

State Water Resources Control  
Board Division of Drinking Water

***Cryptosporidium* Action Plan / Surface Water Treatment  
Optimization**

April 2019

1. Introduction
2. Watershed Control Program and Sanitary Survey
3. Source Bacteriological Monitoring
4. Optimizing Surface Water Treatment
5. Operations Plan
6. Reliable Removal Treatment Processes
7. Alternative Treatment Technologies
8. Consumer Confidence Report
9. Cryptosporidiosis Fact Sheet

## 1. INTRODUCTION

In 1993, a waterborne illness outbreak in which over 400,000 persons were infected occurred in Milwaukee, Wisconsin. The outbreak was caused by an intestinal parasite called *Cryptosporidium*, which was discovered in 1976 to cause illness in humans. Symptoms of cryptosporidiosis are similar to other intestinal illnesses, such as the stomach flu, and usually goes away within one to two weeks in people with healthy immune systems. *Cryptosporidium* is found intermittently in surface water sources. The parasite exists in a shell called an “oocyst” that enables it to survive many environmental conditions for extended periods of time and be resistant to chlorine disinfection. Since it is smaller than *Giardia lamblia* cysts, it is more difficult to remove during conventional drinking water treatment.

The U.S. Environmental Protection Agency (EPA), through the Information Collection Rule (ICR, adopted May 1996), required public water systems serving 100,000 or more persons using surface water or groundwater under the direct influence (GWUDI) of surface water to conduct source water microbial monitoring monthly for 18 consecutive months. Microbial monitoring included *Cryptosporidium*, *Giardia*, total culturable viruses, total coliforms and fecal coliforms or *E.coli*. Data collected through the ICR was used to adopt the Interim Enhanced Surface Water Treatment Rule (IESWTR, adopted December 1998) and the Long Term 1 Enhanced Surface Water Treatment Rule (LT1ESWTR, adopted January 2002). The rules established a maximum contaminant level goal (MCLG) of zero for *Cryptosporidium*, a 2-log *Cryptosporidium* removal requirement for systems that provide filtration, and requires systems that do not provide filtration treatment to develop watershed protection programs that address *Cryptosporidium*. The Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR, adopted January 2006) requires systems to monitor their surface water, or GWUDI source, for *Cryptosporidium* and/or *E.coli* to determine if their source is vulnerable to contamination and established additional treatment for *Cryptosporidium*, if necessary.

To thoroughly address the public health risks from waterborne illness in drinking water caused by *Cryptosporidium*, the Division of Drinking Water (DDW) initially developed the *Cryptosporidium* Action Plan (CAP) in April 1995, which was implemented as required within Section 116360 of the California Health and Safety Code. The following CAP is an update to the April 1995 CAP and is intended to facilitate comprehensive compliance with the State’s existing Surface Water Treatment Rule (SWTR) and to ensure continued compliance with Health and Safety Code section 116360. The CAP does not contain any requirements beyond the scope or intent of current regulation; rather, it clarifies existing requirements to support drinking water utilities in optimizing the treatment process and reducing the risk of a waterborne illness outbreak. The CAP includes strategies necessary for protecting public health from *Cryptosporidium* exposure, such as source protection and monitoring, conducting comprehensive sanitary surveys of public water systems’ sources, infrastructures, operations and management to identify potential risks and optimization of all treatment processes to maximize turbidity and pathogen removals. The CAP should be comprehensively implemented and promoted among all public water utilities for the protection of public health.

## **2. WATERSHED CONTROL PROGRAM AND SANITARY SURVEY**

Source protection and monitoring is key in the control and prevention of *Cryptosporidium* occurrences. A Watershed Control Program Plan, as discussed within the EPA LT2ESWTR Toolbox Guidance Manual, should be developed. The Plan should identify the source(s) of *Cryptosporidium*, such as grazing animals, the location and quantity of these sources, control measures to prevent runoff of *Cryptosporidium* and other pathogens into the source water, watershed topography and land use. Partnerships with local government, landowners and other stakeholders involved in the management and use of the watershed should be established.

