Oregon Health Authority – Drinking Water Program
Disinfection Verification Form – Groundwater Systems

PWSID Number: _____ **County:** _____

System Name: _____

Groundwater Source: _____

Operator and Phone Number: _____

If your system adds a chlorine compound, and will perform Compliance Monitoring, please submit a copy of this form or similar documentation to your Regulating Agency (Drinking Water Program, local County Health Agency, Department of Agriculture contact). Please provide a copy for each groundwater source that your system uses. Additional copies of this form are available at **http://public.health.oregon.gov/HealthyEnvironments/DrinkingWater/Rules/GWR/Documents/gwdisinfection.pdf**, under the Rules & Regulations-Groundwater Rule-Compliance Monitoring heading. Please retain a copy of the completed form for your records.

Mail the completed form to:
Your Regulating Agency (Drinking Water Program, County, Dept. of Agriculture)

For more information, contact the DWP:
Drinking Water Program
P.O. Box 14450
Portland, OR 97232
(971) 673-0405

Does Your System Provide 4-log Inactivation of Viruses?

If your system adds a chlorine compound, use the instructions below to document whether your system provides 4-log treatment (99.99 % removal and/or inactivation) of viruses. The concept of "CT" is used to verify this level of treatment. "CT" is an indication of the effectiveness of chlorine addition to protect public health from bacteria, viruses and protozoa in drinking water. CT is achieved by providing enough time for chlorine to inactivate potentially harmful organisms in your drinking water before it is consumed. CT represents an abbreviation of chlorine **C**oncentration (measured at the first user of your drinking water) multiplied by contact **T**ime (the water's time of travel from the point of chlorine addition to your system and the first user). Note that the following steps are intended to assist you in determining whether adequate disinfection is achieved in your system. The actual CT of your system will be determined in Step 1 below. The CT required for 4-log inactivation of viruses will depend on your groundwater source's pH, temperature and the free chlorine residual concentration in your water at the first user, and will be determined in Step 2. In Step 3 the two values will be compared to

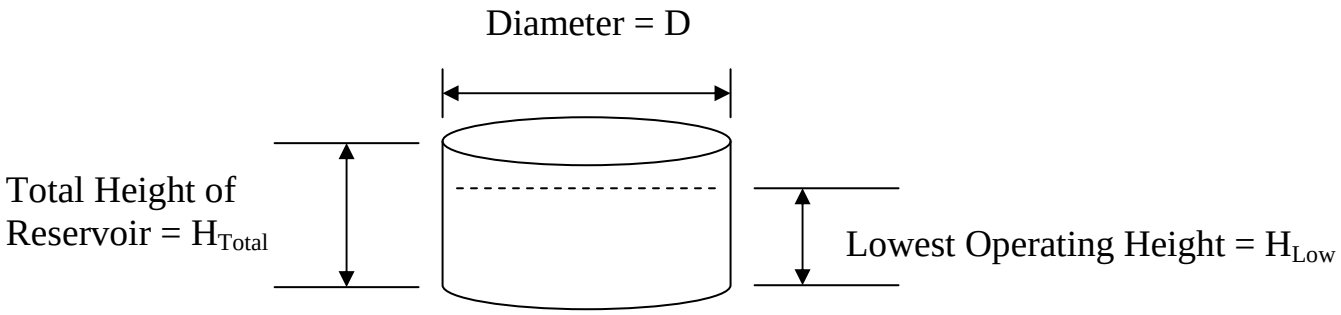
determine whether or not you are documenting that your system provides 4-log inactivation, pending Regulating Agency review.

Note: If your Regulating Agency verifies that your system provides 4-log inactivation of viruses, a representative will contact you to indicate the chlorine monitoring requirements and the minimum chlorine concentration that you will need to maintain at the first user.

Step 1: Determine the actual CT at your water system

Note that the actual CT for your system is derived by calculating the individual CT values for all segments of your system where water is in contact with chlorine before the 1st user. While the steps below are available for systems to calculate the actual CT, an automated, interactive electronic tool to calculate CT achieved at your water system is provided on U.S. EPA's Groundwater Rule Compliance Help Webpage at: http://water.epa.gov/lawsregs/rulesregs/sdwa/gwr/compliancehelp.cfm.

