



Pennsylvania Department of Environmental Protection
Bureau of Water Supply and Wastewater Management

**MONITORING AND REPORTING REQUIREMENTS
FOR THE
DISINFECTANTS/DISINFECTION
BYPRODUCTS RULE**



May 2003

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Introduction

This manual was developed as a supplement to the Department of Environmental Protection's Regional Trainers course on the Disinfectants/Disinfection Byproducts (DBP) Rule. The manual specifically focuses on the rule's monitoring requirements, compliance calculations, and reporting requirements. Having a clear idea of this rule's monitoring and reporting requirements will enable readers to learn about when, where and how to monitor correctly. Proper monitoring during *routine* monitoring may allow water systems to take full advantage of *reduced* monitoring requirements and possibly save a considerable amount of money. Furthermore, correct monitoring will avoid unnecessary violations and prevent numerous problems associated with responding to violations.

After reviewing this manual, readers will be able to:

- Understand the DBP Rule's compliance dates for water systems with various population sizes and source water types.
- Find out where to access information on sample locations, monitoring frequencies, compliance calculations, and reporting frequencies for various population sizes and types of water systems.
- Learn where to access a monitoring plan template.
- Determine the requirements to qualify for and remain on a reduced monitoring program.
- Find out about the treatment technique requirements for total organic carbon.
- Describe the basic monitoring plan requirements.

The information in this manual is grouped into five main areas:

1. Compliance Schedules
2. Maximum Residual Disinfectant Levels
3. Disinfection Byproducts
4. Precursor Monitoring and Removal Requirements
5. Monitoring Plans

Compliance Schedules

Compliance for the Disinfectants/Disinfection Byproducts (DBP) Rule is effective on the following dates:

January 2002

- Community water systems and nontransient noncommunity water systems with surface water or *GUDI sources serving at least 10,000 persons; and
- Transient noncommunity water systems with surface water or GUDI sources serving at least 10,000 persons and treating with chlorine dioxide.

January 2004

- Community water systems and nontransient noncommunity water systems with surface water or GUDI sources serving <10,000 persons;
- Community water systems and nontransient noncommunity water systems with groundwater sources only;
- Transient noncommunity water systems with surface water or GUDI sources serving <10,000 persons and treating with chlorine dioxide;
- Transient noncommunity water systems with groundwater sources only and treating with chlorine dioxide; and
- Bottled, vended, retail and bulk systems.

This manual does not cover bottled water and vended water systems, retail water facilities or bulk water hauling systems. To determine the requirements for these facilities and systems, refer to Subchapter J, Chapter 109 Safe Drinking Water Regulations.

The DBP Rule phases out the old Total Trihalomethane Maximum Contaminant Level of 0.10 mg/L with the new DBP Rule effective dates (January 1, 2002 and January 1, 2004). Community water systems with a running annual trihalomethane average above 0.080 mg/L but below 0.10 mg/L shall include health effects language prescribed under the Consumer Confidence Rule.

In the federal regulations—which spell out the various compliance dates—and in many guidance documents from the U.S. Environmental Protection Agency (EPA), you would see a reference to “Subpart H” water systems. The EPA classifies surface water systems and GUDIs as “Subpart H” systems in the federal drinking water regulations.

*** For groundwater systems under the direct influence of surface water (GUDIs), the monitoring locations, frequencies, and other requirements of the rule are identical to surface water systems.**

Maximum Residual Disinfectant Levels (MRDLs)

Regulated Disinfectants

- Chlorine
- Chloramines
- Chlorine Dioxide

The “MRDL” is defined as the level of a disinfectant measured in drinking water that may not be exceeded without an unacceptable possibility of adverse health effects. Basically, the MRDLs establish upper limits of disinfectants that a water system may provide to consumers.

EPA specifically allows short-term exceedances of chlorine and chloramine MRDLs to control microbiological contamination problems such as coliforms. These situations may include instances of cross connection contaminations, floods, and other emergencies. This does not apply to the chlorine dioxide MRDL.

MRDLs are explicitly stated with specific numbers of significant figures. Rounding for the calculation of compliance with MRDLs takes this into account. For example: the MRDL for chlorine = 4.0 mg/L, so 4.04 mg/L still complies.

Chlorine and Chloramines

The MRDL for chlorine and chloramines applies to all community water systems and nontransient noncommunity water systems that treat their water with chlorine or chloramines. This includes surface water, groundwater, and consecutive water systems that serve water that contains a chlorine or chloramine residual. Large surface water systems start monitoring in January 2002 and all other affected water systems start in January 2004.

The MRDL for chlorine and chloramines is 4.0 mg/L (for each chemical).

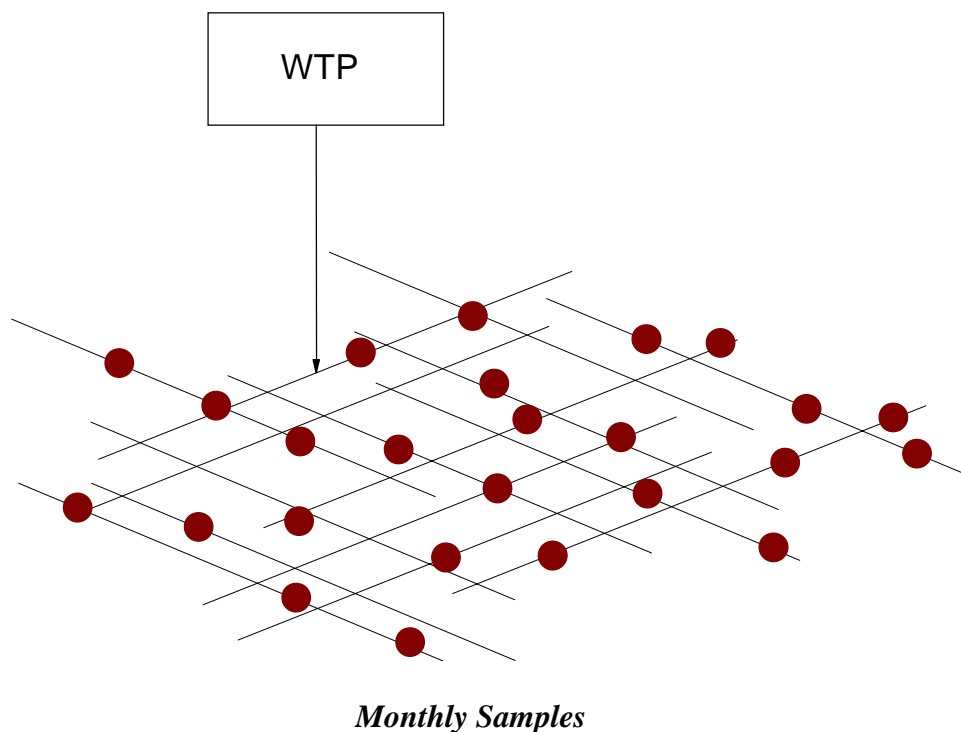
1. MRDL Monitoring Requirements for Chlorine and Chloramines

a. Routine Monitoring

- The monitoring points for chlorine and chloramines are located in the distribution system and not at the entry point. Although the Surface Water Treatment Rule requires a minimum free chlorine residual of 0.2 mg/L at the entry point to the distribution system at surface water treatment plants, the DBP Rule does not set an upper limit on chlorine or chloramine dosages or residuals at the entry point.
- Systems measure residual disinfectant levels at the same points in the distribution system and at same time that total coliforms are sampled.
- Systems maintaining free chlorine residuals monitor either free or total chlorine residuals.

- Systems maintaining chloramine residuals monitor either total or combined residuals.

The diagram below provides a representation of chlorine or chloramine sampling locations in the distribution system. The Total Coliform Rule (TCR) requires a minimum number of coliform samples per month based on the water system's population. Since 25 samples are indicated below, we can guess that this system serves between 21,501 and 25,000 people as outlined in section 109.301 of Pennsylvania's Safe Drinking Water Regulations.



Noncommunity System Tip: Check section 109.301 for the number of coliform monitoring sites and frequencies for the Total Coliform Rule. Most systems monitor monthly. A noncommunity water system using only groundwater and serving 1,000 or fewer persons per day takes 1 Total Coliform Rule sample and 1 disinfectant residual each calendar quarter.

Groundwater System Tip: Currently, community and nontransient noncommunity systems using groundwater might not be monitoring disinfectant residuals. These systems will need to remember to measure residuals under the DBP Rule at their Total Coliform Rule sample sites.

b. Reduced Monitoring

- The DBP Rule does not allow reduced monitoring for chlorine and chloramine MRDLs.

2. Compliance for Chlorine and Chloramine MRDLs

If a system exceeds a chlorine or chloramine MRDL, the system is in violation, shall notify the public, and report to DEP.

- The MRDL compliance is based on a running annual arithmetic average (RAA), computed *quarterly*, of monthly averages of all samples collected by the system. *Systems will be considered in violation of the MRDL whenever the results of the monitoring will cause the RAA of that system to exceed the MRDL.*
- If the running annual average for any consecutive 4-quarter period exceeds the MRDL, the system is in violation, shall notify the public, and report to DEP.
- If the system switches between the use of chlorine and chloramines during the year, compliance is determined by including together all monitoring results of both chlorine and chloramines in calculating compliance. In other words, the system will still need to monitor the appropriate residuals but will not have to calculate running annual averages separately for each type of residual.
- Failure to monitor will be treated as a violation for the entire period covered by the annual average, where compliance is based on a running annual average of monthly or quarterly samples and the system's failure to monitor makes it impossible to determine compliance with the MRDLs. In other words, if a system fails to monitor in a specific month or months, they will then use available residual data to calculate running annual averages, thus risking an MRDL violation for the entire year, even though data is available for only part of the year.

Here's an example compliance calculation for a community water system using chlorine in the first year of monitoring under the DBP Rule:

Month	Cl ₂ Monthly Avg. mg/L	Cl ₂ RAA Calculation mg/L	Cl ₂ RAA mg/L
1	1.2	--	--
2	0.8	--	--
3	0.9	2.89 / 12	0.2
4	1.4	--	--
5	0.8	--	--
6	1.1	6.2 / 12	0.5
7	0.9	--	--
8	4.5	--	--
9	1.4	13 / 12	1.1
10	1.6	--	--
11	1.0	--	--
12	1.0	16.6 / 12	1.4

During the second year (and subsequent years) of monitoring, the compliance calculation would look something like this:

Month	Cl ₂ Monthly Avg. mg/L	Cl ₂ RAA Calculation mg/L	Cl ₂ RAA mg/L
1	0.8	--	--
2	0.8	--	--
3	0.9	16.2 / 12 ¹	1.4
4	1.2	--	--
5	1.2	--	--
6	1.0	6.3 / 12 ²	1.4
7	1.5	--	--
8	2.2	--	--
9	1.2	14.4 / 12 ³	1.2
10	0.9	--	--
11	0.8	--	--
12	0.9	13.4 / 12 ⁴	1.1

¹ 16.2 represents values from the last 9 months of the previous year plus the first 3 months of the current year.

