

STAGE 1 DBPR

Overview

1. Chlorine & Chloramines

2. TTHM and HAA5*

3. DBP Precursors

**4. Chlorine Dioxide &
Chlorite**

5. Bromate

**6. Other Compliance
Issues***

Monitoring Plans

You must develop a monitoring plan detailing how you will:

- Collect samples
- Determine compliance

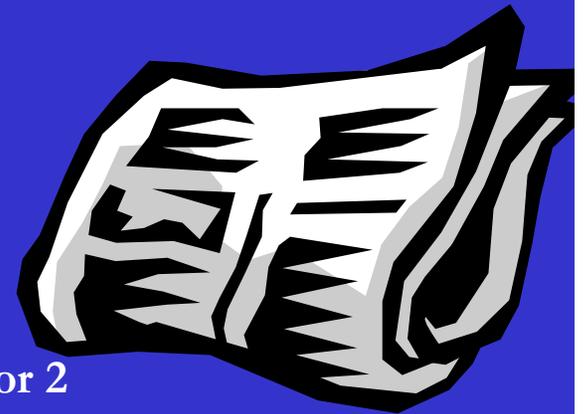


Consecutive system monitoring plans must reflect the entire distribution system



Public Notification Rule

- Promulgated in May 2000
- Requires systems to notify the public of violations
- Level and timing of notification based on severity
 - Tier 1: acute ClO₂ MRDL violations
 - Tier 2: all other MRDL, MCL, and TT violations
 - Tier 3: all monitoring violations not requiring Tier 1 or 2 notification



CHLORINE & CHLORAMINES

Chlorine & Chloramines

- Inactivate harmful microorganisms
- Excessive levels can cause eye/nose irritation, stomach discomfort, and anemia
- React with NOM to form harmful DBPs



MRDL

Chlorine & Chloramines MRDL = 4.0 mg/L



- Applies to all CWSs and NTNCWSs that add chlorine or chloramines
- MRDLs are like an MCL but for disinfectants
- Ensures adequate disinfection
- Flexible - keeps disinfectant levels low enough to minimize DBP formation and limit health effects



Monitoring

Monitor for chlorine and chloramines every time you sample for total coliform

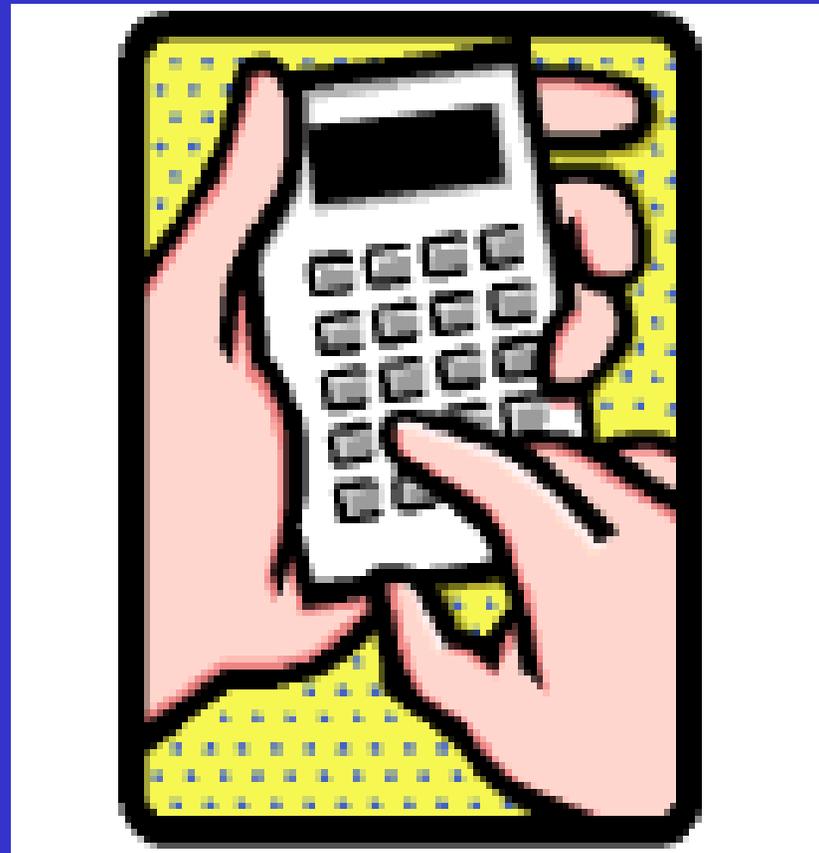
- Includes repeat total coliform-positive monitoring
- Includes reduced TCR monitoring
- Must be taken at same location as TCR samples

1 TCR sample
=
1 chlorine or
chloramines sample



Calculating Compliance

1. Calculated each quarter using monthly averages
2. Based on RAA of monthly averages
3. Any RAA of monthly averages that exceeds the MRDL is a violation



