c. Proposed Requirements

If a system that is required to produce a disinfection profile decides to make a significant change in disinfection practice after the profile is developed, it must consult with the State and receive approval before implementing such a change. Significant changes in disinfection practice are defined as: (1) moving the point of disinfection (other than routine seasonal changes already approved by the State); (2) changing the type of disinfectant; (3) changing the disinfection process; or (4) making other modifications designated as significant by the State. Supporting materials for such consultation with the State must include a description of the proposed change, the disinfection profile developed under today's proposed rule for *Giardia lamblia* (and, if necessary, viruses for systems using ozone or chloramines), and an analysis of how the proposed change might affect the current level of *Giardia* inactivation. In addition, the State is required to review disinfection profiles as part of its periodic sanitary survey.

A log inactivation benchmark is calculated as follows:

(1) Calculate the average log inactivation for either each calendar month, or critical monitoring period (depending on final rule requirement for the profiling provisions).

(2) Determine the calendar month with the lowest average log inactivation; or lowest inactivation level within the critical monitoring period.

(3) The lowest average month, or lowest level during the critical monitoring period becomes the critical measurement for that year.

(4) If acceptable data from multiple years are available, the average of critical periods for each year becomes the benchmark.

(5) If only one year of data is available, the critical period (lowest monthly average inactivation level) for that year is the benchmark.

d. Request for Comments

EPA has included a requirement that State approval be obtained prior to making a significant change to disinfection practice. EPA requests comment on whether the rule should require State approval or whether only state consultation is necessary.

EPA also requests comment on providing systems serving fewer than 500 the option to provide raw data to the State, and allowing the State to determine the benchmark.

*C. Additional Requirements*

1. Inclusion of *Cryptosporidium* in definition of GWUDI

a. Overview and Purpose

Groundwater sources are found to be under the direct influence of surface water (GWUDI) if they exhibit specific traits. The SWTR defined ground waters containing *Giardia lamblia* as GWUDI. One such trait is the presence of protozoa such as *Giardia* which migrate from surface water to groundwater. The IESWTR expanded the SWTR's definition of GWUDI to include the presence of *Cryptosporidium*. The Agency believes it appropriate and necessary to extend this modification of the definition of GWUDI to systems serving fewer than 10,000 persons.

b. Data

The Agency issued guidance on the Microscopic Particulate Analysis (MPA) in October 1992 as the Consensus Method for Determining Groundwater Under the Direct Influence of Surface Water Using Microscopic Particulate Analysis (EPA, 1992). Additional guidance for making GWUDI determinations is also available (USEPA, 1994a,b). Since 1990, States have acquired substantial experience in making GWUDI determinations and have documented their approaches (Massachusetts Department of Environmental Protection, 1993; Maryland, 1993; Sonoma County Water Agency, 1991). Guidance on existing practices undertaken by States in response to the SWTR may also be found in the State Sanitary Survey Resource Directory, jointly published in December 1995 by EPA and the Association of State Drinking Water Administrators (EPA/ASDWA). AWWARF has also published guidance (Wilson et al., 1996).

Most recently, Hancock et al. (1997) used the MPA test to study the occurrence of *Giardia* and *Cryptosporidium* in the subsurface. They found that, in a study of 383 ground water samples, the presence of *Giardia* correlated with the presence of *Cryptosporidium*. The presence of both pathogens correlated with the amount of sample examined, but not with the month of sampling. There was a correlation between source depth and occurrence of *Giardia* but not *Cryptosporidium*. The investigators also found no correlation between the distance of the ground water source from adjacent surface water and the occurrence of either *Giardia* or *Cryptosporidium*. However, they did find a correlation between distance from a surface water source and generalized MPA risk ratings of high (high represents an MPA score of 20 or greater), medium or low, but no correlation was found with the specific numerical values that are calculated by the MPA scoring system. An additional two reports (SAIC 1997a and 1997b) provide data on wells with *Giardia* cyst and *Cryptosporidium* oocyst recovery and concurrent MPA analysis.

c. Proposed Requirements

In today's proposed rule, EPA is modifying the definition of GWUDI to include *Cryptosporidium* for systems serving fewer than 10,000 persons.

Under the SWTR, States were required to determine whether systems using ground water were using ground water under the direct influence of surface water (GWUDI). State determinations were required to be completed by June 29, 1994 for CWSs and by June 29, 1999 for NCWSs. EPA does not believe that it is necessary to make a new determination of GWUDI for this rule based on the addition of *Cryptosporidium* to the definition of ''ground water under the direct influence of surface water''. While a new determination is not required, States may elect to conduct a new analysis based on such factors as a new land use pattern (conversion to dairy farming, addition of septic tanks).

EPA does not believe that a new determination is necessary because the current screening methods appear to adequately address the possibility of *Cryptosporidium* in the ground water.

d. Request for Comments

The Agency requests comment on the proposal to modify the definition of GWUDI to include *Cryptosporidium* for systems serving fewer than 10,000 persons.

2. Inclusion of *Cryptosporidium* Watershed Requirements for Unfiltered Systems

a. Overview and Purpose

Existing SWTR requirements for unfiltered surface water and GWUDI systems require these systems to minimize the potential for source water contamination by *Giardia lamblia* and viruses. Because *Cryptosporidium* has proven resistant to levels of disinfection currently practiced at systems throughout the country, the Agency felt it imperative to include *Cryptosporidium* in the watershed control provisions wherever *Giardia lamblia* is mentioned. The IESWTR therefore, modified existing watershed regulatory requirements for unfiltered systems to include the control of

*Cryptosporidium*. The Agency believes it appropriate and necessary to extend this requirement to systems serving fewer than 10,000 persons.

It should be noted that today's proposed requirements do not replace requirements established for unfiltered systems under the SWTR. Systems must continue to maintain compliance with the requirements of the SWTR for avoidance of filtration. If an unfiltered system fails any of the avoidance criteria, that system must install filtration within 18 months, regardless of future compliance with avoidance criteria.

EPA anticipates that in the planned Long Term 2 Enhanced Surface Water Treatment rule, the Agency will reevaluate treatment requirements necessary to manage risks posed by *Cryptosporidium* and other microbial pathogens in both filtered and unfiltered surface water systems. In conducting this reevaluation, EPA will utilize the results of several large surveys, including the Information Collection Rule (ICR) and ICR Supplemental Surveys, to more fully characterize the occurrence of waterborne pathogens, as well as watershed and water quality parameters which might serve as indicators of pathogen risk level. The LT2ESWTR will also incorporate the results of ongoing research on removal and inactivation efficiencies of treatment processes, as well as studies of pathogen health effects and disease transmission. Promulgation of the LT2ESWTR is currently scheduled for May, 2002.

b. Data

Watershed control requirements were initially established in 1989 (54 FR 27496, June 29, 1989) (EPA, 1989b), as one of a number of preconditions that a public water system using surface water must meet to avoid filtration. The SWTR specifies the conditions under which a system can avoid filtration (40 CFR 141.71). These conditions include good source water quality, as measured by concentrations of coliforms and turbidity; disinfection requirements; watershed control; periodic on-site inspections; the absence of waterborne disease outbreaks; and compliance with the Total Coliform Rule and the MCL for TTHMs. The watershed control program under the SWTR must include a characterization of the watershed hydrology characteristics, land ownership, and activities which may have an adverse effect on source water quality, and must minimize the potential for source water contamination by *Giardia lamblia* and viruses.

The SWTR Guidance Manual (EPA, 1991a) identifies both natural and human-caused sources of contamination to be controlled. These sources include wild animal populations, wastewater treatment plants, grazing animals, feedlots, and recreational activities. The SWTR Guidance Manual recommends that grazing and sewage discharges not be permitted within the watershed of unfiltered systems, but indicates that these activities may be permissible on a case-by-case basis where there is a long detention time and a high degree of dilution between the point of activity and the water intake. Although there are no specific monitoring requirements in the watershed protection program, the non-filtering utility is required to develop State-approved techniques to eliminate or minimize the impact of identified point and non-point sources of pathogenic contamination. The guidance already suggests identifying sources of microbial contamination, other than *Giardia*, transmitted by animals, and points out specifically that *Cryptosporidium* may be present if there is grazing in the watershed.

c. Proposed Requirements

In today's proposed rule, EPA is extending the existing watershed control regulatory requirements for unfiltered systems serving fewer than 10,000 people to include the control of *Cryptosporidium*. *Cryptosporidium* will be included in the watershed control provisions for these systems wherever *Giardia lamblia* is mentioned.

Specifically, the public water system must maintain a watershed control program which minimizes the potential for contamination by *Giardia lamblia,* and *Cryptosporidium* oocysts and viruses in the water. The State must determine whether the watershed control program is adequate to meet this goal. The adequacy of a program to limit potential contamination by *Giardia lamblia* cysts, *Cryptosporidium* oocysts and viruses must be based on: The comprehensiveness of the watershed review; the effectiveness of the system's program to monitor and control detrimental activities occurring in the watershed; and the extent to which the water system has maximized land ownership and/or controlled land use within the watershed.

It should be noted that unfiltered systems must continue to maintain compliance with the requirements of the SWTR for avoidance of filtration. If an unfiltered system fails any of the avoidance criteria, that system must install filtration within 18 months, regardless of future compliance with avoidance criteria.

d. Request for Comments

EPA requests comment on the inclusion of these requirements for unfiltered systems serving fewer than 10,000 people.

3. Requirements for Covering New Reservoirs

a. Overview and Purpose

Open finished water reservoirs, holding tanks, and storage tanks are utilized by public water systems throughout the country. Because these reservoirs are open to the environment and outside influences, they can be subject to the reintroduction of contaminants which the treatment plant was designed to remove. The IESWTR contains a requirement that all newly constructed finished water reservoirs, holding tanks, and storage tanks be covered. The Agency believes it appropriate and necessary to extend this requirement to systems serving fewer than 10,000 people.

b. Data

Existing EPA guidelines recommend that all finished water reservoirs and storage tanks be covered (EPA, 1991b). The American Water Works Association (AWWA) also has issued a policy statement strongly supporting the covering of reservoirs that store potable water (AWWA, 1993). In addition, a survey of nine States was conducted in the summer of 1996 (Montgomery Watson, 1996). The States which were surveyed included several in the West (Oregon, Washington, California, Idaho, Arizona, and Utah), two States in the East known to have water systems with open reservoirs (New York and New Jersey), and one midwestern State (Wisconsin). Seven of the nine States which were surveyed require by direct rule that all new finished water reservoirs and tanks be covered.

Under the IESWTR, systems serving populations of 10,000 or greater were prohibited from constructing uncovered finished water reservoirs after February 16, 1999. The Agency developed an Uncovered Finished Water Reservoirs Guidance Manual (USEPA, 1999f) which provides a basic understanding of the potential sources of external contamination in uncovered finished water reservoirs. It also provides guidance to water treatment operators for evaluating and maintaining water quality in reservoirs. The document discusses:

- Existing regulations and policies pertaining to uncovered reservoirs;
- Development of a reservoir management plan;

• Potential sources of water quality degradation and contamination;
• Operation and maintenance of reservoirs to maintain water quality; and
• Mitigating potential water quality degradation.

As discussed in the 1997 IESWTR NODA (EPA, 1997b), when a finished water reservoir is open to the atmosphere it may be subject to some of the environmental factors that surface water is subject to, depending upon site-specific characteristics and the extent of protection provided. Potential sources of contamination to uncovered reservoirs and tanks include airborne chemicals, surface water runoff, animal carcasses, animal or bird droppings and growth of algae and other aquatic organisms due to sunlight that results in biomass (Bailey and Lippy, 1978). In addition, uncovered reservoirs may be subject to contamination by persons tossing items into the reservoir or illegal swimming (Pluntze 1974; Erb, 1989). Increases in algal cells, heterotrophic plate count (HPC) bacteria, turbidity, color, particle counts, biomass and decreases in chlorine residuals have been reported (Pluntze, 1974, AWWA Committee Report, 1983, Silverman et al., 1983, LeChevallier et al. 1997a).

Small mammals, birds, fish, and the growth of algae may contribute to the microbial degradation of an open finished water reservoir (Graczyk et al., 1996a; Geldreich, 1990; Fayer and Ungar, 1986;). In one study, sea gulls contaminated a 10 million gallon reservoir and increased bacteriological growth, and in another study waterfowl were found to elevate coliform levels in small recreational lakes by twenty times their normal levels (Morra, 1979). Algal growth increases the biomass in the reservoir, which reduces dissolved oxygen and thereby increases the release of iron, manganese, and nutrients from the sediments. This, in turn, supports more growth (Cooke and Carlson, 1989). In addition, algae can cause drinking water taste and odor problems as well as impact water treatment processes. A 1997 study conducted by the City of Seattle (Seattle Public Utilities, 1997) evaluated nutrient loadings by three groups of birds at Seattle's open reservoirs. Table IV.9 indicated the amount of soluble nutrient loadings estimated over the course of the year. It shows that bird feces may contribute nutrient loadings that can enhance algal growth in the reservoir.

TABLE IV.9.—1997 NUTRIENT LOADINGS BY BIRD GROUPS IN SEATTLE'S OPEN RESERVOIRS

| Reservoir | Geese | | Gulls | | Ducks | | Overall | |
|---|---|---|---|---|---|---|---|---|
| | Nitr. kg/yr | Phos. kg/yr | Nitr. kg/yr | Phos. kg/yr | Nitr. kg/yr | Phos. kg/yr | Total kg/yr | Conc. (mg/L) |
| Beacon Hill* | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Bitter Lake | 0.82 | 0.24 | 0.01 | 0.00 | 0.06 | 0.02 | 1.15 | 14.09 |
| Green Lake | 1.78 | 0.52 | 0.03 | 0.01 | 0.53 | 0.16 | 3.04 | 16.05 |
| Lake Forest | 2.23 | 0.65 | 0.36 | 0.11 | 0.07 | 0.02 | 3.43 | 15.09 |
| Lincoln | 0.00 | 0.00 | 0.24 | 0.07 | 0.01 | 0.00 | 0.31 | 3.96 |
| Maple Leaf | 2.16 | 0.63 | 0.13 | 0.04 | 0.35 | 0.10 | 3.42 | 15.43 |
| Myrtle | 0.00 | 0.00 | 0.08 | 0.02 | 0.01 | 0.00 | 0.12 | 4.35 |
| Volunteer | 0.00 | 0.00 | 0.01 | 0.00 | 0.01 | 0.00 | 0.03 | 0.42 |
| West Seattle | 0.40 | 0.12 | 0.38 | 0.11 | 0.02 | 0.01 | 1.03 | 4 |

c. Proposed Requirements

In today's proposed rule EPA is requiring surface water and GWUDI systems that serve fewer than 10,000 people to cover all new reservoirs, holding tanks or other storage facilities for finished water for which construction begins 60 days after the publication of the final rule in the **Federal Register**. Today's proposed rule does not apply these requirements to existing uncovered finished water reservoirs.

d. Request for Comments

EPA solicits comments regarding the requirement to require that all new reservoirs, holding tanks and storage facilities for finished water be covered.

*D. Recycle Provisions for Public Water Systems Employing Rapid Granular Filtration Using Surface Water and GWUDI as a Source*

Section 1412(b)(14) of the 1996 SDWA Amendments requires EPA to promulgate a regulation to govern the recycle of filter backwash within the treatment process of public water systems. The Agency is concerned that the recycle of spent filter backwash and other recycle streams may introduce additional *Cryptosporidium* oocysts to the treatment process. Adding oocysts to the treatment process may increase the risk oocysts will occur in finished water supplies and threaten public health. The Agency is further concerned because *Cryptosporidium* is not inactivated by standard disinfection practice, an important treatment barrier employed to control microbial pathogens. Oocysts returned to the plant by recycle flow therefore remain a threat to pass through filters into the finished water.

The Agency engaged in three primary information gathering activities to investigate the potential risk posed by returning recycle flows that may contain *Cryptosporidium* to the treatment process. First, the Agency performed a broad literature search to gather research papers and information on the occurrence of *Cryptosporidium* and organic and inorganic materials in recycle flows. The literature search also sought information regarding the potential impact recycle may have on plant treatment efficiency. Second, the Agency worked with AWWA, AWWSCo., and Cincinnati Water Works to develop twelve issue papers on commonly generated recycle flows (Environmental Engineering and Technology, Inc.,1999). These papers are summarized in the next section. Information from EPA's literature search was incorporated into the issue papers. Third, the Agency presented preliminary data and potential regulatory components to stakeholders, and solicited feedback, at public meetings in Denver, Colorado, and Dallas, Texas. EPA also received valuable input from representatives of small water systems through the SBREFA process.

Through the above activities, the Agency has identified four primary concerns regarding the recycle of spent filter backwash and other recycle streams within the treatment process of PWSs. The first concern is that some recycle flows contain *Cryptosporidium* oocysts, frequently at higher concentrations than plant source waters. Recycling these flows may increase the number of oocysts entering the plant and the number of oocysts reaching the filters. Loading more oocysts to the filters could increase finished water oocyst concentrations. The second concern regards the location in the treatment process recycle flow is returned. The return of recycle at the point of primary coagulant addition or downstream of it may disrupt treatment chemistry by introducing residual coagulant or other treatment chemicals to the process stream and thereby lower plant treatment efficiency. Also, recycle flow returned to the clarification process may not achieve sufficient residence time for oocysts in the recycle flow to be removed, or it may create hydraulic currents that lower the unit's overall oocyst removal efficiency. The third concern regards direct filtration plants. Direct filtration plants do not employ clarification in their primary treatment process to remove suspended solids and oocysts; all oocyst removal is achieved by the filters. If the recycle flow is not treated before being returned to the plant, all of the oocysts captured by a filter during a filter run will be returned to the plant and again loaded to the filters. This may lead to ever increasing levels of oocysts being applied to the filters and could increase the concentration of oocysts in finished water. Therefore, it is important for direct filtration plants to provide adequate recycle flow treatment to remove oocysts and protect the integrity of the filters and finished water quality. Finally, the fourth concern is that the direct recycle of spent filter backwash without first providing treatment, equalization, or some form of hydraulic detention for the recycle flow, may cause plants to exceed State-approved operating capacity during recycle events. This can cause clarification and filter loading rates to be exceeded, which may lower overall oocyst removal provided by the plant and increase finished water oocyst concentrations.

EPA has particular concerns regarding the direct recycle of spent filter backwash water as it is produced (i.e., recycle flow is not retained in an equalization basin, treatment unit, or other hydraulic detention unit prior to reintroduction to the main treatment process) for the following reasons:

(1) Direct recycle may cause operating rates for clarification and filtration to be exceeded, which may lower overall *Cryptosporidium* removal;

(2) Direct recycle may hydraulically upset some plants, lowering overall plant treatment performance, and;

(3) Clarification and filtration operating rates may be exceeded at precisely the time recycle flow may be returning large numbers of oocysts to the treatment process.

The impact of direct recycle practice to smaller plants with few filters is of greatest concern because return of recycle flow can double or triple plant influent flow, which may hydraulically overload the plant and reduce oocyst removal.

Since standard disinfection practice does not inactivate *Cryptosporidium*, its control is entirely dependent on physical removal processes. The Agency is concerned that direct recycle may cause some plants to exceed operating capacity and thus lower their physical removal capabilities. This can increase the risk of oocysts entering the finished water and lead to an increased risk to public health.

The limited data (Cornwell and Lee, 1993) EPA has identified regarding plants with existing equalization and/or treatment indicates they may be at no greater risk of hydraulic upset or degradation of oocyst removal performance than non-recycle plants. Given current data limitations, it is reasonable to assume the presence and utilization of adequate recycle flow equalization and/or treatment processes will alleviate the potential for hydraulic disruptions and the impairment of treatment performance. Data suggesting otherwise is currently unavailable.

The potential for recycle to return significant numbers of oocysts to the treatment train does provide a general basis for concern regarding the impact of recycle practice to finished water quality. However, the Agency does not currently believe data warrants a national regulation requiring all recycle plants to provide recycle flow equalization or treatment for the following reasons:

(1) Data correlating oocyst occurrence in recycle streams to increased oocyst occurrence in finished water is unavailable;

(2) Data regarding the response of full-scale plants to recycle events is limited;

(3) Data is not available to determine the level of recycle flow equalization or treatment full-scale systems may need, if any, to control the risk of oocysts entering finished water, and;

(4) Whether and the extent to which oocyst occurrence in source water influences the necessary level of recycle treatment and equalization is unknown.

The Agency believes requiring plants that may be at greater risk due to recycle, such as direct recycle plants and direct filtration plants, to characterize their recycle practice and provide data to the State for its review provides a cost effective opportunity to increase public health protection and supply a measure of safety to finished drinking water supplies. EPA believes that today's proposal will address potentially higher risk recycle situations that may threaten the performance of some systems, and will do so by allowing State drinking water programs to consider site-specific treatment conditions and needs. The Agency believes these recycle provisions are needed to protect plant performance, the quality of finished water supplies, and to provide an additional measure of public health protection.

1. Treatment Processes That Commonly Recycle and Recycle Flow Occurrence Data

a. Treatment Processes That Commonly Recycle

The purpose of this section is to provide general background on common treatment plant processes, fundamental plant operations, and the origin of plant recycle streams. Detailed information on the specific recycle flows these processes generate are presented after this background discussion. Four general types of water treatment processes, conventional filtration, direct filtration, softening, and contact clarification, are discussed. Although there are numerous variations of these four treatment processes, only the most basic configurations are discussed here. The operation of package plants and options to returning recycle to the treatment process are also summarized.

i. Conventional Treatment Plants

Conventional water filtration plants are defined by the use of four essential unit processes: Rapid mix, coagulation/flocculation, sedimentation, and filtration. Sedimentation employs gravity settling to remove floc and particles. Particles not removed by sedimentation may be removed by the filters. Periodically, accumulated solids must be removed from the sedimentation unit. These solids, termed ''residuals,'' are currently disposed to sanitary sewer, treated with gravity thickening, or some other process prior to returning them to plant headworks or other locations in the treatment train. Clarification processes other than sedimentation may also be used, and they also produce process residuals.

Clarification sludge may be processed on-site if the plant is equipped with solids treatment facilities. Commonly employed treatment processes include thickeners, dewatering equipment (*e.g.*, plate and frame presses, belt filter presses, or centrifuges), and lagoons. Each of these processes produces residual water streams that are currently returned to the treatment process at the headworks or other locations prior to filtration. The volume of residuals produced by clarification depends upon the amount of solids present in the raw water, the dose and type of coagulant applied, and the concentration of solids in the treated water stream.

The one residual stream associated with filtration, spent filter backwash water, is produced during periodic backwashing events performed to remove accumulated solids from the filter. Spent filter backwash is frequently returned to the treatment process at the head of the plant, other locations prior to the filters, or disposed of to sanitary sewer or surface water. Some plants have the capability to send the filtrate produced during the filter ripening period to plant headworks, a raw water reservoir, or to a sanitary sewer or surface water rather than to the clear well as finished water. This practice, referred to as ''filter-to-waste'' is used to prevent solids, which pass through the filter more easily during the ripening period, from entering the finished water.

Filter backwash operations can differ significantly from plant to plant. The main variables are the time between backwashes (length of filter run), the rate of backwash flow, the duration of the backwash cycle, and the backwashing method. The time between filter backwashes is generally a function of either run time, headloss, or solids breakthrough. Both headloss and solids breakthrough can be dependent upon the quality of the sedimentation effluent. Regardless of the variable driving backwash frequency, the interval between backwashes typically vary from 24 to 72 hours. Recommended backwash frequency is every 24–48 hours (ASCE/AWWA, 1998).

There are a number of different methods that can be used to backwash a filter. These include: Upflow water only, upflow water with surface wash, and air/water backwash. Air/water backwash systems typically use 30–50 percent less water than the other two methods. The filter backwash flow rate can vary, depending on media type, water temperature, and backwash method, but generally has a maximum of 15–23 gpm/ft$^2$ (air/water backwash may have a lower maximum rate of 6–7 gpm/ft$^2$). A number of different backwash sequences are employed, but a typical backwash consists of a low rate wash (6–7 gpm/ft$^2$ for several minutes), followed by a high rate wash (15–23 gpm/ft$^2$ for 5–15 minutes), which is then followed by a final low rate wash (6–7 gpm/ft$^2$ for several additional minutes). Some treatment plants only use a high rate wash for 15 to 30 minutes. Backwash rates are significantly higher than filtration rates, which vary from 1 to 8 gpm/ft$^2$.

ii. Direct Filtration Plants

The direct filtration process is similar to conventional treatment, except the clarification process is not present. Direct filtration plants produce the same filter residual as conventional filtration plants, namely filter backwash, and may also generate a filter-to-waste flow. Direct filtration plants do not produce clarification residuals because clarification is not employed. Filter backwash may be either recycled to the head of the plant or discharged to surface waters or a sanitary sewer. Although direct filtration plants generally treat source waters that have low concentrations of suspended material, the solids loading to the filters may be higher than at conventional plants because solids are not removed in a clarification process prior to filtration. If spent filter backwash is not treated to remove solids prior to recycle, solids loading onto the filters will continue to increase over time, as an exit from the treatment process is unavailable. Filter run length may be shorter in some direct filtration plants relative to conventional plants because the solids loading to the filters may be higher due to the lack of a clarification process. The concentration of solids in the source water is a key variable in filter run length.

iii. Softening Plants

Softening plants utilize the same basic treatment processes as conventional treatment plants. Softening plants remove hardness (calcium and magnesium ions) through precipitation, followed by solids removal. Many softening plants employ a two-stage process, which consists of a rapid mix-flocculation-sedimentation sequence, in series, followed by filtration. Others use a single stage process, resembling conventional treatment plants. Precipitation of the calcium and magnesium ions is accomplished through the addition of lime (calcium hydroxide), with or without soda ash (sodium carbonate), which reacts with the calcium and magnesium ions in the raw water to form calcium carbonate and magnesium hydroxide. The precipitation of the calcium carbonate can be improved by recirculating some of the calcium carbonate sludge into the rapid mix unit because the additional solids provide nucleation points for the precipitation of calcium and magnesium. Without this recirculation, additional hydraulic detention time in the flocculation and sedimentation basins may be required to prevent excessive scale deposits in the plant clearwell or in the distribution system.

A softening plant generally has the same residual streams as a conventional plant: Filter backwash, sedimentation solids, and thickener supernatant and dewatering liquids. A filter-to-waste flow may also be generated. These residual streams are either disposed or recycled within the plant. A portion of the sedimentation basin solids are commonly recycled as the sedimentation basin solids contain significant quantities of precipitated calcium carbonate, recycle of these solids reduces the required chemical dose. Solids are generally recycled into the rapid mix chamber to maximize their effectiveness.

iv. Contact Clarification Plants

In the contact clarification process, the flocculation and clarification (and often the rapid mix) processes are combined in one unit, an upflow solids contactor or contact clarifier. Contact clarifiers are employed in both softening and non-softening processes. Raw water flows into the contact clarifier at the top of the central compartment, where chemical addition and rapid mix occurs. The water then flows underneath a skirt and into the outer sedimentation zone where solid separation occurs. A large portion of previously settled solids from the sedimentation zone is circulated to the mixing zone to enhance flocculation. The remainder of the solids are disposed to prevent their accumulation. Circulation and disposal of accumulated solids allows clarifier loading rates to be 10 to 20 times greater than loading rates for conventional sedimentation basins. Solids recirculation rates are generally different for softening and turbidity removal applications, with rates of up to 12 times the raw water flow for softening processes and up to 8 times the raw water flow for non-softening processes (ASCE/AWWA, 1998). Following clarification, treated water from the contactor is then filtered.

The residual streams from contact clarification plants are similar to those for conventional filtration plants. They include filter backwash, clarification solids, thickener supernatant, and dewatering liquids. The key operational consideration for these types of systems is the maintenance of a high concentration of solids within the skirt to allow high loading rates while maintaining adequate solids removal. Solids recirculation (*e.g.*, recycle) helps contact clarification processes maintain the necessary solids concentration.

Softening plants may also generate filter to waste flow.

v. Package Plants

Package plants are typically used to produce between a few thousand to 1 million gallons of water per day. Package plants can employ a conventional treatment train, as well as proprietary unit processes. Package plants typically include the same processes found in large plants, including coagulation, flocculation, clarification and filtration. The potential recycle streams are also comparable. The recycle of filter backwash may occur, however, the typical package plant may not be designed to convey process streams back into the plant as recycle.

vi. Summary of Recycle Disposal Options

Two recycle disposal options available to some plants are direct discharge to sanitary sewers or discharge to surface waters. Discharge of recycle waters to the municipal sewer system may occur when the treatment plant and Publicly Owned Treatment Works (POTW) are under the same authority or when the plant has access to a sanitary sewer and a POTW agrees to accept its discharge.

There may be a fee associated with discharge to a sanitary sewer system, and the total fee may vary with the volume of backwash effluent discharged as well as the amount of solids in the effluent (Cornwell and Lee, 1994). In addition to the fee requirement, discharging into the sewer system may require the plant to equalize the effluent prior to discharging to the POTW. The equalization process requires holding the effluent in tanks and gradually releasing it into the sanitary sewer system. The fee associated with sanitary sewer discharge may influence whether a plant recycles to the treatment process or discharges to a sanitary sewer.

