2. TURBIDITY REQUIREMENTS: IESWTR

2.1 Introduction

Under the 1996 Safe Drinking Water Act (SDWA) Amendments, EPA must supplement the existing 1989 Surface Water Treatment Rule (SWTR) with the Interim Enhanced Surface Water Treatment Rule (IESWTR) to improve protection against waterborne pathogens. Key provisions established in the IESWTR include (USEPA, 1998):

- A maximum contaminant level goal (MCLG) of zero for *Cryptosporidium*; 2-log (99 percent) *Cryptosporidium* removal requirements for systems that filter;
- Strengthened combined filter effluent turbidity performance standards;
- Individual filter turbidity monitoring provisions;
- Disinfection benchmark provisions to assure continued levels of microbial protection while facilities take the necessary steps to comply with new disinfection byproduct standards;
- Inclusion of *Cryptosporidium* in the definition of ground water under the direct influence of surface water (GWUDI) and in the watershed control requirements for unfiltered public water systems;
- Requirements for covers on new finished water reservoirs; and
- Sanitary surveys for all surface water systems regardless of size.

Figure 2-1 presents the general IESWTR requirements.

The following chapter outlines the regulatory requirements, reporting and recordkeeping requirements, and additional compliance aspects of the IESWTR related to turbidity.

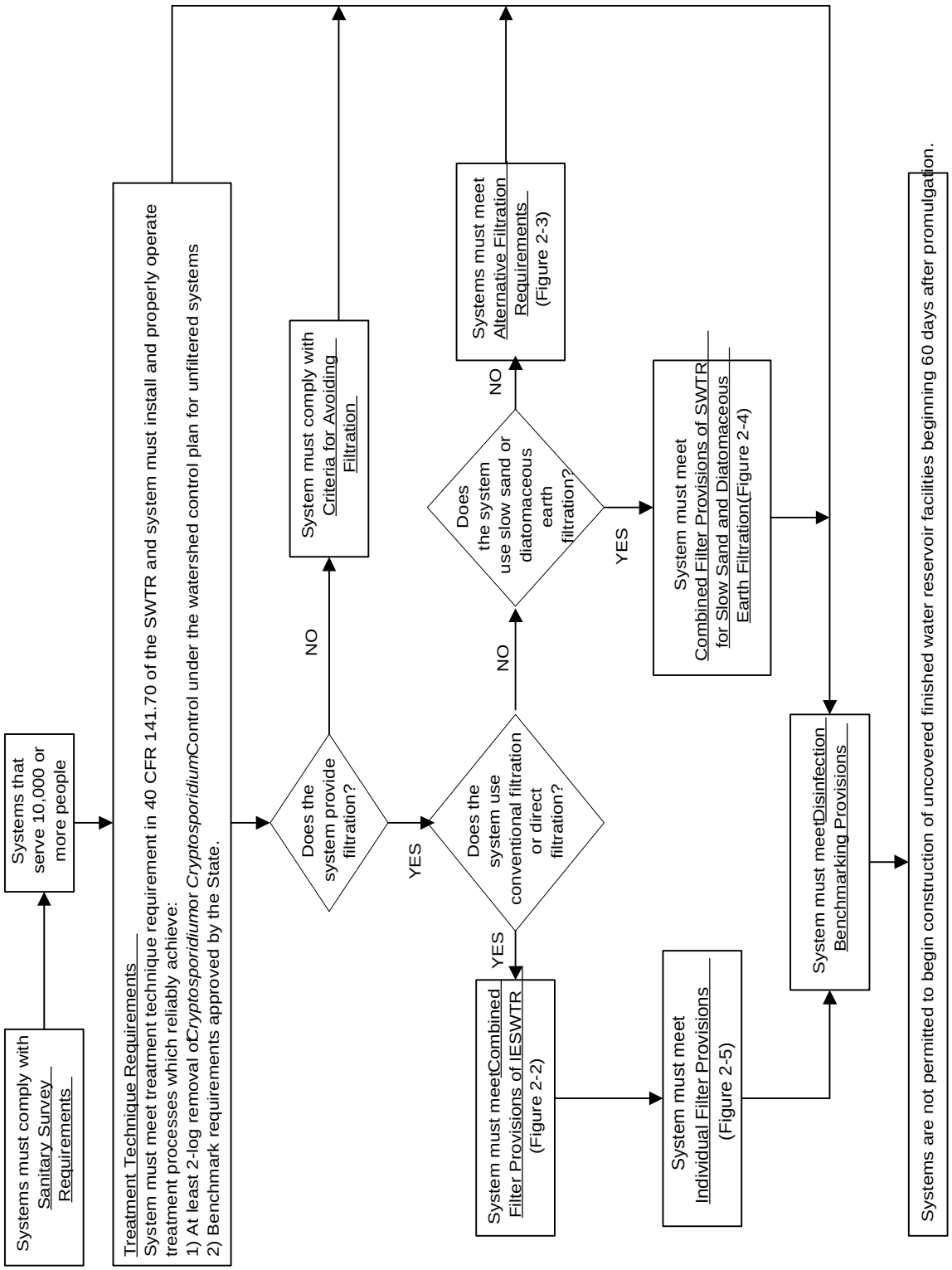

Figure 2-1. Flowchart of IESWTR General Requirements

2.2 Regulatory Requirements

As described above, the Interim Enhanced Surface Water Treatment Rule contains several key provisions including strengthened combined filter effluent turbidity performance standards and individual filter turbidity monitoring.

