

**INSTRUCTIONS FOR COMPLETING THE SURFACE WATER
TREATMENT PLANT DISINFECTION AND TURBIDITY
MONTHLY OPERATION REPORT (MOR)
EPA FORM 5109 (1/00)**

1. PUBLIC WATER SYSTEM INFORMATION

Print or type name of public water system (PWS) and name of source treatment unit (STU).

Enter the PWS ID number and the STU ID number.

2. DISTRIBUTION DISINFECTANT REPORTING

Enter the number of disinfectant samples analyzed during the reporting period.

Enter the number of disinfectant samples analyzed that had results below the required residual.

Enter the percent of disinfectant samples meeting the required residual [$\frac{\text{(number of samples analyzed)} - \text{(number of samples below req. residual)}}{\text{(number of samples analyzed)}}$] multiplied by 100.

Enter the percent of disinfectant samples meeting the required residual from the previous month.

3. FILTRATION TYPE

Place an X in the appropriate box whether filtration is Conventional, Slow Sand, or Direct.

4. LABORATORY INFORMATION

Enter month and year being reported.

Enter the name and ID number of the laboratory that analyzed the sample(s).

5. CLEARWELL INFORMATION

Place an X in the appropriate box whether the calculation type is single or complex.

Place an X in the appropriate box whether or not the disinfectant is monitored continuously.

Enter the ID, surface area (sq. Ft.), and approved effective volume factor of each clearwell. Indicate whether each clearwell is used for calculations.

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6. DISINFECTION ANALYTICAL INFORMATION

- (a) Free - enter the day's lowest free residual disinfectant concentration (mg/l) of water entering the distribution system.
- (b) Combined - enter the day's lowest combined residual disinfectant concentration (mg/l) of water entering the distribution system.
- (c) Duration Residual ... - enter the duration of time (to the nearest tenth of an hour) that the residual disinfectant fell below the requirement of 0.2 mg/l free or 1.0 mg/l combined.
- (d) Peak Hourly ... - enter the day's peak hourly treatment flow rate (peak treated water flow) in gallons per minute (GPM).

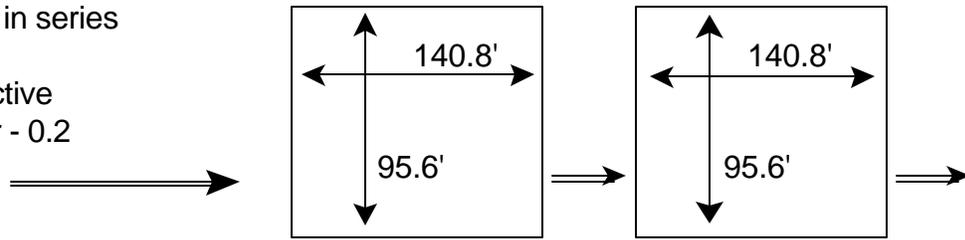
NOTE: Total treated water flow, **NOT** high service pumping rate!

- (e) Highest pH - enter the day's highest recorded pH measured during the peak hourly flow rate for the treated water.
- (f) Lowest Temp. - enter the day's lowest temperature in degrees Celsius [degrees Celsius = (degrees Fahrenheit - 32) divided by 1.8] measured during the peak hourly flow rate.
- (g) Lowest Clearwell ... - enter the day's lowest clearwell operating depth in feet measured during the peak hourly flow rate.
- (h) Lowest Disinfectant ... - enter the day's lowest disinfectant concentration of the clearwell effluent in mg/l during the peak hourly flow rate.
- (i) Effective Disinfectant ... - enter the effective disinfectant contact time (in minutes) that the disinfectant was in contact with the water. [(clearwell surface area in sq. ft.) multiplied by (g) multiplied by (approved effective volume factor) multiplied by (7.48)] divided by (d).
- (j) Minimum Actual CT - enter the minimum actual CT value (minutes multiplied by mg/l) achieved during peak hourly flow [(h) multiplied by (i)]. When the peak flow rate lasts more than 1 hour, select the concurrent pH, temperature, clearwell depth/level, and disinfectant concentration which results in the lowest minimum actual CT.
- (k) Required CT - entered the required CT value (minutes multiplied by mg/l) necessary to provide adequate disinfection (from CT Tables in OAC 3745-81-72).
- (l) Interpolation - place an X in the box if interpolation of CT values was performed.

EXAMPLE CT CALCULATION #1

Two clearwells in series

Approved Effective
Volume Factor - 0.2



NOTE: All areas must be in square feet, and all flow rates must be in gallons per minute.

