

Monitoring of Surface Water Systems

NONCOMMUNITY PUBLIC WATER SUPPLY PROGRAM

Regulatory Requirements

The Safe Drinking Water Act (SDWA) requires that Public Water Systems (PWS) that use surface water and Groundwater Under the Direct Influence of Surface Water (GWUDI) sources monitor for chlorine residual, turbidity, and total coliform bacteria. While the SDWA requires that these facilities treat for *Giardia*, *Cryptosporidium*, and viruses, those organisms are difficult to measure. Instead of measuring them directly, turbidity and chlorine are measured as indicators of the performance of the treatment system, and total coliform bacteria is measured as an indicator of the bacteriological water quality. Thus, monitoring of the surface water treatment system is a vital aspect of providing safe drinking water. Along with challenge testing of filters and ensuring proper system design, monitoring provides confidence that the treatment plant is adequately treating *Giardia*, *Cryptosporidium*, and viruses.

If the system serves less than 500 people, turbidity and chlorine residual must be measured at least daily. Frequency will increase for larger systems. The values must be recorded and submitted to MDH each month.

If the system serves less than 1000 people, a single total coliform bacteria sample must be collected from the distribution system each month. For larger systems, the number of monthly samples will increase.

Chlorine Residual Monitoring

Chlorine is used as a disinfectant in surface water systems. It has the ability to inactivate viruses and *Giardia* but not

Cryptosporidium. The higher the chlorine concentration and the more time the chlorine is allowed to react with the water, the more disinfection it provides. The same amount of disinfection can be achieved with a low chlorine concentration and long contact time, or a high chlorine concentration and short contact time. Thus, the required chlorine concentration is unique to each system and is based on the contact time provided. Large storage volumes, slow flow rates, and good mixing conditions yield more contact time. The required chlorine residual is the minimum amount that needs to be provided, given the available contact time, to achieve the *Giardia* and virus inactivation required by the SDWA.

Chlorine residual should be measured immediately after all contact time and prior to or at the first tap on the distribution system. This sample point is known as the Entry Point. The measurement should be made using an approved DPD or amperometric method. When using a DPD method, a reagent is added to the water sample that turns pink in the presence of chlorine; darker pink indicates higher chlorine concentration. Free chlorine residual should be measured instead of total chlorine residual. For further instruction on chlorine residual measurement, refer to the measurement guide or the instrument manual.

Maintaining a consistent chlorine residual is often the most difficult aspect of operating a small surface water system. This difficulty occurs because chlorine reacts slowly with natural organic matter in the water and degrades when exposed to sunlight. The older the water in the distribution system,

the lower the chlorine residual will be. It is common for chlorine residual to drop significantly, even to zero, if there is little water usage or if the distribution plumbing is very long. To minimize these issues, best practices should be followed:

- Minimize water age by not oversizing storage tanks.
- Flush water during periods of low customer usage.
- Record the daily chlorine measurement during the time of peak water usage. If needed, flush water until the minimum residual is reached.
- Keep transparent storage tanks out of direct sunlight. Place them under a roof or cover with a tarp.

Turbidity Monitoring

Turbidity is a measurement of water clarity. The lower the turbidity, the fewer particles are in the water and the more clear it appears. Filters used in surface water systems are designed to remove *Giardia* and *Cryptosporidium*, meaning they also remove other particles that are similarly sized and larger than these organisms. If the filter is functioning properly, it should produce water with a low turbidity, indicating that it is removing *Giardia* and *Cryptosporidium* as intended. The required turbidity that must be achieved is based on the type of filter. Generally, bag and cartridge filters should produce water with turbidity below 1.0 NTU, and membrane filters and conventional treatment plants should produce water with turbidity below 0.3 NTU.

Turbidity should be measured immediately after the final filter and prior to storage tanks. Measuring at this location ensures that the measurement is accurately

assessing the filter performance. The water system should be running (water is flowing through the filter) when the measurement is taken. The measurement must be taken with an instrument certified to EPA Method 180.1. Instruments certified to other methods may not provide accurate results. For further instruction on turbidity measurement, refer to the measurement guide or the instrument manual.

