Water Quality Evaluation

For

Gene Camp Water System and Site Improvements

75 % DESIGN SUBMITTAL

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Metropolitan Water District

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1. Introduction

1.1 Executive Summary

Metropolitan Water District's (MWD) water treatment system provides potable water to the Gene Camp Pump Station facilities and the neighboring Gene Camp Village. The existing system's water effluent currently meets all of the U.S. Environmental Protection Agency's Drinking Water Standards using standard surface water filtration methods. Although effective, the 75 year old water treatment system is in need for improvements and further optimization. Due to a majority of manual operation, intermittent on-off cycles, non-chlorine tolerant membranes, irregular maintenance efforts, and natural deterioration, the current system currently operates inefficiently and requires increased routine maintenance efforts.

1.2 Project Scope

Level 17 Engineering has been contracted by the Metropolitan Water District to make improvements to the Gene Camp water system and village. This report identifies all of the regulatory requirements and water treatment design standards to commision a new domestic water supply treatment system by increasing the overall efficiency and reliability while following the new water treatment design and reliability standards.

1.3 Purpose

The purpose of this report is to evaluate the current water supply treatment processes, the water quality influent going into the distribution system, identifying the effluent requirements, and to provide recommendations on the necessary system improvements.

2. Project Description

2.1 Project Location

The Gene Camp water system is located two miles west of the Whitsett Intake of the Colorado River. The pump station pumps its source water from Gene Wash Reservoir through a 16-foot diameter inlet siphon and then lifts it 303 feet to an elevation of 1,037 feet. The on-site water treatment system provides potable water to the pump station facilities and the adjacent Gene Camp Village.

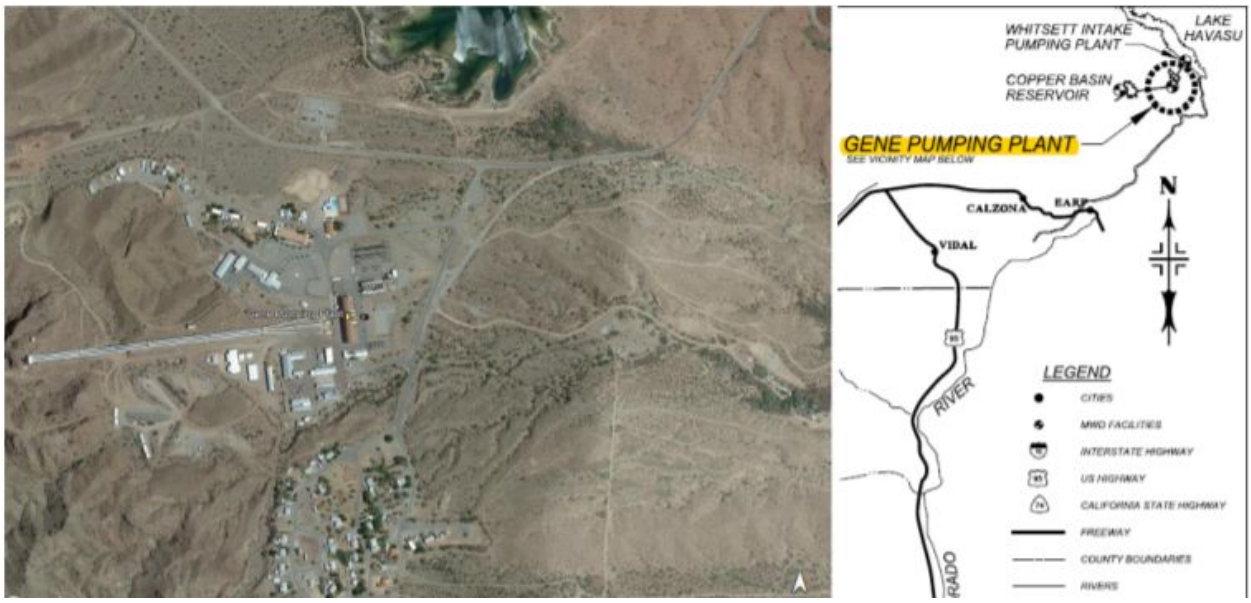

Figure 1: Vicinity Map

2.2 Project Background

The Metropolitan Water District (MWD) of Southern California is composed of 26 cities cooperatives and member water agencies . MWD imports water from the Colorado River and Northern California to provide potable water to 19 million people in six counties. The Gene Camp pumping station, one of MWD's five major pump stations and the on-site water treatment system has been in operation for over 75 years and has shown signs of wear and tear resulting in repetitive failures and deterioration that require increased staff

maintenance efforts. Level 17 Engineering has been contracted by MWD to make improvements to both the pump station and the water treatment system which serves a community of plant operators and their families.

2.3 Existing Water Treatment System

Each of the five CRA pumping plant domestic water supply treatment systems are classified as either a Community Water System that serves 15 or more service connections or as a State Small System that serves between 5 to a max of 14 service connections, and Gene Camp is classified as a Community Water System. Gene Camp's existing water treatment system consists of two 150 µm strainers, a 15 square meter high-pressure polypropylene microfiltration unit, two 34 cubic feet granulated activated carbon vessels, and a sodium hypochlorite disinfection system.

3. Regulatory Requirements

3.1 Primary and Secondary Drinking Water Standards

Under federal law, all potable water treatment plants must treat water up to the United States Environmental Protection Agency's Drinking Water Standards. The Primary Drinking Water Standards address maximum contaminant levels of pollutants that affect human health. The Secondary Drinking Water Standards address other pollutants of concern that affect the aesthetics of the water. A list of the specific contaminants and water pollutants from the Drinking Water Standards can be found in Appendix A and B.

3.2 Surface Water Treatment Rule

The United States Environmental Protection Agency passed the Surface Water Treatment Rule (SWTR) 1989 (Appendix C) to improve public health protection through the control of microbial contaminants, particularly viruses, *Giardia*, and *Cryptosporidium*.

The Surface Water Treatment Rule applies to all public water systems using surface water or groundwater under the direct influence of surface water to control microbial bacteria.

For a Community Water System, the SWTR requires that the water supply treatment system provides multi-barrier treatment including:

- ➔ removal/filtration and inactivation/disinfection of waterborne pathogens
- ➔ Achieve 4-log, 3-log, and 2-log removal/inactivation of viruses, *Giardia*, and *Cryptosporidium*, respectively.

Additionally, Gene Camp's water treatment system's microfiltration units provide compliance with the Long Term 1 and 2 Enhanced Surface Water Treatment Rules (ESWTRs) on top of the original SWTR (Appendix D).

3.3 Turbidity

The SWTR lists four approved filtration technologies approved to treat surface water: conventional filtration, slow sand filtration, diatomaceous earth filtration, and direct filtration. Originally, Gene Camp's water supply system used pressure and sand filtration but were replaced with MFU systems to ensure compliance with the SWTR.

According to the MFU system may be used as an alternative to the four approved filtration technologies provided that:

- ➔ The filtration technology has completed challenge testing to demonstrate to the Division of Drinking Water (DDW) that the technology provides a minimum of 2-log *Giardia* and *Cryptosporidium* removal, and
- ➔ Operations of the water supply treatment system meets turbidity performance standards as shown in Table 1.

Treatment Technology	At All Times:	95% of Measurements
Conventional Package Plant	≤ 5.0 NTU	≤ 2.0 NTU
Polymeric MF/UF	≤ 1.0 NTU	≤ 1.0 NTU
Ceramic MF/UF	≤ 1.0 NTU	≤ 1.0 NTU
Nanofiltration	≤ 1.0 NTU	≤ 1.0 NTU

Table 1: DDW Turbidity Performance Standards for Alternative Filtration Technologies

To ensure compliance with effluent turbidity standards, MWD has established Action Response Guidelines that identify a 'Normal' range for filter effluent turbidity as no greater than 0.1 NTU.

3.4 Disinfection and Disinfection Byproducts Rule

The 1998 US EPA Disinfectants and Disinfection Byproducts Rule (DBPR) (Appendix E) was designed to improve public health protection by reducing exposure to disinfection byproducts that have been linked to cause cancer and reproductive effects in lab animals/humans.

According to the DBPR, public water systems must comply with established maximum contaminant levels (MCLs) and operational evaluation levels (OELs) for DBPs and maximum residual disinfectant levels (MRDLs) for disinfectant residuals. Disinfection is quantified by the CT concept identified in Figure 2 as Table 2-3 and 2-4 of the US EPA Surface Water Treatment Guidance Manual (Appendix F) as a function of temperature, pH, and disinfectant type and concentration.

Table 2-3. CT Values for Inactivation of Viruses in Water at 10°C with pH 6.0–9.0

Disinfectant	CT values (in mg-min/L) 2-log Inactivation (99.0%)	3-log Inactivation (99.9%)	4-log Inactivation (99.99%)
Chlorine	3	4	6
Chloramine	643	1,067	1,491
Chlorine Dioxide	4.2	12.8	25.1
Ozone	0.5	0.8	1.0

CT values were obtained from Appendix E (AWWA, 1991).

Table 2-4. CT Values for Inactivation of Giardia Cysts in Water at 10°C with pH 6.0–9.0

Disinfectant	CT values (mg-min/L) 0.5-log Inactivation (68.0%)	1-log Inactivation (90.0%)	1.5-log Inactivation (96.8%)	2-log Inactivation (99.0%)	2.5-log Inactivation (99.7%)	3-log Inactivation (99.9%)
Chlorine[1]	17	35	52	69	87	104
Chloramine	310	615	930	1,230	1,540	1,850
Chlorine Dioxide	4	7.7	12	15	19	23
Ozone	0.23	0.48	0.72	0.95	1.2	1.43

CT values were obtained from Appendix E (AWWA, 1991).
[1] at pH 7.0 and chlorine residual ≤ 0.4 mg/L.

