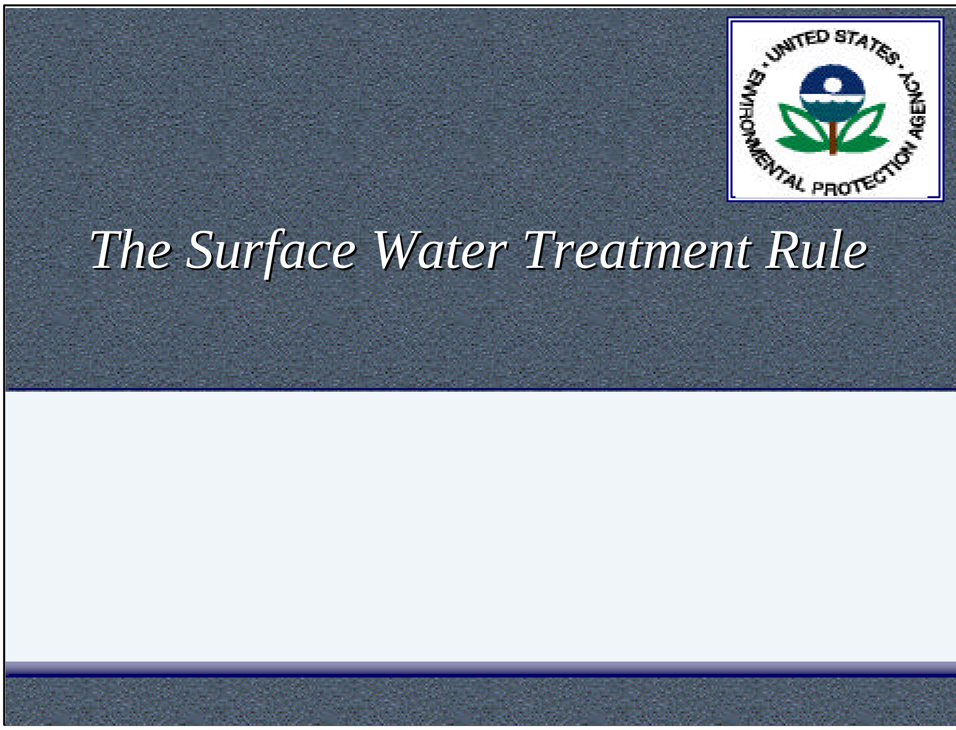
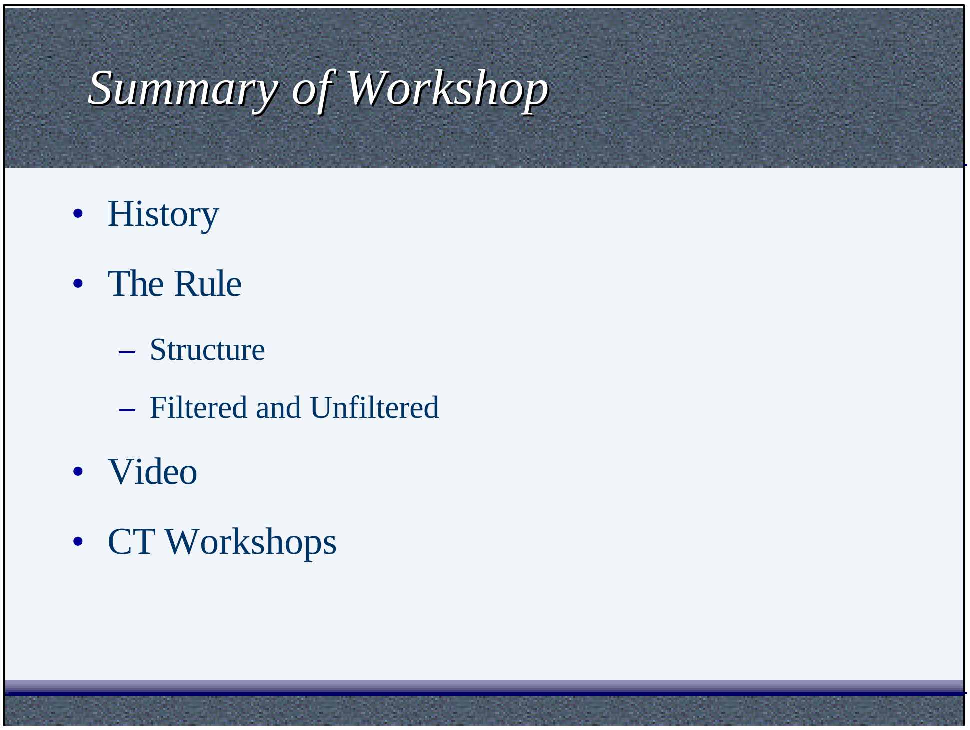

The Surface Water Treatment Rule

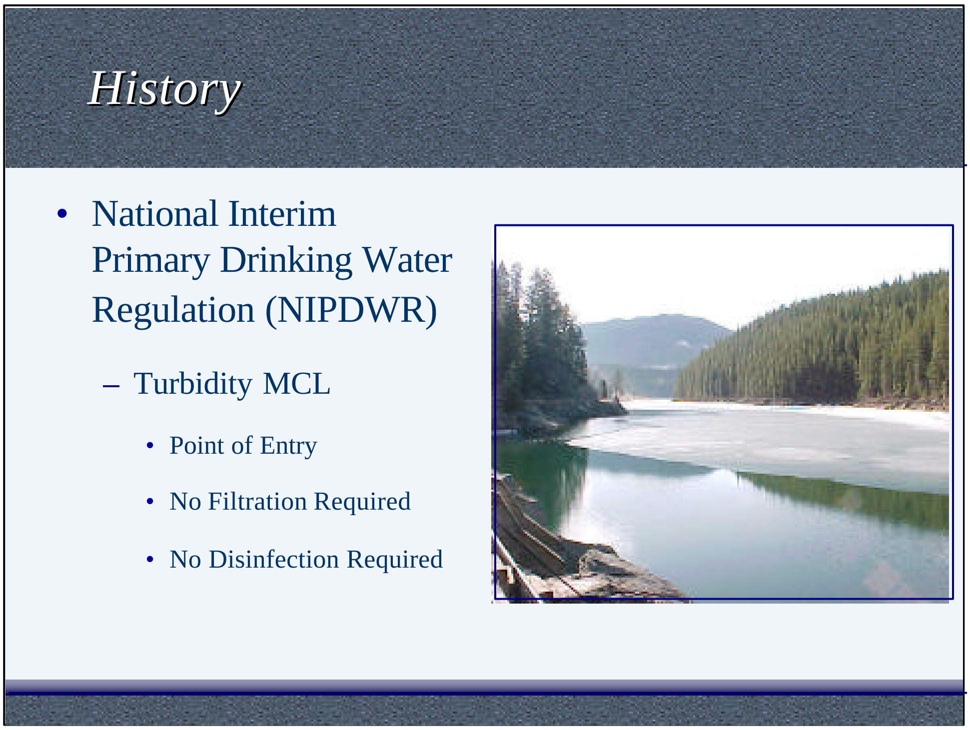


This presentation begins with a short history of the development of the Surface Water Treatment Rule and develops the logic for its construction.

Then the SWTR itself is covered generally in the same order as it is found in the CFR.

Nearly equal emphasis is placed upon filtered and unfiltered surface water systems and how the Rule is structured to ensure the provision of reasonably safe water from each. Some discussion will be provided in terms of the public health protection short comings of the SWTR.

A separate video has been developed that expands upon methods and experiences of systems that meet the filtration avoidance criteria of the rule. Both large and small unfiltered surface water systems are used as examples.



The 1976 NIPDWRs addressed the safety of surface water as follows:

1 NTU as determined by a monthly average except that five or fewer NTU may be allowed if the supplier can demonstrate to the State that the higher turbidity does not:

- Interfere with disinfection
- Prevent maintenance of an effective residual
- Interfere with microbial determinations

- **5 NTU** based on an average for two consecutive days

Section 141.122 Turbidity sampling and analytical requirements

- Samples must be collected at a representative entry point
  - At least once per day
  - States can give reduced sampling frequency to noncommunity systems if
    - they practice full-time disinfection and
    - maintain a residual in the distribution system
- When a sample is > the MCL, resample as soon as practicable but within 1 hour
  - The repeat sample determines whether the MCL has been exceeded or if the two-day average exceeds 5 NTU

After passage of the SDWA and promulgation of the NIPDWRs it soon became apparent that existing regulations did not provide adequate protection for public health. Occurrence of water borne outbreaks of *Giardia*, mostly at unfiltered systems, provided ample evidence that this was the case.

Cryptosporidiosis had not yet become recognized as a public health issue of drinking water.

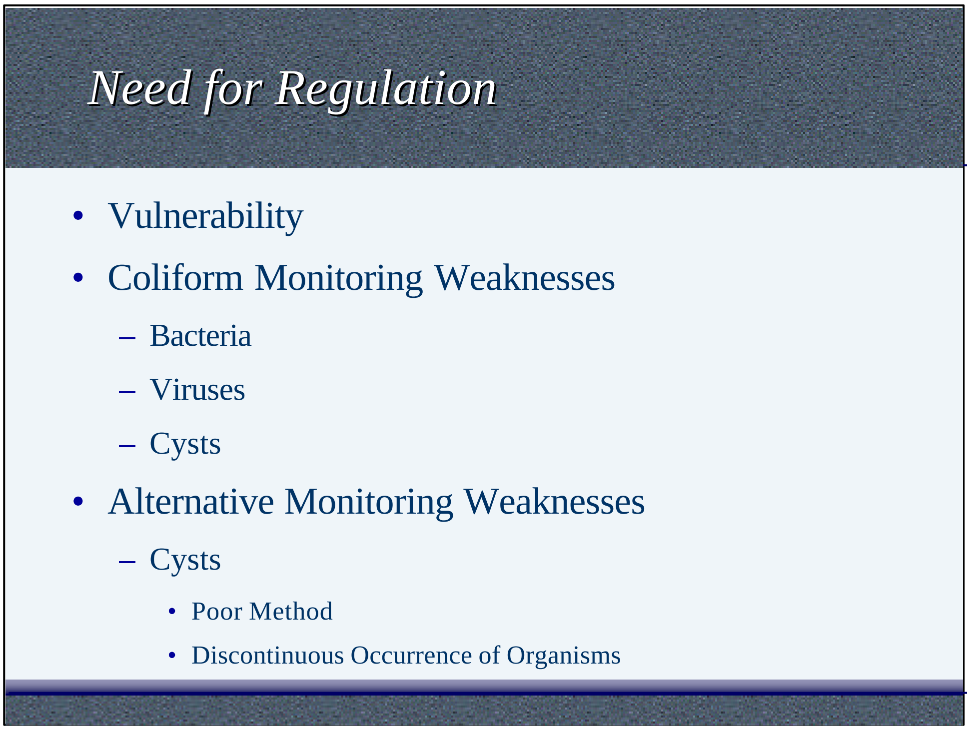
Water borne outbreaks of disease occurred at both filtered and unfiltered systems pointing out that more protection was needed by both filtered and unfiltered systems.

History (cont.)

- Filtered Water Sources
  - Usually in Compliance

Filtered systems, even small ones, were usually in compliance with the NIPDWRs. In part because only one turbidity sample had to be collected each day at a representative entry point.

For small systems that operated a limited number of hours each day that meant they would usually arrive at the plant and collect the daily turbidity sample from the clearwell, prior to starting the plant. This allowed the filtered water overnight settling in the clearwell and virtually ensured water that would meet the 1 NTU monthly standard, even though filtered water entering the clearwell might often have relatively high turbidity readings.

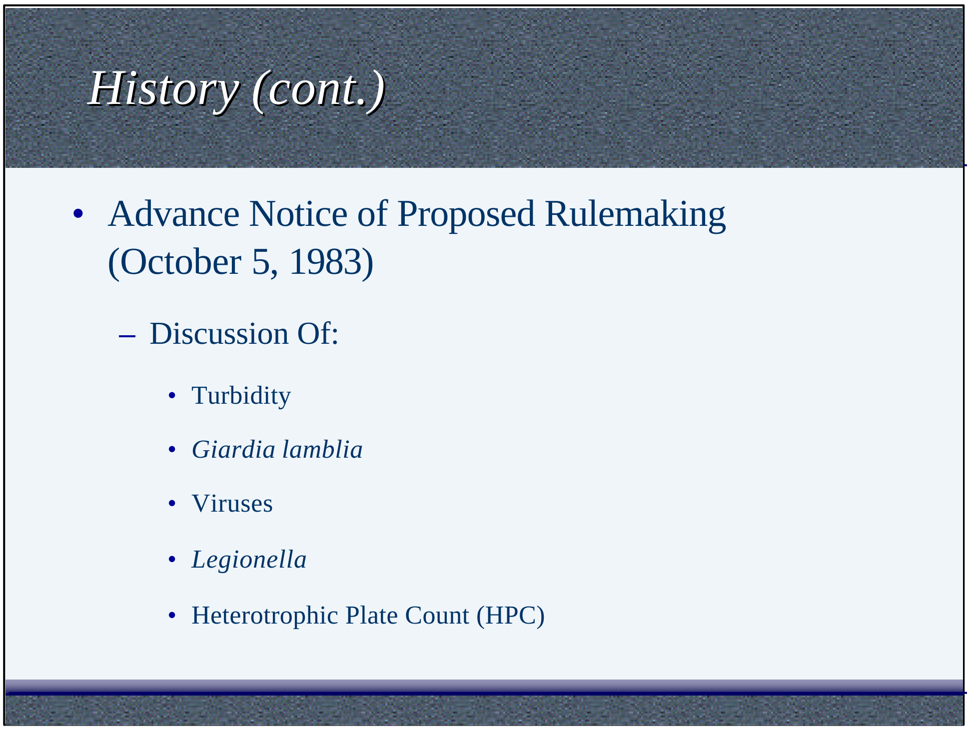


Some of the issues include:
Surface water systems are typically vulnerable to various types of contaminants simply by virtue of them being open to collect runoff, wind blown contaminants, spills, and etc.