² 16.3 represents values from the last 6 months of the previous year plus the first 6 months of the current year.

³ 14.4 represents values from the last 3 months of the previous year plus the first 3 months of the current year.

⁴ 13.4 represents values from all 12 months of the current year.

All the distribution samples are averaged into one monthly value. At the end of each quarter (March, June, September, and December) the past 12 monthly averages are then averaged to determine compliance. The exception to this is the first year of monitoring, when only the data from that year are used.

Chloramine Tip: Normally, a water system monitors either free or total chlorine residuals in the distribution system. Some systems, however, produce chloramines as a separate process for distribution. If a system anticipates changes between chlorine and chloramines, the best residual to monitor and report may be total chlorine because this type of residual is appropriate for either chlorine or chloramine treatment.

As you can see, water systems in Pennsylvania should have no difficulty in complying with these MRDLs. Not only are all the distribution system samples averaged each month, but also the results are averaged throughout the year. It is unlikely that a water system will constantly maintain chlorine or chloramine residuals at such high levels. The challenge will involve learning the proper monitoring locations, frequencies, and compliance calculations.

3. Reporting Requirements for Chlorine and Chloramine MRDLs

Within 10 days after the end of the month, water systems report the following information to DEP on the revised SDWA-S form:

- The number of samples collected during the previous month.
- The number of required samples for the previous month.
- The monthly average of all samples collected during the previous month.

Note: For nontransient noncommunity groundwater systems serving less than 1,000 people, the reporting requirement is quarterly instead of monthly.

Each quarter, DEP will calculate:

- The average of all monthly averages for the last twelve months. This value is also known as the running annual average.
- Whether the running annual average exceeds the MRDL.

Chlorine Dioxide

The chlorine dioxide MRDL applies to community water systems, nontransient noncommunity water systems, **and transient water systems** that treat their water with chlorine dioxide for disinfection or oxidation. This includes surface water, GUDIs or groundwater systems. Large surface water systems start monitoring in January 2002 and all other affected water systems start in January 2004.

The MRDL for chlorine dioxide is 0.8 mg/L as ClO₂. As explained below, exceeding the MRDL does not necessarily mean a violation has occurred.

1. MRDL Monitoring Requirements for Chlorine Dioxide

a. Routine Monitoring

- A daily sample is collected at the entrance to the distribution system, but only at a treatment plant using chlorine dioxide.

b. Follow-Up to an Exceedance

- A single exceedance at the entry point is not an MRDL violation, but is a trigger for additional monitoring that must be completed in the distribution system.
- If any daily entry point sample exceeds 0.8 mg/L, the water system must take **3** distribution system samples the following day.
- Systems with no booster chlorination collect 3 distribution system samples “in time” as close as possible to the first customer at intervals of at least 6 hours, e.g., 6-, 12-, and 18-hours.

- Systems with booster chlorination collect 3 distribution system samples “by location,” which means (1) as close as possible to first customer, (2) a location representative of average residence time, **and** (3) as close as possible to the end of the distribution system, usually referred to as the “maximum residence time.”

Chlorine Dioxide Tip: If chlorine dioxide is added early in the treatment processes at a filter plant, it is very difficult to exceed 0.8 mg/L at the entry point. This is because chlorine dioxide is very reactive and dissipates rapidly.

c. Reduced Monitoring

- The DBP Rule does not allow reduced monitoring for chlorine dioxide.

2. MRDL Compliance for Chlorine Dioxide

As stated above, if any daily sample taken at the entrance to the distribution system exceeds 0.8 mg/L, the water system must take 3 additional samples in the distribution system the following day.

“Nonacute Violation” (Tier 2)

- If any entry point samples exceed 0.8 mg/L on two consecutive days and all distribution system samples are below 0.8 mg/L, the system is in violation and shall take immediate corrective action and notify the public of a nonacute public health risk.
- On the day following a 0.8 mg/L exceedance at any entry point: if the water system fails to monitor at the entry point, a violation occurs and the system shall notify the public of a nonacute violation.

“Acute Violation” (Tier 1)

- If one or more of the samples in the distribution system (taken the day following an exceedance) is > 0.8 mg/L, the water system is in violation and shall take immediate corrective action and notify the public of an acute public health risk.
- On the day following a 0.8 mg/L exceedance at any entry point: if the water system fails to take 3 additional samples in the distribution system, a violation occurs and the system shall notify the public of an acute violation.

3. Public Notification for Chlorine Dioxide

For acute (Tier 1) violations, the system shall:

- Report the violation to DEP within 1 hour;
- Provide a public notice as soon as possible, but no later than 24 hours after it learns of the violation;
- Initiate consultation with DEP within the same 24-hour period; and

- Comply with any additional public notice requirements that are established as a result of the consultation with DEP. These requirements may include the timing, form, manner, duration, frequency and content of the initial and any repeat notices.

For nonacute (Tier 2) violations, the system shall:

- Report the violation to DEP within 1 hour;
- Provide a public notice as soon as possible, but no later than 30 days after it learns of the violation; and
- Repeat the notice every 3 months as long as the violation persists.

The water system shall meet all content requirements, such as including the standard health effects language for acute or nonacute violations or situations.

Refer to the *Public Notification Handbook* or contact your local DEP office for more information about the form, manner, content and delivery requirements for public notification.

4. Reporting Requirements for Chlorine Dioxide MRDLs

Within 10 days after the end of the month, water systems report the following information to DEP:

- Using the SDWA-S form (as revised in 2002), the number of entry point samples required and taken, based on the number of days of chlorine dioxide treatment and the number of entry points delivering water treated with chlorine dioxide.
- Using the SDWA-1 form, the dates, locations and results of all entry point and distribution samples that were collected during the previous month.

Each month, DEP will calculate:

- Whether the MRDL was exceeded.
- Whether the proper number of distribution samples were collected (if required). Note: DEP will also use data reported on the SDWA-S form to calculate the proper number of daily entry point chlorine dioxide and chlorite sample results that should be reported on the SDWA-1 form.
- Whether the MRDL was exceeded in any two consecutive daily samples and whether the resulting violation was acute or nonacute.

Even though DEP calculates this MRDL information after the end of the month, water systems still need to adhere to the MRDL monitoring, compliance, and public notification requirements for chlorine dioxide during the month, when applicable.

Disinfection Byproducts

Regulated Disinfection Byproducts

- Total Trihalomethanes
- Haloacetic Acids
- Chlorite
- Bromate

The Maximum Contaminant Levels (MCL) for these contaminants are explicitly stated with specific numbers of significant figures. Rounding for the compliance calculation of MCLs takes this into account. For example, the MCL for Total Trihalomethanes (TTHM) = 0.080 mg/L, so 0.0804 mg/L still complies.

With the exception of bromate, the Pennsylvania Drinking Water Information System will automate the reduced monitoring process provided water systems submit the appropriate data and meet reduced monitoring provisions.

TTHM and HAA5

The MCLs for Total Trihalomethanes (TTHMs) and Haloacetic Acids (HAA5) apply to all community water systems and nontransient noncommunity water systems that treat their water with a chemical disinfectant or serve water that contains a disinfectant residual. This includes surface water, groundwater, and consecutive water systems. Large surface water systems serving at least 10,000 people start monitoring in January 2002 and all other affected water systems start in January 2004.

TTHMs currently include the sum of the following 4 contaminants:

- Chloroform
- Bromodichloromethane
- Bromoform
- Dibromochloromethane

The MCL for TTHM = 0.080 mg/L, which can also be expressed as 80.0 ug/L.

HAA5 currently includes the sum of the following 5 contaminants:

- Monochloroacetic acid
- Dichloroacetic acid
- Trichloroacetic acid
- Monobromoacetic acid
- Dibromoacetic acid

The MCL for HAA5 = 0.060 mg/L, which can also be expressed as 60.0 ug/L.

Helpful Tips:

- In the following pages, you will see references to “**sample sets.**” TTHM and HAA5 samples are collected during the same monitoring period and at the same location in the distribution system, so they are referred to as a set. Some water systems will need to collect up to four of these sets at various locations in the distribution system.
- This part of the regulations does not *require* **Total Organic Carbon (TOC)** monitoring of the raw water. However, all surface water systems serving at least 500 people need to collect a monthly raw TOC sample to take advantage of a reduced monitoring program for TTHM and HAA5. Surface water systems serving less than 500 people do not qualify for reduced TTHM/HAA5 monitoring – they must always monitor TTHM and HAA5 at least annually.
- Unlike other parts of the rule, the section on TTHM and HAA5 monitoring has several **population categories**. Surface water systems and GUDIs are divided into groups of large (at least 10,000 people), small (500 to 9,999 people) and very small (<500). Ground water systems only involve two groups: large (at least 10,000 people) and small (<10,000 people). The number of samples collected and frequency are based on these population groups.
- For all population and source categories, the number of samples is also based on the number of treatment plants. For this purpose, **a plant is defined as:**
 - any filtration plant where a disinfectant is added;
 - any disinfection treatment facility for a groundwater source. All treatment facilities associated with wells within the same aquifer may be considered as a single plant (subject to DEP approval); and
 - a purchased water connection with another water system that uses a disinfectant. More than one connection delivering the same water from the same seller may be considered as a single plant.

Note: Booster chlorination stations do not count as plants. Emergency treatment facilities and purchased water connections are not counted unless placed into service.

Links with other regulations:

Large surface water systems serving at least 10,000 people completed quarterly TTHM and HAA5 monitoring from April 1999 to March 2000 for the **Interim Enhanced Surface Water Treatment Rule**. The monitoring was a one-time “early implementation activity” in preparation for the Disinfectants/Disinfection Byproducts Rule.

