MCHB-TS-EWS

GUIDANCE FOR CONFORMING TO THE REQUIREMENTS OF THE INTERIM ENHANCED SURFACE WATER TREATMENT RULE AND THE DISINFECTANT/DISINFECTION BYPRODUCTS RULE
WATER SUPPLY MANAGEMENT INFORMATION PAPER NO. 31-024

1. REFERENCES. Appendix A contains references.

2. PURPOSE. This information paper provides guidance to address the recently promulgated Interim Enhanced Surface Water Treatment Rule (IESWTR) and the Stage 1 Disinfectant/Disinfection Byproduct (D/DBP) Rule. Actions that Army water suppliers may need to take are also discussed.

3. DEFINITIONS. The IESWTR and the Stage 1 D/DBP Rule contain numerous terms that may be unfamiliar or are unique to the new rules. Definitions are provided in Appendix B.

4. BACKGROUND.

a. REGULATORY FRAMEWORK. The 1974 Safe Drinking Water Act (SDWA) was passed by Congress in order to ensure safe drinking water supplies in the United States. The nation's drinking water supplies are regulated with respect to contaminants impacting health by the National Primary Drinking Water Regulations (NPDWR) (reference 1). Congress passed amendments to the SDWA in 1986 and 1996. The USACHPPM Technical Guide 179 (reference 2), published in 1995, describes the NPDWR as it applied to Army installations up to that time. The 1996 amendments required the Environmental Protection Agency (EPA) to further regulate certain microbial contaminants and disinfection byproducts (reference 3). The IESWTR and the Stage 1 D/DBP rule are the first rules to be issued by the EPA under the 1996 Amendments (references 4,5). These new rules are a product of six years of collaboration between the water industry, environmental and public health groups, and local, state and Federal government. These and associated future rules are also referred to as the Microbial and Disinfection Byproduct (M-DBP) rules (reference 6).

b. DRINKING WATER AND HEALTH CONCERNS.

(1) The vast majority of Americans drink tap water that meets all existing health standards. These new rules will further strengthen existing drinking water standards and thus increase protection for many water systems. The EPA's Science Advisory Board concluded in 1990 that exposure to microbial contaminants such as bacteria, viruses, and protozoa (e.g., *Giardia lamblia* and *Cryptosporidium*) was likely the greatest remaining health risk management challenge for drinking water suppliers (reference 6). Acute health effects from exposure to microbial pathogens are documented and associated illness can range from mild to moderate cases lasting only a few days to more severe infections that can last several weeks and may result in death for those with weakened immune systems. Most waterborne illnesses are gastrointestinal in nature and include nausea and diarrhea as symptoms.

(2) Disinfection, primarily by chlorination, has unquestionably, significantly reduced the number and extent of waterborne illness during the last 50 years. However, while disinfectants are effective in controlling many microorganisms, health information obtained during the last 2 decades has helped regulators recognize that the disinfectants and resulting byproducts may themselves impact human health. Disinfectants react with natural organic and inorganic matter in source water and distribution systems to form the disinfection byproducts (DBPs). Many of these DBPs have been shown to cause cancer and reproductive and developmental effects in laboratory animals (reference 5). The human health effects are less well known and studies continue. For example, the contaminants known collectively as total trihalomethanes (TTHM) have been recognized as DBPs. Large water systems serving ? 10,000 have had a TTHM regulatory requirment for years under the NPDWR. Now other DBPs have been identified as well. More than 200 million people consume water that has been disinfected. Because of the large population exposed, health risks associated with DBPs, even if small, need to be taken seriously.

(3) Therefore, a major challenge for water suppliers is how to balance the risks from microbial pathogens and the DBPs. It is important to provide protection from these microbial pathogens while simultaneously ensuring decreasing health risks to the population from the chemical disinfectants. This fact sheet contains general information about the two new rules and others that are a part of the M-DBP Rules.

(4) *Cryptosporidium* – A Special Challenge. Some microbial pathogens, such as *Cryptosporidium*, have proven resistant to traditional disinfection practices. *Cryptosporidum* is a protozoan microbe carried in the gut of numerous animal species, most notably young cattle. The organism is shed in fecal material and ultimately can be found in nearly all surface water supplies (reference 7). In the environment, the organism exists in a protective shell called an oocyst. When ingested by humans the *Cryptosporidium* can cause a severe diarrheal illness. In 1993, *Cryptosporidium* caused 400,000 people in Milwaukee to experience intestinal illness. More than 4,000 were hospitalized, and at least 50 deaths have been attributed to that event (reference 6). Although there are no effective drugs to treat the illness, persons with competent immune

systems normally recover in less than 2 weeks. There have also been cryptosporidiosis outbreaks in Nevada, Oregon, and Georgia over the past several years. Disinfection of *Cryptosporidium* using chlorine is completely ineffective (reference 4). Therefore, it is critical that the other treatment processes operate optimally to eliminate the *Crytposporidium* presence. Ensuring this optimal treatment against *Cryptosporidium* is at the heart of the IESWTR.

c. RELATED REGULATIONS. The NPDWR already contain a number of regulations to address microbial and DBP concerns. These existing regulations are in the 40 Code of Federal Regulations (CFR), Part 141, NPDWR.

(1) The Surface Water Treatment Rule (SWTR), promulgated in 1989, applies to all public water systems (PWS) using surface water sources or ground water sources under the direct influence of surface water (GWUDI) (reference 8). It established maximum contaminant level goals (MCLGs) for viruses, bacteria and *Giardia lamblia*. It also includes treatment technique requirements for filtered and unfiltered systems that are specifically designed to protect against the adverse health effects of exposure to these microbial pathogens. Included in the treatment technique requirements are filtered water turbidity standards and disinfection standards. Conventional water treatment facilities, for example, must achieve finished water turbidity removals to ? 0.5 NTU in 95 % of measurements. The concept of a disinfectant "CT" (concentration X contact time) was applied. Using the combination of filtration and disinfection, water systems had to demonstrate 3 log (99.9 %) removal of *Giardia lamblia* and 4 log (99.99 %) removal of viruses.