All Measured During Peak Hourly Flow:

Free Chlorine Concentration of Clearwell Effluent	1.2 mg/l
Water Temperature	8°C
Minimum Clearwell	17.5 feet
pH	8.2
Peak Hourly Flow	12,490 gpm

NOTE: Peak Hourly Flow is total treated water flow, **NOT** high service pumping rate!

STEP 1. Calculate Total Surface Area for All Clearwells (A)

$$A = (95.6 \times 140.8) + (95.6 \times 140.8)$$

$$A = 26,921 \text{ sq. ft.}$$

STEP 2. Calculate Effective Contact Time (T)

$$T = \frac{\text{Effective Volume Factor} \times \text{Surface Area} \times \text{Minimum Clearwell Level} \times (7.48)}{\text{Peak Hourly Flow}}$$

$$T = \frac{0.2 \times 26,921 \times 17.5 \times 7.48}{12,490}$$

$$T = 56.4 \text{ min.}$$

STEP 3. Calculate the Actual CT Value for Peak Hourly Pumping

$$CT = 1.2 \times 56.4$$

$$CT = 67.7$$

$$CT = 68 \text{ (rounded off)}$$

**EXAMPLE CT CALCULATION #1
(Continued)**

Temperature	8°C
pH	8.2
Free Chlorine Concentration	1.2 mg/l
Disinfection for Log Inactivation Required	
for Conventional Filtration	0.5
for Direct or Slow Sand Filtration	1.0

Temperature is rounded down to 5°C, pH is rounded up to 8.5 (alternatively, results may be interpolated from the tables).

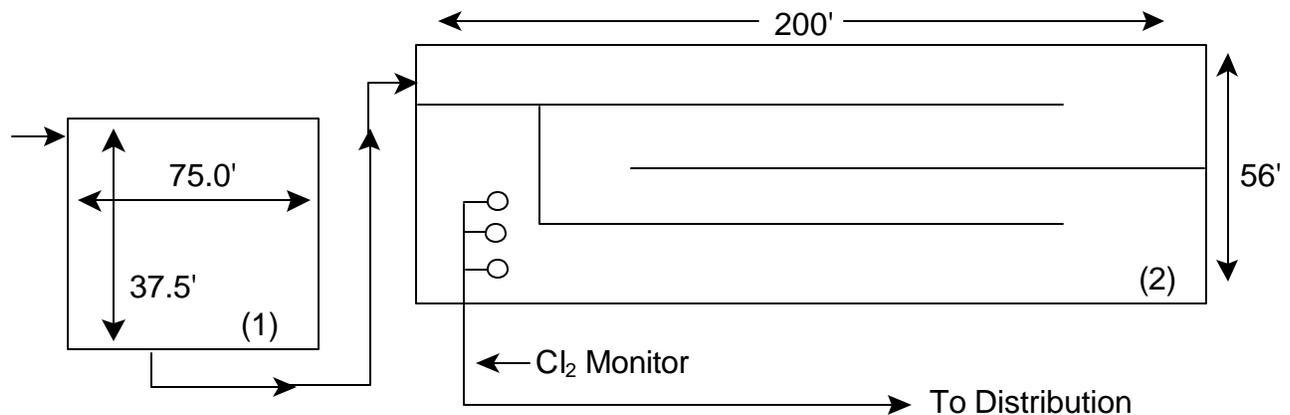
CHLORINE CONCENTRATION (mg/l)	5°C		pH = 8.5			
	Log Inactivations					
	0.5	1.0	1.5	2.0	2.5	3.0
<=0.4	39	79	118	157	197	236
0.6	41	81	122	163	203	244
0.8	42	84	126	168	210	252
1.0	43	87	130	173	217	260
1.2	45	89	134	173	223	267
1.4	46	91	137	183	228	274
1.6	47	93	141	187	234	281
1.8	48	96	144	191	239	287
2.0	49	98	147	196	245	294
2.2	50	100	150	200	250	300
2.4	51	102	153	204	255	306
2.6	52	104	156	208	260	312
2.8	53	106	159	212	265	318
3.0	54	108	162	216	270	324

The required CT value is 45 for Conventional Filtration.

The required CT value is 89 for Direct or Slow Sand Filtration.

EXAMPLE CT CALCULATION #2

Complex Calculation - 2 clearwells with different Approved Effective Volume Factors and different water.



Approved Effective Volume Factors
 Clearwell No. 1 - 0.1
 Clearwell No. 2 - 0.6

Free Chlorine Concentration of Clearwell Effluent	1.2 mg/l
Water Temperature	8°C
Minimum Clearwell Levels	
Clearwell No. 1	8 feet
Clearwell No. 2	10 feet
pH	8.2
Peak Hourly Flow	4,150 gpm

NOTE: Peak Hourly Flow is total treated water flow, **NOT** high service pumping rate!