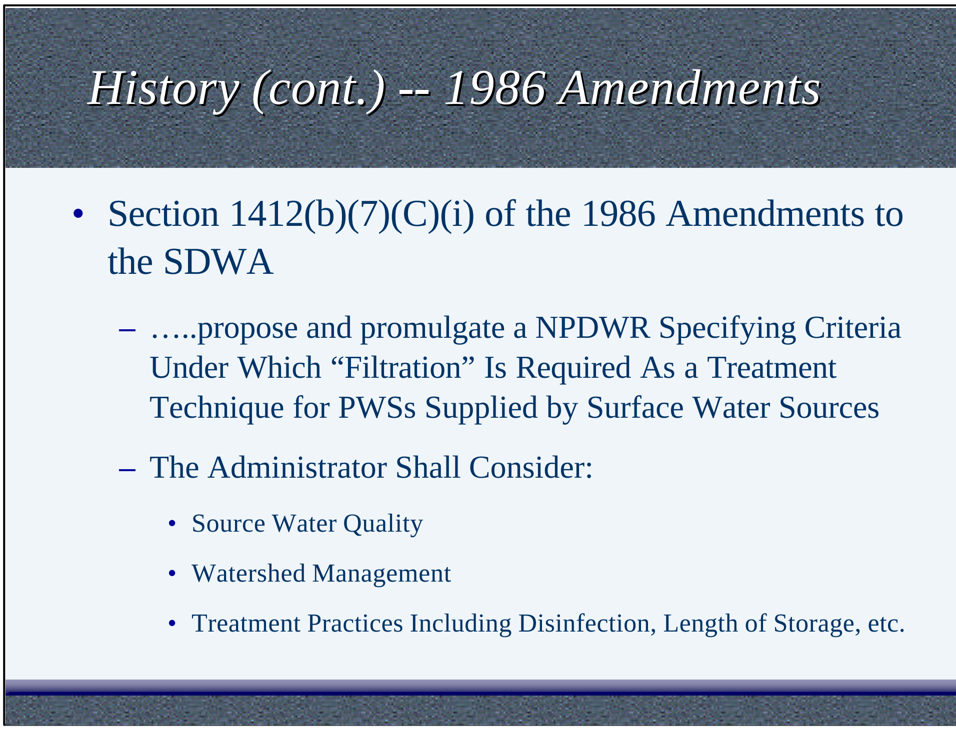
The turbidity monitoring was designed to ensure some level of water clarity and treatment. It did not, however, provide an adequate measure of either treatment (in the case of filtered systems) or of the effectiveness of the disinfection process.

Coliform monitoring was relatively effective for determining the risks of bacteria and some viruses. However, it did not work well for *Giardia lamblia* because *Giardia* is more resistant to disinfectants than are coliforms. Coliform free water could well harbor viable cysts of pathogenic protozoa.

Some systems and States attempted to assess risks from *Giardia* by filtering hundred of gallons of water through wound filters, then examining the filters for cysts. This process proved to be very inaccurate and, ultimately, public health officials recognized cysts occur discontinuously, therefore, treatment should be in place to address them when they are present.

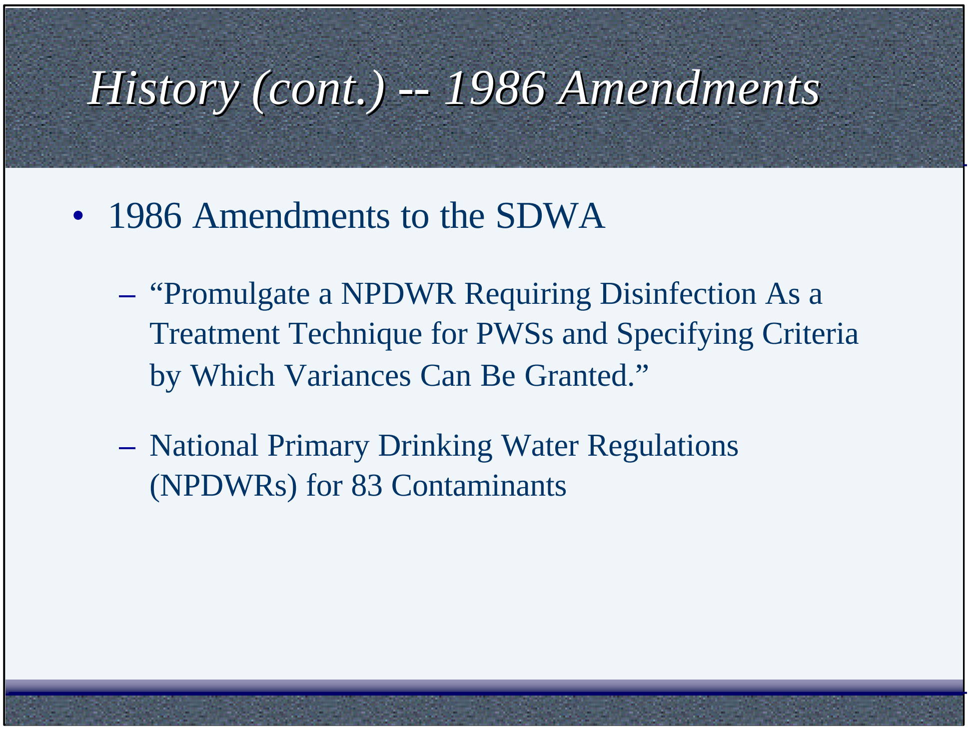


EPA published an *Advanced Notice of Proposed Rulemaking* on October 5, 1983. This contained a discussion of many of the issues associated with health risks from the above bulleted contaminants typically found in surface water sources.



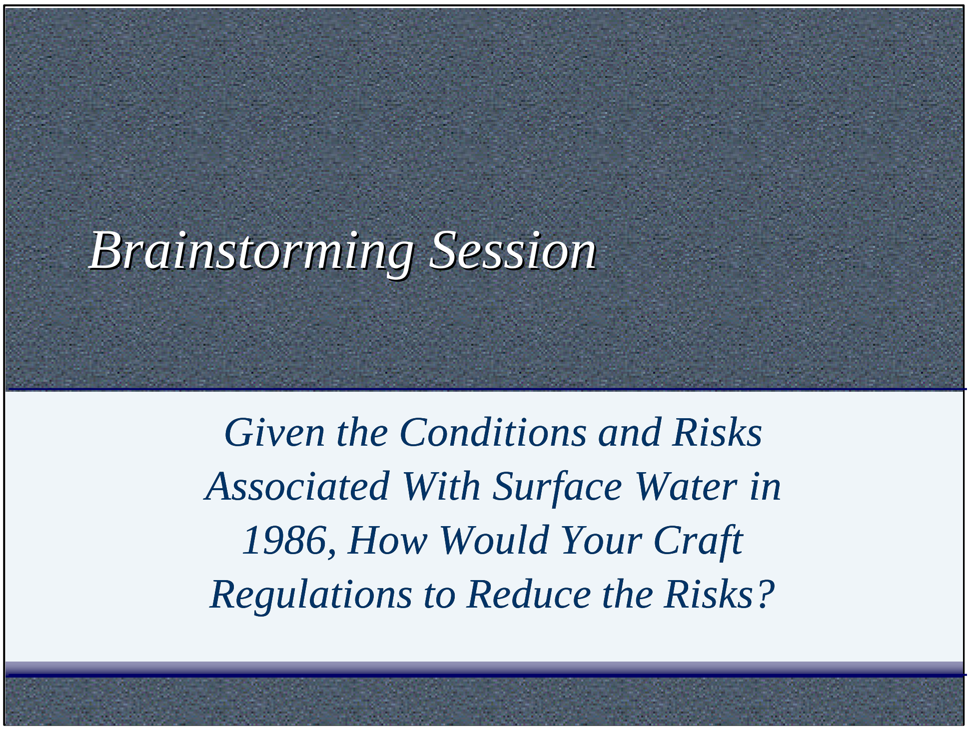
Subsequently Congress passed the 1986 Amendments to the SDWA. Included in the 1986 Amendments was the requirement for EPA to address surface water as a drinking water health issue. The Act still left open the opportunity for surface water systems to remain unfiltered should they meet the criteria under which filtration would not be required.

Congress included some guidance that the Administrator should consider when specifying criteria under which filtration would be required as a treatment technique.



The Amendments also addressed disinfection of PWSs but again left open the opportunity for some to remain undisinfected should the proper criteria, to be established by EPA, be met.

Congress also demanded more action from EPA on other fronts including regulation of VOCs, SOCs and IOCs.



Break up the class into groups of 6 – 10 persons and have them craft a regulation for surfac water systems based upon the the material covered in the previous slides and the next slide.

About 20 – 25 minutes should be allowed for this workshop. Then each group should have a few minutes to present their regulation and to explain the logic they used in establishing the requirements.

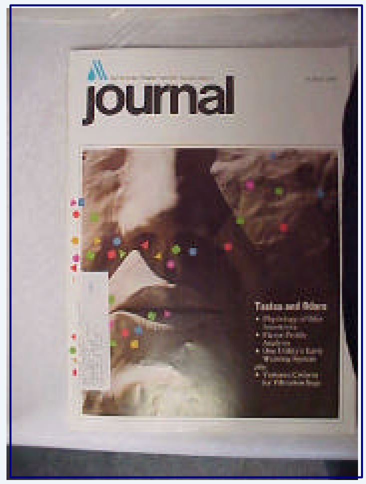
Questions and Considerations

- MCLs or Treatment Techniques or Both?
- Should All Surface Sources be Filtered?
- Should All Surface Sources be Disinfected?
- What Technologies Should be Allowed For Filtration?
- For Disinfection?
- What Monitoring Should be Required?

These questions should be considered by participants when devising their strategies for regulating surface water systems.

History (cont.)

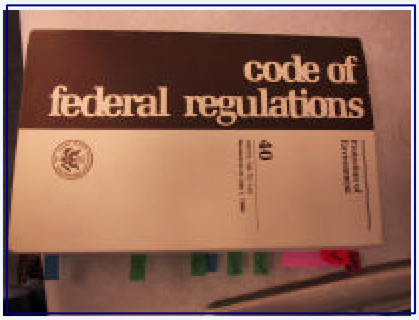
- Journal AWWA, March 1986
  - *Variance Analyses and Criteria for Treatment Regulations*
    - *Appiah Amirtharajah*



In March of 1986 an article by Appiah Amirtharajah entitled *Variance Analyses and Criteria for Treatment Regulations* appeared in the JAWWA and presented:

- Rationale for mandatory treatment
- Rationale for filtration and disinfection of surface water
- Benefit-cost implications of a filtration treatment regulation.
- Performance capabilities of treatment technologies.
  - Percentage removal of target organisms
  - Virus and *Giardia* inactivation by disinfection
- Removals by filtration-disinfection and storage-disinfection sequences
  - The multiple barrier concept
  - Conventional filtration as a "standard of the industry" for surface water treatment.
- Criteria for granting variances
  - Watershed control
  - Waterborne disease outbreak history
  - Source and Finished water monitoring
  - Control of disinfection practices
  - Distribution system monitoring

History (cont.)



- Thursday June 29, 1989
- 40 CFR Parts 141 and 142
  - *Drinking Water; National Primary Drinking Water Regulations; Filtration, Disinfection; Turbidity,* Giardia lamblia*, Viruses,* Legionella*, and Heterotrophic Bacteria; Final Rule*

On Thursday June 29, 1989 the Surface Water Treatment Rule (SWTR) was published in the federal register.

Additions and modifications were made to several existing sections of 40 CFR Part 141 including those listed above.

We will go through these changes and additions in they order the occur in the CFR.

A new Subpart H entitled *Filtration and Disinfection* was added to 40 CFR Part 141. It included the sections listed on the above slide.

The bulk of the substantive parts of the SWTR are contained in subpart H. With the Interim Enhanced Surface Water Treatment Rule, promulgated in December of 1998, another new definition was subsequently included. It defined **subpart H systems** as those that use surface water or ground water under the direct influence of surface water.

Part 141—National Primary Drinking Water Regulations (cont.)

- 141.2 Definitions
  - Coagulation
  - Conventional Filtration Treatment
  - CT or CTcalc
  - Diatomaceous Earth Filtration
  - Direct Filtration
  - Disinfection Contact Time
  - Disinfection
  - Filtration

These new definitions were added to part 141.2 Definitions.

These definitions are critical for implementation of the SWTR. The instructor should refer to the rule and have an understanding of each.

Part 141—National Primary Drinking Water Regulations (cont.)