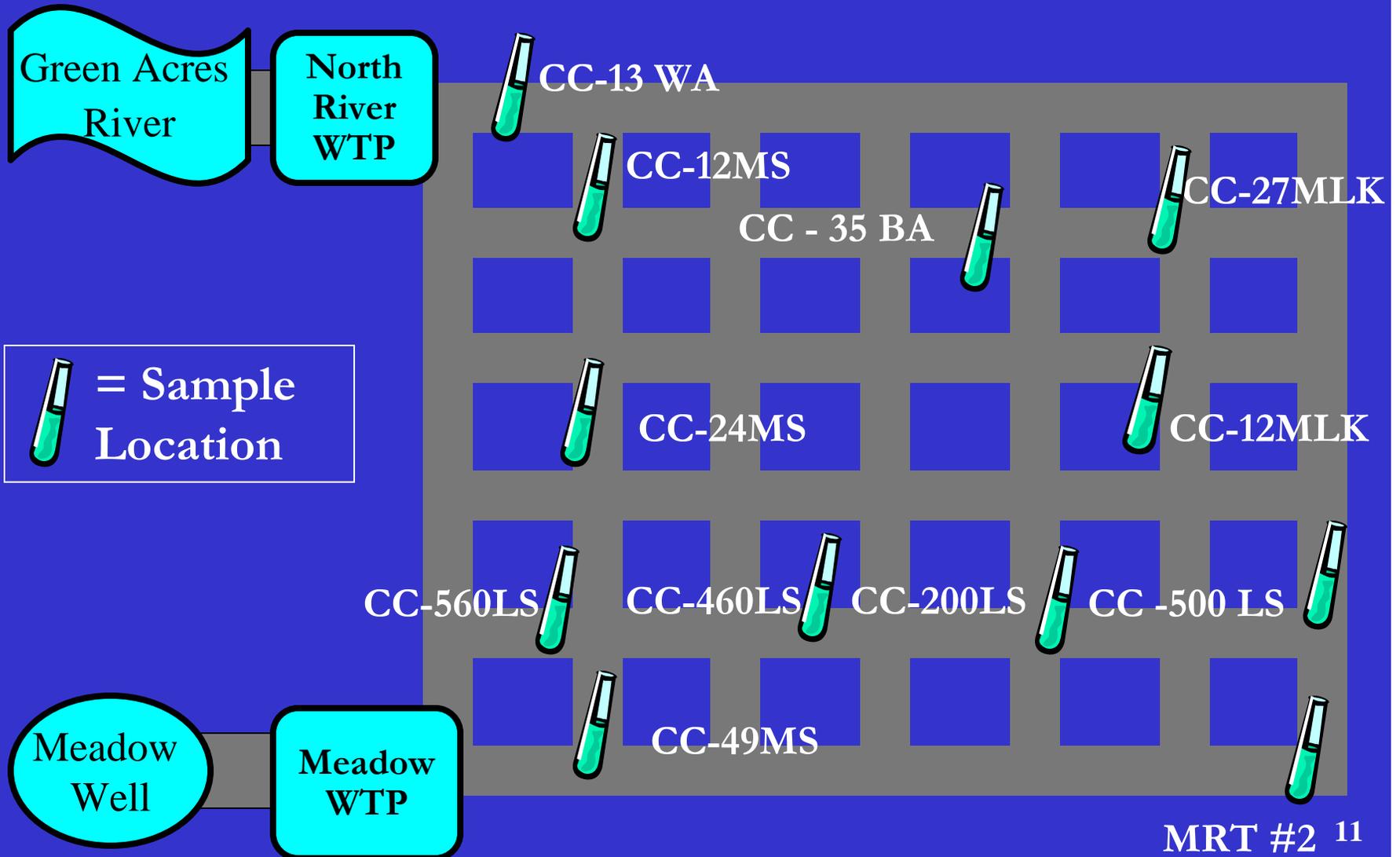
Compliance Reporting

Report to state within 10 days of the end of each quarter:

- **Number of samples taken during each month of the last quarter**
- **The monthly arithmetic average of all samples taken in each month for the last 12 months**
- **The arithmetic average of the monthly averages for the last 12 months**
- **Whether the MRDL was violated**



System Schematic (Example)



Summary

- Chlorine & chloramines MRDLs = 4.0 mg/L
- Monitoring based on TCR monitoring
- Compliance based on RAA of monthly averages calculated quarterly

Questions?