Another option to recycle within the treatment process is the direct discharge of recycle flow to surface waters, such as creeks, streams, rivers, and reservoirs. Direct discharge is a relatively common method of disposal for water treatment plant flows. A National Pollutant Discharge Elimination System (NPDES) permit requires that certain water quality conditions be met prior to the discharge of effluent into surface waters. Treatment of the effluent prior to discharge may be required. The cost of effluent treatment may influence whether plants recycle within the treatment process or discharge to surface water.

b. Recycle Flow Occurrence Data

EPA has not regulated recycle flows in previous rulemakings. The 1996 SDWA Amendments have lead the Agency to perform an examination of recycle flow occurrence data for the first time. EPA discovered through its literature search and its work with AWWA, AWWSCo., and Cincinnati Water Works to develop the issue papers, that the amount of recycle stream occurrence data available is very limited, particularly for *Cryptosporidium*, the primary focus of this regulation. This may be because *Cryptosporidium* was identified as a contaminant of concern relatively recently and because currently available oocyst detection methods have limitations.

Twelve issue papers were developed to compile information on several commonly produced recycle streams. Each individual paper summarizes how the recycle stream is generated, the typical volume generated, characterizes the occurrence of various recycle stream constituents to the extent data allows, (*i.e.*, occurrence of *Cryptosporidium* and inorganic and organic material), and briefly discusses potential impacts of recycling the stream. The discussion of potential impacts is usually brief, due to overall data limitations and particularly due to a lack of data on *Cryptosporidium* occurrence. The 12 recycle streams examined include:

- untreated spent filter backwash water
- gravity settled spent filter backwash water
- combined gravity thickener supernatant (spent filter backwash and clarification process solids)
- gravity thickener supernatant from sedimentation basin solids
- mechanical dewatering device concentrate
- untreated basin solids
- lagoon decant
- sludge drying bed leachate
- monofill leachate membrane concentrate
- ion exchange regenerate
- minor streams

A total of 112 references were used to complete the issue papers, and AWWSCo. and Cincinnati Water Works performed sampling of non-microbial recycle stream constituents to supplement occurrence information.

*Cryptosporidium* occurrence data was only identified for five recycle streams, namely: untreated spent filter backwash water, gravity settled spent filter backwash water, untreated sedimentation basin solids, combined thickener supernatant, and sludge drying bed leachate. Oocysts may occur in the other recycle streams as well, but published occurrence data was not identified. The issue papers and supporting literature indicate data does not exist to correlate oocyst occurrence in recycle streams to the occurrence of oocysts in finished water. However, the issue papers did identify data showing that oocysts occur in recycle streams, often at concentrations higher than that of the source water.

*Cryptosporidium* is not the only constituent of recycle waters. Other common constituents are manganese, iron, aluminum, disinfection byproducts, organic carbon, *Giardia* lamblia and particles. EPA does not currently have data to indicate these constituents occur in recycle streams at levels which threaten treatment plant performance, finished water quality, or public health. Additionally, current regulations may largely control any minor risk these constituents may present. For example, organic matter in recycle flow may form disinfection byproducts in the presence of oxidants. The Stage 1 DBPR, which requires monitoring for disinfection byproducts, will identify systems experiencing disinfection byproduct occurrence above or near applicable MCLs through distribution system monitoring. Additionally, Secondary Maximum Contaminant Levels (SMCLs) have been promulgated to control occurrence of aluminum, iron, and manganese at levels of .05–.2 mg/l, .3 mg/l, and .05 mg/l, respectively. Particle levels are controlled by effluent turbidity standards and *Giardia* lamblia is controlled through a combination of disinfection and filtration requirements. EPA believes existing regulations control these recycle stream constituents. Therefore, their control is not a primary goal of today's proposal. Additionally, detailed discussion of these constituents is not provided in the below summary of the issue papers because: (1) control of *Cryptosporidium* is the focus of the recycle provisions, and; (2) concentrations of inorganic and organic materials reported in the issue papers are for recycle streams, not finished water occurrence. The recycle stream concentrations will be significantly diluted by mixing with source water.

The occurrence of recycle flow constituents other than *Cryptosporidium* is not discussed in today's preamble for the above reasons. The following discussion of recycle stream occurrence data covers only untreated spent filter backwash water, gravity settled spent filter backwash water, combined gravity thickener supernatant (a combination of spent filter backwash and clarification process solids), gravity thickener supernatant from clarification process solids, and mechanical dewatering device liquids. These five recycle streams are discussed in detail because they are most likely to present a threat to treatment plant performance or finished water quality when recycled. For example, treated and untreated spent filter backwash water and thickener supernatant are the only two recycle streams of sufficient volume to cause plants to exceed their operating capacity during recycle events. The five recycle streams discussed below are also most likely to contain *Cryptosporidium*.

Copies of all the issue papers are available for public review in the Office of Water docket for this rulemaking. Portions of the following recycle stream descriptions use excerpts from the issue papers.

*i. Untreated Spent Filter Backwash Water*

Water treatment plants that employ rapid granular filtration (e.g., conventional, softening, direct filtration, contact clarification) generate spent filter backwash water. The backwash water is generated when water is forced through the filter, counter-current to the flow direction during treatment operations, to dislodge and remove accumulated particles and pathogens residing in the filter media. Backwash rates are typically five to eight times the process rate, and are used to clean the filter at the end of a filter run, which is generally 24 to 72 hours in length. Backwash operations usually last from 10 to 25 minutes. The flow rate and duration of backwashing are the primary factors that determine the volume of backwash water produced. Once the backwashing process is complete, the backwash water and entrained solids are either disposed of to a sanitary sewer, discharged to a surface water, or returned to the treatment process. Plants currently return spent filter backwash to the treatment process at a variety of locations, usually between plant headworks and clarification. Data regarding common recycle return locations is discussed in the next section of this preamble.

Spent filter backwash can be returned to the treatment process directly as it is produced, be detained in an equalization basin, or passed through a treatment process, such as clarification, prior to being returned to the plant. On a daily basis, spent filter backwash can range from 2 to 10 percent of plant production. Spent filter backwash is usually produced on an intermittent basis, but large plants with numerous filters may produce it continuously. At small and mid-size plants, large volume, short duration flows of spent filter backwash are usually produced. This may cause some plants, particularly smaller plants that recycle directly without flow equalization or treatment, to exceed their operating capacity or to experience hydraulic disruptions, both of which may negatively impact treatment efficiency and oocyst removal.

The concentrations of *Cryptosporidium* reported in the untreated spent filter backwash issue paper ranges from non-detect to a concentration of 18,421 oocysts per 100 L. This range is not amenable to formal statistical analysis, but rather provides a summary of minimum and maximum oocyst concentrations reported in available literature. Although a few studies report isolated data points of greater than 10,000 oocysts/100L for filter backwash water (Rose *et al.*, 1989; Cornwell and Lee, 1993; Colbourne, 1989), occurrence studies that collected the largest number of samples reported mean filter backwash oocyst occurrence concentrations of a few hundred oocysts per 100L (States *et al.*, 1997; Karanis *et al.*, 1996). The high concentration of oocysts found in some spent filter backwash samples is cause for concern, because oocysts are not inactivated by standard disinfection practice. They remain a threat to pass through the plant into the finished water if they are returned to the treatment process. However, current oocyst detection methods do not allow the occurrence of oocysts in spent filter backwash water to be correlated to finished water oocyst concentrations for a range of plant types, source water qualities, and recycle practices. Today's proposal does not require the installation of recycle equalization or treatment for spent filter backwash water on a national basis due to these data limitations.

The Agency is concerned that certain recycle practices, such as returning spent filter backwash to locations other than prior to the point of primary coagulant addition, or hydraulically overloading the plant with recycle flow so it exceeds its State approved operating capacity, may present risk to finished water quality and public health. Exceeding plant operating capacity during recycle events may cause greater risk to finished water quality, because plant performance is potentially being lowered at precisely the time oocysts are returned to the plant in the recycle flow. To address this concern, today's proposal requires that certain direct recycle plants that recycle spent filter backwash water and/or thickener supernatant to perform a self assessment of their recycle practice and report the results to the State. The self assessment requirements are discussed in detail later in this preamble.

*ii. Gravity Settled Spent Filter Backwash Water*

Gravity settled spent filter backwash water is generated by the same filter backwash process and is produced in the same volume as untreated spent filter backwash water. The difference between the two streams is that the former is treated by gravity settling prior to its return to the primary treatment process. Sedimentation treatment is usually accomplished by retaining the spent filter backwash water in a treatment unit for a period of time to allow suspended solids (including oocysts) to settle to the bottom of the basin. Polymer may be used to improve process efficiency. The water that leaves the basin is gravity settled spent filter backwash water. Removing solids from the spent filter backwash causes only a minor reduction in volume as the solids content of the untreated stream is low, usually below 1 percent.

Providing gravity settling for spent filter backwash is advantageous for two reasons. First, the sedimentation process detains the spent filter backwash in treatment basins for a period of hours, which lowers the possibility a large recycle volume will be returned to the plant in a short amount of time and cause the plant operating capacity to be exceeded. Second, treating the spent filter backwash flow can remove *Cryptosporidium* oocysts from the flow, which will reduce the number of oocysts returned to the plant.

Limited data show that sedimentation can effectively remove oocysts. Cornwell and Lee (1993) conducted limited sampling of spent filter backwash water at two plants prior to and after sedimentation treatment. The first facility practiced direct filtration and was sampled twice. The *Cryptosporidium* concentrations into and out of the sedimentation basin treating spent filter backwash were 900/100L and 140/100L, respectively, for the first sampling and 850/100L in the influent and 750/100L in the effluent for the second sampling. At the second plant a sludge settling pond received both sedimentation basin sludge and spent filter backwash, and the spent filter backwash oocyst concentration was 16,500/100L, and the treated recycle water concentration was 420/100L. In a study by Karanis (1996), *Cryptosporidium* was regularly detected in settled backwash waters. Of the 50 samples collected, 82 percent tested positive for *Cryptosporidium.* The mean value for *Cryptosporidium* was 22 oocysts/100L.

Sedimentation treatment can remove oocysts from spent filter backwash, but data indicate oocysts remain in gravity settled spent filter backwash water even after treatment. The Agency believes that sedimentation treatment for spent filter backwash waters is capable of removing oocysts and improving the quality of the water prior to recycle. However, given current data limitations, the Agency does not believe it is possible to specify, in a national regulation, the conditions (*e.g.*, source water oocyst concentrations, primary treatment train performance, concentration of oocysts in spent filter backwash, ability of sedimentation to remove oocysts under a range of conditions) under which sedimentation treatment of spent filter backwash water may be appropriate. This decision is best made by State programs to allow consideration of site-specific conditions and treatment needs.

*iii. Combined Gravity Thickener Supernatant*

Combined gravity thickener supernatant is derived from the treatment of filter backwash water and sedimentation basin solids in gravity thickener units. These two flows may not reside in the thickener at the same time or in equal volumes, depending on plant operations. The volume of thickener supernatant generated at a water treatment plant is a function of the type of flows it treats, the solids content of the influent stream, and the method of thickener operation. Regardless of whether a continuous or a batch process is used, a number of factors, including residuals production (a function of plant production, raw water suspended solids, and coagulant dose), volume of spent filter backwash water produced, and the level of treatment provided to thickener influent streams, directly affect the quantity of thickener supernatant produced.

The flow entering the thickener is primarily spent filter backwash water. Sedimentation basin solids is the second largest flow. Flow from dewatering devices, which is generated by the dewatering of residuals, may comprise a minor volume entering the thickener. Combined thickeners will have an influent that may be eighty-percent spent filter backwash or more by volume. About eighty-percent of the solids entering the thickener will be from the sedimentation basin sludge, as spent filter backwash water has a comparatively low solids concentration.

A recent FAX survey (AWWA, 1998) identified more than 300 water treatment plants in the United States with production capacities ranging from less than 2 mgd to greater than 50 mgd that recycle spent filter backwash water. Many of the survey respondents indicated that they recycle more than just spent filter backwash water. Based on the survey and published literature, thickener supernatant is probably the second largest and second most frequently recycled stream at water treatment facilities after spent filter backwash.

Data summarized in the issue paper showed that thickener supernatant quality varies widely, due in large part because the type and quality of recycle streams entering thickeners varies over time and from plant to plant. The turbidity, total suspended solids, and particle counts of thickener effluent are directly impacted by the quality of water loaded onto the thickener, thickener design, and thickener operation (e.g., residence time, use of polymer).

Data on the occurrence of *Cryptosporidium* was limited to two samples, with oocyst occurrence ranging from 82 to 420 oocysts per 100 L. Data is too limited, and practice varies too widely, to draw conclusions on the impact recycle of this flow may have on plant performance. However, given that the contents of the thickener have been treated and the amount of flow produced by gravity thickeners is relatively modest, it may be feasible to recycle the flow in a manner that minimizes adverse impact. Additionally, treatment plant personnel have a vested interest in optimizing thickener operation to minimize sludge dewatering and handling costs; optimization of thickener operation is likely to assist oocyst removal. However, additional data is needed to characterize the occurrence of *Cryptosporidium* and the potential impact recycle of combined thickener supernatant may have on finished water quality.

*iv. Gravity Thickener Supernatant from Sedimentation Solids*

Gravity settled sedimentation basin solids are sedimentation basin solids that have undergone settling to allow solid sludge components to settle to the bottom of a gravity thickener. The supernatant from the thickener is a potential recycle flow. The tank bottom is sloped to enhance solids thickening and collection and removal of settled solids is accomplished with a bottom scraper mechanism. If the supernatant is recycled, it can be returned to the plant continuously or intermittently, depending on whether the thickener is operated in batch mode. Thickeners may receive and treat both spent filter backwash water and sedimentation basin solids. For purposes of this discussion, and the data presented in the issue paper, the gravity thickener is only receiving sedimentation basin solids.

The volume of treated sedimentation basin solids supernatant generated is dependent on the amount of sludge produced in the sedimentation basin, the solids content of the sludge, and method of thickener operation. Sludge production is a function of plant production, raw water suspended solids, coagulant type, and coagulant dose. The quantity of sedimentation basin sludge supernatant is approximately 75 to 90 percent of the original volume of sedimentation basin sludge produced.

There is a very limited amount of data on the quality of thickener supernatant produced by gravity settling of only sedimentation basin solids (i.e., spent filter backwash and other flows are not added to the thickener), and no data was identified regarding the concentration of *Cryptosporidium* that occur in the supernatant. As is the case with combined gravity thickener supernatant, it is difficult to determine what impact, if any, the return of the supernatant may have on plant operations and finished water quality due to limited data. Additional data is necessary to determine the concentration of oocysts in this recycle stream, and to characterize the impact its recycle may have to plant performance.

*v. Mechanical Dewatering Device Liquids*

Water treatment plant residuals (usually thickened sludge) are usually dewatered prior to disposal to remove water and reduce volume. Two common mechanical dewatering devices used to separate solids from water are the belt filter press, which compresses the residuals between two continuous porous belts stretched over a series of rollers, and the centrifuge, which applies a strong centrifugal force to separate solids from water. The plate and frame press is another dewatering device that contains a series of filter plates, supported and contained in a structured frame, which separate sludge solids from water using a positive pressure differential as the driving force. Water removed from the solids with a belt filter press is called filtrate, from a filter press it is called pressate, and the water separated from the residuals with a centrifuge is referred to as centrate.

These streams will be collectively referred to as ''dewatering liquid'' for the following discussion.

The volume of dewatering liquid produced depends primarily on the volume and solids content of the thickened residuals fed to the mechanical dewatering device. Plants that produce small sludge volumes, and hence a low volume of thickener residuals, will process fewer residuals in the mechanical dewatering device and hence produce a smaller volume of dewatering liquid than a plant producing a large volume of solids, all else being equal. Since residuals are often thickened (typically to about 2 percent solids) prior to dewatering, the volume of the dewatering device feed stream is significantly lower than the volume of sedimentation basin residuals generated. If the sedimentation basin sludge flow is assumed to be 0.6 percent of plant production, then dewatering device flow may be approximately 0.1 to 0.2 percent of plant flow. Generally these streams are mixed in with other recycle streams prior to being returned to the plant. Mechanical dewatering devices may be operated intermittently, after a suitable volume of residuals have been produced for dewatering. The production of dewatering liquid and its recycle may not be a continuous process.

Data on the constituents in dewatering liquid were found in three references, one on belt filter press liquids, one on plate and frame pressate, and one on centrifuge centrate. Data on the occurrence of *Cryptosporidium* was not identified. Given the small, intermittent flow produced by mechanical dewatering devices, recycle flows from them are unlikely to cause plants to exceed operating capacity. However, it is possible that dewatering device liquid contains *Cryptosporidium* because it derived from solids likely to hold a large numbers of oocysts. Additional data is necessary to determine the concentration of oocysts in this recycle stream, and to characterize any impact its recycle may have to plant performance.

2. National Recycle Practices

a. Information Collection Rule

Public water systems affected by the ICR were required to report whether recycle is practiced and sample washwater (i.e., recycle flow) between the washwater treatment plant (if one existed) and the point at which recycle is added to the process train. Sampling of plant recycle flow was required prior to blending with the process train. Monthly samples were required for pH, alkalinity, turbidity, temperature, calcium and total hardness, TOC, $UV_{254}$, bromide, ammonia, and disinfectant residual if disinfectant was used. Systems were also required to measure recycle flow at the time of sampling, the twenty four hour average flow prior to sampling, and report whether treatment of the recycle was provided and, if so, the type of treatment. Reportable treatment types were plain sedimentation, coagulation and sedimentation, filtration, disinfection, or a description of an alternative treatment type. Plants were also required to submit a plant schematic to identify sampling locations. EPA used the sampling schematics and other reported information to compile a database of national recycle practice.

*i. Recycle Practice*

The Agency developed a database from the ICR sampling schematics and other reported information. Table IV.10 summarizes the plants in the database. Of the 502 plants in the database at the time the analysis was performed, 362 used rapid granular filtration.

TABLE IV.10.—RECYCLE PRACTICE AT ICR PLANTS

| Plant classification | Number |
|---|---|
| All ICR plants | 502 |
| Filtration plants [a] | 362 |
| Filtration plants recycling [b] | 226 |
| Filtration plants treating recycle | 148 |
| Recycle plants serving ≥100,000 | 168 |
| Recycle plants serving <100,000 | 58 |

[a] Defined as conventional, lime softening, other softening, and direct filtration plants.
[b] Plants report existence of a recycle stream, not its origin.

These plants are classified as conventional, lime softening, other softening, and direct filtration. The remaining 140 plants in the database do not employ rapid granular filtration capability and generally provide disinfection for ground water. Of the 362 filtration plants in the database, 226 (62.4 percent) reported recycling to the treatment process. Seventy-four percent of the plants that recycle serve populations greater than 100,000 and 26 percent serve populations below 100,000. Figure IV.9 shows the distribution of plants by treatment type and Figure IV.10 shows the distribution of plants by population served. Table IV.11 shows that 88 percent of ICR recycle plants use surface water. An additional one percent use GWUDI and another one percent use a combination of ground water and surface water. Therefore, 90 percent of ICR recycle plants use a source water that could contain *Cryptosporidium*.

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**Figure IV.9 ICR Plants by Treatment Train Type**

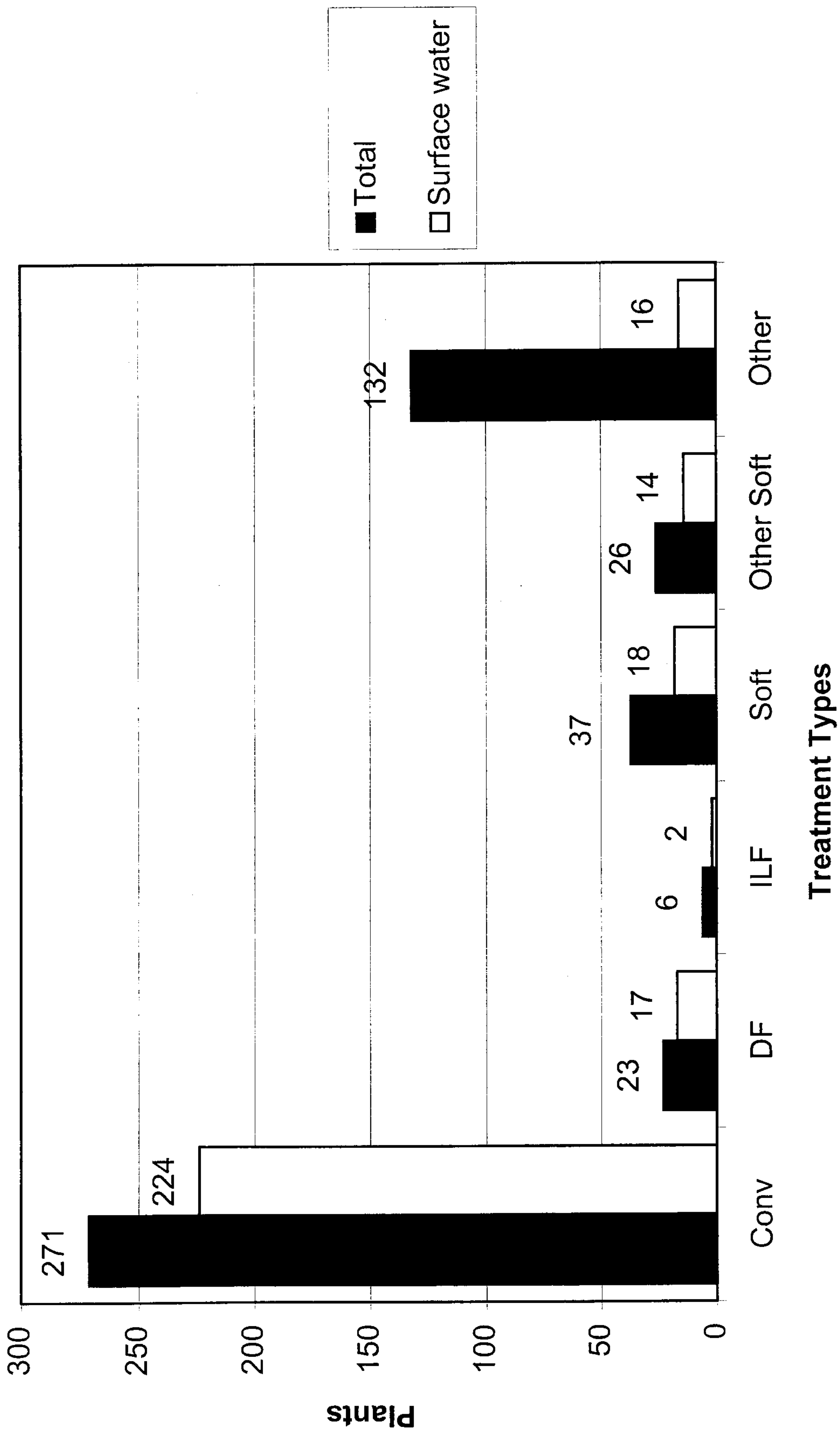

Figure IV.10 ICR Recycle Plants by Population Served

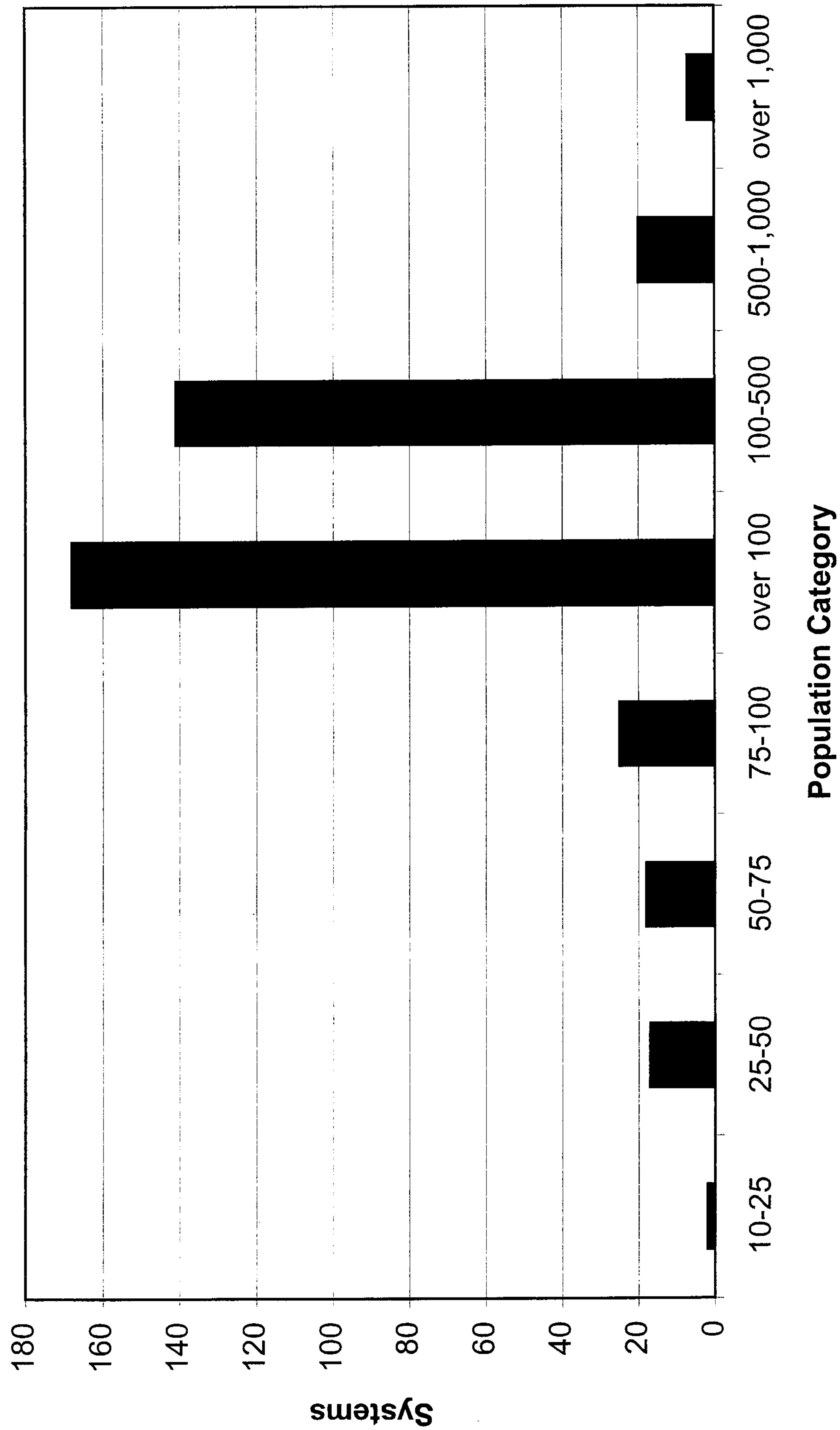


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TABLE IV.11.—SOURCE WATER USE BY ICR RECYCLE PLANTS

| Source water type | Number of plants | Percent of recycle plants |
|---|---|---|
| Total number of recycle plants | 226 | 100 |
| Surface Water | 199 | 88 |
| Ground water under the influence | 3 | 1 |
| Ground water and surface water | 2 | 1 |
| Ground water only | 22 | 10 |

Table IV.12 shows that 65 percent of ICR recycle plants report providing treatment for the recycle flow. The percentage of plants providing treatment is the same for the subsets of plants serving greater than and less than 100,000 people. Sedimentation is the most widely reported treatment method, as 77 percent of plants providing treatment employ it. The database does not provide information on the solids removal efficiency of the sedimentation units. All direct filtration plants practicing recycle reported providing treatment for the recycle flow.

TABLE IV.12.—TREATMENT OF RECYCLE AT ICR PLANTS [1]

| ICR recycling plants | Number of plants | Percentage of recycle plants |
|---|---|---|
| Number of recycle plants | 226 | 100 |
| Practice recycle treatment | 147 | 65 |
| Use sedimentation | 114 | 77 |
| Use sedimentation/coagulation | 14 | 10 |
| Use two or more treatments | 14 | 10 |
| Other treatment | 5 | 3 |

[1] Disinfection not counted as treatment because it does not inactivate *Cryptosporidium*.

Table IV.13 indicates that 75 percent of ICR recycle plants return recycle prior to rapid mix. Fifteen percent return it prior to sedimentation, and ten percent of plants return it prior to filtration. These percentages hold for the subsets of plants serving greater than and less than 100,000 people. The data indicate that introducing recycle prior to rapid mix may be a common practice. EPA believes that introducing recycle flow prior to the point of primary coagulant addition, is the best recycle return location because it limits the possibility residual treatment chemicals in the recycle flow will disrupt treatment chemistry.

TABLE IV.13.—RECYCLE RETURN POINT

| Point of recycle return | Number of plants | percent of plants |
|---|---|---|
| Number of recycle plants | [1] 224 | 100 |
| Prior to point of primary coagulant addition | 169 | 75 |
| Prior to sedimentation | 34 | 15 |
| Prior to filtration | 21 | 10 |

[1] Recycle return point could not be determined for two plants.