A. If your system disinfects with chlorine and intends to claim contact time for viral inactivation based on clearwell (reservoir) storage **only**, use the formulas below to determine the actual CT (Cylindrical Storage Reservoirs) *Note for rectangular shaped reservoirs, enter the lowest total volume in Line 2, and follow steps 3 and 4 to determine lowest operating volume in Line 4*:



1.	Average Free chlorine residual (C) measured at the first user	_____	milligrams per liter - mg/L
2.	Total Volume of Reservoir (V_{Total}) If not known, V_{Total} = (D × D × H_{Total} × 5.87); D is diameter of reservoir and H_{Total} is total filled height, both in feet	_____	gallons
3.	Lowest Operating Height (H_{Low}) of Reservoir	_____	feet
4.	Lowest Operating Volume (V_{Low}) = (H_{Low}/H_{Total}) × V_{Total}	_____	gallons
5.	Estimated Baffling Factor of Reservoir (BF) (see last page of handout)	_____	%
6.	Effective Volume available for Contact Time (EV) = (V_{Low} × BF ÷ 100) or (Line 4 × Line 5 ÷ 100)	_____	gallons
7.	Peak flow (F) through reservoir during busiest day, used for contact time	_____	gallons/minute
	Note How Peak Flow Was Determined: □ Meter measuring flow leaving the tank □ Flow equivalent based on a fixture count □ Other:_____		
8.	Contact Time (T): (EV ÷ F) or (Line 6 ÷ Line 7)	_____	minutes
9.	Actual CT: C x T = Line 1 x Line 8	_____	mg-minutes/L

B. <u>If your system disinfects with chlorine and intends to claim contact time for viral inactivation using piped volume **only**, use the formulas below to determine the actual CT</u>:

1.	Average Free chlorine residual (C) measured at the first user	_____	mg/L

2. Length of pipe (L) from point of disinfection to first user _____ feet

3. Diameter of pipe (D) between point of disinfection and first user _____ inches

4. Volume of pipe (V) = $(L \times D^2) \div 24.5$ or $(L \times D \times D) \div 24.5$ or (Line 2 × Line 3 × Line 3) ÷ 24.5 _____ gallons

5. Repeat calculations if additional lengths of pipe used for contact time Volume of pipe (V_2) = $(L_2 \times D_2^2) \div 24.5$ or $(L_2 \times D_2 \times D_2) \div 24.5$): _____ gallons

6. Total Volume of pipe (V_{Total}) = $V_1 + V_2 + \ldots$ _____ gallons

7. Peak flow (F) through total volume of pipe during busiest day of the year, used for contact time _____ gallons/minute

   Note How Peak Flow Was Determined:
   □ Flow equivalent based on a fixture count
   □ Other:_____

8. Contact Time (T): $V_{Total} \div$ Flow (F), or Line 6 ÷ Line 7 _____ minutes

9. Actual CT: C x T = Line 1 × Line 8 _____ mg-minutes/L

C. If your system disinfects with chlorine and you intend to claim contact time for disinfection for **both** pipes and storage reservoirs, use the following formula to determine the actual CT:

1. Actual CT for storage reservoir (Part A Line 9) _____ mg-minutes/L

2. Actual CT for pipes (Part B Line 9) _____ mg-minutes/L

3. Actual Total CT for reservoir and pipelines (Line 1 + Line 2) _____ mg-minutes/L

Step 2: Determine the CT required for your water system

1. System's groundwater source's *coldest* water temperature: ____ In Degrees C. *Note*, that if temperature data is not available, refer to temperature on well log, or take a temperature measurement of the groundwater source. During review, DWP may request an additional measurement. For conversion, Degrees C = 5/9 × (Degrees F – 32).
2. On Line A in the table below circle the value that most closely relates to the temperature recorded in item 1 above. If your system's coldest water temperature is between two numbers, round down and circle the next lowest whole number.
3. On Line B in the table circle the CT value that is associated with the temperature you circled on Line A.

CT Values to Achieve 4-log Inactivation of Viruses by Free Chlorine, pH 6.0-9.0

A	Degrees C	5	6	7	8	9	10	11	12	13	14	15
B	CT	8.0	7.6	7.2	6.8	6.4	6.0	5.6	5.2	4.8	4.4	4.0

Groundwater pH values are generally between 6.0 and 9.0; this is an assumption for this table. If the pH of your groundwater source is known to be outside this range, please contact DWP.

Step 3: Determine your system's ability to provide 4-log inactivation of viruses

Compare your Actual CT value from either Section A Line 9, Section B, Line 9, or Section C, Line 3 in Step 1, above with the value you circled in Line B of the table above in Step 2. If your actual water system CT from Step 1 is a number larger than the number you circled in Line B from Step 2, then your documentation indicates that your system provides at least 4-log inactivation of viruses, pending DWP review (1st check box). If your actual CT is a number less than the number you circled in Line B, then your system does not appear to provide 4-log inactivation of viruses.