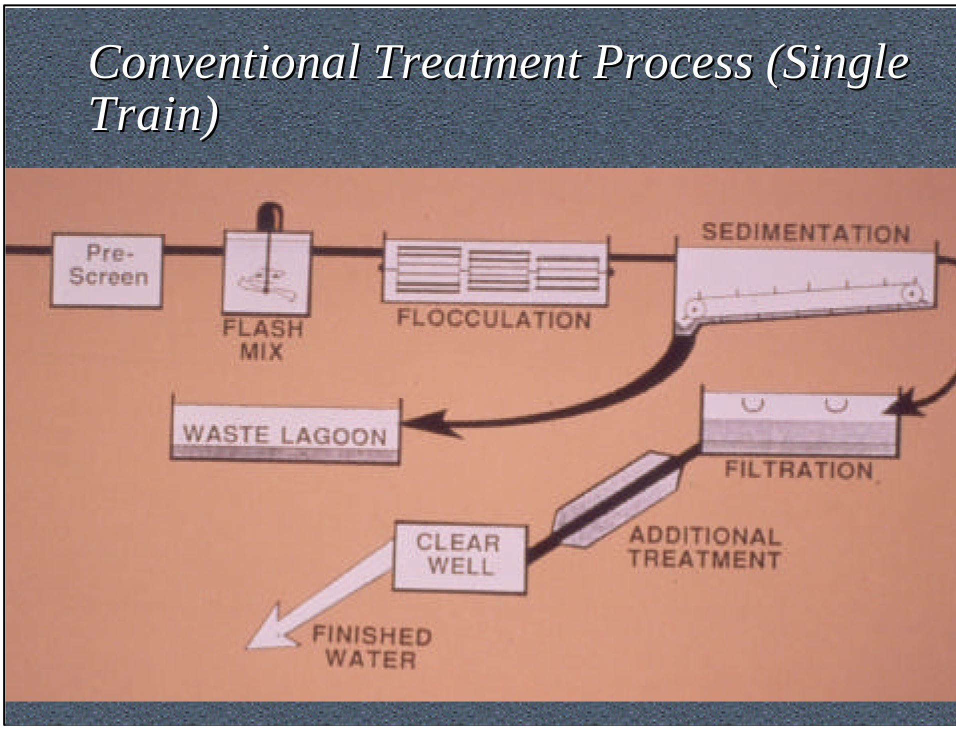
- 141.2 Definitions
  - Flocculation
  - Ground Water Under the Direct Influence of Surface Water
  - *Legionella*
  - Point of Disinfectant Application
  - Residual Disinfectant Concentration
  - Sedimentation
  - Slow Sand Filtration

These definitions are critical for implementation of the SWTR. The instructor should refer to the rule and have an understanding of each.

Part 141—National Primary Drinking Water Regulations (cont.)

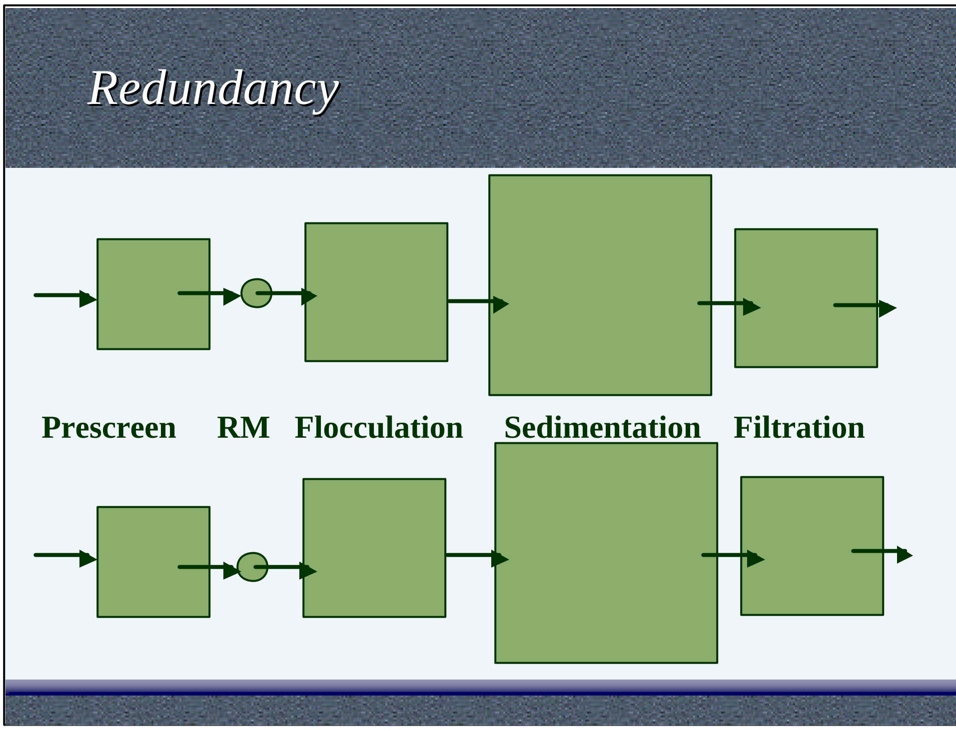
- 141.2 Definitions
  - Surface Water
  - Waterborne Disease Outbreak
  - Virus

These definitions are critical for implementation of the SWTR. The instructor should refer to the rule and have an understanding of each.



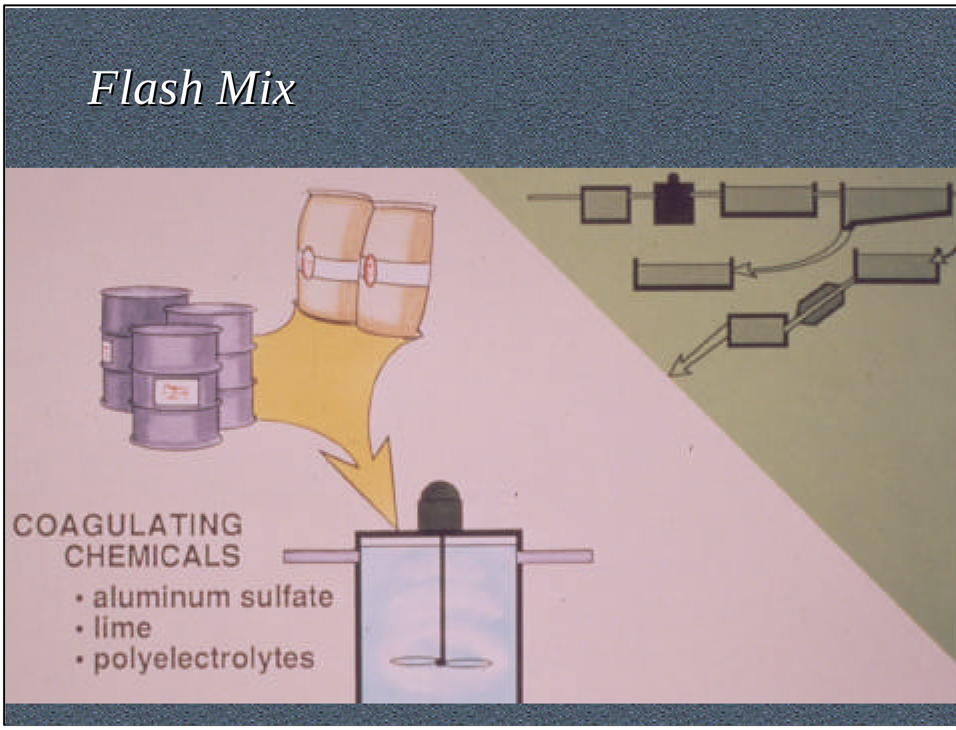
Over the past several decades experience has shown that water borne disease is uncommon, even with surface water sources, when they are treated by a well designed and properly operated "conventional" filtration plant. Such a plant makes use of the "multiple barrier" concept of public health protection. Put in its simplest form that is, establishing sequential treatment barriers designed to remove and/or inactivate pathogenic organisms that might be in the raw water source.

In conventional treatment those barriers typically include; 1. Coagulation/flocculation and sedimentation, 2. Filtration, and 3. Disinfection with adequate contact time. In this presentation we will address each of these barriers and explain their purpose. It is important to note that the SWTR was developed to ensure that conventional treatment plants are properly operated and that other filtration technologies provide equivalent protection to the water users. Additionally, it is crafted to ensure that systems that meet the criteria to avoid filtration also provide equivalent public health protection to water users.



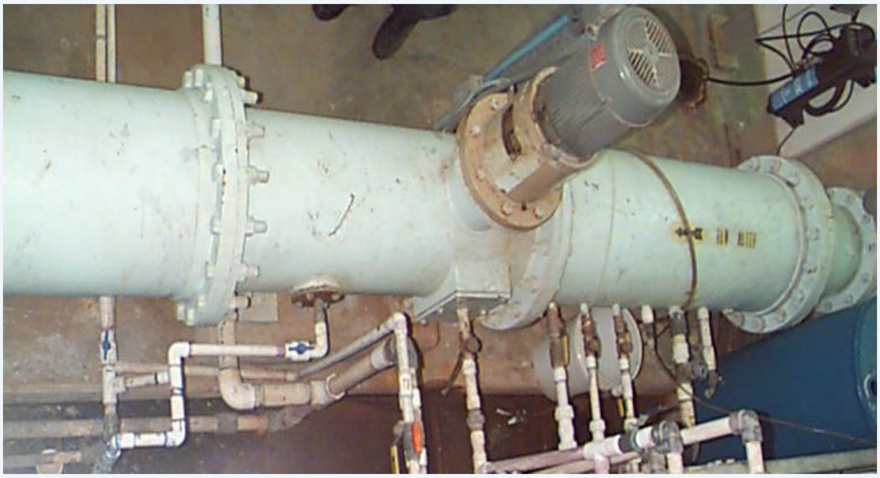
As an aside, it is useful to note that most surface water treatment plants are built with redundant treatment trains. That is, side-by-side unit processes that provide the same treatment. The SWTR primarily addresses the quality of the combined filter effluent (i.e. the water from all treatment trains after it is combined). Thus, one or more treatment trains might be making poor quality water and the problems could be masked by blending that water with higher quality water from the other trains. This could result is more exposure of users to pathogens than what would occur if all treatment trains were providing equally high quality water.

This is a weakness in the SWTR that we should be aware of and is addressed in future rules and in training.



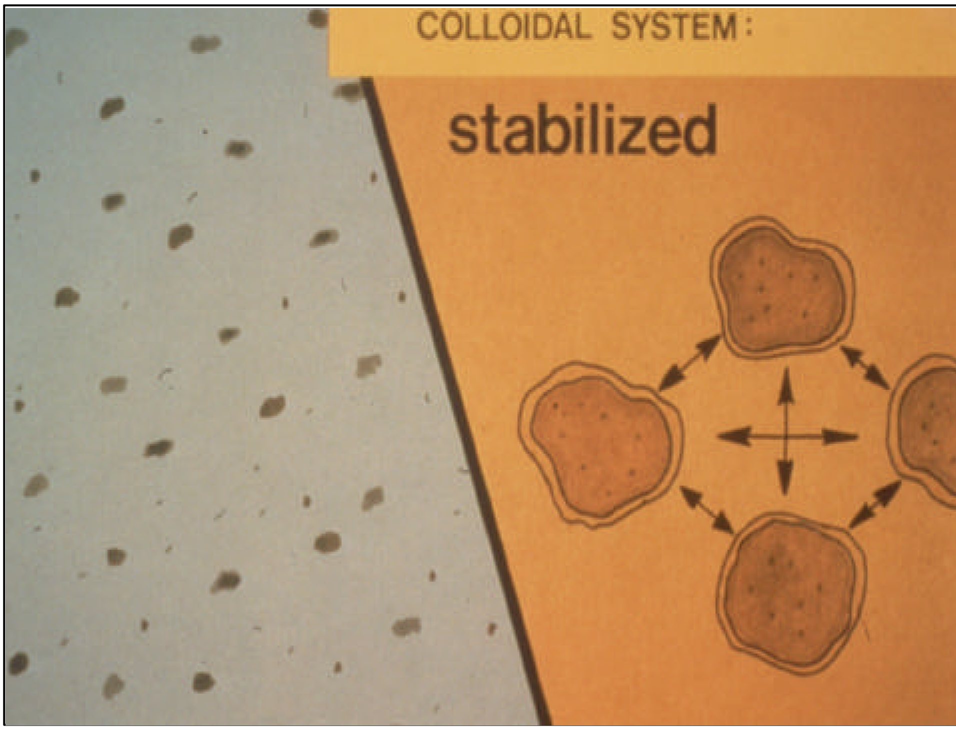
Surface water is typically screened to take out sticks, leaves, rocks, etc. Then the water passes through a "flash mix" unit where coagulant chemicals are added and coagulation takes place. Based on research and years of practical experience, engineers have learned the mixing intensity flash mixers must provide to optimize coagulation.