2.2.1 Applicability

Entities potentially regulated by the IESWTR are public water systems that use surface water or ground water under the direct influence of surface water and serve at least 10,000 people (including Industries, State, Local, Tribal, or Federal governments). To determine whether your facility may be regulated by this action, you should carefully examine the applicability criteria in subpart H (systems subject to the Surface Water Treatment Rule) and subpart P (subpart H systems that serve 10,000 or more people) of the final rule.

Systems subject to the turbidity provisions of the IESWTR are a subset of systems subject to the IESWTR, which utilize rapid granular filtration (i.e., conventional filtration treatment and direct filtration) or other filtration processes (excluding slow sand and diatomaceous earth filtration).

2.2.2 Combined Filter Effluent Monitoring

Under the SWTR, a subpart H system which provides filtration treatment must monitor turbidity in the combined filter effluent. Turbidity measurements must be performed on representative samples of the system's filtered water every four hours (or more frequently) that the system serves water to the public. A public water system may substitute continuous turbidity monitoring for grab sample monitoring if it validates the continuous measurement for accuracy on a regular basis using a protocol approved by the State.

The turbidity performance requirements of the IESWTR require that all surface water systems which use conventional treatment or direct filtration and serve a population $\geq$10,000 people must meet two distinct combined filter effluent limits: a maximum limit and a 95% limit. These limits, set forth in the IESWTR, are outlined below for the different types of treatment employed by systems.

Conventional Treatment or Direct Filtration

For conventional and direct filtration systems (including those systems utilizing in-line filtration), the turbidity level of representative samples of a system's filtered water (measured every four hours) must be less than or equal to ***0.3 NTU*** in at least 95 percent of the measurements taken each month. The turbidity level of representative samples of a system's filtered water must not exceed ***1 NTU*** at any time.

Conventional filtration is defined as a series of processes including coagulation, flocculation, sedimentation, and filtration resulting in substantial particulate removal.

Direct filtration is defined as a series of processes including coagulation and filtration but excluding sedimentation resulting in substantial particle removal. Figure 2-2 presents a flowchart of the combined filter provisions for conventional and direct filtration systems.

Other Treatment Technologies (Alternative Filtration)

For other filtration technologies (those technologies other than conventional, direct, slow sand or diatomaceous earth filtration), a system may demonstrate to the State, using pilot plant studies or other means, that the alternative filtration technology, in combination with disinfection treatment, consistently achieves 99.9 percent removal and/or inactivation of *Giardia lamblia* cysts and 99.99 percent removal and/or inactivation of viruses, and 99 percent removal of *Cryptosporidium* oocysts. For a system that makes this demonstration, then representative samples of a system's filtered water must be less than or equal to ***a value determined by the State which the State determines is indicative of 2-log* Cryptosporidium *removal, 3-log* Giardia *removal, and 4-log virus removal*** in at least 95 percent of the measurements taken each month and the turbidity level of representative samples of a system's filtered water must at no time exceed ***a maximum turbidity value determined by the State***. Figure 2-3 presents a flow chart of combined filter provisions for alternative filtration technologies. Examples of such technologies include bag or cartridge filtration, microfiltration, and reverse osmosis. EPA recommends a protocol similar to the "Protocol For Equipment Verification Testing for Physical Removal of Microbiological and Particulate Contaminants," prepared by NSF International with support from EPA. Information regarding this protocol may be found at NSF's website at: http://www.nsf.org/verification/verification.html.

Slow Sand & Diatomaceous Earth Filtration

The IESWTR does not contain new turbidity provisions for slow sand or diatomaceous earth (DE) filtration systems. Utilities utilizing either of these filtration processes must continue to meet the requirements for their respective treatment as set forth in the SWTR (1 NTU 95%, 5 NTU max). Figure 2-4 presents a flowchart of combined filter provisions for slow sand and diatomaceous earth filtration.