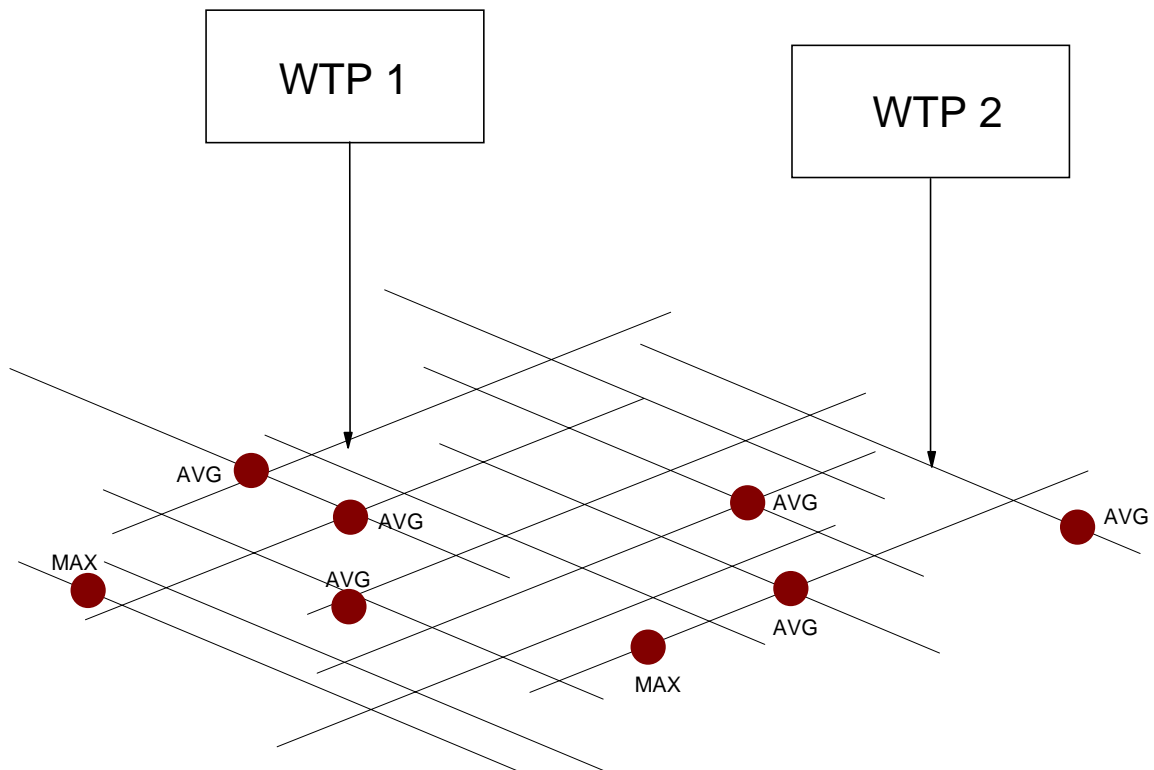
Similar to the “early implementation activity” in IESWTR, the small *surface* water systems collected TTHM and HAA5 samples during the summers of 2002 or 2003 as required under the **Long Term 1 Enhanced Surface Water Treatment Rule**. Notification took place through a direct mailing to the water systems.

1. TTHM and HAA5 Monitoring Requirements for Large Surface Water Systems

a. Routine Monitoring for Large Surface Water Systems (at least 10,000 people)

- TTHM and HAA5 samples are taken at the same sample location.
- **4** of these TTHM/HAA5 “sample sets” are collected each **quarter** for each of the water system’s treatment plants.
- 3 samples sets are taken at locations representative of the average residence time.
- 1 sample set is taken at a location representative of the maximum residence time.
- If more than 4 of these “sample sets” are taken, at least 25% of all the samples are taken at locations representative of maximum residence time.

The diagram below provides a representation of routine TTHM and HAA5 monitoring locations for a large surface water system that operates two plants.



Quarterly Samples

Maximum Residence Tip: You'll see a lot of references to "**maximum residence time**" as part of the TTHM and HAA5 sampling requirements. These are distribution system areas where water has the longest time to form DBPs. Dead ends of the distribution system or storage tanks with low turnover rates are areas where the water has long standing times. Most operators know where the chlorine residuals are lowest in the system, which is often an indicator of maximum residence time.

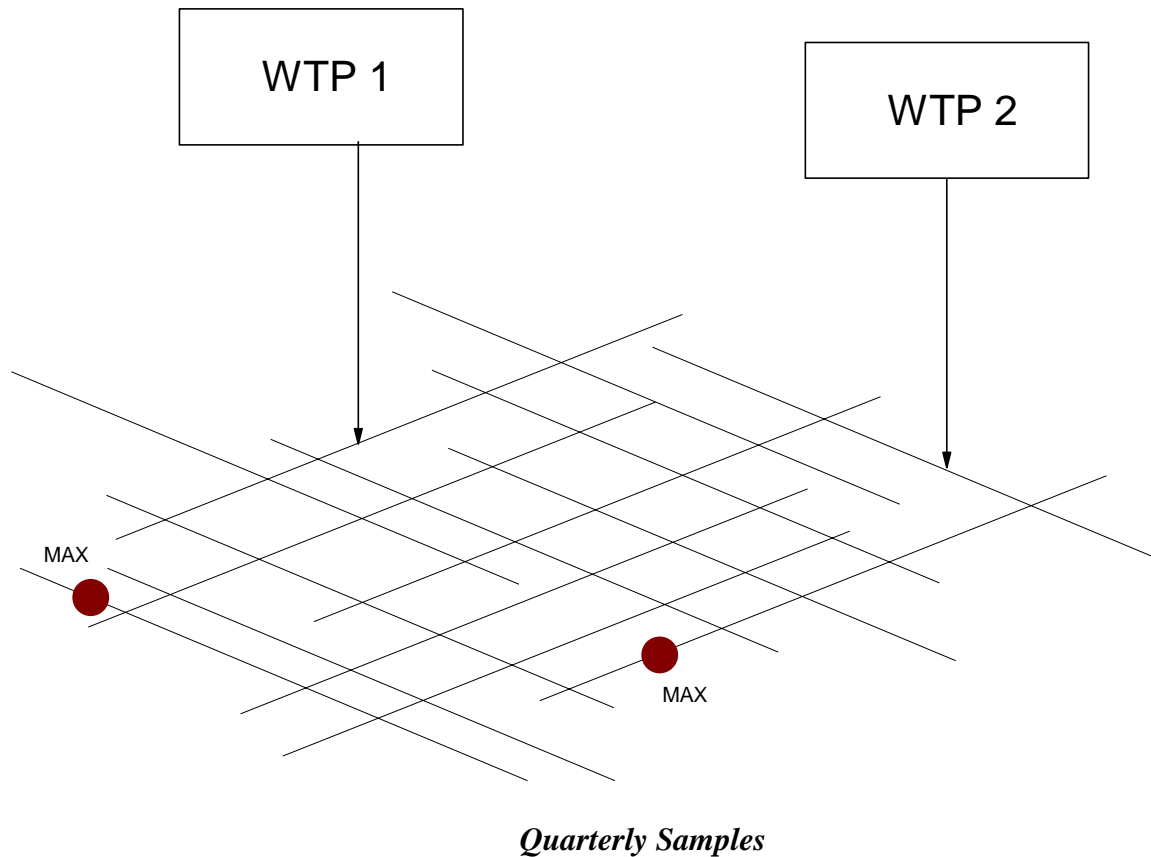
b. Reduced Monitoring for Large Surface Water Systems (at least 10,000 people)

To qualify for reduced monitoring, after at least one year of monitoring, the TTHM running annual average (RAA) must be ≤ 0.040 mg/L and the HAA5 RAA must be ≤ 0.030 mg/L, AND the source water TOC must not exceed 4.0 mg/L prior to treatment (based on the RAA of monthly or quarterly samples).

- TTHM and HAA5 samples are taken at the same sample location.
- 1 of these "sample sets" is collected each quarter for each of the water system's plants.
- The sample set is taken at a location representative of the maximum residence time.
- Raw water TOC sampling may be discontinued while in a reduced monitoring program, but only for plants not using "conventional" filtration processes.

The system resumes routine monitoring to 4 samples per plant per quarter if the TTHM RAA exceeds 0.060 mg/L OR the HAA5 RAA exceeds 0.045 mg/L. Systems not using conventional filtration should also resume source water TOC sampling to be eligible for reduced monitoring again.

The following diagram provides a representation of reduced TTHM and HAA5 monitoring locations for a large surface water system that operates two plants.

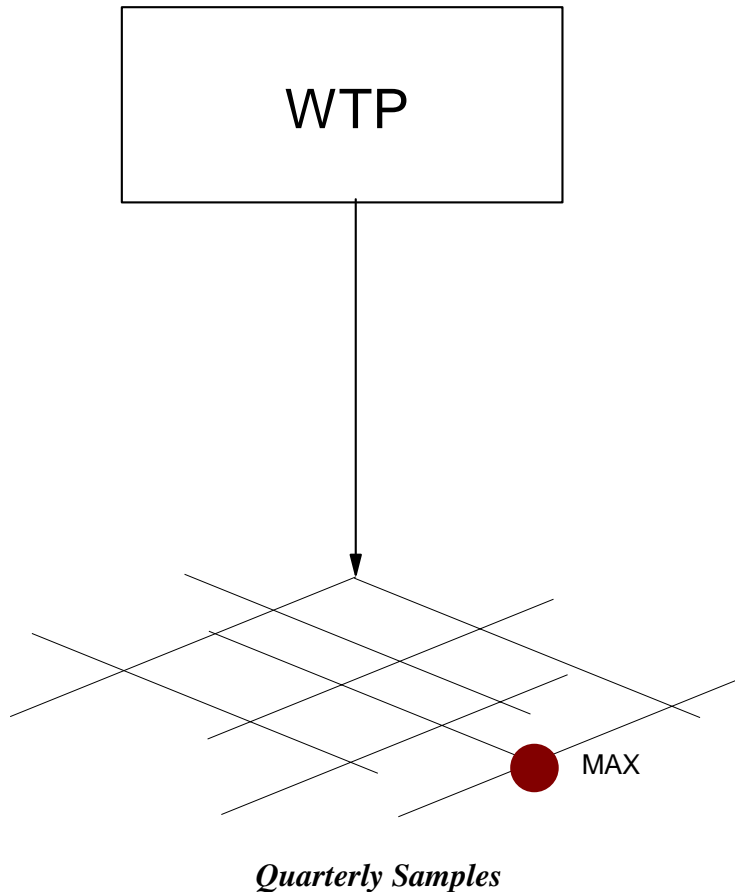


2. TTHM and HAA5 Monitoring Requirements for Small Surface Water Systems

a. Routine Monitoring for Small Surface Water Systems (500-9,999 people)

- TTHM and HAA5 samples are taken at the same sample location.
- **1** of these TTHM/HAA5 “sample sets” is collected each **quarter** for each of the water system’s treatment plants.
- The sample set is taken at a location representative of the maximum residence time.
- If more than 1 of these “sample sets” is taken, at least 25% of all the samples are taken at locations representative of maximum residence time.

The following diagram provides a representation of routine TTHM and HAA5 monitoring locations for a small surface water system that operates one plant.



