

DATE: February 8, 2013

TO: Office of Drinking Water Technical Staff

FROM: John J. Aulbach, P.E., Director  
Office of Drinking Water 

SUBJECT: DESIGN AND CONSTRUCTION – Disinfection of Groundwater Sources

REFERENCE: WM 813 (Groundwater Source Development and Monitoring)  
WM 898 (Compliance Sampling and Reporting)  
WM 910 (Ground Water Rule Implementation Procedures)

Project Leader: Jim Moore

Reviewed By: Susan E. Douglas 

SUMMARY STATEMENT:

This memo clarifies ODW policy and procedures for requiring disinfection treatment at groundwater sources and provides staff guidance in reviewing plans and specifications for issuance of a construction permit. Clarification is provided to avoid potential conflicts with the Groundwater Rule (GWR) and the current disinfection design requirements contained in the *Waterworks Regulations (Regulations)*.

1. BACKGROUND

- 1.1 The *Regulations* require disinfection to be accomplished by the application of chlorine (see 12VAC5-590-1000 B). The specific chlorine compound shall be selected on the basis of water flow rates, application rates, pH of the water, cost of equipment and chemicals, availability of the disinfectant, and reliability of feed equipment. Alternate chemicals and methods for disinfection will be evaluated by the commissioner on a case-by-case basis, and the provisions of 12VAC5-590-290 (special permits for new or nonconventional methods, processes, and equipment) may apply.
- 1.2 Currently the *Regulations* require the owners of waterworks with groundwater sources to provide adequate disinfection under the following circumstances:
- a. When monitoring results indicate groundwater sources that have a Total Coliform geometric mean greater than 3 but less than 100 (12VAC5-590-380 H and 12VAC5-590-840 A). This is based on at least a 20 sample series collected during a well yield and drawdown test (development samples) or resulting from the routine source water monitoring required in the *Regulations* 12VAC5-590-425.
  - b. When monitoring results indicate groundwater sources with a confirmed fecal indicator, *E coli* (12VAC5-590-421). This is based upon Ground Water Rule requirements.
  - c. When groundwater sources have development samples indicating the presence of *E coli* in two or more samples (12VAC5-590-380 H)
  - d. When groundwater sources with routine source water monitoring results indicates the presence of *E coli* in two or more samples during any running six-month period (12VAC5-590-380 H).

- e. All spring sources (12VAC5-590-840 C 5 f)
  - f. When the source water quality is determined to contribute to the waterworks failure to meet the bacteriological PMCL (12VAC5-590-380 H)
  - g. When the owner has been notified of a Significant Deficiency as described in 12VAC5-590-350 D and does not (i) correct the significant deficiency, (ii) provide an alternate source of water or (iii) eliminate the source of contamination as described in 12VAC5-590-421 A.1.
- 1.3 The current language in the *Regulations* contains two separate design requirements for chlorine disinfection. These include one design (12VAC5-590-421) for situations when the confirmed presence of *E coli* is documented, and a second design (12VAC5-590-1000) for situations based upon the presence of Total Coliform above a certain level or to solve source water quality related bacteriological PMCL violations:
- a. 12 VAC5-590-421 – Requires disinfection treatment to provide at least 4-log inactivation of virus. Required chlorine contact is based upon calculations to include an appropriate baffling factor, described in Appendix L of the *Regulations*, minimum maintained free chlorine residual, pH and water temperature. In addition compliance monitoring is required consisting of daily chlorine residual monitoring for each day the source is utilized or providing on-line continuous monitoring equipment.
  - b. 12VAC5-590-1000 – Requires disinfection treatment to include 30 minutes of chlorine contact time at design flow. There is no requirement that the 30 minutes be equal to  $T_{10}$  (i.e. applying an appropriate baffling factor); or to consider chlorine concentration, pH or temperature in computing disinfection efficiency. The 30 minutes contact time has often been calculated simply as volume divided by design flow. Chlorine residual monitoring is not required, although suggested monitoring is contained in Appendix G of the *Regulations*.
- 1.4 In actual practice, some Field Offices have required chlorine feed systems to be installed to resolve Total Coliform MCL violations without any dedicated chlorine contact time. The reason for this action was that the Total Coliform MCL violations were determined to be distribution system-related, and not as a result of source water quality. (This is often referred to as a “secondary disinfection” purpose). At this time there is no allowance for this in the current *Regulations*. ODW does not want to discourage this solution, so a policy is needed in the interim.