The data provides the following conclusions regarding the recycle practice of ICR plants: (1) The recycle of spent filter backwash and other process streams is a common practice; (2) the great majority of recycle plants in the database use filtration and surface water sources; (3) a majority of plants in the database that recycle provide treatment for recycle flow, and; (4) a large majority of plants in the database that recycle (approximately 3 out of 4) recycle prior to the point of primary coagulant addition.

b. Recycle FAX Survey

The AWWA sent a FAX survey (AWWA, 1998) to its membership in June 1998 to gather information on recycle practices. Plants were not targeted based on source water type, the type of treatment process employed, or any other factor. The survey was sent to the broad membership to increase the number of responses. Responses indicating a plant recycled spent filter backwash or other flows were compiled to create a database. The resulting database included 335 plants. The database does not contain information from respondents who reported recycle was not practiced. Data from some of the FAX survey respondents also populates the ICR database. Plants in the database are well distributed geographically and represent a broad range of plant sizes as measured by capacity. Figure IV.11 shows plant distribution by capacity and Figure IV.12 by geographic location. The following discussion of FAX survey data is divided into two sections. The first discusses national recycle practice and the second discusses options for recycle disposal in lieu of returning recycle to the treatment process.

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**Figure IV.11 Distribution of Fax Survey Plants by Plant Capacity**

(Environmental Engineering and Technology, Inc., 1998)

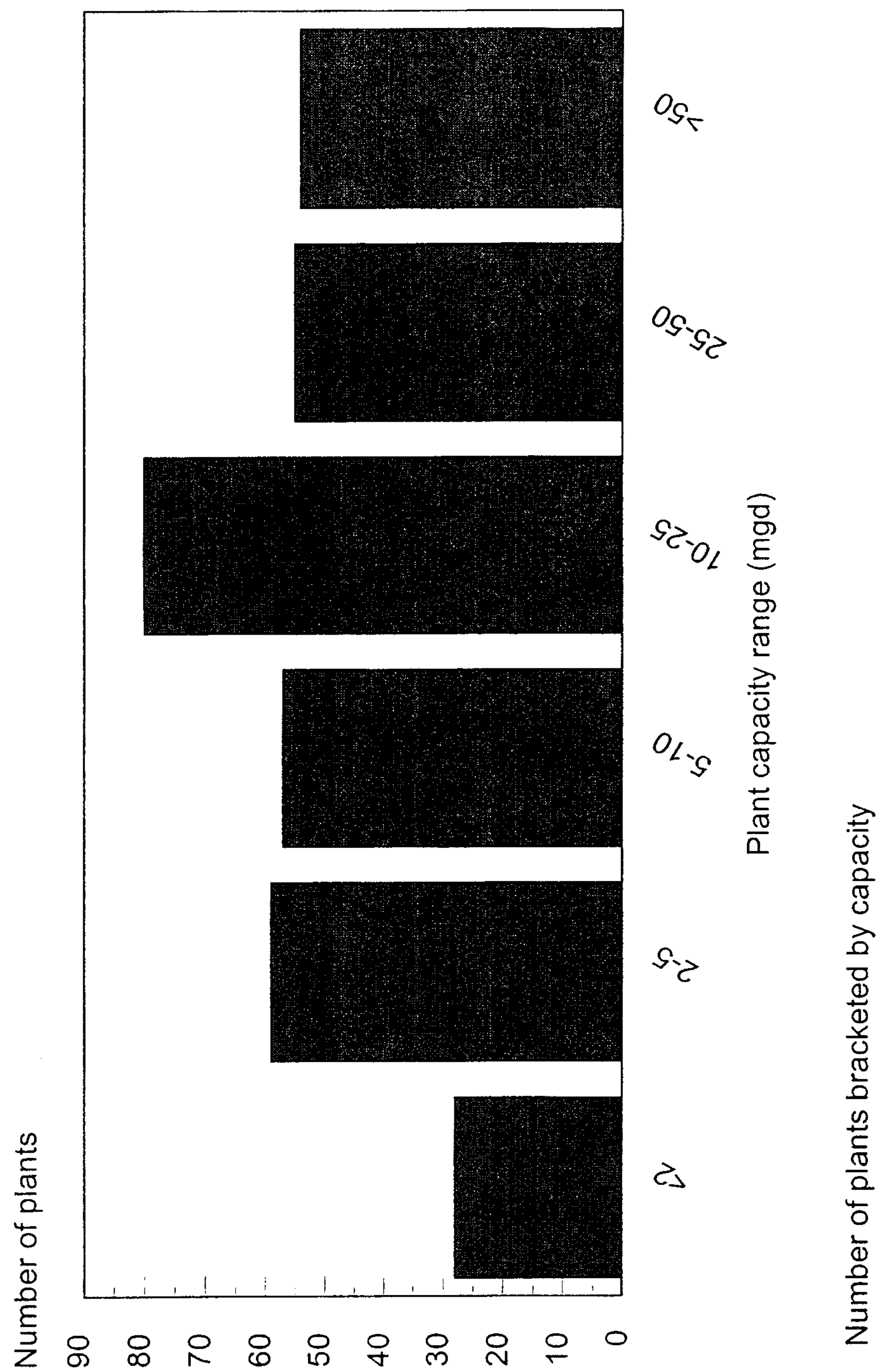
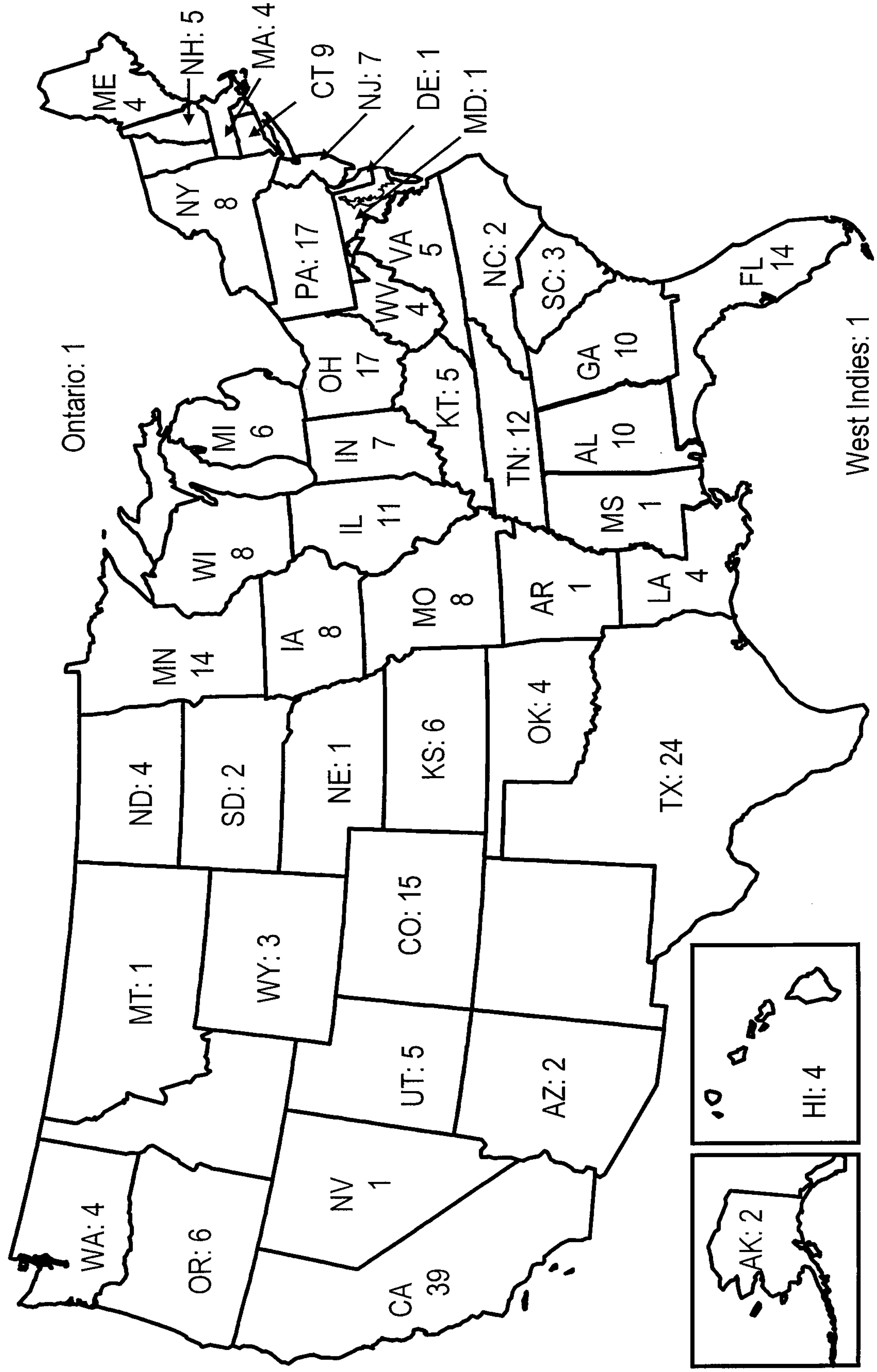


**Figure IV.12 Number of Plants per State Included in AWWA Recycle Survey**

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i. Recycle practice

Data summarized in Table IV.14 show that 78 percent of plants in the database rely on a surface water as their source. The percentage of plants using source water influenced by a surface water (which may contain *Cryptosporidium*) could be higher because the data do not report whether wells were pure ground water or GWUDI.

TABLE IV.14.—SOURCE WATER USED BY FAX SURVEY PLANTS

| Source water type | Percent of plants |
|---|---|
| Surface Water | 78 |
| River | 27 |
| Reservoir | 28 |
| Lake | 16 |
| Other | 7 |
| Well [1] | 22 |

[1] Wells sources not defined as either ground water or ground water under the direct influence of surface water.

Table IV.15 shows that a wide variety of treatment process types are included in the data, with conventional filtration (rapid mix, coagulation, sedimentation, filtration) representing over half of the plants submitting data. Upflow clarification is the second most common treatment process reported. Ten percent of plants in the database use direct filtration. Only four percent of plants do not use rapid granular filtration.

TABLE IV.15.—TREATMENT TRAINS OF FAX SURVEY PLANTS

| Treatment process type | Percent of plants [1] |
|---|---|
| Rapid mix, coagulation, filtration | 51 |
| Upflow clarifier | 21 |
| Softening | 14 |
| Direct filtration | 10 |
| Other | 4 |

[1] 96 percent of plant in the database provide filtration.

Table IV.16 indicates that a vast majority of plants recycle prior to the point of primary coagulant addition. Only six percent of plants returned recycle in the sedimentation basin or just prior to filtration.

TABLE IV.16.—RECYCLE RETURN POINT OF FAX SURVEY PLANTS

| Return point | Percent of plants |
|---|---|
| Prior to point of primary coagulant addition | 83 |
| Pre-sedimentation (e.g., rapid mix) | 11 |
| Sedimentation basin | 4 |
| Before filtration | 2 |

Table IV.17 shows that the majority of plants in the database provide some type of treatment for the recycle flow prior to its reintroduction to the treatment process. Approximately 70 percent of plants reported providing treatment, with sedimentation being employed by over half of these plants. Equalization, defined as a treatment technology by the survey, is practiced by 20 percent of plants in the database. Fourteen percent of plants reported using both sedimentation and equalization.

TABLE IV.17.—RECYCLE TREATMENT AT FAX SURVEY PLANTS

| Treatment type | Percent of plants |
|---|---|
| No treatment | 30 |
| Treatment | 70 |
| Sedimentation | 54 |
| Equalization | 20 |
| Sedimentation and equalization | 14 |
| Lagoon | 5 |
| Others | 7 |

Table IV.18 summarizes recycle treatment practice and frequency of direct recycle based on population served. The table illustrates that, for plants supplying data, treatment of recycle with sedimentation is provided more frequently as plant service population deceases. Plants serving populations of less than 10,000 recycle directly (27.5 percent) less frequently than plants serving populations greater than 100,000 (50 percent). The data indicate that a majority of small plants in the database may have installed equalization or sedimentation treatment to protect treatment process integrity from recycle induced hydraulic disruption. All direct filtration plants in the FAX survey provide recycle treatment or equalization.

TABLE IV.18.—RECYCLE PRACTICE BASED ON POPULATION SERVED [1]

| Population served | Recycle practice | | | |
|---|---|---|---|---|
| | #Plants | Equalization | Sedimentation | Direct recycle |
| <10,000 | 43 | 9% (n=4) | 67% (n=29) | 23% (n=10) |
| 10,000–50,000 | 79 | 10% (n=8) | 57% (n=45) | 33% (n=26) |
| 50,000–100,000 | 35 | 17% (n=6) | 54% (n=19) | 29% (n=10) |
| 100,000 | 65 | 35% (n=23) | 23% (n=15) | 42% (n=27) |

[1] Based on 222 surface water plants suppling all necessary data to make determination.

FAX survey data support the following conclusions regarding the recycle practice of plants supplying data: (1) The recycle of spent filter backwash and other process streams is a common practice; (2) the majority of recycle plants use surface water as their source and are thereby at risk from *Cryptosporidium*; (3) a large majority of plants providing data recycle prior to the point of primary coagulant addition, and; (4) a majority of plants supplying data provide treatment for recycle waters prior to reintroducing them to the treatment plant. The FAX survey provides an informative snapshot of national recycle practices due to the number of recycle plants it includes, the geographic distribution of respondents, and the good representation of plants serving populations of less than 10,000 people.

ii. Options to recycle.

The FAX survey asked whether feasible alternatives to recycle are available (i.e., NPDES surface water discharge permit, pretreatment permit for discharge to POTW) and the importance of recycle to optimizing treatment performance and meeting production requirements. Responses to these questions is summarized in Table IV.19.

Table IV.19 shows that approximately 20 percent of respondents could not obtain either an NPDES surface water discharge permit or a pretreatment permit for discharge to a POTW. Approximately 90 percent of respondents stated that recycle flow is not important to meet typical demand.

Twenty-four percent of all respondents stated that returning recycle to the treatment process is important for optimal operation. ''Optimal operation'' was not defined by the survey and respondents may have considered not changing current plant operation (e.g., not changing current recycle practice) an aspect of optimal treatment, rather than addressing whether recycle practice is important for the plant to produce the highest quality finished water.

TABLE IV.19.—OPTIONS TO RECYCLE AS REPORTED BY FAX SURVEY PLANTS [1]

| Question | Percent Yes | Percent No | Percent Unknown |
|---|---|---|---|
| Able to obtain NPDES surface discharge permit? | 41% (n=131) | 37% (n=120) | 22% (n=70) |
| Able to obtain pretreatment permit for POTW discharge? | 43% (n=137) | 42% (n=136) | 15% (n=48) |
| Can obtain either an NPDES or a POTW discharge permit? | 60% (n=192) | 19.5% (n=63) | 20.5% (n=66) |
| Is recycle important to meet peak demand? | 14% (n=44) | 80% (n=257) | 6% (n=20) |
| Is recycle important to meet typical demand? | 9% (n=28) | 85% (n=272) | 6% (n=21) |
| Is recycle important to optimal operation? (All plants in survey) | 24% (n=75) | 70% (n=225) | 6% (n=21) |
| Is recycle important to optimal operation? [2] (softening plants only) | 13% (n=3) | 83% (n=19) | 4% (n=1) |

[1] Number of plants varies from question to question due to different response rates.
[2] Optimal operation not defined by survey. May include overall plant operation rather than importance of recycle to producing highest possible quality finished water.

iii. Conclusions

The ICR and FAX survey data are complimentary, as the ICR data supplies a wealth of data regarding recycle practices at large capacity plants, while the FAX Survey provides data on recycle practices over a range of plant capacities. Taken together, the two data sets provide a good picture of current recycle practice. The data indicate that recycle is a common practice for plants sampled. Approximately half of the respondents providing data return recycle flow to the treatment process and 70 percent provide some type of recycle treatment. Sedimentation and equalization are the two most commonly employed treatment technologies for plants supplying data. Approximately 80 percent of plants sampled return recycle prior to the point of primary coagulant addition. Examining the recycle practices of plants in the ICR and FAX survey data show that small plants (*i.e.*, fewer than 10,000 people served) are more than twice as likely as large plants (*i.e.*, greater than 100,000 people served) to provide sedimentation for recycle treatment (58 versus 26 percent).

The FAX survey responses show that approximately half of plants providing data have an option to recycle return, whether it be an NPDES surface water discharge permit or discharge to a POTW. Eighty-five percent of respondents stated that recycle flow is not important to meet peak demand. Less than a quarter of respondents have monitored pathogen concentrations in backwash water and fewer than half have any monitoring data to characterize the quality of the backwash water.

3. Recycle Provisions for PWSs Employing Rapid Granular Filtration Using Surface Water or Ground Water Under the Direct Influence of Surface Water

a. Return Select Recycle Streams Prior to the Point of Primary Coagulant Addition

i. Overview and Purpose

Today's proposal requires that systems employing rapid granular filtration and using surface water or GWUDI as a source return filter backwash, thickener supernatant, and liquids from dewatering processes to the primary treatment process prior to the point of primary coagulant addition. The goal of this provision is to protect the integrity of chemical treatment and ensure these recycle streams are passed through as many physical removal processes as possible to provide maximum opportunity for removal of *Cryptosporidium* oocysts from the recycle flow. Since *Cryptosporidium* is resistant to standard disinfection practice, it is important that chemical treatment be optimized to protect treatment plant efficiency and that all available physical removal processes be employed to remove it.

Today's proposal requires these flows be returned prior to the point of primary coagulant addition because these streams are either of sufficient volume to cause hydraulic disruption within the treatment process when recycled and/or are likely to contain *Cryptosporidium* oocysts. Minor recycle streams, such as lab sample lines, pump packing water, and infrequent process overflows are not likely to threaten plants' hydraulic stability or contain appreciable numbers of oocysts.

Treatment plant types that need to return recycle to a location other than prior to the point of primary coagulant addition to maintain optimal treatment performance (optimal performance as indicated by finished water or intra-plant turbidity levels), plants that are designed to employ recycle flow as an intrinsic component of their operations, plants with very low influent turbidity levels that may need alternative recycle locations to obtain satisfactory suspended solids removal, or other types of plants constrained by unique treatment considerations, may apply to the State to recycle at an alternative location under today's proposal. Once approved by the State, plants may recycle to the specified location.

ii. Data

Data from the ICR and FAX Survey indicate that 75 and 78 percent of plants, respectively, return recycle prior to the point of primary coagulant addition. The ''point of primary coagulant addition'' was defined in both analyses as the return of recycle prior to the rapid mix unit. The FAX Survey data indicate that 77 percent of plants serving under 10,000 people recycle prior to the point of primary coagulant addition. It also showed that 78 percent percent of all plants in the database return recycle there, which suggests that plants serving smaller populations may return recycle prior to the point of primary coagulant addition as frequently as plants serving larger populations. Other common recycle return locations are the rapid mix unit, between rapid mix and clarification, or into the clarification unit itself.

The Agency does not believe filter backwash, thickeners supernatant, or liquids from dewatering processes should be recycled at the point of primary coagulant addition or after it for three reasons:

(1) Addition of these recycle streams, which can contain residual coagulant and other treatment chemicals, after the location of primary coagulant addition, may render the chemical dose applied less effective, potentially harming the efficiency of subsequent treatment processes;

(2) Introduction of recycle into the flocculation unit or clarification unit may create hydraulic currents that exacerbate or create short circuiting, and;

(3) Recycle introduced into the clarification process may not experience sufficient residence time for adequate solids removal to occur.

The Agency is concerned that plants may not adjust chemical dosage during recycle events to account for: (1) The presence of a potentially significant amount of residual treatment chemical in recycle flow and changes in recycle flow quality, and; (2) potentially large fluctuations in plant influent flow during recycle events. EPA is concerned that changes in influent water quality and flow are not monitored on an instantaneous basis during recycle events. Since the chemistry of the recycle flow and source water may differ significantly, it is important plants mix source and recycle water to establish a uniform chemistry prior to applying treatment chemical so the dose is appropriate for the mixture. Additionally, wide fluctuation in plant influent flow during recycle events may cause chemical over-or under-dosing, which can lower overall oocyst removal efficiency. In an article concerning optimization of filtration performance, Lytle and Fox (1996) state, ''The capability to instantaneously monitor treatment processes and rapidly and effectively respond to raw and filter effluent quality changes are important factors in consistently producing low turbidity water.'' Logdson (1987) further states, ''For a plant to be operated properly, the total flow rate has to be known on an instantaneous basis or by volumetric measurement.'' EPA believes it is important plants diligently monitor the appropriateness of chemical dosing at all times, but particularly during recycle events, and strive for real-time chemical dose and influent flow management to optimize plant oocyst removal.

Pilot-scale research conducted by Patania *et al.* (1995) to examine the optimization of filtration found that chemical pretreatment was the most important variable determining oocyst removal by filtration. Edzwald and Kelley (1998) performed pilot-scale work to determine the ability of sedimentation, DAF, and filtration to remove *Cryptosporidium* and found that coagulation is critical to effective *Cryptosporidium* control by clarification and filtration. Bellamy *et al.* (1993) stated that the most important factor in plant performance is the use of optimal chemical dosages. Coagulation was recognized as the single most important step in the process of water clarification by Conley (1965). Ten pilot scale runs performed by Dugan *et al.* (1999) showed that coagulation has a large influence on the log removal of *Cryptosporidium* achieved by sedimentation. The importance of proper coagulation to filter performance was noted by Robeck *et al.* (1964) in pilot and full-scale work that showed proper coagulation is more important to the production of safe water than the filtration rate used. Results of direct filtration pilot studies, summarized by Trussell *et al.* (1980), showed that ''effective coagulant is absolutely necessary if good effluent qualities are to be consistently produced.''

Given the critical role proper chemical dosing plays in maintaining effective clarification and filtration processes, the Agency believes it is prudent and necessary to minimize the possibility recycle of spent filter backwash, thickener supernatant, and dewatering liquids will render chemical dosages applied during recycle events inaccurate, due to the presence of residual chemical or variations in influent flow, by requiring they be returned prior to the point of primary coagulant addition.

Finally, a fundamental tenet of water treatment is multiple treatment barriers should be provided to prevent microbial pathogens from entering finished water. To achieve this, conventional plants rely on coagulation, flocculation, clarification, and filtration as preventive microbial barriers. The Agency believes it is important that recycle waters be passed through each of these treatment processes to maximize the probability disinfection resistant oocysts will be removed in the plant and not enter the finished water supply.

iii. Proposed Requirements

Today's proposal requires that rapid granular filtration plants using surface water or GWUDI as a source return filter backwash, thickener supernatant, and liquids from dewatering processes prior to the point of primary coagulant addition. Plants that require an alternative recycle return location to maintain optimal finished water quality (as indicated by finished water or intra-plant turbidity levels), plants that are designed to employ recycle flow as an intrinsic component of the treatment process, or plants with unique treatment requirements or processes may apply to the State to return recycle flows to an alternative location. Plants may utilize this alternative location once granted by the State. EPA will develop detailed guidance and make it available to States and PWSs.

Softening systems may recycle process solids, but not spent filter backwash, thickener supernatant, or liquids from dewatering processes, at the point of lime addition immediately preceding the softening process to improve treatment efficiency. Literature establishes that return of process solids to point of lime addition decreases production of nuclei, increases the rate of crystallization, and increases crystal size, all of which enhance settling and process integrity (Randtke, 1999; Snoeyink and Jenkins, 1980). Contact clarification systems may recycle process solids, but not spent filter backwash, thickener supernatant, or liquids from dewatering processes, directly into the contactor to improve treatment efficiency.

iv. Request for Comments

EPA requests comment on the proposed requirements. The Agency also requests comment on the following aspects of this provision:

(1) What regulatory options are available to ensure direct recycle plants practice real-time chemical dose and influent flow management? Should flow-paced coagulant feed be required at direct recycle plants to minimize potential harmful impacts of recycle? What regulatory requirements may be applicable to ensure the integrity of the coagulation process?

(2) What treatment processes or treatment configurations may need an alternative recycle location to maintain optimal treatment?

(3) What alternative recycle locations are appropriate for such treatment configurations and what location may be inappropriate?

(4) Are there other reasons, beyond maintaining optimal treatment efficiency, to justify granting alternate recycle locations to plants? What are they?

(5) What criteria, operating practices, or other parameters should be evaluated to determine whether an alternative recycle return location should be granted?

(6) Does recycling at the point of primary coagulant addition, instead of prior to it, provide assurance that an appropriate dose of treatment chemicals will be consistently applied during recycle events? Is it necessary to mix the recycle and raw water prior to chemical addition to ensure a consistent water chemistry for chemical dosing?

(7) Are there circumstances where it would be appropriate to allow systems to recycle at the point of primary coagulant addition?

b. Recycle Requirements for Systems Practicing Direct Recycle and Meeting Specific Criteria

i. Overview and Purpose

Today's proposal requires that self assessments be performed at conventional filtration plants meeting all of the following criteria and the results of the self assessment reported to the State. The criteria are:

(1) Use of surface water or GWUDI as a source;

(2) Employ of 20 or fewer filters to meet production requirements during the highest production month in the 12 month period prior to LT1FBR's compliance date, and;

(3) Recycle spent filter backwash or thickener supernatant directly to the treatment process (*i.e.,* recycle flow is returned within the treatment process of a PWS without first passing the recycle flow through a treatment process designed to remove solids, a raw water storage reservoir, or some other structure with a volume equal to or greater than the volume of spent filter backwash water produced by one filter backwash event.)

The goal of the self assessment is to identify those direct recycle plants that exceed their State approved operating capacity, on an instantaneous basis, during recycle events. Plants are required to submit a monitoring plan to the State prior to conducting the month long self assessment monitoring. Results of self assessment monitoring must be reported to the State. The State is required to determine, by reviewing the self assessment, whether the plant's current recycle practice should be modified to protect plant performance and provide an additional measure of public health protection. The State is required to report its determination for each plant performing a self assessment to EPA and briefly summarize the reason(s) supporting each determination.

EPA selected the three aforementioned criteria to identify plants required to perform a self assessment for the following reasons. First, surface or GWUDI source waters may contain *Cryptosporidium*. Second, the hydraulic impact of recycle to plants typically employing more than 20 filters to meet production requirements should be dampened because plant influent flow is of significantly greater magnitude than the flow produced by a backwash event. Third, plants that practice direct recycle of filter backwash and/or thickener supernatant may exceed their operating capacity during recycle events due to the large volume of these streams.

ii. Data

Plants that recycle filter backwash and thickener supernatant, directly, without recycle flow equalization or treatment, may exceed their operating capacity during recycle events. Table IV.20 illustrates the magnitude by which direct recycle plants may exceed their operating capacity during recycle events. For purposes of the table, operating capacity is assumed to be either plant design flow or average flow (see example below). The values in the table are conservative, as they are likely to over predict the factor by which direct recycle plants will exceed operating capacity during recycle events. This conservatism is due to the assumed filter backwash rate of 15 gpm/ft$^2$ and the assumed backwash duration of 15 minutes, the minimum backwash rate and duration recommended by the Great Lakes-Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers (1997). Design and average flow values assumed for plant operating capacity were developed from equations presented in EPA's baseline handbook (1999g). For purposes of this example, plant design and average flow are assumed to equal State approved operating capacity to illustrate the potential for plants to exceed operating capacity during recycle events. Relevant equations and example calculations are shown below.

*Example*

(1) Design to average ratios:

design flow < .25 mgd; ratio design flow : average flow = 3.2:1
design flow > .25 mgd to 1 mgd; ratio design flow : average flow = 2.8:1
design flow > 1 mgd to 10 mgd; ration design flow : average flow = 2.4:1
design flow > 10 mgd; ratio design flow : average flow = 2.0:1

(2) Maximum filter size: 700 sq./ft$^2$ (EPA, 1998a)

(3) Backwash volume calculation:

Filter area (ft$^2$) $\times$ 15 gpm/ft$^2$ $\times$ 15 minutes = volume of one backwash

(4) Design and average capacity exceedence factors:

(Backwash flow + design (or average) flow) ÷ design flow = exceedence factor

(5) Percent Influent that is recycle:

Backwash flow ÷ (Backwash flow + design (or average flow)) = percent of influent that is backwash

(6) Design flow = State approved operating flow

TABLE IV.20.—IMPACT OF DIRECT RECYCLE

| Design flow (MGD) | Number of filters | Area of one filter (sq. ft) | Volume of one backwash (gallons) | Backwash return flow (15 minute return; gpm) | Design flow (gpm) | Average flow (gpm) | Factor design flow is exceeded by during recycle (at design flow) | Percent influent that is recycle (at design flow) (percent) | Factor design flow is exceeded by during recycle (at average flow) | Percent influent that is recycle (at average flow) (percent) |
|---|---|---|---|---|---|---|---|---|---|---|
| .033 | 2 | 5 | 1,125 | 75 | 23 | 7 | 4.3 | 77 | 3.6 | 91 |
| .669 | 4 | 50 | 11,250 | 750 | 465 | 166 | 2.6 | 62 | 2.0 | 82 |
| 2.02 | 6 | 100 | 22,500 | 1,500 | 1,403 | 584 | 2.1 | 52 | 1.5 | 72 |
| 8.8 | 8 | 320 | 72,000 | 4,800 | 6,111 | 2,546 | 1.8 | 44 | 1.2 | 65 |
| 14.5 | 10 | 425 | 95,625 | 6,375 | 10,069 | 5,135 | 1.6 | 39 | 1.1 | 55 |
| 42.44 | 18 | 700 | 157,500 | 10,500 | 29,472 | 14,736 | 1.4 | 26 | .86 | 42 |
| 56.23 | 24 | 700 | 157,500 | 10,500 | 39,048 | 19,524 | 1.3 | 21 | .77 | 35 |

The purpose of Table IV.20 is to illustrate the impact direct recycle can have on plant hydraulic loading and the factor by which plant operating capacity can be exceeded during recycle events. As shown in Table IV.20, a plant with two filters would process influent at over three times its operating capacity during a recycle event. Even if the plant reduced or eliminated its raw water influent flow for the duration of the event, the remaining filter would be subject to a loading rate that exceeds its operating capacity, which could harm finished water quality.