The SWTR requires all public water systems using an approved surface water source to conduct a sanitary survey of their watershed(s) at least every five years. The first survey was required to be completed by January 1, 1996. A report of the survey must be submitted to DDW within 60 days following completion of the survey. The survey and report must include a physical and hydrogeological description of the watershed, a summary of source water quality monitoring data, a description of activities and sources of contamination, a description of any significant changes that have occurred since the last survey which could affect the quality of the source water, a description of watershed control and management practices, an evaluation of the system's ability to meet requirements of the SWTR, and recommendations for corrective actions. The Watershed Sanitary Survey Guidance Manual, developed by the American Water Works Association (AWWA) in December 1993, may assist systems in defining the scope of their watershed sanitary surveys and to provide information on the methods and sources of information for conducting the surveys.

## **3. SOURCE BACTERIOLOGICAL MONITORING**

The LT2ESWTR required filtered systems serving at least 10,000 people to sample their source water for *Cryptosporidium*, *E.coli* and turbidity at least monthly for 24 months over two different time frames (Rounds 1 and 2). Assessment of source water *Cryptosporidium* concentration was used to determine the water system's "bin" classification and to assess whether additional treatment is necessary for the protection of public health. Due to the relatively high cost of analyzing samples for *Cryptosporidium*, EPA identified *E.coli* as an indicator that can be used to identify some of the water sources that are unlikely to exceed a *Cryptosporidium* level of 0.075 oocysts/L – the level at which filtered public water systems must provide additional treatment under LT2ESWTR. As such, filtered systems serving fewer than 10,000 people were required to sample their source water for *E.coli* at least once every two weeks for 12 months during Rounds 1 and 2. *Cryptosporidium* monitoring was required if the annual mean *E.coli* concentration was greater than 100 MPN/100 mL. LT2ESWTR monitoring for all systems were completed by October 2018, except for systems required to conduct triggered *Cryptosporidium* monitoring.

The SWTR requires a supplier using an approved surface water source to monitor the raw water supply for *E.coli* bacteria using density analysis at least once per month. Increased monitoring and treatment for *E.coli*, *Giardia lamblia* cysts and viruses may be considered based on factors such as source of contamination; treatment plant performance and control systems; filtration and disinfection credit; and monitoring frequencies and locations. Public water systems should work closely with their DDW

District Office to evaluate their source bacteriological data to determine whether additional monitoring and treatment is necessary.

#### **4. OPTIMIZING SURFACE WATER TREATMENT**

The EPA, AWWA and other national drinking water organizations part of the Partnership for Safe Water established a goal to provide a new measure of safety by implementing prevention based around optimizing treatment plant performance and distribution system operation. One of the treatment plant performance goals is to produce filter effluent turbidity values less than 0.1 NTU. DDW agrees with and endorses this turbidity goal. Water systems using a surface water source should adopt a philosophy of always optimizing their surface water treatment plant operations in a manner designed to achieve maximum turbidity removal to minimize the risk to exposure of pathogens, including Cryptosporidium, in the drinking water delivered to their customers. The following practices should be considered to optimize treatment performance:

- a. Monitor all plant unit processes closely and respond to any indication of unit treatment process malfunction immediately. The proper operation of all pretreatment processes is critical to achieve optimum filter performance.
- b. Operate unit treatment processes at hydraulic loading rates that will enable meeting optimization goals. Operating at the loading rates needed to meet peak summer demands is not recommended when the system demand is reduced. This is especially important when turbidity and coliform data indicate recent runoff may have increased the pathogen concentrations in the water source.
- c. Establish procedures for optimizing the coagulation, flocculation and sedimentation processes to enable maximum turbidity removal in the pretreatment units with a turbidity goal of 1 to 2 NTU in the effluent of the sedimentation basin at all times. This includes adjusting the coagulant dose when plant influent conditions change such as the flow, solids loading, return of properly treated backwash water, temperature, pH, etc. It is important to use jar tests or particle counters to determine proper pretreatment chemical and dose. For those systems with the resources to install particle counting systems, the information obtained may be helpful for adjusting pretreatment chemicals and determine when to backwash filters. DDW encourages the continued development and use of this monitoring tool for determination of chemical dosages and length of filter runs.
- d. Monitoring of plant operations should include turbidity monitoring of individual filters on both a continuous basis and intermittent grab samples. For conventional filtration treatment, turbidity of the settled water must be monitored at least once a day. If recycling filter backwash water, the system must also monitor the turbidity and determine the flow of the recycled water at least once a day or once during each recycle event. Monitoring must be representative of the recycled water.
- e. Calibrate turbidimeters in accordance with manufacturer's specifications.