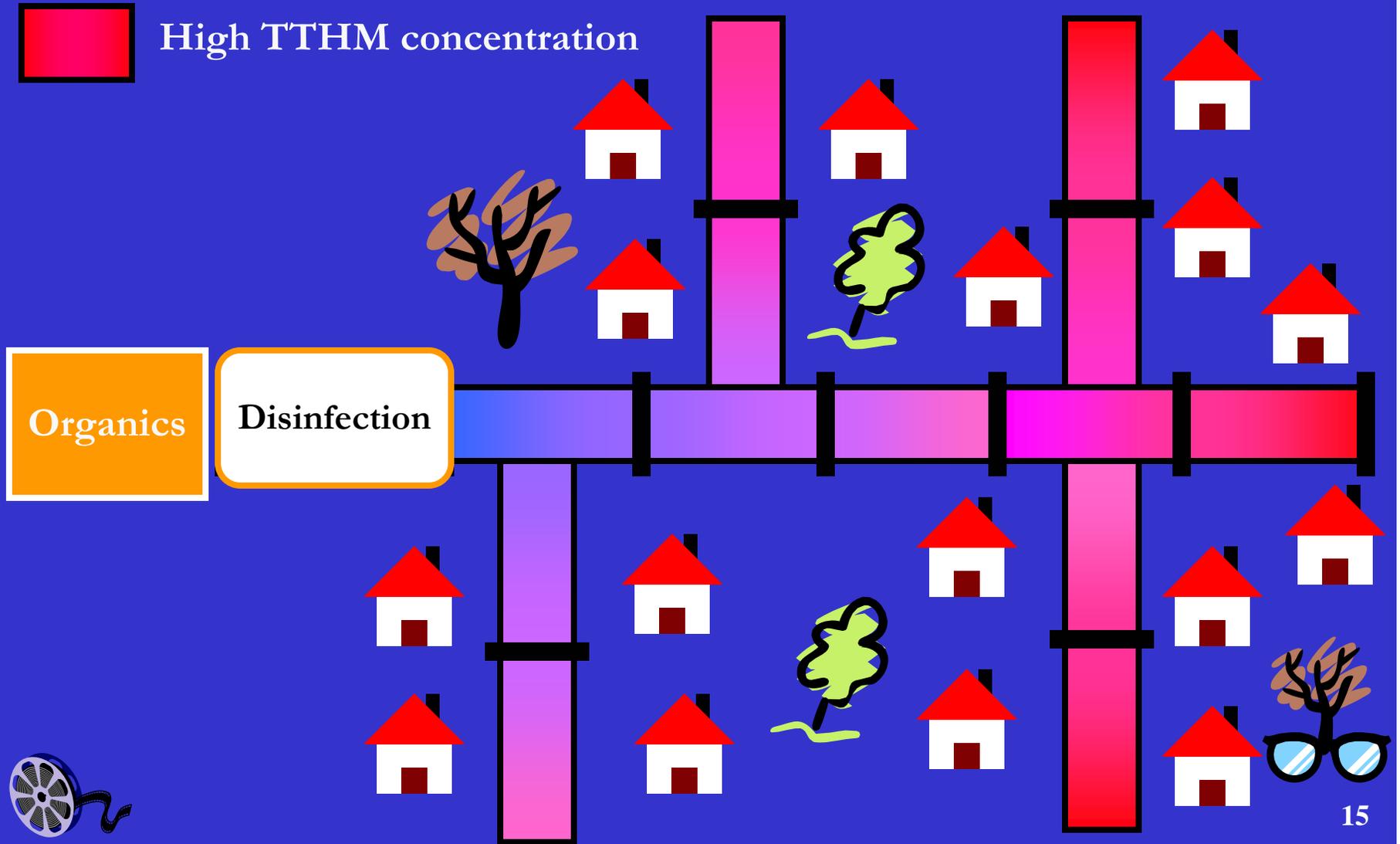
TTHM & HAA5

TTHM & HAA5

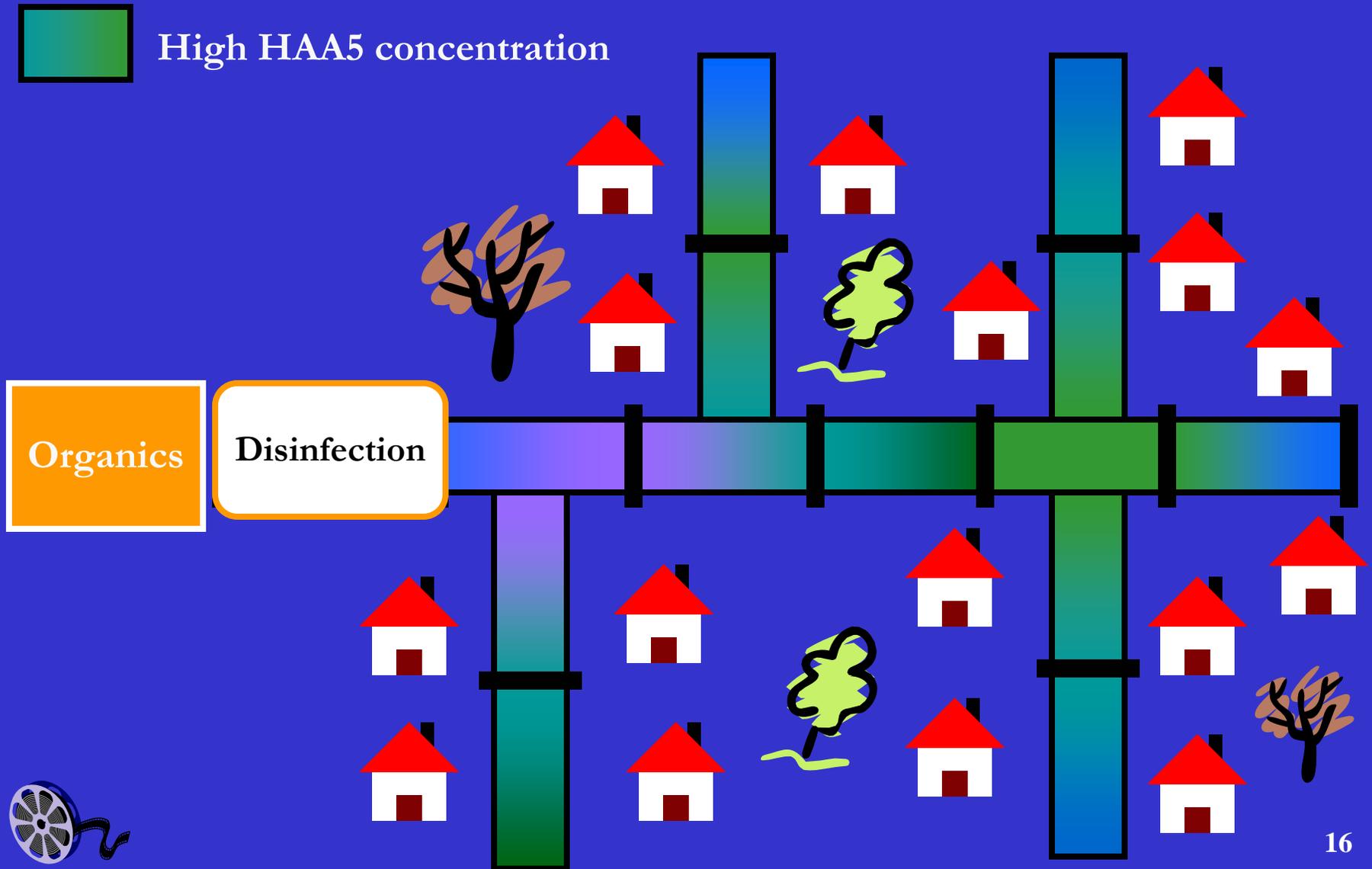
- Product of reaction between chemical disinfectants and NOM
- Cause cancer, as well as liver, kidney, and central nervous system problems