Figure 2: CT Values for Inactivation

The disinfection residual entering the distribution system must not decrease below 0.2 mg/L for more than 4 hours in any 24-hour period. The residual disinfectant must also be detectable in at least 95% of samples taken each month. In the MWD Action Response Guidelines, the domestic tank effluent chlorine residuals should be between 0.5 mg/L to 1.80 mg/L and the distribution system chlorine residuals should be between 0.30 to 1.80 mg/L.

3.5 Lead and Copper Rule

The regulatory action levels (RALs) for lead is 0.015 mg/L and 1.3 mg/L for copper. Currently, Gene Camp's domestic water system does not have any lead service lines.

4. Summary of Water Quality

4.1 Water Quality Testing

The improved water system will utilize digital analyzers for turbidity, chlorine residual, total organic carbon, temperature, and pH. Manual grab samples will be pulled directly from the system and sent to the water quality lab in La Verne, California. An annual water quality report will be recorded and sent to the Division of Drinking Water (DDW) and MWD.

4.2 Influent Water Quality at Gene Camp Village

In Table 2, the influent water quality of the Gene Camp System has been recorded as minimums, medians, and maximums from January 2006 to August 2018.

Water Quality Parameter	Units	Minimum	Median	Maximum
pH	pH Units	7.78	8.2	8.5
Tem	°C	10.00	19	30
TOC	mg/L	2.60	3.00	3.8
Total Alkalinity as CaCO3	mg/L	124.00	1334	140
Total Dissolved Solids	mg/L	551.00	618	686
Total Hardness as CaCO3	mg/L	265.00	294	332
Turbidity	NTU	0.20	0.67	3.2

Table 2: Water Quality Influent

4.3 Effluent Requirements

In Table 3, the effluent water quality of the Gene Camp System has the following specifications:

Water Quality Parameter	Units	Requirements
Turbidity	NTU	< 0.1
Particle Removal	Log Removal	> 4.0-log
Giardia Inactivation	Log Removal	≥ 3-log
Cryptosporidium Inactivation	Log Removal	≥ 2-log

Table 3: Filtrate Specifications

In addition to the effluent water quality requirements in Table 3, the filtrate must also continue to meet U.S. EPA's Primary Drinking Water Standards (Appendix A) and Secondary Drinking Water Standards (Appendix B).

5. Criteria of Standards

5.1 Design Standards

All new surface water treatment facilities shall be designed and constructed to comply with the following:

1. Be free of structural and sanitary hazards.
2. Protect against contamination by backflow.
3. Have the capacity to meet the system's maximum daily demand. The maximum daily demand is defined as the highest daily usage during the past 10 years. The

system shall also have storage equal to or greater than the maximum daily demand unless it has an additional source of supply.

4. Be operated in a manner to ensure that the minimum operating pressure in the water main at the user service line connection throughout the distribution system is not less than 20 pounds per square inch (psi) at all times.
5. Provide flow measuring and recording equipment.
6. Take into consideration the effects of events such as earthquakes, fires, floods, freezing, and sabotage that are reasonably foreseeable.

5.2 Reliability Standards

The following reliability features shall be included in the design and construction of all new surface water treatment facilities:

1. Alarm devices to provide warning of treatment process failures. All devices shall 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.
2. Standby replacement equipment available to assure continuous operation and control of unit processes for coagulation, filtration, and disinfection.
3. A continuous turbidity monitoring and recording unit on the combined filter effluent prior to clearwell storage.
4. Multiple filter units providing redundant capacity when filters are out of service for backwash or maintenance.
5. A supply of chemicals necessary to provide continuous operation of disinfection facilities shall be maintained as a reserve or demonstrated to be available.
6. An emergency plan shall be developed prior to initiating operation of the disinfection facilities. The plan shall be implemented in the event of disinfection failure to prevent delivery to the distribution system of any contaminated or inadequately disinfected water. The plan shall be posted in an area readily accessible to the plant operator.

6. Recommended Water Treatment System Improvements

Gene Camp's domestic water supply system operates intermittently which requires operators and maintenance staff to regularly respond outside of normal work hours to alarms due to operational or water quality issues. The MFU system must be replaced with chlorine tolerant membranes to keep the system running continuously while the Colorado River Aqueduct is chlorinated. The NaOCL disinfection application is partly manual and a chemical injection system must be constructed to improve transportation of the disinfectant to the application points and to readjust chemical feed rates according to the influent water quality.

6.1 Supervisory Control and Data Acquisition (SCADA) Upgrade

A Supervisory Control and Data Acquisition (SCADA) System will be included in the water treatment system improvements to regulate the chemical feed rates based on influent water quality parameters measured by digital analyzers, automatically control valves, and to reduce the need of maintenance efforts.

6.2 Proposed Chemical Injection System

The existing process for chemical disinfection requires an operator to retrieve small amounts of NaOCL (Sodium Hypochlorite), roughly 100-400ml, from a 500 gallon storage tank before diluting the chemical in a separate container. In the proposed chemical injection system, Sodium Hypochlorite will be injected at a feed rate of 4.1 ml/minute by an adequate pump directly from the storage tank - thereby optimizing chemical disinfection at Gene Camp and minimizing operations & maintenance efforts. The chemistry calculations and proposed chemical injection pump can be seen in Appendix G.

6.2.1 Sodium Hypochlorite

Sodium Hypochlorite is the chemical disinfectant of choice for the Gene Camp Water Treatment Facility. It is continuously injected at a dose of 2-3 mg/L to disinfect the influent water -- which flows in at a rate of 45 gpm. This dosage of NaOCL is used to ensure that chlorine demand of the influent water is met and that total chlorine residual is maintained at 0.5 -1.8 mg/L throughout the entire distribution network.

6.2.2 Chemical Storage

All the cleaning chemicals for the MFU such as memclean, hydrogen peroxide, and citric acid, and the sodium hypochlorite will be stored in a temperature controlled storage room where each chemical's longevity and potency will be prolonged. The chemical injection system will be constructed directly from this storage room to the MFUs and the disinfection application points using a steel pipe network and a variety of pumps and flow controlled valves to reduce the manual labor required to transport the chemicals down to the treatment system.

6.3 Chlorine Tolerant MFUs

The Colorado River Aqueduct is chlorinated on a monthly and as-needed basis. The current MFU membranes are to be replaced with chlorine tolerant high pressure Polyvinylidene fluoride (PVDF) membranes to keep the system on at all times. The MEMCOR CP Pressurized Ultrafiltration Systems with a flux of 0.68 cubic meters per hour-square meter is recommended.

$$Flux\ J\ =\ 45\ gal/min\ *\ 1\ m^3/264.172\ gal\ *\ 60\ min/1\ hr\ /\ 15\ square\ meters\ =\ 0.68\ m^3/hr-m^2$$

6.4 75% Full Capacity Use of Existing Domestic Storage Tank with an Secondary Clearwell Storage Tank

The current water treatment system operates based on water demand of the Gene Camp Village which results in many on/off cycles of the system. To reduce the intermittent power cycles, the on/off switch in the domestic water storage tank will be lowered to 75%

capacity to fully utilize its capacity. Additionally, a secondary clearwell storage tank will be constructed as an emergency reserve to provide potable water if water demands sharply increase at any time and may also be used for fire flow in case of fire emergencies.

7. Summary of Recommendations

Level 17 Engineering highly recommends the district consider automating the water treatment system; which will in-turn improve the overall reliability and efficiency, reduce operation and maintenance efforts, and consistently provide potable water up to the Drinking Water Standards. We further suggest integrating Supervisory Control and Data Acquisition (SCADA) into the new water treatment system, constructing a disinfection chemical storage tank complete with a system of pipes and a flow controlled pump, the MFU membranes will be replaced with polyvinylidene fluoride (PVDF) chlorine tolerant membranes to tolerate the chlorination of the colorado river aqueduct, and a secondary clearwell storage tank will be constructed as a secondary source of potable water to meet water demand.