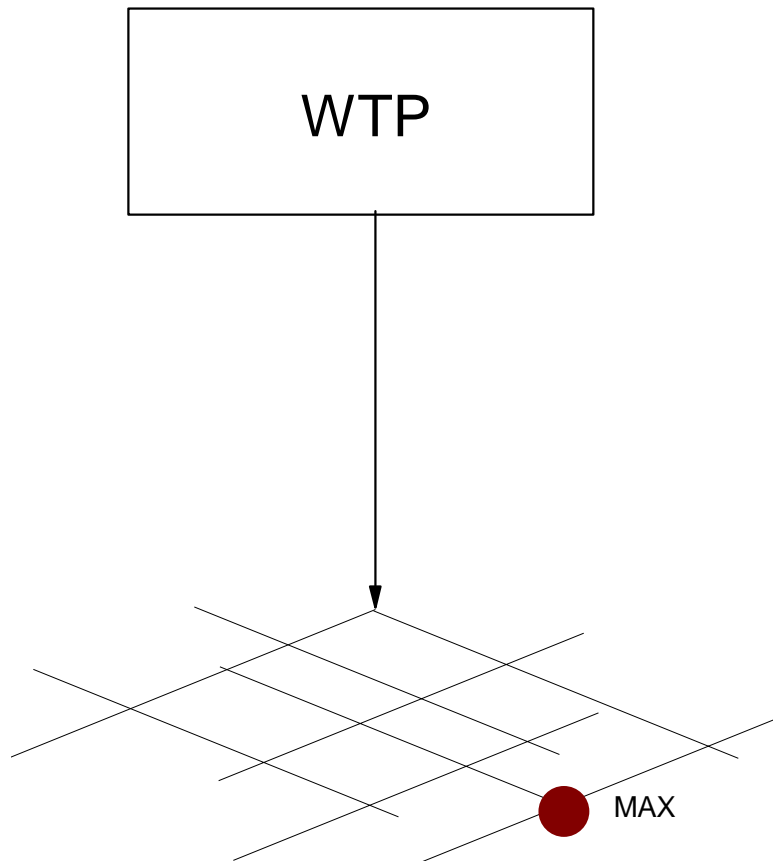
b. Reduced Monitoring for Small Surface Water Systems (500-9,999 people)

To qualify for reduced monitoring, after at least one year of monitoring, the TTHM running annual average (RAA) must be ≤ 0.040 mg/L and the HAA5 RAA must be ≤ 0.030 mg/L, AND the source water TOC must not exceed 4.0 mg/L prior to treatment (based on RAA of monthly or quarterly samples).

- TTHM and HAA5 samples are taken at the same sample location.
- 1 of these “sample sets” is collected each year for each of the water system’s plants.
- The sample set is taken at a location representative of the maximum residence time.
- The samples are taken during the month of warmest water temperatures.
- Raw water TOC sampling may be discontinued while in a reduced monitoring program, but only for plants not using a “conventional” filtration process.

The system resumes routine monitoring to 1 sample per plant per quarter if the TTHM or HAA5 sample, taken during the month of warmest water temperature, exceeds 0.060 mg/L or 0.045 mg/L, respectively. If this happens, routine monitoring resumes in the quarter following the TTHM or HAA5 exceedance. Systems not using conventional filtration should also resume source water TOC sampling to be eligible for reduced monitoring again.

The following diagram provides a representation of reduced TTHM and HAA5 monitoring locations for a small surface water system that operates one plant.



Annual samples during the month of warmest water temperature

3. TTHM and HAA5 Monitoring Requirements for Very Small Surface Water Systems

a. Routine Monitoring for Very Small Surface Water Systems (<500 people)

- TTHM and HAA5 samples are taken at the same sample location.
- **1** of these “sample sets” is collected each **year** for each of the water system’s plants.
- The sample set is taken at a location representative of the maximum residence time.
- The samples are taken during the month of warmest water temperatures.
- If more than 1 of these “sample sets” is taken, at least 25% of all the samples are taken at locations representative of maximum residence time.

The system must increase monitoring to **1** sample per plant per **quarter** if the average of all TTHM or HAA5 samples, taken during the month of warmest water temperature, exceeds the TTHM or HAA5 MCL value. Increased monitoring begins the quarter following the MCL exceedance. Remember that the system may only incur a TTHM or HAA5 MCL violation

while on quarterly monitoring and the RAA exceeds the MCL. To resume routine annual monitoring, the TTHM RAA must be ≤ 0.060 mg/L and the HAA5 RAA must be ≤ 0.045 mg/L after at least 4 quarters of monitoring.

b. Reduced Monitoring for Very Small Surface Water Systems (<500 people)

- The DBP Rule does not allow reduced TTHM and HAA5 monitoring for very small surface water systems. They must always monitor at least annually.

4. TTHM and HAA5 Monitoring Requirements for Large Ground Water Systems

a. Routine Monitoring for Large Ground Water Systems (at least 10,000)

- TTHM and HAA5 samples are taken at the same sample location.
- 1 of these “sample sets” is collected each quarter for each of the water system’s treatment plants. With DEP approval, multiple wells drawing from the same aquifer may be considered as a single treatment plant.
- The sample set is taken at a location representative of the maximum residence time.
- If more than 1 of these “sample sets” is taken, at least 25% of all the samples are taken at locations representative of maximum residence time.

b. Reduced Monitoring for Large Ground Water Systems (at least 10,000)

To qualify for reduced monitoring, after at least 4 quarters of monitoring, the TTHM running annual average (RAA) must be ≤ 0.040 mg/L and the HAA5 RAA must be < 0.030 mg/L.

- TTHM and HAA5 samples are taken at the same sample location.
- 1 of these “sample sets” is collected each year for each of the water system’s plants.
- The sample set is taken at a location representative of the maximum residence time.
- The samples are taken during the month of warmest water temperatures. Water systems can check records to determine if groundwater temperatures fluctuate significantly through the year.

The system resumes routine monitoring to 1 sample per plant per quarter if the TTHM or HAA5 sample, taken during the month of warmest water temperature, exceeds 0.060 mg/L or 0.045 mg/L, respectively. If this happens, routine monitoring resumes in the quarter following the TTHM or HAA5 exceedance. Remember, the system can only incur a TTHM or HAA5 MCL violation while on quarterly monitoring and the RAA exceeds the MCL

5. TTHM and HAA5 Monitoring Requirements for Small Ground Water Systems

a. Routine Monitoring for Small Ground Water Systems (<10,000)

- TTHM and HAA5 samples are taken at the same sample location.

- 1 of these “sample sets” is collected each year for each of the water system’s plants. With DEP approval, multiple wells drawing from the same aquifer may be considered as a single treatment plant.
- The sample set is taken at a location representative of the maximum residence time.
- The samples are taken during the month of warmest water temperatures. Water systems can check records to determine if groundwater temperatures fluctuate significantly through the year.
- If more than 1 of these “sample sets” is taken, at least 25% of all the samples are taken at locations representative of maximum residence time.

The system must increase monitoring to 1 sample per plant per quarter if the average of all TTHM or HAA5 samples, taken during the month of warmest water temperature, exceeds the TTHM or HAA5 MCL value. Increased monitoring begins the quarter following the MCL exceedance. Remember, the system may only incur a TTHM or HAA5 MCL violation while on quarterly monitoring and the RAA exceeds the MCL. To return to routine annual monitoring, the TTHM RAA must be ≤ 0.060 mg/L and the HAA5 RAA must be ≤ 0.045 mg/L after at least 4 quarters of monitoring.

b. Reduced Monitoring for Small Ground Water Systems (<10,000)

To qualify for reduced monitoring, the average of all samples taken during the month of warmest water temperature for TTHM and HAA5 must be 0.040 mg/L or less and 0.030 mg/L or less, respectively, for 2 consecutive years

OR

The average of all samples taken during the month of warmest water temperature for TTHM and HAA5 must be ≤ 0.020 mg/L and ≤ 0.015 mg/L, respectively, for 1 year.

- TTHM and HAA5 samples are taken at the same sample location.
- 1 of these “sample sets” is collected once every 3 years for each of the water system’s plants.
- The sample set is taken at a location representative of the maximum residence time.
- The samples are taken during the month of warmest water temperatures. Water systems can check records to determine if groundwater temperatures fluctuate significantly through the year.

The system resumes routine monitoring to 1 sample per plant per year if the TTHM or HAA5 sample, taken during the month of warmest water temperature, exceeds 0.060 mg/L or 0.045 mg/L, respectively. If this happens, routine monitoring resumes in the year following the TTHM or HAA5 exceedance. The system increases to quarterly monitoring (1 sample per plant per quarter) if either the TTHM or HAA5 MCL value is exceeded. If this happens, routine monitoring resumes in the quarter following the TTHM or HAA5 exceedance. Remember, the system will not incur an MCL violation unless the system is on quarterly monitoring and the running annual average exceeds the MCL.

6. TTHM and HAA5 Monitoring Requirements for Consecutive Water Systems

The DBP Rule applies to consecutive water systems. Consecutive systems are defined as systems that purchase all of their water from another water system. Consecutive systems need to develop a monitoring plan. The TTHM and HAA5 monitoring requirements for consecutive systems are dependent on the following three factors:

- the number of people that the consecutive system serves;
- whether the selling system (also called the parent system) obtains water from a groundwater source or surface water source; and
- the number of interconnections with the selling system.

Let's look at a consecutive system serving less than 10,000 people that buys water from a system that serves at least 10,000 people. They purchase water through one interconnection. When does this system start monitoring and how many samples should they collect?

First, determine the population of the consecutive system. Let's say this system serves 3,400 people. Since it serves less than 10,000 people, the DBP Rule will not affect it until 2004. Remember, only large surface water systems start monitoring in 2002.

Next, determine the source water of the selling system. If the selling system in the above example obtains water from a surface water source, then 1 set of TTHM/HAA5 samples is collected each quarter at a location representative of the maximum residence time in the consecutive system. If the selling system is classified as groundwater, 1 set of samples is collected each year, during the month of warmest water temperature, at a location representative of the maximum residence time. Note that the population of the selling system does not affect the monitoring requirements of the consecutive system.

Finally, keep in mind that this example system only has one interconnection, which counts as one "plant" for monitoring purposes. Multiple interconnections from the same selling system are generally considered the same as one interconnection (which is considered the same as one plant) as long as the water chemistry is the same. Additional interconnections with additional selling systems are considered to be additional "plants," and therefore will affect monitoring requirements.

It is very important to remember that purchased water with high TTHM or HAA5 levels could trigger a violation in a consecutive system. Thus, it is essential to open a dialogue with the selling system to identify DBP control strategies and disinfectant residual strategies. Water systems should work with DEP to achieve a comprehensive solution to this scenario.