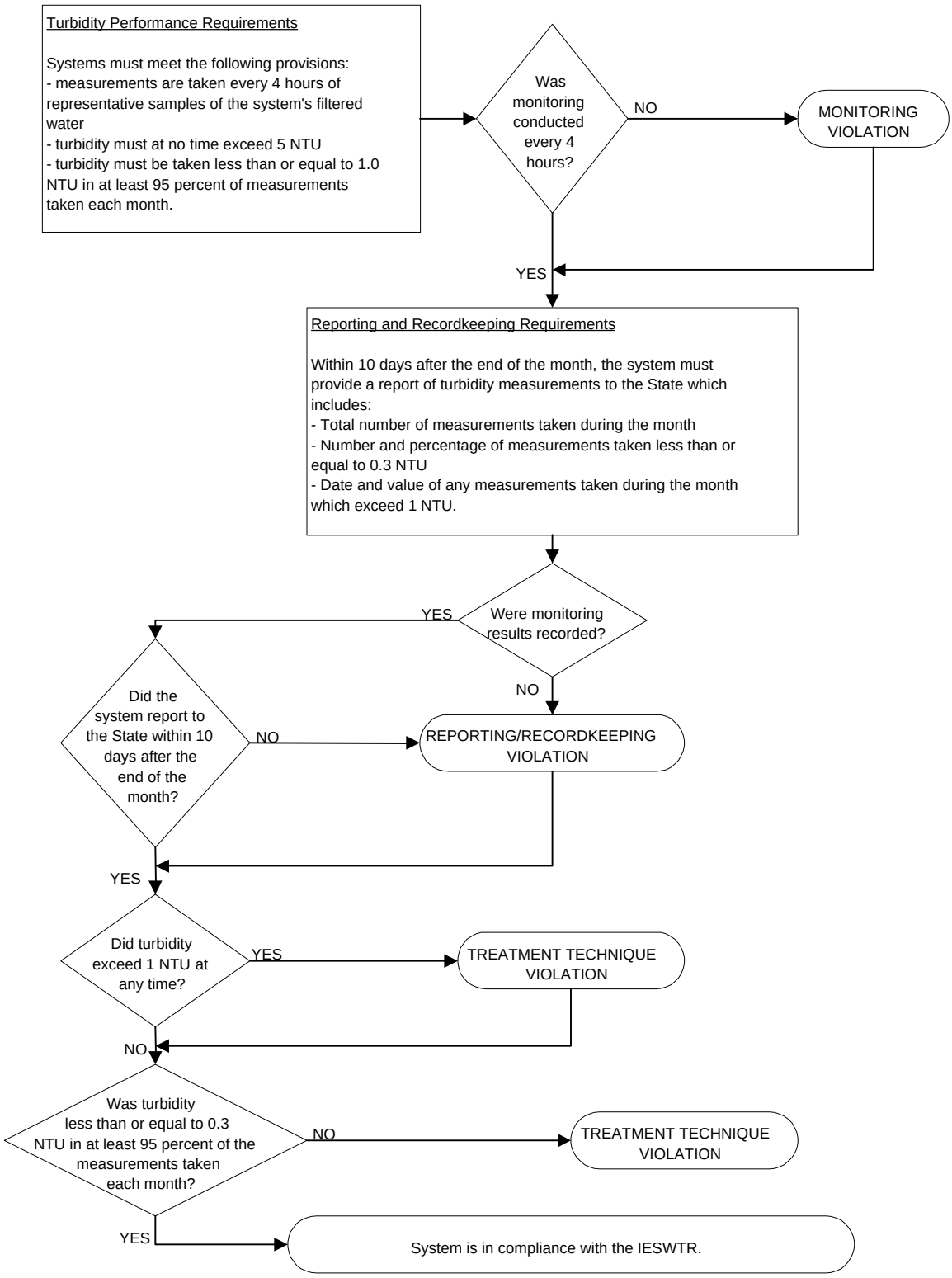

Figure 2-2. Flowchart of IESWTR Combined Filter Provisions for Conventional and Direct Filtration Systems