- f. Establish procedures for optimizing filter operations to avoid turbidity spikes after service interruptions. This can be achieved by filter to waste, by bringing filters on line slowly, or by the proper use of filter aid chemicals during the backwash process. AWWA research shows that *Cryptosporidium* oocyst breakthrough can occur at much lower turbidity levels than those allowed for by the existing regulations. This is especially true of the turbidity levels (up to 2 NTU) allowed during the first 4 hours after backwash. Attempting to achieve turbidities of 0.3 NTU or less after backwash should be the operator's goal.
- g. Operate in such a way as to avoid sudden increases in flows through a filter. Such events can result in a short and quick release of filtered material (which can include pathogens) to the plant effluent.
- h. Optimize the performance of backwash water recovery systems. Recycling of backwash water should not be practiced if it interferes with optimization of the treatment process. An operational goal of less than 2.0 NTU should be established for the backwash water returned to the headworks of the treatment plant. Use of coagulant chemicals to assist in the solids separation is advisable and usually necessary to meet the 2.0 NTU goal. The flow rate of the backwash water returned to the headworks should not exceed ten percent of the incoming treatment plant flow rate. Disinfection of the backwash water prior to recycling to the headworks may be considered to reduce the pathogen concentration in the returned stream. Alternate disinfection practices, such as ozone and UV, should be considered for the disinfection of the backwash water to limit disinfection byproduct formation.

## **5. OPERATIONS PLAN**

The turbidity performance goal of 0.1 NTU and the treatment optimization practices recommended above should be included within the system's Operations Plan that is required within Section 64661 of the SWTR. The operations plan should be designed to produce the optimal water quality from the treatment processes and include a statement at the beginning of the plan that it is the goal of the water system to attempt to optimize performance of all plant unit treatment processes and thereby maximize the turbidity removal. The system should endorse the idea that a properly designed and operated plant will be able to consistently achieve an effluent turbidity of 0.1 NTU and thereby achieve an effluent quality which presents the lowest pathogen risk to system customers.

Direct and conventional filtration treatment plants must demonstrate that optimum coagulation is being achieved by either at least an 80 percent turbidity reduction through the filters of the monthly average raw water turbidity or jar testing, pilot testing or other means. The water system must operate its treatment plant in accordance with the approved plan at all times.

## **6. RELIABLE REMOVAL TREATMENT PROCESSES**

The effectiveness of a surface water treatment plant to provide optimal removal of pathogens under all conditions and at all times is dependent upon the condition of each

unit process and related appurtenances and the reliability features required of all treatment plants. All treatment plants must have the following reliability features:

- a. Alarm devices to provide warning of coagulation, filtration and disinfection failures. All devices must warn a person designated by the supplier as responsible for taking corrective action, or have provisions to shut the plant down until corrective action can be taken.
- b. Standby replacement equipment available to assure continuous operation and control of unit processes for coagulation, filtration and disinfection.
- c. A continuous turbidity monitoring and recording unit on the combined filter effluent prior to clearwell storage.
- d. Multiple filter units which provide redundant capacity when filters are out of service for backwash or maintenance.

Failed equipment and alarms should be quickly repaired or replaced. All monitoring equipment, pumps and motors should be regularly inspected and calibrated in accordance with the manufacturer's specifications. Alarms, shutdown features, notification and other warning systems should be tested periodically to assure proper operation.

Water systems should also routinely evaluate the condition and remaining useful life expectancy of all unit processes and equipment and develop a Capital Improvement Plan (CIP) to replace aging infrastructures before they catastrophically fail.

## **7. ALTERNATIVE TREATMENT TECHNOLOGY**

Cryptosporidium and other pathogenic microorganism removal in surface water treatment most commonly include coagulation, flocculation, sedimentation and filtration processes, followed by disinfection to inactivate any remaining pathogens. Due to the potential of Cryptosporidium passing through traditional media filters, Cryptosporidium's resistance to common disinfection practices such as chlorination and chloramination, and efforts to reduce disinfection by products, alternative treatment technologies have been accepted for the removal and inactivation of Cryptosporidium and other pathogens. Such technologies include membrane filtration, chlorine dioxide, ozone and ultraviolet (UV) disinfection.