THM Formation



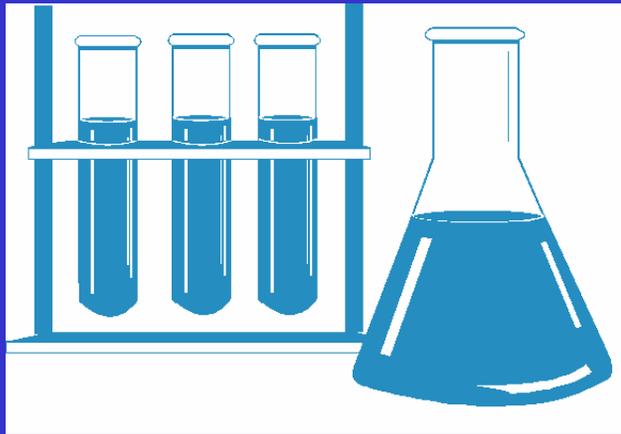
HAA5 Formation



MCLs

TTHM MCL = 0.080 mg/L

HAA5 MCL = 0.060 mg/L



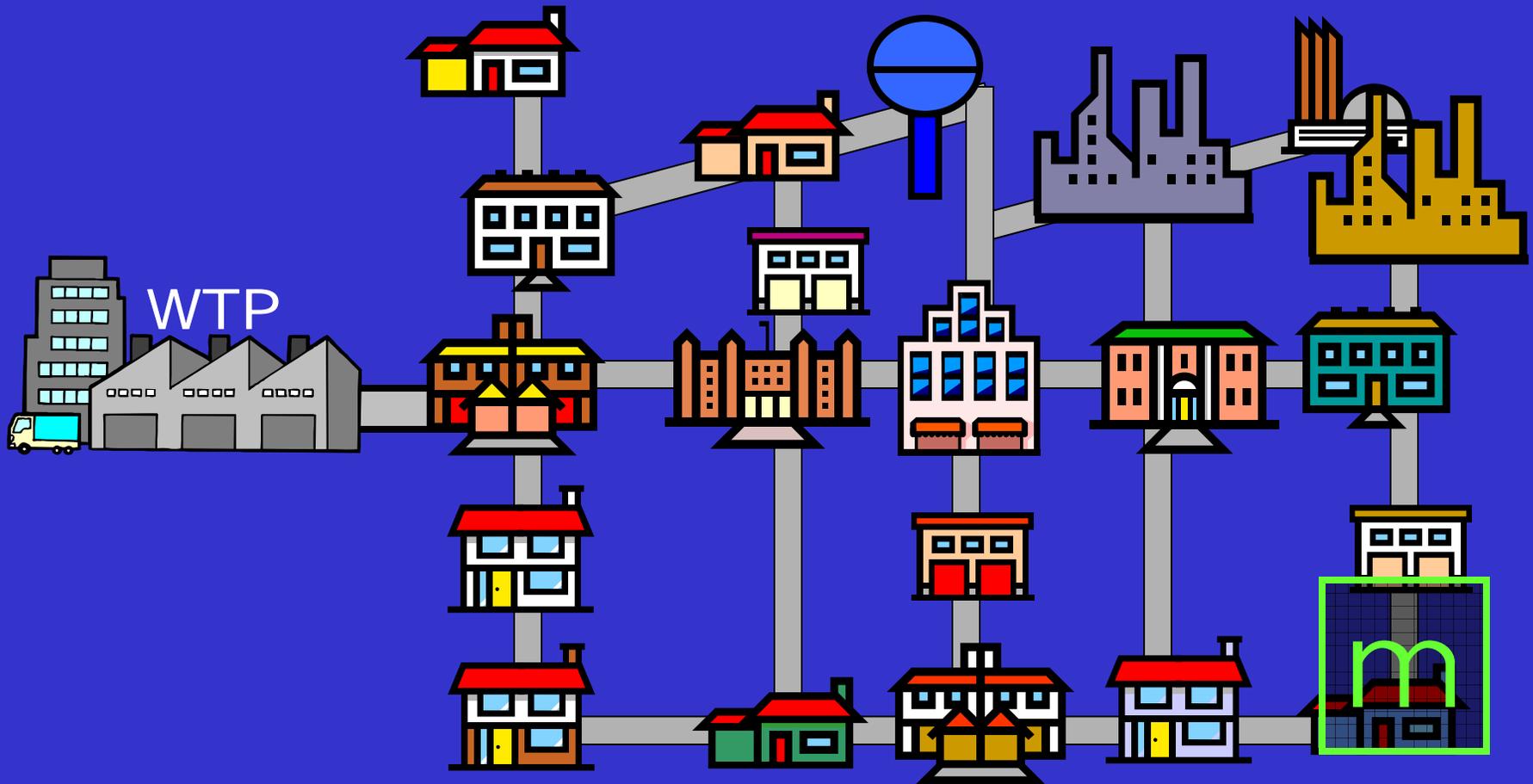
- Apply to CWSs and NTNCWSs that add a disinfectant to their water
- Reduce health risks associated with elevated levels of byproducts

§ 141.132 Monitoring—DBPs

Routine—TTHMs and HAA5			Reduced	
System Type	Frequency	Location	Conditions	Frequency
Subpart H ≥ 10,000	4/plant/qtr	25% Max. Residence Time (RT) 75% Rep.	≤ 50% of MCLs TOC ≤ 4.0 mg/L	1/plant/qtr at Max RT
Subpart H ≥ 500 – 9,999	1/plant/qtr	Max. RT	≤ 50% of MCLs TOC ≤ 4.0 mg/L	1/plant/year in month of warmest water temp. Max RT
Ground Water ≥ 10,000	1/plant/qtr	Max. RT	≤ 50% of MCLs	1/plant/year in month of warmest water temp. Max RT
Subpart H < 500	1/plant/year in month of warmest water temp.	Max. RT	No Reduced Monitoring	
Ground Water <10,000	1/plant/year in month of warmest water temp.	Max. RT	≤ 50% of MCLs (2 years) or ≤ 25% of MCLs (1 year)	1/plant/3 years in month of warmest water temp. Max RT

Example Monitoring Location:

GW < 10,000
Subpart H < 500



m

Location of MRT



Calculating Compliance:

1. Based on RAA of quarterly results or averages
2. Any RAA of quarterly averages that exceeds the MCL is a violation
3. If on reduced and annual sample $>$ MCL, not yet in violation of MCL *unless* result would cause RAA to exceed MCL



Compliance Reporting

Report to state within 10 days of the end of each quarter in which a sample is taken:

- Number of samples taken during the last quarter
- Location, date, and result of each sample taken during the last quarter
- Arithmetic average of all samples taken in the last quarter
- The annual arithmetic average of the quarterly averages for the last four quarters
- Whether the MCL was violated



Summary

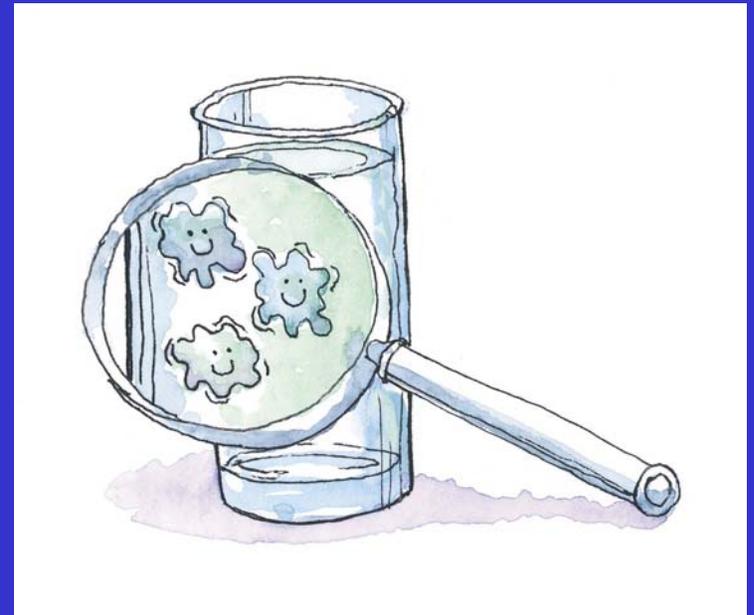
- TTHM MCL = 0.080 mg/L
- HAA5 MCL = 0.060 mg/L
- Monitoring depends on system size and source:
- Reduced monitoring available except for Subpart H < 500
- Compliance based on RAA of quarterly results or averages calculated quarterly

Questions?