APPENDIX A

U.S. Environmental Protection Agency Primary Drinking Water Standards

National Primary Drinking Water Regulations

Contaminant	MCL or TT[1] (mg/L)[2]	Potential health effects from long-term[3] exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal (mg/L)[2]
Acrylamide	TT[4]	Nervous system or blood problems; increased risk of cancer	Added to water during sewage/ wastewater treatment	zero
Alachlor	0.002	Eye, liver, kidney, or spleen problems; anemia; increased risk of cancer	Runoff from herbicide used on row crops	zero
Alpha/photon emitters	15 picocuries per Liter (pCi/L)	Increased risk of cancer	Erosion of natural deposits of certain minerals that are radioactive and may emit a form of radiation known as alpha radiation	zero
Antimony	0.006	Increase in blood cholesterol; decrease in blood sugar	Discharge from petroleum refineries; fire retardants; ceramics; electronics; solder	0.006
Arsenic	0.010	Skin damage or problems with circulatory systems, and may have increased risk of getting cancer	Erosion of natural deposits; runoff from orchards; runoff from glass & electronics production wastes	0
Asbestos (fibers >10 micrometers)	7 million fibers per Liter (MFL)	Increased risk of developing benign intestinal polyps	Decay of asbestos cement in water mains; erosion of natural deposits	7 MFL
Atrazine	0.003	Cardiovascular system or reproductive problems	Runoff from herbicide used on row crops	0.003
Barium	2	Increase in blood pressure	Discharge of drilling wastes; discharge from metal refineries; erosion of natural deposits	2
Benzene	0.005	Anemia; decrease in blood platelets; increased risk of cancer	Discharge from factories; leaching from gas storage tanks and landfills	zero
Benzo(a)pyrene (PAHs)	0.0002	Reproductive difficulties; increased risk of cancer	Leaching from linings of water storage tanks and distribution lines	zero
Beryllium	0.004	Intestinal lesions	Discharge from metal refineries and coal-burning factories; discharge from electrical, aerospace, and defense industries	0.004
Beta photon emitters	4 millirems per year	Increased risk of cancer	Decay of natural and man-made deposits of certain minerals that are radioactive and may emit forms of radiation known as photons and beta radiation	zero
Bromate	0.010	Increased risk of cancer	Byproduct of drinking water disinfection	zero
Cadmium	0.005	Kidney damage	Corrosion of galvanized pipes; erosion of natural deposits; discharge from metal refineries; runoff from waste batteries and paints	0.005
Carbofuran	0.04	Problems with blood, nervous system, or reproductive system	Leaching of soil fumigant used on rice and alfalfa	0.04

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Contaminant	MCL or TT[1] (mg/L)[2]	Potential health effects from long-term[3] exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal (mg/L)[2]
Carbon tetrachloride	0.005	Liver problems; increased risk of cancer	Discharge from chemical plants and other industrial activities	**zero**
Chloramines (as Cl_2)	MRDL=4.0[1]	Eye/nose irritation; stomach discomfort; anemia	Water additive used to control microbes	**MRDLG=4[1]**
Chlordane	0.002	Liver or nervous system problems; increased risk of cancer	Residue of banned termiticide	**zero**
Chlorine (as Cl_2)	MRDL=4.0[1]	Eye/nose irritation; stomach discomfort	Water additive used to control microbes	**MRDLG=4[1]**
Chlorine dioxide (as ClO_2)	MRDL=0.8[1]	Anemia; infants, young children, and fetuses of pregnant women: nervous system effects	Water additive used to control microbes	**MRDLG=0.8[1]**
Chlorite	1.0	Anemia; infants, young children, and fetuses of pregnant women: nervous system effects	Byproduct of drinking water disinfection	**0.8**
Chlorobenzene	0.1	Liver or kidney problems	Discharge from chemical and agricultural chemical factories	**0.1**
Chromium (total)	0.1	Allergic dermatitis	Discharge from steel and pulp mills; erosion of natural deposits	**0.1**
Copper	TT[5]; Action Level=1.3	Short-term exposure: Gastrointestinal distress. Long-term exposure: Liver or kidney damage. People with Wilson's Disease should consult their personal doctor if the amount of copper in their water exceeds the action level	Corrosion of household plumbing systems; erosion of natural deposits	**1.3**
Cryptosporidium	TT[7]	Short-term exposure: Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste	**zero**
Cyanide (as free cyanide)	0.2	Nerve damage or thyroid problems	Discharge from steel/metal factories; discharge from plastic and fertilizer factories	**0.2**
2,4-D	0.07	Kidney, liver, or adrenal gland problems	Runoff from herbicide used on row crops	**0.07**
Dalapon	0.2	Minor kidney changes	Runoff from herbicide used on rights of way	**0.2**
1,2-Dibromo-3-chloropropane (DBCP)	0.0002	Reproductive difficulties; increased risk of cancer	Runoff/leaching from soil fumigant used on soybeans, cotton, pineapples, and orchards	**zero**
o-Dichlorobenzene	0.6	Liver, kidney, or circulatory system problems	Discharge from industrial chemical factories	**0.6**
p-Dichlorobenzene	0.075	Anemia; liver, kidney, or spleen damage; changes in blood	Discharge from industrial chemical factories	**0.075**
1,2-Dichloroethane	0.005	Increased risk of cancer	Discharge from industrial chemical factories	**zero**

LEGEND DISINFECTANT | DISINFECTION BYPRODUCT | INORGANIC CHEMICAL | MICROORGANISM | ORGANIC CHEMICAL | RADIONUCLIDES

Contaminant	MCL or TT[1] (mg/L)[2]	Potential health effects from long-term[3] exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal (mg/L)[2]
1,1-Dichloroethylene	0.007	Liver problems	Discharge from industrial chemical factories	**0.007**
cis-1,2-Dichloroethylene	0.07	Liver problems	Discharge from industrial chemical factories	**0.07**
trans-1,2, Dichloroethylene	0.1	Liver problems	Discharge from industrial chemical factories	**0.1**
Dichloromethane	0.005	Liver problems; increased risk of cancer	Discharge from industrial chemical factories	**zero**
1,2-Dichloropropane	0.005	Increased risk of cancer	Discharge from industrial chemical factories	**zero**
Di(2-ethylhexyl) adipate	0.4	Weight loss, liver problems, or possible reproductive difficulties	Discharge from chemical factories	**0.4**
Di(2-ethylhexyl) phthalate	0.006	Reproductive difficulties; liver problems; increased risk of cancer	Discharge from rubber and chemical factories	**zero**
Dinoseb	0.007	Reproductive difficulties	Runoff from herbicide used on soybeans and vegetables	**0.007**
Dioxin (2,3,7,8-TCDD)	0.00000003	Reproductive difficulties; increased risk of cancer	Emissions from waste incineration and other combustion; discharge from chemical factories	**zero**
Diquat	0.02	Cataracts	Runoff from herbicide use	**0.02**
Endothall	0.1	Stomach and intestinal problems	Runoff from herbicide use	**0.1**
Endrin	0.002	Liver problems	Residue of banned insecticide	**0.002**
Epichlorohydrin	TT[4]	Increased cancer risk; stomach problems	Discharge from industrial chemical factories; an impurity of some water treatment chemicals	**zero**
Ethylbenzene	0.7	Liver or kidney problems	Discharge from petroleum refineries	**0.7**
Ethylene dibromide	0.00005	Problems with liver, stomach, reproductive system, or kidneys; increased risk of cancer	Discharge from petroleum refineries	**zero**
Fecal coliform and *E. coli*	MCL[6]	Fecal coliforms and *E. coli* are bacteria whose presence indicates that the water may be contaminated with human or animal wastes. Microbes in these wastes may cause short term effects, such as diarrhea, cramps, nausea, headaches, or other symptoms. They may pose a special health risk for infants, young children, and people with severely compromised immune systems.	Human and animal fecal waste	**zero[6]**

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DISINFECTANT | DISINFECTION BYPRODUCT | INORGANIC CHEMICAL | MICROORGANISM | ORGANIC CHEMICAL | RADIONUCLIDES

Contaminant	MCL or TT[1] (mg/L)[2]	Potential health effects from long-term[3] exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal (mg/L)[2]
Fluoride	4.0	Bone disease (pain and tenderness of the bones); children may get mottled teeth	Water additive which promotes strong teeth; erosion of natural deposits; discharge from fertilizer and aluminum factories	**4.0**
Giardia lamblia	TT[7]	Short-term exposure: Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste	**zero**
Glyphosate	0.7	Kidney problems; reproductive difficulties	Runoff from herbicide use	**0.7**
Haloacetic acids (HAA5)	0.060	Increased risk of cancer	Byproduct of drinking water disinfection	**n/a[9]**
Heptachlor	0.0004	Liver damage; increased risk of cancer	Residue of banned termiticide	**zero**
Heptachlor epoxide	0.0002	Liver damage; increased risk of cancer	Breakdown of heptachlor	**zero**
Heterotrophic plate count (HPC)	TT[7]	HPC has no health effects; it is an analytic method used to measure the variety of bacteria that are common in water. The lower the concentration of bacteria in drinking water, the better maintained the water system is.	HPC measures a range of bacteria that are naturally present in the environment	**n/a**
Hexachlorobenzene	0.001	Liver or kidney problems; reproductive difficulties; increased risk of cancer	Discharge from metal refineries and agricultural chemical factories	**zero**
Hexachloro-cyclopentadiene	0.05	Kidney or stomach problems	Discharge from chemical factories	**0.05**
Lead	TT[5]; Action Level=0.015	Infants and children: Delays in physical or mental development; children could show slight deficits in attention span and learning abilities; Adults: Kidney problems; high blood pressure	Corrosion of household plumbing systems; erosion of natural deposits	**zero**
Legionella	TT[7]	Legionnaire's Disease, a type of pneumonia	Found naturally in water; multiplies in heating systems	**zero**
Lindane	0.0002	Liver or kidney problems	Runoff/leaching from insecticide used on cattle, lumber, and gardens	**0.0002**
Mercury (inorganic)	0.002	Kidney damage	Erosion of natural deposits; discharge from refineries and factories; runoff from landfills and croplands	**0.002**
Methoxychlor	0.04	Reproductive difficulties	Runoff/leaching from insecticide used on fruits, vegetables, alfalfa, and livestock	**0.04**
Nitrate (measured as Nitrogen)	10	Infants below the age of six months who drink water containing nitrate in excess of the MCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue-baby syndrome.	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits	**10**

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DISINFECTANT | DISINFECTION BYPRODUCT | INORGANIC CHEMICAL | MICROORGANISM | ORGANIC CHEMICAL | RADIONUCLIDES