The amount of sedimentation basin or clarification process storage available during recycle events will have an impact on the hydraulic loading to the filters and the performance of the sedimentation or clarification process. The actual increase to filter loading rates may be less than predicted in Table IV.20 due to site-specific conditions. However, the potential for direct recycle plants to exceed operating capacity is cause for concern because oocyst removal can be compromised. The Agency believes 20 filters is an appropriate number for specifying which plants are required to perform a self assessment due to the results in Table IV.20 and the above considerations.

The importance of maintaining proper plant hydraulics has been acknowledged, notably by Logdson (1987) who wrote, ''Both the quantity and quality of filtered water can be affected by plant hydraulics. Maximum hydraulic capacity is an obvious limitation. The adverse influences of rate of flow and flow patterns on water quality may not be so obvious, but they can be important.'' Fulton (1987) recognized that short circuiting can diminish the performance of settling basins, cause overloading of filters, and increase breakthrough of turbidity. Other publications (Cleasby, 1990) recognize that settled water quality deteriorates when the surface loading rate of sedimentation basins is increased. Direct recycle practice can give rise to short circuiting, cause plant operating capacity to be exceeded, and increase surface loading rates, all of which can be detrimental to *Cryptosporidium* removal.

Direct recycle practice can abruptly increase filter loading rates, which has been shown to lower filter performance. Cleasby et al. (1963) performed experimental runs with three pilot plant filters by increasing the filtration rate ten, twenty-five, and fifty-percent over various time periods and monitoring the passage of a target material during the rate increase. Conclusions drawn from the experiments were:

(1) Disturbance in filtration rate can cause filters to pass previously deposited material and the amount of material passed is dependent on the magnitude of the rate disturbance;

(2) More rapid disturbances cause more material to be flushed through the filter;

(3) The amount of material flushed through the filter is independent, or very nearly independent of disturbance's duration, and;

(4) The amount of material flushed through the filter following a disturbance is dependent on the type of material being filtered.

Pilot scale work was recently performed by Glasgow and Wheatley (1998) to investigate whether surges affect filtrate quality. Effluent turbidity and headloss within the filter media were monitored for two pilot filter columns that were surged at different magnitudes. The results were compared to control runs through the same pilot columns to determine the effect of the surge. Results indicated that surging may significantly affect full scale filter performance. Additional work is needed to confirm these results.

Recent pilot scale work by McTigue *et al.* (1998) examined the impact of doubling the filter loading instantaneously and gradually (over an 80 minute period) on pilot filters that had been in operation for a period of time or were ''dirty.'' The experiments showed that *Cryptosporidium* removal achieved by the filters was lowered by changes in filtration rate regardless of whether loading rate was increased instantaneously or gradually. In the experiment, filter loading rates of 2 gpm/ft$^2$ and 4 gpm/ft$^2$ were doubled in six separate test runs to determine whether oocysts removal was affected. Results showed that log removal of oocysts was reduced by approximately 1.5 to 2.0 logs for when filter loading rates of 2 gpm/ft$^2$ and 4 gpm/ft$^2$ were either instantaneously and gradually doubled. The report states, ''These data clearly demonstrate that any change in filter loading rate on a filter that is dirty presents a risk for breakthrough of *Giardia* and *Cryptosporidium* to the finished water, should these organisms be present in the filter.'' Effluent turbidity values remained low during increases in filter loading rates but particle count concentrations immediately increased with increases in loading rate. This may indicate that turbidity is not a good indicator of oocyst passage by dirty filters during filtration rate increases.

Results of three other pilot runs from the study showed that log removal of oocysts did not change when the influent oocyst concentration varied and all other treatment conditions were held constant. A four log removal of oocysts was obtained for all three runs despite influent oocyst concentrations of 4,610/L, 688/L, and 26/L. The report states, ''This finding indicates that the risk for passage of large numbers of cysts to the finished water is greater when a water treatment plant receives a highly concentrated slug of cysts at its intake.'' The Agency believes this is an interesting conclusion, even though it is based on a limited number of pilot runs. If further pilot and full-scale work verifies this finding, it indicates that log removal of oocysts does not increase as more oocysts are loaded to plant. Recycle of flows containing oocysts would therefore increase the number of oocysts present in finished water, relative to the number of oocysts that would occur were recycle not practiced, because plant treatment efficiency would not increase to remove the additional oocysts returned by recycle.

In summary, the Agency is concerned that direct recycle of spent filter backwash, thickener supernatant, and liquids from dewatering process may increase the risk of oocyst occurrence in finished water for the following reasons:

(1) Sampling has established that oocysts occur in finished water supplies (see Table II.6 of this preamble);

(2) Data show that oocysts occur in recycle streams;

(3) Literature indicates that hydraulically overloading the sedimentation process, as may happen during direct recycle events, can harm sedimentation performance;

(4) Literature indicates increasing or abruptly changing filtration rates can lead to more material passing through filters, and;

(5) Recent pilot scale work by McTigue *et al.* (1998) and Glasgow and Wheatley (1998) indicates that filter performance can be harmed by surges and changes to filtration rate.

The Agency encourages the States to closely examine recycle self assessments performed by direct recycle plants to determine whether direct recycle poses an unacceptable risk to finished water quality and public health and needs to be modified due to the considerations cited above.

Finally, EPA realizes that State programs may use different methodologies to set plant operating capacity. States may also apply safety factors of different magnitudes when determining operating capacity. The Agency does not believe it is appropriate to erode any safety factor or margin of safety States provide when setting operating capacity. Safety factors are provided for a reason: to provide a margin of safety to public health protection efforts. The integrity and magnitude of a safety factor should be maintained, as it is in and of itself integral to adequate public health protection. The fact a safety factor is applied when plant operating capacity is set is not a justification, *a priori,* for allowing plants to operate above said operating capacity during recycle events.

EPA also acknowledges that States may use different methodologies to set plant operating capacity. The Agency is confident that the State programs, its partners in public health protection, set plant capacity to provide necessary level of public health protection. The fact that some State programs may set plant operating capacities with different methodologies likely reflects geographical conditions and public expectations unique to certain States and sections of the country. EPA believes methodologies employed by the States results in establishment of operating capacities necessary to protect public health, meet regulatory requirements, and satisfy unique treatment needs and considerations where they exist.

iii. Proposed Requirements

Self assessments must be performed at plants meeting all of the following criteria and the results of the self assessment reported to the State:

(1) Use surface water or GWUDI as a source and employ conventional rapid granular filtration treatment;

(2) Employ of 20 or fewer filters to meet production requirements during the highest production month in the 12 month period prior to LT1FBR's compliance date, and;

(3) Recycle spent filter backwash or thickener supernatant directly to the treatment process (*i.e.,* recycle flow is returned within the treatment process of a PWS without first passing the recycle flow through a treatment process designed to remove solids, a raw water storage reservoir, or some other structure with a volume equal to or greater than the volume of spent filter backwash water produced by one filter backwash event).

Systems are required to develop and submit a recycle self assessment monitoring plan to the State no later than three months after the rule's compliance date for each plant the requirements are applicable to. At a minimum, the monitoring plan must identify the month during which monitoring will be conducted, contain a schematic identifying the location of raw and recycle flow monitoring devices, describe the type of flow monitoring devices to be used, and describe how data from the raw and recycle flow monitoring devices will be simultaneously retrieved and recorded.

The self assessment of recycle practices shall consist of the following five steps:

(1) From historical records, identify the month in the calendar year preceding LT1FBR's effective date with the highest water production.

(2) Perform the monitoring described below in the twelve month period following submission of the monitoring plan to the State.

(3) For each day of the month identified in (1), separately monitor source water influent flow and recycle flow before their confluence during one filter backwash recycle event per day, at three minute intervals during the duration of the event. Monitoring must be performed between 7:00 a.m. and 8:00 p.m. Systems that do not have a filter backwash recycle event every day between 7:00 am and 8:00 p.m. must monitor one filter backwash recycle event per day, any three days of the week, for each week during the month of monitoring, between 7:00 a.m. and 8:00 p.m. Record the time filter backwash was initiated, the influent and recycle flow at three minute intervals during the duration of the event, and the time the filter backwash recycle event ended. Record the number of filters in use when the filter backwash recycle event is monitored.

(4) Calculate the arithmetic average of all influent and recycle flow values taken at three minute intervals in (3). Sum the arithmetic average calculated for raw water influent and recycle flows. Record this value and the date the monitoring was performed. This value is referred to as event flow.

(5) After monitoring is complete, order the event flow values in increasing order, from lowest to highest, and identify the monitoring events in which plant operating capacity is exceeded.

Systems are required to submit a self assessment report to the State within one month of completing the self assessment monitoring. At a minimum, the report must provide the following information:

(1) All source and recycle flow measurements taken and the dates they were taken. For all events monitored, report the times the filter backwash recycle event was initiated, the flow measurements taken at three minute intervals, and the time the filter backwash recycle event ended. Report the number of filters in use when the backwash recycle event is monitored.

(2) All data and calculations performed to determine whether the plant exceeded its operating capacity. Report the number of event flows that exceed State approved operating capacity.

(3) A plant schematic showing the origin of all recycle flows, the hydraulic conveyance used to transport them, and their final destination in the plant.

(4) A list of all the recycle flows and the frequency at which they are returned to the plant.

(5) Average and maximum backwash flow through the filters and the average and maximum duration of backwash events in minutes, for each monitoring event, and;

(6) Typical filter run length, number of filters typically employed, and a written summary of how filter run length is determined (preset run time, headloss, turbidity level).

EPA is proposing that the State review all self assessments submitted by PWSs and report to the Agency the below information as it applies to individual plants:

(1) A finding that modifications to recycle practice are necessary, followed by a brief description of the required change and a summary of the reason(s) the change is required, or;

(2) A finding that changes to recycle practice are not necessary and a brief description of the reason(s) this determination was made.

The Agency also considered requiring all recycle plants without existing recycle flow equalization or treatment to install recycle flow equalization. As summarized in Table IV.21, several recommendations for recycle equalization and treatment have been provided. However, these recommendations are based on theoretical calculations and/or limited pilot-scale data that has not been verified by full-scale plant performance data. The Agency currently believes insufficient data is available to determine whether recycle flow equalization is necessary to protect finished water quality, and, if it is, the level of equalization required to provide protection to finished water supplies for a wide variety of source water qualities, treatment process types, and levels of treatment effectiveness. The Agency does not believe it is appropriate at this time to propose a national recycle flow equalization requirement for the following reasons:

(1) Data on the occurrence of oocysts in recycle streams, and their impact to

finished water quality upon recycle, is very limited;

(2) Data that establishes the magnitude of hydraulic disruption caused by direct recycle events for a variety of plant types, designs, and operational practices has not been identified; without this data, it is not possible to quantify how much treatment efficiency is reduced by the hydraulic disruption and the number of oocysts in the recycle flow that will enter the finished water due to the disruption. Without this information, it is not possible to specify the level of equalization necessary to control hydraulic disruption for a variety of plant configurations and operational practices with any degree of certainty and cost effectiveness, and;

(3) A uniform, national equalization standard may not be appropriate because it would not allow consideration of site-specific factors such as plant treatment efficiency, loading capacity of clarification and filtration units, source water quality, and other site-specific factors that influence the level of equalization a plant may need to control recycle event induced hydraulic disruption.

EPA believes some plants can realize substantial benefit by installing recycle flow equalization and will review data to determine the need for an equalization requirement when it becomes available. The Agency requests that commenters submit the following pilot or full-scale data to assist its effort to conduct a thorough analysis of equalization based upon the best available science:

(1) Data on the magnitude of hydraulic disruption caused by recycle events and its affect on finished water turbidity and particle count levels;

(2) Data that correlate hydraulic disruption to increased oocyst concentration in finished water, and;

(3) Any other data commenters believe that may be appropriate to analyze the need for equalization, and;

(4) Whether the regulation should require States to specify modifications to recycle practice, for all plants that exceed operating capacity during monitoring, to ensure said plants' remain below their State approved operating capacity during recycle events.

TABLE IV.21—RECOMMENDED EQUALIZATION PERCENTAGES

| Source of recommendation [a] | Equalization Percentage | Is recycle treatment recommended? |
|---|---|---|
| Recommended Standards for Water Works. Great Lakes—Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers. 1997. Albany: Health Education Services. | 10% | No. |
| Removal of *Cryptosporidium* Oocysts by Water Treatment Process. Foundation for Water Research Limited, United Kingdom (1994). | 10% | Yes. Turbidity less than 5.0 NTU or residual of 10mg/L suspended solids in treated recycle flow. |
| Recycle Stream Effects on Water Treatment. Cornwell, D., and R. Lee. 1993. Denver: AWWARF. | Use equalized, continuous recycle. | Use proper waste stream treatment prior to recycle. |

[a] See the reference list at the end of the preamble for complete citations.

Finally, the Agency considered requiring conventional filtration plants that recycle within the treatment process to provide sedimentation or more advanced recycle treatment and concluded a national treatment requirement is inappropriate at this time due data deficiencies. The Agency believes the following data is necessary to determine whether recycle flow treatment is necessary to protect public health and the requisite level of treatment:

(1) Significant amounts of additional data on the occurrence of oocysts for a complete range of recycle streams generated by a wide variety of source water qualities, treatment plant types, plant operational and recycle practices, and plant treatment efficiencies;

(2) Data that correlates recycle stream oocyst occurrence to finished water occurrence;

(3) Additional data on the ability of full-scale sedimentation basins to remove oocysts during normal operation and during recycle events. The Agency has identified only three full-scale studies, States *et al.* (1995), Baudin and Laine (1998), and Kelly *et al.* (1995), that allow quantification of oocyst removal by sedimentation basins. Pilot scale work, such as Edzwald and Kelley (1998) and Dugan *et al.* (1999) is also available, but the number of studies is not extensive. The removal achieved by sedimentation and other clarification processes is critical for determining the number of oocysts loaded to the filters, the likely concentration of oocysts in various recycle streams, and the impact recycle may have on intra-plant oocyst concentrations. Good oocyst removal in the clarification process will remove a large percentage of oocysts from recycle and source water flows before they reach the filters. The amount of removal provided by primary clarification therefore has a large influence on the level of recycle flow treatment that may be needed to mitigate risk to finished water quality. Given that data on oocyst removal by sedimentation and other clarification processes is very limited, the Agency does not believe it is possible to assess the need for recycle treatment and specify a minimum treatment level that is meaningful for a wide variety of plant types and recycle practices;

(4) Data regarding the ability of DAF and other clarification processes to remove oocysts from recycle flow is very limited. This data is important, because the Agency anticipates plants may respond to any recycle treatment requirement by using DAF to treat recycle flow because of the advantages it provides relative to sedimentation. However, EPA has only identified four studies, Hall *et al.* (1995), Plummer *et al.* (1995), Edzwald and Kelley (1998), and Alvarez *et al.* (1999), that determined the ability of DAF to remove oocysts from source water. One study, by Grubb *et al.* (1997), addresses the ability of DAF to treat filter backwash waters has been identified, but sampling for oocyst removal was not performed, although turbidity and color removal were monitored and good results obtained. Additional data is needed to characterize the ability of DAF to remove oocysts from recycle flow before it can be used to meet any recycle treatment requirement;

(5) Full-scale data on the ability of sedimentation and other clarification processes to remove oocysts from recycle streams before they are returned to the plant is very limited. EPA has identified two studies, one by Cornwell and Lee (1993) and a study by Karanis *et al.* (1998) that provide data regarding

sedimentation's ability to remove oocysts from recycle flows. Additional information is needed to establish lower and upper bounds on the oocyst removal sedimentation can achieve; without this data, it is difficult to specify a feasible level of oocyst removal in a recycle flow treatment requirement;

(6) Microfiltration and ultrafiltration membranes appear to be very reliable at removing *Cryptosporidium* from source waters (Jacangelo *et al.,* 1995). However, the Agency has identified limited data regarding the ability of membranes to effectively treat recycle flow, and treatment of backwash with membranes may not be appropriate at all locations (Thompson *et al.,* 1995) due to incompatibility between membrane filter material and residual treatment chemical(s) in the backwash water. Additional information regarding the ability of microfiltration and ultrafiltration membranes to treat recycle flow is necessary to comprehensively evaluate their applicability, and;

(7) EPA is not aware of a surrogate, including turbidity, particle counts, or any other common and easy to measure parameter, that can serve as an indicator of the log removal of *Cryptosporidium* recycle flow treatment units achieve. The Agency does not believe it is economically or technically feasible to directly monitor oocyst removal by treatment units. Without an accurate, easy to measure surrogate for *Cryptosporidium* removal, the Agency does not believe it is possible to ascertain the level of treatment recycle flow treatment units achieve during routine operations.

Given the above limiting factors, the Agency does not believe it is prudent to establish a national recycle flow treatment requirement until additional data becomes available. EPA requests the following data be submitted:

(1) Data regarding intra-plant and recycle stream occurrence of oocysts;

(2) Information on the ability of individual treatment units of the primary treatment train to remove oocysts during normal, hydraulically challenged, and suboptimal chemical dose operations;

(3) Data on the ability of sedimentation and other clarification processes to remove oocysts from a wide range of recycle streams;

(4) Data on the compatibility of specific ultrafiltration and microfiltration membrane materials with residual chemicals that occur in recycle streams and data regarding the performance of these membrane materials at full and pilot scale, and;

(5) Information on potential surrogates that can be easily measured and can accurately establish the log removal of oocysts removed by recycle flow treatment processes.

iv. Request for Comments

EPA requests comment on the proposed requirements. The Agency also requests comment on the following:

(1) What other parameters could be monitored or what other overall monitoring schemes could be employed to assess whether a plant is exceeding its operating capacity?

(2) What data should the plant report to the State as part of its self assessment, beyond the monitoring data and other information listed above?

(3) Is monitoring during the highest flow month appropriate? Is monitoring during additional months necessary? Is daily monitoring necessary or would less frequent monitoring during the month be sufficient?

(4) Should systems be required to monitor and report turbidity measurements from a representative filter taken immediately preceding and after recycle events monitored during the self assessment to help characterize the impact of recycle on plant performance?

(5) Is limiting the self assessment to plants with 20 or less filters appropriate? Should the number of filters be less or greater than 20? What is the appropriate number of filters?

(6) Should systems be required to monitor sedimentation overflow rates or clarification loading rates while the recycle flow monitoring is performed?

(7) EPA requests comment on criteria that may identify recycle plants that could receive substantial benefit from implementing recycle equalization or treatment as a standard practice.

(8) What type and amount of data is required to determine whether recycle flow equalization would provide a benefit to finished water quality? What methodology could be used to determine an appropriate recycle flow equalization percentage, and how relevant are turbidity and particle counts, at various locations in a plant, to assessing an appropriate equalization percentage for a single plant or a plant type?

*d. Requirements for Direct Filtration Plants that Recycle Using Surface Water or GWUDI*

i. Overview and Purpose

Today's proposal requires direct filtration plants that recycle to report to the State whether flow equalization or treatment is provided for recycle flow prior to its return to the treatment process. The purpose of today's proposed requirement is to assess whether the existing recycle practice of direct filtration plants addresses potential risks. The Agency believes that direct filtration plants need to remove oocysts from recycle flow prior to reintroducing it to the treatment process.

ii. Data

Twenty-three direct filtration plants that used surface water responded to the FAX Survey (AWWA, 1998). In the FAX survey, plants could report whether they provide recycle flow equalization, sedimentation, or some other type of treatment. Of the respondents, 21 reported providing treatment for the recycle flow and two plants reported providing only equalization. In the ICR database, there were 23 direct filtration plants and fourteen of them recycled to the treatment process. All fourteen plants provide recycle treatment. It is not possible to determine the level of oocyst removal FAX survey and ICR plants achieve with available data.

The treatment train of a direct filtration plant does not have a clarification process to remove *Cryptosporidium* before they reach the filters; all oocyst removal is achieved by the filters. If recycle flow treatment is not provided, all of the oocysts captured in the filters will be returned to the treatment process in the recycle flow. Because a primary clarification process is not present to remove recycled oocysts, they are caught in a closed ''loop'' from which the only exit is passage through the filters into the distribution system. The Agency believes direct filtration plants should provide solids removal treatment for recycle flows to limit the number of oocysts returned to the treatment plant.

iii. Proposed Requirements

EPA is proposing that PWSs using direct filtration that recycle to the treatment process and utilize surface water or GWUDI as a source report data to the State that describes their current recycle practice. Plants should report the following information to the State:

(1) Whether recycle flow treatment or equalization is in place;

(2) The type of treatment provided for the recycle flow;

(3) If equalization, sedimentation, or some type of clarification process is used, the following information should be provided: a) physical dimensions of the unit (length, width, (or circumference) depth,) sufficient to allow calculation of volume and the

type, typical dose, and frequency with which treatment chemicals are used;

(4) The minimum and maximum hydraulic loading the treatment unit experiences, and;

(5) Maximum backwash rate, duration, typical filter run length, and the number of filters at the plant.

The State should use the above information to determine which plants need to modify recycle practice to provide additional public health protection. States are required to report to EPA whether they required individual direct filtration plants to modify recycle practice and provide a brief explanation of the reason(s) for the decision.

The Agency also considered requiring that all direct filtration plants provide a specific level of treatment for the recycle flow. However, data necessary to determine the appropriate level of treatment is unavailable. Specifically, the following data is needed:

(1) Data on the on the occurrence of oocysts in the spent filter backwash of direct filtration plants. Direct filtration plants generally use higher quality source water than conventional plants (AWWA, 1990) and it would be inaccurate to use spent filter backwash occurrence data from conventional plants to assess the level of treatment direct recycle plants may need;

(2) Data regarding the ability of sedimentation and other clarification processes to remove oocysts from recycle flows is needed to determine what may be a feasible level of treatment. This data need was treated to a detailed discussion in the previous section of the preamble;

(3) An easy to measure and accurate surrogate for oocyst removal is currently unavailable; without such a surrogate, it is not feasible to monitor the performance of recycle treatment units, and;

(4) Data on the applicability of microfiltration and ultrafiltration for treating spent filter backwash produced by direct filtration plants. This data need was discussed in detail in the previous section.

Given the lack of oocyst occurrence data for direct filtration recycle streams, and limited knowledge of the level of treatment clarification processes can achieve, the Agency does not currently believe it is possible to identify a treatment standard for direct filtration plants.

iv. Request for Comments

EPA requests comment on the proposed requirements. The Agency also requests comment on the following:

(1) Whether direct filtration plants should be required to provide treatment for recycle flows;

(2) The level of treatment direct filtration plants should achieve;

(3) Data that establishes turbidity, particle counting, or some other surrogate as an appropriate indicator of oocyst removal achieved by recycle treatment units, and;

(4) Data on the ability of clarification processes to remove oocysts and criteria that can be used to determine the applicability of specific membrane materials for treatment of spent filter backwash produced by direct filtration plants.

*d. Request for Additional Comment*

EPA requests comment on the following:

(1) Should the recycle of untreated clarification sludges be allowed to continue, or should the Agency ban this practice? What affect would a ban have on the operation of specific plant types, such as softening plants?

(2) Is it appropriate to apply regulatory requirements to the combined recycle flow rather than stipulating requirements for individual recycle flows? Which flows should be regulated individually and why?

## V. State Implementation and Compliance Schedules

This section describes the regulations and other procedures and policies States have to adopt, or have in place, to implement today's proposed rule. States must continue to meet all other conditions of primacy in 40 CFR part 142.

Section 1413 of the SDWA establishes requirements that a State or eligible Indian tribe must meet to maintain primary enforcement responsibility (primacy) for its public water systems. These include: (1) Adopting drinking water regulations that are no less stringent than Federal NPDWRs in effect under sections 1412(a) and 1412(b) of the Act, (2) adopting and implementing adequate procedures for enforcement, (3) keeping records and making reports available on activities that EPA requires by regulation, (4) issuing variances and exemptions (if allowed by the State) under conditions no less stringent than allowed by sections 1415 and 1416, and (5) adopting and being capable of implementing an adequate plan for the provision of safe drinking water under emergency situations.

40 CFR part 142 sets out the specific program implementation requirements for States to obtain primacy for the public water supply supervision program, as authorized under section 1413 of the Act. In addition to adopting the basic primacy requirements, States may be required to adopt special primacy provisions pertaining to a specific regulation. These regulation-specific provisions may be necessary where implementation of the NPDWR involves activities beyond those in the generic rule. States are required by 40 CFR 142.12 to include these regulation-specific provisions in an application for approval of their program revisions. These State primacy requirements apply to today's proposed rule, along with the special primacy requirements discussed below.

To implement today's proposed rule, States are required to adopt revisions to § 141.2—definitions; § 141.32—public notification; § 141.70—general requirements; § 141.73—filtration; § 141.76—recycle; § 141.153—content of the reports; § 141.170—general requirements; § 142.14—records kept by States; § 142.16—special primacy requirements; and a new subpart T, consisting of § 141.500 to § 141.571.

*A. Special State Primacy Requirements*

In addition to adopting drinking water regulations at least as stringent as the Federal regulations listed above, EPA requires that States adopt certain additional provisions related to this regulation to have their program revision application approved by EPA. This information advises the regulated community of State requirements and helps EPA in its oversight of State programs. States which require without exception subpart H systems (all public water systems using a surface water source or a ground water source under the direct influence of surface water) to provide filtration, need not demonstrate that the State program has provisions that apply to systems which do not provide filtration treatment. However, such States must provide the text of the State statutes or regulations which specifies that public water systems using a source water must provide filtration.

EPA is currently developing, with stakeholders input, several guidance documents to aid the States and water systems in implementing today's proposed rule. This includes guidance for the following topics: Disinfection benchmarking and profiling, Turbidity, and Filter Backwash and Recycling. EPA will also work with States to develop a State implementation guidance manual.

To ensure that the State program includes all the elements necessary for a complete enforcement program, the State's application must include the following in order to obtain EPA's approval for implementing this rule:

(1) Adoption of the promulgated LT1FBR.

(2) Description of the procedures the State will use to determine the adequacy of changes in disinfection process by systems required to profile and benchmark under § 142.16(h)(2)(ii) and how the State will consult with PWSs to approve modifications to disinfection practice.

(3) Description of existing or adoption of appropriate rules or other authority under § 142.16(h)(1) to require systems to participate in a Comprehensive Technical Assistance (CTA) activity, and the performance improvement phase of the Composite Correction Program (CCP).

(4) Description of how the State will approve a method to calculate the logs of inactivation for viruses for a system that uses either chloramines or ozone for primary disinfection.

(5) For filtration technologies other than conventional filtration treatment, direct filtration, slow sand filtration or diatomaceous earth filtration, a description of how the State will determine under § 142.16(h)(2)(iii), that a public water system may use a filtration technology if the PWS demonstrates to the State, using pilot plant studies or other means, that the alternative filtration technology, in combination with the disinfection treatment that meets the requirements of Subpart T of this title, 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; and a description of how, for the system that makes this demonstration, the State will set turbidity performance requirements that the system must meet 95 percent of the time and that the system may not exceed at any time a level that consistently achieves 99.9 percent removal and/or inactivation of *Giardia* lamblia cysts, 99.99 percent removal and/or inactivation of viruses, and 99 percent removal of *Cryptosporidium* oocysts.

(6) Description of the criteria the State will use under § 142.16(b)(2)(vi) to determine whether public water systems completing self assessments under § 141.76 (c) are required to modify recycle practice and the criteria that will be used to specify modifications to recycle practice.

(7) Description of the criteria the State will use under § 142.16(b)(2)(vii) to determine whether direct filtration systems reporting data under § 141.76 (d) are required to change recycle practice and the criteria that will be used to specify changes to recycle practice.

(8) The application must describe the criteria the State will use under § 142.16(b)(2)(viii) to determine whether public water systems applying for a waiver to return recycle to a location other than prior to the point of primary coagulant addition, will be granted the waiver for an alternative recycle location.