To receive removal credit for Cryptosporidium under the LT2ESWTR, membrane technologies, which includes microfiltration, ultrafiltration, nanofiltration and reverse osmosis, must meet the following three criteria.

- a. The process must comply with the definitions of membrane filtration as stipulated by the rule.
- b. The removal efficiency of a membrane filtration process must be established through a product-specific challenge test and ongoing, site-specific direct integrity testing during system operation.
- c. The membrane filtration system must undergo periodic direct integrity

testing and continuous indirect integrity monitoring during operation.

A list of approved membrane filtration technologies is available on the DDW website under Drinking Water Program Publications.

The design, monitoring and operational considerations of chlorine dioxide, ozone and UV disinfection is further discussed within the EPA LT2ESWTR Guidance Toolbox Manual.

## **8. CONSUMER CONFIDENCE REPORT**

Community and nontransient-noncommunity water systems are required to prepare and deliver a Consumer Confidence Report (CCR) annually by July 1<sup>st</sup>. For systems that performed monitoring that indicates the presence of *Cryptosporidium* in either the source water or the finished water, the CCR must include a summary of the monitoring results and an explanation of their significance. Below is an example of an explanation of the significance of the results.

*EXAMPLE – Cryptosporidium is a microbial pathogen found in surface water throughout the U.S. Although filtration removes Cryptosporidium, the most commonly-used filtration methods cannot guarantee 100 percent removal. Our monitoring indicates the presence of these organisms in our source water and/or finished water. Current test methods do not allow us to determine if the organisms are dead or if they are capable of causing disease. Ingestion of Cryptosporidium may cause cryptosporidiosis, an abdominal infection. Symptoms of infection include nausea, diarrhea, and abdominal cramps. Most healthy individuals can overcome the disease within a few weeks. However, immuno-compromised people, infants and small children, and the elderly are at greater risk of developing life-threatening illness. We encourage immuno-compromised individuals to consult their doctor regarding appropriate precautions to take to avoid infection. Cryptosporidium must be ingested to cause disease, and it may be spread through means other than drinking water.*

## **9. CRYPTOSPORIDIOSIS – FACT SHEET**

### **What is cryptosporidiosis?**

Cryptosporidiosis (KRIP-toe-spo-rid-ee-OH-sis) or Crypto is a diarrheal disease caused by a microscopic parasite called *Cryptosporidium*. The parasite lives in the intestine of infected humans and animals.

Chlorination and other methods of water purification will not kill *Cryptosporidium*, making it one of the most common causes of waterborne disease (recreational and drinking water) in the U.S.

Crypto has also been responsible for outbreaks in child care settings, foodborne illness outbreaks associated with contaminated foods or ill food handlers, and through contact with livestock or animals at petting zoos.

### **How is cryptosporidiosis spread?**

Crypto is a contagious disease. When a person or animal infected with Crypto begins to have symptoms, millions of Crypto parasites are shed in their feces during a bowel

movement. The shedding of the parasites can last for weeks after the symptoms stop.

Crypto may be found in soil, food, water, or surfaces that have been contaminated with the feces from infected humans or animals. You may become infected even if you can't see the contamination.

### **How can you get Crypto?**

You can get Crypto if you:

- Drink water contaminated with Crypto parasites.
- Swim in water contaminated with Crypto parasites & accidentally swallow some of it.
- Eat food contaminated with Crypto.
- Touch your hand to your mouth if your hand has been in contact with a contaminated surface or object.
- Have close contact with other infected people or animals — especially their feces — which can allow the parasite to be transmitted from your hands to your mouth.
- Are exposed to feces from an infected person during sexual activity.

### **What are the symptoms of cryptosporidiosis?**

Symptoms of Crypto infection can begin two to ten days after becoming infected with the parasite. Watery diarrhea is the most common symptom. Other symptoms include: stomach cramps or pain, dehydration, nausea, vomiting, fever, and weight loss.