Contaminant	MCL or TT[1] (mg/L)[2]	Potential health effects from long-term[3] exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal (mg/L)[2]
Nitrite (measured as Nitrogen)	1	Infants below the age of six months who drink water containing nitrite in excess of the MCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue-baby syndrome.	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits	1
Oxamyl (Vydate)	0.2	Slight nervous system effects	Runoff/leaching from insecticide used on apples, potatoes, and tomatoes	0.2
Pentachlorophenol	0.001	Liver or kidney problems; increased cancer risk	Discharge from wood-preserving factories	zero
Picloram	0.5	Liver problems	Herbicide runoff	0.5
Polychlorinated biphenyls (PCBs)	0.0005	Skin changes; thymus gland problems; immune deficiencies; reproductive or nervous system difficulties; increased risk of cancer	Runoff from landfills; discharge of waste chemicals	zero
Radium 226 and Radium 228 (combined)	5 pCi/L	Increased risk of cancer	Erosion of natural deposits	zero
Selenium	0.05	Hair or fingernail loss; numbness in fingers or toes; circulatory problems	Discharge from petroleum and metal refineries; erosion of natural deposits; discharge from mines	0.05
Simazine	0.004	Problems with blood	Herbicide runoff	0.004
Styrene	0.1	Liver, kidney, or circulatory system problems	Discharge from rubber and plastic factories; leaching from landfills	0.1
Tetrachloroethylene	0.005	Liver problems; increased risk of cancer	Discharge from factories and dry cleaners	zero
Thallium	0.002	Hair loss; changes in blood; kidney, intestine, or liver problems	Leaching from ore-processing sites; discharge from electronics, glass, and drug factories	0.0005
Toluene	1	Nervous system, kidney, or liver problems	Discharge from petroleum factories	1
Total Coliforms	5.0 percent[8]	Coliforms are bacteria that indicate that other, potentially harmful bacteria may be present. See fecal coliforms and *E. coli*	Naturally present in the environment	zero
Total Trihalomethanes (TTHMs)	0.080	Liver, kidney, or central nervous system problems; increased risk of cancer	Byproduct of drinking water disinfection	n/a[9]
Toxaphene	0.003	Kidney, liver, or thyroid problems; increased risk of cancer	Runoff/leaching from insecticide used on cotton and cattle	zero
2,4,5-TP (Silvex)	0.05	Liver problems	Residue of banned herbicide	0.05
1,2,4-Trichlorobenzene	0.07	Changes in adrenal glands	Discharge from textile finishing factories	0.07

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Contaminant	MCL or TT[1] (mg/L)[2]	Potential health effects from long-term[3] exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal (mg/L)[2]
1,1,1-Trichloroethane	0.2	Liver, nervous system, or circulatory problems	Discharge from metal degreasing sites and other factories	**0.2**
1,1,2-Trichloroethane	0.005	Liver, kidney, or immune system problems	Discharge from industrial chemical factories	**0.003**
Trichloroethylene	0.005	Liver problems; increased risk of cancer	Discharge from metal degreasing sites and other factories	**zero**
Turbidity	TT[7]	Turbidity is a measure of the cloudiness of water. It is used to indicate water quality and filtration effectiveness (e.g., whether disease-causing organisms are present). Higher turbidity levels are often associated with higher levels of disease-causing microorganisms such as viruses, parasites, and some bacteria. These organisms can cause short term symptoms such as nausea, cramps, diarrhea, and associated headaches.	Soil runoff	**n/a**
Uranium	30µg/L	Increased risk of cancer, kidney toxicity	Erosion of natural deposits	**zero**
Vinyl chloride	0.002	Increased risk of cancer	Leaching from PVC pipes; discharge from plastic factories	**zero**
Viruses (enteric)	TT[7]	Short-term exposure: Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste	**zero**
Xylenes (total)	10	Nervous system damage	Discharge from petroleum factories; discharge from chemical factories	**10**

LEGEND DISINFECTANT | DISINFECTION BYPRODUCT | INORGANIC CHEMICAL | MICROORGANISM | ORGANIC CHEMICAL | RADIONUCLIDES

NOTES

1 Definitions
- **Maximum Contaminant Level Goal (MCLG):** The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety and are non-enforceable public health goals.
- **Maximum Contaminant Level (MCL):** The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to MCLGs as feasible using the best available treatment technology and taking cost into consideration. MCLs are enforceable standards.
- **Maximum Residual Disinfectant Level Goal (MRDLG):** The level of a drinking water disinfectant below which there is no known or expected risk to health. MRDLGs do not reflect the benefits of the use of disinfectants to control microbial contaminants.
- **Maximum Residual Disinfectant Level (MRDL):** The highest level of a disinfectant allowed in drinking water. There is convincing evidence that addition of a disinfectant is necessary for control of microbial contaminants.
- **Treatment Technique (TT):** A required process intended to reduce the level of a contaminant in drinking water.

2 Units are in milligrams per liter (mg/L) unless otherwise noted. Milligrams per liter are equivalent to parts per million (ppm).

3 Health effects are from long-term exposure unless specified as short-term exposure.

4 Each water system must certify annually, in writing, to the state (using third-party or manufacturers certification) that when it uses acrylamide and/or epichlorohydrin to treat water, the combination (or product) of dose and monomer level does not exceed the levels specified, as follows: Acrylamide = 0.05 percent dosed at 1 mg/L (or equivalent); Epichlorohydrin = 0.01 percent dosed at 20 mg/L (or equivalent).

5 Lead and copper are regulated by a Treatment Technique that requires systems to control the corrosiveness of their water. If more than 10 percent of tap water samples exceed the action level, water systems must take additional steps. For copper, the action level is 1.3 mg/L, and for lead is 0.015 mg/L.

6 A routine sample that is fecal coliform-positive or E. coli-positive triggers repeat samples--if any repeat sample is total coliform-positive, the system has an acute MCL violation. A routine sample that is total coliform-positive and fecal coliform-negative or E. coli-negative triggers repeat samples--if any repeat sample is fecal coliform-positive or E. coli-positive, the system has an acute MCL violation. See also Total Coliforms.

7 EPA's surface water treatment rules require systems using surface water or ground water under the direct influence of surface water to (1) disinfect their water, and (2) filter their water or meet criteria for avoiding filtration so that the following contaminants are controlled at the following levels:
- ***Cryptosporidium*:** 99 percent removal for systems that filter. Unfiltered systems are required to include Cryptosporidium in their existing watershed control provisions.
- **Giardia lamblia:** 99.9 percent removal/inactivation
- **Viruses:** 99.9 percent removal/inactivation
- ***Legionella*:** No limit, but EPA believes that if *Giardia* and viruses are removed/inactivated, according to the treatment techniques in the surface water treatment rule, *Legionella* will also be controlled.
- **Turbidity:** For systems that use conventional or direct filtration, at no time can turbidity (cloudiness of water) go higher than 1 nephelometric turbidity unit (NTU), and samples for turbidity must be less than or equal to 0.3 NTU in at least 95 percent of the samples in any month. Systems that use filtration other than the conventional or direct filtration must follow state limits, which must include turbidity at no time exceeding 5 NTU.
- **HPC:** No more than 500 bacterial colonies per milliliter
- **Long Term 1 Enhanced Surface Water Treatment:** Surface water systems or ground water systems under the direct influence of surface water serving fewer than 10,000 people must comply with the applicable Long Term 1 Enhanced Surface Water Treatment Rule provisions (e.g. turbidity standards, individual filter monitoring, *Cryptosporidium* removal requirements, updated watershed control requirements for unfiltered systems).
- **Long Term 2 Enhanced Surface Water Treatment:** This rule applies to all surface water systems or ground water systems under the direct influence of surface water. The rule targets additional *Cryptosporidium* treatment requirements for higher risk systems and includes provisions to reduce risks from uncovered finished water storages facilities and to ensure that the systems maintain microbial protection as they take steps to reduce the formation of disinfection byproducts. (Monitoring start dates are staggered by system size. The largest systems (serving at least 100,000 people) will begin monitoring in October 2006 and the smallest systems (serving fewer than 10,000 people) will not begin monitoring until October 2008. After completing monitoring and determining their treatment bin, systems generally have three years to comply with any additional treatment requirements.)
- **Filter Backwash Recycling:** The Filter Backwash Recycling Rule requires systems that recycle to return specific recycle flows through all processes of the system's existing conventional or direct filtration system or at an alternate location approved by the state.

8 No more than 5.0 percent samples total coliform-positive in a month. (For water systems that collect fewer than 40 routine samples per month, no more than one sample can be total coliform-positive per month.) Every sample that has total coliform must be analyzed for either fecal coliforms or E. coli. If two consecutive TC-positive samples, and one is also positive for E. coli or fecal coliforms, system has an acute MCL violation.

9 Although there is no collective MCLG for this contaminant group, there are individual MCLGs for some of the individual contaminants:
- **Haloacetic acids:** dichloroacetic acid (zero); trichloroacetic acid (0.3 mg/L)
- **Trihalomethanes:** bromodichloromethane (zero); bromoform (zero); dibromochloromethane (0.06 mg/L)

APPENDIX B

U.S. Environmental Protection Agency Secondary Drinking Water Standards

NATIONAL SECONDARY DRINKING WATER REGULATION

National Secondary Drinking Water Regulations are non-enforceable guidelines regarding contaminants that may cause cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor, or color) in drinking water. EPA recommends secondary standards to water systems but does not require systems to comply. However, some states may choose to adopt them as enforceable standards.