STEP 1. Calculate the Surface Area for each Clearwell (A)

Clearwell No. 1 $A_1 = 37.5 \times 75$	Clearwell No. 2 $A_2 = 56 \times 200$
$A_1 = 2,813 \text{ sq. ft.}$	$A_2 = 11,200 \text{ sq. ft.}$

STEP 2. Calculate Effective Contact Time (T)

$$T = \frac{(\text{Effective Volume Factor}) \times (\text{Surface Area}) \times (\text{Minimum Clearwell Level}) \times 7.48}{\text{Peak Hourly Flow}}$$

Clearwell No. 1 $T_1 = \frac{0.1 \times 2,813 \times 8 \times 7.48}{4,150}$	Clearwell No. 2 $T_2 = \frac{0.6 \times 11,200 \times 10 \times 7.48}{4,150}$
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$$T_1 = 4 \text{ min.}$$

$$T_2 = 121 \text{ min.}$$

STEP 3. Calculate the Total Effective Contact Time (Tt)

$$\begin{aligned} T_t &= T_1 + T_2 \\ T_t &= 4 + 121 \\ &= 125 \text{ min.} \end{aligned}$$

STEP 4. Calculate the Actual CT Value for Peak Hourly Pumping

$$\begin{aligned} CT &= 1.2 \times 125 \\ CT &= 150 \text{ min. - mg/l} \end{aligned}$$

**EXAMPLE CT CALCULATION #2
(Continued)**

Temperature	8°C
pH	8.2
Free Chlorine Concentration	1.2 mg/l
Disinfection for Log Inactivation Required	
for Conventional Filtration	0.5
for Direct or Slow Sand Filtration	1.0

Temperature is rounded down to 5°C, pH is rounded up to 8.5 (alternatively, results may be interpolated from the tables).

CHLORINE CONCENTRATION (mg/l)	5°C		pH = 8.5			
	Log Inactivations					
	0.5	1.0	1.5	2.0	2.5	3.0
<=0.4	39	79	118	157	197	236
0.6	41	81	122	163	203	244
0.8	42	84	126	168	210	252
1.0	43	87	130	173	217	260
1.2	45	89	134	173	223	267
1.4	46	91	137	183	228	274
1.6	47	93	141	187	234	281
1.8	48	96	144	191	239	287
2.0	49	98	147	196	245	294
2.2	50	100	150	200	250	300
2.4	51	102	153	204	255	306
2.6	52	104	156	208	260	312
2.8	53	106	159	212	265	318
3.0	54	108	162	216	270	324

**The required CT value is 45 for Conventional Filtration.
The required CT value is 89 for Direct or Slow Sand Filtration.**

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7. TURBIDITY REPORTING INFORMATION

Enter the Ohio EPA accepted turbidity sampling location used at the plant.
Accepted values are:

- A for Combined filter effluent prior to entry into clearwell.
- B for Average of measurements from each filter effluent.
- C for Clearwell effluent.
- D for Plant effluent or immediately prior to entry into the distribution system.

Grab Sampling

Rule 3745-81-74 (OAC) requires that turbidity measurements shall be performed on representative samples of filtered water at least every four hours that the water treatment plant is in operation.

NOTE: Systems monitoring at locations A or B shall monitor within the first and last hours of filter operation and ever four hours in between.

Systems monitoring at locations C or D shall monitor turbidity every four hours unless the high service pumps are locked out for a portion of the date. If the pumps are locked out for a portion of the day, samples shall be taken during the first and last hours of pump operation, and every four hours in between.

- (m) Total Hours Filtering - enter the total hours water was filtered for the day.
- (n) Maximum Turbidity - enter the maximum turbidity value (in NTU) for the day.
- (o) Minimum Turbidity - enter the minimum turbidity value (in NTU) for the day.
- (p) Average Turbidity - enter the average turbidity value (in NTU) for the day.
- (q) Total Number of Results - enter the total number of turbidity filtered water grab samples analyzed for the day.
- (r) Number of Results Exc... - enter the total number of turbidity filtered water grab samples exceeding the standard for the day.

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(u) Enter the following for each column:

Total Hours Filtering:	record the total number of hours (to the nearest 0.1 hour) that the plant filtered water.
Maximum Turbidity (NTU):	record the maximum turbidity value for the month.
Minimum Turbidity (NTU):	record the minimum turbidity value for the month.
Average Turbidity (NTU):	record the <u>average</u> daily turbidity value for the month.
Total Number of Results:	record the total number of turbidity determination made for the month.
Number of Results Exceeding Standard:	record the total number of turbidity determinations for the month that exceeded the applicable standard.