### *B. State Recordkeeping Requirements*

Today's rule includes changes to the existing record-keeping provisions to implement the requirements in today's proposed rule. States must maintain records of the following: (1) Turbidity measurements must be kept for not less than one year;

(2) disinfectant residual measurements and other parameters necessary to document disinfection effectiveness must be kept for not less than one year; (3) decisions made on a system-by-system basis and case-by-case basis under provisions of part 141, subpart H or subpart P or subpart T; (4) records of systems consulting with the State concerning a modification of disinfection practice (including the status of the consultation);

(5) records of decisions that a system using alternative filtration technologies can consistently achieve a 99 percent removal of *Cryptosporidium* oocysts as well as the required levels of removal and/or inactivation of *Giardia* and viruses for systems using alternative filtration technologies, including State-set enforceable turbidity limits for each system. A copy of the decision must be kept until the decision is reversed or revised and the State must provide a copy of the decision to the system, and; (6) records of systems required to do filter self-assessments, CPE or CCP. These decision records must be kept for 40 years (as currently required by § 142.14 for other State decision records) or until a subsequent determination is made, whichever is shorter.

### *C. State Reporting Requirements*

Currently States must report to EPA information under 40 CFR 142.15 regarding violations, variances and exemptions, enforcement actions and general operations of State public water supply programs. Today's proposal requires States to report a list of direct recycle plants performing self assessments, whether the State required these systems to modify recycle practice, and the reason(s)modifications were or were not required and a list of direct filtration plants performing self assessments, whether the State required these systems to modify recycle practice, and the reason(s) modifications were or were not required

### *D. Interim Primacy*

On April 28, 1998, EPA amended its State primacy regulations at 40 CFR 142.12 (63 FR 23362) (EPA 1998i) to incorporate the new process identified in the 1996 SDWA amendments for granting primary enforcement authority to States while their applications to modify their primacy programs are under review. The new process grants interim primary enforcement authority for a new or revised regulation during the period in which EPA is making a determination with regard to primacy for that new or revised regulation. This interim enforcement authority begins on the date of the primacy application submission or the effective date of the new or revised State regulation, whichever is later, and ends when EPA makes a proposed determination. However, this interim primacy authority is only available to a State that has primacy for every existing national primary drinking water regulation in effect when the new regulation is promulgated.

As a result, States that have primacy for every existing NPDWR already in effect may obtain interim primacy for this rule, beginning on the date that the State submits its final application for primacy for this rule to EPA, or the effective date of its revised regulations, whichever is later. Interim primacy is available for the following rules:

- Stage 1 Disinfectants and Disinfection Byproducts Rule (December 16, 1998)(EPA,1998c)
- Interim Enhanced Surface Water Treatment Rule (EPA,1998a)
- Consumer Confidence Report Rule (EPA, 1998f)
- Variances and Exemptions Rule (EPA, 1998g)
- Drinking Water Contaminant Candidate List (EPA, 1998h)
- Revisions to State Primacy Requirements (EPA,1998i)
- Public Notification Rule (EPA, 1999i)

In addition, a State which wishes to obtain interim primacy for future NPDWRs must obtain primacy for this rule. After the effective date of the final rule, any State that does not have primacy for this rule cannot obtain interim primacy for future rules.

### *E. Compliance Deadlines*

Section 1412(b)(10) of SDWA provides that drinking water rules become effective 36 months after promulgation unless the Administrator determines that an earlier time is practicable. The Administrator may also extend the effective date by an additional 24 months if capital improvements are necessary. The Agency believes the three year effective date is appropriate for all of the provisions in today's notice except for those provisions that address the return of recycle flows. The Agency believes providing a five year compliance period for systems making modifications to recycle practice is appropriate and warranted under 1412(b)(10). To effectively modify recycle practice, capital improvements, such as installing additional equipment and/or constructing new facilities, will likely be required. Specific examples of potential capital improvements are installing new piping and pumps to convey recycle flow prior to the point of primary coagulant addition and constructing equalization basins or recycle flow treatment facilities. A limited number of systems may be able to make operational modifications, per the State's determination, that will effectively address potential risks. However, the Agency believes the great majority of systems required to either relocate their recycle return location or modify recycle practice as directed by the State will need to perform capital improvements. The capital improvement process is lengthy; systems will need to engage in preliminary planning activities, consult with State and local officials, develop engineering and construction designs, obtain financing, and construct the facilities. The Agency believes the widespread need that systems making modifications to recycle practice will have for capital improvements warrants the additional 24 months for compliance purposes. The Agency solicits comment on the appropriateness of providing an additional two years for compliance with the recycle provisions. EPA seeks comment on extending the compliance deadline an extra two years because systems are expected to make capital improvements to address recycle practice. EPA also seeks comment on a similar two year extension to comply with the turbidity provisions of today's proposed rule.

**II. Economic Analysis**

This section summarizes the Health Risk Reduction and Cost Analysis in support of the Long Term 1 Enhanced Surface Water Treatment and Filter Backwash Rule (LT1FBR) as required by Section 1412(b)(3)(C) of the 1996 Amendments to the SDWA. In addition, under Executive Order 12866, Regulatory Planning and Review, EPA must estimate the costs and benefits of LT1FBR in a Regulatory Impact Analysis (RIA) and submit the analysis to the Office of Management and Budget (OMB) in conjunction with publication of the proposed rule. EPA has prepared an RIA to comply with the requirements of this Order and the SDWA Health Risk Reduction and Cost Analysis (EPA, 1999h). The RIA has been published on the Agency's web site, and can be found at *http://www.epa.gov/safewater.* The RIA can also be found in the docket for this rulemaking.

The goal of the following section is to provide an analysis of the costs, benefits, and other impacts of the proposed rule to support future decisions regarding the development of the LT1FBR.

*A. Overview*

The analysis for this rule examines the costs and benefits for five rule provisions: filter effluent turbidity, applicability monitoring, disinfection benchmark profiling, uncovered finish water reservoirs, and recycle. Several options were considered for each provision. Costs were estimated for three individual turbidity options, three profiling options, and three applicability monitoring options. In addition, costs were estimated for four different recycle options. All four recycle options require spent filter backwash, thickener supernatant, and liquids from dewatering be returned to the treatment process prior to the point of primary coagulant addition. The extent of modifications to recycle practice varies among the rule options.

The value of health benefits from the turbidity provision was estimated for the preferred option. The benefits from the other rule provisions are described qualitatively. Several non-health benefits from this rule were also considered by EPA but were not monetized. The non-health benefits of this rule include: avoided outbreak response costs and possibly reduced uncertainty and averting behavior costs. By adding the non-monetized benefits with those that are monetized, the overall benefits of these rule options increase beyond the dollar values reported.

Additional analysis was conducted by EPA to look at the incremental impacts of the various rule options, impacts on households, benefits from reductions in co-occurring contaminants, and possible increases in risk from other contaminants. Finally, the Agency evaluated the uncertainty regarding the risk, benefits, and cost estimates.

*B. Quantifiable and Non-Quantifiable Costs*

In estimating the costs of each rule option, the Agency considered impacts on public water systems and on States (including territories and EPA implementation in non-primacy States). The LT1FBR will result in increased costs to public water systems for improved turbidity treatment, applicability monitoring, disinfection benchmarking, covering new finished water reservoirs and modification to recycle practice. States will also face implementation costs. Most of the provisions of this rule, except the recycle provision, apply to systems using surface water or ground water under the direct influence of surface water that serve less than 10,000 people. The recycle provisions, however, apply to all surface water systems that recycle filter backwash, thickener supernatant, or liquids from dewatering.

1. Total Annual Costs

EPA estimates that the annualized cost of the preferred alternatives for the proposed rule will be $97.5 million. This estimate includes capital costs for treatment changes and start-up labor costs for monitoring and reporting activities that have been annualized assuming a 7% discount rate and a 20-year amortization period. Other cost estimates reported in this section also use these same amortization assumptions. The estimated cost of the preferred alternatives also includes annual operating and maintenance costs for treatment changes and annual labor for turbidity monitoring activities.

The turbidity provisions (including treatment changes, monitoring, and exceptions reporting) account for 70% ($68.6million annually) of total costs and the recycling provisions (*i.e.,* recycle to headworks, self assessment, and direct filtration) account for 25% ($24.5 million annually) of total costs. Utility expenditures for all provisions equal almost 93% ($90.2 million annually) of total costs; State expenditures make up the other 7% ($6.7 million annually).

To reduce the potential cost to small systems, EPA developed and evaluated the cost implications of several regulatory alternatives for four of the proposed LT1FBR provisions: individual filter turbidity monitoring, applicability monitoring, disinfection benchmark profiling, and recycle. Many of these alternatives reduce the labor burden on small systems relative to what it would be if the proposed rule used the same requirements as IESWTR. The total national costs previously discussed only included the costs of the preferred alternatives. The following section will describe the cost estimates for each provision and discuss the cost of other alternatives that were considered.

2. Annual Costs of Rule Provisions

The national estimate of annual utility costs for the proposed turbidity provisions is based on estimates of system-level costs for the various provisions of the rule and estimates of the number of systems expected to incur each type of cost. The following paragraphs describe the cost estimates for each of the rule provisions.

Turbidity Provision Costs

The turbidity provisions are estimated to cost $69.0 million annually. This cost is associated with three primary activities that result from this provision: treatment changes, monitoring, and exceptions reporting.

The treatment costs associated with meeting the revised turbidity standard of 0.3 NTU or less are the main costs associated with the turbidity provision. EPA estimates that 2,406 systems will modify their turbidity treatment in response to this rule. These costs are estimated to be $52.2 million annually. O&M expenditures account for 59% of annual costs and the remain 41% percent is annualized capital costs.

In addition to the turbidity treatment costs, turbidity monitoring costs apply to all small surface water or GWUDI systems using conventional or direct filtration methods. There are an estimated 5,896 systems that fall under this criteria. EPA estimated the costs to utilities for three turbidity monitoring alternatives. Alternative B, the preferred alternative, excludes the exceptions report for an individual filter exceeding 0.5 NTU in two consecutive measurements, enabling systems to shift from daily to weekly analysis and review of the monitoring data. The annualized individual filter turbidity cost to public water systems for this preferred option is approximately $10.1 million. In contrast, under the IESWTR monitoring requirements of Alternative A, small systems would expend $63.3 million annually for turbidity monitoring. Alternative C, which only requires monthly analysis is estimated to cost $5.6 million annually. The total state turbidity start-up and monitoring annual costs are $4.98 million annually and is assumed to be the same for all of the three alternatives.

In addition to the turbidity treatment and monitoring costs, individual filter turbidity exceptions are estimated to cost utilities $120 thousand annually for the preferred option. State costs will be approximately $1.17 million. This cost includes the annual exception reports and annual individual filter self assessment costs. Costs are slightly higher for the other two alternative individual filter turbidity monitoring options because they result in increased number of exception reports.

Disinfection Benchmarking Costs

Disinfection benchmarking involves three components: profiling, applicability monitoring, and benchmarking. Four options were costed for applicability monitoring. Alternative 3, which uses the critical monitoring period, is estimated to cost less than $0.4 million annually. This is substantially lower than the $6.0 million estimated for Alternative 1, which has the same requirements as IESWTR. Alternative 2 requires sampling once per quarter for 4 quarters for systems serving 501–10,000, but allows systems under 500 to sample once during the critical monitoring period. This option has an annualized cost of $1.1 million. The preferred option, Alternative 4, makes it optional to sample during the critical monitoring period and is estimated to cost $0.04 million annualized.

Three options were considered for disinfection profiling and benchmarking. They differed in the frequency and duration of data collection. The preferred alternative, Alternative 2, requires weekly monitoring for one year and is estimated to have an annualized cost of $0.8 million. In comparison, Alternative 1 which requires daily data collection for one year, has an annualized cost of approximately $1.3 million. The final option, Alternative 3, requires daily monitoring for 1 month and has an estimated annualized cost of $0.5 million.

State disinfection benchmarking annualized costs are estimated to be $0.4 million. This estimate includes start-up, compliance tracking/recordkeeping, and benchmark related costs.

Covered Finished Water Reservoir Provision Costs

The proposed LT1FBR requires that new systems cover all finished water reservoirs, holding tanks, or other storage facilities for finished water. Historical construction rates suggest that new reservoirs over the next 20 years will roughly equal to five percent of the existing number of systems. Assuming then that 580 new uncovered finished water reservoirs would be built in the next 20 years, total annual costs, including annualized capital costs and one year of O&M costs are expected to be $2.6 million for this provision using a 7% discount rate. This estimate is calculated from a projected construction rate of new reservoirs and unit cost assumptions for covering new finished water reservoirs.

Recycle Provision Cost

EPA considered four different regulatory options for recycle. Each of the four options requires spent filter backwash, thickener supernatant, and liquids from dewatering be returned prior to the point of primary coagulant addition. Alternative 1, is estimated to result in an annualized cost of $16.7 million. Of the total costs of this alternative, State start-up and review costs for this alternative are only $20 to $30 thousand annually.

Alternative 2, the preferred option, further requires that conventional rapid granular filtration plants using surface water or GWUDI perform a self assessment if they recycle spent filter backwash and thickener supernatant, employ 20 or less filters, and practice direct recycle (treatment for the recycle flow or equalization in a basin that has a volume equal to the volume of spent filter backwash produced by a single filter backwash event is not provided). The results of the self assessment are reported to the State, and it specifies whether modifications to recycle practice are necessary. PWSs are required to implement the modification specified by the State. Under Alternative 2, direct filtration plants are required to submit data to the State on current recycle practice, and the State specifies whether changes to recycle practice are required. The total annualized cost of Alternative 2 is $17.4 to $24.5 million. $0.4 to $5.9 million of the total annualized cost is for the direct recycle component, $0.1 to $1.7 million is for the direct filtration component, and the remaining cost is for the requirement to return recycle prior to the point of primary coagulant addition. Of the total costs of this alternative, State start-up, review, and self assessment costs for this alternative is only $115 thousand annually.

Alternative 3 contain the same requirements for direct filtration plants and also requires the three recycle flows mentioned above be returned prior to the point of primary coagulant addition. Direct recycle plants are required to install equalization basins with a volume equal to or greater than the volume produced by two filter backwash events. The annualized cost of Alternative 3 is $55.0 to $56.7 million. Of this range, $38.1 million of the annualized cost is directly associated with requiring direct recycle plants to install equalization, and $0.1 to $1.7 million is associated with the direct filtration component. State start-up and self assessment costs for this alternative is $95 thousand annually.

Alternative 4 requires the three recycle flows mentioned above be returned prior to the point of primary coagulant addition and also requires that all systems that recycle (conventional and direct systems) install sedimentation basins for recycle flow treatment. Systems may also install recycle flow treatment technologies that provide treatment capability equivalent or superior to sedimentation. For cost estimation purposes, sedimentation basins with tube settlers and polymer addition where used. The Agency approximated the annualized costs of this option to be $151.8 million. The sedimentation basin treatment requirement for conventional and direct filtration plants is 88% ($133.3 million) of the total annualized cost of Alternative 4. State start-up and self assessment costs for this alternative is $100 thousand annually.

3. Non-Quantifiable Costs

Although EPA has estimated the cost of all the rule's components on drinking water systems and States, there are some costs that the Agency did not quantify. These non-quantifiable costs result from uncertainties surrounding rule assumptions and from modeling assumptions. For example, EPA did not estimate a cost for systems to acquire land if they needed to build a treatment facility or significantly expand their current facility. This was not costed because many systems will be able to construct new treatment facilities on land already owned by the utility. In addition, if the cost of land was prohibitive, a system may choose another lower cost alternative such as connecting to another source. A cost for systems choosing this alternative is unquantified in our analysis.

*C. Quantifiable and Non-Quantifiable Health Benefits*

The primary benefits of today's proposed rule come from reductions in the risks of microbial illness from drinking water. In particular, LT1FBR focuses on reducing the risk associated with disinfection resistant pathogens, such as *Cryptosporidium*. Exposure to other pathogenic protozoa, such as *Giardia*, or other waterborne bacteria, viral pathogens, and other emerging pathogens are likely to be reduced by the provisions of this rule as well but are not quantified. In addition, LT1FBR produces nonquantifiable benefits associated with the risk reductions that result from the recycle provision, uncovered reservoirs provision, including *Cryptosporidium* in GWUDI definition, and including *Cryptosporidium* in watershed requirements for unfiltered systems.

1. Quantified Health Benefits

a. Turbidity Provisions

The quantification of benefits from this rule is focused solely on reductions in the risk of cryptosporidiosis. Cryptosporidiosis is an infection caused by *Cryptosporidium* which is an acute, self-limiting illness lasting 7 to 14 days with symptoms that include diarrhea, abdominal cramping, nausea, vomiting and fever (Juranek, 1995). The cost of illness avoided of cryptosporidiosis is estimated to have a mean of $2,016 (Harrington et al., 1985; USEPA 1999h)

The benefits of the turbidity provisions of LT1FBR come from improvements in filtration performance at water systems. The benefits analysis attempts to take into account some of the uncertainties in the analysis by estimating benefits under two different current treatment and three improved removal assumptions. The benefits analysis also used Monte Carlo simulations to derive a distribution of estimates, rather than a single point estimate.

The benefits analysis focused on estimating changes in incidence of cryptosporidiosis that would result from the rule. The analysis included estimating the baseline (pre-LT1FBR) level of exposure from *Cryptosporidium* in drinking water, reductions in such exposure resulting from treatment changes to comply with the LT1FBR, and resultant reductions of risk.

Baseline levels of *Cryptosporidium* in finished water were estimated by assuming national source water occurrence distribution (based on data by LeChevallier and Norton, 1995) and a national distribution of *Cryptosporidium* removal by treatment.

In the LT1FBR RIA, the following two assumptions were made regarding the current *Cryptosporidium* oocyst performance to estimate finished water *Cryptosporidium* concentrations. First, based on treatment removal efficiency data presented in the 1997 IEWSTR, EPA assumed a national distribution of physical removal efficiencies with a mean of 2.0 logs and a standard deviation of ± 0.63 logs. Because the finished water concentrations of oocysts represent the baseline against which improved removal from the LT1FBR is compared, variations in the log removal assumption could have considerable impact on the risk assessment. Second, to evaluate the impact of the removal assumptions on the baseline and resulting improvements, an alternative mean log removal/inactivation assumption of 2.5 logs and a standard deviation of ± 0.63 logs was also used to calculate finished water concentrations of *Cryptosporidium*.

For each of the two baseline assumptions, EPA assumed that a certain number of plants would show low, mid or high improved removal, depending upon factors such as water matrix conditions, filtered water turbidity effluent levels, and coagulant treatment conditions. As a result, the RIA considers six scenarios that encompass the range of endemic health damages avoided based on the rule.

The finished water *Cryptosporidium* distributions that would result from additional log removal with the turbidity provisions, were derived assuming that additional log removal was dependent on current removal, i.e., that sites currently operating at the highest filtered water turbidity levels would show the largest improvements or high improved removal assumption (e.g., plants now failing to meet a 0.4 NTU limit would show greater removal improvements than plants now meeting a 0.3 NTU limit).

Table VI.1 indicates estimated annual benefits associated with implementing the LT1FBR. The benefits analysis quantitatively examines endemic health damages avoided based on the LT1FBR for each of the six scenarios mentioned above. For each of these scenarios, EPA calculated the mean of the distribution of the number of illnesses avoided. The 10th and 90th percentiles imply that there is a 10 percent chance that the estimated value could be as low as the 10th percentile and there is a 10 percent chance that the estimated value could be as high as the 90th percentile. EPA's Office of Water has evaluated drinking water consumption data from USDA's 1994–1996 Continuing Survey of Food Intakes by Individuals (CSFII) Study. EPA's analysis of the CSFII Study resulted in a daily water ingestion lognormally distributed with a mean of 1.2 liters per person (EPA, 2000a). The risk and benefit analysis contained within the RIA reflects this distribution.

TABLE VI.1.—NUMBER AND VALUE OF ILLNESSES AVOIDED ANNUALLY FROM TURBIDITY PROVISIONS [a]

[Dollar amounts in billions]

| Improved Log-Removal Assumption | Daily Drinking Water Ingestion and Baseline *Cryptosporidium* Log-Removal Assumptions (Mean = 1.2 Liters per person) | |
|---|---|---|
| | 2.0 log | 2.5 log |
| Illnesses Avoided with Low Improved *Cryptosporidium* Removal Assumption: | | |
| Mean | 62,800.0 | 22,800.0 |
| 10th Percentile | 0.0 | 0.0 |
| 90th Percentile | 152,000.0 | 43,900.0 |
| COI Avoided with Low Improved *Cryptosporidium* Removal Assumption: | | |
| Mean | $150.3 | $53.9 |
| 10th Percentile | $0.0 | $0.0 |
| 90th Percentile | $288.2 | $81.4 |
| Illnesses Avoided with Mid Improved *Cryptosporidium* Removal Assumption: | | |
| Mean | 77,500.0 | 27,900.0 |
| 10th Percentile | 0.0 | .00 |
| 90th Percentile | 184,000.0 | 52,900.0 |
| COI Avoided with Mid Improved *Cryptosporidium* Removal Assumption: | | |
| Mean | $185.3 | $66.2 |
| 10th Percentile | $0.0 | $0.0 |
| 90th Percentile | $350.9 | $98.8 |
| Illnesses Avoided with High Improved *Cryptosporidium* Removal Assumption: | | |
| Mean | 83,600.0 | 30,000.0 |
| 10th Percentile | 0.0 | 0.0 |
| 90th Percentile | 196,000.0 | 56,500.0 |
| COI Avoided with High Improved *Cryptosporidium* Removal Assumption: | | |
| Mean | $199.5 | $71.1 |
| 10th Percentile | $0.0 | $0.0 |
| 90th Percentile | $376.7 | $105.8 |

[a] All values presented are in January 1999 dollars.

According to the RIA performed for the LT1FBR published today, the rule is estimated to reduce the mean annual number of illnesses caused by *Cryptosporidium* in water systems with improved filtration performance by 22,800 to 83,600 cases depending upon which of the six baseline and improved *Cryptosporidium* removal assumptions was used, and assuming the 1.2 liter drinking water consumption distribution. Based on these values, the mean estimated annual benefits of reducing the illnesses ranges from $54 million to $200 million per year. The RIA also indicated that the rule could result in a mean reduction of 3 to 10 fatalities each year, depending upon the varied baseline and improved removal assumptions. Using a mean value of $5.7 million per statistical life saved, reducing these fatalities could produce benefits in the range of $16.0 million to $60 million.

Combining the value of illnesses and mortalities avoided, the total benefits range from $70 million to $260 million assuming a 1.2 liter drinking water consumption distribution.

b. Sensitivity Analysis for Recycle Provisions

Available literature research demonstrates that increased hydraulic loading or disruptive hydraulic currents, such as may be experienced when plants exceed State-approved operating capacity or when recycle is returned directly into the sedimentation basin, can disrupt filter (Cleasby, 1963; Glasgow and Wheatley, 1998; McTigue et al, 1998) and sedimentation (Fulton, 1987; Logsdon, 1987; Cleasby, 1990) performance. However, the literature does not quantify the extent to which performance can be lowered and, more specifically, does not quantify the log reduction in *Cryptosporidium* removal that may be experienced during direct recycle events.

In the absence of quantified log reduction data, the Agency performed a sensitivity analysis to estimate a range of potential benefit provided by the recycle provisions. The analysis assumes a baseline *Cryptosporidium* log removal value of 2.0. The analysis estimates the effect of recycle by reducing the average baseline log removal by a range of values (reduction ranged from 0.05 to 0.50 log) to account for the reduction in removal performance plants may experience if they exceed State-approved operating capacity or return recycle to the sedimentation basin. The installation of equalization to eliminate exceedence of State-approved operating capacity or moving the recycle return location from the sedimentation basin to prior to the point of primary coagulant addition will result in the health benefit. The benefit estimate is conservative, because it does not account for the fact that recycle returns additional oocysts to the plant.

Benefits are estimated by assuming that the installation of equalization or moving the recycle return point prior to the point of primary coagulant addition will return the plant to the baseline *Cryptosporidium* removal of 2.0 log. The difference between the number of illnesses that result from the baseline situation and the reduced performance is used to calculate the monetary benefit. The benefit is compared to the cost of returning recycle prior to the point of primary coagulant additional and the cost of installing equalization for two service populations. Service populations of 1,900 persons, which represents a plant serving fewer than 10,000 people, and a service population of 25,108, which represents a plant serving greater than 10,000 people, are used. Results are summarized in Tables IV.2 and IV.3 below.

TABLE IV.2.—BENEFIT FOR SERVICE POPULATION OF 1,900

| Log removal reduction | Benefit [a] for population of 1,900 | Cost [a] of moving recycle return | Cost [a] of installing equalization |
|---|---|---|---|
| 0.05 | $1,400 | $5,200 | $25,200 |
| 0.50 | 30,700 | 5,200 | 25,200 |

[a] Cost and benefit are annualized with a 7% capital cost over 20 years.

TABLE IV.3.—BENEFIT RANGE FOR SERVICE POPULATION OF 25,108

| Log removal reduction | Benefit [a] for population of 25,108 | Cost [a] of moving recycle return | Cost [a] of installing rqualization |
|---|---|---|---|
| 0.05 | $18,700 | $18,700 | $57,200 |
| 0.50 | 405,800 | 18,700 | 57,200 |

[a] Cost and benefit are annualized with a 7% capital cost over 20 years.

Although literature research does not quantify the log reduction caused by specific recycle practices, the results of the sensitivity analysis show that the benefit a plant serving 25,108 people would realize by improving its baseline performance to 2.0 logs would range from $18,700 to $405,800. $27,256 Benefits would range from $1,400 to $30,700 for a plant serving 1,900. This benefit range supports the Agency's determination that unquantified benefits will justify costs. The determination is discussed in the Benefit Cost Determination section.

2. Non-Quantified Health and Non-Health Related Benefits

a. Recycle Provisions

The benefits associated with the filter backwash provision are unquantified because of data limitations. Specifically, there is a lack of treatment performance data to accurately model the oocysts removal achieved by individual full-scale treatment processes and the impact recycle may have on treatment unit performance and finished water quality. Additional data on the ability of unit processes (sedimentation, DAF, contact clarification, filtration) to remove oocysts from source and recycle flows, the extent to which recycle may generate hydraulic surge within plants and lower the performance of individual treatment processes, data on the potential for recycle to threaten the integrity of chemical treatment, and additional information on the occurrence of oocysts in recycle streams are all needed before an impact model can be calibrated and used as a predictive tool.

However, available data demonstrate that oocysts occur in recycle streams, often at concentrations higher than found in source water, and returning recycle streams to the plant will increase intra-plant oocyst concentrations. Data also shows that oocysts frequently occur in the finished water of treatment plants that are not operating under stressed conditions. Engineering literature also shows that proper coagulation and the maintenance of balanced hydraulic conditions within the plant (*i.e.,* not exceeding State approved sedimentation/clarification and filtration operating rates) are important to protect the integrity of the entire treatment process. Some recycle practices, such as direct recycle, can potentially upset coagulation and the proper hydraulic operation of sedimentation/clarification and filtration processes. The benefits of the recycle provisions are derived from protecting the coagulation process and the hydraulic performance of sedimentation/clarification and filtration processes. Today's recycle provisions reduce the risk posed by recycle and provided additional public health protection in the following ways:

(1) Returning spent filter backwash, thickener supernatant, and liquids from dewatering into, or downstream of, the point of primary coagulant addition may disrupt treatment chemistry by introducing residual coagulant or other treatment chemicals to the process stream. The wide variation in plant influent flow can also result in chemical over-or under-dosing if chemical dosage is not adjusted to account for flow variation. Returning the above flows prior to the point of primary coagulant addition will help protect the integrity of coagulation and protect the performance of downstream unit processes, such as clarification and filtration, that require proper coagulation be conducted to maintain proper performance. This will provide an additional measure of public health protection.

(2) The direct recycle of spent filter backwash without first providing treatment, equalization, or some form of hydraulic detention for the flow, may cause plants to exceed State-approved operating capacity during recycle events. This may lead to lower overall oocyst removal performance due to the hydraulic overload unit processes (i.e., clarification and filtration) experience and increase finished water oocyst concentrations. The self assessment provision in today's rule will help the States identify direct recycle systems that may experience this problem so modifications to recycle practice can be made to protect public health.

(3) Direct filtration plants do not employ a sedimentation basin in their primary treatment process to remove solids and oocysts; all oocyst removal is achieved by the filters. If treatment for the recycle flow is not provided prior to its return to the plant, all of the oocysts captured by a filter during a filter run will be returned to the plant and again loaded to the filters. This may lead to ever increasing levels of oocysts being applied to the filters and could increase the concentration of oocysts in finished water. Today's provision for direct recycle systems will help States identify those systems that are not obtaining sufficient oocyst removal from the recycle flow. Public health protection will be increased when systems implement modifications to recycle practice specified by the State.

The goal of the recycle provisions is to reduce the potential for oocysts getting into the finished water and causing cases of cryptosporidiosis. Other disinfection resistant pathogens may also be removed more efficiently due to implementation of these provisions.

b. Issues Associated With Unquantified Benefits

The monetized benefits from filter performance improvements are likely not to fully capture all the benefits of the turbidity provisions. EPA monetized the benefits from reductions in cryptosporidiosis by using cost-of-illness (COI) estimates. This may underestimate the actual benefits of these reductions because COI estimates do not include pain and suffering. In general, the COI approach is considered a lower bound estimate of willingness-to-pay (WTP) to avoid illnesses. EPA requests comment on the use of an appropriate WTP study to calculate the benefits of this rule.