What if a system has its own water sources with treatment and purchases water from one or more selling system as well? The system will need to count each of its own treatment plants and each interconnection as a plant, and monitor accordingly. The monitoring will depend on the total number of plants, the type of source water, and the system's population.

7. Compliance for TTHM and HAA5

If a system exceeds a TTHM or HAA5 MCL, the system is in violation, shall notify the public, and report to DEP.

Systems will not be considered in violation of an MCL until they have completed at least 1 year of quarterly monitoring. A water system can only incur an MCL violation when on a quarterly monitoring frequency. All MCL compliance is based on the running annual average (RAA), computed quarterly, rather than any one set of samples. Therefore, any systems on a “less-than-quarterly” monitoring schedule will not incur MCL violations until samples are collected over four consecutive quarters. For example, a small groundwater system, normally on routine annual monitoring, cannot incur an MCL violation unless their monitoring requirement has been increased to a quarterly frequency. The one exception is when the average of all samples taken during the month of warmest water temperature by a water system on annual or triennial monitoring exceeds four times the MCL. That situation will trigger quarterly monitoring, and the annual or triennial sample will count as the first quarter of quarterly monitoring. Therefore, the system will already be in violation, because it will be impossible for any results in the subsequent three quarters to cause the RAA to be less than the MCL.

Here’s an example TTHM compliance calculation for a large groundwater system with two treatment plants, on quarterly monitoring, during their **first** year of DBP Rule. Since they must take one maximum residence sample per plant, they have to take two samples per quarter.

Quarter	Sample 1 (mg/L)	Sample 2 (mg/L)	TTHM Quarterly Avg. (mg/L) of Two Samples	TTHM Running Annual Avg. (mg/L)
1 (Jan-Mar)	.046	.058	$\frac{.0104}{2} = .052$	$\frac{.052}{4} = .013$
2 (Apr-Jun)	.048	.082	$\frac{.13}{2} = .065$	$\frac{.117}{4} = .029$
3 (Jul-Sep)	.065	.105	$\frac{.17}{2} = .085$	$\frac{.202}{4} = .051$
4 (Oct-Dec)	.059	.095	$\frac{.154}{2} = .077$	$\frac{.279}{4} = .070$

In the above example, this system did not meet the criteria for reduced monitoring ($RAA \leq 0.040$ mg/L after one year of monitoring). Using additional example data, the calculations for the following year (and subsequent years) might look something like this:

Quarter	Sample 1 (mg/L)	Sample 2 (mg/L)	TTHM Quarterly Avg. (mg/L) of Two Samples	TTHM Running Annual Avg. (mg/L)
1 (Jan-Mar)	.044	.052	$\frac{.096}{2} = .048$	Add 3 qtrly avgs from prev yr plus this qtr and divide by 4 $\frac{.275}{4} = .069$
2 (Apr-Jun)	.042	.070	$\frac{.112}{2} = .056$	Add 2 qtrly avgs from prev yr plus 2 qtrs this yr and divide by 4 $\frac{.284}{4} = .071$
3 (Jul-Sep)	.058	.092	$\frac{.15}{2} = .075$	Add 1 qtrly avg from prev yr plus 3 qtrs this yr and divide by 4 $\frac{.256}{4} = .064$
4 (Oct-Dec)	.047	.075	$\frac{.122}{2} = .061$	Add all 4 qtrly avgs from this yr and divide by 4 $\frac{.240}{4} = .060$

Note: In calculating the running annual average, the divisor is reduced by one for each quarter that the system fails to monitor. For example, if a system fails to monitor one quarter (when on quarterly monitoring), then the divisor is 3 instead of 4. If a system fails to monitor two quarters during a year (when on quarterly monitoring), then the divisor is 2 instead of 4. This prevents a system from averting an MCL violation simply by not taking enough samples.

If a system on a “less-than-quarterly” schedule (e.g., annual) exceeds an MCL, the system increases monitoring to once per quarter per plant. If the system fails to complete 4 quarters of monitoring, compliance is based on the average of available data.

If the running average of any consecutive 4-quarter period exceeds an MCL, the water system is in violation, shall report to DEP, and notify the public.

Compliance Quiz #1

A small surface water system with one treatment plant is on a reduced monitoring schedule, so the water system staff collect one annual set of TTHM/HAA5 samples during the month of warmest water temperature at the location of maximum residence time. Here's how the TTHM results appear on a worksheet:

Quarter	TTHM Maximum Residence Sample (mg/L)	TTHM Running Annual Avg. (mg/L)
1 (Jan-Mar)		Not computed because on annual monitoring schedule
2 (Apr-Jun)		Not computed because on annual monitoring schedule
3 (Jul-Sep) (Qtr containing month with warmest water temperature)	.085	Not computed because on annual monitoring schedule
4 (Oct-Dec)	.042	$\frac{.127}{4 \text{ quarters}} = .032$

Is this small surface system in compliance with the TTHM MCL while on reduced monitoring?

Answer: Yes. Even though their annual sample exceeded the TTHM MCL value, they do not have a violation because this small surface water system is on a reduced monitoring schedule. Compliance is based only on quarterly sampling. However, because the annual sample exceeded the trigger for resuming routine quarterly monitoring (0.060 mg/L), the system must resume quarterly monitoring the very next quarter. That is why you see a sample result in the table for the last quarter of the year. The annual sample counts as the first quarterly sample, so starting with the next quarter, the running annual average is computed to determine compliance*. Even if the annual HAA5 result had been very low, both parameters would have to resume to quarterly monitoring, because TTHM and HAA5 are always tested together as a set.

* Don't forget, however, if the annual sample had been greater than four times the MCL, the system would be in violation immediately, because it would be impossible for any results in the subsequent three quarters to cause the running annual average to be less than the MCL.

Compliance Quiz #2

A small surface water system is on a routine quarterly monitoring schedule, and the water system staff collects one quarterly set of TTHM/HAA5 samples at the maximum residence time in the distribution system. Below is the data from the last two quarters of 2004 and the first two quarters of 2005.

Quarter	TTHM Maximum Residence Sample (mg/L)	TTHM Running Annual Avg. (mg/L)
(Jul-Sep 2004)	.077	.023
(Oct-Dec 2004)	.090	.041
(Jan-Mar 2005)	.088	.064
(Apr-Jun 2005)	.087	.086

Is this small surface water system, which is on a routine quarterly monitoring, in compliance with the TTHM MCL?

Answer: No, the water system has violated the MCL for TTHM. The compliance calculation for this small surface water system is based a running annual average of a routine quarterly monitoring schedule, and in the April-June quarter, the running annual average exceeded the MCL of 0.080 mg/L. Similarly, HAA5 compliance would be calculated in the same manner.

8. Reporting Requirements for TTHM and HAA5

The DBP Rule requires that DEP-certified laboratories must perform all TTHM/HAA5 sample analyses. These certified laboratories use an SDWA-1 form to report the following data to DEP:

- The date, location, and result of each sample taken during each calendar quarter. When on annual or triennial monitoring, report the result of each sample taken during the month of warmest water temperature.

DEP will calculate:

- The average of all samples taken in a quarter.
- The running annual average for all systems on quarterly monitoring.
- Whether the running annual average, for systems on quarterly monitoring, exceeds the MCL for either TTHM or HAA5.
- Whether the average of all samples taken during the quarter containing the month of warmest water temperature, for systems on annual or triennial monitoring, is four times greater than the MCL for either TTHM or HAA5.

Chlorite

The chlorite MCL only applies to community water systems and nontransient noncommunity water systems that use chlorine dioxide for disinfection or oxidation. This includes surface water and groundwater systems. Even though affected transient noncommunity water systems monitor chlorine dioxide residuals, they do not have to monitor for chlorite. Large surface water systems serving at least 10,000 people start monitoring in January 2002 and all other affected water systems start in January 2004.

The MCL for chlorite is 1.0 mg/L in the distribution system. As you'll see, exceeding 1.0 mg/L at the entry point does not mean a violation has occurred.

1. Monitoring Requirements for Chlorite

a. Routine Daily Monitoring

- A daily sample is collected at the entrance point to the distribution system, but only at a treatment plant using chlorine dioxide.

b. Follow-Up to an Exceedance

- An exceedance is not an MCL violation, but is a trigger for increased monitoring in the distribution system.
- If any sample exceeds 1.0 mg/L, the system takes additional samples the following day at specified locations and sends the samples to a certified lab.
- Systems collect 3 follow-up samples “by location,” which means (1) as close as possible to first customer, (2) a location representative of average residence time, **and** (3) as close as possible to the end of the distribution system, usually referred to as the “maximum residence time.” These samples are collected on the same day.
- If the **average** chlorite value for all 3 follow-up samples is above 1.0 mg/L, the system will be in violation of the MCL.

Chlorite Tip: The follow-up chlorite monitoring should not be confused with the chlorine dioxide monitoring in the distribution system that follows the 0.8 mg/L MRDL at the entry point.

c. Routine Monthly Monitoring

- Monthly chlorite monitoring must be conducted at 3 points in the distribution system: (1) as close as possible to first customer, (2) a location representative of average residence time, **and** (3) as close as possible to the end of the distribution system, usually referred to as the “maximum residence time.” These samples are collected on the same day.
- If an additional 3-sample set is collected in response to an entry point chlorite level exceeding 1.0 mg/L, the set may be used as the 3-sample set for routine monthly monitoring.

d. Reduced Monitoring

- The DBP Rule does not allow reduced monitoring for daily (entry point) chlorite samples.
- Monthly (distribution system) chlorite samples may be reduced to one 3-sample set per quarter. These samples are still collected on the same day.
- Sampling may be reduced only if no routine monthly distribution samples or no routine daily entry point samples have exceeded 1.0 mg/L during one calendar year. DEP

recognizes that water systems might treat with chlorine dioxide only intermittently. Therefore, eligibility for reduced (quarterly) monitoring is evaluated at the end of each calendar year.

- If any single sample exceeds 1.0 mg/L at the entry point or in the distribution system during reduced monitoring, the system resumes routine monthly distribution system monitoring (one 3-sample set per month).

2. Compliance for Chlorite

If a system violates the chlorite MCL, the system shall notify the public and report to DEP.

- The MCL compliance for chlorite is based on the arithmetic average of each 3-sample set.
- If the average of any 3-sample set collected in the distribution system in any month exceeds 1.0 mg/L, the system notifies the public and reports to DEP. This includes any 3-sample chlorite set taken in the distribution system for any reason.
- Failure to monitor will be treated as a violation for the entire period where the system's failure to monitor makes it impossible to determine compliance with the MCLs.