(2) The Total Coliform Rule, revised in 1989, applies to all PWSs and established a maximum contaminant level (MCL) for total coliforms (reference 9). The total coliform bacteria group is used as the primary indicator of the microbial quality of drinking water. Water systems cannot exceed a level of 5 % of monthly samples containing total coliforms. The rule also implemented a requirement that total coliform-positive samples must be analyzed for either fecal coliforms or *E. coli* in order to better determine true health significance of the total coliform presence.

(3) Disinfection Byproducts: In 1979, EPA set an interim MCL for total trihalomethanes (TTHM) of 0.10 mg/l (100 ppb) as an annual average (reference 10). This applies to any community water system serving at least 10,000 people that adds a disinfectant to the drinking water during any part of the treatment process.

(4) Information Collection Rule. To support the M-DBP rulemaking process, the Information Collection Rule (ICR) established monitoring and data reporting requirements for large public water systems serving at least 100,000 people (reference 11). This rule was intended to provide EPA with information on the occurrence in drinking water of microbial pathogens and DBPs. In addition, as part of the ICR, EPA is collecting engineering data on how PWSs currently control such contaminants. Of the regulations outlined in this section, the ICR did not apply to Army systems because Army systems did not meet minimum population requirements.

d. DEVELOPMENT AND PROMULGATION OF THE M/DBP RULES. The final rules resulted from formal regulatory negotiations with a wide range of stakeholders that took place in 1992-93 and 1997. The Federal Advisory Committee Act (FACA) provided the basis to establish the M-DBP committee that consisted of Federal and state regulators, health experts and water facility representatives. The EPA finalized the IESWTR and Stage 1 D/DBP in November 1998, as required by the 1996 Amendments to the Safe Drinking Water Act, Section 1412(b)(2)(C). The two rules were subsequently promulgated on 16 December 1998 (references 4 and 5).

e. ARMY DISINFECTION PRACTICES. Currently, most Army PWSs in the United States use chlorine as their disinfectant. Some Army systems employ chloramine. A very limited number may use chlorine dioxide.

5. INTERIM ENHANCED SURFACE WATER TREATMENT RULE.

a. GENERAL. A priority in developing the IESWTR was to provide a way to regulate *Cryptosporidium* in a manner similar to that of *Giardia lamblia* and viruses, i.e., through a treatment technique. The IESWTR, with tightened turbidity performance criteria and required individual filter monitoring, is designed to optimize treatment reliability and to enhance physical removal efficiencies to minimize the *Cryptosporidium* levels in finished water (reference 12). In addition, the rule includes disinfection benchmark provisions to assure continued levels of microbial protection while facilities take the necessary steps to comply with new DBP standards. The rule builds upon the treatment technique requirements of the SWTR with the following key additions and modifications:

- Maximum contaminant level goal (MCLG) of zero for *Cryptosporidium*
- 2-log (99%) *Cryptosporidium* removal requirements for systems that filter
- Strengthened combined filter effluent turbidity performance standards
- Individual filter turbidity monitoring provisions
- Disinfection profiling and benchmarking provisions
- Systems using ground water under the direct influence of surface water now subject to the new rules dealing with *Cryptosporidium*
- Inclusion of *Cryptosporidium* in the watershed control requirements for unfiltered public water systems
- Requirements for covers on new finished water reservoirs
- Sanitary surveys, conducted by states, for all surface water systems regardless of size

b. AFFECTED WATER SYSTEMS. The IESWTR applies to those PWSs using surface water, or GWUDI source water, that serve 10,000 or more persons. The rule also includes provisions for states to conduct sanitary surveys for surface water systems regardless of system size.

c. COMPLIANCE TIMELINES. Most requirements of the IESWTR, for example tightened turbidity monitoring, are not effective until December 2001. However, one requirement must be acted upon immediately for affected water systems. As part of the disinfectant profiling process, explained below, certain PWSs must compile 1 year of monitoring data, in the form of quarterly sample sets, for the DBP groups TTHM and haloacetic acids (HAA5). Haloacetic acids are also formed upon reaction of organics with chlorine.

d. CRYPTOSPORIDIUM MCLG. The MCLG is an unenforceable guideline that is established as the treatment goal to ensure protection of health. Previously, MCLGs have been set for those contaminants where monitoring to demonstrate presence or absence is not technically achievable or practical for PWSs to implement. The SWTR contains MCLGs of zero (0) for Giardia and viruses. Similarly the IESWTR sets the Cryptosporidium MCLG at zero. Although Cryptosporidium parvum is the only species presently known to cause illness in humans, the MCLG is listed for the entire Crypto genus, i.e., all species. This approach follows the guidance for setting MCLGs that have an adequate margin of safety.

e. REMOVAL OF *CRYPTOSPORIDIUM* THROUGH FILTRATION. The IESWTR adds *Cryptosporidium* to the list of microbes regulated under the SWTR, including *Giardia lamblia*, viruses and *Legionella* and the associated turbidity. The SWTR uses a combination of filtration and disinfection to achieve levels of microorganism removal. Because *Cryptosporidium* is so resistant to chlorine disinfection, the treatment technique has been set at a 2 log removal achieved through proper filtration. In other terms, a PWS must be capable of removing 99 % of *Cryptosporidium* oocysts during treatment. Systems using filtration must ensure that the removal occurs at a point where the source water cannot be re-contaminated with surface water runoff and the first customer. Unfiltered systems already have stringent water shed protection requirements and those systems must now include *Cryptosporidium* control in their program. **??Applies to surface water and GWUDI serving> 10,000 and that are required by the SWTR to filter?? verify**

f. FILTERED WATER TURBIDITY MONITORING.