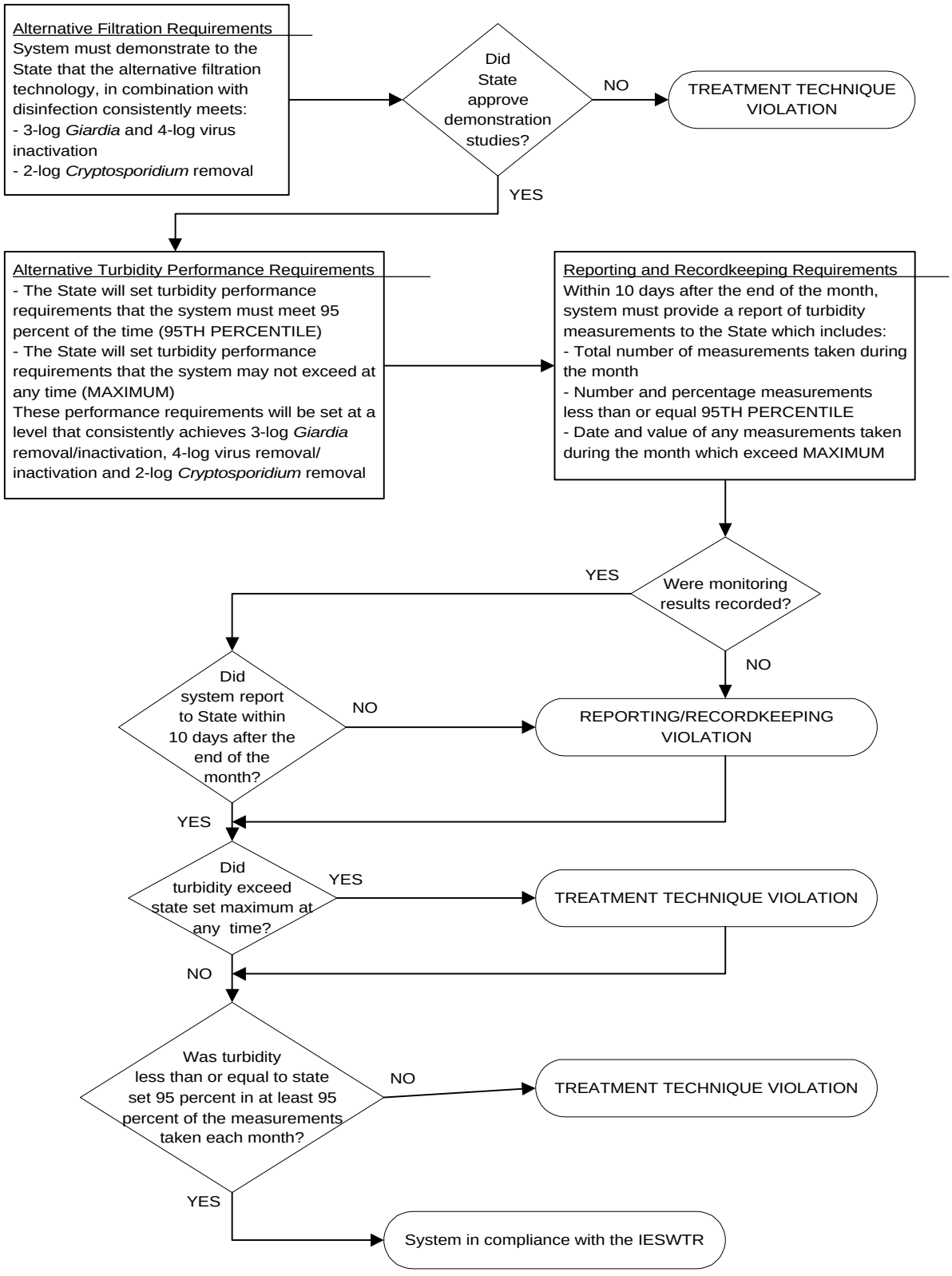

Figure 2-3. Flowchart of IESWTR Combined Filter Provisions for Alternative Filtration Technologies

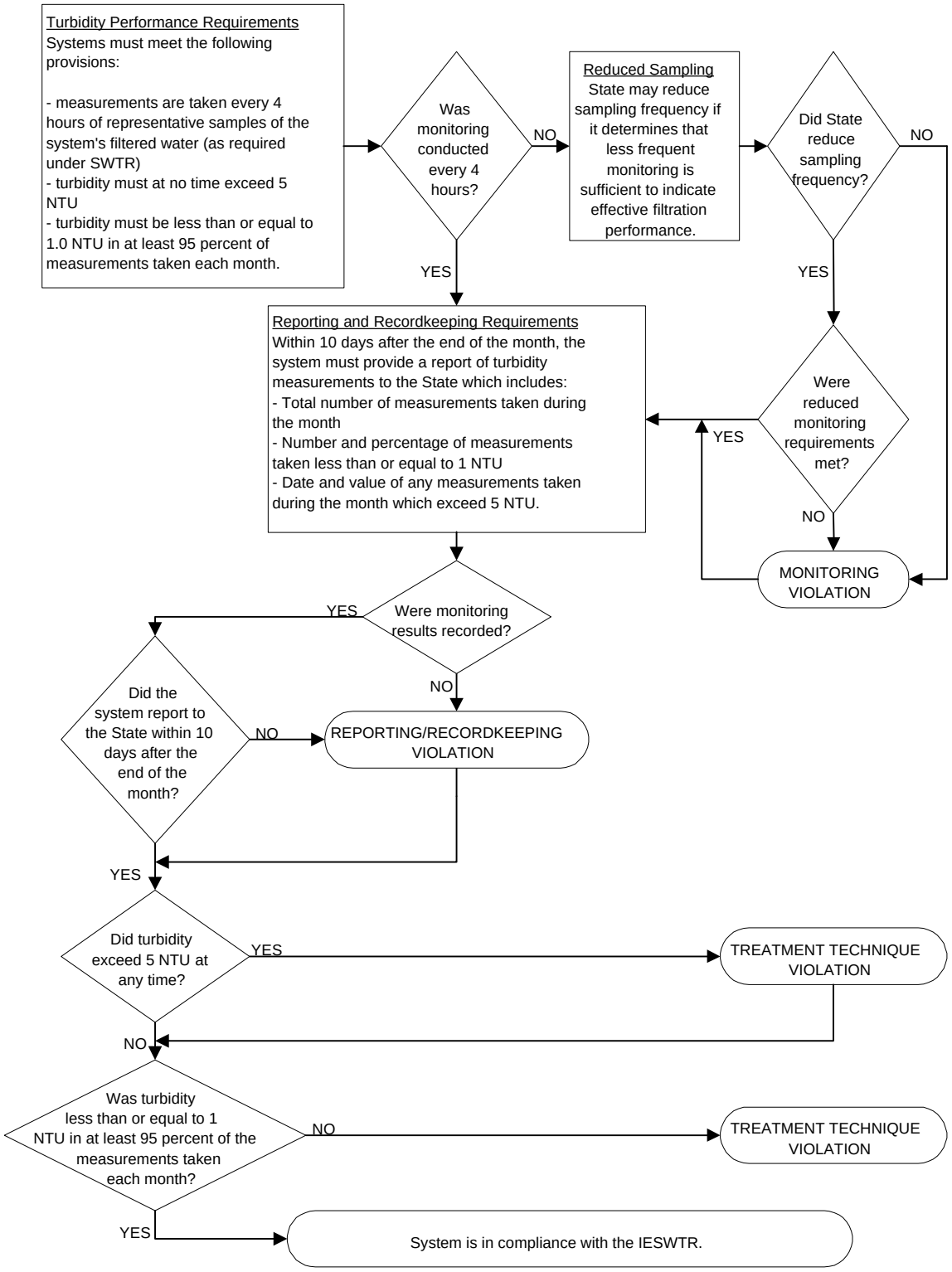

Figure 2-4. Flowchart of SWTR Combined Filter Provisions for Slow Sand and Diatomaceous Earth Filtration

Systems which Utilize Lime Softening

Systems which practice lime softening may experience difficulty in meeting the turbidity performance requirements due to residual lime floc carryover inherent in the process. EPA is allowing such systems to acidify turbidity samples prior to measurement using a protocol approved by States. The chemistry supporting this decision is well documented in environmental chemistry texts.

EPA recommends that acidification protocols lower the pH of samples to <8.3 to ensure an adequate reduction in carbonate ions and corresponding increase in bicarbonate ions. Acid should consist of either hydrochloric acid or sulfuric acid of Standard Lab Grade. Care should be taken when adding acid to samples. Operators should always follow the sampling guidelines outlined in Section 3.4.4 of this document.