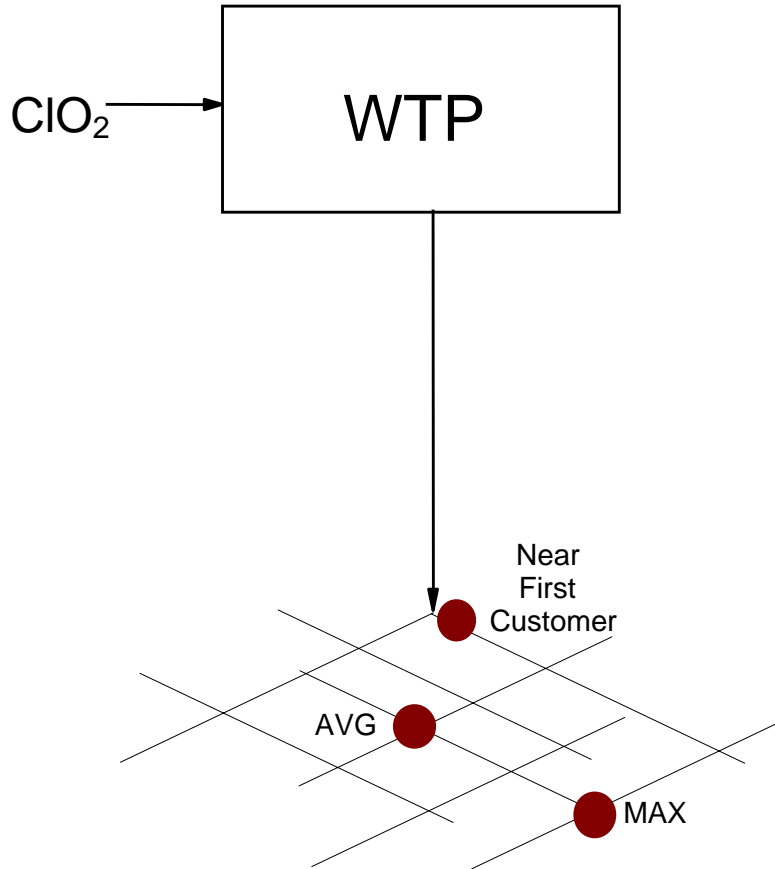
Compliance Quiz #1

A surface water system (any population size) is on a daily chlorite monitoring schedule and exceeds a chlorite level of 1.0 mg/L at entry point #101 to the distribution system (see data below). In this case, the entry point (EP) is designated as "EP 101."

Day	EP 101 Daily Chlorite mg/L
1	0.7
2	0.6
3	1.2
4	0.9
5	1.1
6	0.6
7	0.8
8	0.7
9	0.4
10	0.9
--	--

Is this community water system on routine daily monitoring in compliance with the chlorite MCL?

Answer: Yes, because the MCL does not apply to the entry point sample. Exceeding a chlorite level of 1.0 mg/L on days 3 and 5 does not trigger a violation, but causes the water system staff to collect additional follow-up samples in the distribution system. The distribution samples would be collected at the locations shown below. As you'll see in a minute, these same locations are used for routine monthly chlorite distribution system monitoring.



Compliance Quiz #2

Follow-up distribution system samples were taken on days 4 and 6. These samples are associated with the elevated daily entry point results on days 3 and 5.

<u>Day</u>	<u>Chlorite Daily Data mg/L</u>	<u>Chlorite DS NFC mg/L</u>	<u>Chlorite DS AVG mg/L</u>	<u>Chlorite DS MAX mg/L</u>	<u>Chlorite DS Avg. mg/L</u>
1	0.7	--	--	--	--
2	0.6	--	--	--	--
3	1.2	--	--	--	--
4	0.9	1.3	0.9	0.6	0.9
5	1.1	--	--	--	--
6	0.6	1.1	1.4	0.8	1.1
7	0.8	--	--	--	--
8	0.7	--	--	--	--
9	0.4	--	--	--	--
10	0.9	--	--	--	--
...

Note: DS = distribution system NFC = near first customer

Is this community water system in compliance with the chlorite MCL?

Answer: No, because the day 6 average chlorite values for all three samples is above 1.0 mg/L. Note that both rounds of follow-up distribution system samples were necessary due to the elevated results at the entry point on days 3 and 5. The first set of distribution system samples taken on day 3 also satisfies the requirement for routine monthly monitoring in the distribution system.

3. Reporting Requirements for Chlorite

The DBP Rule requires that DEP-certified laboratories or certified operators perform all chlorite sample analyses. The following data is reported to DEP on an SDWA-1 form within 10 days after the end of a month or quarter:

- The date, location, and result of each entry point sample taken during the last month. The water system may analyze these samples.
- The date, location, and result of each distribution sample taken during the last monitoring period. A certified laboratory must analyze these samples.

DEP will calculate:

- The number of daily chlorite entry point samples required during the month, and whether the distribution samples were required based on the chlorine dioxide summary information reported on the new version of the SDWA-S form.
- The average of each 3-sample set of distribution samples collected during the monitoring period.
- Whether the MCL was exceeded and (if applicable) the month in which it was exceeded.

Bromate

The bromate monitoring requirements and MCL only applies to community water systems and non-transient noncommunity water systems whose treatment plant uses ozone for disinfection or oxidation. This includes surface water and groundwater systems. Large surface water systems serving at least 10,000 people start monitoring in January 2002 and all other affected water systems start in January 2004.

The MCL for bromate is 0.010 mg/L.

1. Monitoring Requirements for Bromate

a. Routine Monitoring

- One monthly sample for bromate is collected at the entry point to the distribution system for each treatment plant using ozone.

b. Reduced Monitoring

To qualify for reduced **bromate** monitoring, the system collects **monthly bromide** samples in the raw water for at least one year and the running annual average of bromide results must be less than 0.05 mg/L. Water systems desiring a reduced monitoring schedule must report monthly bromide results to DEP.

- Systems can reduce bromate sampling to **1** sample per **quarter** per plant.
- If the running annual average **bromide** concentration (computed quarterly) is 0.05 mg/L or more, the system resumes monthly **bromate** monitoring.
- Systems must continue monthly **bromide** monitoring to remain on reduced **bromate** monitoring.

2. Compliance for Bromate

If a system exceeds a bromate MCL, the system is in violation, shall notify the public, and report to DEP.

- Bromate MCL compliance is based on the running annual arithmetic average of monthly samples, computed quarterly rather than any one set of samples. *Systems will not be considered in violation of an MCL until they have completed at least 1 year of monthly monitoring (unless the running annual average computed in any given quarter is already at least four times the MCL).*
- If ozone treatment occurs at more than one treatment plant, all samples taken at all entry points are averaged together to represent the results for one month for a water system.
- If a system does not complete 12 consecutive months of monitoring, the MCL compliance for the last 4-quarter period is based on the average of available data.

- Failure to monitor will be treated as a violation for the entire period covered by the annual average, where compliance is based on a running annual average (RAA) of monthly or quarterly samples and the system's failure to monitor makes it impossible to determine compliance with the MCLs.

Compliance Quiz #1

A surface water system (any population size) that uses ozone is on a monthly bromate monitoring schedule and obtains the following results. The data below assumes results are from one entry point.

Month	BrO ₃ Monthly Data mg/L	BrO ₃ RAA Calculation mg/L	BrO ₃ RAA mg/L
1	0.015	--	--
2	0.018	--	--
3	0.007	0.040 / 12	0.003
4	0.008	--	--
5	0.007	--	--
6	0.009	0.064 / 12	0.005
7	0.007	--	--
8	0.006	--	--
9	0.007	0.084 / 12	0.007
10	0.011	--	--
11	0.007	--	--
12	0.006	0.108 / 12	0.009

Is this community water system on routine bromate monitoring in compliance with the MCL?

Answer: Yes, because the running annual average is below 0.010 mg/L.

Compliance Quiz #2

A community water system uses ozone at a treatment plant part of the year and turns off the ozone system for maintenance for the rest of the year starting in late July. They obtain the following results.

Month	BrO ₃ Monthly Data mg/L	BrO ₃ RAA Calculation mg/L	BrO ₃ RAA mg/L
1	0.015	--	--
2	0.018	--	--
3	0.007	0.040 / 12	0.003
4	0.006	--	--
5	0.006	--	--
6	0.020	0.072 / 12	0.006
7	0.014	--	--
8	0	--	--
9	0	0.086 / 12	0.007
10	0	--	--
11	0	--	--
12	0	0.086 / 12	0.007

How does this community water system determine compliance with the bromate MCL?

Answer: When a water system discontinues the use of ozone, the running annual average is based on available data. The water system in this case complies with the bromate MCL.

Note: However, if the system continued to treat with ozone the entire year, but simply failed to conduct bromate monitoring during the last five months, the running annual average in September would be calculated by dividing by 10 instead of 12 (because of the two monthly monitoring violations). The running annual average for September would then be 0.008 mg/L (0.086 / 10). The running annual average in December would then be calculated by dividing by 7 instead of 12 (because of the five monthly monitoring violations). The running annual average for December would then be **0.012 mg/L** (0.086 / 7). In this case, the water system would **not** be in compliance with the bromate MCL.

3. Reporting Requirements for Bromate

The DBP Rule requires that DEP-certified laboratories must perform all bromate sample analyses. These certified laboratories must report the following data to DEP on the SDWA-1 form within 10 days after the end of a quarter:

- The date, location, and result of each sample taken during the last quarter.

Each quarter, DEP will calculate:

- The running annual average of all monthly samples collected in the last year (running 12 months). Keep in mind, if ozone treatment occurs at more than one treatment plant, all samples taken at all entry points are averaged together to represent the results for one month for a water system.
- Whether the running annual average exceeds the MCL.

Precursor Monitoring and Removal Requirements

The precursor monitoring and removal requirements apply to all surface water systems using conventional filtration treatment. These systems may operate with “enhanced coagulation” to achieve a specific percent removal of total organic carbon (TOC). Optionally, the system can meet at least one of the “alternative compliance criteria” if they cannot achieve the specific TOC removal. Large surface water systems serving at least 10,000 people start monitoring in January 2002 and all other affected water systems start in January 2004.

An example routine monitoring calendar for a large conventional surface water system is included in the Appendices.

Note: this manual does not cover information or requirements for conventional surface water treatment plants that practice enhanced <u>softening</u> because there are so few in Pennsylvania.
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Let’s backtrack for a minute and get a clear idea of these terms. Webster’s defines “**precursor**” as “*a substance that precedes and is the source of another substance.*” In the case of the DBP Rule, we are interested in precursors to TTHM and HAA5 formation. The precursors are naturally occurring organic matter that is found in many rivers, lakes and reservoirs. However, the organic matter is very difficult and expensive to measure, so we use TOC as a substitute and indicator of precursors. TOC, then, is considered a precursor to disinfection byproducts.