Example of Inline Mixer



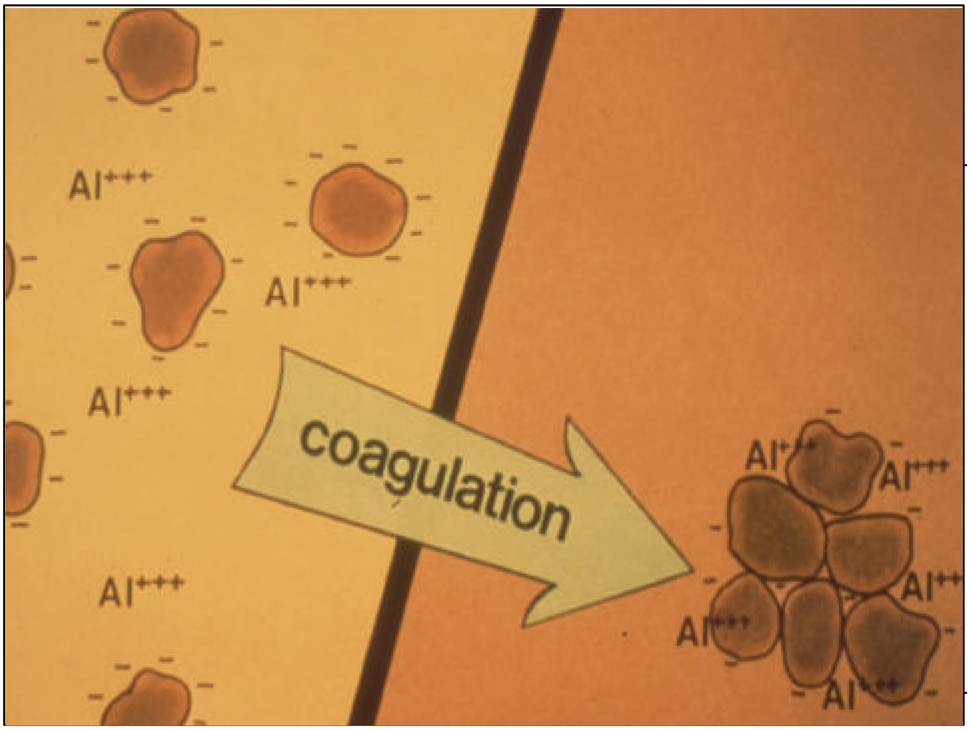
This is an example of a mechanical flash mixer. It operates much like a kitchen blender with the electric motor spinning an impeller that "blends" or "flash mixes" the chemicals added just upstream. These types of flash mixers are often designed so the speed or mixing intensity can be adjusted to fine tune and enhance the coagulation process. Note that the chemicals are typically added just ahead of the mixer. Some chemicals that may be damaged by the intensity of the mixing may be added after the mixer.

Often "static mixers" are used, particularly in small plants. These are essentially sections of pipe with vanes arranged within the pipe to create turbulent flow with the correct intensity to cause coagulation to occur.



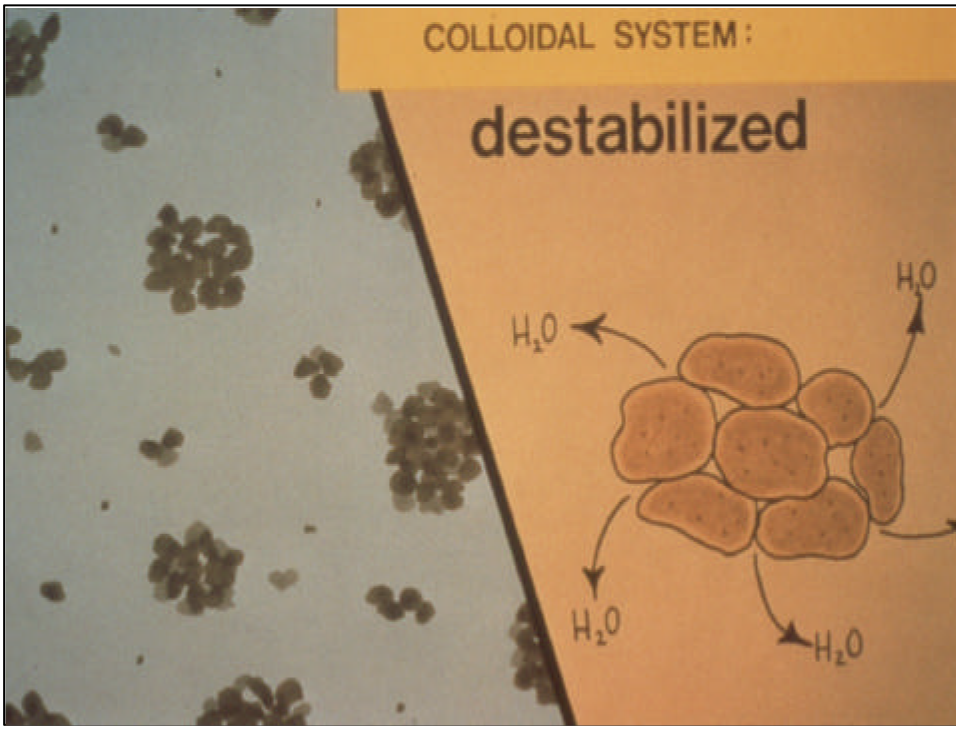
Turbidity particles, including pathogens, that need to be removed from surface water are typically colloidal in size. That is, they are very small and have negative charges and, therefore, will not settle out of the suspension. The like charges tend to keep the particles from clumping together. This, their size and the fact that they are typically hydrophilic (water loving) make them very difficult to settle out or otherwise remove.

Obviously, these problems must be overcome to remove the particles.

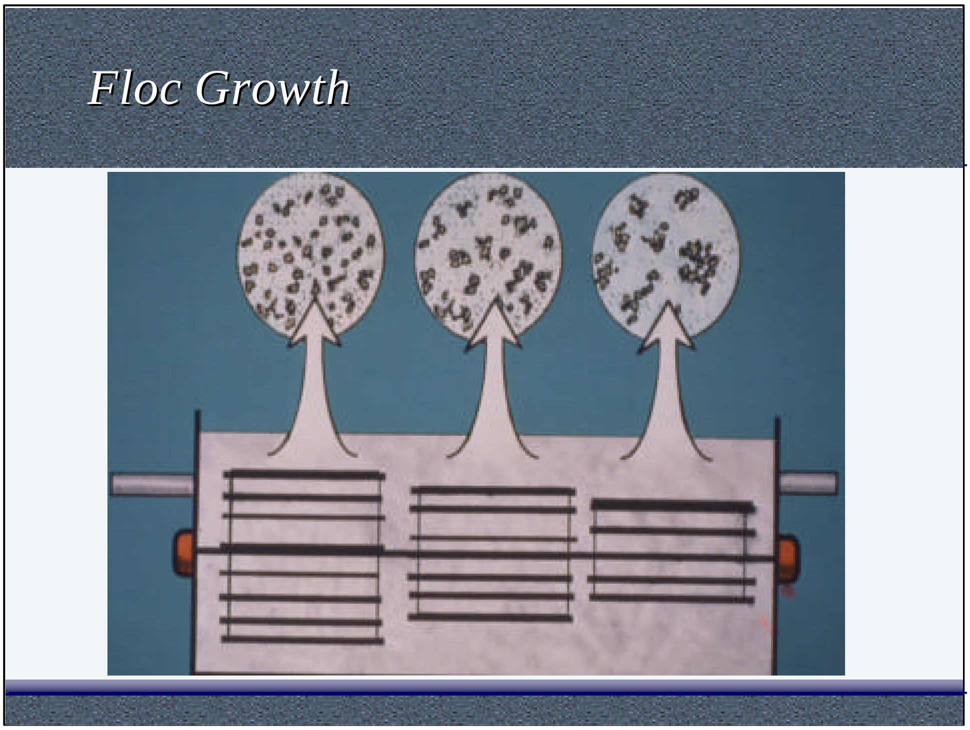


Inorganic coagulant chemicals such as alum, ferric chloride and ferrous sulfate are typically added to aid in the removal of turbidity. These coagulants are salts of aluminum or iron and the positive charges associated with them are able, when fed at a proper dosage, to neutralize the negative charges of the colloidal particles. This charge neutralization process allows the particles to come together and form larger particles.

Organic polymers can also be used as coagulants and as coagulant aids.

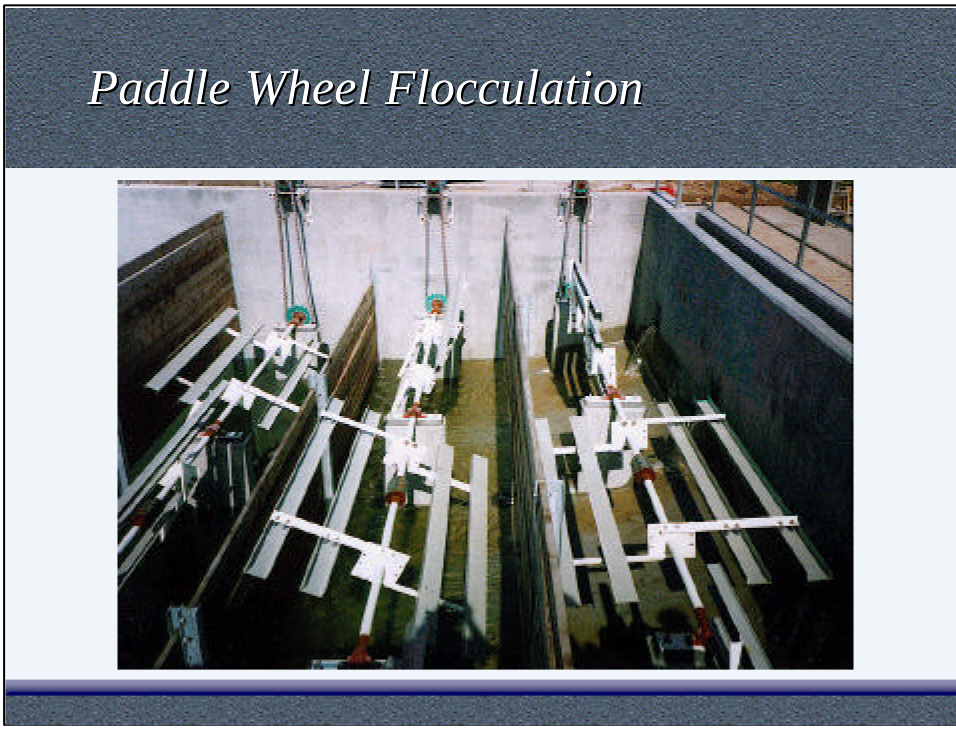


When the particles are neutralized they start to come together and form a "floc."

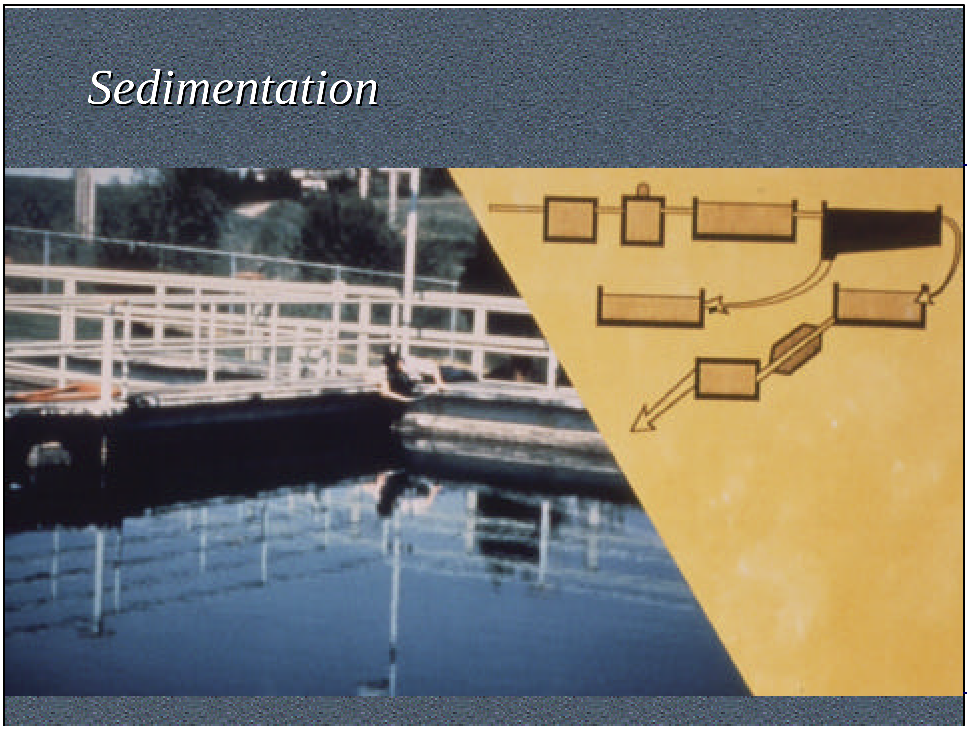


In the next stage of the treatment process, flocculation, the water is mixed to allow the destabilized particles to come into contact with each other. The flocculator shown above is designed to be "staged" or "tapered" and has higher mixing intensities in the upstream units. The mixing intensity decreases as the water passes through each stage. Thus larger and larger floc particles are formed in each stage and the slower mixing allows this to happen and avoids tearing apart floc particles.

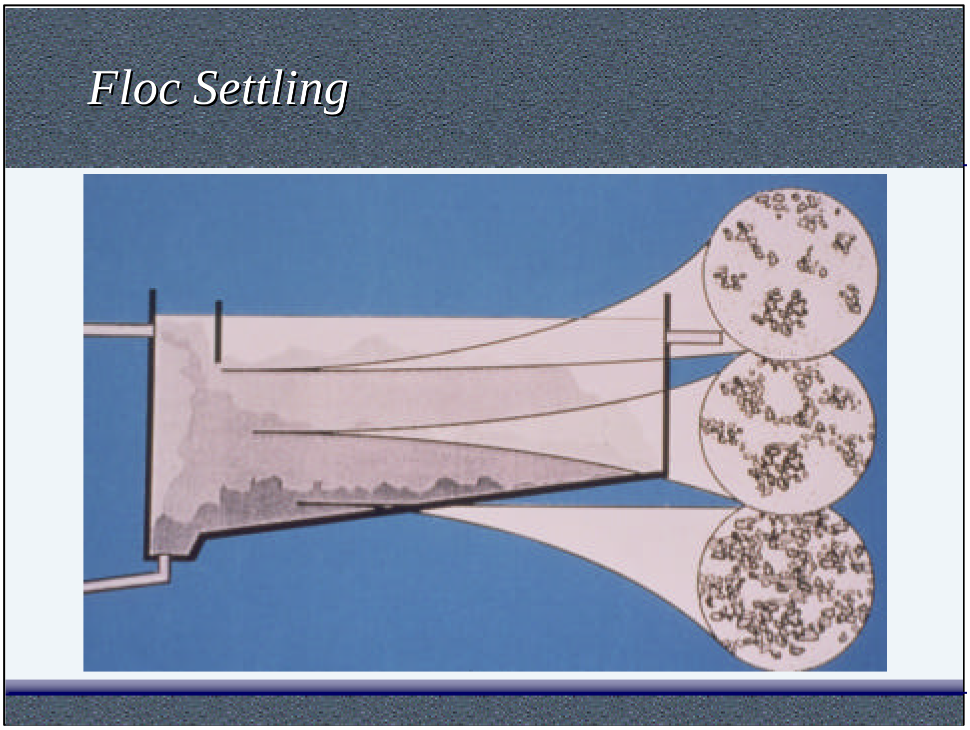
In this process floc particles are being formed that can settle out in the plant's sedimentation basin or "clarifier."