If systems choose to use acidification, EPA recommends systems maintain documentation regarding the turbidity with and without acidification as well as pH values and quantity of acid added to the sample.

2.2.3 Individual Filter Monitoring

In addition to the combined filter effluent monitoring discussed above, those systems that use ***conventional treatment or direct filtration*** (including in-line filtration) must conduct continuous monitoring of turbidity for each individual filter using an approved method in §141.74(a) and must calibrate turbidimeters using the procedure specified by the manufacturer. Systems must record the results of individual filter monitoring every 15 minutes. If the individual filter is not providing water which contributes to the combined filter effluent, (i.e., it is not operating, is filtering to waste, or recycled) the system does not need to record or monitor the turbidity for that specific filter.

Systems which utilize filtration other than conventional or direct filtration are not required to conduct individual filter monitoring although EPA recommends such systems consider individual filter monitoring.

If there is a failure in continuous turbidity monitoring equipment, the system must conduct grab sampling every four hours in lieu of continuous monitoring, but must return to 15 minute monitoring no more than five working days following the failure of the equipment.

2.3 Reporting and Recordkeeping

There are distinct reporting and recordkeeping requirements for the turbidity provisions of the IESWTR for both systems and States.

2.3.1 System Reporting Requirements

Under the IESWTR, systems are tasked with specific reporting requirements associated with combined filter effluent monitoring and individual filter effluent monitoring.

Combined Filter Effluent Reporting

Turbidity measurements as required by §141.173 must be reported within 10 days after the end of each month the system serves water to the public. Information that must be reported includes:

1. The total number of filtered water turbidity measurements taken during the month.

2. The number and percentage of filtered water turbidity measurements taken during the month which are less than or equal to the turbidity limits specified in §141.173. (0.3 NTU for conventional and direct and the turbidity limit established by the State for other filtration technologies)

3. The date and value of any turbidity measurements taken during the month which exceed 1 NTU for systems using conventional filtration treatment or direct filtration and the maximum limit established by the State for other filtration technologies.

This reporting requirement is similar to the reporting requirement currently found under the SWTR.

Individual Filter Requirements

Systems utilizing conventional and direct filtration must report that they have conducted individual filter monitoring in accordance with the requirements of the IESWTR within 10 days after the end of each month the system serves water to the public. Figure 2-5 presents a flowchart of individual filter requirements.