In persons with healthy immune systems, symptoms usually last about one to two weeks. Some people with Crypto will have no symptoms at all. People with weakened immune systems, including those with HIV/ AIDS and transplant recipients, may be very ill for a much longer period of time and can have serious complications. More information regarding diagnosis and treatment for people with weakened immune systems can be found on the U.S. Centers for Disease Control and Prevention crypto webpage:

<https://www.cdc.gov/parasites/crypto/audience-immune-compromised.html>

### **How is cryptosporidiosis diagnosed?**

Crypto can be difficult to diagnose. Routine tests for diarrheal illnesses do not detect Crypto. If you feel that you have Crypto, tell your health care provider. Your health care provider can request specific testing for the parasite. Because testing for Crypto can be difficult, you may be asked to submit fecal specimens over several days.

### **How is cryptosporidiosis treated?**

It is very important to see your health care provider if you think you may have Crypto. Most people who have healthy immune systems will recover without treatment. Prescription medicine is available if needed.

## **How can cryptosporidiosis be prevented?**

- Wash hands with soap and water for at least 20 seconds, rubbing hands together vigorously and scrubbing all surfaces:
  - Before preparing or eating food
  - After using the toilet
  - After changing diapers or cleaning up a child who has used the toilet
  - Before and after tending to someone who is ill with diarrhea
  - After handling an animal or animal waste
- Purify untreated water (such as from a stream or a lake) before drinking by:
  - Boiling water for at least one minute. Above 6500 feet, boil water for at least three minutes.
  - Using special water filters that can remove Crypto.
- Around animals:
  - Minimize contact with the feces of all animals, particularly young animals.
  - When cleaning up animal feces, wear disposable gloves, and always wash hands when finished.
  - Wash hands after any contact with animals or their living areas.
- If you have a weakened immune system, speak to your health care provider. Additional precautions may be recommended.

## **How do I protect others if I have diarrhea or cryptosporidiosis?**

- Children with diarrhea or Crypto
  - Children with diarrhea should be excluded from child care settings until the diarrhea has stopped.
- At recreational water venues (pools, water slides, interactive fountains, lakes, ocean)
  - Do not swim or participate in water activities if you have diarrhea (this is essential for children in diapers). If you have been diagnosed with cryptosporidiosis, do not swim for at least 2 weeks after diarrhea stops.
  - Shower before entering the water.
  - Wash children thoroughly (especially their bottoms) with soap and water after they use the toilet or their diapers are changed and before they enter the water.
  - Take children on frequent bathroom breaks and check their diapers often.
  - Change diapers in the bathroom, not at the poolside.

## **What is public health doing about cryptosporidiosis?**

The California Department of Public Health (CDPH) and local health departments (LHDs) monitor cryptosporidiosis in California. If an outbreak of Crypto is reported, CDPH and LHDs public health will investigate to find the cause, fix the problem, and educate the public.

To help prevent spread of cryptosporidiosis to others, LHDs may restrict persons with cryptosporidiosis from certain types of work (such as food handling) or other activities until the person has not had diarrhea for 48 hours. Persons with Crypto should stay out of public pools for at least 2 weeks after diarrhea has stopped.

## **What is public health doing to ensure that my drinking water is not contaminated with Cryptosporidium?**

Public water systems must follow rules and standards set by the U.S. Environmental Protection Agency and State Water Resources Control Board – Division of Drinking Water. These requirements reduce the levels of Cryptosporidium in public drinking water so that the risk of contamination is very low.

Private wells and individual water systems may not have the same level of monitoring as large public water systems. Owners of these systems are responsible for ensuring that their well water is safe from contaminants, including Cryptosporidium.

## **Where can I get more information on cryptosporidiosis?**

You can get more information from your health care provider or your local health department, the U.S. Centers for Disease Control and Prevention crypto webpage <https://www.cdc.gov/parasites/crypto/> and <https://www.cdc.gov/healthywater/index.html>.

You can also contact:

California Department of Public Health – Infectious Disease Branch at (510) 620-3434.

State Water Resources Control Board – Division of Drinking Water – District Offices [https://www.waterboards.ca.gov/drinking\\_water/programs/documents/ddwem/DDWdistrictoffice.smap.pdf](https://www.waterboards.ca.gov/drinking_water/programs/documents/ddwem/DDWdistrictoffice.smap.pdf)