(1) Turbidity has been used historically as a measure of the filter performance. The SWTR set performance criteria for conventional and direct filtration sytems of achieving filtered water turbidity ? 0.5 Nephelometric Turbidity Unit (NTU) in at least 95 % of measurements during the month. Currently, a system exceeding 5 NTU for any measurement would violate the treatment technique criteria as well. These measurements are taken at the combined filter effluent. The IESWTR will require even more stringent turbidity control for conventional/direct filtration systems of ? 0.3 NTU in at least 95 % of monthly samples and the maximum allowable turbidity will be 1 NTU for combined filtered water. The turbidity performance standards for slow sand and diatomaceous earth

systems remain the same as required by the SWTR, at 95 % monthly measurements ? 1 NTU and a maximum turbidity of 5 NTU in any measurement.

(2) A new requirement of the IESWTR is that continuous turbidity monitoring must now be performed on individual filters in a treatment train. This requirement is not part of the treatment technique but is intended to help water systems identify poorly performing filters and make needed adjustments. Conventional or direct filtration systems must use calibrated turbidimeters to continually record individual filter turbidities every 15 minutes. Monitoring the individual filters applies only to conventional and direct filtration systems.

(3) Four conditions have been identified where the water system will be required to take action to address an unusual turbidity condition that occurs at any of the individual filters. The conditions and required action are described below. Each of the conditions is based on consecutive turbidity measurements 15 minutes apart.

(a) Two consecutive measurements > 1.0 NTU. Record the date, filter number, and measurements. Produce a filter profile within 7 days if no obvious reason for excursion can be identified. Within 10 days, report to the State that the filter profile has been completed or identify reason for excursion.

(b) Two consecutive measurements > 0.5 NTU following 4 hours operation after filter backwashing or being offline. Record the date, filter number, and measurements. Produce a filter profile within 7 days if no obvious reason for excursion can be identified. Report to the State that the filter profile has been completed or identify reason for excursion, within 10 days after end of the month of the occurrence.

(c) Two consecutive measurements > 1.0 NTU in each of 3 consecutive months. Record the date, filter number, and measurements. Assess the filter performance within 14 days. Develop a filter profile identifying performance limiting factors. Prepare a filter self-assessment report.

(d) Two consecutive measurements > 2.0 NTU in 2 consecutive months. Record the date, filter number, and measurements. Arrange for a comprehensive performance evaluation (CPE) within 30 days of excess turbidity measurements. Perform and report CPE findings within 90 days.

g. SYSTEM IMPROVEMENTS THROUGH COMPREHENSIVE PERFORMANCE EVALUATIONS. As described above, individual filter monitoring may identify that filters are not functioning properly resulting in particles including microbes which may pass into the finished water. Conditions may require a CPE be performed . The EPA developed a CPE assessment guideline, or protocol, that provides a thorough performance-based evaluation of a conventional surface water treatment facililities process pursuant to the SWTR (**reference___)**

(1) The CPE protocol includes a detailed statistical evaluation of filtered water turbidities measured at least every 4 hours to assess conformance with the 95/5 percent occurrence criteria. The protocol also includes a detailed evaluation of disinfection efficacy based on application of the CT concept that allows a subsequent determination of actual and required microbial log reductions.

(2) The U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) Water Supply Management Program used the CPE protocol to develop its Water System Performance Evaluation (WSPE) protocol. The WSPE protocol evaluates the ability of an entire waterworks, from source to tap, taking into account the classic source, treatment, and distribution barriers as well as regulatory, operational, and monitoring activities and staffing to produce safe drinking water for all consumers. The modular nature of the WSPE allows application not only to any element of a waterworks (e.g., only treatment), but also to any type and size of waterworks. The WSPE protocol has been successfully applied at numerous Army installations.

h. DISINFECTION PROFILING AND BENCHMARKING.

(1) The intent of this requirement is to help systems determine if there would be an increased risk from microbial pathogens if disinfection changes are made as a result of Stage 1 D/DBP requirements. For those systems affected, a three-step approach must be followed – determining if a profile is required, developing the disinfection profile, and calculating the disinfection benchmark.

(2) The IESWTR requires that a PWS perform monitoring for the DBP groups TTHMs and HAA5. The TTHM group consists of the compounds chloroform, bromodichloromethane, dibromochloromethane,and bromoform. The compounds comprising the HAA5 group are monochloroacetic acid, dichloroacetic acid, trichloroacetic acid, monobromoacetic acid and dibromoacetic acid. The purpose of monitoring the DBPs for a 1-year period is to determine whether the PWS must prepare a disinfection profile. In April 1999, the U.S. Army Environmental Center (USAEC) issued a memorandum to all major Army commands (MACOMs) informing that some Army water systems would need to perform this concurrent DBP monitoring (reference 14).

(3) Determining if the PWS must develop a disinfection profile.
A disinfection profile will be required if the annual average of the DBPs exceeds 80 percent of the new maximum contaminant levels (MCL) established under the Stage 1 D/DBP rule. The new TTHM MCL is 0.080 mg/L and the HAA5 MCL is 0.060 mg/L. Therefore, the annual averages under this IESWTR monitoring cannot exceed 0.064 mg/L and 0.048 mg/L, respectively. If either level is exceeded a disinfectant profile must be prepared.

. (a) The TTHM group has been previously regulated under the NPDWR (reference 8) and pursuant primacy state regulations. A set of samples from the distribution system is analyzed once per quarter. Compliance with the former MCL of 0.10 mg/L was determined on a running annual average of four quarters of data. A number of Army

systems have been required to monitor for TTHMs. The 1996 ICR implemented the initial requirement to monitor for HAA5 as well. However, the ICR requirement essentially only applied to surface water systems serving 100,000 and above. No Army systems fell into that category. Now, the IESWTR requires that the HAA5 be monitored and reported in the same manner as the TTHMs.

(b) Monitoring and reporting of data to state authorities must by completed by the end of the month, 15 months after rule promulgation, i.e. by 31 March 2000. A stipulation of the requirement is that monitoring for the TTHMs and HAA5 must occur concurrently within the same period of time.