Several non-health benefits from this rule were also considered by EPA but were not monetized. The non-health benefits of this rule include avoided outbreak response costs and possibly reduced uncertainty and averting behavior costs. By adding the non-monetized benefits with those that are monetized, the overall benefits of this rule would increase beyond the dollar values reported.

*D. Incremental Costs and Benefits*

EPA evaluated the incremental or marginal costs of today's proposed turbidity option by analyzing various turbidity limits, 0.3 NTU, 0.2 NTU, and 0.1 NTU. For each turbidity limit, EPA developed assumptions about which process changes systems might implement to meet the turbidity level and how many systems would adopt each change. The comparison of total compliance cost estimates show that costs are expected to increase significantly across turbidity limits. The total cost of a 0.1 NTU limit, $404.6 million, is almost eight times higher than the cost of the 0.3 NTU limit, which is $52.2 million. Similarly, the total cost of the 0.2 NTU limit, $134.1 million, is more than twice as great as the 0.3 NTU cost.

Analytical limitations in the estimation of the benefits of LT1FBR prevent the Agency from quantitatively describing the incremental benefits of alternatives. The Agency requests comment on how to analyze and the appropriateness of analyzing incremental benefits and costs for treatment techniques that address microbial contaminants.

*E. Impacts on Households*

The cost impact of LT1FBR at the household level was also assessed. Household costs are a way to represent water system treatment costs as costs to the system's customers. As expected, costs per household increase as system size decreases. Costs to households are higher for households served by smaller systems than larger systems for two reasons. First, smaller systems serve far fewer households than larger systems, and consequently, each household must bear a greater percentage share of capital and O&M costs. Second, filter backwash recycling may pose a greater risk because the flow of water from filter backwash recycling is a larger portion of the total water flow in smaller systems. This greater risk potential in small systems makes it more likely that some form of recycle treatment might be needed.

The average (mean) annual cost for the turbidity, benchmarking, and covered finished water provision per household is $8.66. For almost 86 percent of the 6.6 million households affected by these provisions, the per-household costs are $10 per year or less, and costs of $120 per year (i.e., $10 per month) or less for approximately 99 percent of the households. Costs exceeding $500 per household occur only for the smallest size category, and the number of affected households represent about 34 of the smallest systems. The highest per-household cost estimate is $2,177. This extreme estimate, however, is an artifact of the way the system cost distribution was generated. It is unlikely that any small system will incur annual costs of this magnitude because less costly options are available.

The average household cost for the recycle provisions is $1.80 per year for households that are served by systems that recycle. The cost per household is less than $10 per year for almost 99% of 12.9 million households potentially affected by the proposed rule. The cost per household exceeds $120 per year for less than 1800 households and it exceeds $500 per year for approximately 100 households. The maximum cost of $1,238 per year would only be incurred if a direct filtration system that serves less than 100 customers installed a sedimentation basin for backwash treatment.

There are approximately 1.5 million households served by small drinking water systems that may be affected by the recycling provisions in addition to the turbidity, benchmarking, and covered finished water provisions. The expected aggregate annual cost to these households can be approximated by the sum of the expected cost for each distribution, which is $10.45 per year.

The assumptions and structure of this analysis tend to overestimate the highest costs. To face the highest household costs, a system would have to implement all, or almost all, of the treatment activities. These systems, however, might seek less costly alternatives, such as connecting into a larger regional water system.

*F. Benefits From the Reduction of Co-Occurring Contaminants*

If a system chooses to install treatment, it may choose a technology that would also address other drinking water contaminants. For example, some membrane technologies installed to remove bacteria or viruses can reduce or eliminate many other drinking water contaminants including arsenic.

The technologies used to reduce individual filter turbidities have the potential to reduce concentrations of other pollutants as well. Reduction in turbidity that result from today's proposed rule are aimed at reducing *Cryptosporidium* by physical removal. It is reasonable to assume that similar microbial contaminants will also be reduced as a result of improvements in turbidity removal. Health risks from *Giardia lamblia* and emerging disinfection resistant pathogens, such as microsporidia, *Toxoplasma,* and *Cyclospora,* are also likely to be reduced as a result of improvements in turbidity removal and recycle practices. The frequency and extent that LT1FBR would reduce risk from other contaminants has not been quantitatively evaluated because of the Agency's lack of data on the removal efficiencies of various technologies for emerging pathogens and the lack of co-occurrence data for microbial pathogens and other contaminants from drink water systems.

*G. Risk Increases From Other Contaminants*

It is unlikely that LT1FBR will result in any increased risk from other contaminants. Improvements in plant turbidity performance will not result in any increases in risk. In addition, the benchmarking and profiling provisions were designed to minimize the potential reductions in microbial disinfection in order to lower disinfection byproduct levels to comply with the Stage 1 Disinfection Byproducts Rule. Furthermore, the filter backwash provision does not potentially increase the risk from other contaminants.

*H. Other Factors: Uncertainty in Risk, Benefits, and Cost Estimates*

There is uncertainty in the baseline number of systems, the risk calculation, and the cost estimates. Many of these uncertainties are discussed in more detail in previous sections of today's proposal.

First, the baseline number of systems is uncertain because of data limitation problems in SDWIS. For example, some systems use both ground and surface water but because of other regulatory requirements are labeled in SDWIS as surface water. Therefore, EPA does not have a reliable estimate of how many of these mixed systems exist. The SDWIS data on non-community water systems does not have a consistent reporting convention for population served. Some states may report the population served over the course of a year, while others may report the population served on an average day. Also, SDWIS does not require states to provide information on current filtration practices and, in some cases, it may overestimate the daily population served. For example, a park may report the population served yearly instead of daily. EPA is looking at new approaches to address these issues and both are discussed below in request for comment.

Second, there are several important sources of uncertainty that enter the benefits assessment. They include the following:

- Occurrence of *Cryptosporidium* oocysts in source waters
- Baseline occurrence of *Cryptosporidium* oocysts in finished waters
- Reduction of *Cryptosporidium* oocysts due to improved treatment, including filtration and disinfection
- Viability of *Cryptosporidium* oocysts after treatment
- Infectivity of *Cryptosporidium*
- Incidence of infections (including impact of under reporting)
- Characterization of the risk Willingness-to-pay to reduce risk and avoid costs.
- The baseline water system treatment efficiency for the removal of *Cryptosporidium* is uncertain. Turbidity measurements have been used as a means of estimating removal treatment efficiency (*i.e.* log removal). In addition to the baseline treatment efficiency estimates, improvements in treatment efficiency for *Cryptosporidium* removal that result from this rule are uncertain.

The benefit analysis incorporates all of the uncertainties associated with the benefits assessment in either the Monte Carlo simulations or the assumption of two baselines—2.0 log removal and 2.5 log removal. The results in table VI.1 show that benefits are more sensitive to the baseline log removal assumptions than the range of low to high improved removal assumptions. Third, some costs of today's proposed rule are uncertain because of the diverse nature of the modifications that may be made to address turbidity limits. Cost analysis uncertainties are primarily caused by assumptions made about how many systems will be affected by various provisions and how they will likely respond. Capital and O&M expenditures account for a majority of total costs. EPA derived these costs for a ''model'' system in each size category using engineering models, best professional judgement, and existing cost and technology documents. Costs for systems affected by the proposed rule could be higher or lower, which would affect total costs. Also, the filter backwash provision's flexibility for States to assess plants' need to modify recycle practices leads to some uncertainty in the estimates of how many plants will have to potentially install some form of recycle equalization or treatment. These uncertainties could either under or overestimate the costs of the rule.

### *I. Benefit Cost Determination*

The Agency has determined that the benefits of the LT1FBR justify the costs. EPA made this determination for both the LT1 and the FBR portions of the rule separately as described below.

The Agency has determined that the benefits of the LT1 provisions justify their costs on a quantitative basis. The LT1 provisions include enhanced filtration, disinfection benchmarking and other non-recycle related provisions. The quantified benefits of $70 million to $259.4 million annually exceed the costs of $73 million at the seven percent cost of capital over a substantial portion of the range of benefits. In addition, the non-quantified benefits include avoided outbreak response costs and possibly reduced uncertainty and averting behavior costs.

The Agency has determined that the benefits of the recycle provisions (FBR) justify their cost on a qualitative basis. The recycle provisions will reduce the potential for certain recycle practices to lower or upset treatment plant performance during recycle events; the provisions will therefore help prevent *Cryptosporidium* oocysts from entering finished drinking water supplies and will increase public health protection.

The Agency strongly believes that returning *Cryptosporidium* to the treatment process in recycle flows, if performed improperly, can create additional public health risk. The Agency holds this belief for three reasons. First, returning recycle flow directly to the plant, without equalization or treatment, can cause large variations in the influent flow magnitude and influent water quality. If chemical dosing is not adjusted to reflect this, less than optimal chemical dosing can occur, which may lower the performance of sedimentation and filtration. Returning recycle flows prior to the point of primary coagulant addition will help diminish the risk of less than optimal chemical dosing and diminished sedimentation and filtration performance. Second, exceeding State-approved operating capacity, which is likely to occur if recycle equalization or treatment is not in place, can hydraulically overload plants and diminish the ability of individual unit processes to remove *Cryptosporidium*. Exceeding approved operating capacity violates fundamental engineering principles and water treatment objectives. States set limits on plant operating capacity and loading rates for individual unit processes to ensure treatment plants and individual treatment processes are operated to within their capabilities so that necessary levels of public health protection are provided. Third, returning recycle flows directly into flocculation or sedimentation basins, which can generate disruptive hydraulic currents, may lower the performance of these units and increase the risk of *Cryptosporidium* in finished water supplies.

The recycle provisions in today's proposal are designed to address those recycle practices that are inconsistent with fundamental engineering and water treatment principles. The objective of the provisions is to eliminate practices that are counter to common sense, sound engineering judgement, and that create additional and preventable risk to public health. EPA believes the public health protection benefit provided by the recycle provisions justifies their cost because they are based upon sound engineering principles and are designed to eliminate recycle practices that are very likely to create additional public health risk.

### *J. Request for Comment*

Pursuant to Section 3142(b)(3)(C), the Agency requests comment on all aspects of the rule's economic impact analysis. Specifically, EPA seeks input into the following two issues.

#### NTNC and TNC Flow Estimates

As part of the total cost estimates for LT1FBR, EPA estimated the cost of the rule on NTNC and TNC water systems by using flow models. However, these flow models were developed to estimate flows only for CWS and they may not accurately represent the much smaller flows generally found in NTNC and TNC systems. The effect of the overestimate in flow would be to inflate the cost of the rule for these systems. The Agency requests comment on an alternative flow analysis for NTNC and TNC water systems described below.

Instead of using the population served to determine the average flow for use in the rule's cost calculations, this alternative approach would re-categorize NTNC and TNC water systems based on service type (*e.g.,* restaurants or parks). Service type would be obtained from SDWIS data. However, service type data is not always available because it is a voluntary SDWIS data field. Where unavailable, the service type would be assigned based on statistical analysis. Estimates of service type design flows would be obtained from engineering design manuals and best professional judgement if no design manual specifications exist.

In addition, each service type category would also have corresponding rates for average population served and average water consumption. These would be used to determine contaminant exposure which is used in the benefit determination. For example, schools and churches would be two separate service type categories. They each would have their own corresponding average design flow, average population served (rather than the population as reported in SDWIS), and average water consumption rates. These elements could be used to estimate a rule's benefits and costs for the average church and the average school.

Mixed Systems

Current regulations require that all systems that use any amount of surface water as a source be categorized as surface water systems. This classification applies even if the majority of water in a system is from a ground water source. Therefore, SDWIS does not provide the Agency with information to identify how many mixed systems exist. This information would help the Agency to better understand regulatory impacts.

EPA is investigating ways to identify how many mixed systems exist and how many mix their ground and surface water sources at the same entry point or at separate entry points within the same distribution systems. For example, a system may have several plants/entry points that feed the same distribution system. One of these entry points may mix and treat surface water with ground water prior to its entry into the distribution system. Another entry point might use ground water exclusively for its source while a different entry point would exclusively use surface water. However, all three entry points would supply the same system classified in SDWIS as surface water.

One method EPA could use to address this issue would be to analyze CWSS data then extrapolate this information to SDWIS to obtain a national estimate of mixed systems. CWSS data, from approximately 1,900 systems, details sources of supply at the level of the entry point to the distribution system and further subdivides flow by source type. The Agency is considering this national estimate of mixed systems to regroup surface water systems for certain impact analyses when regulations only impact one type of source. For example, surface water systems that get more than fifty percent of their flow from ground water would be counted as a ground water system in the regulatory impact analysis for this rule. The Agency requests comment on this methodology and its applicability for use in regulatory impact analysis.

## VII. Other Requirements

### *A. Regulatory Flexibility Act (RFA), as amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA), 5 USC 601 et seq.*

1. Background

The RFA, generally requires an agency to prepare a regulatory flexibility analysis of any rule subject to notice and comment rulemaking requirements under the Administrative Procedure Act or any other statute unless the agency certifies that the rule will not have a significant economic impact on a substantial number of small entities. Small entities include small businesses, small organizations, and small governmental jurisdictions.

2. Use of Alternative Definition

The RFA provides default definitions for each type of small entity. It also authorizes an agency to use alternative definitions for each category of small entity, ''which are appropriate to the activities of the agency'' after proposing the alternative definition(s) in the **Federal Register** and taking comment. 5 U.S.C. secs. 601(3)–(5). In addition to the above, to establish an alternative small business definition, agencies must consult with SBA's Chief Counsel for Advocacy.

EPA is proposing the LT1FBR which contains provisions which apply to small PWSs serving fewer than 10,000 persons. This is the cut-off level specified by Congress in the 1996 Amendments to the Safe Drinking Water Act for small system flexibility provisions. Because this definition does not correspond to the definitions of ''small'' for small businesses, governments, and non-profit organizations, EPA requested comment on an alternative definition of ''small entity'' in the preamble to the proposed Consumer Confidence Report (CCR) regulation (63 FR 7620, February 13, 1998). Comments showed that stakeholders support the proposed alternative definition. EPA also consulted with the SBA Office of Advocacy on the definition as it relates to small business analysis. In the preamble to the final CCR regulation (63 FR 4511, August 19, 1998). EPA stated its intent to establish this alternative definition for regulatory flexibility assessments under the RFA for all drinking water regulations and has thus used it in this proposed rulemaking.

In accordance with Section 603 of the RFA, EPA prepared an initial regulatory flexibility analysis (IRFA) that examines the impact of the proposed rule on small entities along with regulatory alternatives that could reduce that impact. The IRFA is available for review in the docket and is summarized below.

3. Initial Regulatory Flexibility Analysis

As part of the 1996 amendments to the Safe Drinking Water Act (SDWA), Congress required the U.S. Environmental Protection Agency (EPA) to develop a Long Term Stage 1 Enhanced Surface Water Treatment Rule (LT1ESWTR) under Section 1412(b)(2)(C) which focuses on surface water drinking water systems that serve fewer than 10,000 persons. Congress also required EPA to develop a companion Filter Backwash Recycle Rule (FBRR) under Section 1412(b)(14) which will require that all surface water public water systems, regardless of size, meet new requirements governing the recycle of filter backwash within the drinking water treatment process. The goal of both the LT1ESWTR and the related FBRR is to provide additional protection from disease-causing microbial pathogens for community and non-community public water systems (PWSs) utilizing surface water.

For purposes of assessing the impacts of today's rule on small entities, small entity is defined by systems serving fewer than 10,000 people. The small entities directly regulated by this proposed rule are surface water and systems using ground water under the direct influence of surface water (GWUDI), using filtration and serving fewer than 10,000 people. We have determined that the final rule would result in approximately 2,400 systems needing capital improvement to meet the turbidity requirements, approximately 3,360 systems would need to significantly change their disinfection practices, and approximately 790 systems would need to make capital improvements to change the location of return of their filter backwash recycle stream. A discussion of the impacts on small entities is described in more detail in chapters six and seven of the Regulatory Impact Analysis of the LT1FBR (EPA, 1999).

The following recordkeeping and reporting burdens were projected in the IRFA:

Turbidity Monitoring and Reporting Costs

Utility monitoring activities at the plant level include data collection, data review, data reporting and monthly reporting to the State. The labor burden hours for data collection and review were calculated under the assumption that plants are using on-line monitoring, in the form of a SCADA or other automated data collection system. The data collection process requires that a plant engineer gather and organize turbidimeter readings from the SCADA output and enter them into either a spreadsheet or a log once per 8-hour shift (three times per day).

After data retrieval, the turbidity data from each turbidimeter will be reviewed by a plant engineer once per 8-hour shift (three times per day) to ensure that the filters are functioning properly and are not displaying erratic or exceptional patterns. A monthly summary data report would be prepared. This task involves the review of daily spreadsheets and the compilation of a summary report. It is assumed to take one employee 8 hours per month to prepare. Recordkeeping is expected to take 5 hours per month. Recordkeeping entails organizing daily monitoring spreadsheets and monthly summary reports.

Plant-level data will also be reviewed monthly at the system level to ensure that each plant in a system is in compliance with the rule. A system-level manager or technical worker will review the daily monitoring spreadsheets and monthly summary reports that are generated at the plant level. This task is estimated to take about 4 hours per month. Once the plant-level data have been reviewed, the system manager or technical worker will also compile a monthly system summary report. These reports are estimated to take 4 hours each month to prepare.

Disinfection Benchmarking Monitoring and Reporting Costs

It is assumed that all Subpart H systems currently collect the daily inactivation data required to generate a disinfection profile, in either an electronic or paper format, and therefore would not incur additional data collection expenses due to microbial profiling. Costs per plant are divided into costs per plant using paper data, costs per plant using mainframe data and costs per plant using PC data. Plants with paper data were assumed to represent half of the number of plants needing benchmarking, while plants with mainframe and plants with PC data each represent a quarter.

Filter Backwash Monitoring and Reporting Costs

The proposed requirements are as follows: All subpart H systems, regardless of size, that use conventional rapid granular filtration, and that return spent filter backwash, thickener supernatant, or liquids from dewatering process to submit a schematic diagram to the State showing their intended changes to move the return location above the point of primary coagulant addition.

All subpart H systems, regardless of size, that use conventional rapid granular filtration and employ 20 or fewer filters during the highest production month and that use direct recycling, to perform a self assessment of their recycle practice and report the results to the State.

All subpart H systems, regardless of system size that use direct filtration must submit a report of their recycling practices to the State. The State would then determine whether changes in recycling practices were warranted.

EPA believes that the skill level required for compliance with all of the above recordkeeping, reporting and other compliance activities are similar or equivalent to the skill level required to pass the first level of operator certification required by most States.

*Relevant Federal Rules*

EPA has issued a Stage 1 Disinfectants/Disinfection Byproducts Rule (DBPR) along with an Interim Enhanced Surface Water Treatment Rule (IESWTR) in December 1998, as required by the Safe Drinking Water Act Amendments of 1996. EPA proposed these rules in July 1994. The Stage 1 DBPR includes a THM MCL of 0.080 mg/L (reduced from the existing THM MCL of 0.10 mg/L established in 1979) and an MCL of 0.060 mg/L for five haloacetic acids (another group of chlorination) as well as MCLs for chlorite (1.0 mg/L) and bromate (0.010 mg/L) byproducts. The Stage 1 DBPR also finalized MRDLs for chlorine (4 mg/L as $Cl_2$), chloramine (4 mg/L as $Cl_2$) and chlorine dioxide (0.8 mg/L as $ClO_2$).

In addition, the Stage 1 DBPR includes requirements for enhanced coagulation to reduce the concentration of TOC in the water and thereby reduce DBP formation potential. The IESWTR was proposed to improve control of microbial pathogens and to control potential risk trade-offs related to the need to meet lower DBP levels under the Stage 1 DBPR.

None of these regulations duplicate, overlap or conflict with this proposed rule.

*Significant Alternatives*

As a result of consultations during the SBREFA process, and public meetings held subsequently, EPA has developed several alternative options to those presented in the IRFA, and has selected preferred alternatives for each of the turbidity, disinfection benchmarking and filter backwash recycle provisions. These alternatives were developed based on feedback from small system operators and trade associations and are designed to protect public health, while minimizing the burden to small systems. In summary, the proposed turbidity requirements are structured to require recordkeeping once a week as opposed to daily which was written in the IRFA; the proposed disinfection profile requirements are structured to be taken once per week, as opposed to daily which was written in the IRFA; and the filter backwash requirements have been scaled back significantly from those included in the IRFA, *i.e.* a ban on recycle is no longer being considered, nor are several treatment techniques now being considered that were in the IRFA prior to discussions with stakeholders. The provisions being proposed are: systems that recycle will be required to return recycle flows prior to the rapid mix unit; direct recycle systems will need to perform a self assessment to determine whether capacity is exceeded during recycle events, and States will determine whether recycle practices need to be changed based on the self-assessment; and direct filtration systems will need to report their recycle practices to the State, which will determine whether changes to recycle practices are required.

4. Small Entity Outreach and Small Business Advocacy Review Panel

As required by section 609(b) of the RFA, as amended by SBREFA, EPA also conducted outreach to small entities and convened a Small Business Advocacy Review Panel to obtain advice and recommendations of representatives of the small entities that potentially would be subject to the rule's requirements. The SBAR Panel produced two final reports; one for the LT1 provisions and the other for the filter backwash provisions. Although the LT1 and filter backwash provisions have since been combined into the same rule, the projected economic impact of the provisions have not significantly changed, and the relevance of SERs' comments has not been affected.

The Agency invited 24 SERs to participate in the SBREFA process, and 16 agreed to participate. The SERs were provided with background information on the Safe Drinking Water Act and the LT1FBR in preparation for a teleconference on April 28, 1998. This information package included data on options as well as preliminary unit costs for treatment enhancements under consideration. Eight SERs provided comments on these materials.

On August 25, 1998, EPA's Small Business Advocacy Chair person convened the Panel under section 609(b) of the Regulatory Flexibility Act as amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA). In addition to its chairperson, the Panel consisted of the Director of the Standards and Risk Management Division of the Office of Ground Water and Drinking Water within EPA's Office of Water, the Administrator of the Office of Information and Regulatory Affairs within the Office of Management and Budget, and the Chief Counsel for Advocacy of the Small Business Administration. The SBAR Panels reports, Final Report of the SBREFA Small Business Advocacy Review Panel on EPA's Planned Proposed Rule: Long Term 1 Enhanced Surface Water Treatment (EPA, 1998k) and the Final Report of the SBREFA Small Business Advocacy Review Panel on EPA's Planned Proposed Rule: Filter Backwash Recycling (EPA, 1998l), contain the SERs comments on the components of the LT1FBR.

The SERs were provided with additional information on potential costs related to LT1FBR regulatory options during teleconferences on September 22 and 25, 1998. Nine SERs provided additional comments during the September 22 teleconference, four SERs provided additional comments during the September 25 teleconference, and three SERs provided written comment on these materials.

In general, the SERs that were consulted on the LT1FBR were concerned about the impact of the proposed rule on small water systems (because of their small staff and limited budgets), small systems' ability to acquire the technical and financial capability to implement requirements, and maintaining flexibility to tailor requirements to the needs and limitations of small systems. Consistent with the RFA/SBREFA requirements, the Panel evaluated the assembled materials and small-entity comments on issues related to the elements of the IRFA. The background information provided to the SBAR Panel and the SERs are available for review in the water docket. A copy of the Panel report is also included in the docket for this proposed rule. The Panel's recommendations to address the SERs concerns are described next.

a. Number of Small Entities Affected

When the IRFA was prepared, EPA initially estimated that there were 5,165 small public water systems that use surface water or GWUDI. A more detailed discussion of the impact of the proposed rule and the number of entities affected is found in Section VI. None of the commenters questioned the information provided by EPA on the number and types of small entities which may be impacted by the LT1FBR. This information is based upon the national Safe Drinking Water Information System (SDWIS) database, which contains data on all public water systems in the country. The Panel believed this was a reasonable data source to characterize the number and types of systems impacted by the proposed rule.

b. Recordkeeping and Reporting

The Panel noted that some small systems are operated by a sole, part time operator with many duties beyond operating and maintaining the drinking water treatment system and that several components of the proposed rule may require significant additional operator time to implement. These included disinfection profiling, individual filter monitoring, and ensuring that short-term turbidity spikes are corrected quickly.

One SER stated that assumptions can be made that small systems will have to add an additional person to comply with the monitoring and recordkeeping portions of the rule. Another SER commented that the most viable and economical option would be to use circuit riders (a trained operator who travels between plants) to fill staffing needs, but the LT1FBR would increase the amount of time that a circuit rider would be required to spend at each plant. An additional option recommended by several SERs to reduce monitoring burden and cost was to allow the use of one on-line turbidimeter to measure several filters. This would entail less frequent monitoring of each filter but might still be adequate to ensure that individual filter performance is maintained.

The proposed LT1FBR takes into consideration the recordkeeping and reporting concerns identified by the Panel and the SERs. For example, initially the Agency considered requiring systems to develop a profile of individual filter performance. Based on concerns from the SERs this requirement was eliminated. In addition, the Agency initially considered requiring operators to record pH, temperature, residual chlorine and peak hourly flow every day. This requirement has been scaled back to once per week to meet difficulties faced by small system operators. Finally, in today's proposed rule the Agency is requesting comment on a modification to allow one on-line turbidimeter instead of several to be used at the smallest size systems (systems serving fewer than 100 people).

c. Interaction With Other Federal Rules

The Panel noted that the LT1FBR and Stage 1 DBP rules will affect small systems virtually simultaneously and that the Agency should analyze the net impact of these rules and consider regulatory options that would minimize the impact on small systems.

One SER commented that any added responsibility or workload due to regulations will have to be absorbed by him and his staff. He noted that many systems, including his own, are losing staff through attrition and are unable to hire replacements. The SER stated that he hoped the Panel was aware of the volume of rules and regulations to which small systems are currently subject. As an example, the SER stated that he had spent a week's time collecting samples for the mandated tests of the Lead and Copper rule. He noted that the sampling had delayed important maintenance to his system by over a month.

The Agency considered these comments when developing the requirements of today's proposed rule, and developed the alternatives with the realization that small systems will be required to implement several rules in a short time frame. In today's proposed rule, the preferred options attempt to minimize the impact on small systems by reducing the amount of monitoring and the amount of operator's time necessary to collect and analyze data. For example, under the IESWTR, large systems are required to monitor disinfection byproducts for 1 year to determine whether or not they must develop a disinfection profile (based on daily measurements of operating conditions). In response to SERs concerns, the Agency is proposing to eliminate the requirement for disinfection byproduct monitoring all together. Under the proposed requirements, all systems would develop a disinfection profile based on weekly measurements of operating parameters for 1 year. Overall, this will save small system operators both time and money. The proposed rule also requests comment on several additional strategies for reducing impacts.

d. Significant Alternatives

During the SBAR panel several alternatives were discussed with the Panel and SERs. These alternatives and the Panel's recommendations are discussed next.

i. Turbidity Provisions

During the SBAR Panel, the Agency presented the IESWTR turbidity provisions as appropriate components for the LT1FBR. The Panel noted that one SER commented that it was a fair assumption that turbidity up to 1 NTU maximum and 0.3 NTU in 95% of all monthly samples is a good indicator of two log removal of *Cryptosporidium*, but stressed the need to allow operators adequate time to respond to exceedances in automated systems. They were referring to the fact the small system operators are often away from the plant performing other duties, and cannot respond immediately if the turbidity levels exceed a predetermined level. The Panel recommended that EPA consider this limitation when developing reporting and recordkeeping requirements.

The Panel also noted that another SER agreed that lowered turbidity level is a good indicator of overall plant performance but thought the 0.3 NTU limit for the 95th percentile reading was too low in light of studies which appear to show variability and inaccuracies in low level turbidity measurements. This SER referenced specific data suggesting that current equipment used to measure turbidity levels below the 0.3 NTU may nonetheless give readings above 0.3 which would put the system out of compliance. EPA has evaluated this issue in the context of the 1997 IESWTR FACA negotiations and believes that readings below the 0.3 NTU are reliable. Moreover, EPA notes that the SERs' concern was based on raw performance evaluation data that had not been fully analyzed.

Finally, the Panel recognized that several SERs supported individual filter monitoring, provided there was flexibility for short duration turbidity spikes. Other SERs, however, noted that the assumption that individual filter monitoring was necessary was unreasonable. The Panel recommended that EPA consider the likelihood and significance of short duration spikes (*i.e.,* during the first 15–30 minutes of filter operation) when evaluating the frequency of individual filter monitoring and reporting requirements and the number and types of exceedances that will trigger requirements for Comprehensive Performance Evaluations (CPEs). The Panel also noted the concern expressed by several SERs that individual filter monitoring may not be practical or feasible in all situations.