This is a photograph of paddle wheel flocculator units. The speed of the paddle wheels is slowed down as the water travels from the first unit on through the process.

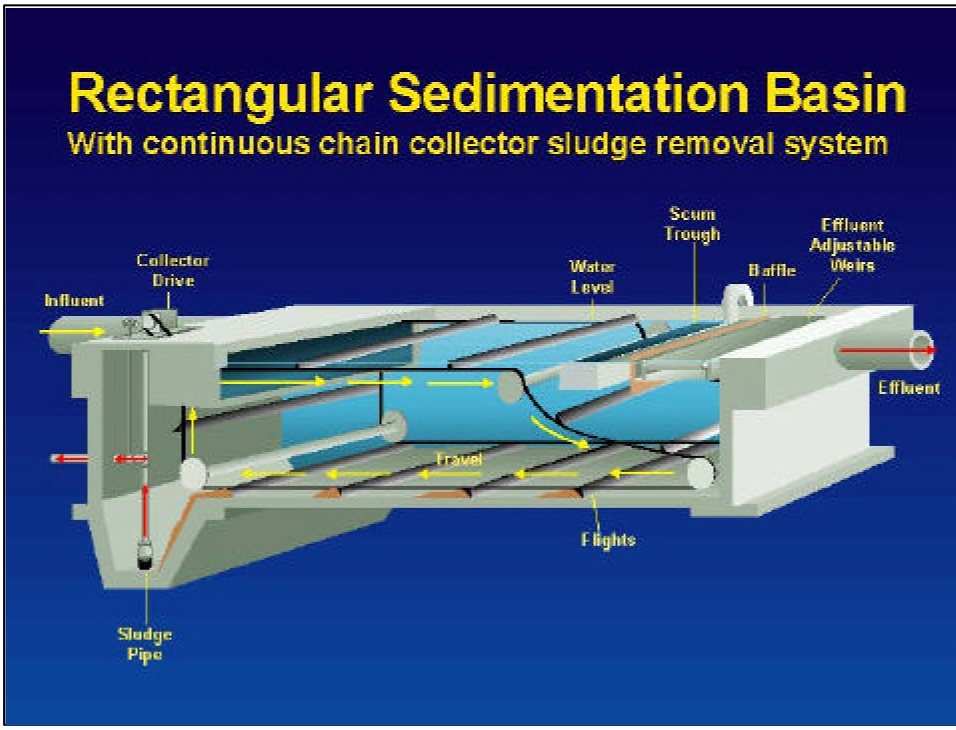


The next stage in the process is called sedimentation or clarification. This occurs in sedimentation basins or clarifiers. This is where the bulk of the floc particles are removed by gravity. The clean or "clarified" water then passes out of this basin and goes on to the filters.

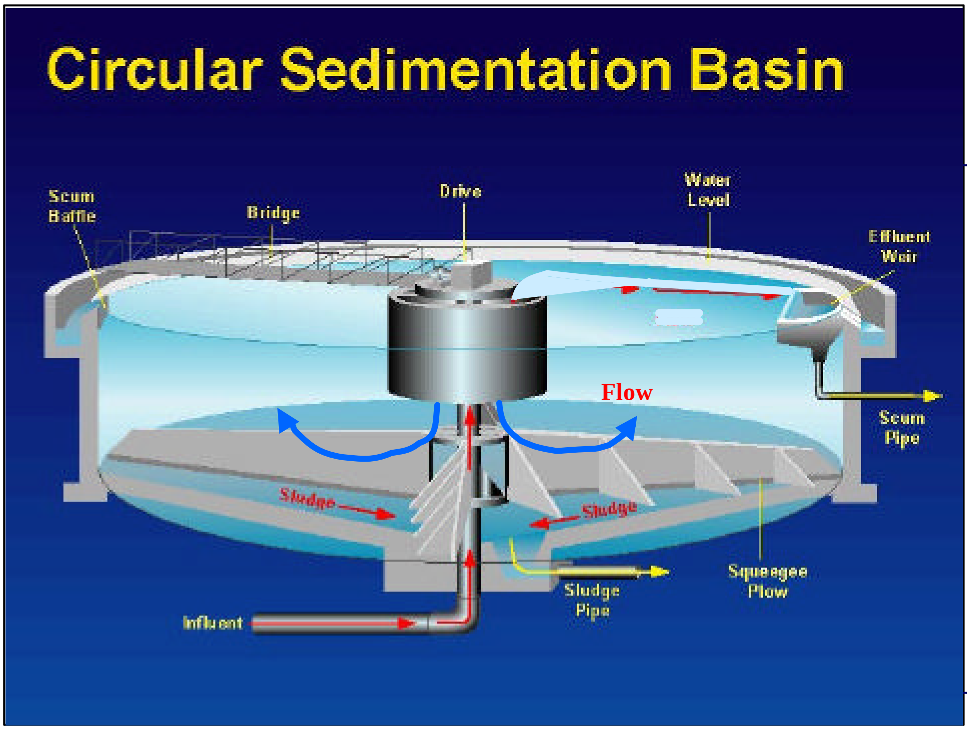


This diagram shows how the floc particles settle and come into contact with other floc particles. The concentration of floc particles increases as the particles settle deeper and deeper into the clarifier. The higher concentration of particles, known as "sludge" is removed from the bottom of the clarifier.

In this photograph the water is traveling in the direction of the super-imposed arrow. You can see the blanket of floc particles settle deeper into the water as the water moves through the basin. At the far end the photo shows the water near the surface is clear. This clarified water will move over collector weirs and be transferred to the filters for further treatment.

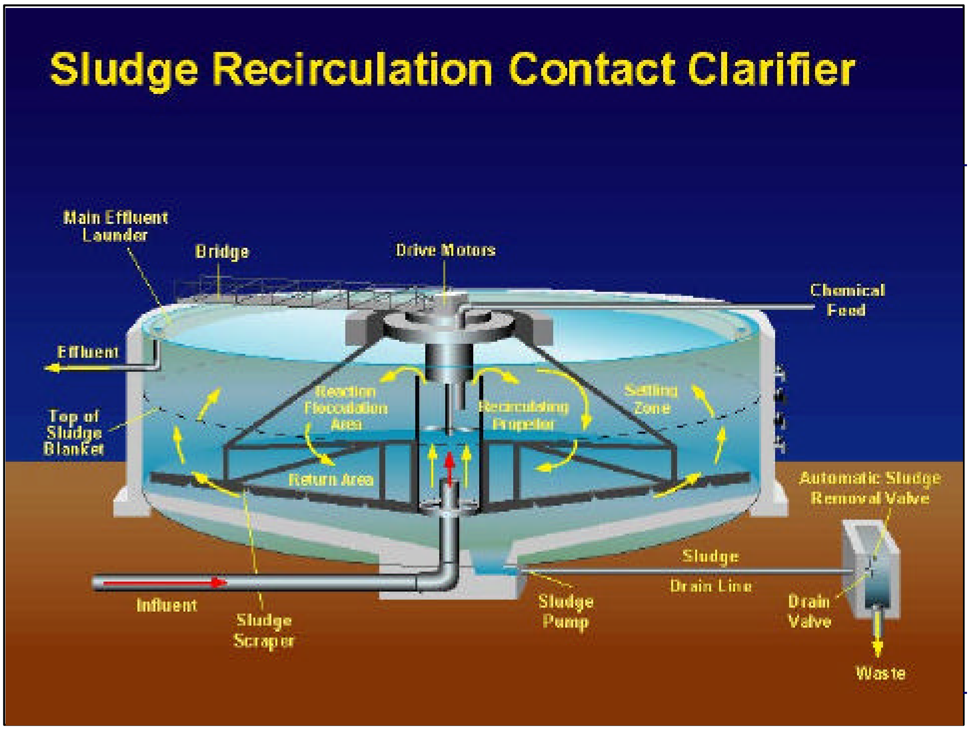


This is a drawing of a rectangular clarifier that can be used for water treatment.



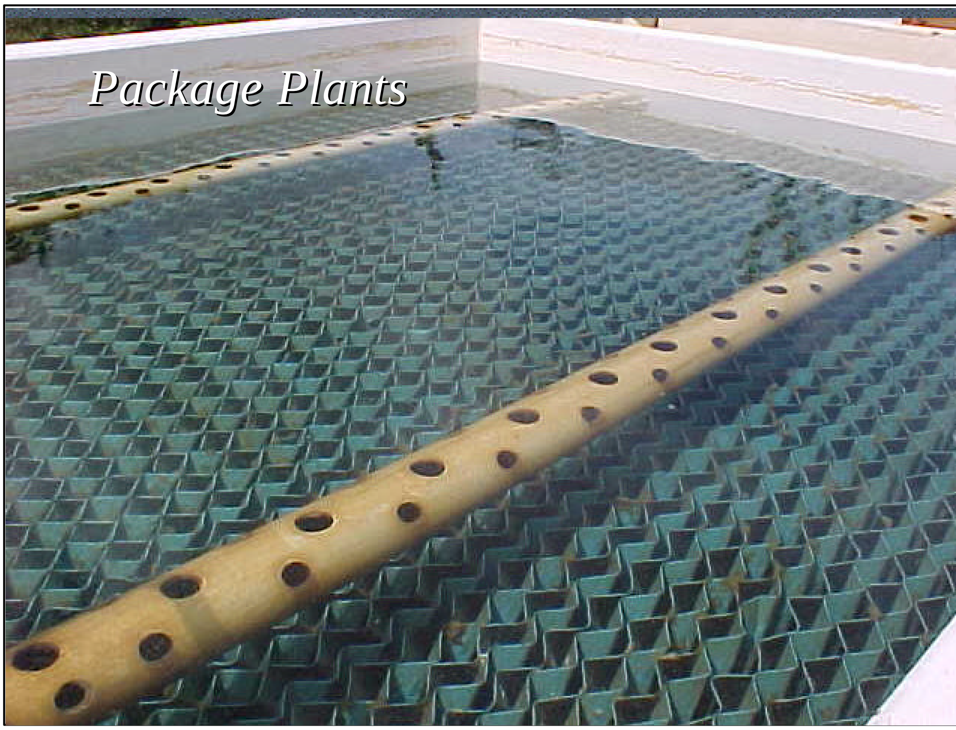
This drawing shows water entering the center of a round clarifier. As the water and floc move outward from the center the floc settles and the clarified water goes over the weirs. As the water moves outward in the basin its velocity decreases and more settling occurs.

This is a photo of a round clarifier that has been drained.

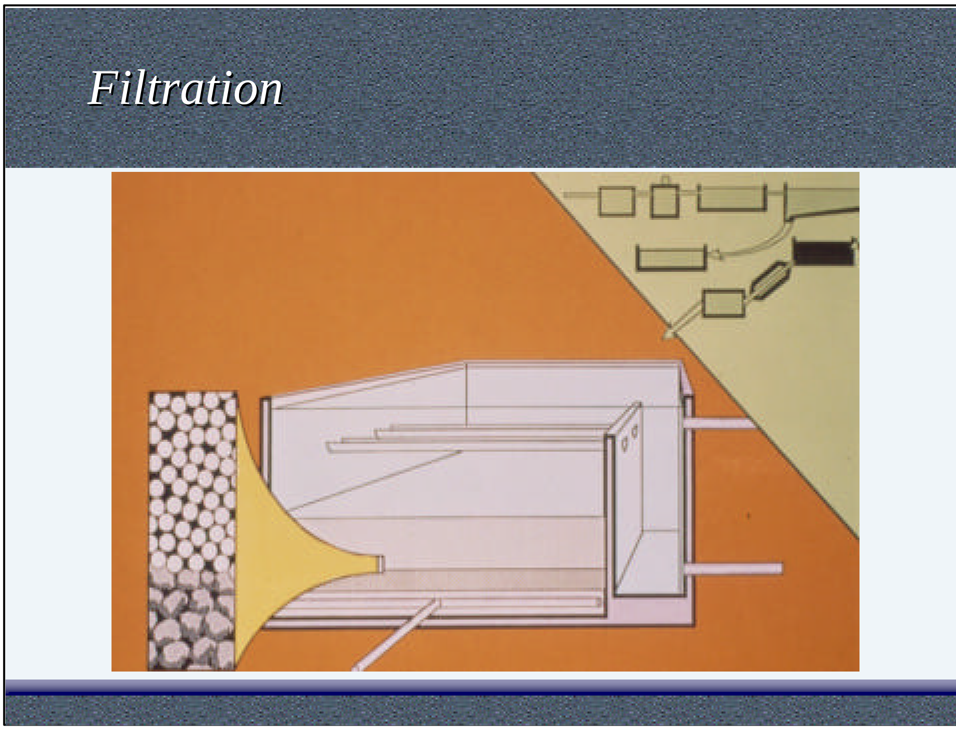


This is a cross sectional drawing of a unit that allows flash mixing, flocculation, and sedimentation to occur in a single tank. The water is introduced in the center of the tank where flash mixing of chemicals occurs. Then the coagulated water is slowly mixed as it is forced downward under the skirt shown above. In this process the formation of floc begins. After passing under the skirt the water and floc is forced upwards. Here the water moves upward and the heavier floc particles have a tendency to settle. A sludge blanket is created that effectively removes more floc as it passes through the blanket. The clarified water exits at the top of the basin via weirs that are located around the outer edge of the round tank.