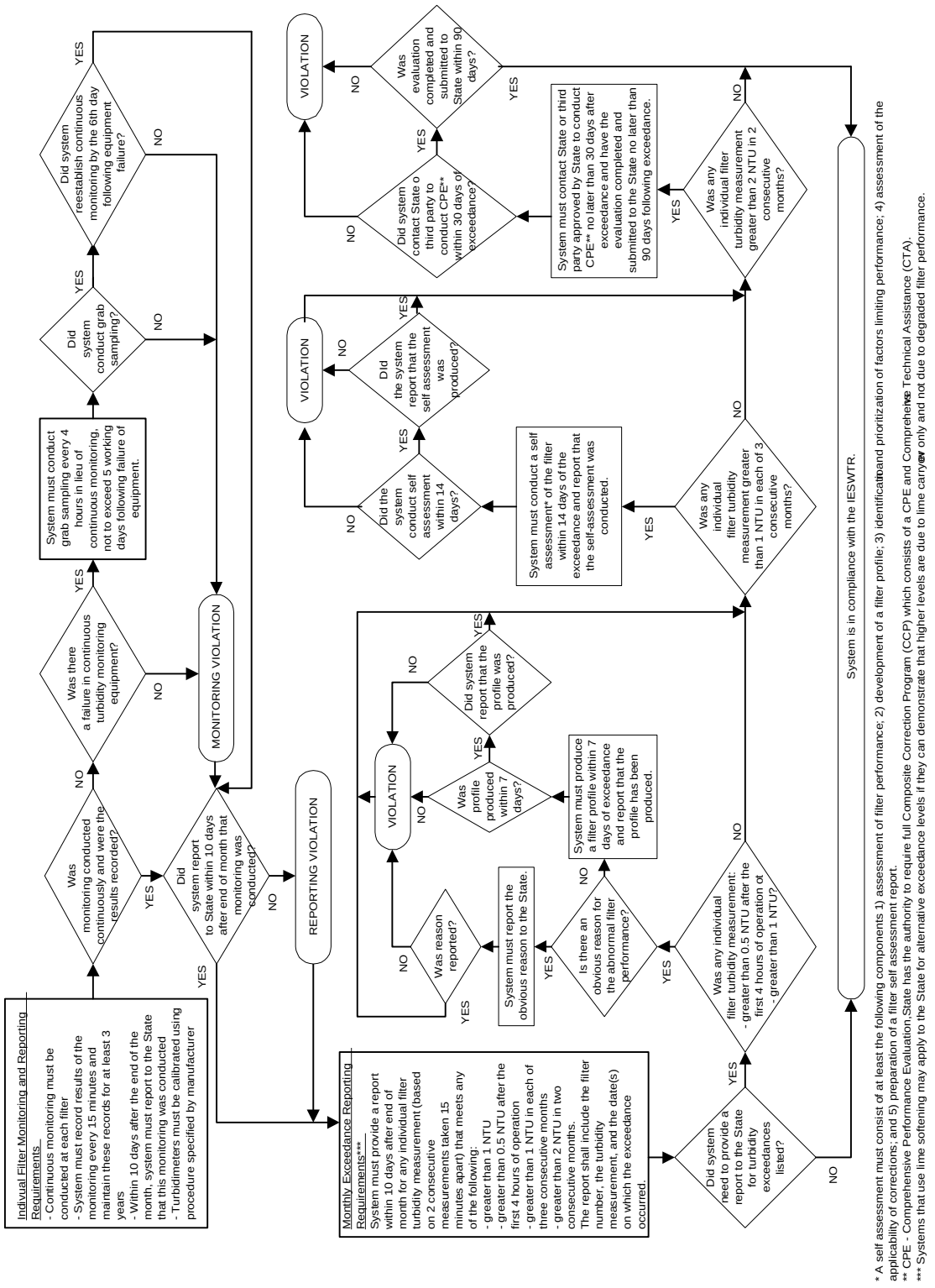

Figure 2-5. Flowchart of IESWTR Individual Filter Provisions

Additionally, systems must report individual filter turbidity measurements within 10 days after the end of each month the system serves water to the public ***only if*** measurements demonstrate one of the following:

- Any individual filter has a measured turbidity level greater than 1.0 NTU in two consecutive measurements taken 15 minutes apart. The system must report the filter number, the turbidity measurement, and the date(s) on which the exceedance occurred. In addition, the system must either produce a filter profile for the filter within 7 days of the exceedance (if the system is not able to identify an obvious reason for the abnormal filter performance) and report that the profile has been produced or report the obvious reason for the exceedance.

- Any individual filter has a measured turbidity level of greater than 0.5 NTU in two consecutive measurements taken 15 minutes apart at the end of the first four hours of continuous filter operation after the filter has been backwashed or otherwise taken offline. The system must report the filter number, the turbidity, and the date(s) on which the exceedance occurred. In addition, the system must either produce a filter profile for the filter within 7 days of the exceedance (if the system is not able to identify an obvious reason for the abnormal filter performance) and report that the profile has been produced or report the obvious reason for the exceedance.

- Any individual filter has a measured turbidity level of greater than 1.0 NTU in two consecutive measurements taken 15 minutes apart at any time in each of three consecutive months. The system must report the filter number, the turbidity measurement, and the date(s) on which the exceedance occurred. In addition, the system shall conduct a self-assessment of the filter.

- Any individual filter has a measured turbidity level of greater than 2.0 NTU in two consecutive measurements taken 15 minutes apart at any time in each of two consecutive months. The system must report the filter number, the turbidity measurement, and the date(s) on which the exceedance occurred. In addition, the system shall contact the State or a third party approved by the State to conduct a comprehensive performance evaluation.

2.3.2 State Reporting Requirements

Under §142.15, each State which has primary enforcement responsibility is required to submit quarterly reports to the Administrator of the EPA on a schedule and in a format prescribed by the Administrator, which includes:

1. New violations by public water systems in the State during the previous quarter with respect to State regulations adopted to incorporate the requirements of national primary drinking water regulations.

2. New enforcement actions taken by the State during the previous quarter against public water systems with respect to State regulations adopted to incorporate the requirements of national primary drinking water standards.

Any violations or enforcement actions with respect to turbidity, would be included in the quarterly report noted above. EPA has developed a State Implementation guidance manual which includes additional information on State reporting requirements.

2.3.3 System Recordkeeping Requirements

Systems must maintain the results of individual filter monitoring taken under §141.174 for at least three years. These records must be readily available for State representatives to review during Sanitary Surveys or other visits.

2.3.4 State Recordkeeping Requirements

Records of turbidity measurements must be kept for not less than one-year. The information retained must be set forth in a form which makes possible comparison with limits specified in §§141.71, 141.73, 141.173, and 141.175.

Records of decisions made on a system-by-system and case-by-case basis under provisions of part 141, subpart H or subpart P, must be made in writing and kept by the State (this includes records regarding alternative filtration determinations). EPA has developed a State Implementation guidance manual which includes additional information on State recordkeeping requirements.

2.4 Additional Compliance Issues

The following section outlines additional compliance issues associated with the IESWTR. These include Schedule, Individual Filter Follow-up Action, Notification, and Variances and Exemptions.

2.4.1 Schedule

The IESWTR was published on December 16, 1998, and became effective on February 16, 1999.

The SDWA requires, within 24 months following the promulgation of a rule, that the Primacy Agencies adopt any State regulations necessary to implement the rule. Under Sec. 1413, these rules must be at least as stringent as those required by EPA. Thus, primacy agencies must promulgate regulations which are at least as stringent as the IESWTR by December 17, 2000.

Beginning December 17, 2001, systems serving at least 10,000 people must meet the turbidity requirements in §141.173.

2.4.2 Individual Filter Follow-up Action

Based on the monitoring results obtained through continuous filter monitoring discussed in Section 2.3 of this chapter, a system may have to conduct one of the following follow-up actions due to persistently high turbidity levels at an individual filter:

- Filter profile
- Individual filter self assessment
- Comprehensive Performance Evaluation.

These specific requirements are found in §141.175(b) (1)-(4).

Abnormal Filter Operations- Filter Profile

A filter profile must be produced if no obvious reason for abnormal filter performance can be identified. A filter profile is a graphical representation of individual filter performance based on continuous turbidity measurements or total particle counts versus time for an entire filter run, from startup to backwash inclusively that includes assessment of filter performance while another filter is being backwashed. The run length during this assessment should be representative of typical plant filter runs. The profile should include an explanation of the cause of any filter performance spikes during the run. An example filter profile is included in Figure 2-6.