Another new term you will see is “**Specific Ultraviolet Absorbance**,” also called SUVA. Like TOC, the SUVA value may be an indicator of precursors and correlate well with the types of dissolved organic carbon that are easier to remove by enhanced coagulation.

The phrase “**enhanced coagulation**” is a method of removing TTHM and HAA5 precursors. The word “enhanced” means optimizing coagulant doses and pH levels to improve precursor removal. If a water system removes specific percentages of TOCs from the source water, its coagulation processes will be considered “enhanced.” This part of the removal requirement is often called “**Step 1**”. Remember, this process only applies to the conventional filtration systems.

Precursor removal and TOC reduction is regulated as a “**treatment technique**” instead of an MCL. This is much like turbidity, which has no direct health impact and cannot be practically regulated by establishing an MCL.

In summary, if a system meets Step 1, they are:

- meeting the TOC removal requirements (and thus the treatment technique).
- practicing enhanced coagulation.
- meeting the ultimate goal of the DBP Rule, which is precursor removal.

TOC Removal

Step 1 requires specific percentages of TOC removal through an enhanced coagulation process. TOC removal must occur between the raw water monitoring point and a location in the treatment plant following the sedimentation process, also called the treated water or “**post-sedimentation**” location. The required removal of TOC ranges from a 15 percent reduction to as high as a 50 percent reduction. These percentages depend on the source water TOC and the source water alkalinity levels at the time of sampling. The following table, also called the “**3-by-3 matrix**,” shows these TOC removal percentages:

3-by-3 Matrix

Source Water TOC (mg/L)	Source Water Alkalinity (mg/L as CaCO₃)		
	0 to 60	> 60 to 120	> 120
> 2.0 to 4.0	35.0%	25.0%	15.0%
> 4.0 to 8.0	45.0%	35.0%	25.0%
> 8.0	50.0%	40.0%	30.0%

3-by-3 Matrix Tip: The percentage of TOC removal is calculated monthly. Since source water conditions will change throughout the year, the removal requirements will likely change from month to month.

Compliance Quiz #1

During July 2002, a conventional filter plant obtains raw water samples from a reservoir with a TOC level of 4.2 mg/L and an alkalinity of 62 mg/L. How much TOC must be removed from the raw water?

Answer: Referring to the 3-by-3 matrix above, at least a 35.0 percent removal of raw water TOC must occur. In other words, the post-sedimentation TOC sample must be 35.0 percent lower than the raw water TOC sample at this treatment plant in July 2002.

Compliance Quiz #2

In the above example, what is the maximum allowable TOC level in the post-sedimentation water that will obtain at least a 35.0 percent reduction?

Answer: Convert 35.0 percent into a decimal (0.350) and then subtract it from 1. Multiply this result by the raw water TOC (4.2 mg/L).

$$(1-.350) \times 4.2 \text{ mg/L} = 2.7 \text{ mg/L}$$

The post-sedimentation sample must contain no more than 2.7 mg/L of TOC to achieve a 35.0 percent removal of the raw water TOC level.

Alternative Compliance Criteria

In addition to removing TOC, water systems can meet one of these six “**alternative compliance criteria**”:

(1) If the source water TOC is less than 2.0 mg/L (based on a running annual average).

OR

(2) If the treated water TOC is less than 2.0 mg/L (based on a running annual average).

OR

(3) If the following three running annual averages are met: source water TOC is less than 4.0 mg/L, the source alkalinity is greater than 60 mg/L, and the distribution system TTHM levels are 0.040 mg/L or less AND HAA5 levels are 0.030 mg/L or less. If the system meets these TOC and alkalinity levels but *not* the TTHM and HAA5 levels, they may choose to do the following:

- make a clear and irrevocable financial commitment to use technologies that limit TTHM to 0.040 mg/L or less and HAA5 0.030 mg/L or less;
- make this financial commitment on or before the applicable compliance date; and
- ensure the technologies are operational no later June 30, 2005.

OR

(4) If the TTHM levels are 0.040 mg/L or less AND HAA5 levels are 0.030 mg/L or less (running annual averages) and the system uses only chlorine for primary and residual disinfection.

OR

(5) If the source water SUVA values are 2.0 L/mg-m or less (running annual average).

OR

(6) If the finished water SUVA values are 2.0 L/mg-m or less (running annual average).

The “clear and irrevocable financial commitment” mentioned in alternative #3 could mean the water system has obtained funding, developed a construction timetable, and has applied for permits. In

addition, DEP may require a Consent Order and Agreement to assure the timely construction and completion of the facilities to reduce the levels of TTHM and HAA5.

Because each of the alternative compliance criteria are based on a running annual average, water systems won't know if they are in compliance with this part of the regulation until a year's worth of data has been collected. However, **meeting the running annual average for just one of these criteria puts the system in compliance regardless of the TOC removal requirements.**

In addition to running annual averages mentioned above, TOC and SUVA values can be used **each month** to help a system comply with the rule. If the TOC is less than 2.0 mg/L or SUVA is at 2.0 L/mg-m or less during monthly monitoring, these results could help the system remain in compliance. We will discuss this more in the section titled, "Compliance for Precursor Monitoring and Removal."

SUVA and TOC Tip: For finished water SUVA tests, the sample location is at the entry point and *before* any oxidant (disinfectant or potassium permanganate) is added. Since almost all plants provide water at the entry point that contains an oxidant, finished SUVA can be measured in jar tests that simulate the plant's actual treatment (without the oxidant). For post-sedimentation TOC tests, it is acceptable to collect the sample after oxidant addition.

To maximize the opportunity of remaining in compliance, staff at a conventional treatment plant should monitor and track all possible water quality parameters specified in the alternative compliance criteria. In addition—and this is very important—the system should also calculate the percent removal of TOC between the raw water and the post-sedimentation water that we already mentioned in the "TOC Removal" section.

If the required running annual averages for TOC removal or the alternative compliance criteria are unattainable, the system will need a DEP-approved "Step 2" percentage. This is also called the "alternative minimum TOC removal" requirements. Step 2 is a series of jar tests conducted over a year to determine the best possible TOC removal. The system applies to DEP for Step 2 requirements within 3 months of not meeting Step 1 requirements, but only after completing monitoring during the first applicable compliance year (i.e., after 2002 or 2004). Very few systems in Pennsylvania will need to go as far as Step 2. Therefore, we will not go into the details of TOC removal under Step 2.

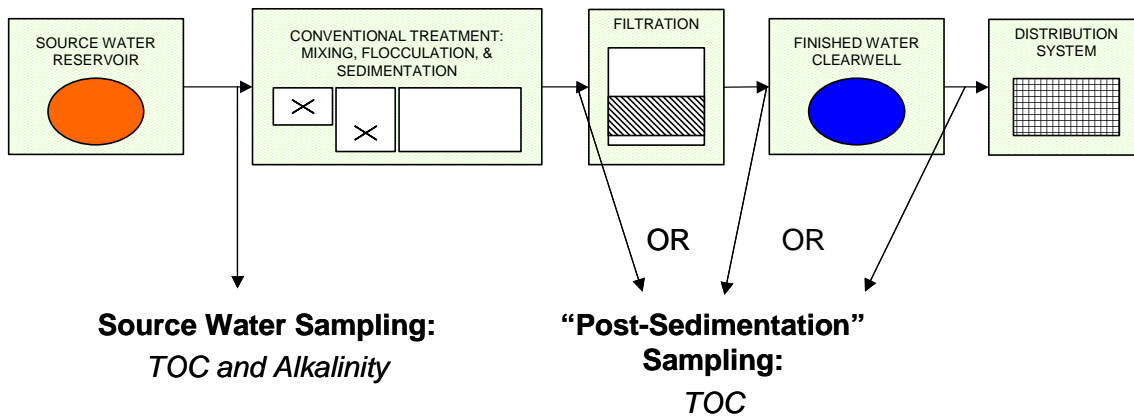
1. Monitoring Requirements for Systems That Must Remove TOC

a. Routine Monitoring for TOC and Alkalinity

This part of the DBP Rule only applies to conventional surface water treatment plants. Large surface water systems serving at least 10,000 people start monitoring in January 2002 and all other affected water systems start in January 2004.

- The TOC sample is collected in the source water prior to any treatment.
- The post-sedimentation TOC sample is collected from the combined filter effluent or top of filters (settled water). If this location is not available, the water system obtains DEP approval to use the clearwell or entry point. The system's sampling plan should also reflect this alternative location. Compositing samples are not allowed.
- These "paired samples" are taken simultaneously. At large plants, the system may want to allow for a "lag" time in the treatment processes.
- The water system collects one paired sample set per month at each treatment plant.
- The water system collects one source water alkalinity sample per month at same time and location as the source water TOC sample.

Here's a representation of the monthly TOC sampling locations:



Early Implementation Tip - Large Systems: Surface water systems using conventional filtration and serving at least 10,000 people should begin routine monitoring in January 2001. Even though this is not a requirement, it will help determine if they will meet the required TOC removal (Step 1). Otherwise, if they are cannot remove sufficient TOC after a year's worth of monitoring (at the end of 2002), they will be in violation of the rule!!!

Early Implementation Tip - Small Systems: Surface water systems using conventional filtration and serving <10,000 people should begin routine monitoring in January 2003. Even though this is not a requirement, it will help determine if they will meet the required TOC removal (Step 1). Otherwise, if they cannot remove sufficient TOC after a year's worth of monitoring (at the end of 2004), they will be in violation of the rule!!!

b. Reduced Monitoring for TOC and Alkalinity

To qualify for reduced TOC monitoring, the system must have a post-sedimentation TOC level of less than 2.0 mg/L for 2 consecutive years or less than 1.0 mg/L for 1 year based on a running annual average.

- The water system may reduce monitoring to one paired sample per plant per quarter.
- The water system may reduce monitoring to one alkalinity sample per plant per quarter.
- If the average annual post-sedimentation TOC is 2.0 mg/L or more, the system reverts to routine monitoring.

2. Monitoring Requirements for the Alternative Compliance Criteria

This part of the rule—although optional—is extremely beneficial for conventional surface water treatment plants. Large surface water systems serving at least 10,000 people should start monitoring in January 2001 and all other affected water systems should start in January 2003. If the system already collects TOC samples as outlined under the section, “Monitoring Requirements for Systems That Must Remove TOC,” then these results may also be used as part of the alternative compliance criteria.