(c) Some PWS may have already conducted monitoring for both TTHM and HAA5, either under ICR requirements or as recommended by the state to obtain DBP information. Systems that have 1 year of TTHM and HAA5 data from ICR monitoring, must report that data to their state by December 1999. Because Army systems did not have to fulfill ICR sampling requirements, it is expected that Army water systems would not necessarily have previously performed concurrent TTHM/HAA5 monitoring.

(d) Water systems that have previously monitored for TTHMs but have not also monitored for HAA5 during the same interval, must have samples analyzed for HAA5 in addition to TTHMs during the next 1-year compliance period. The monitoring must begin during the calendar quarter April – June 1999. Thereafter, collect IESWTR samples at approximately equal 90-day intervals.

(e) As an alternative to conducting one year of concurrent TTHM and HAA5 monitoring, a system may elect to forego the monitoring and begin the development of the disinfection profile.

(4) Developing the Disinfection Profile. This in turn will be a year long process, whereby the system must determine the adequacy of disinfection against the protozoan *Giardia lamblia*. The water system must determine the total logs of *Giardia* inactivation each day of operation for at least one year beginning March 2000. To determine the log inactivation a number of steps must be conducted - determining disinfectant contact time (T) at each residual monitoring point; measuring the residual concentration (C) of the disinfectant before or at the first customer; calculating the total inactivation ratio (CT calc/CT 99.9) before or at first customer.

Add one paragraph on calculating disinfection benchmark

i. SANITARY SURVEYS. Sanitary surveys will be required for community systems every 3 years with the first survey completed by December 2004. The State authorities must conduct the sanitary surveys for water systems. The State may authorize the frequency interval at 5 years for optimal systems. Noncommunity systems must complete a sanitary survey no later than December 2006. As a minimum, the sanitary surveys must

address water source, treatment, distribution system, finished water storage, pump facilities, controls, monitoring and reporting of analyses, data verification procedures and overall system management.

6. STAGE 1 D/DBP RULE REQUIREMENTS.

a. GENERAL.

(1) While disinfectants are effective in controlling many microorganisms, they react with natural organic and inorganic matter in source water and distribution systems to form DBPs. Results from toxicology studies have shown several DBPs (e.g., bromodichloromethane, bromoform, chloroform, dichloroacetic acid, and bromate) to be carcinogenic in laboratory animals. Other DBPs (e.g., chlorite, bromodichloromethane, and certain haloacetic acids) have also been shown to cause adverse reproductive or developmental effects in laboratory animals. Several epidemiology studies have suggested a weak association between certain cancers (e.g, bladder) or reproductive and developmental effects, and exposure to chlorinated surface water.

(2) The anticipated benefits from implementation of the Stage 1 D/DBP are many. The EPA estimates that nearly140 million people will receive increased protection from DBP health impacts. There will be a significant reduction in the national average TTHM levels and as well as reduced exposure to the DBPs formed when ozone and chlorine dioxide are used as the primary water disinfectants (reference 13). Bromate is a DBP formed from ozone and chlorite is formed during chlorine dioxide use. The costs of implementing newly required treatment to reduce the DBPs will be significant. The total cost to implement the Stage 1 D/DBP rule is expected to be approximately $700 million annually. However, EPA estimates that 95 percent of U.S. households will incur additional costs of less than $1 per month on their water bills.

(3) Key Provisions of the Stage 1 Rule. The Stage 1 D/DBP Rule updates and supersedes the 1979 regulations for total TTHM. In addition, it will reduce exposure to three disinfectants and many disinfection byproducts. The rule establishes maximum residual disinfectant level goals (MRDLGs) and maximum residual disinfectant levels (MRDLs) for three chemical disinfectants - chlorine, chloramine and chlorine dioxide. The terms MRDLG and MRDL were created to distinguish disinfectants, which are beneficial when applied correctly, from drinking water contaminants which are assigned maximum contaminant levels (MCLs). The Stage 1 D/DBP also establishes MCLGs and MCLs for TTHMs, HAA5s, chlorite and bromate (see Table 1). Another important provision is the inclusion of a treatment technique for water systems to remove DBP precursor material in order to reduce DBP levels.

b. AFFECTED WATER SYSTEMS.

The Stage 1 Disinfectants and Disinfection Byproducts Rule applies to all PWS classified as community or nontransient noncommunity (NTNC) water systems that treat their water with a chemical disinfectant for either primary or residual treatment.

c. COMPLIANCE TIMELINES.

Large surface water systems (? 10,000) are required to comply with the Stage 1 D/DBP three years after rule promulgation, i.e., by December 2001. These systems are also known as large Subpart H systems meaning they have been required in the past to meet SWTR requirments. Ground water systems and small surface water systems must comply with the Stage 1 D/DBP Rule by December 2003.

d. MAXIMUM D/DBP LEVELS. The “maximum” goals and levels are summarized in Table 1 below.

MRDLGs are set for chlorine, chloramines and chlorine dioxide.

MRDLs are set for the same disinfectants. Together, establishing MRDLGs and MRDLs should protect consumers from potentially harmful concentrations of disinfectants.

MCLGs are set for the four compounds comprising the TTHMs, two of the HAA5s and the byproducts bromate and chlorite.

The MCL for TTHM has been reduced from 0.100 mg/L to 0.080 mg/L. An MCL is established for the HAA5 at 0.060 mg/L.

e. MONITORING FOR DISINFECTANTS. Water systems will be required to routinely monitor for the disinfectants used in their system.

(1) Monitoring for Free Chlorine and Chloramine Residual.

(a) All PWS using either free chlorine or chloramines must monitor the disinfectant levels in the distribution system at sample points used for total coliform monitoring at the time total coliform samples are collected.