Contaminant	Secondary Maximum Contaminant Level
Aluminum	0.05 to 0.2 mg/L
Chloride	250 mg/L
Color	15 (color units)
Copper	1.0 mg/L
Corrosivity	Noncorrosive
Fluoride	2.0 mg/L
Foaming Agents	0.5 mg/L
Iron	0.3 mg/L
Manganese	0.05 mg/L
Odor	3 threshold odor number
pH	6.5-8.5
Silver	0.10 mg/L
Sulfate	250 mg/L
Total Dissolved Solids	500 mg/L
Zinc	5 mg/L

FOR MORE INFORMATION ON EPA'S SAFE DRINKING WATER:

visit: **epa.gov/safewater**

call: **(800) 426-4791**

ADDITIONAL INFORMATION:

To order additional posters or other ground water and drinking water publications, please contact the National Service Center for Environmental Publications at: **(800) 490-9198**, or email: **nscep@bps-lmit.com**.

APPENDIX C

U.S. Environmental Protection Agency Surface Water Treatment Rule

EPA United States Environmental Protection Agency

Comprehensive Surface Water Treatment Rules Quick Reference Guide: Systems Using Slow Sand, Diatomaceous Earth, or Alternative Filtration

Overview of the Rules

Title	**Surface Water Treatment Rule** (SWTR) - 40 CFR 141.70-141.75 **Interim Enhanced Surface Water Treatment Rule** (IESWTR) - 40 CFR 141.170-141.175 **Long Term 1 Enhanced Surface Water Treatment Rule** (LT1ESWTR) - 40 CFR 141.500-141.571
Purpose	Improve public health protection through the control of microbial contaminants, particularly viruses, *Giardia*, and *Cryptosporidium*.
General Description	The **Surface Water Treatment Rules**: ▸ Applies to all public water systems (PWSs) using surface water or ground water under the direct influence of surface water (GWUDI), otherwise known as **"Subpart H systems."** ▸ Requires all Subpart H systems to disinfect. ▸ Requires Subpart H systems to filter unless specific filter avoidance criteria are met. ▸ Applies a treatment technique requirement for control of microbials.

Overview of Requirements

The purpose of this table is show how the requirements for the IESWTR and LT1ESWTR build on the existing requirements established in the original SWTR.

APPLICABILITY: PWSs that use surface water or ground water under the direct influence of surface water (Subpart H) that practice slow sand, diatomaceous earth or alternative filtration.		**Final Rule Dates**		
		SWTR 1989	**IESWTR 1998**	**LT1ESWTR 2002**
Population Served	≥10,000	✓	✓	
	< 10,000	✓	N/A (except for sanitary survey provisions)	✓
Regulated Pathogens	99.99% (4-log) removal/inactivation of viruses	✓	Regulated under SWTR	Regulated under SWTR
	99.9% (3-log) removal/inactivation of *Giardia lamblia*	✓	Regulated under SWTR	Regulated under SWTR
	99% (2-log) removal of *Cryptosporidium*		✓	✓
Residual Disinfectant Requirements	Entrance to distribution system (≥ 0.2 mg/L)	✓	Regulated under SWTR	Regulated under SWTR
	Detectable in the distribution system	✓	Regulated under SWTR	Regulated under SWTR
Turbidity Performance Standards	Combined Filter Effluent - Slow Sand and Diatomaceous Earth	✓	Regulated under SWTR	Regulated under SWTR
	Combined Filter Effluent - Alternative	✓	✓	✓
Disinfection Profiling & Benchmarking	Systems must profile inactivation levels and generate benchmark, if required		✓	✓
Sanitary Surveys (state requirement)	CWS: Every 3 years NCWS: Every 5 years		✓	Regulated under IESWTR
Covered Finished Reservoirs/Water Storage Facilities (new construction only)			✓	✓
Operated by Qualified Personnel as Specified by State		✓	Regulated under SWTR	Regulated under SWTR

(CWS) Community Water System (NCWS) Non-community Water System

Turbidity

Turbidity is measured as Combined Filter Effluent (CFE) for slow sand, diatomaceous earth, and alternative filtration. The CFE 95th % value and CFE maximum value for slow sand and diatomaceous earth were not lowered in the IESWTR and LT1ESWTR since these filtration technologies are assumed to provide 2-log *Cryptosporidium* removal with the turbidity limits established by SWTR. Alternative filtration technologies (defined as filtration technologies other than conventional, direct, slow sand, or diatomaceous earth) must demonstrate to the state that filtration and/or disinfection achieve 3-log Giardia and 4-log virus removal and/or inactivation. The IESWTR and LT1ESWTR also require alternative filtration technologies to demonstrate 2-log Cryptosporidium removal.

Turbidity: Monitoring and Reporting Requirements

Turbidity Type and Reporting Requirements *(Reports due by the 10th day of the following month the system serves water to the public.)*		**Monitoring/ Recording Frequency**	**SWTR As of June 29, 1993**	**IESWTR ≥10,000 people As of January 1, 2002**	**LT1ESWTR < 10,000 people As of January 1, 2005**
Slow Sand & Diatomaceous Earth	CFE 95%	At least every 4 hours*	≤1 NTU	Regulated under SWTR	Regulated under SWTR
	CFE Max	At least every 4 hours*	5 NTU	Regulated under SWTR	Regulated under SWTR
Alternative ▸ **Membranes** ▸ **Cartridges** ▸ **Other**	CFE 95%	At least every 4 hours*	≤1 NTU	Established by state	Established by state (not to exceed 1 NTU)
	CFE Max	At least every 4 hours*	5 NTU	Established by state	Established by state (not to exceed 5 NTU)

*Monitoring frequency may be reduced by the state to once per day for systems using slow sand or alternative filtration. Monitoring frequency may be reduced by the state to once per day for systems serving 500 or fewer people regardless of type of filtration used.

CFE Turbidity: Reporting Requirements

Report to State:	**SWTR Measurements**	**IESWTR Measurements**	**LT1ESWTR Measurements****
Within 10 days after the end of the month:	Total number of monthly measurements	Total number of monthly measurements	Total number of monthly measurements
	Number and percent less than or equal to designated 95th percentile turbidity limits	Number and percent less than or equal to designated 95th percentile turbidity limits	Number and percent less than or equal to designated 95th percentile turbidity limits
	Date and value exceeding 5 NTU	Date and value exceeding 5 NTU for slow sand and diatomaceous earth or maximum level set by state for alternative filtration	Date and value exceeding 5 NTU for slow sand and diatomaceous earth or maximum level set by state for alternative filtration
Within 24 hours:	Exceedances of 5 NTU for CFE	Exceedances of 5 NTU for slow sand and diatomaceous earth or maximum CFE level set by state for alternative filtration	Exceedances of 5 NTU for slow sand and diatomaceous earth or maximum CFE level set by state for alternative filtration

** Systems serving fewer than 10,000 people must begin complying with these requirements beginning January 1, 2005.

Disinfection

Disinfection must be sufficient to ensure that the total treatment process (disinfection plus filtration) of the system achieves at least:

- 99.9% (3-log) inactivation and/or removal of *Giardia lamblia*.
- 99.99% (4-log) inactivation and/or removal of viruses.

Cryptosporidium must be removed by filtration and no inactivation credits are currently given for disinfection. Systems must also comply with the maximum residual disinfectant level (MRDL) requirements specified in the Stage 1 Disinfectants/ Disinfection Byproducts Rule (Stage 1 DBPR).

Residual Disinfectant Monitoring and Reporting Requirements

Location	Concentration	Monitoring Frequency	Reporting (Reports due 10th of the following month)
Entry to distribution system.	Residual disinfectant concentration cannot be < 0.2 mg/L for more than 4 hours.	Continuous, but states may allow systems serving 3,300 or fewer persons to take grab samples from 1 to 4 times per day, depending on system size.	Lowest daily value for each day, the date and duration when residual disinfectant was < 0.2 mg/L, and when state was notified of events where residual disinfectant was < 0.2 mg/L.
Distribution system - same location as total coliform sample location(s).	Residual disinfectant concentration cannot be undetectable in greater than 5% of samples in a month, for any 2 consecutive months. Heterotrophic plate count (HPC) ≤ 500/mL is deemed to have detectable residual disinfectant.	Same time as total coliform samples.	Number of residual disinfectant or HPC measurements taken in the month resulting in no more than 5% of the measurements as being undetectable in any 2 consecutive months.

Disinfection Profiling and Benchmarking Requirements

A **disinfection profile** is the graphical representation of a system's microbial inactivation over 12 consecutive months.

A **disinfection benchmark** is the lowest monthly average microbial inactivation value. The disinfection benchmark is used as a baseline of inactivation when considering changes in the disinfection process.

Disinfection Profiling and Benchmarking Requirements Under IESWTR & LT1ESWTR

The purpose of disinfection profiling and benchmarking is to allow systems and states to assess whether a change in disinfection practices creates a microbial risk. Systems should develop a disinfection profile that reflects *Giardia lamblia* inactivation (systems using ozone or chloramines must also calculate inactivation of viruses), calculate a benchmark (lowest monthly inactivation) based on the profile, and consult with the state prior to making a significant change to disinfection practices.