- The raw water TOC and/or SUVA sample is collected in the source water prior to any treatment. The water system collects one TOC and/or SUVA sample per month.
- The post-sedimentation TOC sample is collected from the combined filter effluent or top of filters (settled water). If this location is not available, the water system obtains DEP approval to use the clearwell or entry point. The system’s sampling plan should also reflect this alternative location. Compositing samples are not allowed.
- These “paired samples” are taken simultaneously at each treatment plant. At large plants, the system may want to allow for a “lag” time in the treatment processes.
- The finished water SUVA value is collected at the entry point to the distribution system and prior to the addition of a disinfectant or oxidant. Because almost all filter plants do not have this option, most finished water SUVA samples will need to be collected from jar tests that simulate the full-scale treatment facilities. The water system collects one sample per month.
- The TTHM and HAA5 data is collected in the distribution system. These are the same samples collected under the “TTHM and HAA5” section of this manual. The results may be used for the alternative compliance criteria if the system uses only chlorine for primary and residual disinfection.

SUVA Tip: SUVA is a calculated parameter. It is the ultraviolet absorption at 254 nm (UV254) (measured as m⁻¹) divided by the Dissolved Organic Carbon concentration (measured as mg/L).

$$\text{SUVA} = 100 \text{ (cm/m)} \times [\text{UV254}(\text{cm}^{-1})/\text{DOC} \text{ (mg/L)}]$$

Waters with low SUVA values contain primarily non-humic matter and are not amenable to enhanced coagulation.

3. Compliance for Precursor Monitoring and Removal

a. Compliance for Systems That Must Remove TOC

Even if a system meets the TOC removal percentages, it is still very beneficial to monitor and track as many of the alternative compliance criteria as possible. Therefore, also read the “Alternative Compliance Criteria” section of the manual because meeting just one of the criteria could be another means of remaining in compliance with the rule. If a system exceeds the treatment technique for TOC removal, the system is in violation, shall notify the public, and report to DEP.

- *Systems will not be considered in violation of a treatment technique until they have completed 1 year of monthly monitoring.* All treatment technique compliance is based on the running annual arithmetic average computed monthly rather than any one set of samples. Systems on a reduced monitoring program will collect samples once each quarter and perform quarterly calculations.
- The **actual** monthly TOC percent removal is determined.
- The **required** monthly TOC percent removal is determined.
- Each month, the **actual** removal is divided by the **required** removal to obtain a performance ratio. Performance ratios higher than 1.0 are better.
- Twelve months of performance ratios (**actual** removal divided by **required** removal) are added together and then divided by 12 to obtain the running annual average at each treatment plant. Although the performance ratio is calculated monthly, the data is only reported to DEP once a quarter.
- If the result of the running annual average is less than 1.00, the system does not comply with the TOC percent removal requirements.
- For any month where the TOC or SUVA “Alternative Compliance Criteria” was met, the performance ratio is set equal to 1.0. We will discuss this more in a minute.
- If, in rare circumstances, the post-sedimentation TOC is **higher** than the source water TOC, a **negative value** is used as the monthly performance ratio.

The following example table shows 12 months of TOC removal calculations and the final running annual average calculation:

Month	<u>A</u> Treated TOC (mg/L)	<u>B</u> Source TOC (mg/L)	<u>C</u> (1-A/B) x 100	<u>D</u> Source Water Alkalinity (mg/L)	<u>E</u> Required TOC Removal (%)	<u>F</u> C/E
Jan.	3.6	5.8	38.5	90	35	1.10
Feb.	3.6	5.6	32.9	80	35	0.94
Mar.	4.7	7.4	36.1	65	35	1.03
Apr.	4.9	8.5	42.8	70	40	1.07
May	4.9	8.1	39.2	75	40	0.98
Jun.	4.1	7.2	43.4	75	35	1.24
Jul.	4.7	7.6	38.5	70	35	1.10
Aug.	4.6	7.4	37.5	75	35	1.07
Sep.	5.0	7.8	35.7	70	35	1.02
Oct.	4.6	8.2	44.0	70	40	1.10
Nov.	4.0	6.1	34.3	75	35	0.98
Dec.	4.4	6.2	29.1	85	35	0.83

G/12 = 1.04 = H

If H ≥ 1.00, then the PWS is in compliance

If H < 1.00, then the PWS is not in compliance

Σ (F) = 12.48 = G

The above example shows that column F’s performance ratios vary from 0.83 to 1.24. In this case, the annual average value of 1.04 means the system is in compliance.

b. Compliance for Systems Meeting One of the Alternative Compliance Criteria

Even if a system meets one of the alternative compliance criteria, it is still very beneficial to perform the calculations that we just outlined for TOC removal. Therefore, make sure you also read the “TOC Removal” section of the manual because the results of these calculations could be another means of remaining in compliance with the rule. As an added bonus, calculating the percent TOC removal could allow a system to use a monthly performance value of greater than 1.0 if enough TOC is removed. A conventional treatment plant may receive a monthly performance ratio of 1.0 if it meets one of the following conditions in any month:

- If the source water TOC level is less than 2.0 mg/L.
- If the post-sedimentation TOC level is less than 2.0 mg/L.
- If the source water SUVA value (prior to treatment) is 2.0 L/mg-m or less.
- If the finished water SUVA is 2.0 L/mg-m or less.

By now, you should see the benefits of calculating the percent TOC removal and monitoring for all the alternative compliance criteria. Let’s look at the above table one more time. If any TOC or SUVA samples would have met the alternative compliance criteria during the month, then the water system would receive a 1.0 in column F for the month—especially if the calculated performance ratio was less than 1.0. Furthermore, if the water system met the running annual average for any of the **six** alternative compliance criteria, the system would be in compliance, even if the running annual average of the performance ratio is less than 1.00.

For example, if a system only uses chlorine and if their running annual TTHM levels are 0.040 mg/L or less and HAA5 levels are 0.030 mg/L or less, the system receives a 1.0 and remains in compliance for the previous 12 months. This overrides the calculated performance ratio for the year.

3. Reporting for Precursor Monitoring and Removal

a. Reporting for Systems That Must Remove TOC

DEP-Certified laboratories must perform TOC analyses. For water systems that are monitoring either monthly or quarterly for TOC and meeting the TOC removal requirements, these certified laboratories must use an SDWA-1 form to report the following data to DEP within 10 days after the end of the quarter:

- The date, location, and result of each paired sample taken and the associated alkalinity taken during the last quarter.

DEP will calculate the following for each treatment plant:

- For each month that paired samples were taken, the average of percent TOC removal for each paired sample and the required TOC percent removal.
- Whether the system complies with the TOC removal requirements in the last four quarters.

b. Reporting for Systems Meeting One of the Six Alternative Compliance Criteria

Wise water systems will monitor as many of the alternative compliance criteria as possible. Water systems that are monitoring monthly (or reduced quarterly) for TOC and meeting one of the alternative compliance criteria shall report, through their certified laboratories, the following data to DEP. The data is reported on the SDWA-1 form within 10 days after the end of the quarter:

- The date, location, and result of each SUVA and paired TOC samples taken and the associated alkalinity taken during the last quarter.

DEP will calculate the following for each treatment plant:

- The running annual average of monthly (or reduced quarterly) **source** water TOC levels if using this criterion for alternative compliance.
- The running annual average of monthly (or reduced quarterly) **post-sedimentation** TOC levels if using this criterion for alternative compliance.
- The running annual average of monthly **source** water SUVA values if using this criterion for alternative compliance.
- The running annual average of monthly **finished** water SUVA values if using this criterion for alternative compliance.

- The running annual averages of monthly source water TOC, monthly source water alkalinity, and distribution system TTHM and HAA5 levels if using this data set for the applicable alternative compliance criterion.
- For systems using only chlorine for primary and residual disinfection, the running annual averages of distribution system TTHM and HAA5 levels if using this criterion for alternative compliance.
- Whether the system complies with the particular alternative compliance criterion.

Alternative Compliance Criteria Tip: The water system needs to report data only for the particular alternative they are trying to meet. For example, if a water system obtains source water SUVA results but not finished water SUVA, they only need to report the source SUVA information as part of the alternative compliance criteria.

Monitoring Plans

Each water system that is required to monitor under DBP Rule shall develop and implement a monitoring plan. The plans shall include applicable disinfectants, disinfection byproducts, disinfection byproduct precursors, and other applicable water quality parameters. Water systems shall develop, maintain and submit their plans to DEP no later than the following dates:

- Surface water and GUDI systems serving at least 10,000 people: **January 10, 2002**
- Surface water and GUDI systems serving <10,000 people: **January 10, 2004**
- As a general requirement, groundwater systems do not have to submit their plans to DEP.

Water systems shall have a monitoring plan available for the public no later than the following dates:

- Surface water and GUDI systems serving at least 10,000 people: **February 1, 2002**
- Surface water and GUDI systems serving <10,000 people: **February 1, 2004**
- All groundwater systems: **February 1, 2004**

DEP has the authority to require any water system to submit a monitoring plan. Furthermore, DEP may require changes in any of the plan components.

Monitoring plans shall include the following items:

- The specific locations where samples will be collected.
- The schedules for collecting the samples.
- The methods used to calculate compliance with MCLs, MRDLs, and treatment techniques.
- A reflection of the entire distribution system. It is especially important for consecutive water systems as well as their selling systems to discuss their individual monitoring plans.

Water suppliers are encouraged to use DEP's monitoring plan template. However, water suppliers may use their own design, provided all the required elements are included. DEP's template is available at www.dep.state.pa.us. Type directLINK word "**filtration**" (without the quotes) and then select "**New Drinking Water Regulations.**" Choose the box called, "**Disinfectants/Disinfection Byproducts Rule.**"

Of course, water systems will need to update their monitoring plan as time goes on. However, they will need to notify DEP prior to any revisions and submit the proposed changes within 30 days of the notification to DEP that revisions have been made.

Monitoring Plan Tip: Water systems should take all samples during normal operating conditions. For example, TTHM and HAA5 samples should not be collected during unusual source water conditions or if chlorine levels are abnormal. DEP recommends that systems include scenarios in their monitoring plans when samples will not be collected. For example, a surface water system may declare in their plan that TTHM and HAA5 samples will not be collected on days when the source water turbidity is greater than a specific turbidity level or during days when the entry point chlorine levels have remained unusually low.

Sampling plans should reflect fairly normal intervals between sample collection dates. For example, systems on a quarterly monitoring schedule for TTHM and HAA5 should not collect samples in late December (“fourth” quarter) and then in early January (“first” quarter) to take advantage of the coldest water conditions.

Failure to monitor in accordance with the system’s monitoring plan is a monitoring violation.