TABLE 1

MRDLGs, MRDLs, MCLGs and MCLs for Stage 1 Disinfectants and Disinfection Byproducts Rule

DISINFECTANT RESIDUAL	MRDLG (mg/L)	MRDL (mg/L)	**COMPLIANCE BASED ON**
Chlorine	**4 (as free Cl_2)**	**4.0 (as free Cl_2)**	**Annual Average**
Chloramine	**4 (as Cl_2)**	**4.0 (as Cl_2)**	**Annual Average**
Chlorine Dioxide	**0.8 (as ClO_2)**	**0.8 (as ClO_2)**	**Daily Samples**
DISINFECTION BYPRODUCTS	**MCLG (mg/L)**	**MCL (mg/L)**	**COMPLIANCE BASED ON**
Total trihalomethanes (TTHM)[1] **- Chloroform** **- Bromodichloromethane** **- Dibromochloromethane** **- Bromoform**	**N/A** **0** **0** **0.06** **0**	**0.080**	**Annual Average**
Haloacetic acids (five) (HAA5)[2] **- Dichloroacetic acid** **- Trichloroacetic acid**	**N/A** **0** **0.3**	**0.060**	**Annual Average**
Chlorite	**0.8**	**1.0**	**Monthly Average**
Bromate	**0**	**0.010**	**Annual Average**

N/A - Not applicable because there are individual MCLGs for TTHMs or HAAs

1-Total trihalomethanes is the sum of the concentrations of chloroform, bromodichloromethane, dibromochloromethane, and bromoform.

2-Haloacetic acids (five) is the sum of the concentrations of mono-, di-, and trichloroacetic acids and mono- and dibromoacetic acids.

Water systems that use surface water or ground water under the direct influence of surface water and use conventional filtration treatment are required to remove specified percentages of organic materials, measured as total organic carbon (TOC), that may react with disinfectants to form DBPs (See Table 2). Removal will be achieved through a treatment technique (enhanced coagulation or enhanced softening) unless a system meets alternative criteria.

(b) To determine compliance, average all monthly samples. Monthly samples are then arithmetically averaged to determine the quarterly average. For compliance the most recent 4-quarter average cannot exceed the MRDL.

(c) The water systems must maintain records and report to their state the following: number of monthly residual test samples during a quarter; monthly arithmetic average of all residual samples tested each month for a 12 month period; the average of the previous 12 monthly averages; whether the MRDL has been exceeded.

(2) Monitoring for Chlorine Dioxide Residual

(a) If a water system uses chlorine dioxode rather than free chlorine or chloramine, other monitoring requirements apply. A significant difference is that monitoring for chlorine dioxide applies to transient non-community water systems (TNCWS) as well as community and the NTNC systems. The disinfectant residual must be measured daily at the entrance to the distribution system. If the MRDL of 0.8 mg/L is exceeded, three follow-up samples must be collected from the distribution system.

(b) Non-acute and acute violations of this monitoring requirement have been identified. Failure to monitor at the distribution system entrance following a MRDL exceedance or if two consecutive daily entry point samples exceed 0.8 mg/L but all follow-up distribution system samples remain below 0.8 mg/L are non-acute situations. An acute violation occurs when an entry point sample exceeds 0.8 mg/L and one or more of the follow-up distribution system samples also exceeds 0.8 mg/L.

(c) Water systems using chlorine dioxide must report the following to their primacy state: locations and results of residual samples during the past quarter; whether the MRDL was exceeded and if so, was it exceeded during two consecutive samples; was the violation acute or non-acute.

f. MONITORING FOR DBPS. Another requirement of the Stage 1 D/DBP is that monitoring must be performed for the DBPs. Monitoring schedules are implemented according to the size of the water system and the type of disinfectant.

(1) General. Under the Stage 1 D/DBP the current MCL of 0.10 mg/L for TTHMs will be replaced with a new MCL of 0.080 mg/L with effective dates of December 2001 effective date (large systems) and December 2003 (small systems and ground water). The system must submit a DBP monitoring plan to their primacy state with 30 days of the effective compliance dates. The monitoring plan must reflect the complete distribution system and include sample collection points and information regarding calculating MCL, MRDL and treatment technique compliance.

(2) TTHM and HAA5 – Large Subpart H Systems (? 10,000)

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(a) Routine Monitoring. Compliance monitoring samples shall be taken under normal operating conditions. Samples for TTHM and HAA5 are collected at the same time. Similar to current TTHM requirements, systems must collect compliance samples from four locations within the distribution system on a quarterly basis. Three locations should represent average water residence time. The fourth sample should be from a location representing maximum residence time. The arithmetic average for the TTHMs

and HAA5 is calculated for the quarter. Compliance is based on a running annual average for the most recent 4 quarters.

(b) Reduced Monitoring. The system can qualify for reduced monitoring if certain criteria are met. The TTHM annual average must be ? 0.040 mg/l and the HAA5 average must be ? 0.030 mg/L. Additionally, the source water total organic carbon (TOC) level may not exceed 4.0 mg/L for the previous year of monthly averages. Under these conditions the TTHM and HAA5 monitoring may be reduced to one quarterly sample collected from a maximum residence point.

(3) TTHM/HAA5 – Small Subpart H Systems (500-9,999)

(a) Routine Monitoring. Compliance monitoring samples shall be taken under normal operating conditions. Samples for TTHM and HAA5 are collected at the same time. Typically one sample will be collected each quarter from a location representing maximum residence time. If more than one sample is collected in a quarter, at least 25 % must be from the maximum point.

(b) Reduced Monitoring. The small system can qualify for reduced monitoring if the same criteria described above for large system reduced monitoring are met. In that case the small system may, with state approval collect one sample per year from the maximum residence point during the month of warmest water temperature. Compliance would be based on the average for samples collected during the year.

. (4) TTHM/HAA5 – Large Ground Water Systems (? 10,000).

Both routine and reduced monitoring requirements for these systems are the same as those described for Small Subpart H Systems. If the system monitors on a less than quarterly basis, compliance is based on the DBP average for the year.

(5) TTHM/HAA5 – Small Ground Water Systems (< 10,000).