The 4 spigots on the side of the basin are used to remove sludge to regulate the density of the sludge blanket.

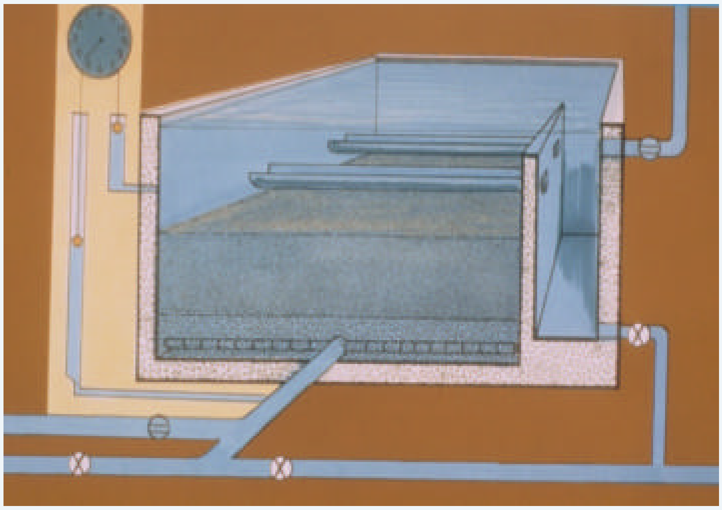


Tube settlers or plate settlers are installed in many clarifiers. They have been shown to make the settling process more efficient.

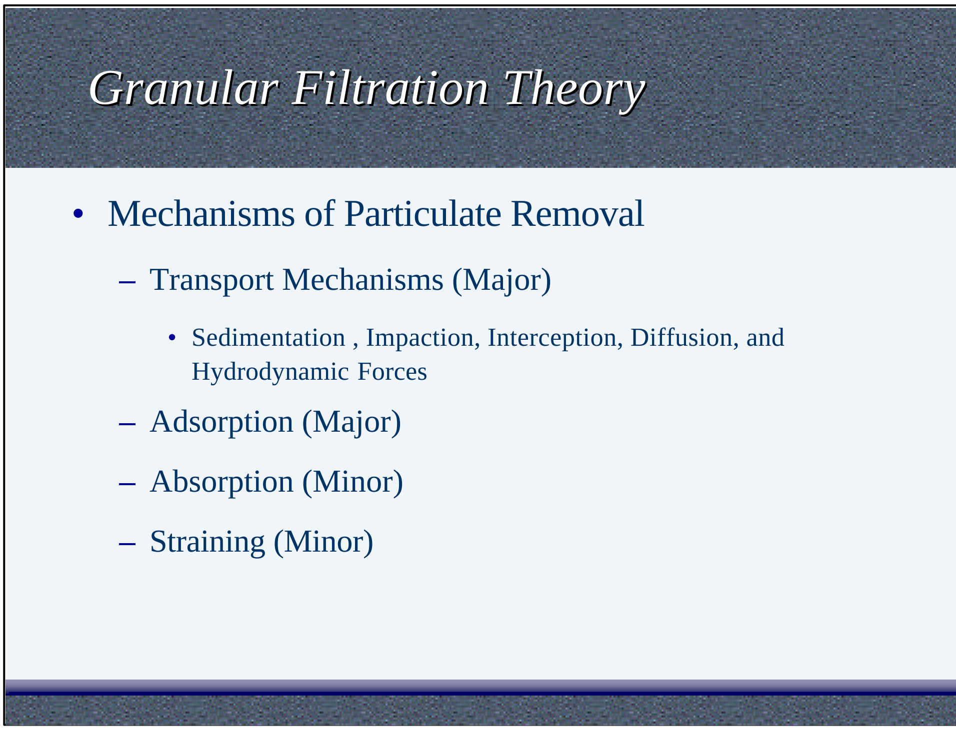


Next the clarified water passes on to granular media filters where the finer destabilized floc particles are removed. In this process the particles typically adsorb or attach to the grains of sand or anthracite in the filter.

Filtration



This is a cross sectional drawing of a granular media filter. Water enters through the top, travels though the media, is collected in underdrain piping systems below, and eventually exits the filter and passes on to the clearwell or distribution system. As particles are removed in the media, loss of head occurs in the filter.



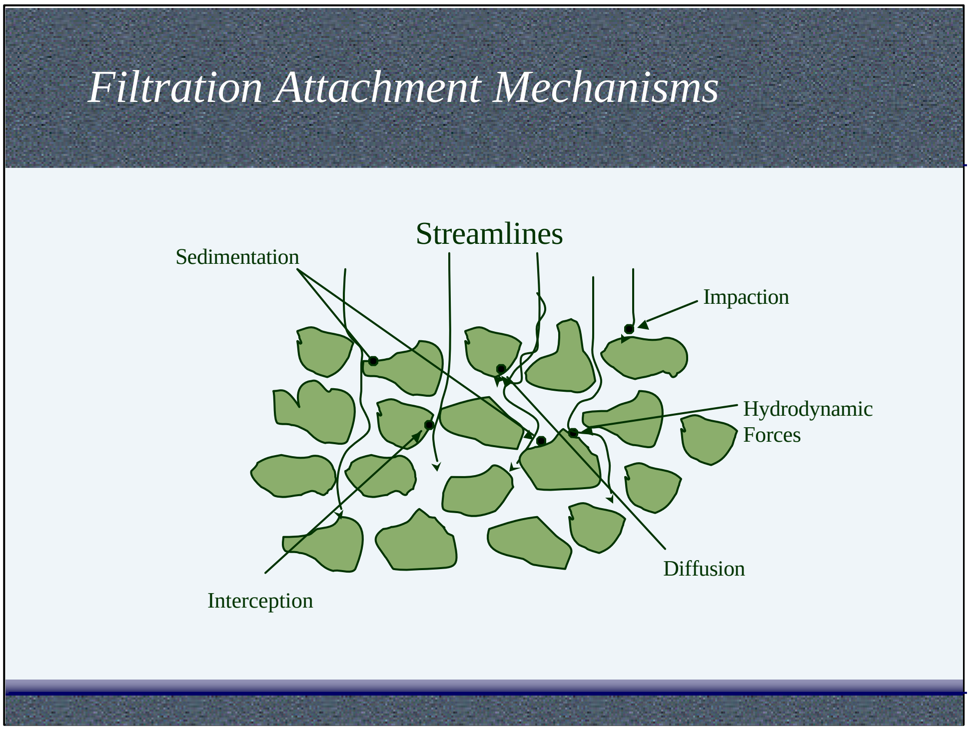
The fundamental system that removes particulate matter is filtration, the most common filters are composed of granular media of certain sizes and depths. **The forces that typically remove particles in granular media filters include:**

Transport Mechanisms: <u>Sedimentation</u>--Density of particle is significantly greater than water and deviates particulate path from the water streamlines. <u>Impaction</u>--Inertia of particle is greater than hydrodynamic force. <u>Interception</u>--Particle remains in the fluid streamlines, but passes within a distance of half the particles diameter. <u>Diffusion</u>--Affects only colloidal particles (<1-micron) Dependent upon density, particle size, and flow velocity. <u>Hydrodynamic--</u>Not an important force with laminar (non-turbulent) flow, but basically particles are transported out the fluid streamlines to the surface of the media.

Adsorption--collection of particulate matter on the surface or interface zone of media. Short range surface forces. Can only be realized if adequate destabilization has been accomplished (functions similar to coagulation).

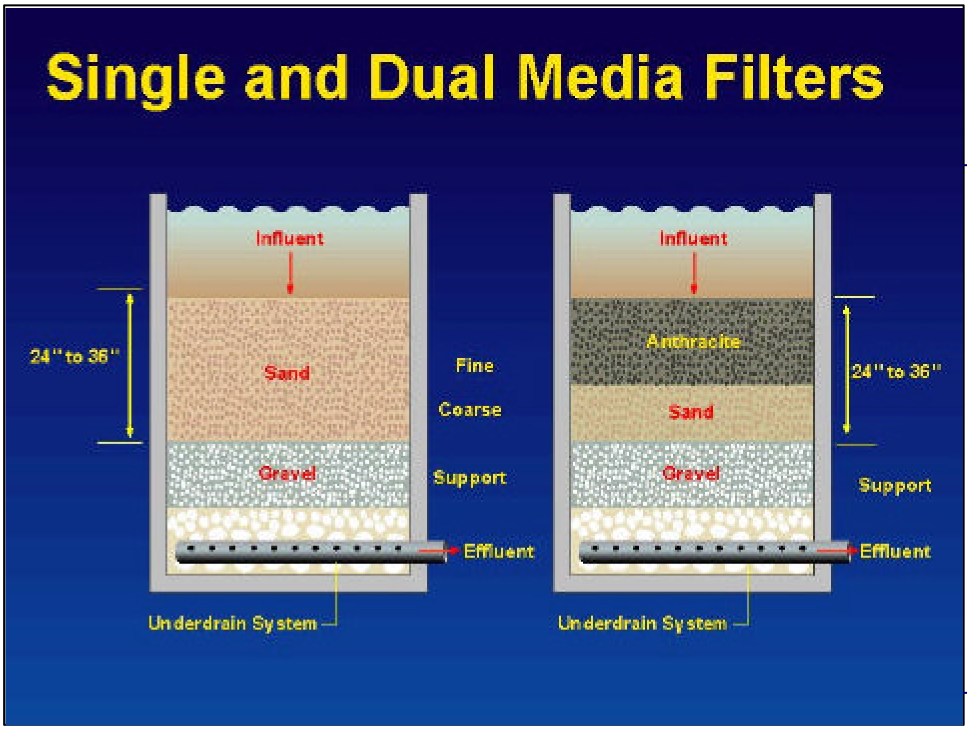
Absorption--taking in or absorbing contaminants. This mechanism is of little importance after the initial wetting.

Straining--Removal of particulate by passing liquid through a media with smaller pore sizes than the particles. Relatively unimportant because most of the particles are too small to be effectively strained.

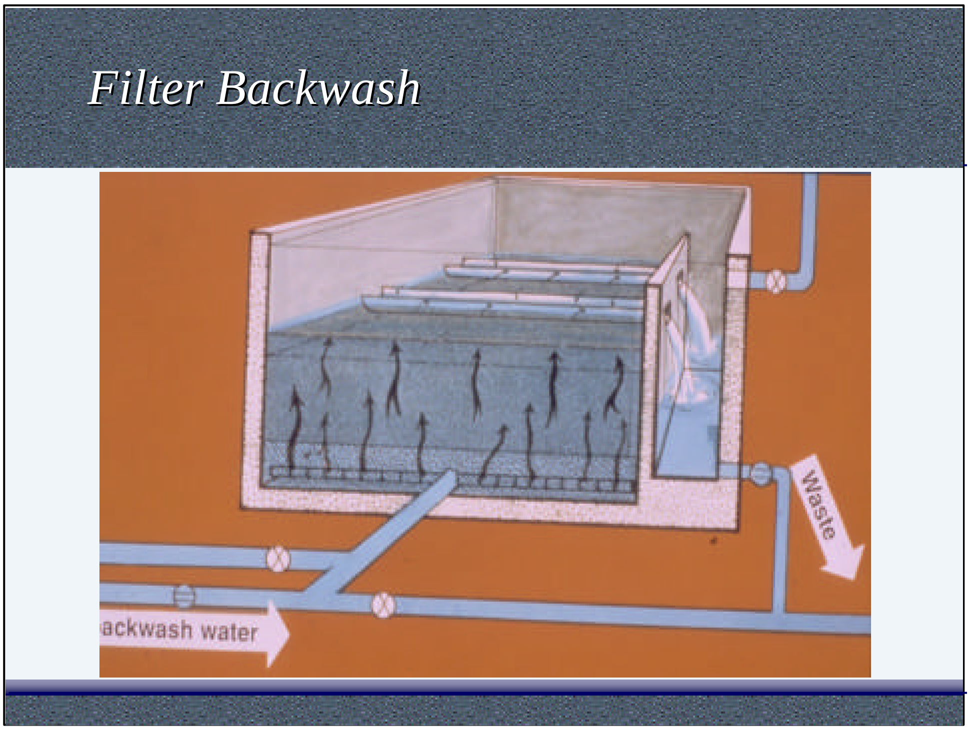


This is a schematic of sand or anthracite grains within a granular filter bed. The pores within the media perform very much like small sedimentation basins and the mechanisms discussed in the previous slide work to remove particles as they pass through.