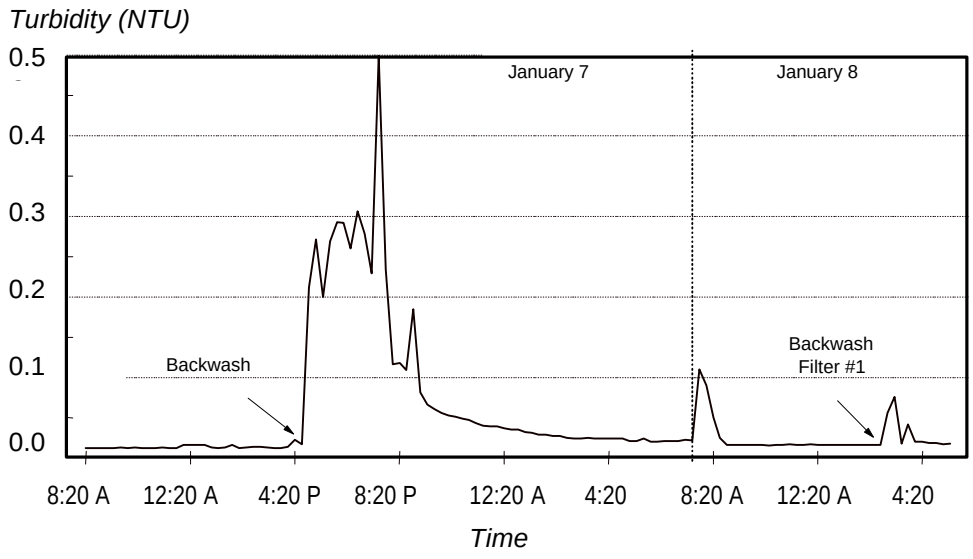

Figure 2-6. Example Filter Profile

Additional information regarding filter profiles is found in Chapter 5, Individual Filter Self Assessment. Examples of possible abnormal filter operations which may be obvious to operators include the following:

- Outages or maintenance activities at processes within the treatment train
- Coagulant feed pump or equipment failure
- Filters being run at significantly higher loading rates than approved

It is important to note that while the reasons for abnormal filter operation may appear obvious they could be masking other reasons which are more difficult to identify. These may include situations such as:

- Disruption in filter media
- Excessive or insufficient coagulant dosage
- Hydraulic surges due to pump changes or other filters being brought on/offline.

Systems need to use best professional judgement and discretion when determining when to develop a filter profile. Attention at this stage will help systems avoid the other forms of follow-up action described below.

Individual Filter Self-Assessment

A system must conduct an individual filter self-assessment for any individual filter that has a measured turbidity level of greater than 1.0 NTU in two consecutive measurements taken 15 minutes apart in each of three consecutive months. The system must report the filter number, the turbidity measurement, and the dates on which the exceedances occurred. Chapter 5 discusses how to conduct an individual filter assessment or self-assessment.

Comprehensive Performance Evaluation

A system must conduct a comprehensive performance evaluation (CPE) if any individual filter has a measured turbidity level of greater than 2.0 NTU in two consecutive measurements taken 15 minutes apart in two consecutive months. The system must report the filter number, the turbidity measurement, and the date(s) on which the exceedance occurred. The system shall contact the State or a third party approved by the State to conduct a comprehensive performance evaluation.

Chapter 6 briefly discusses how to conduct a Comprehensive Performance Evaluation. Additionally, EPA has developed a guidance document called, *Handbook: Optimizing Water Treatment Plant Performance Using the Composite Correction Program* (EPA/625/6-91/027, Revised August 1998).

2.4.3 Notification

The IESWTR contains two distinct types of notification: State and public. It is important to understand the differences between each and the requirements of each.

State Notification

Systems are required to notify States under §141.31. Systems must report to the State within 48 hours, the failure to comply with any national primary drinking water regulation. The system within 10 days of completion of each public notification required pursuant to §141.32, must submit to the State a representative copy of each type of notice distributed, published, posted, and/or made available to persons served by the system and/or the media.

The water supply system must also submit to the State (within the time stated in the request made by the State) copies of any records required to be maintained under §141.33 or copies of any documents then in existence which the State or the Administrator is entitled to inspect pursuant to the authority of section 1445 of the Safe Drinking Water Act or the equivalent provisions of the State Law.

Public Notification

The IESWTR specifies that the public notification requirements of the Safe Drinking Water Act (SDWA) and the implementation regulations of 40 CFR §141.32 must be followed. These regulations divide public notification requirements into two tiers. These tiers are defined as follows:

- ***TIER 1***
  - Failure to comply with MCL
  - Failure to comply with prescribed treatment technique
  - Failure to comply with a variance or exemption schedule
- ***TIER 2***
  - Failure to comply with monitoring requirements
  - Failure to comply with a testing procedure prescribed by a NPDWR
  - Operating under a variance/exemption. This is not considered a violation but public notification is required.

The IESWTR classifies violations of §§141.70, 141.71(c), 141.72 and 141.73, and 141.173 (i.e., treatment technique requirements as specified in §141.76) as Tier 1 violations and violations of §§141.74, and 141.174 as Tier 2 violations. Violations of §§141.75 and 141.175 (reporting requirements) do not require public notification.