With state approval systems in this category will routinely collect one sample per year from the maximum residence point during the month of warmest water temperature.

(6) Monitoring for Chlorite.
Community water systems and NTNCWS that disinfect with chlorine dioxide must perform monitoring for chlorite. A daily sample at the entrance to the distribution system must be tested with no allowance for reduced monitoring. In addition, monthly monitoring consists of three samples – from the entrance, a point of average residence time and a point of maximum residence time. Compliance is based on the 3-sample set average < 1.0 mg/L. If a system exceeds the MCL, the state and the public must be notified.

(7) Monitoring for Bromate.
Community water systems and NTNCWS that use ozone as a disinfectant must monitor for the presence of the DBP bromate. A system tests monthly samples from the entrance to the distribution system. Compliance with the MCL is based on an annual arithmetic average that is calculated quarterly. **Reduced monitoring Possible**?

g. BEST AVAILABLE TECHNOLOGIES (BAT).
The EPA has designated a number of treatment techniques, known as best available technologies (BAT), that are recommended to reduce and control the presence of disinfectants and resulting DBPs. The BATs that have been identified for chlorine, chloramine, and chlorine dioxide residuals and TTHM, HAA5, chlorite and bromate are described at Appendix C.

h. TREATMENT TECHNIQUE - REMOVAL OF DBP PRECURSORS.

(1) Subpart H systems using conventional filtration may be required to apply treatment to further reduce the development of DBPs through total organic carbon (TOC) removal. The additional treatment is by either enhanced coagulation or enhanced softening. To avoid this requirement one the following "alternative compliance" criteria must be met.

(a) The source water annual TOC average must be < 2.0 mg/L

(b) The treated water annual average TOC must be < 2.0 mg/L.

(c) The source water TOC < 4.0 mg/L, annual average alkalinity > 60 mg/L, annual average TTHM ? 0.040, and annual average HAA5 ? 0.030.

(d) The PWS makes a irrevocable financial commitment to implement technologies to limit the TTHM and HAA5 levels to 0.040 and 0.030, respectively.

(e) The PWS uses only chlorine for primary/residual disinfection and annual averages for TTHM ? 0.040 mg/L and for HAA5 ? 0.030 mg/L.

(f) specific ultraviolet absorbance (SUVA) ? 2.0 L/mg-m (annual average) for the source water or the treated water.

(2) Treatment using either enhanced coagulation or enhanced softening will be implemented according to a step-wise approach with allowances for system specific conditions. Step 1 is to achieve TOC removals as listed in Table 2 below. At state discretion, the following criteria may be applied to water systems that cannot achieve the TOC removal: softening that reduces treated water alkalinity to < 60 mg/L or softening that removes at least 10 mg/L of magnesium hardness (annual average).

Table 2
Required Removal of Total Organic Carbon by Enhanced Coagulation and Enhanced Softening for Subpart H Systems Using Conventional Treatment[1]

Source Water TOC (mg/L)	Source Water Alkalinity (mg/L as $CaCO_3$)		
	0-60	>60-120	>120[2]
>2.0-4.0	35.0%	25.0%	15.0%
>4.0-8.0	45.0%	35.0%	25.0%
>8.0	50.0%	40.0%	30.0%

[1]Systems meeting at least one of the alternative compliance criteria in the rule are not required to meet the removals in this table.
[2]Systems practicing softening must meet the TOC removal requirements in the last column to the right.

(3) Under Step 2, a system may apply for alternative minimum TOC removal by softening or coagulation. Systems using enhanced softening must achieve removals listed in the right column, Table 2. Systems using enhanced coagulation must determine a minimum TOC removal performance level. This is accomplished by setting coagulant dosage and pH so that 10 mg/L increments of alum result in TOC removal of 0.3 mg/L. This approach is applied until the state approves a new value based on bench scale testing.

(4) The actual and "required" percent of TOC removal are compared to determine compliance with the treatment technique requirements. If the actual TOC removal divided by the required TOC removal is < 1.00, the system does not comply with percent removal requirements.

7. EPA TECHNICAL MANUALS.

a. The EPA will publish a number of guidance manuals to support the IESWTR and the Stage 1 D/DBP Rule. The manuals will aid EPA, State agencies and affected public water systems in implementing the two interrelated rules, and will help to ensure consistency of rule implementation. EPA anticipates that the manuals will be available for review by mid-1999. The guidance manuals will be finalized throughout 1999. The EPA intends to post the completed guidance manuals at the Office of Ground Water and Drinking Water website www.epa.gov/OGWDW and link www.epa.gov/safewater. Another source to obtain information about the status of the guidance manuals is the EPA Safe Drinking Water Hotline at 1-800-426-4791. The manuals are briefly described below. More detailed explanation of each guidance manual is provided at Appendix D.

b. Disinfection Benchmarking Guidance Manual. This manual will help determine whether a disinfection profile (an evaluation of current disinfection practice) is required and how to do one; when a disinfection benchmark must be determined and how to extract it from the profile; and how a public water system must use the benchmark, in consultation with the State, to assure protection from microbial risk is maintained when the system changes disinfection practice.

c. Turbidity Guidance Manual. The first section of this manual provides technical information regarding specific requirements of the IESWTR relating to turbidity and is intended for experienced operators and others in the regulated community. The second section of the document provides background on concepts surrounding turbidity and serves as a primer for less experienced operators and individuals.

d. M/DBP Simultaneous Compliance Manual. In this manual information will be provided to assist public water systems on complying simultaneously with various drinking water regulations (e.g., Stage 1 Disinfectants and Disinfection Byproducts Rule, Interim Enhanced Surface Water Treatment Rule, Lead and Copper Rule and the Total Coliform Rule). The manual will include operational problems systems may encounter when implementing these rules.

e. Guidance Manual for Conducting Sanitary Surveys of Public Water Systems. This guidance manual will provide an overview of how to conduct a sanitary survey of all water systems using surface water and ground water under the direct influence of surface water. It is intended to help state agencies improve their sanitary survey programs where needed.