DBP Precursors

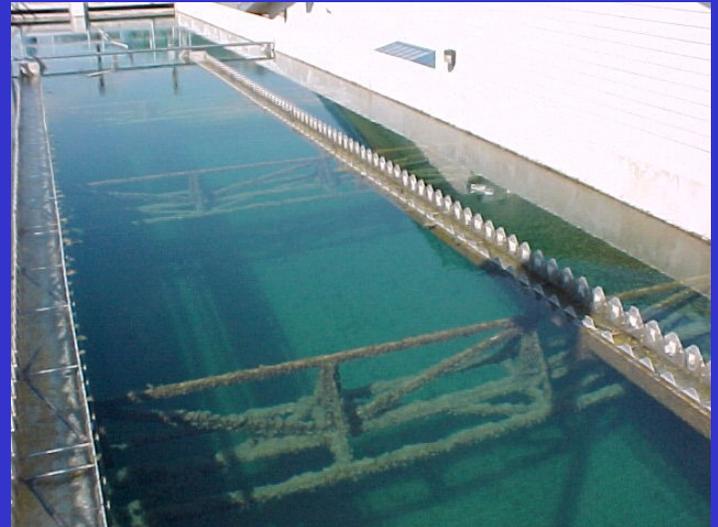
DBP Precursors

- Disinfection byproduct precursors
- Naturally found in water
- React with disinfectants to produce harmful DBPs
- Reduction limits formation of DBPs



Treatment Technique (TT)

Applies only to Subpart H systems using conventional filtration or lime softening



Removal Percentages

Removal requirements depend on source water characteristics:

Treatment Technique Removal Percentages:

Source Water TOC (mg/L)	Source water alkalinity (mg/L as CaCO ₃)		
	0-60	>60-120	>120
> 2.0 – 4.0	35.0%	25.0%	15.0%
> 4.0 – 8.0	45.0%	35.0%	25.0%
> 8.0	50.0%	40.0%	30.0%

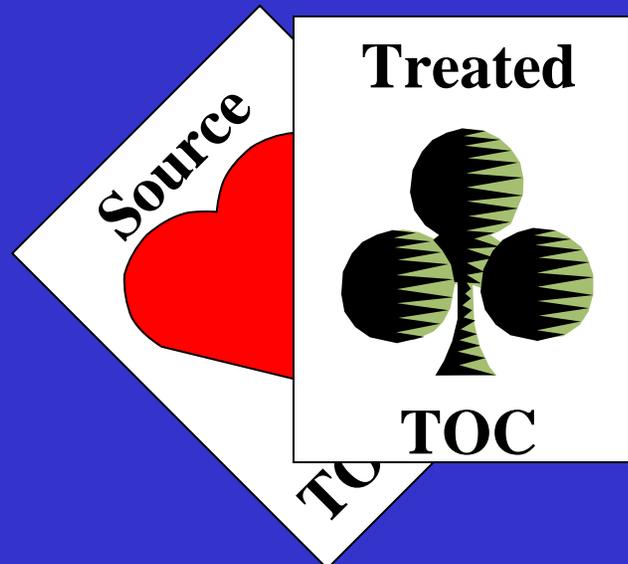
Systems practicing softening must meet TOC removal requirements in this column

Routine Monitoring Requirements

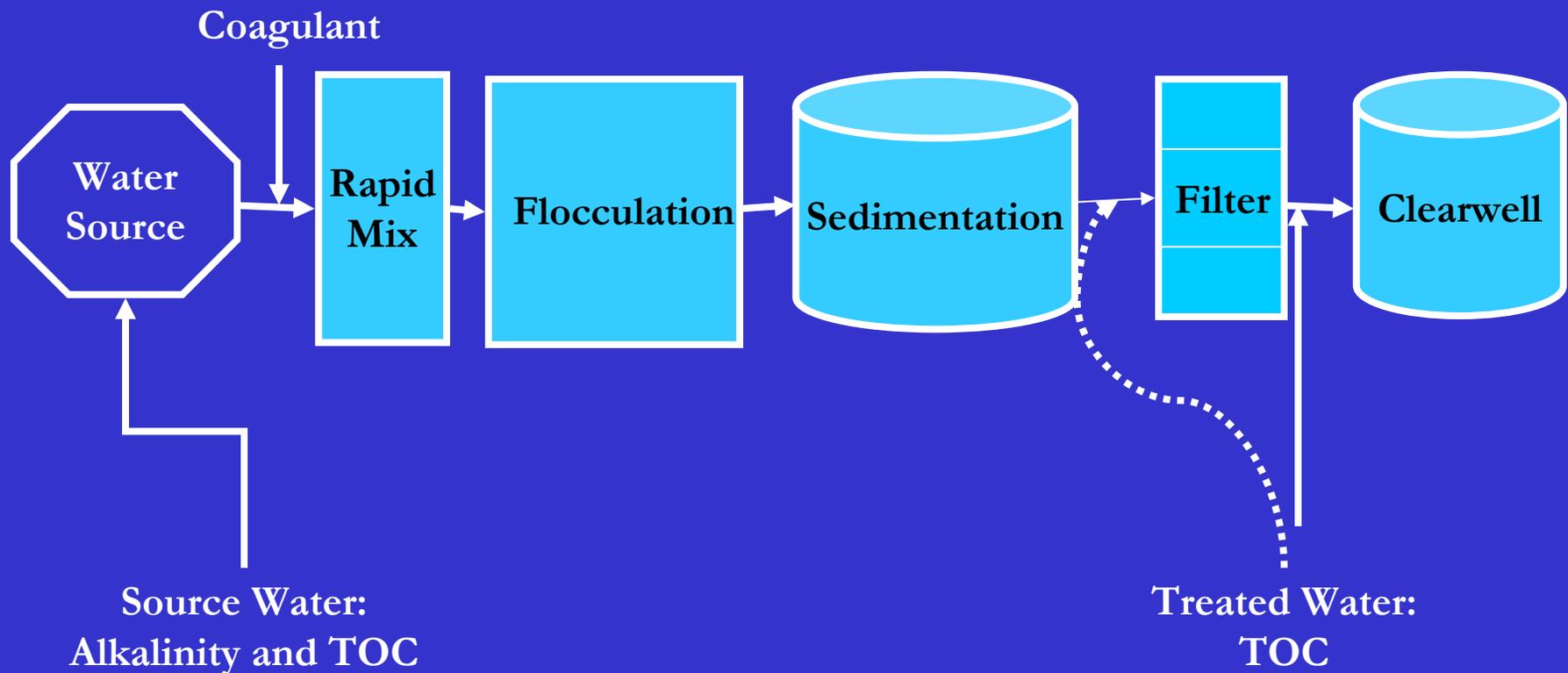
1 sample set per month:

1. Source water alkalinity
2. Source water TOC
3. Treated water TOC

Paired sample



Example Monitoring Locations



Monitoring Results

- Source water samples determine TOC removal target
- Example:
 - Alkalinity 65 mg/L
 - Source Water TOC 9.0 mg/L
 - Required Removal Percentage = 40%

Source Water TOC (mg/L)	Source water Alkalinity (mg/L as CaCO ₃)		
	0-60	>60-120	>120
> 2.0 – 4.0	35.0%	25.0%	15.0%
> 4.0 – 8.0	45.0%	35.0%	25.0%
> 8.0	50.0%	40.0%	30.0%

- Treated water sample determines what percentage of TOC was removed



Monitoring Results

- Source water samples determine TOC removal target
- Example:
 - Alkalinity 65 mg/L
 - Source Water TOC 9.0 mg/L
 - Required Removal Percentage = 40%

