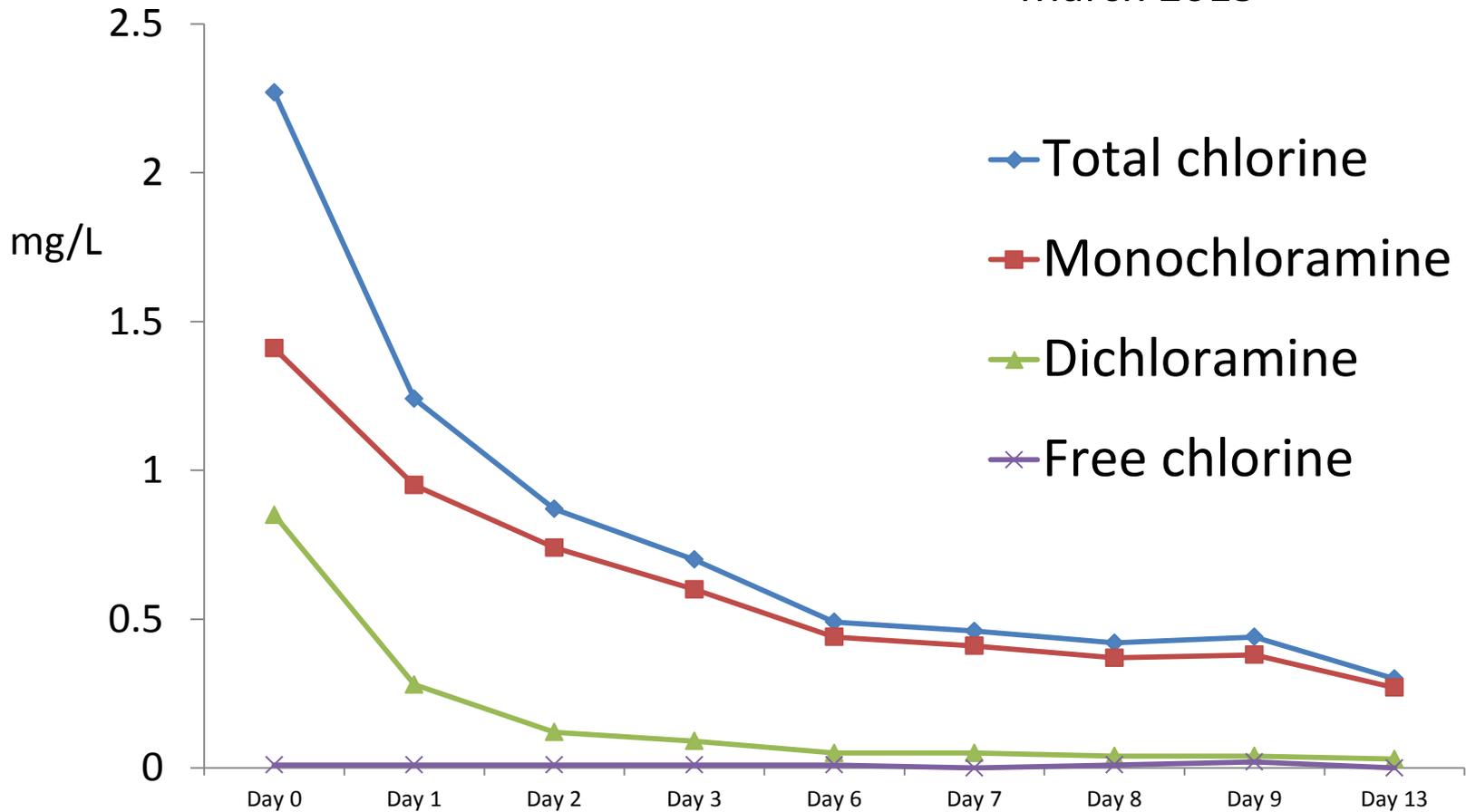
Chloramine Stability Study
Chlorine Decay, Ideal Conditions
Surface Water A , March 2015

After raising Cl_2



Chlorine Decay Ideal Conditions

Surface Water B
March 2015



Summary of Chloramine Stability Studies

Under Ideal Conditions

- Chlorine decayed
- Monochloramine dominated
- Little dichloramine
- Increased pH improved stability