f. Unfiltered Water Supply Guidance Manual. This manual will supplement the existing Interim Surface Water Treatment Rule guidance for unfiltered surface water supplies and to identify the issues and requirements associated with the new regulations.

g. Uncovered Finished Water Reservoirs. This manual will provide detailed information on the following subjects: developing and implementing comprehensive open finished water reservoir management plans based on site-specific conditions; identifying potential sources of contamination in open finished water reservoirs and potential mitigation measures; employing different methods to control the degradation of water quality while it resides in the reservoir; monitoring schemes that can be used to characterize water quality and identify water quality degradation before it becomes severe and is difficult to correct.

h. Guidance Manual for Enhanced Coagulation and Enhanced Precipitative Softening. Information in this manual will assist utilities in implementing, monitoring, and complying with the treatment technique requirements in the final Stage 1 Disinfectants and Disinfection Byproducts Rule and guidance to State staff responsible for implementing the treatment requirements.

i. Alternative Disinfectants and Oxidants Guidance Manual.

This manual will include technical data and engineering information on disinfectants and oxidants that are not as commonly used as chlorine. Systems can evaluate their options for developing disinfection schemes to control water quality problems such as zebra mussels and Asiatic clams, and oxidation to control water quality problems associated with iron and manganese.

8. FUTURE MICROBIAL/DBP REGULATIONS. The EPA must finalize and promulgate additional rules to meet requirements of the 1996 SDWA Amendments as discussed below.

a. LONG TERM 1 ENHANCED SURFACE WATER TREATMENT RULE (ESWTR). This rule will strengthen the treatment for microbes that small water systems, serving less than 10,000 persons, must provide. It is anticipated that there will be elements similar to the IESWTR to include tighter turbidity control and individual filter monitoring that will apply to small water systems.

b. LONG TERM 2 ESWTR AND STAGE 2 DBP.
Currently the EPA plans to finalize the rules simultaneously because the requirements are so closely linked. The EPA will use monitoring data and lessons learned from implementation of the IESWTR and the Stage 1 D/DBP rule to provide additional public health protection, if required, from microbial pathogens and DBPs. An important note is that under Stage 2 DBP the MCLs for TTHMs and HAA5 are expected to be reduced even further. Levels as low as 40 and 30 mg/L respectively may be set. Water treatment processes may have to be significantly improved.

c. GROUND WATER RULE.
This rule will be implemented to protect those consumers who rely on ground water as their drinking water source. Over 109 million people in the U.S. are served by about 158,000 ground water systems. Generally, ground water is less subject to microbial contamination than surface water supplies. However, the EPA has accumulated ample evidence of contaminated ground water systems and resulting illnesses to warrant such a regulation. The Ground water rule is expected to specify minimum levels of disinfection and other health protective measures.

Table 3. Schedule of M-DBP Rules

December 1998 -- Final Rule	Interim Enhanced Surface Water Treatment Rule & Stage 1 Disinfection Byproduct Rule
August 2000 -- Final Rule	Filter Backwash Recycling Rule
November 2000 -- Final Rule	Long Term 1 Enhanced Surface Water Treatment Rule & Ground Water Rule
May 2002 -- Final Rule	Stage 2 Disinfection Byproduct Rule & Long Term 2 Enhanced Surface Water Treatment Rule

9. CONCLUSIONS.

a. The IESWTR and the Stage 1 D/DBP Rule have been promulgated by the EPA in an effort to reduce health threats from both microbial pathogens and disinfectants and byproducts formed during the disinfection process.

b. The rules are very complex. Implementing the monitoring requirements and treatment changes required will impact numerous Army water treatment facilities.

c. Army personnel responsible for managing/operating Army water systems should work closely with the primacy State authority to seek guidance and ensure compliance.

d. Additionally, it is important to seek any necessary assistance from other sources such as the USACHPPM or the USAEC.

e. Future rules will be more restrictive, e.g., DBP criteria will be more stringent as MCLs may be reduced by half. **reference in text?**

10. ACTIONS FOR ARMY WATER SUPPLIERS TO TAKE.

This information paper describes numerous requirements that will be imposed on PWSs throughout the United States. Army water suppliers (both CONUS and **OCONUS**?) that operate a PWS will be subject to some requirements of the IESWTR and based on system size, the appropriate requirements of the D/DBP Rule. Some steps for compliance, such as simultaneous monitoring for TTHM and HAA5 under the IESWTR should be currently underway. Planning in order to meet future requirements is advised. Army water suppliers should include the programming of resources to meet compliance requirements as part of the planning process. The following section provides steps that Army water systems should be implementing, according to each rule.

a. PREPARING FOR THE IESWTR

(1) Simultaneous Monitoring for TTHMs and HAA5. Army water systems using surface water sources and serving ? 10,000 people which must perform the monitoring to determine whether a disinfection profile is required should have received notification from their primacy State. This requirement is expected to apply to Army systems that have previously performed TTHM monitoring.

(a) Systems should collect the required DBP samples at the typical locations within the distribution system used for TTHM monitoring, i.e., a minimum of four samples from the system and one of the locations representing maximum residence time.

(b) Coordinate with your State certified drinking water laboratory to analyze for HAA5 in addition to TTHMs.

(c) The monitoring and reporting of TTHM and HAA5 results must begin by the end of Jun 1999. Continue monitoring/reporting of quarterly samples at approximately equal intervals of 90 days, until four quarters of analyses are completed prior to the end of March 2000. This guidance was issued previously by the USAEC (reference 10).

(d) After 1 year of DBP monitoring has been completed, determine whether the annual average for either the TTHM or HAA5 has exceeded the 80 percent MCL mark, 0.064 mg/L and 0.048 mg/L respectively. A disinfection profile will be required for systems meeting/exceeding those levels. Contact your primacy State to assist in this process.