REQUIREMENT	IESWTR	LT1ESWTR
AFFECTED SYSTEMS:	Community, non-transient non-community, and transient systems.	Community and non-transient non-community systems only.
BEGIN PROFILING BY:	April 1, 2000	► July 1, 2003 for systems serving 500-9,999 people. ► January 1, 2004 for systems serving fewer than 500 people.
FREQUENCY & DURATION:	**Daily** monitoring for 12 consecutive calendar months to determine the total logs of *Giardia lamblia* inactivation (and viruses, if necessary) for each day in operation.	**Weekly** inactivation of *Giardia lamblia* (and viruses, if necessary), on the same calendar day each week over 12 consecutive months.
STATES MAY WAIVE DISINFECTION PROFILING REQUIREMENTS IF:	TTHM annual average <0.064 mg/L and HAA5 annual average <0.048 mg/L: ► Collected during the same period. ► Annual average is arithmetic average of the quarterly averages of four consecutive quarters of monitoring. ► At least 25% of samples at the maximum residence time in the distribution system. ► Remaining 75% of samples at representative locations in the distribution system.	One TTHM sample <0.064 mg/L and one HAA5 sample <0.048 mg/L: ► Collected during the month of warmest water temperature; **AND** ► At the maximum residence time in the distribution system. Samples must have been collected after January 1, 1998.
DISINFECTION BENCHMARK MUST BE CALCULATED IF:	Systems required to develop a disinfection profile and are considering any of the following: ► Changes to the point of disinfection. ► Changes to the disinfectant(s) used. ► Changes to the disinfection process. ► Any other modification identified by the state. Systems must consult the state prior to making any modifications to disinfection practices.	Same as IESWTR, and systems must obtain state approval prior to making any modifications to disinfection practices.

APPENDIX D

U.S. Environmental Protection Agency Long Term 1 Enhanced Surface Water Rule

EPA
United States
Environmental Protection
Agency

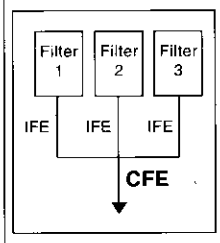
Long Term 1 Enhanced Surface Water Treatment Rule: A Quick Reference Guide

Overview of the Rule

Title	Long Term 1 Enhanced Surface Water Treatment Rule (LT1ESWTR) 67 FR 1812, January 14, 2002, Vol. 67, No. 9
Purpose	Improve public health protection through the control of microbial contaminants, particularly *Cryptosporidium*. Prevent significant increases in microbial risk that might otherwise occur when systems implement the Stage 1 Disinfectants and Disinfection Byproducts Rule.
General Description	Builds upon the requirements of the 1989 Surface Water Treatment Rule (SWTR). Smaller system counterpart of the Interim Enhanced Surface Water Treatment Rule (IESWTR).
Utilities Covered	Public water systems that use surface water or ground water under the direct influence of surface water (GWUDI) and serve fewer than 10,000 people.

Major Provisions

Control of *Cryptosporidium*	▸ The maximum contaminant level goal (MCLG) is set at zero. ▸ Filtered systems must physically remove 99% (2-log) of *Cryptosporidium*. ▸ Unfiltered systems must update their watershed control programs to minimize the potential for contamination by *Cryptosporidium* oocysts. ▸ *Cryptosporidium* is included as an indicator of GWUDI.
Combined Filter Effluent (CFE) Turbidity Performance Standards	***Specific CFE turbidity requirements depend on the type of filtration used by the system.*** <u>Conventional and direct filtration:</u> ▸ ≤ 0.3 nephelometric turbidity units (NTU) in at least 95% of measurements taken each month. ▸ Maximum level of turbidity: 1 NTU. <u>Slow sand and diatomaceous earth (DE) filtration:</u> ▸ Continue to meet CFE turbidity limits specified in the SWTR: • 1 NTU in at least 95% of measurements taken each month. • Maximum level of turbidity: 5 NTU. <u>Alternative technologies (other than conventional, direct, slow sand, or DE):</u> ▸ Turbidity levels are established by the State based on filter demonstration data submitted by the system. • State-set limits must not exceed 1 NTU (in at least 95% of measurements) or 5 NTU (maximum).



Turbidity Monitoring Requirements

Combined Filter Effluent	▸ Performed at least every 4 hours to ensure compliance with CFE turbidity performance standards.[1]
Individual Filter Effluent (IFE) (for systems using conventional and direct filtration only)	***Since the CFE may meet regulatory requirements even though one filter is producing high turbidity water, the IFE is measured to assist conventional and direct filtration treatment plant operators in understanding and assessing individual filter performance.*** ▸ Performed continuously (recorded at least every 15 minutes). ▸ Systems with two or fewer filters may conduct continuous monitoring of CFE turbidity in place of individual filter effluent turbidity monitoring. ▸ Certain follow-up actions are required if the IFE turbidity (or CFE for systems with two filters) exceeds 1.0 NTU in 2 consecutive readings or more (i.e., additional reporting, filter self-assessments, and/or comprehensive performance evaluations (CPEs)).

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For additional information on the LT1ESWTR

Call the Safe Drinking Water Hotline at 1-800-426-4791; visit the EPA web site at www.epa.gov/safewater/mdbp/lt1eswtr.html; or contact your State drinking water representative.

[1] This frequency may be reduced by the State to once per day for systems using slow sand/alternative filtration or for systems serving 500 persons or fewer regardless of the type of filtration used.

SM-2

Disinfection Profiling and Benchmarking Requirements

Community and non-transient non-community public water systems must evaluate impacts on microbial risk before changing disinfection practices to ensure adequate microbial protection is maintained. This is accomplished through a process called disinfection profiling and benchmarking.

What are the disinfection profiling and benchmarking requirements?

- **Systems must develop a disinfection profile, which is a graphical compilation of weekly inactivation *of Giardia lamblia*, taken on the same calendar day each week over 12 consecutive months. (Systems using chloramines, ozone, or chlorine dioxide for primary disinfection must also calculate inactivation of viruses). Results must be available for review by the State during sanitary surveys.**
- **A State may deem a profile unnecessary if the system has sample data collected after January 1, 1998–during the month of warmest water temperature and at maximum residence time in the distribution system–indicating TTHM levels are below 0.064 mg/L and HAA5 levels are below 0.048 mg/L.**
- **Prior to making a significant change to disinfection practices, systems required to develop a profile must calculate a disinfection benchmark and consult with the State. The benchmark is the calculation of the lowest monthly average of inactivation based on the disinfection profile.**

Additional Requirements

- **Construction of new uncovered finished water reservoirs is prohibited.**

Critical Deadlines and Requirements

For Drinking Water Systems

March 15, 2002	Construction of uncovered finished reservoirs is prohibited.
July 1, 2003	No later than this date, systems serving between 500-9,999 persons must report to the State: ▸ Results of optional monitoring which show levels of TTHM < 0.064 mg/L and HAA5 < 0.048 mg/L, OR ▸ System has started profiling.
January 1, 2004	No later than this date, systems serving fewer than 500 persons must report to the State: ▸ Results of optional monitoring which show levels of TTHM < 0.064 mg/L and HAA5 < 0.048 mg/L, OR ▸ System has started profiling.
June 30, 2004	Systems serving between 500 and 9,999 persons must complete their disinfection profile unless the State has determined it is unnecessary.
December 31, 2004	Systems serving fewer than 500 persons must complete their disinfection profile unless the State has determined it is unnecessary.
January 14, 2005	Surface water systems or GWUDI systems serving fewer than 10,000 people must comply with the applicable LT1ESWTR provisions (e.g., turbidity standards, individual filter monitoring, *Cryptosporidium* removal requirements, updated watershed control requirements for unfiltered systems).

For States

January 2002	As per the IESWTR, States begin first round of sanitary surveys (at least every 3 years for community water systems and every 5 years for non-community water systems).
October 14, 2003	States are encouraged to submit final primacy applications to EPA.
January 14, 2004	Final primacy applications must be submitted to EPA unless granted an extension.
December 2004	States must complete first round of sanitary surveys for community water systems (as per the IESWTR).
January 14, 2006	Final primacy revision applications from States with approved 2-year extension agreements must be submitted to EPA.
December 2006	States must complete first round of sanitary surveys for non-community water systems (as per the IESWTR).

Public Health Benefits

Implementation of the LT1ESWTR will result in . . .	▸ Increased protection against gastrointestinal illnesses from *Cryptosporidium* and other pathogens through improvements in filtration. ▸ Reduced likelihood of endemic illness from *Cryptosporidium* by an estimated 12,000 to 41,000 cases annually. ▸ Reduced likelihood of outbreaks of cryptosporidiosis.
Estimated impacts of the LT1ESWTR include . . .	▸ National total annualized cost: $39.5 million. ▸ 90% of affected households will incur an increase of less than $1.25 per month. ▸ One percent of affected households are likely to incur an increase of more than $10 per month.

U.S. Environmental Protection Agency Long Term 2 Enhanced Surface Water Rule

EPA United States Environmental Protection Agency

Long Term 2 Enhanced Surface Water Treatment Rule: A Quick Reference Guide For Schedule 1 Systems

Overview of the Rule

Title	Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR) 71 FR 654, January 5, 2006, Vol. 71, No. 3
Purposes	Improve public health protection through the control of microbial contaminants by focusing on systems with elevated *Cryptosporidium* risk. Prevent significant increases in microbial risk that might otherwise occur when systems implement the Stage 2 Disinfectants and Disinfection Byproducts Rule (Stage 2 DBPR).
General Description	The LT2ESWTR requires systems to monitor their source water, calculate an average *Cryptosporidium* concentration, and use those results to determine if their source is vulnerable to contamination and may require additional treatment.
Utilities Covered	▸ Public water systems (PWSs) that use surface water or ground water under the direct influence of surface water (GWUDI). ▸ Schedule 1 systems include PWSs serving 100,000 or more people OR wholesale PWSs that are part of a combined distribution system in which the largest system serves 100,000 or more people.