The Agency has structured today's proposed rule with an emphasis on providing flexibility for small systems. The individual filter provisions have been tailored to be easier to understand and implement and require less data analysis. For example, the operator can look at monitoring data once per week under this rule, as opposed to having to review turbidity data every day as the larger systems are required to do. The proposed rule also requests comment on several modifications to provide additional flexibility to small systems.

ii. Disinfection Benchmarking: Applicability Monitoring Provisions

None of the SERs commented specifically on the applicability monitoring provisions which are designed to identify systems that may consider cutting back on their disinfection doses in order to avoid problems with disinfection byproducts formation. The Panel noted, however, that burden on small systems might be reduced if alternative applicability monitoring provisions were adopted. In consideration of the Panel's suggestions, the Agency first considered limiting the applicability monitoring, and has now eliminated this requirement from the proposal. It is optional, however, for systems who believe their disinfection byproduct levels are below 80% of the MCL—as required under the Stage 1 DBPR.

The Panel noted SER comments that monitoring and computing *Giardia lamblia* inactivation on a daily basis for a year would place a heavy burden on operators that may only staff the plant for a few hours per day. The Panel therefore recommended that EPA consider alternative profiling strategies which ensure adequate public health protection, but will minimize monitoring and recordkeeping requirements for small system operators.

The Agency considered several alternatives to the profile development strategies, and decided to propose that systems perform the necessary monitoring and record the results once per week, instead of every day as the larger systems are required to do. This will significantly reduce burden and costs for small systems.

iii. Recycling Provisions

During the SBAR Panel, the Agency proposed several alternatives for consideration in the LT1FBR including a ban on recycle, a requirement to return recycle flow to the head of the plant, recycle flow equalization, and recycle flow treatment. The Panel noted the concern of the SERs regarding a ban on the recycle of filter backwash water. These concerns included the expense of filter backwash disposal and the economic and operational concerns of western and southwestern drinking water systems which depend on recycled flow to maintain adequate supply. The Panel strongly recommended that EPA explore alternatives to an outright ban on the recycle of filter backwash and other recycle flows.

The Panel noted that SERs supported a requirement that all recycled water be reintroduced at the head of the plant. This was considered an element of sound engineering practice. The Panel recommended that EPA consider including such a requirement in the proposed rule, and investigate whether there are small systems for which such a requirement would present a significant financial and operational burden.

The Panel noted that SERs agreed with the appropriateness of flow equalization for filter backwash. The Panel supported the concept of flow equalization as a means to minimize hydraulic surges that may be caused by recycle and the reintroduction of a large number of *Cryptosporidium* oocysts or other pathogenic contaminants to the plant in a brief period of time. The Panel noted that there are various ways of achieving flow equalization and suggested that specific requirements remain flexible.

The Panel noted the concerns of SERs regarding installation of treatment, solely for the purpose of treating filter backwash water and/or recycle streams may be costly and potentially prohibitive for small systems. The Agency addressed this concern by allowing the States to determine whether recycle flow equalization or treatment is necessary based on the results of the self assessment prepared by the system rather than requiring universal flow equalization or treatment. This will allow site-specific factors to be considered and help minimize cost and burden.

e. Other Comments

The Panel also noted the concern of several SERs that flexibility be provided in the compliance schedule of the rule. SERs noted the technical and financial limitations that some small systems will have to address, the significant learning curve for operators with limited experience, and the need to continue providing uninterrupted service as reasons why additional compliance time may be needed for small systems. The panel encouraged EPA to keep these limitations in mind in developing the proposed rule and provide as much compliance flexibility to small systems as is allowable under the SDWA. We invite comments on all aspects of the proposal and its impacts on small entities.

The Agency structured the timing of the LT1ESWTR provisions specifically to follow the promulgation of the IESWTR. Since the IESWTR served as a template for the establishment of the LT1ESWTR provisions, the Agency decided that small systems would have an advantage by giving them an opportunity to see what was in the rule, and how it was implemented by larger systems.

Under SDWA, systems have 3 years to comply with the requirements of the final rule. If capital improvements are necessary for a particular PWS, a State may allow the system up to an additional 2 years to comply with the regulation. The Agency is developing guidance manuals to assist the compliance efforts of small entities.

*B. Paperwork Reduction Act*

The information collection requirements in this proposed rule have been submitted for approval to the Office of Management and Budget (OMB) under the Paperwork Reduction Act, 44 U.S.C. 3501 *et seq.* An Information Collection Request (ICR) document has been prepared by EPA (ICR No. 1928.01) and a copy may be obtained from Sandy Farmer by mail at OP Regulatory Information Division; U.S. Environmental Protection Agency (2137); 401 M St., S.W.; Washington, DC 20460, by email at farmer.sandy@epamail.epa.gov, or by calling (202) 260–2740. A copy may also be downloaded off the Internet at *http://www.epa.gov/icr.* For technical information about the collection contact Jini Mohanty by calling (202) 260–6415.

The information collected as a result of this rule will allow the States and EPA to determine appropriate requirements for specific systems, in some cases, and to evaluate compliance with the rule. For the first three years after the effective date (six years after promulgation) of the LT1FBR, the major information requirements are (1) monitor filter performance and submit any exceedances of turbidity requirements (*i.e.* exceptions reports) to the State; (2) develop a 1 month recycle monitoring plan and submit both plan and results to the State; (3) submit flow monitoring plan and results to the State; and (4) report data on current recycle treatment (self assessment) to the State. The information collection requirements in Part 141, for systems, and Part 142, for States are mandatory. The information collected is not confidential.

Burden means the total time, effort, or financial resources expended by persons to generate, maintain, retain, or disclose or provide information to or for a Federal Agency. This includes the time needed to review instructions; develop, acquire, install, and utilize technology and systems for the purposes of collecting, validating, and verifying information, processing and maintaining information, and disclosing and providing information; adjust the existing ways to comply with any previously applicable instructions and requirements; train personnel to be able to respond to a collection of information; search data sources; complete and review the collection of information; and transmit or otherwise disclose the information.

The preliminary estimate of aggregate annual average burden hours for LT1FBR is 311,486. Annual average aggregate cost estimate is $10,826,919 for labor, $2,713,815 for capital, and $1,898,595 for operation and maintenance including lab costs which is a purchase of service. The burden hours per response is 18.9. The frequency of response (average responses per respondent) is 2.7 annually. The estimated number of likely respondents is 6,019 (the product of burden hours per response, frequency, and respondents does not total the annual average burden hours due to rounding). Most of the regulatory provisions discussed in this notice entail new reporting and recordkeeping requirements for States, Tribes, and members of the regulated public. An Agency may not conduct or sponsor, and a person is not required to respond to a collection of information unless it displays a currently valid OMB control number. The OMB control numbers for EPA's regulations are listed in 40 CFR Part 9 and 48 CFR Chapter 15.

Comments are requested on the Agency's need for this information, the accuracy of the provided burden estimates, and any suggested methods for minimizing respondent burden, including through the use of automated collection techniques. Send comments on the ICR to the Director, OP Regulatory Information Division; U.S. Environmental Protection Agency (2137); 401 M St., S.W.; Washington, DC 20460; and to the Office of Information and Regulatory Affairs, Office of Management and Budget, 725 17th St., N.W., Washington, DC 20503, marked ''Attention: Desk Officer for EPA.'' Include the ICR number in any correspondence. Since OMB is required to make a decision concerning the ICR between 30 and 60 days after April 10, 2000, a comment to OMB is best assured of having its full effect if OMB receives it by May 10, 2000. The final rule will respond to any OMB or public comments on the information collection requirements contained in this proposal.

*C. Unfunded Mandates Reform Act*

1. Summary of UMRA requirements

Title II of the Unfunded Mandates Reform Act of 1995 (UMRA), Public Law 104–4, establishes requirements for Federal agencies to assess the effects of their regulatory actions on State, local, and tribal governments and the private sector. Under UMRA section 202, EPA generally must prepare a written statement, including a cost-benefit analysis, for proposed and final rules with ''Federal mandates'' that may result in expenditures by State, local, and tribal governments, in the aggregate, or to the private sector, of $100 million or more in any one year. Before promulgating an EPA rule, for which a written statement is needed, section 205 of the UMRA generally requires EPA to identify and consider a reasonable number of regulatory alternatives and adopt the least costly, most cost-effective or least burdensome alternative that achieves the objectives of the rule. The provisions of section 205 do not apply when they are inconsistent with applicable law. Moreover, section 205 allows EPA to adopt an alternative other than the least costly, most cost effective or least burdensome alternative if the Administrator publishes with the final rule an explanation why that alternative was not adopted.

Before EPA establishes any regulatory requirements that may significantly or uniquely affect small governments, including tribal governments, it must have developed, under section 203 of the UMRA, a small government agency plan. The plan must provide for notification to potentially affected small governments, enabling officials of affected small governments to have meaningful and timely input in the development of EPA regulatory proposals with significant Federal intergovernmental mandates and informing, educating, and advising small governments on compliance with the regulatory requirements.

2. Written Statement for Rules With Federal Mandates of $100 Million or More

EPA has determined that this rule does not contain a Federal mandate that may result in expenditures of $100 million or more for the State, local and Tribal governments, in the aggregate, or the private sector in any one year. Thus today's rule is not subject to the requirements of sections 202 and 205 of the UMRA. Nevertheless, since the estimate of annual impact is close to $100 million under certain assumptions EPA has prepared a written statement, which is summarized below, even though one is not required. A more detailed description of this analysis is presented in EPA's Regulatory Impact Analysis of the LT1FBR (EPA, 1999h) which is available for public review in the Office of Water docket under docket number W–99–10. The document is available for inspection from 9 a.m. to 4 p.m., Monday through Friday, excluding legal holidays. The docket is located in room EB 57, USEPA Headquarters, 401 M St. SW, Washington, D.C. 20460. For access to docket materials, please call (202) 260–3027 to schedule an appointment.

a. Authorizing Legislation

Today's rule is proposed pursuant to Section 1412 (b)(2)(C) and 1412(b)(14) of the SDWA. Section 1412 (b)(2)(C) directs EPA to establish a series of regulations including an interim and final enhanced surface water treatment rule. Section 1412(b)(14) directs EPA to promulgate a regulation to govern the recycling of filter backwash water. EPA intends to finalize the LT1FBR in the year 2000 to allow systems to consider the dual impact of this rule and the Stage 1 DBP rule on their capital investment decisions.

b. Cost Benefit Analysis

Section VI of this preamble discusses the cost and benefits associated with the LT1FBR. Also, the EPA's Regulatory Impact Analysis of the LT1FBR (EPA, 1999h) contains a detailed cost benefit analysis. Today's proposal is expected to have a total annualized cost of approximately $ 97.5 million using a 7 percent discount rate. At a 3 percent discount rate the annualized costs drop to $87.6 million. The national cost estimate includes cost for all of the rule's major provisions including turbidity monitoring, disinfection benchmarking monitoring, disinfection profiling, covered finished storage, and recycling. The majority of the costs for this rule will be incurred by the public sector. A more detailed discussion of these costs is located in Section VI of this preamble.

In addition, the regulatory impact analysis includes both monetized benefits and descriptions of unquantified benefits for improvements to public health and safety the rule will achieve. Because of scientific uncertainty regarding LT1FBR's exposure and risk assessment, the Agency has used Monte Carlo methods and sensitivity analysis to assess the quantified benefits of today's rule. The monetary analysis was based upon quantification of the number of cryptosporidiosis illnesses avoided due to improved particulate removal that results from the turbidity provisions. The Agency was not able to monetize the benefits from the other rule provisions such as disinfection benchmarking and covered finished storage. The monetized annual benefits of today's rule range from $70.1 million to $259.4 million depending on the baseline and removal assumptions. Better management of recycle streams required by the proposal also result in nonquantifiable health risk reductions from disinfection resistant pathogens. The rule may also decrease illness caused by *Giardia* and other emerging disinfection resistant pathogens, further increasing the benefits.

Several non-health benefits from this rule were also identified by EPA but were not monetized. The non-health benefits of this rule include outbreak response costs avoided, and possibly reduced uncertainty and averting behavior costs. By adding the non-monetized benefits with those that are monetized, the overall benefits of this rule increase beyond the dollar values reported.

Various Federal programs exist to provide financial assistance to State, local, and Tribal governments in complying with this rule. The Federal government provides funding to States that have primary enforcement responsibility for their drinking water programs through the Public Water Systems Supervision Grants program. Additional funding is available from other programs administered either by EPA, or other Federal Agencies. These include EPA's Drinking Water State Revolving Fund (DWSRF), U.S. Department of Agriculture's Rural Utilities' Loan and Grant Program, and Housing and Urban Development's Community Development Block Grant Program.

For example, SDWA authorizes the Administrator of the EPA to award capitalization grants to States, which in turn can provide low cost loans and other types of assistance to eligible public water systems. The DWSRF helps public water systems finance the cost of infrastructure necessary to achieve or maintain compliance with SDWA requirements. Each State has considerable flexibility to design its program and to direct funding toward the most pressing compliance and public health protection needs. States may also, on a matching basis, use up to ten percent of their DWSRF allotments each fiscal year to run the State drinking water program.

Furthermore, a State can use the financial resources of the DWSRF to assist small systems. In fact, a minimum of 15% of a State's DWSRF grant must be used to provide infrastructure loans to small systems. Two percent of the State's grant may be used to provide technical assistance to small systems. For small systems that are disadvantaged, up to 30% of a State's DWSRF may be used for increased loan subsidies. Under the DWSRF, Tribes have a separate set-aside which they can use. In addition to the DWSRF, money is available from the Department of Agriculture's Rural Utility Service (RUS) and Housing and Urban Development's Community Block Grant (CDBG) program. RUS provides loans, guaranteed loans, and grants to improve, repair, or construct water supply and distribution systems in rural areas and towns up to 10,000 people. In fiscal year 1997, the RUS had over $1.3 billion in available funds. Also, three sources of funding exist under the CDBG program to finance building and improvements of public faculties such as water systems. The three sources of funding include: (1) Direct grants to communities with populations over 200,000; (2) direct grants to States, which they in turn award to smaller communities, rural areas, and colonias in Arizona, California, New Mexico, and Texas; and (3) direct grants to US. Territories and Trusts. The CDBG budget for fiscal year 1997 totaled over $4 billion dollars.

c. Estimates of Future Compliance Costs and Disproportionate Budgetary Effects

To meet the UMRA requirement in section 202, EPA analyzed future compliance costs and possible disproportionate budgetary effects. The Agency believes that the cost estimates, indicated previously and discussed in more detail in Section VI of this preamble, accurately characterize future compliance costs.

In analyzing the disproportionate impacts, EPA considered four measures:

(1) The impacts of small versus large systems and the impacts within the five small system size categories;

(2) The costs to public versus private water systems;

(3) The costs to households, and;

(4) The distribution of costs across States.

First, small systems will experience a greater impact than large systems under LT1FBR because large systems are subject only to the recycle provisions. The Interim Enhanced Surface Water Treatment Rule (IESWTR) promulgated turbidity, benchmarking, and covered finished storage provisions for large systems in December, 1998. However, small systems have realized cost savings over time due to their exclusion from the IESWTR. Also, some provisions in the LT1FBR have been modified so they would not be as burdensome for small systems. Further information on these changes can be found in section VII.A.3.of this proposal.

The second measure of impact is the relative total cost to privately owned water systems compared to the incurred by publicly owned water systems. A majority of the systems are publicly owned (60 percent of the total). As a result, publicly owned systems will incur a larger share of the total costs of the rule.

The third measure, household costs, is described in further detail in VI.E of this preamble. The fourth measure, distribution of costs across States, is described in greater detail in the RIA for today's proposed rule (EPA, 1999h). There is nothing to suggest that costs to individual systems would vary significantly from State to State, but as expected, the States with the greatest number of systems experience the greatest costs.

d. Macro-Economic Effects

As required under UMRA Section 202, EPA is required to estimate the potential macro-economic effects of the regulation. These types of effects include those on productivity, economic growth, full employment, creation of productive jobs, and international competitiveness. Macro-economic effects tend to be measurable in nationwide econometric models only if the economic impact of the regulation reaches 0.25 percent to 0.5 percent of Gross Domestic Product (GDP). In 1998, real GDP was $7,552 billion. This proposal would have to cost at least $18 billion to have a measurable effect. A regulation of less cost is unlikely to have any measurable effect unless it is highly focused on a particular geographic region or economic sector. The macro-economic effects on the national economy from LT1FBR should not have a measurable effect because the total annual cost of the preferred option is approximately $ 97.5 million per year (at a seven percent discount rate). The costs are not expected to be highly focused on a particular geographic region or sector.

e. Summary of EPA's Consultation with State, Local, and Tribal Governments and Their Concerns

Consistent with the intergovernmental consultation provisions of section 204 of UMRA EPA has already initiated consultation with the governmental entities affected by this rule.

EPA began outreach efforts to develop the LT1FBR in the summer of 1998. Two public stakeholder meetings, which were announced in the **Federal Register**, were held on July 22–23, 1998, in Lakewood, Colorado, and on March 3–4, 1999, in Dallas, Texas. In addition to these meetings, EPA has held several formal and informal meetings with stakeholders including the Association of State Drinking Water Administrators. A summary of each meeting and attendees is available in the public docket for this rule. EPA also convened a Small Business Advocacy Review (SBAR) Panel in accordance with the Regulatory Flexibility Act (RFA), as amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA) to address small entity concerns including those of small local governments. The SBAR Panel allows small regulated entities to provide input to EPA early in the regulatory development process. In early June, 1999, EPA mailed an informal draft of the LT1FBR preamble to the approximately 100 stakeholders who attended one of the public stakeholder meetings. Members of trade associations and the SBREFA Panel also received the draft preamble. EPA received valuable comments and stakeholder input from 15 State representatives, trade associations, environmental interest groups, and individual stakeholders. The majority of concerns dealt with reducing burden on small systems and maintaining flexibility. After receipt of comments, EPA made every effort to make modifications to address these concerns.

To inform and involve Tribal governments in the rulemaking process, EPA presented the LT1FBR at three venues: the 16th Annual Consumer Conference of the National Indian Health Board, the annual conference of the National Tribal Environmental Council, and the OGWDW/Inter Tribal Council of Arizona, Inc. tribal consultation meeting. Over 900 attendees representing tribes from across the country attended the National Indian Health Board's Consumer Conference and over 100 tribes were represented at the annual conference of the National Tribal Environmental Council. At both conferences, an OGWDW representative conducted two workshops on EPA's drinking water program and upcoming regulations, including the LT1FBR.

At the OGWDW/Inter Tribal Council of Arizona meeting, representatives from 15 tribes participated. The presentation materials and meeting summary were sent to over 500 tribes and tribal organizations. Additionally, EPA contacted each of our 12 Native American Drinking Water State Revolving Fund Advisors to invite them, and representatives of their organizations to the stakeholder meetings described previously. A list of tribal representatives contacted can be found in the docket for this rule.

The primary concern expressed by State, local and Tribal governments is the difficulty the smallest systems will encounter in adequately staffing drinking water treatment facilities to perform the monitoring and reporting associated with the new requirements. Today's proposal attempts to minimize the monitoring and reporting burden to the greatest extent feasible and still accomplish the rule's objective of protecting public health. The Agency believes the monitoring and reporting requirements are necessary to ensure consumers served by small systems receive the same level of public health protection as consumers served by large systems. Summaries of the meetings have been included in the public docket for this rulemaking.

f. Regulatory Alternatives Considered

As required under Section 205 of the UMRA, EPA considered several regulatory alternatives for individual filter monitoring and disinfection benchmarking, as well as several alternative strategies for addressing recycle practices. A detailed discussion of these alternatives can be found in Section IV and also in the RIA for today's proposed rule (EPA, 1999h). Today's proposal also seeks comment on several regulatory alternatives that EPA will consider for the final rule.

g. Selection of the Least Costly, Most-Cost Effective or Least Burdensome Alternative That Achieves the Objectives of the Rule

As discussed previously, EPA has considered and requested comment on various regulatory options that would reduce *Cryptosporidium* occurrence in the finished water of surface water systems. The Agency believes that the preferred option for turbidity performance, disinfection benchmarking, and recycle management are the most cost effective combination of options to achieve the rule's objective; the reduction of illness and death from *Cryptosporidium* occurrence in the finished water of PWSs using surface water. The Agency will carefully review comments on the proposal and assess suggested changes to the requirements.

3. Impacts on Small Governments

In developing this proposal, EPA consulted with small governments to address impacts of regulatory requirements in the rule that might significantly or uniquely affect small governments. As discussed previously, a variety of stakeholders, including small governments, were provided the opportunity for timely and meaningful participation in the regulatory development process through the SBREFA panel, public stakeholder and Tribal meetings. EPA used these processes to notify potentially affected small governments of regulatory requirements being considered and provided officials of affected small governments with an opportunity to have meaningful and timely input to the regulatory development process.

In addition, EPA will educate, inform, and advise small systems, including those run by small governments, about LT1FBR requirements. One of the most important components of this outreach effort will be the Small Entity Compliance Guide, required by the Small Business Regulatory Enforcement Fairness Act of 1996. This plain-English guide will explain what actions a small entity must take to comply with the rule. Also, the Agency is developing fact sheets that concisely describe various aspects and requirements of the LT1FBR and detailed guidance manuals to assist the compliance effort of PWSs and small government entities.

*D. National Technology Transfer and Advancement Act*

Section 12(d) of the National Technology Transfer and Advancement Act of 1995 (NTAA), Public Law No. 104–113, section 12(d) (15 U.S.C. 272 note), directs EPA to use voluntary consensus standards in its regulatory activities unless to do so would be inconsistent with applicable law or otherwise impractical. Voluntary consensus standards are technical standards (e.g., materials specifications, test methods, sampling procedures, business practices) that are developed or adopted by voluntary consensus standards bodies. The NTAA directs EPA to provide Congress, through the Office of Management and Budget, explanations when the Agency decides not to use available and applicable voluntary consensus standards.

Today's rule requires the use of previously approved technical standards for the measurement of turbidity. In previous rulemakings, EPA approved three methods for measuring turbidity in drinking water. These can be found in 40 CFR, Part 141.74 (a). Turbidity is a method-defined parameter and therefore modifications to any of the three approved methods requires prior EPA approval. One of the approved methods was published by the Standard Methods Committee of American Public Health Association, the American Water Works Association, and the Water Environment Federation, the latter being a voluntary consensus standard body. That method, Method 2130B (APHA, 1995), is published in Standard Methods for the Examination of Water and Wastewater (19th ed.). Standard Methods is a widely used reference which has been peer-reviewed by the scientific community. In addition to this voluntary consensus standard, EPA approved two additional methods for the measurement of turbidity. One is the Great Lakes Instrument Method 2, which can be used as an alternate test procedure for the measurement of turbidity (Great Lakes Instruments, 1992). Second, the Agency approved revised EPA Method 180.1 for turbidity measurement in August 1993 in Methods for the Determination of Inorganic Substances in Environmental Samples (EPA–600/R–93–100) (EPA, 1993).

In 1994, EPA reviewed and rejected an additional technical standard, a voluntary consensus standard, for the measurement of turbidity, the ISO 7027 standard, an analytical method which measures turbidity at a higher wavelength than the approved test measurement standards. ISO 7027 measures turbidity using either 90° scattered or transmitted light depending on the turbidity concentration evaluated. Although instruments conforming to ISO 7027 specifications are similar to the GLI instrument, only the GLI instrument uses pulsed, multiple detectors to simultaneously read both 90° scattered and transmitted light. EPA has no data upon which to evaluate whether the separate 90° scattered or transmitted light measurement evaluations, according to the ISO 7027 method, would produce results that are equivalent to results produced using GLI Method 2, Standard Method 2130B (APHA, 1995), or EPA Method 180.1 (EPA, 1993).

Today's proposed rule also requires continuous individual filter monitoring for turbidity and requires PWSs to calibrate the individual turbidimeter according to the turbidimeter manufacturer's instructions. These calibration instructions may constitute technical standards as that term is defined in the NTTAA. EPA has looked for voluntary consensus standards with regard to calibration of turbidimeters. The American Society for Testing and Materials (ASTM) is developing such voluntary consensus standards, however, there do not appear to be any voluntary consensus standards available at this time. EPA welcomes comments on this aspect of the proposed rulemaking and, specifically invites the public to identify potentially applicable voluntary consensus standards and to explain why such standards should be used in this regulation.

EPA plans to implement in the future a performance-based measurement system (PBMS) that would allow the option of using either performance criteria or reference methods in its drinking water regulatory programs. The Agency is currently determining the specific steps necessary to implement PBMS in its programs and preparing an implementation plan. Final decisions have not yet been made concerning the implementation of PBMS in water programs. However, EPA is currently evaluating what relevant performance characteristics should be specified for monitoring methods used in the water programs under a PBMS approach to ensure adequate data quality. EPA would then specify performance requirements in its regulations to ensure that any method used for determination of a regulated analyte is at least equivalent to the performance achieved by other currently approved methods.

Once EPA has made its final determinations regarding implementation of PBMS in programs under the Safe Drinking Water Act, EPA would incorporate specific provisions of PBMS into its regulations, which may include specification of the performance characteristics for measurement of regulated contaminants in the drinking water program regulations.

*E. Executive Order 12866: Regulatory Planning and Review*

Under Executive Order 12866, (58 FR 51735 (October 4, 1993) the Agency must determine whether the regulatory action is ''significant'' and therefore subject to OMB review and the requirements of the Executive Order. The Order defines ''significant regulatory action'' as one that is likely to result in a rule that may:

1. Have an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or State, local, tribal governments or communities;

2. Create a serious inconsistency or otherwise interfere with an action taken or planned by another agency;

3. Materially alter the budgetary impact of entitlement, grants, user fees, or loan programs or the rights and obligations of recipients thereof, or;

4. Raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in the Executive Order.

Pursuant to the terms of Executive Order 12866, it has been determined that this rule is a ''significant regulatory action.'' As such, this action was submitted to OMB for review. Changes made in response to OMB suggestions or recommendations will be documented in the public record.

*F. Executive Order 12898: Environmental Justice*

Executive Order 12898 establishes a Federal policy for incorporating environmental justice into Federal agency missions by directing agencies to identify and address disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations. The Agency has considered environmental justice related issues concerning the potential impacts of this action and consulted with minority and low-income stakeholders.

This preamble has discussed many times how the IESWTR served as a template for the development of the LT1FBR. As such, the Agency also built on the efforts conducted during the IESWTRs development to comply with E.O. 12898. On March 12, 1998, the Agency held a stakeholder meeting to address various components of pending drinking water regulations and how they may impact sensitive sub-populations, minority populations, and low-income populations. Topics discussed included treatment techniques, costs and benefits, data quality, health effects, and the regulatory process. Participants included national, State, tribal, municipal, and individual stakeholders. EPA conducted the meetings by video conference call between eleven cities. This meeting was a continuation of stakeholder meetings that started in 1995 to obtain input on the Agency's Drinking Water Programs. The major objectives for the March 12, 1998 meeting were:

(1) Solicit ideas from stakeholders on known issues concerning current drinking water regulatory efforts;

(2) Identify key issues of concern to stakeholders, and;

(3) Receive suggestions from stakeholders concerning ways to increase representation of communities in OGWDW regulatory efforts.

In addition, EPA developed a plain-English guide specifically for this meeting to assist stakeholders in understanding the multiple and sometimes complex issues surrounding drinking water regulation.

The LT1FBR applies to community water systems, non-transient non-community water systems, and transient non-community water systems that use surface water or ground water under the direct influence (GWUDI) as their source water for PWSs serving less than 10,000 people. The recycle provisions apply to all conventional and direct surface water or GWUDI systems regardless of size.

EPA believes this rule will provide equal health protection for all minority and low-income populations served by systems regulated under this rule from exposure to microbial contamination. These requirements will also be consistent with the protection already afforded to people being served by systems with larger population bases.

*G. Executive Order 13045: Protection of Children from Environmental Health Risks and Safety Risks*

Executive Order 13045: ''Protection of Children from Environmental Health Risks and Safety Risks'' (62 FR 19885, April 23, 1997) applies to any rule that: 1) is determined to be economically significant as defined under E.O. 12866, and; 2) concerns an environmental health or safety risk that EPA has reason to believe may have a disproportionate effect on children. If the regulatory action meets both criteria, the Agency must evaluate the environmental health or safety effects of the planned rule on children and explain why the planned regulation is preferable to other potentially effective and reasonably feasible alternatives considered by the Agency.

While this proposed rule is not subject to the Executive Order because it is not economically significant as defined by E.O. 12866, we nonetheless have reason to believe that the environmental health or safety risk addressed by this action may have a disproportionate effect on children. Accordingly, EPA evaluated available data on the health effect of *Cryptosporidium* on children. The results of this evaluation are contained in Section II.B of this preamble and in the LT1FBR RIA (EPA, 1999h). A copy of the RIA and supporting documents is available for public review in the Office of Water docket at 401 M St. SW, Washington, D.C.

The risk of illness and death due to cryptosporidiosis depends on several factors, including the age, nutrition, exposure, and the immune status of the individual. Information on mortality from diarrhea shows the greatest risk of mortality occurring among the very young and elderly (Gerba et al., 1996). Specifically, young children are a vulnerable population subject to infectious diarrhea caused by *Cryptosporidium* (CDC 1994). Cryptosporidiosis is prevalent worldwide, and its occurrence is higher in children than in adults (Fayer and Ungar, 1986).