(e) Pursue disinfection profiling before starting TTHM/HAA5 quarterly monitoring if desired. Notify the state authority by 16 Dec 99 if choosing that course.

(2) Filtered Water Turbidity Monitoring.

(a) Ensure the ability to monitor water turbidity from each filter on a continuous basis.

(b) Examine current combined filtered water turbidity data to determine the ability to comply with the more stringent turbidity requirement (0.3 NTU 95 % of the time, with a maximum of 1.0 NTU). Pursue corrective measures if necessary.

b. PREPARING FOR THE D/DBP RULE.

(1) Small Army water systems (serving < 10,000 people) should begin to develop TTHM/HAA5 data in accordance with the approach for the IESWTR as described above, for larger systems.

(2) All systems should evaluate routine residual monitoring to determine the ability to comply with the disinfectant residual requirements. Pursue corrective measures if necessary.

c. COORDINATION WITH PRIMACY STATE AUTHORITY. Contact the State regulatory authority for any questions concerning the applicability of the IESWTR or the Stage 1 D/DBP Rule.

d. EPA GUIDANCE MANUALS. To assist in pursuing compliance, obtain relevant EPA guidance manuals, described in paragraph 7.

e. TECHNICAL ASSISTANCE. Pursue assistance, if necessary, from sources such as the USACHPPM, Water Supply Management Program at DSN 584-3919/commercial 410-436-3919 or from the USAEC, Environmental Compliance Division at DSN 584-7068/commercial 410-436-7068.

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APPENDIX A

REFERENCES

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3. USACHPPM Technical Guide 179, Guidance for Providing Safe Drinking Water at Army Installations, November 1995.

2. Public Law 104-182, 6 Aug 1996, The Safe Drinking Water Act Amendments of 1996.

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7. LeChevalier, M.W., et.al., Occurrence of Giardia and Cryptosporidium spp. in Surface Water Supplies, Applied and Environmental Microbiology, Vol 57, 9:2610, 1991.

8. Final Rule, NPDWR: Surface Water Treatment Rule, 54 Federal Register 27486, 29 Jun 1989.

9. Final Rule, NPDWR: Total Coliform Rule, 54 Federal Register 27544, 29 Jun 1989.

10. Interim Rule, National Interim Primary Drinking Water Regulations, 44 Federal Register 68624, ? November 1979.

11. Final Rule, NPDWR: Information Collection Rule, 61 Federal Register 24354, 14 May 1996.

12. Interim Enhanced Surface Water Treatment Rule, EPA (Fact Sheet) 815-F-98-009, Office of Ground Water and Drinking Water, December 1998.

13. Stage 1 Disinfectants and Disinfection Byproducts Rule, EPA (Fact Sheet) 815-F-98-010, Office of Ground Water and Drinking Water, December 1998.

14. Memorandum, SFIM-AEC-EQC, subject: 1999 Drinking Water Monitoring Requirements – Interim Enhanced Surface Water Treatment Rule, 26 April 1999

15. Pontius, Frederick W., Complying With the Stage 1 D/DBP Rule, Journal AWWA, Vol. 91, March 1999.

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APPENDIX B

DEFINITIONS

Best available technology (BAT) Refer to Appendix C.

Community water system

Enhanced coagulation – the addition of enough coagulant to improve removal of disinfection by-product precursors by conventional filtration.

Enhanced softening – the improved removal of DBP precursors by precipatative softening.

Granular Activated Carbon 10 (GAC10) – granular activated carbon filter beds with an empty bed contact time of 10 minutes based on average daily flow and a carbon reactivation frequency of every 180 days.

Gound water under direct influence (GWUDI)

Haloacetic acids – sum of the concentration in mg/L of the five haloacetic acid compounds (monochloroacetic acid, dichloroacetic acid, trichloroacetic acid, monobromoacetic acid, and dibromoacetic acid).

Maximum contaminant level

Maximum contaminant level goal

Maximum residual disinfectant level – the concentration of disinfectant added for water treatment that may not be exceeded at the consumer's tap, without an unacceptable possibility of adverse health effects.

Maximum residual disinfectant level goal – the maximum concentration of a disinfectant added for water treatment at which no known or anticipated adverse effect on human health would occur, with an adequate margin of safety. MRDLGs are non-enforceable health goals and do not reflect the benefit of the addition of a chemical disinfectant for control of waterborne microbial contaminants.

Nephalometric turbidity unit

Nontransient, noncommunity water system (NTNCWS)

Subpart H systems – public water systems that use surface water or ground water under the direct influence of surface water as a source and that are subject to the requirements of 40 CFR 141, Subpart H (Surface Water Treatment Rule).

Specific ultraviolet absorbance (SUVA) – specific ultraviolet light absorbance at 254 nm, an indicator of the humic content of the water.

Total organic carbon – measured using heat, oxygen, ultraviolet radiation chemical oxidants, or combinations of these oxidants that convert organic carbon to carbon dioxide.

APPENDIX C

BEST AVAILABLE TECHNOLOGIES

The following methods have been identified by the EPA as the best options to reduce health effects that may be caused by exposure to disinfectant or disinfection by-products.

DISINFECTANTS

Chlorine residual – control of treatment processes to reduce disinfectant demand and control of disinfection processes to reduce disinfectant concentrations.

Chloramine residual – control of treatment processes to reduce disinfectant demand and control of disinfection processes to reduce disinfectant concentrations.

Chlorine dioxide residual – control of treatment processes to reduce disinfectant demand and control of disinfection processes to reduce disinfectant concentrations.

DISINFECTION BY-PRODUCTS

Total trihalomethanes – enhanced coagulation or enhanced softening or GAC10 with chlorine as the primary and residual disinfectant.

Total Haloacetic acids – enhanced coagulation or enhanced softening or GAC10 with chlorine as the primary and residual disinfectant.

Chlorite – control of treatment processes to reduce disinfectant demand and control of disinfection processes to reduce disinfectant concentrations.

Bromate – control of the ozone treatment process to reduce the production of bromate.