



Public Water Systems: Groundwater Source Disinfection

During construction, maintenance, and routine service activities of groundwater wells, microbial contamination may be introduced by surface water inflows (e.g. runoff), drilling equipment and fluids, and through the drill hole itself. To prevent the spread of potentially pathogenic organisms into the water-bearing formation and distribution system, wells must undergo periodic disinfection.

Wells may also need to be disinfected under specific situations related to TCEQ rules. 30 Texas Administrative Code 290.41(c)(3) requires wells to be disinfected but these rules do not provide the steps to perform the disinfection. This document combines TCEQ rule requirements with AWWA well disinfection standards to assist public water systems that may have well disinfection or well sampling requirements or needs. Additional information on how to disinfect a well is located at American Water Works Association (AWWA): AWWA Standard for [Water Wells](#)¹

When Wells Need to be Sampled or Disinfected

The following are examples of TCEQ regulations that either require well sampling or well disinfection. If any samples are positive for total coliform or *E. coli*, well disinfection may be an effective tool to produce negative raw well sample results. The following situations are from [Title 30 TAC](#)² Chapter 290:

- 290.116(b)(5)(A): Well disinfection as a Corrective Action under the Groundwater Rule.
- 290.41(c)(3)(F): Well disinfection after placing a well into initial service or after it has been reworked. At least one raw sample is required for three successive days for initial well approval or after a well has been reworked. Reworking is deepening, jetting, or any similar major activities.
- 290.41(c)(3)(F): [Required Bacteriological Samples When a Well Pump is Repaired or Replaced](#)³, for minor well work. This guidance allows for a single raw sample after minor well work. Minor work would include pump repair, pump replacement, or other similar activities.

¹ www.tceq.texas.gov/search_forms.html

² www.tceq.texas.gov/goto/view-30tac

³ www.tceq.texas.gov/assets/public/permitting/watersupply/ud/Bacteriological-Samples-Wellpump-Repaired-Replaced.pdf

Disinfection and Testing Procedures

1. During construction and maintenance operations, precautions should be used to minimize contamination. Actions for accomplishing this protection include:
 - Diversion of surface water runoff from the well, drilling fluid pond, and other construction areas.
 - Drilling equipment, gravel, pump column, and any other items and materials that will enter the well must be used and stored in a manner that minimizes contamination. Water used in any drilling operation shall be of safe, sanitary quality. Water used in the mixing of drilling fluids or mud shall contain a chlorine residual of at least 0.5 milligrams per liter (mg/L). (Special care should be taken with petroleum-based and synthetic lubricants and other products.) [290.41(c)(2)(A)]
 - The well site should be covered between work periods.
2. Disinfectants must be approved for use in potable water sources in accordance with the Water Treatment rule. All chemicals and any additional or replacement process media used in treatment of water supplied by public water systems must conform to ANSI/NSF Standard 60 for Drinking Water Treatment Chemicals and ANSI/NSF Standard 61 for Drinking Water System Components. Conformance with these standards must be obtained by certification of the product by an organization accredited by ANSI. [290.42(j)]. These disinfectants include:
 - Liquid chlorine - for use only in combination with appropriate gas-flow chlorinators and injectors.
 - Sodium hypochlorite.
 - Calcium hypochlorite.
3. Gravel / gravel pack chlorination
 - Chlorination of gravel installed in new wells can be accomplished using one of the following procedures. In either case, prior to installing gravel, the drilling fluid must be thinned (reconditioned) as described in ANSI/AWWA A100 A100-20 Water Wells and extended to the top of the casing.
 - 1) Tablet procedure in gravel. Calcium hypochlorite tablets (approximately 5-gram size) must be uniformly mixed with the gravel (0.25 to 0.5 pounds calcium hypochlorite per ton of gravel). Warning: gravel should be free of organic material. There is a potential for an explosion if gravel containing organic material mixes with hypochlorite tablets.
 - 2) Chlorine residual in drilling fluid. After drilling fluid is thinned, gravel can be added to the well annulus. After the drilling mud has been displaced, chlorinated water is introduced into the well to produce a minimum chlorine concentration of 50 mg/L.
 - Chlorination of gravel installed in existing wells. When gravel has settled in an existing well, any replacement gravel used to fill the void must be soaked,

immediately prior to its use, for at least 30 minutes in a chlorine solution >50 mg/L.