Major Provisions

Control of *Cryptosporidium*

Source Water Monitoring	Filtered and unfiltered systems must conduct 24 months of source water monitoring for *Cryptosporidium*. Filtered systems must also record source water *E. coli* and turbidity levels. Filtered systems will be classified into one of four "Bins" based on the results of their source water monitoring. Unfiltered systems will calculate a mean *Cryptosporidium* level to determine treatment requirements. Systems may also use previously collected data (i.e., Grandfathered data). Filtered systems providing at least 5.5 log of treatment for *Cryptosporidium* and unfiltered systems providing at least 3-log of treatment for *Cryptosporidium* and those systems that intend to install this level of treatment are not required to conduct source water monitoring.
Installation of Additional Treatment	Filtered systems must provide additional treatment for *Cryptosporidium* based on their bin classification (average source water *Cryptosporidium* concentration), using treatment options from the "microbial toolbox." Unfiltered systems must provide additional treatment for *Cryptosporidium* using chlorine dioxide, ozone, or UV.
Uncovered Finished Water Storage Facility	Systems with an uncovered finished water storage facility must either: ▸ Cover the uncovered finished water storage facility; or, ▸ Treat the discharge to achieve inactivation and/or removal of at least 4-log for viruses, 3-log for *Giardia lamblia*, and 2-log for *Cryptosporidium*.

Disinfection Profiling and Benchmarking

After completing the initial round of source water monitoring any system that plans on making a significant change to their disinfection practices must:

- Create disinfection profiles for *Giardia lamblia* and viruses;
- Calculate a disinfection benchmark; and,
- Consult with the state prior to making a significant change in disinfection practice.

Bin Classification For Filtered Systems

Cryptosporidium Concentration (oocysts/L)	Bin Classification	Additional *Cryptosporidium* Treatment Required			Alternative Filtration
		Conventional Filtration	Direct Filtration	Slow Sand or Diatomaceous Earth Filtration	
< 0.075	Bin 1	No additional treatment required	No additional treatment required	No additional treatment required	No additional treatment required
0.075 to < 1.0	Bin 2	1 log	1.5 log	1 log	(1)
1.0 to < 3.0	Bin 3	2 log	2.5 log	2 log	(2)
≥ 3.0	Bin 4	2.5 log	3 log	2.5 log	(3)

(1) As determined by the state (or other primacy agency) such that the total removal/inactivation > 4.0-log.
(2) As determined by the state (or other primacy agency) such that the total removal/inactivation > 5.0-log.
(3) As determined by the state (or other primacy agency) such that the total removal/inactivation > 5.5-log.

Inactivation Requirements for Unfiltered Systems

Cryptosporidium Concentration (oocysts/L)	Required *Cryptosporidium* Inactivation
≤ 0.01	2-log
> 0.01	3-log

Critical Deadlines and Requirements

For Drinking Water Systems (Schedule 1)

July 1, 2006	**Systems must submit their:** ▸ **Sampling schedule that specifies the dates of sample collection and location of sampling for initial source water monitoring to EPA electronically; or** ▸ **Notify EPA or the state of the systems intent to submit results for grandfathering data; or** ▸ **Notify EPA or the state of the systems intent to provide at least 5.5 log of treatment for *Cryptosporidium*. Systems should consult with EPA or their state prior to submitting this notice.**
October 2006	**No later than this month systems must begin 24 months of source water monitoring.**
December 10, 2006	**System submit results for first month of source water monitoring.**
December 1, 2006	**No later than this date, systems must submit monitoring results for data that they want to have grandfathered.**
April 1, 2008	**No later than this date, systems must notify the EPA or the state of all uncovered treated water storage facilities.**
September 2008	**No later than this month, systems must complete their inital round of source water monitoring.**
March 2009	**No later than this month, filtered systems must report their initial bin classification to the EPA or the state for approval.**
March 2009	**No later than this month, unfiltered systems must report the mean of all *Cryptosporidium* sample results to the EPA or the state.**
April 1, 2009	**No later than this date, uncovered finished water storage facilities must be covered, or the water must be treated before entry into the distribution system, or the system must be in compliance with a state approved schedule.**
March 31, 2012	**Systems must install and operate additional treatment in accordance with their bin classification.†**
January 1, 2015	**Systems must submit their sampling schedule that specifies the dates of sample collection and location of sampling for second round of source water monitoring to the state.**
April 1, 2015	▸ **Systems are required to begin conducting a second round of source water monitoring.** ▸ **Based on the results, systems must re-determine their bin classification and provide additional *Cryptosporidium* treatment, if necessary.**

For States

January - June 2006	**States are encouraged to communicate with affected systems regarding LT2ESWTR requirements.**
April 1, 2007	**States are encouraged to communicate LT2ESWTR requirements related to treatment, uncovered finished water reservoirs, and disinfection profiling to affected systems.**
October 5, 2007	**States are encouraged to submit final primacy applications or extension requests to EPA.**
January 5, 2008	**Final primacy applications must be submitted to EPA, unless granted an extension.**
June 30, 2008	**States should begin awarding *Cryptosporidium* treatment credit for primary treatments in place.**
January 5, 2010	**Final primacy revision applications from states with approved 2-year extensions agreements must be submitted to EPA.**
December 31, 2012	**States should award *Cryptosporidium* treatment credit for toolbox option implementation.**

† States may allow up to an additional 24 months for compliance for systems making capital improvements.

For additional information on the LT2ESWTR

Call the Safe Drinking Water Hotline at 1-800-426-4791; visit the EPA web site at www.epa.gov/safewater/disinfection/lt2; or contact your State drinking water representative.

APPENDIX E

U.S. Environmental Protection Agency Comprehensive Disinfectants and Disinfection Byproducts Rules

EPA
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Comprehensive Disinfectants and Disinfection Byproducts Rules (Stage 1 and Stage 2): Quick Reference Guide

Overview of the Rules

Titles*	► Stage 1 Disinfectants and Disinfection Byproducts Rule (Stage 1 DBPR) 63 FR 69390, December 16, 1998, Vol. 63, No. 241 ► Stage 2 Disinfectants and Disinfection Byproducts Rule (Stage 2 DBPR) 71 FR 388, January 4, 2006, Vol. 71, No. 2
Purpose	Improve public health protection by reducing exposure to disinfection byproducts. Some disinfectants and disinfection byproducts (DBPs) have been shown to cause cancer and reproductive effects in lab animals and suggested bladder cancer and reproductive effects in humans.
General Description	The DBPRs require public water systems (PWSs) to: ► Comply with established maximum contaminant levels (MCLs) and operational evaluation levels (OELs) for DBPs, and maximum residual disinfection levels (MRDLs) for disinfectant residuals. ► Conduct an initial evaluation of their distribution system. In addition, PWSs using conventional filtration are required to remove specific percentages of organic material that may react to form DBPs through the implementation of a treatment technique.
Utilities Covered	The DBPRs apply to all sizes of community water systems (CWSs) and nontransient noncommunity water systems (NTNCWSs) that add a disinfectant other than ultraviolet (UV) light or deliver disinfected water, and transient noncommunity water systems (TNCWSs) that add chlorine dioxide.

*This document provides a summary of federal drinking water requirements; to ensure full compliance, please consult the federal regulations at 40 CFR 141 and any approved state requirements.

Overview of Requirements

This table shows how the requirements for the Stage 2 DBPR build on the existing requirements established in the Stage 1 DBPR. For more information on changes in monitoring requirements, see Table 1.

		Stage 1 DBPR	Stage 2 DBPR	For More Info:
Coverage	All CWSs and NTNCWSs that add disinfectant other than UV light and TNCWSs that treat with chlorine dioxide.	✓	✓	
	Consecutive systems that deliver water treated with a disinfectant other than UV light.		✓	
TTHM & HAA5 MCL Compliance	MCL compliance is calculated using the running annual average (RAA) of all samples from all monitoring locations across the system.	✓		See Table 3 and Table 4.
	MCL compliance is calculated using the locational RAA (LRAA) for each monitoring location in the distribution system.		✓	
Regulated Contaminants & Disinfectants	*Contaminants*			See Table 2.
	Total Trihalomethanes (TTHM)	✓	✓	
	5 Haloacetic Acids (HAA5)	✓	✓	
	Bromate	✓	Regulated under Stage 1 DBPR[1]	
	Chlorite	✓	Regulated under Stage 1 DBPR	
	Disinfectants			
	Chlorine/chloramines	✓	Regulated under Stage 1 DBPR	
	Chlorine dioxide	✓	Regulated under Stage 1 DBPR	
Operational Evaluation	If an operational evaluation level (OEL) is exceeded, systems must evaluate practices and identify DBP mitigation actions.		✓	See Table 5.

1. A new analytical method for bromate was approved with the Stage 2 DBPR.

Table 1. Changes in Monitoring Requirements

			Stage 1 DBPR	Stage 2 DBPR
TTHM/ HAA5 Routine Monitoring	Number of Samples		Based on source water type, population, and number of treatment plants or wells.	Based on source water type and population.
	Sample Locations		At location of maximum residence time.[1]	Based on Initial Distribution System Evaluation (IDSE) requirements.[2]
	Compliance Calculation		RAA must not exceed the MCL for TTHM or HAA5.	LRAA must not exceed the MCL for TTHM or HAA5.
Reduced Monitoring	Eligibility	TTHM/HAA5	All systems need TTHM RAA ≤ 0.040 mg/L and HAA5 ≤ 0.030 mg/L. Subpart H systems also need source water TOC RAA at location prior to treatment ≤ 4.0 mg/L .[3, 4] The Stage 2 DBPR left eligibility unchanged but specifies that Subpart H systems must take source water TOC samples every 30 days. Subpart H systems on reduced monitoring must take source water TOC samples every 90 days to qualify for reduced monitoring.	
		Bromate[5]	Source water bromide RAA < 0.05 mg/L. With the Stage 2 DBPR specified entry point to distribution system bromate RAA ≤ 0.0025 mg/L.	