Summary of Chloramine Stability Studies

Under Ideal Conditions

- Free ammonia increased slightly
- Little/no nitrite detected

- Little biologic activity
 - ATP
 - HPC with R2A agar

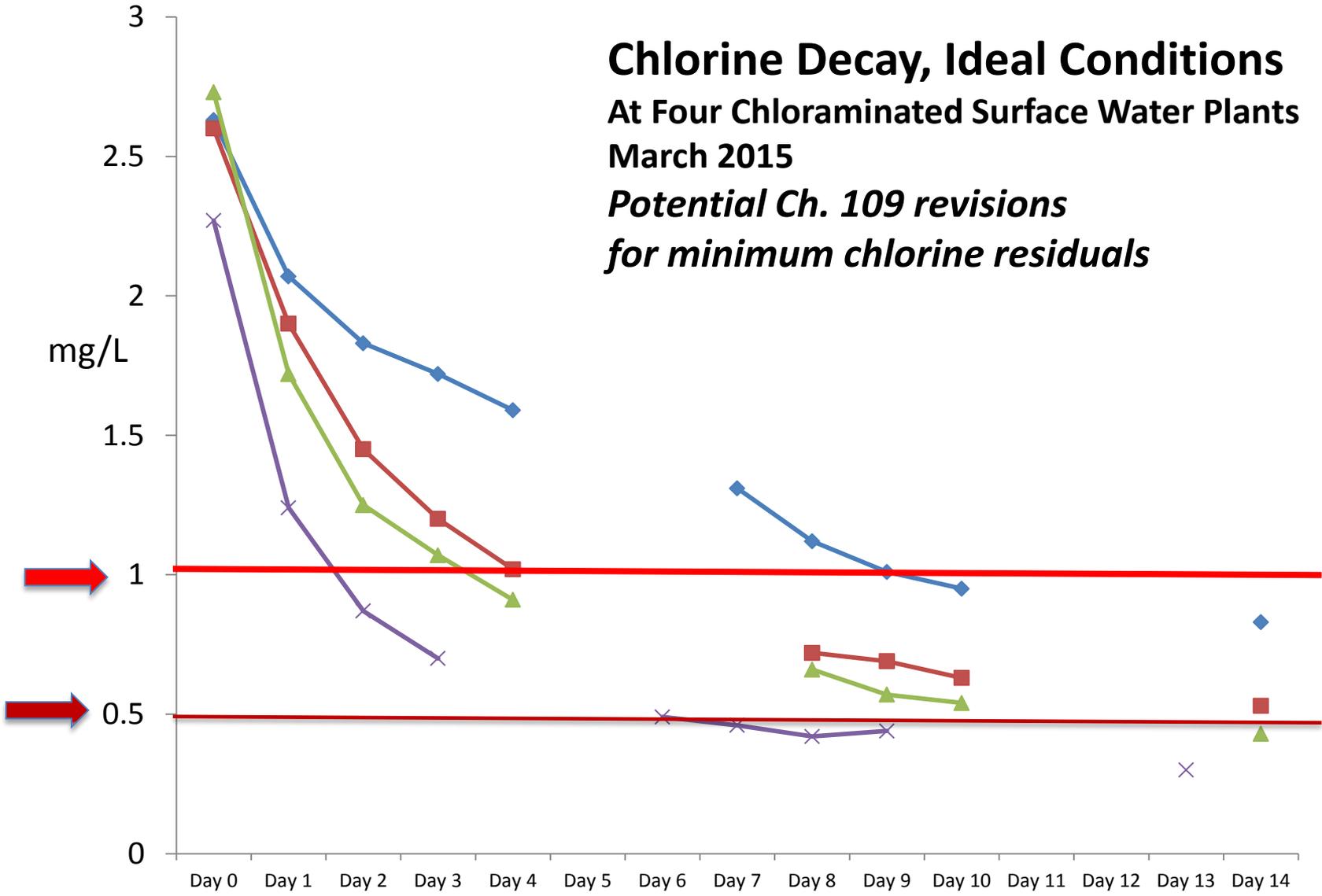
Summary of Chloramine Stability Studies

Under Ideal Conditions

- Trihalomethanes increased
- Little/no impact on:
 - Nitrate
 - pH
 - Alkalinity
 - Total Organic Carbon

Chlorine Decay, Ideal Conditions At Four Chloraminated Surface Water Plants March 2015

*Potential Ch. 109 revisions
for minimum chlorine residuals*



Open Issues, partial list *need for technical discussions*

- Unintended consequences
 - DBPs
 - Effect on corrosion control
 - Lead and copper
 - Discolored water
 - Customer complaints
 - Calls to Aqua increased, e.g. March 2015
 - Taste & odor
 - Chlorine
 - Discolored water

Open Issues, partial list *need for technical discussions*

- Limitation of existing chemical feed systems, capital & operational considerations
 - Chlorine
 - Lime
 - Ammonia
- Chlorine residual, analytical method(s)
 - Accuracy
 - Precision
 - Minimum Reporting Level

Recommendations

- Follow EQB directive to separate RTCR; defer other revisions to Chapter 109 (pre-draft)
- Continue stakeholder input & initiate technical discussions
 - Actual chlorine residuals may be far different from average
 - Estimated compliance rate is flawed, based on monthly averages
- Consider time frame for compliance
 - Recognize difficulty water systems may have
 - If minimum disinfectant residual is changed from “detectable” (0.02 mg/L) to higher levels
 - Implementation will need time
 - May need public outreach

Summary

- Chlorine residuals are just one feature in multi-barrier approach to public health protection
- Complex issues warrant open technical discussion
- Good information presented over last two weeks
- Beginning of process



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