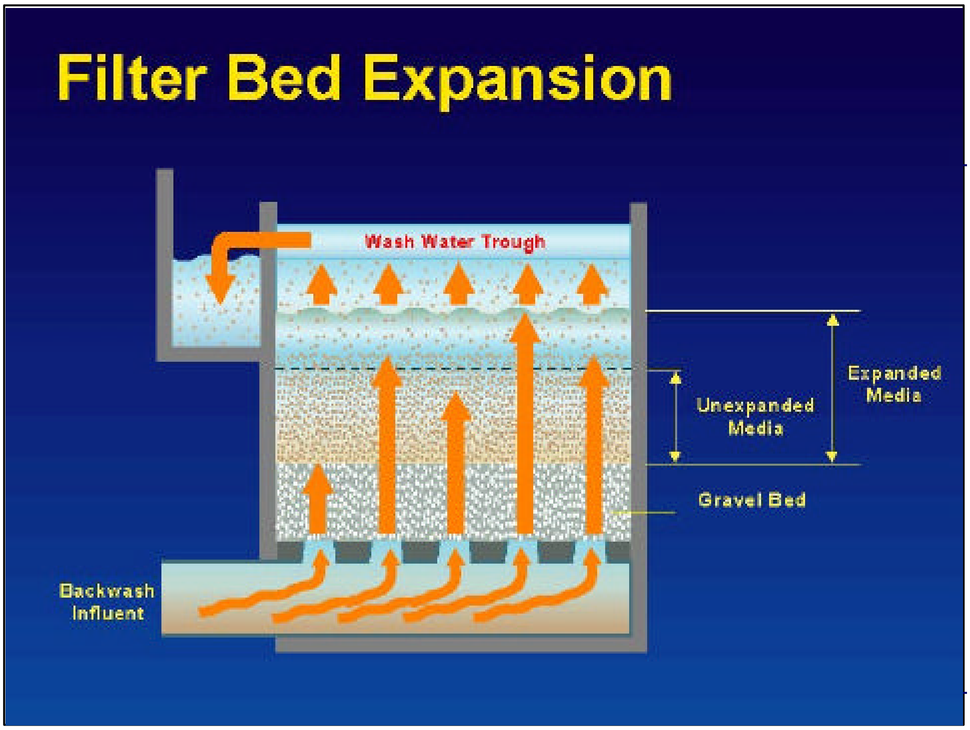
Obviously, as more and more floc particles are removed in the pores of the media, the pores become smaller and smaller. This creates headloss through the filter and causes the velocity of the water traveling through the media to increase (assuming the filtration rate remains constant). This increase in velocity will cause corresponding increased shear forces and will eventually lead to break though of turbidity.



These are cross sectional drawings of typical rapid sand (left) and dual media filters.



This drawing depicts the backwashing process. The media is fluidized and the collected particles are removed and disposed of.



This drawing depicts the backwashing process. The media is fluidized and the collected particles are removed and disposed of.

Part 141—National Primary Drinking Water Regulations (cont.)

- 141.13 MCL for Turbidity
  - Requirements Apply to Unfiltered Systems Until December 30, 1991
    - Unless State Has Determined Filtration Is Required
  - <u>Applies to Unfiltered Systems, Required to Filter, Until June 29, 1993 or Until Filtration Is Installed, Whichever Is Later</u>
  - Requirements Apply to Filtered Systems Until June 29, 1993

"The requirements in this section apply to unfiltered systems that the State has determined, in writing, pursuant to section 1412(b)(7)(C)(iii), must install filtration, until June 29, 1993, or until filtration is installed, whichever is later."

Not later than 18 months after the enactment of the amendments of 1986, the Administrator shall adopt NPDWRs specifying criteria under which filtration is required for PWSs supplied by surface water. The Administrator shall consider watershed protection, treatment practices (e.g. disinfection and length of water storage) and other factors relevant to public health. (THESE ARE NOT THE EXACT WORDS OF THE ACT)

Section 1412(b)(7)(C)(iii): Within 18 months from the time that the Administrator establishes the criteria and procedures under this subparagraph, a State with primary enforcement responsibility shall adopt any necessary regulations to implement this subparagraph. Within 12 months of adoption of such regulations the State shall make determinations regarding filtration for all PWSs within its jurisdiction supplied by surface waters.

Part 141—National Primary Drinking Water Regulations (cont.)

- 141.22 Turbidity Sampling and Analytical Requirements
  - Requirements Apply to Unfiltered Systems Until December 30, 1991
    - Unless State Has Determined Filtration Is Required
  - <u>Applies to Unfiltered Systems, Required to Filter, Until June 29, 1993 or Until Filtration Is Installed, Whichever Is Later</u>
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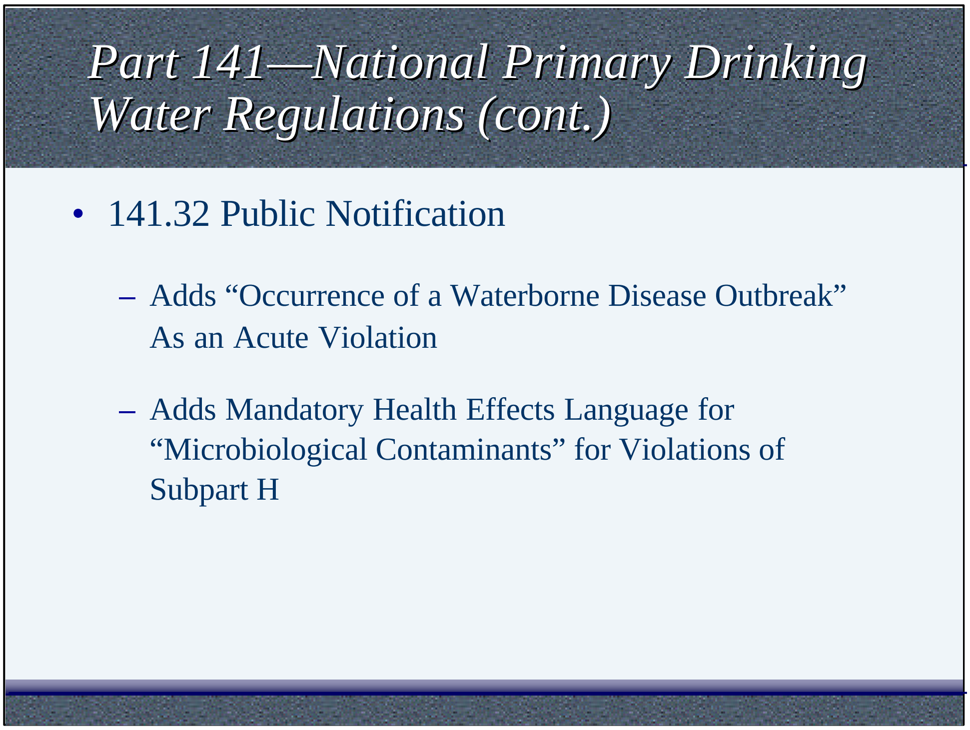


Acute violations that require acute type notification include:

A. Any violations specified by State as posing an acute risk.

B. NO3 or NO4

C. TCR violation with fecal or E. coli in one or more of the samples

D. Occurrence of a waterborne disease as defined in 141.2 (in a system that is determined to be deficient in treatment).

A. Waterborne Disease Outbreak means the significant occurrence of an acute infectious illness associated with drinking water.

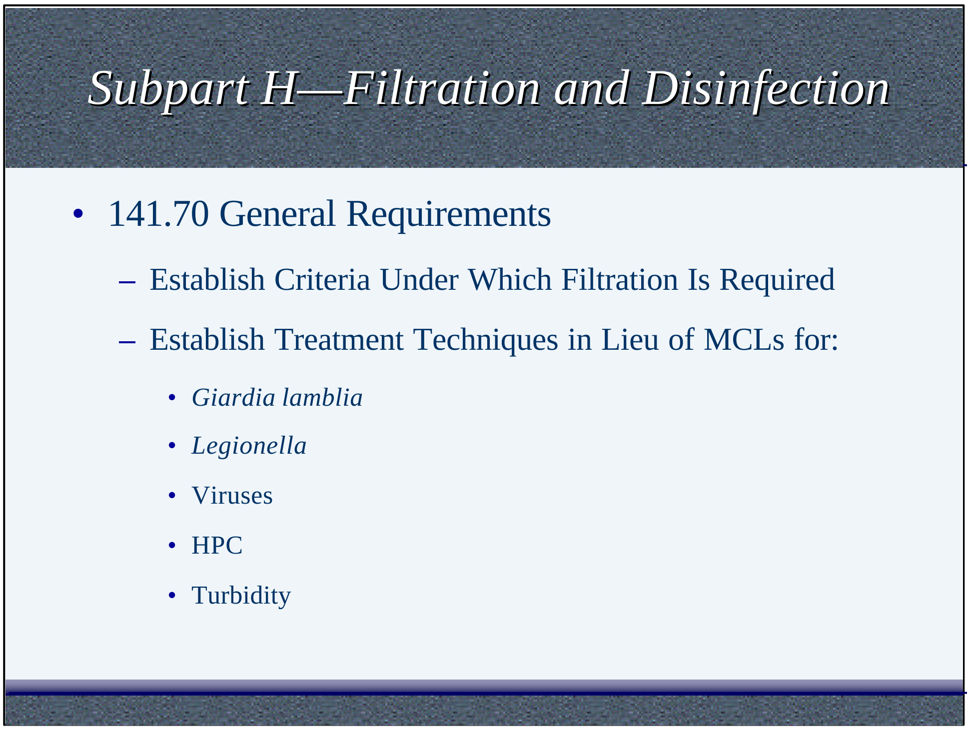
Part 141—National Primary Drinking Water Regulations (cont.)

- 141.52 MCLGs for Microbiological Contaminants

Contaminant	MCLG
Giardia lamblia	Zero
Viruses	Zero
Legionella	Zero

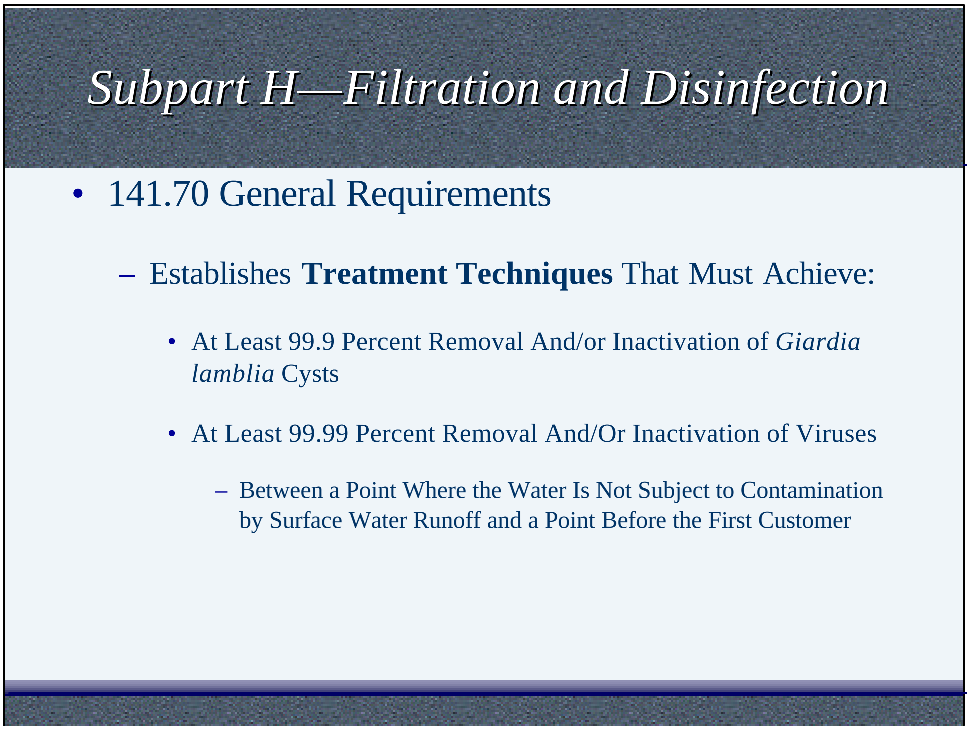
Maximum contaminant level goals are established in the SWTR for these pathogens. The MCLG must be established at a level that poses no risk to water consumers with a margin of safety. Because it is conceivable that one pathogen could cause infection, the EPA established the MCLGs at zero.

Note: The Interim Enhance Surface Water Treatment Rule(IESWTR), effective January 1, 2002, and the Long Term 1 Enhanced Surface Water Treatment Rule (LT1), effective January 14, 2005, establish a MCLG of zero for *Cryptosporidium*.