High turbidity is an indication that the filtration system is not performing adequately. Poor performance could be due to filter failure or poor source water quality. If the turbidity cannot be reduced below the required limit, the filter must be changed. If the issue still persists, additional pre-treatment may be needed to handle intermittent changes to source water quality. Certain water sources may experience high turbidity during rain storms, wind events, and lake turnover. Contact MDH for assistance in diagnosing the cause of high turbidity.

Pressure and Water Usage

The SDWA does not require that surface water systems monitor for pressure and water usage. However, these parameters give invaluable information to the operator and can be essential in diagnosing issues with system components.

Pressure gauges should be installed prior to and after each treatment device in the water system. A drop in pressure should be observed across each filter when installed to get a baseline. Over time, the larger the difference between the inlet and outlet pressures, the more clogged the filter. Thus, pressure difference can be a primary indicator that a bag or cartridge filter needs to be changed, or that a sand or membrane filter needs to be backwashed.

Measuring water usage in total gallons along with instantaneous flow can help assess filter condition, identify leaks, and observe patterns in water usage. Flow meters showing reduced flow through a filter indicate that the filter may need to be changed or backwashed. An increase in daily water usage or a constantly running water meter can indicate a leak in the system. Finally, a familiarity with total daily gallons produced allows an operator to diagnose changes observed in treatment performance. If a bag or cartridge filter did not last as many days as usual, looking at the daily water usage can indicate if more water was used, accelerating clogging. If chlorine residual is lower than normal, looking at the daily water usage can indicate if less water is being used, leading to increased water age and causing a drop in chlorine residual.

Total Coliform Sampling

Coliforms are a group of bacteria present in the gastrointestinal tracts of warm-blooded animals. While some coliform bacteria such as certain strains of *E. coli* are pathogenic, most coliforms do not present a risk of illness. In drinking water systems, they are used as a quick and inexpensive indicator that other microorganisms may be present. Properly operated surface water systems should be absent of total coliform bacteria, from which we infer that it is also likely absent of other pathogenic bacteria.

Total coliform samples are collected by the operator monthly from the distribution system. A chlorine residual must be measured and recorded at the same time

and location as the total coliform sample. The coliform sample should not be collected until a chlorine residual is detected. Care should be taken to avoid contamination of the sample. The tap should be disinfected with a flame or alcohol solution prior to collection. The operator should use hand sanitizer and avoid touching the inside of the bottle cap or the rim of the bottle. The sample should be collected quickly and the cap should not be set down. For further instruction on collecting total coliform samples, refer to the sample collection procedure.

Related Links

- [Free Chlorine Residual Measurement Guide \(PDF\)](https://www.health.state.mn.us/communities/environment/water/docs/ncom/chlormeasureregide.pdf)
(<https://www.health.state.mn.us/communities/environment/water/docs/ncom/chlormeasureregide.pdf>)
- [Turbidity Measurement Guide \(PDF\)](https://www.health.state.mn.us/communities/environment/water/docs/ncom/turbiditymeasure.pdf)
(<https://www.health.state.mn.us/communities/environment/water/docs/ncom/turbiditymeasure.pdf>)
- [Coliform Bacteria in Drinking Water Fact Sheet \(PDF\)](https://www.health.state.mn.us/communities/environment/water/docs/contaminants/coliformbacteria.pdf)
(<https://www.health.state.mn.us/communities/environment/water/docs/contaminants/coliformbacteria.pdf>)
- [Total Coliform Sample Collection Procedure \(PDF\)](https://www.health.state.mn.us/communities/environment/water/docs/sampproc/totalcolifomsp.pdf)
(<https://www.health.state.mn.us/communities/environment/water/docs/sampproc/totalcolifomsp.pdf>)
- [Total Coliform Sample Collection Procedure \(Video\)](https://www.youtube.com/watch?v=MQLn33Wcw4&ab_channel=mnhealth)
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