There are certain general requirements which all public notices must meet. All notices must provide a clear and readily understandable explanation of the violation, any potential adverse health effects, the population at risk, the steps the system is taking to correct the violation, the necessity of seeking alternate water supplies (if any) and any preventative measures the consumer should take. The notice must be conspicuous, and not contain any unduly technical language, unduly small print, or similar problems. The notice must include the telephone number of the owner or operator or designee of the public water system as a source of additional information concerning the violation where appropriate. The notice must be bi- or multilingual if appropriate.

Tier 1 Violations

In addition, the public notification rule requires that when providing notification on potential adverse health effects in Tier 1 public notices and in notices on the granting and continued existence of a variance or exemption, the owner or operator of a public water system must include certain mandatory health effects language. For violations of treatment technique requirements for filtration and disinfection, the mandatory health effects language is:

> **The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that the presence of microbiological contaminants are a health concern at certain levels of exposure. If water is inadequately treated, microbiological contaminants in that water may cause disease. Disease symptoms may include diarrhea, cramps, nausea, and possibly jaundice, and any associated headaches and fatigue. These symptoms, however, are not just associated with disease-causing organisms in drinking water, but also may be caused by a number of factors other than your drinking water. EPA has set enforceable requirements for treating drinking water to reduce the risk of these adverse health effects. Treatment such as filtering and disinfecting the water removes or destroys microbiological contaminants. Drinking water which is treated to meet EPA requirements is associated with little to none of this risk and should be considered safe.**

Further the owner or operator of a community water system must give a copy of the most recent notice for any Tier 1 violations to all new billing units or hookups prior to or at the time service begins.

The medium for performing public notification and the time period in which notification must be sent varies with the type of violation and is specified in §141.32. For Tier 1 violations, the owner or operator of a public water system must give notice:

1. By publication in a local daily newspaper as soon as possible but in no case later than 14 days after the violation or failure. If the area does not have a daily newspaper, then notice shall be given by publication in a weekly newspaper of general circulation in the area, and

2. By either direct mail delivery or hand delivery of the notice, either by itself or with the water bill no later than 45 days after the violation or failure. The Primacy Agency may waive the requirement if it determines that the owner or operator has corrected the violation within 45 days.

Although the IESWTR does not specify any acute violations, the Primacy Agency may specify some Tier 1 violations as posing an acute risk to human health; examples might include:

- A waterborne outbreak in an unfiltered supply
- Turbidity of a filtered water exceeds 1.0 NTU at any time
- Failure to maintain a disinfectant residual of at least 0.2 mg/L in the water being delivered to the distribution system.

For these violations or any others defined by the Primacy Agency as 'acute' violations, the system must furnish a copy of the notice to the radio and television stations serving the area as soon as possible but in no case later than 72 hours after the violation. Depending on the circumstances particular to the system, as determined by the Primacy Agency, the notice may instruct that all water be boiled prior to consumption.

Following the initial notice, the owner or operator must give notice at least once every three months by mail delivery (either by itself or with the water bill), or by hand delivery, for as long as the violation or failures exist.

There are two variations on these requirements. First, the owner or operator of a community water system in an area not served by a daily or weekly newspaper must give notice within 14 days after the violation by hand delivery or continuous posting of a notice of the violation. The notice must continue for as long as the violation exists. Notice by hand delivery must be repeated at least every three months for the duration of the violation.

Secondly, the owner or operator of a noncommunity water system (i.e., one serving a transitory population) may give notice by hand delivery or continuous posting of the notice in conspicuous places in the area served by the system. Notice must be given within 14 days after the violation. If notice is given by posting, then it must continue as long as the violation exists. Notice given by hand delivery must be repeated at least every three months for as long as the violation exists.

Tier 2 Violations

For Tier 2 violations (i.e., violations of 40 CFR §§141.74 and 141.174) notice must be given within three months after the violation by publication in a daily newspaper of general

circulation, or if there is no daily newspaper, then in a weekly newspaper. In addition, the owner or operator shall give notice by mail (either by itself or with the water bill) or by hand delivery at least once every three months for as long as the violation exists. Notice of a variance or exemption must be given every three months from the date it is granted for as long as it remains in effect.

If the area is not served by a daily or weekly newspaper, the owner or operator of a community water system must give notice by continuous posting in conspicuous places in the area served by the system. This must continue as long as the violation exists or the variance or exemption remains in effect. Notice by hand delivery must be repeated at least every three months for the duration of the violation or the variance or exemption.

For noncommunity water systems, the owner or operator may give notice by hand delivery or continuous posting in conspicuous places; beginning within three months of the violation or the variance or exemption. Posting must continue for the duration of the violation or variance or exemption, and notice by hand delivery must be repeated at least every three months during this period.

The Primacy Agency may allow for owner or operator to provide less frequent notice for minor monitoring violations (as defined, by the Primacy Agency if EPA has approved the Primacy Agency's substitute requirements contained in a program revision application).

2.4.4 Variances and Exemptions

As with the SWTR, no variances from the requirements in §141 are permitted for subpart H systems.

Under Section 1416(a), EPA or a State may exempt a public water system from any requirements related to an MCL or treatment technique of an NPDWR if it finds that (1) due to compelling factors (which may include economic factors such as qualification of the PWS as serving a disadvantaged community), the PWS is unable to comply with the requirement or implement measures to develop an alternative source of water supply; (2) the exemption will not result in an unreasonable risk to health; and (3) the PWS was in operation on the effective date of the NPDWR, or for a system that was not in operation by that date, only if no reasonable alternative source of drinking water is available to the new systems; and (4) management or restructuring changes (or both) cannot reasonably result in compliance with the Act or improve the quality of drinking water.

2.5 References

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