Source Water TOC (mg/L)	Source water Alkalinity (mg/L as CaCO ₃)		
	0-60	>60-120	>120
> 2.0 – 4.0	35.0%	25.0%	15.0%
> 4.0 – 8.0	45.0%	35.0%	25.0%
> 8.0	50.0%	40.0%	30.0%

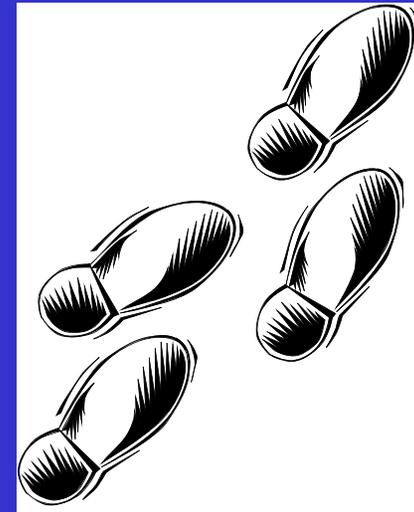
- Treated water sample determines what percentage of TOC was removed



DBP Precursor Compliance Overview

4 standard ways to comply:

1. Alternative compliance criteria
2. Step 1 TOC removal
3. Step 2 TOC removal
4. State waiver



Most systems will be able to comply through alternative compliance criteria or Step 1 TOC removal

Alternative Criteria

1. RAA of monthly source water TOC samples < 2.0 mg/L
2. RAA of monthly treated water TOC samples < 2.0 mg/L
3. RAA of source water TOC < 4.0 mg/L, RAA of source water alkalinity > 60 mg/L, and:
 - TTHM RAA ≤ 0.040 mg/L and HAA5 RAA ≤ 0.030 mg/L
4. TTHM RAA ≤ 0.040 mg/L and HAA5 RAA ≤ 0.030 mg/L, and you use only chlorine for primary disinfection and maintenance of a residual



Alternative Criteria

5. RAA of SUVA prior to any treatment ≤ 2.0 L/mg-m
6. RAA of treated water SUVA ≤ 2.0 L/mg-m



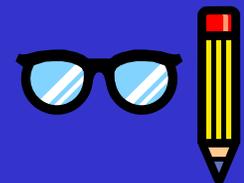
Alternative Criteria: SUVA

- **Some organic compounds strongly absorb UV radiation**
 - UV absorption useful measure of organic material in water
- **High SUVA = high proportion of the organic matter measured is NOT dissolved**
 - easier to remove by coagulation
- **Low SUVA = a greater proportion of the organic matter measured is dissolved**
 - difficult to remove by coagulation

Softening Alternative Criteria

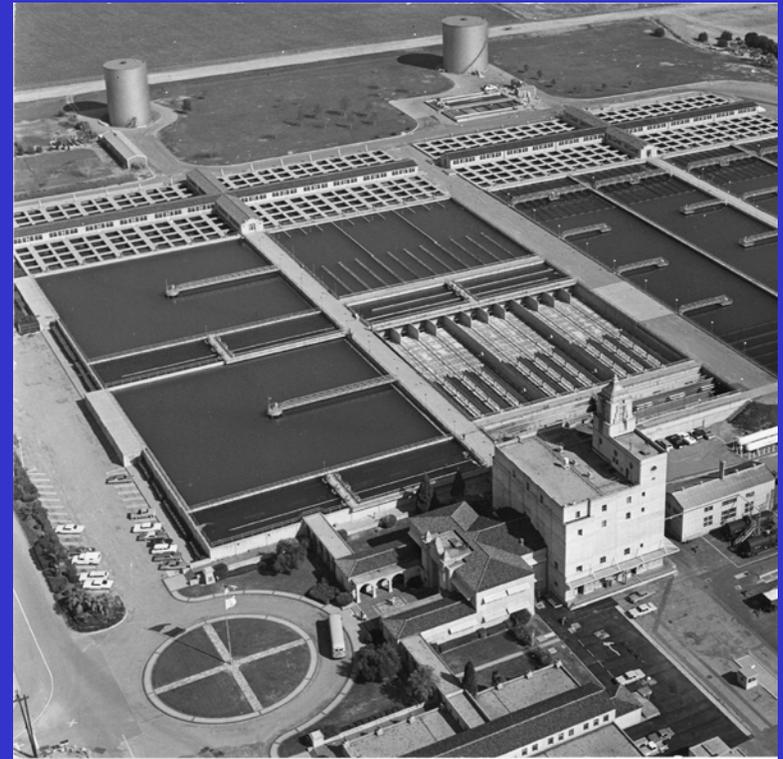
Apply only to softening systems:

7. Softening that results in a RAA of treated water alkalinity < 60 mg/L (as calcium carbonate)
8. Softening that results in a RAA for the removal of magnesium hardness (as calcium carbonate) of at least 10 mg/L



Alternative Criteria: Compliance

- In compliance if you meet the same alternative compliance criterion for 12 consecutive months
- No TOC removal required
- Compliance based on RAA for all alternative criteria
- Must still collect routine DBP precursor sample set



Step 1 TOC Removal

- Systems remove a percentage of TOC based on source water characteristics
- Percentage may change on a month-to-month basis
- Compliance is based on a ratio of the percentage of TOC actually removed to percentage of TOC that you should have removed
- Ratio ≥ 1.00 required to remain in compliance
- Compliance based on RAA calculated quarterly

Source Water TOC (mg/L)	Source water alkalinity (mg/L as CaCO ₃)		
	0-60	>60-120	>120
> 2.0 – 4.0	35.0%	25.0%	15.0%
> 4.0 – 8.0	45.0%	35.0%	25.0%
> 8.0	50.0%	40.0%	30.0%

Step 1 Calculations

- **Calculation 1: Determine removal ratio**
- **Calculation 2: Identify removal ratios for last 12 months**
- **Calculation 3: Calculate the RAA**



Step 1 Calculations: Example #1

Calculation 1

Determine Removal Ratio					
Source Water Alkalinity					65 mg/L
Source Water TOC					9.0 mg/L
Required	Source Water TOC (mg/L)	Source water alkalinity (mg/L as CaCO ₃)			40.0%
Treated					.0 mg/L
TOC Re		0-60	>60-120	>120	.0 - 4.0 =
(Source	> 2.0 – 4.0	35.0%	25.0%	15.0%	.0 mg/L
Actual R	> 4.0 – 8.0	45.0%	35.0%	25.0%	.0/9.0 =
(TOC re	> 8.0	50.0%	40.0%	30.0%	0.556 (or 55.6%)
Calculation of Removal Ratio					$55.6/40.0 = 1.39$
Removal Ratio					1.39



Step 1 Calculations: Example #1

Calculation 1

Determine Removal Ratio	
Source Water Alkalinity	65 mg/L
Source Water TOC	9.0 mg/L
Required Removal Percentage	40.0%
Treated Water TOC	4.0 mg/L
TOC Removed (Source Water TOC-Treated Water TOC)	9.0 - 4.0 = 5.0 mg/L
Actual Removal Percentage (TOC removed/Source Water TOC)	5.0/9.0 = 0.556 (or 55.6%)
Calculation of Removal Ratio	55.6/40.0 = 1.39
Removal Ratio	1.39

Step 1 Example #1, Cont'd.