[1]Subpart H systems serving ≥ 10,000 must have at least 25 percent of samples at the location of maximum residence time; the remaining samples must be representative of average residence time.

[2]All systems are required to satisfy their IDSE requirement by July 10, 2010.

[3]Subpart H systems are water systems that use surface water or ground water under the direct influence of surface water (GWUDI).

[4]Ground water systems serving < 10,000 must meet these RAA for 2 years; can also qualify for reduced monitoring if the TTHM RAA is ≤ 0.020 mg/L and a HAA5 RAA ≤ 0.015 mg/L for 1 year.

[5]A new analytical method for bromate was established with the Stage 2 DBPR.

Table 2. Regulated Contaminants and Disinfectants

	Stage 1 DBPR		Stage 2 DBPR	
Regulated Contaminants	MCL (mg/L)	MCLG (mg/L)	MCL (mg/L)	MCLG (mg/L)
TTHM	0.080		Unchanged[2]	
Chloroform		-		0.07
Bromodichloromethane		Zero		Unchanged[2]
Dibromochloromethane		0.06		Unchanged[2]
Bromoform		Zero		Unchanged[2]
HAA5	0.060		Unchanged[2]	
Monochloroacetic acid		-		0.07
Dichloroacetic acid		Zero		Unchanged[2]
Trichloroacetic acid		0.3		0.2
Bromoacetic acid		-		-
Dibromoacetic acid		-		-
Bromate (plants that use ozone)[1]	0.010	Zero	Unchanged[2]	Unchanged[2]
Chlorite (plants that use chlorine dioxide)	1.0	0.8	Unchanged[2]	Unchanged[2]
Regulated Disinfectants	**MRDL[3] (mg/L)**	**MRDLG[3] (mg/L)**	**MRDL (mg/L)**	**MRDLG (mg/L)**
Chlorine	4.0 as Cl_2	4	Unchanged[2]	Unchanged[2]
Chloramines	4.0 as Cl_2	4	Unchanged[2]	Unchanged[2]
Chlorine dioxide	0.8	0.8	Unchanged[2]	Unchanged[2]

[1]A new analytical method for bromate was established with the Stage 2 DBPR.

[2]Stage 2 DBPR did not revise the MCL or MRDL for this contaminant/disinfectant.

[3]Stage 1 DBPR included MRDLs and MRDLGs for disinfectants, which are similar to MCLs and MCLGs.

Table 3. Compliance Determination

	Stage 1 DBPR	Stage 2 DBPR
TTHM/HAA5	RAA	LRAA
Bromate[1]	RAA	Unchanged[2]
Chlorite	Daily/follow-up monitoring	Unchanged[2]
Chorine dioxide	Daily/follow-up monitoring	Unchanged[2]
Chlorine/chloramines	RAA	Unchanged[2]
DBP precursors (TOC sample set)*	Monthly for TOC and alkalinity	Every 30 days for TOC and alkalinity

[1]A new analytical method for bromate was established with the Stage 2 DBPR.

[2]Stage 2 DBPR did not change the compliance requirements for this contaminant/disinfectant.

*TOC sample set is comprised of source water alkalinity, source water TOC, and treated TOC.

Table 4. Compliance with MCLs and MRDLs (Routine Monitoring)

Contaminant/ Disinfectant	Coverage		Stage 1 DBPR		Stage 2 DBPR	
	Source Water	Population	Monitoring Frequency	Total Distribution System Monitoring Locations	Monitoring Frequency[1]	Total Distribution System Monitoring Locations
TTHM/HAA5	Subpart H	< 500	Per year[2]	1 per treatment plant	Per year[2]	2
		500 - 3,300	Per quarter	1 per treatment plant	Per quarter	2
		3,301 - 9,999				
		10,000 - 49,000		4 per treatment plant		4
		50,000 - 249,999				8
		250,000 - 999,999				12
		1,000,000 - 4,999,999				16
		≥ 5,000,000				20
	Ground water	< 500	Per year[2]	1 per treatment plant	Per year[2]	2
		500 - 9,999				
		10,000 - 99,999	Per quarter		Per quarter	4
		100,000 - 499,999				6
		≥ 500,000				8
Bromate[3]	Systems that use ozone as a disinfectant		Monthly	1 at entry point to distribution system	Unchanged[4]	
Chlorite	Systems that use chlorine dioxide as a disinfectant		**Daily** (at entrance to distribution system); **monthly** (in distribution system)	1 at entry point to distribution system; 3 in distribution system	Unchanged[4]	
Chlorine dixoide	Systems that use chlorine dioxide as a disinfectant		Daily	1 at entry point to distribution system	Unchanged[4]	
Chorine/ Chloramines	All systems		Same location and frequency as Total Coliform Rule (TCR) sampling		Unchanged[4]	
DBP precursors (TOC sample set)*	Systems that use conventional filtration		Monthly	1 per source water source	Unchanged[4]	

[1]All systems must monitor during the month of highest DBP concentrations. Systems on quarterly monitoring, except Subpart H systems serving 500 - 3,300, must take dual sample sets every 90 days at each monitoring location. Systems on annual monitoring and Subpart H systems serving 500 - 3,300 are required to take individual TTHM and HAA5 samples (instead of a dual sample set) at the locations with the highest TTHM and HAA5 concentrations, respectively. If monitoring annually, only one location with a dual sample set per monitoring period is needed if the highest TTHM and HAA5 concentrations occur at the same location and in the same month.

[2]Ground water systems serving < 10,000 and Subpart H systems serving < 500 must increase monitoring to quarterly if an MCL is exceeded.

[3]A new analytical method for bromate was established with the Stage 2 DBPR.

[4]Stage 2 DBPR did not revise the monitoring frequency or location requirements for this contaminant/disinfectant.

*TOC sample set is comprised of source water alkalinity, source water TOC, and treated TOC.

Table 5. Operational Evaluation Levels (OELs)

Applies to:	All systems subject to Stage 2 DBPR monitoring requirements that conduct compliance monitoring and collect samples quarterly.
Purpose of establishing OELs:	To reduce peaks in DBP levels and exposure to high DBP levels.
OEL calculations:	► Calculated for both TTHMs and HAA5s at each monitoring location using Stage 2 DBPR compliance monitoring results. ► OEL is determined by the sum of the two previous quarter's TTHM or HAA5 result plus twice the current quarter's TTHM or HAA5 result at that location, divided by four. ► OEL = (Q1 + Q2 + 2Q3) / 4
OELs are exceeded:	During any quarter in which the OEL is greater than the TTHM or HAA5 MCL.
If an OEL is exceeded, a system must:	► Conduct an operational evaluation. ► Submit a written report of the evaluation to the state no later than 90 days after being notified of the analytical results that caused the exceedance(s). ► Keep a copy of the operational evaluation report and make it publically available upon request.
The operational evaluation must include:	► An examination of the treatment and distribution systems' operational practices that may contribute to TTHM and HAA5 formation. ► Steps to minimize future exceedances.
OEL requirements take effect:	When the system begins compliance monitoring for the Stage 2 DBPR.

Table 6. Standard Monitoring Compliance Dates

If You are a System Serving:	Schedule[1]	Begin LRAA TTHM & HAA5 Monitoring By:
At least 100,000 people or part of a combined distribution system (CDS) serving at least 100,000 people.	1	April 1, 2012
50,000 to 99,999 people or part of a CDS serving 50,000 to 99,999 people.	2	October 1, 2012
10,000 to 49,999 people or part of a CDS serving 10,000 to 49,999 people.	3	October 1, 2013
Less than 10,000 people or part of a CDS serving less than 10,000 people.	4	October 1, 2013[2]

[1]Your schedule is determined by the largest system in your CDS.

[2]Systems not conducting *Cryptosporidium* monitoring under Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR) must begin LRAA TTHM/HAA5 monitoring by this date. Systems conducting *Cryptosporidium* monitoring under LT2ESWTR must begin LRAA TTHM/HAA5 monitoring by October 1, 2014.

Table 7. TOC Removal

Subpart H systems that use conventional filtration treatment are required to remove specific percentages of organic materials, measured as total organic carbon (TOC), that may react with disinfectants to form DBPs. Removal must be achieved through a treatment technique (enhanced coagulation or enhanced softening) unless a system meets alternative criteria. Systems practicing softening must meet TOC removal requirements for source water alkalinity greater than 120 mg/L $CaC0_3$.

Source Water TOC (mg/L)	Source Water Alkalinity, mg/L as $CaCO_3$		
	0 - 60	> 60 to 120	> 120
> 2.0 to 4.0	35.0%	25.0%	15.0%
> 4.0 to 8.0	45.0%	35.0%	25.0%
> 8.0	50.0%	40.0%	30.0%

For additional information on the DBPRs:

Call the Safe Drinking Water Hotline at 1-800-426-4791; visit the EPA web site at http://water.epa.gov/drink; or contact your state drinking water representative.

APPENDIX F

Microbial and Disinfection Byproduct Rules and Compliance Guidance Manual

APPENDIX G

Calculations for Proposed Chemical Injection System