*This issue must NOT be confused with situations where an owner voluntarily chooses to install a chlorine feed system (i.e. there is no water quality issue – either at the source or in the distribution system that would require disinfection). In these situations chlorine contact time is not necessary as ODW is not requiring disinfection.*

## 2. ODW DISINFECTION POLICY FOR GROUNDWATER SOURCES

- 2.1 For all situations described in Section 1.2, when an owner is required to provide adequate disinfection for a groundwater source, the disinfection unit process shall be designed as follows:
- a. The disinfection treatment shall consist of a disinfectant (free chlorine) concentration (C) and contact time (T) to achieve at least a 4-log inactivation of virus. The necessary chlorine contact volume shall be calculated using an appropriate baffling factor to yield a  $T_{10}$  based upon the peak hour flow rate or determined by tracer study. The disinfection treatment process shall be designed and evaluated in accordance with the requirements contained in Working Memo 910, Section 5.F.1 and the *Regulations* Sections 12VAC5-590-421 and Appendix L.
  - b. In addition to the 4-log virus inactivation requirements contained in 2.1.a. above, the minimum provided chlorine contact time, calculated by dividing the volume (gallons) by the peak hour flow rate (gpm), shall be 30 minutes. If the contact volume is provided by a tank, the tank shall be equipped with separate inlet and outlet piping located to minimize short circuiting. A minimum chlorine contact time of 30 minutes calculated using an appropriate baffling factor ( $T_{10}$ ) is recommended.
- 2.2 For all situations where a groundwater source is required to disinfect based upon the confirmed presence of *E. coli*, the Waterworks Operation Permit shall be amended to include Special Permit Requirements. The Requirements shall specify the minimum free chlorine residual that must be maintained and the operational control monitoring requirements. Refer to guidance in Working Memo 910.
- 2.3 For existing waterworks where disinfection is required based upon Total Coliform PMCL violations that are not related to source water quality, the disinfection treatment may be designed and approved without any dedicated chlorine contact time if the owner:
- a. demonstrates that the source water is free of bacteriological contamination and the commissioner determinations that the Total Coliform MCL violations are not related to source water quality, and
  - b. maintains a free chlorine residual at the entry point to the distribution system of at least 0.2 mg/L, and
  - c. maintains a detectable free chlorine residual throughout the distribution system, and
  - d. conducts source water monitoring per the requirements of 12VAC5-590-425
- 2.4 For situations where an owner voluntarily chooses to install a chlorine feed system for the purpose of maintaining a disinfectant residual in the distribution system to provide a safeguard against contamination, the disinfection treatment may be designed and approved without any dedicated chlorine contact time.
- 2.5 Compliance monitoring requirements. Waterworks owners shall be required to conduct chlorine residual monitoring at the following locations and frequencies:

- a. At the entry point to the distribution system (following all treatment and chlorine contact time, if required):
    1. When disinfection is required based upon confirmed *E. coli* contamination in the source water, the Ground Water Rule compliance monitoring requirements shall apply. These requirements (daily chlorine residual monitoring or the installation of on-line continuous monitoring equipment) are detailed in Working Memo 910 and in the *Regulations* section 12VAC5-590-421 C.
    2. When disinfection is required for any other reason or provided voluntarily by an owner, the District Engineer will determine the frequency of disinfectant residual monitoring. Guidance is contained in the *Regulations* Appendix G - Monitoring and Reporting.
  - b. At representative locations within the distribution system:
    1. As a minimum chlorine residual monitoring within the distribution system shall be monitored in accordance with 12 VAC5-590-370 B 3 h. This section requires that chlorine residuals be monitored “*at the same points in the distribution system and at the same time as total coliforms are sampled*”.
    2. For situations where disinfection is required based upon Total Coliform PMCL violations that are not related to source water quality and no chlorine contact time is provided (see 2.3 above), the District Engineer may require an increased frequency of distribution system chlorine residual monitoring.
- 2.6 Additional Monitoring Requirements. Waterworks owners that install disinfection treatment (either voluntarily or required) shall comply with the monitoring requirements for disinfection byproducts (12VAC5-590-370 B 3) and raw water monitoring requirements (12VAC5-590-425).

END OF MEMO