Calculation 2

Identify removal ratios for last 12 months

Example

For 3rd quarter of 2005, use ratios from October 2004 – September 2005

Compliance ratios from last 12 months:

September 2005: 1.41
August 2005: 1.69
July 2005: 1.52
June 2005: 0.88
May 2005: 0.87
April 2005: 1.03

March 2005: 0.64
February 2005: 1.06
January 2005: 1.11
December 2004: 1.29
November 2004: 1.32
October 2004: 0.38

Step 1 Example #1, Cont'd.

Calculation 3

Calculate a RAA

Example:

$$(0.38+1.32+1.29+1.11+1.06+0.64+1.03+0.87+0.88+1.52+1.69+1.41) = 13.20$$

$$\text{Sum of Monthly Averages} = 13.20$$

$$\text{RAA} = 13.20/12$$

$$\text{RAA} = 1.10 \geq 1.00$$

System is in compliance

Step 1 Example #2

Month	<u>A</u> Source TOC (mg/L)	<u>B</u> Source Alk. (mg/L)	<u>C</u> Required TOC Removal (%)	<u>D</u> Treated TOC (mg/L)	<u>E</u> % Removed (A-D)/A	<u>F</u> E/C
Oct.						1.15
Nov.						0.96
Dec.						1.31
Jan.						1.12
Feb.						0.99
Mar.						1.23
Apr.						1.45
May						1.18
Jun.						1.00
Jul.	8.2	70	40.0	4.6	43.9	1.10
Aug.	6.1	75	35.0	4.0	34.4	0.98
Sep.	6.2	80	35.0	4.4	29.0	0.83

since average is ≥ 1.00 ,
the system is in compliance

sum column (F) = 13.30
 $13.33/12 = 1.11$

Mixing and Matching

- You may use most alternative compliance criteria to comply with the Step 1 TOC or Step 2 TOC removal requirements on a month-to-month basis
- Calculate RAA as you normally would, using 1.00 for months when you comply through an alternative criterion



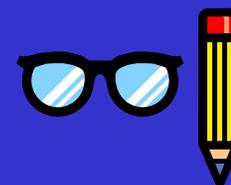
Summary

- Treatment technique matrix
- Monitoring: 1 sample set (3 samples) per month
- Location:
 - Source water alkalinity
 - Source water TOC
 - Treated water TOC
- Compliance methods:
 - Alternative compliance criteria
 - Step 1 TOC removal
 - Step 2 TOC removal
 - State waiver
- Compliance determinations: RAA of monthly ratios
- Mix and match compliance methods

Questions?

DBP Precursors

Part II



Contents

- Step 2 TOC Removal
- Bench Testing
- Step 2 Removal Percentages
- Step 2 Special Cases
- Using Step 2 Results

Step 2 TOC Removal

- Necessary if you cannot meet Step 1 or alternative compliance criteria
- Apply before compliance deadline to avoid violation
- Include results of bench or pilot testing
- State sets alternative minimum TOC removal requirements
- Alternative requirements are called “Step 2”