- Chlorination of existing gravel pack in wells. The gravel pack should be chlorinated by feeding water containing >100 mg/L chlorine residual down the gravel chute.

4. Chlorination of permanent equipment and material used in wells

- All permanent equipment and material in the well must be chlorinated just prior to installation by spraying the areas with a solution having a chlorine residual >200 mg/L.

5. Chlorination of well after installing permanent equipment

- After installing permanent equipment, the well must be chlorinated by:
 - 1) treating water in the well casing to provide a chlorine residual of approximately 50 mg/L;
 - 2) circulating the chlorinated water within the well casing and pump column; and
 - 3) pumping the well to waste to remove chlorinated water.
- Treating water in the well casing. Water in the well casing must be treated with chlorine providing an average chlorine residual of 50 mg/L. After chlorine is applied, the well must be surged a minimum of three times to improve mixing and induce contact of the chlorinated water with the adjacent aquifer. Chlorinated water should remain in the casing for 12 to 24 hours but no more than 24 hours.
- Circulating the chlorinated water. Following disinfection of water in the well casing, a pressure-tight connection must be made at least 2 inches in diameter (but not larger than the discharge piping) from the pump discharge piping to the casing vent. The pump must be operated against a throttled discharge valve to return a flow of several hundred gallons per minute down the well casing while the rest of the pumped water is discharged to waste.
- In low-producing wells, the rate of return need not exceed half the maximum rate of production of the well.
- When zero chlorine residual is measured, the well must continue to be pumped to waste for at least 15 minutes. The well must then be sampled and analyzed for microbial (Total Coliform/E. coli) presence or absence at a TCEQ-accredited laboratory.
- Disinfection of flowing wells. Flowing wells discharging at the surface generally do not require chlorination; however, bacteriological sampling for coliforms must be done. If coliforms are present, chlorine should be applied at or below the lowest aquifer producing the artesian condition in an amount that will produce a minimum chlorine concentration of 25 mg/L in the flowing water. Chlorine may be introduced through a weighted tube discharging a solution with a high concentration of chlorine (i.e. 15,000 mg/L) or using calcium hypochlorite tablets confined in a perforated

container. If coliforms are still present after this disinfection, all necessary corrective actions must be performed.

6. Disposal of Contaminants

- Any oil or other significant contaminant pumped from the well must be collected for proper disposal. Additionally, if the discharge of chlorinated water would be harmful to vegetation or wildlife, chlorinated water must be impounded, or chlorine content neutralized. Federal, state, or local environmental regulations may require special provisions or permits prior to disposal of highly chlorinated water.

7. Verification of Successful Disinfection

- Bacteriological evaluation - After the well has been chlorinated and pumped to waste for at least 15 minutes with zero chlorine residual, a minimum of two samples for coliform organisms must be collected no less than 30 minutes apart. All analyses must be conducted by a TCEQ-accredited laboratory.
- If any of the sample results are positive for coliform, one of the following procedures must be used:
 1. Pump the well to waste for at least 15 additional minutes and collect a minimum of two coliform samples not less than 30 minutes apart.
 2. Chlorinate and re-test the well as described in AWWA C654-03.
 3. Perform all necessary corrective actions needed to produce negative coliform results.
- The well source has been properly disinfected when all the above procedures have been followed and a minimum of two total coliform-negative results have been obtained.
- Record of Compliance - Microbial test results certifying that the well is producing water free of coliform organisms is the record of compliance.