Cryptosporidiosis appears to be more prevalent in populations that may not have established immunity against the disease and may be in greater contact with environmentally contaminated surfaces, such as infants (DuPont, et al., 1995). Once a child is infected it may spread the disease to other children or family members. Evidence of such secondary transmission of cryptosporidiosis from children to household and other close contacts has been found in many outbreak investigations (Casemore, 1990; Cordell et al., 1997; Frost et al., 1997). Chapell et al., 1999, found that prior exposure to *Cryptosporidium* through the ingestion of a low oocyst dose provides protection from infection and illness. However, it is not known whether this immunity is life-long or temporary. Data also indicate that either mothers confer short term immunity to their children or that babies have reduced exposure to *Cryptosporidium*, resulting in a decreased incidence of infection during the first year of life. For example, in a survey of over 30,000 stool sample analyses from different UK patients, the 1–5 year age group suffered a much higher infection rate than individuals less than one year of age. For children under one year of age, those older than six months of age showed a higher rate of infection than individuals aged fewer than six months (Casemore, 1990).

EPA has not been able to quantify the differential health effects for children as a result of *Cryptosporidium*-contaminated drinking water. However, the result of the LT1FBR will be a reduction in the risk of illness for the entire population, including children. Furthermore, the available anecdotal evidence indicates that children may be more vulnerable to cryptosporidiosis than the rest of the population. The LT1FBR would, therefore, result in greater risk reduction for children than for the general population.

The public is invited to submit or identify peer-reviewed studies and data, of which EPA may not be aware, that assessed results of early life exposure to *Cryptosporidium*.

### *H. Consultations with the Science Advisory Board, National Drinking Water Advisory Council, and the Secretary of Health and Human Services*

In accordance with section 1412 (d) and (e) of the SDWA, the Agency will consult with the National Drinking Water Advisory Council (NDWAC) and the Secretary of Health and Human Services and request comment from the Science Advisory Board on the proposed LT1FBR.

### *I. Executive Order 13132: Executive Orders on Federalism*

Executive Order 13132, entitled ''Federalism'' (64 FR 43255, August 10, 1999), requires EPA to develop an accountable process to ensure ''meaningful and timely input by State and local officials in the development of regulatory policies that have federalism implications.'' ''Policies that have federalism implications'' is defined in the Executive Order to include regulations that have ''substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government.''

Under section 6 of Executive Order 13132, EPA may not issue a regulation that has federalism implications, that imposes substantial direct compliance costs, and that is not required by statute, unless the Federal government provides the funds necessary to pay the direct compliance costs incurred by State and local governments, or EPA consults with State and local officials early in the process of developing the proposed regulation. EPA also may not issue a regulation that has federalism implications and that preempts State law, unless the Agency consults with State and local officials early in the process of developing the proposed regulation.

If EPA complies by consulting, Executive Order 13132 requires EPA to provide to the Office of Management and Budget (OMB), in a separately identified section of the preamble to the final rule, a federalism summary impact statement (FSIS). The FSIS must include a description of the extent of EPA's prior consultation with State and local officials, a summary of the nature of their concerns and the agency's position supporting the need to issue the regulation, and a statement of the extent to which the concerns of State and local officials have been met. Also, when EPA transmits a draft final rule with federalism implications to OMB for review pursuant to Executive Order 12866, EPA must include a certification from the agency's Federalism Official stating that EPA has met the requirements of Executive Order 13132 in a meaningful and timely manner.

EPA has concluded that this proposed rule may have federalism implications since it may impose substantial direct compliance costs on local governments, and the Federal government will not provide the funds necessary to pay those cost. Accordingly, EPA provides the following FSIS as required by section 6(b) of Executive Order 13132.

As discussed further in section VII.C.2.e, EPA met with a variety of State and local representatives, who provided meaningful and timely input in the development of the proposed rule. Summaries of the meetings have been included in the public record for this proposed rulemaking. EPA consulted extensively with State, local, and tribal governments. For example, two public stakeholder meetings were held on July 22–23, 1998, in Lakewood, Colorado, and on March 3–4, 1999, in Dallas, Texas. Several key issues were raised by stakeholders regarding the LT1 provisions, many of which were related to reducing burden and maintaining flexibility. The Office of Water was able to significantly reduce burden and increase flexibility by tailoring requirements to reduce monitoring, reporting, and recordkeeping requirements faced by small systems. These modifications and others aided in lowering the cost of the LT1FBR by $87 million (from $184.5 million to $97.5 million). It should be noted that this rule is important because it will reduce the level of *Cryptosporidium* in filtered finished drinking water supplies through improvements in filtration and recycle practices resulting in a reduced likelihood of outbreaks of cryptosporidiosis. The rule is also expected to increase the level of protection from exposure to other pathogens (i.e., *Giardia* and other waterborne bacterial or viral pathogens). Because consultation on this proposed rule occurred before the November 2, 1999 effective date of Executive Order 13132, EPA will initiate discussions with State and local elected officials regarding the implications of this rule during the public comment period.

### *J. Executive Order 13084: Consultation and Coordination With Indian Tribal Governments*

Under Executive Order 13084, EPA may not issue a regulation that is not required by statute, that significantly or uniquely affects the communities of Indian tribal governments, and that imposes substantial direct compliance costs on those communities, unless the Federal government provides the funds necessary to pay the direct compliance costs incurred by the tribal governments or EPA consults with those governments. If EPA complies by consulting, Executive Order 13084 requires EPA to provide to the Office of Management and Budget, in a separately identified section of the preamble to the rule, a description of the extent of EPA's prior consultation with representatives of affected tribal governments, a summary of the nature of their concerns, and a statement supporting the need to issue the regulation. In addition, Executive Order 13084 requires EPA to develop an effective process permitting elected officials and other representatives of Indian tribal governments ''to provide meaningful and timely input in the development of regulatory policies on matters that significantly or uniquely affect their communities.''

EPA has concluded that this rule may significantly or unique affect the communities of Indian tribal governments. It may also impose substantial direct compliance costs on such communities. The Federal government will not provide the funds necessary to pay all the direct costs incurred by the Tribal governments in complying with the rule. In developing this rule, EPA consulted with representatives of Tribal governments pursuant to UMRA and Executive Order 13084. EPA held extensive meetings that provided Indian Tribal governments the opportunity for meaningful and timely input in the development of the proposed rule. Summaries of the meetings have been included in the public docket for this rulemaking. EPA's consultation, the nature of the government's concerns, and the position supporting the need for this rule are discussed in Section VII.C.2.e, which addresses compliance with UMRA.

*K. Likely Effect of Compliance with the LT1FBR on the Technical, Financial, and Managerial Capacity of Public Water Systems*

Section 1420(d)(3) of the SDWA as amended requires that, in promulgating a NPDWR, the Administrator shall include an analysis of the likely effect of compliance with the regulation on the technical, financial, and managerial capacity of public water systems. This analysis can be found in the LT1FBR RIA (EPA, 1999h).

Overall water system capacity is defined in EPA guidance (EPA, 1998j) as the ability to plan for, achieve, and maintain compliance with applicable drinking water standards. Capacity has three components: technical, managerial, and financial.

Technical capacity is the physical and operational ability of a water system to meet SDWA requirements. Technical capacity refers to the physical infrastructure of the water system, including the adequacy of source water and the adequacy of treatment, storage, and distribution infrastructure. It also refers to the ability of system personnel to adequately operate and maintain the system and to otherwise implement requisite technical knowledge. A water system's technical capacity can be determined by examining key issues and questions, including:

- *Source water adequacy.* Does the system have a reliable source of drinking water? Is the source of generally good quality and adequately protected?
- *Infrastructure adequacy.* Can the system provide water that meets SDWA standards? What is the condition of its infrastructure, including well(s) or source water intakes, treatment, storage, and distribution? What is the infrastructure's life expectancy? Does the system have a capital improvement plan?
- *Technical knowledge and implementation.* Is the system's operator certified? Does the operator have sufficient technical knowledge of applicable standards? Can the operator effectively implement this technical knowledge? Does the operator understand the system's technical and operational characteristics? Does the system have an effective operation and maintenance program?

Managerial capacity is the ability of a water system to conduct its affairs to achieve and maintain compliance with SDWA requirements. Managerial capacity refers to the system's institutional and administrative capabilities. Managerial capacity can be assessed through key issues and questions, including:

- *Ownership accountability.* Are the system owner(s) clearly identified? Can they be held accountable for the system?
- *Staffing and organization.* Are the system operator(s) and manager(s) clearly identified? Is the system properly organized and staffed? Do personnel understand the management aspects of regulatory requirements and system operations? Do they have adequate expertise to manage water system operations? Do personnel have the necessary licenses and certifications?
- *Effective external linkages.* Does the system interact well with customers, regulators, and other entities? Is the system aware of available external resources, such as technical and financial assistance?

Financial capacity is a water system's ability to acquire and manage sufficient financial resources to allow the system to achieve and maintain compliance with SDWA requirements. Financial capacity can be assessed through key issues and questions, including:

- *Revenue sufficiency.* Do revenues cover costs? Are water rates and charges adequate to cover the cost of water?
- *Credit worthiness.* Is the system financially healthy? Does it have access to capital through public or private sources?
- *Fiscal management and controls.* Are adequate books and records maintained? Are appropriate budgeting, accounting, and financial planning methods used? Does the system manage its revenues effectively?

Systems not making significant modifications to the treatment process to meet LT1FBR requirements are not expected to require significantly increased technical, financial, or managerial capacity.

*L. Plain Language*

Executive Order 12866 and the President's memorandum of June 1, 1998, require each agency to write its rules in plain language. We invite your comments on how to make this proposed rule easier to understand. For example: Have we organized the material to suit your needs? Are the requirements in the rule clearly stated? Does the rule contain technical language or jargon that is not clear? Would a different format (grouping and order of sections, use of headings, paragraphing) make the rule easier to understand? Would shorter sections make the final rule easier to understand? Could we improve clarity by adding tables, lists, or diagrams? What else could we do to make the rule easier to understand?

**VIII. Public Comment Procedures**

EPA invites you to provide your views on this proposal, approaches we have not considered, the potential impacts of the various options (including possible unintended consequences), and any data or information that you would like the Agency to consider. Many of the sections within today's proposed rule contain ''Request for Comment'' portions which the Agency is also interested in receiving comment on.

*A. Deadlines for Comment*

Send your comments on or before June 9, 2000. Comments received after this date may not be considered in decision making on the proposed rule. Again, comments must be received or post-marked by midnight June 9, 2000.

*B. Where To Send Comment*

Send an original and 3 copies of your comments and enclosures (including references) to W–99–10 Comment Clerk, Water Docket (MC4101), USEPA, 401 M, Washington, D.C. 20460. Comments may also be submitted electronically to ow-docket@epamail.epa.gov. Electronic comments must be submitted as an ASCII, WP5.1, WP6.1 or WP8 file avoiding the use of special characters and form of encryption. Electronic comments must be identified by the docket number W–99–10. Comments and data will also be accepted on disks in WP 5.1, 6.1, 8 or ASCII file format. Electronic comments on this notice may be filed online at many Federal Depository Libraries. Those who comment and want EPA to acknowledge receipt of their comments must enclose a self-addressed stamped envelope. No facsimiles (faxes) will be accepted. Comments may also be submitted electronically to ow-docket@epamail.epa.gov.

*C. Guidelines for Commenting*

To ensure that EPA can read, understand and therefore properly respond to comments, the Agency would prefer that commenters cite, where possible, the paragraph(s) or sections in the notice or supporting documents to which each comment refers. Commenters should use a separate paragraph for each issue discussed. Note that the Agency is not soliciting comment on, nor will it respond to, comments on previously published regulatory language that is included in this notice to ease the reader's understanding of proposed language. You may find the following suggestions helpful for preparing your comments:

1. Explain your views as clearly as possible.

2. Describe any assumptions that you used.

3. Provide solid technical information and/or data to support your views.

4. If you estimate potential burden or costs, explain how you arrived at the estimate.

5. Indicate what you support, as well as what you disagree with.

6. Provide specific examples to illustrate your concerns.

7. Make sure to submit your comments by the deadline in this proposed rule.

8. At the beginning of your comments (*e.g.,* as part of the ''Subject'' heading), be sure to properly identify the document you are commenting on. You can do this by providing the docket control number assigned to the proposed rule, along with the name, date, and **Federal Register** citation.

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## List of Subjects

*40 CFR Part 141*

Environmental protection, Chemicals, Indians-lands, Intergovernmental relations, Radiation protection, Reporting and recordkeeping requirements, Water supply.

*40 CFR Part 142*

Environmental protection, Administrative practice and procedure, Chemicals, Indians-lands, Radiation protection, Reporting and recordkeeping requirements, Water supply.

Dated: March 27, 2000.

**Carol M. Browner,**

*Administrator.*

For the reasons set forth in the preamble, title 40 chapter I of the Code of Federal Regulations is proposed to be amended as follows:

## PART 141—NATIONAL PRIMARY DRINKING WATER REGULATIONS

3. The authority citation for part 141 continues to read as follows:

**Authority:** 42 U.S.C. 300f, 300g–1, 300g–2, 300g–3, 300g–4, 300g–5, 300g–6, 300j–4, 300j–9, and 300j–11.

4. Section 141.2 is amended by revising the definition of ''Ground water under the direct influence of surface water'' and ''Disinfection profile'' and adding the following definitions in alphabetical order to read as follows:

### § 141.2 Definitions.

* * * * *

*Direct recycle* is the return of recycle flow within the treatment process of a public water system without first passing the recycle flow through a treatment process designed to remove solids, a raw water storage reservoir, or some other structure with a volume equal to or greater than the volume of spent filter backwash water produced by one filter backwash event.

* * * * *

*Disinfection profile* is a summary of *Giardia* lamblia inactivation through the treatment plant, from the point of disinfectant application to the first customer. The procedure for developing a disinfection profile is contained in § 141.172 (Disinfection profiling and benchmarking) in subpart P and §§ 141.530–141.536 (Disinfection profile) in subpart T of this part.

* * * * *

*Equalization* is the detention of recycle flow in a structure with a volume equal to or greater than the volume of spent filter backwash produced by one filter backwash event.

* * * * *

*Ground water under the direct influence of surface water* (GWUDI) means any water beneath the surface of the ground with significant occurrence of insects or other macroorganisms, algae, or large-diameter pathogens such as *Giardia lamblia* or *Cryptosporidium*, or significant and relatively rapid shifts in water characteristics such as turbidity, temperature, conductivity, or pH which closely correlate to climatological or surface water conditions. Direct influence must be determined for individual sources in accordance with criteria established by the State. The State determination of direct influence may be based on site-specific measurements of water quality and/or documentation of well construction characteristics and geology with field evaluation.

* * * * *

*Membrane Filtration* means any filtration process using tubular or spiral wound elements that exhibits the ability to mechanically separate water from other ions and solids by creating a pressure differential and flow across a membrane with an absolute pore size <1 micron.

* * * * *

*Operating capacity* is the maximum finished water production rate approved by the State drinking water program.

* * * * *

*Recycle* is the return of any water, solid, or semisolid generated by plant treatment processes, operational processes, maintenance processes, and residuals treatment processes into a PWS's primary treatment processes.

* * * * *

5. Section 141.32 is amended by revising paragraph (e)(10) to read as follows:

### § 141.32 Public notification.

* * * * *

(e) * * *

(10) *Microbiological contaminants* (for use when there is a violation of the treatment technique requirements for filtration and disinfection in subpart H, subpart P, or subpart T of this part). 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.

* * * * *

6. Section 141.70 is amended by revising paragraph (b)(2) and adding paragraph (e) to read as follows:

### § 141.70 General requirements.

* * * * *

(b) * * *

(2) It meets the filtration requirements in § 141.73, the disinfection

requirements in § 141.72(b) and the recycle requirements in § 141.76.

* * * * *

(e) *Additional requirements for systems serving fewer than 10,000 people.* In addition to complying with requirements in this subpart, systems serving fewer than 10,000 people must also comply with the requirements in subpart T of this part.

7. Section 141.73 is amended by adding paragraph (a)(4) and revising paragraph (d) to read as follows:

**§ 141.73 Filtration.**

* * * * *

(a) * * *

(4) Beginning [DATE 36 MONTHS AFTER DATE OF PUBLICATION OF FINAL RULE IN THE FEDERAL REGISTER], systems serving fewer than 10,000 people must meet the turbidity requirements in §§ 141.550 through 141.553.

* * * * *

(d) *Other filtration technologies.* A public water system may use a filtration technology not listed in paragraphs (a) through (c) of this section if it demonstrates to the State, using pilot plant studies or other means, that the alternative filtration technology, in combination with disinfection treatment that meets the requirements of § 141.72(b), consistently achieves 99.9 percent removal and/or inactivation of *Giardia lamblia* cysts and 99.99 percent removal and/or inactivation of viruses. For a system that makes this demonstration, the requirements of paragraph (b) of this section apply. Beginning December 17, 2001, systems serving at least 10,000 people must meet the requirements for other filtration technologies in paragraph (b) of this section. Beginning [DATE 36 MONTHS AFTER DATE OF PUBLICATION OF FINAL RULE IN THE FEDERAL REGISTER], systems serving fewer than 10,000 people must meet the requirements for treatment technologies in §§ 141.550 through141.553.

8. Subpart H is amended by adding a new § 141.76 to subpart H to read as follows:

**§ 141.76 Recycle Provisions.**

(a) Public water systems employing conventional filtration or direct filtration that use surface water or ground water under the direct influence of surface water and recycle within the treatment process must meet all applicable requirements of this section. Requirements are summarized in the following table.

RECYCLE PROVISIONS FOR SUBPART H SYSTEMS

| If you are a . . . | You are required to meet the requirements in . . . |
|---|---|
| (1) subpart H public water system employing conventional or direct filtration returning spent filter backwash, thickener supernatant, or liquids from dewatering processes concurrent with or downstream of the point of primary coagulant addition. | § 141.76 (b). |
| (2) Plant that is part of a subpart H public water system, employ conventional filtration treatment, practice direct recycle, employ 20 or fewer filters to meet production requirements during the highest production month in the 12 month period [date 60 months after publication of final rule], and recycle spent filter backwash or thickener supernatant to the treatment process. | § 141.76 (c). |
| (3) subpart H public water system practicing direct filtration and recycling to the treatment process. | § 141.76 (d). |

(b) Recycle return location. All subpart H systems employing conventional filtration or direct filtration and returning spent filter backwash, thickener supernatant, or liquids from dewatering processes at or after the point of primary coagulant addition must return these recycle flows prior to the point of primary coagulant addition by [DATE 60 MONTHS AFTER DATE OF PUBLICATION OF FINAL RULE IN THE FEDERAL REGISTER]. The system must apply to the State for approval of the change in recycle location before the system implements it.

(1) All subpart H systems employing conventional filtration or direct filtration, returning spent filter backwash, thickener supernatant, or liquids from dewatering processes at or after the point of primary coagulant addition must submit a plant schematic to the State by [DATE 42 MONTHS AFTER DATE OF PUBLICATION OF FINAL RULE IN THE FEDERAL REGISTER] showing the current recycle return location(s) for the recycle stream(s) and the new return location that will be used to establish compliance. The system must keep the plant schematic on file for review during sanitary surveys.

(2) Softening systems may recycle process solids at the point of lime addition preceding the softening process to improve treatment efficiency. Process solids may not be returned prior to the point of lime addition. Softening systems shall not return spent filter backwash, thickener supernatant, or liquids from dewatering processes to a location other than prior to the point of primary coagulant addition unless an alternate location is granted by the State.

(3) Contact clarification systems may recycle process solids directly into the contactor. Contact clarification systems shall not return spent filter backwash, thickener supernatant, or liquids from dewatering processes to a location other than prior to the point of primary coagulant addition unless an alternate location is granted by the State.

(4) Systems may apply to the State to return spent filter backwash, thickener supernatant, or liquids from dewatering processes to an alternate location other than prior to the point of primary coagulant addition.

(c) Plants that are part of subpart H public water systems that employ conventional rapid granular filtration, practice direct recycle, employ 20 or fewer filters to meet production requirements during the highest production month in the 12 month period prior to [DATE 60 MONTHS AFTER PUBLICATION OF FINAL RULE IN THE **Federal Register**], and recycle spent filter backwash or thickener supernatant to the primary treatment process shall complete a recycle self assessment, as stipulated in paragraphs(c)(1) and (c)(2) by [Date 51 Months After Date of Publication of Final Rule in the **Federal Register**]. Systems required to perform the self assessment shall:

(1) Submit a recycle self assessment monitoring plan to the State no later than [Date 39 Months After Date of Publication of Final Rule in the **Federal Register**]. At a minimum, the monitoring plan must identify the highest water production month during

which monitoring will be conducted, contain a schematic identifying the location of raw and recycle flow monitoring devices, describe the type of flow monitoring devices to be used, identify the system's State approved operating capacity, and describe how data from the raw and recycle flow monitoring devices will be simultaneously retrieved and recorded.

(2) Implement the following recycle self assessment monitoring and analysis steps:

(i) *Steps for Implementation of Recycle Self Assessment:*

(A) Identify the highest water production month during the 12 month period preceding [Date 36 Months After Date of Publication of Final Rule in the **Federal Register**].

(B) Perform the monitoring described in paragraph (c)(2)(i)(C) of this section during the 12 month period after submission of the monitoring plan to the State. The twelve month period must begin no later than [Date 39 Months After Date of Publication of Final Rule in the **Federal Register**].

(C) For each day of the month identified in paragraph (c)(2)(i)(A) of this section, separately monitor source water influent flow and recycle flow before their confluence during one filter backwash recycle event per day, at three minute intervals during the duration of the event. Monitoring must be performed between 7:00 a.m. and 8:00 p.m. Systems that do not have a filter backwash recycle event every day between 7:00 am and 8:00 p.m. must monitor one filter backwash recycle event per day, any three days of the week, for each week during the month of monitoring, between 7:00 a.m. and 8:00 p.m. Record the time filter backwash was initiated, the influent and recycle flow at three minute intervals during the duration of the event, and the time the filter backwash recycle event ended. Record the number of filters in use when the filter backwash recycle event is monitored.

(D) Calculate the arithmetic average of all influent and recycle flow values taken at three minute intervals in paragraph (c)(2)(i)(c) of this section. Sum the arithmetic average calculated for raw water influent and recycle flows. Record this value and the date the monitoring was performed. This value is referred to as event flow.

(E) After the month of monitoring is complete, order the event flows in a list of increasing order, from lowest to highest. Highlight the event flows that exceed State approved operating capacity and then sum the number of event flows highlighted.

(ii) [Reserved]

(3) Subpart H systems performing recycle self assessments are required to report the results of the self assessment and supporting documentation to the State within one month of completing raw water influent and recycle flow monitoring. The report must be submitted no later than [DATE 52 MONTHS AFTER DATE OF PUBLICATION OF FINAL RULE IN THE FEDERAL REGISTER]. If the State determines the self assessment is incomplete or inaccurate, it may require the system to correct deficiencies or perform an additional self assessment. At a minimum, the report must contain the following information:

(i) *Minimum Information Included in Recycle Assessment Report to State:*

(A) All source and recycle flow measurements taken and the dates they were taken. For all events monitored, report the times the filter backwash recycle event was initiated, the flow measurements taken at three minute intervals, and the time the filter backwash recycle event ended. Report the number of filters in use when the backwash recycle event is monitored.

(B) All data used and calculations performed to determine whether the system exceeded operating capacity during monitored recycle events and the number of event flow values that exceeded State approved operating capacity.

(C) A plant schematic showing the origin of all recycle flows, the hydraulic conveyance used to transport them, and their final destination in the plant.

(D) A list of all the recycle flows and the frequency at which they are returned to the plant's primary treatment process.

(E) Average and maximum backwash flow rate through the filters and the average and maximum duration of the filter backwash process, in minutes.

(F) Typical filter run length and a written summary of how filter run length is determined (preset run time, headloss, turbidity breakthrough, *etc.).*

(ii) [Reserved]

(4) All subpart H systems performing self assessments are required to modify their recycle practice in accordance with the State determination by [DATE 60 MONTHS AFTER DATE OF PUBLICATION OF FINAL RULE IN THE FEDERAL REGISTER] and keep a copy of the self assessment report submitted to the State on file for review during sanitary surveys.

(d) Subpart H public water systems practicing direct filtration and recycling to the primary treatment process are required to submit data to the State on their current recycle treatment no later than [DATE 42 MONTHS AFTER DATE OF PUBLICATION OF FINAL RULE IN THE FEDERAL REGISTER.]

(1) Direct filtration systems submitting data to the State shall report the following information, at a minimum:

(i) *Data Submitted to States by Direct Filtration Systems:*

(A) A plant schematic showing the origin of all recycle flows, the hydraulic conveyance used to transport them, and their final destination in the plant.

(B) The number of filters used at the plant to meet average daily production requirements and average and maximum backwash flow rate through the filter and the average and maximum duration of the filter backwash process, in minutes.

(C) Whether recycle flow treatment or equalization is in place.

(D) The type of treatment provided for the recycle flow.

(E) For recycle equalization and treatment units: data on the physical dimensions of the unit (length, width (or circumference), depth,) sufficient to allow calculation of volume; typical and maximum hydraulic loading rate; type of treatment chemicals used and average dose and frequency of use, and frequency at which solids are removed from the unit, if applicable.

(ii) [Reserved]

(2) All direct filtration systems submitting data to the State are required to modify their recycle practice in accordance with the State determination no later than [DATE 60 MONTHS AFTER DATE OF PUBLICATION OF FINAL RULE IN THE FEDERAL REGISTER] and keep a copy of the report submitted to the State on file for review during sanitary surveys.

9. Section 141.153 is amended by revising the first sentence of paragraph (d)(4)(v)(C) to read as follows:

**§ 141.153 Content of the reports.**

* * * * *

(d) * * *

(4) * * *

(v) * * *

(C) When it is reported pursuant to § 141.73 or § 141.173 or § 141.551: the highest single measurement and the lowest monthly percentage of samples meeting the turbidity limits specified in § 141.73 or § 141.173, or § 141.551 for the filtration technology being used. * * *

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10. The heading to Subpart P is revised as follows:

## Subpart P—Enhanced Filtration and Disinfection-Systems Serving 10,000 or More People

* * * * *

11. Section 141.170 is amended by adding paragraph (d) to read as follows:

### § 141.170 General requirements.

* * * * *

(d) Subpart H systems that did not conduct applicability monitoring under § 141.172 because they served fewer than 10,000 persons when such monitoring was required but serve more than 10,000 persons prior to [DATE 36 MONTHS AFTER DATE OF PUBLICATION OF FINAL RULE IN THE FEDERAL REGISTER] must comply with §§ 141.170, 141.171, 141.173, 141.174, and 141.175. These systems must also consult with the State to establish a disinfection benchmark. A system that decides to make a significant change to its disinfection practice, as described in § 141.172(c)(1)(i) through (iv) must consult with the State prior to making such change.

* * * * *

12. Part 141 is amended by adding a new subpart T to read as follows:

## Subpart T—Enhanced Filtration and Disinfection—Systems Serving Fewer than 10,000 People



### Subpart T—Enhanced Filtration and Disinfection—Systems Serving Fewer Than 10,000 People

**General Requirements**

### § 141.500 General requirements.

The requirements of subpart T constitute national primary drinking water regulations. These regulations establish requirements for filtration and disinfection that are in addition to criteria under which filtration and disinfection are required under subpart H of this part. The regulations in this subpart establish or extend treatment technique requirements in lieu of maximum contaminant levels for the following contaminants: *Giardia lamblia,* viruses, heterotrophic plate count bacteria, *Legionella, Cryptosporidium* and turbidity. The treatment technique requirements consist of installing and properly operating water treatment processes which reliably achieve:

(a) At least 99 percent (2 log) removal of *Cryptosporidium* between a point where the raw water is not subject to recontamination by surface water runoff and a point downstream before or at the first customer for filtered systems, or *Cryptosporidium* control under the watershed control plan for unfiltered systems.

(b) Compliance with the profiling and benchmark requirements in §§ 141.530 through 141.544.

### § 141.501 Who is subject to the requirements of subpart T?

You are subject to these requirements if your system:

(a) Is a public water system;

(b) Uses surface water or GWUDI as a source; and

(c) Serves fewer than 10,000 persons annually.

### § 141.502 When must my system comply with these requirements?

You must comply with these requirements beginning [DATE 36 MONTHS AFTER DATE OF PUBLICATION OF FINAL RULE IN THE FEDERAL REGISTER] except where otherwise noted.

### § 141.503 What does subpart T require?

There are six requirements of this subpart which your system may need to comply with. These requirements are discussed in detail later in this subpart. They are:

(a) Any finished water reservoir for which construction begins on or after [DATE 60 DAYS AFTER DATE OF PUBLICATION OF FINAL RULE IN THE FEDERAL REGISTER] must be covered;

(b) Unfiltered systems must comply with updated watershed control requirements;

(c) All systems subject to the requirements of this subpart must develop a disinfection profile;

(d) All systems subject to the requirements of this subpart that are considering a significant change to their disinfection practice must develop a disinfection benchmark and receive State approval before changing their disinfection practice;

(e) Filtered systems must comply with specific combined filter effluent turbidity limits and monitoring and reporting requirements; and

(f) Filtered systems using conventional or direct filtration must