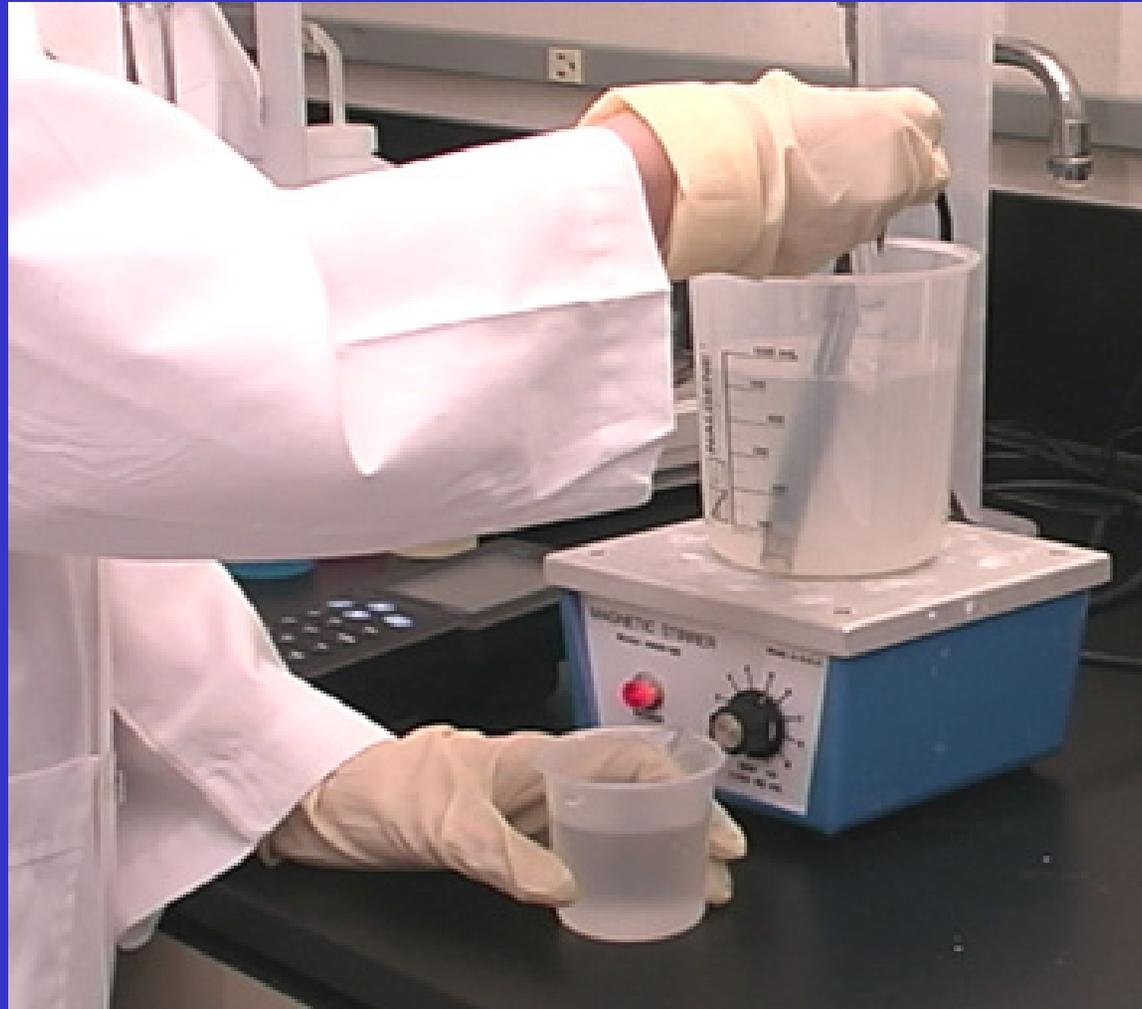
Bench or Pilot Testing

- Jar Testing: add 10 mg/L increments of alum
- Continue until pH \leq Step 2 target pH listed below:

Alkalinity (mg/L as CaCO ₃)	Target pH
0-60	5.5
>60-120	6.3
>120-240	7.0
>240	7.5



Jar Testing-Target pH



Jar Testing Equipment



Jar Testing-Floc Formation



Step 2 Removal Percentages

- Continue adding coagulant until TOC removal ≤ 0.3 mg/L for an incremental addition of 10 mg/L of alum or ferric salt at the target pH level
- Percentage removed is your minimum TOC removal requirement
- May stray from your turbidity “comfort zone”
- Negotiate whether you need to jar test every month



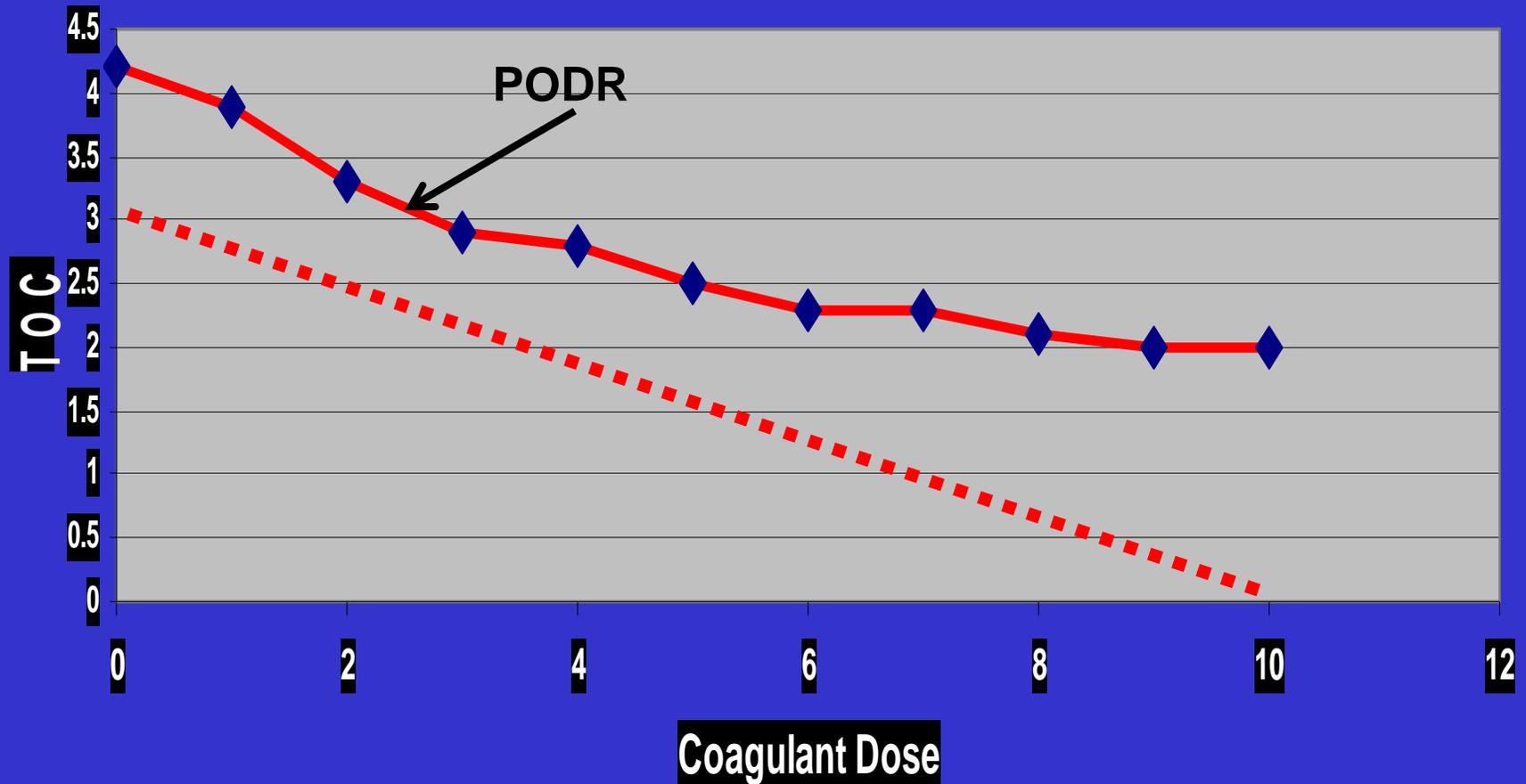
Step 2 Example



Mg/L of coagulant

Point of Diminishing Returns Example

TOC vs. Coagulant Dose



Using Step 2 Results

- **Results can be used for:**
 - Compliance for a full year
 - Compliance for a particular month (mixed and matched)
- **Calculate Step 2 removal ratio**
- **Use removal ratio to calculate RAA (just like Step 1)**

Summary

- Step 2 TOC removal
- Bench or pilot testing
 - Add 10 mg/L increments of alum or ferric salt
- Alternative TOC removal percentages
 - Point of diminishing returns
- Special Cases

Questions?

OTHER COMPLIANCE ISSUES

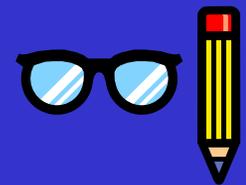
Contents

- Qualified Operators
- Simultaneous Compliance



Qualified Operators

Every system regulated under the Stage 1 DBPR must be operated by a qualified operator



Simultaneous Compliance

- Sampling Schedule
- PN Rule
- LCR
- TCR
- SWTR/IESWTR/LT1SWTR



Summary

- Qualified operators must operate systems
- Consider simultaneous compliance issues, especially with the LT1ESWTR

Questions?