(v) Percent Within Standard - enter the percent of turbidity samples that were within the standard (did not exceed) $\left\{ \frac{(\text{total number of results}) - (\text{total number of results exceeding standard})}{(\text{total number of results})} \right\}$ multiplied by 100

Continuous Monitoring Sampling

The system may substitute continuous monitoring for grab sample monitoring if the system validates the continuous measurement for accuracy on a regular basis using a protocol approved by the director. A recording continuous turbidimeter shall be used.

NOTE: Systems monitoring at locations A or B shall report during hours of filter operations. Systems monitoring at locations C or D shall report results 24 hours a day unless the high service pumps are locked out for a portion of the day.

(m) Total Hours Filtering - enter the total hours water was filtered for the day.

(n) Maximum Turbidity - enter the maximum turbidity value (in NTU) for the day.

(o) Minimum Turbidity - enter the minimum turbidity value (in NTU) for the day.

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- (p) Average Turbidity - enter the average turbidity value (in NTU) for the day.
- (s) Number of Hours Results were... - enter the total number of hours that filter water turbidity was monitored by a continuous monitoring device for the day (to the nearest 0.1 of an hour).
- (t) Number of Hours Results Exc... - enter the total number of hours that filter water turbidity results exceeded the standard for the day (to the nearest 0.1 of an hour).

(u) Enter the following for each column:

Total Hours Filtering:	record the total number of hours (to the nearest 0.1 hour) that the plant filtered water.
Maximum Turbidity (NTU):	record the maximum turbidity value for the month.
Minimum Turbidity (NTU):	record the minimum turbidity value for the month.
Average Turbidity (NTU):	record the <u>average</u> daily turbidity value for the month.
Number of Hours Results were Recorded:	record the total number of hours (to the nearest 0.1 hour) that turbidity determination were made for the month.
Number of Hours Results Exceeding Standard:	record the total number of hours (to the nearest 0.1 hour) for the month in which turbidity values exceeded the applicable standard.

- (v) Percent Within Standard - enter the percent of turbidity samples that were within the standard (number of hours did not exceed) $\left\{ \frac{\text{(total number of hours of filtering)} - \text{(total number of hours results exceeding standard)}}{\text{(total number of hours)}} \right\}$ multiplied by 100

8. RESULTS EXCEEDING STANDARD

- (w) Date - enter the date that the particular turbidity result exceeded the standard.
- (x) Time - enter the time that the particular turbidity result exceeded the standard.
- (y) Turbidity - enter the actual turbidity value (in NTU).
- (z) Duration - enter the duration in hours (to the nearest tenth) that the turbidity exceeded the standard.

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9. Name and Certification Number of Operator in Charge, the signature of the responsible official, and the date the report is completed.
10. Return completed report to your district office no later than 10 days after the end of the month you are reporting.

NOTE: Turbidity values that have been determined, but are not required to be reported on this form, are required to be kept and made available for inspection upon request. The record retention requirement for these analysis is 12 years.



SURFACE WATER TREATMENT PLANT DISINFECTION AND TURBIDITY

PUBLIC WATER SYSTEM INFORMATION:

PWS Name: _____
 STU Name: _____
 PWSID #: _____ STU #: _____

LABORATORY INFORMATION:

Reporting Period: _____
 Analytical Lab: _____ ID: _____

DISTRIBUTION DISINFECTANT REPORTING:

Number of Samples Analyzed: _____
 Number of Samples Below Required Residual: _____
 Percent of Number Meeting Disinfectant Required:
 _____ %
 Percent Meeting Minimum Disinfectant Requirement for
 Previous Month: _____ %

CLEARWELL INFORMATION:

Calculation Type Level: **G** Single **G** Complex
 Disinfectant Monitored Continuously? **G** Yes **G** No

Clearwell ID	Surface Area (sq. ft.)	Approved Eff. Volume Factor	Used for Calculations?

FILTRATION TYPE:

Conventional
 Slow Sand
 Direct

Date	Lowest Residual Disinfection at Entrance to Distribution System		Duration Residual Disinfectant Fell Below Requirement (hours, tenths)	Peak Hourly Treatment Flow (gpm)	Highest pH	Lowest Temp. (°C)	Lowest Clearwell Operating Depth/Level (feet)	Lowest Disinfectant Concentration (mg/l)	Effective Disinfectant Contact Time (minutes)	Minimum Actual CT (min. x mg/l)	Required CT (min. x mg/l)	Interpolation
	Free	Combined										
1	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
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