Step 4: Determine minimum chlorine residual to achieve 4-log viral inactivation: (Note, minimum chlorine residual needs to be at least 0.2 mg/L)

Note: Step 4 will be verified by your Regulating Agency during review

Calculated min chl. residual = CT Required (Step 2) ÷ [Contact Time for pipe (Step 1: A. 8.) + Contact Time for tank (Step 1: B. 8.]
Calculated min chlorine residual = (_____ mg-min/L) ÷ (_____ min) = _____ mg/L

Minimum Chlorine Residual Assigned = _____ mg / L

Notes: (Not all chlorination scenarios are addressed in the steps above. If you have additional documentation or comments, please attach/explain):

_____
_____
_____
_____
_____
_____
_____
_____

Remember to retain a copy of the completed form for your records.

Internal Regulating Agency Use Only:

1. Y ☐ N ☐ Verification of 4-log inactivation of viruses approved?

2. Y ☐ N ☐ Has GW source construction been reviewed and approved by DWP?

3. Y ☐ N ☐ Groundwater Rule Compliance Monitoring requirements forwarded in writing to PWS (letter with minimum chlorine residual, date to begin monitoring, frequency of monitoring –daily or continuous, and monthly reporting form)?

4. Y ☐ N ☐ GWR compliance monitoring tracking materials submitted to DWP-DMCE (dwp.dmce@state.or.us or 971 673-0694 FAX)?
   - Entry Structure Diagram with D-361 treatment code -Found on County/Dept of Ag Resources-Water System Inventory Updates-DWP website
   - Minimum chlorine residual assigned at entry point
   - Chlorine residual monitoring frequency (daily/continuous)
   - Date to begin compliance monitoring

Example Calculation

1. System's free chlorine residual (in mg/L) at first user's service connection: 0.5 mg/L
2. Shortest amount of time (in minutes) water is coming into contact with the chlorine: 10 min.
3. Multiply number and enter result: (0.5 × 10) = 5 mg-minutes/L (Total CT)
4. System's groundwater source's coldest water temperature: 10 In Degrees C

On Line A in the table below circle the value that most closely relates to the temperature recorded on line 4 above. On Line B in the table circle the 4-log inactivation value that is associated with the temperature you circled on Line A. Compare your CT value from Line 3 above with the value your circled in Line B of the table below. If your CT is a number larger than the number you circled in Line B then your system probably provides a least 4-log inactivation of viruses.

This systems does not achieve 4-log inactivation of viruses because the value from Line 3(CT=5) is smaller than the value circled on Line B (CT for 10°C=6)

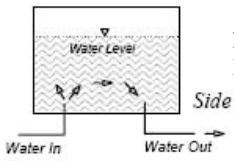
CT Values to Achieve Inactivation of Viruses by Free Chlorine, pH 6.0-9.0

A	Degrees C	5	6	7	8	9	10	11	12	13	14	15
B	4-log Inactivation	8.0	7.6	7.2	6.8	6.4	6.0	5.6	5.2	4.8	4.4	4.0

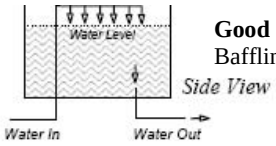
CT values provided in the tables are modified by linear interpolation between 5°C increments.

Estimated Baffling Factors for Storage Reservoirs* – Contact Time Calculation

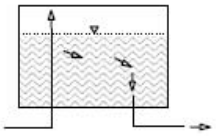
Estimated Baffling Factors for Various Storage and Pressure Tanks



Poor Circulation
Baffling Factor = 5-10%

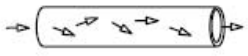


Good Circulation
Baffling Factor = 30 - 50%

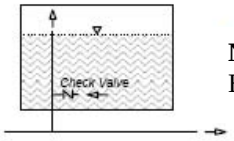


Poor Circulation
Baffling Factor = 10%

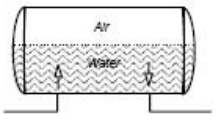
Superior Circulation
Baffling Factor = 70%



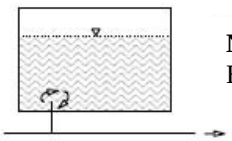
Perfect Circulation
Baffling Factor = 100%
Plug flow through a length of pipe



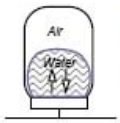
No Circulation
Baffling Factor = 0%



Poor Circulation
Baffling Factor = 10%
Hydropneumatic Tank



No Circulation
Baffling Factor = 0%



No Circulation
Baffling Factor = 0%
Bladder-Type Pressure Tank

* Baffling Factor graphic provided courtesy of the Washington Dept. of Health-Office of Drinking Water (September 2009)