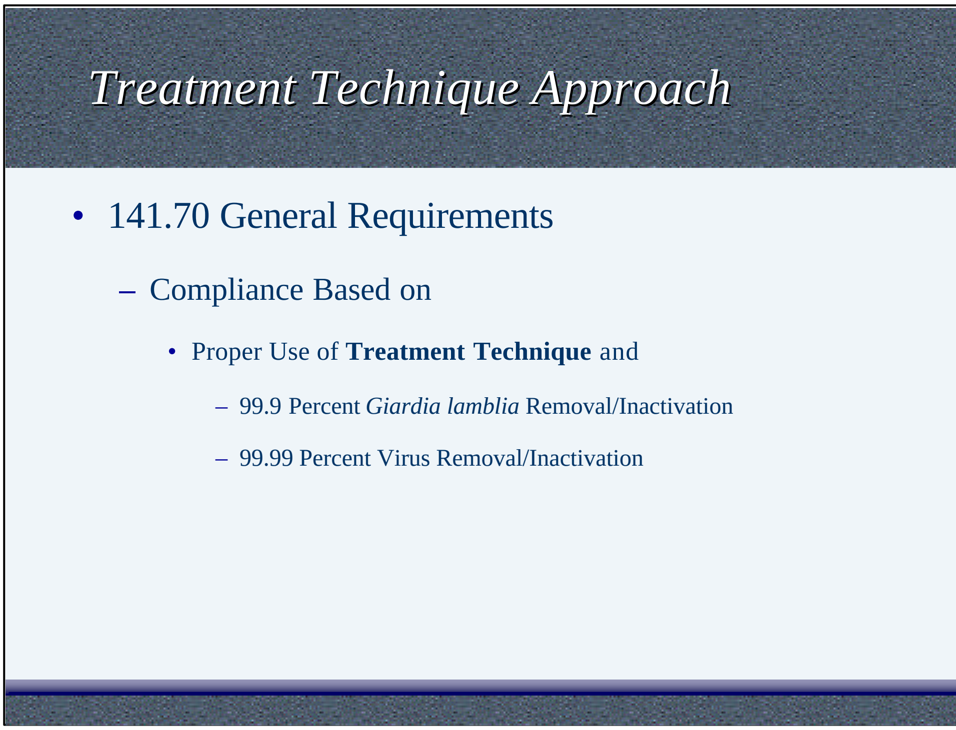
This section provides a preface to the requirements of the rule and points out that the rule establishes criteria under which filtration will be required of systems using surface water or GWUDI. It points out that treatment techniques are established, in lieu of MCLs, for the control of the bulleted pathogens. Treatment techniques are established when it is not practical for controlling a contaminant or contaminants by use of an MCL and monitoring.

Note: The IESWTR and LT1 address *Cryptosporidium* by requiring filtration systems by remove 2 log and unfiltered systems to address it in their watershed protection program.



The section also outlines the minimum requirements that must be achieved for subpart H systems to be in compliance with the SWTR's treatment technique requirements.

Note: The IESWTR and LT1 address *Cryptosporidium* by requiring filtration systems by remove 2 log and unfiltered systems to address it in their watershed protection program.



Later in the rule performance standards will be established to ensure the 3 log and 4 log removal and/or inactivation requirements are being met.

Percentage vs. Log Reductions

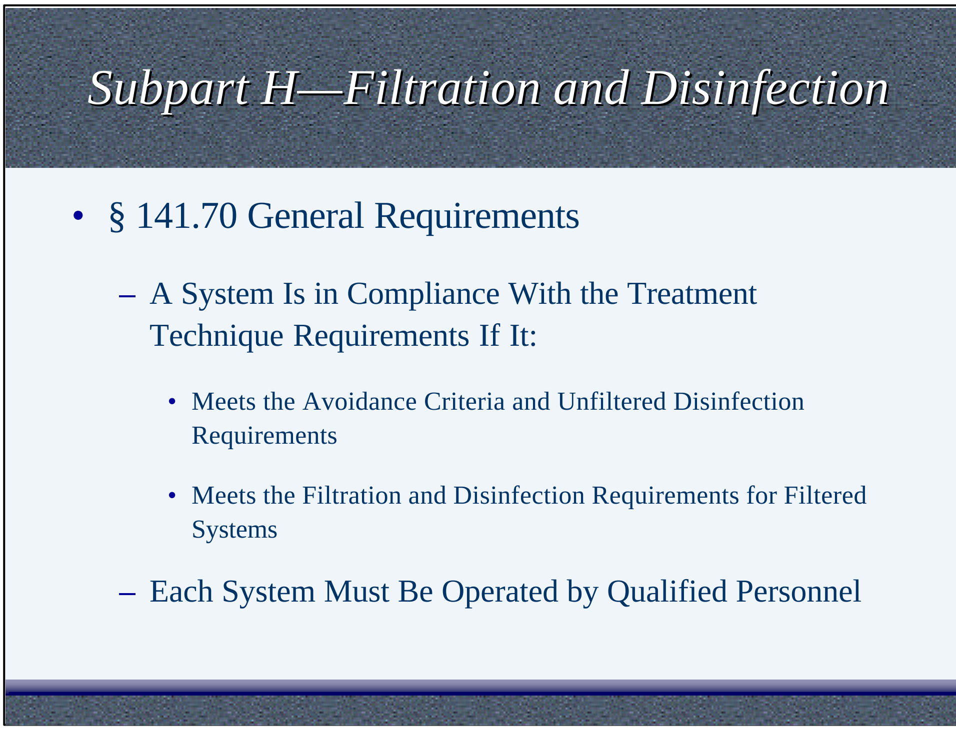
Percentage Reductions	Log Reductions
90	1-log
99	2-log
99.9	3-log
99.99	4-log

Most people commonly refer to the

- 99.9 % removal/inactivation requirement as "3 log removal/inactivation" and the
- 99.99% removal as "4 log removal/inactivation.

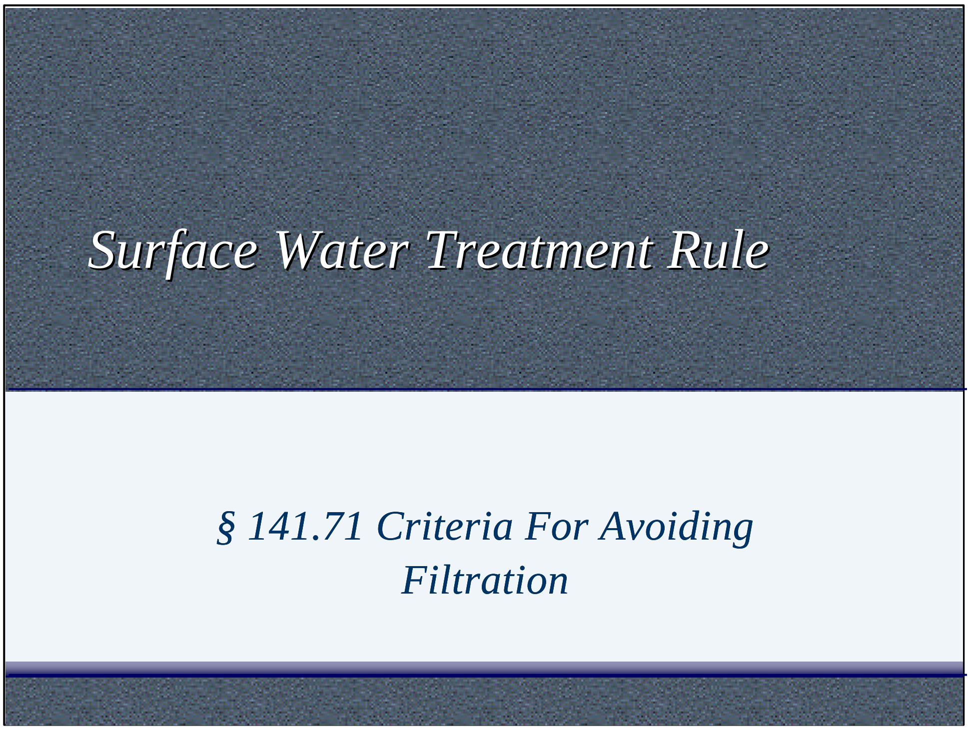
This is because the log removal number is based on the "negative base 10 log of the fraction remaining." Thus if 1,000 cysts are in the raw water and 99.9% of them are removed by filtration 1 cyst (1/1,000 of the raw water total) will be remaining. The log of 1/1,000 is -3.00, therefore the negative log is 3.00. Thus 99.9% removal equates to 3 log removal. 90% = 1 log, 99% = 2 log, and 99.99% = 4 log.

This proves to be a handy technique and the log removal/inactivations across a plant's various treatment units are additive. Thus the log removal at each treatment stage can be added to the log removals of other units to determine the final log removal/inactivation credit that will be allowed by the regulatory agency. For example, if a plant removes 2.5 log of *Giardia lamblia* cysts by sedimentation and filtration, and inactivates 1.2 log cysts with disinfection, the primacy would credit them with 2.5 + 1.2 or 3.7 log removal and inactivation.



This rule specifies that all subpart H systems must be operated by "qualified personnel." This is EPA's first effort to ensure that properly trained operators are in charge of complex systems.

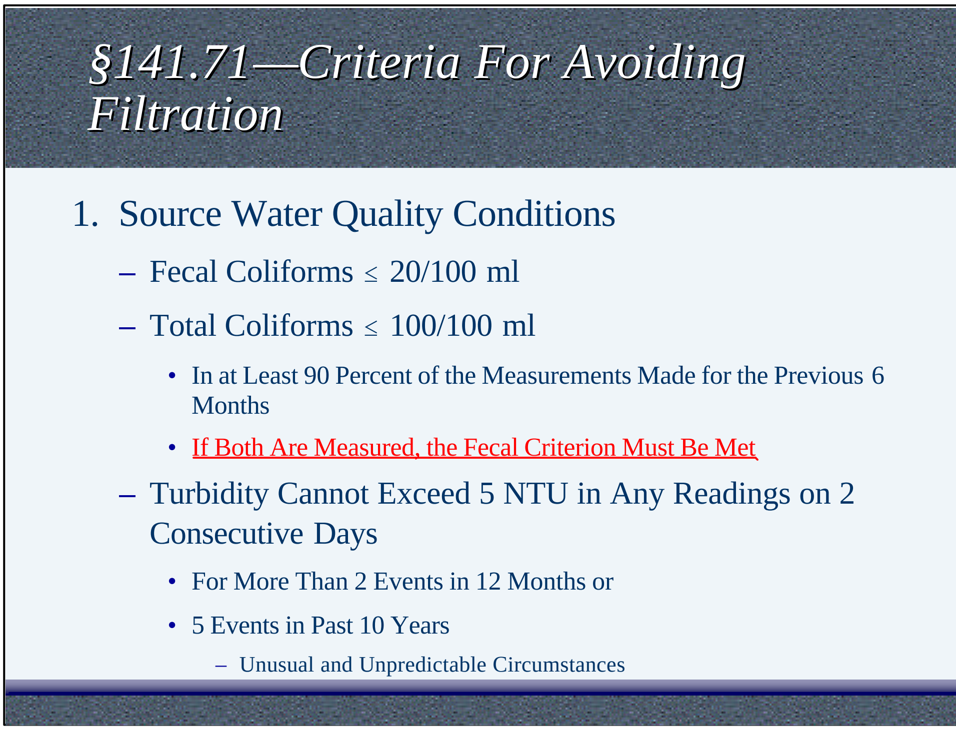
After the 1996 Amendments to the the SDWA EPA has addressed formal certification of operators by States. All States now have a certification program that meets EPA's guidelines and properly certified operators are deemed "qualified" under the SWTR.


Surface Water Treatment Rule
§ 141.71 Criteria For Avoiding Filtration

§141.71 Criteria for Avoiding Filtration

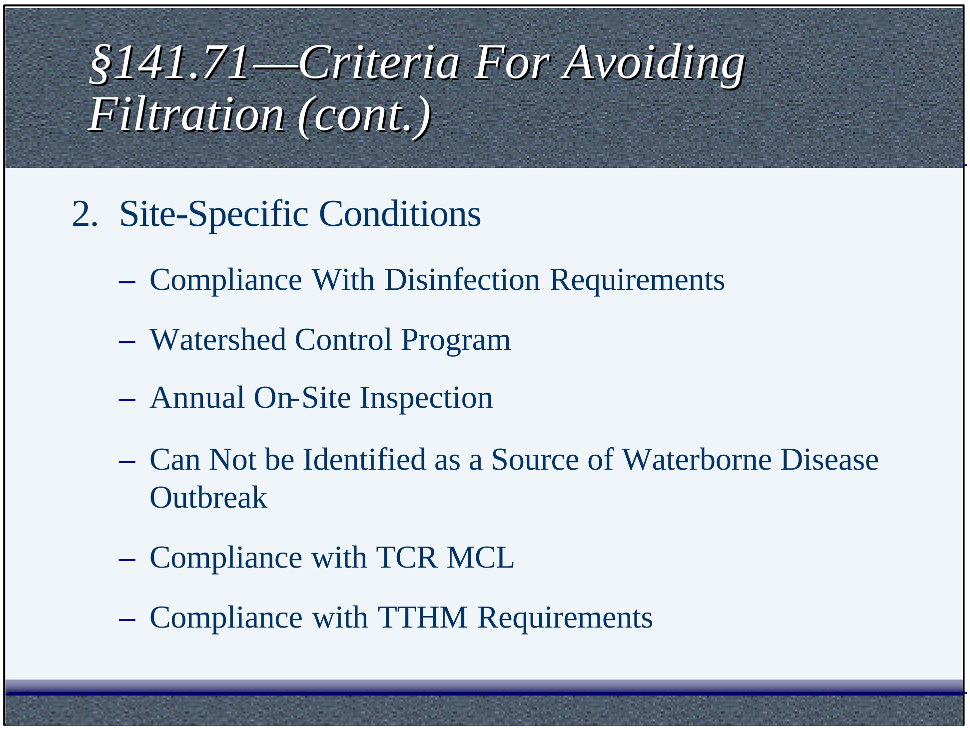
- To Avoid Filtration a System Must Meet Specific
  1. **Source Water Quality Conditions**
  2. **Site-Specific Conditions**
     - **Disinfection Requirements**
     - **Watershed Control**
     - **Annual On-Site Inspection**
     - **TCR and TTHM Compliance**

To avoid filtration a surface water system has to meet specific source water quality conditions and other site specific conditions designed to make and keep the high quality water safe.



The source water of unfiltered systems must meet specific limits for bacteriological content and turbidity. The bacteriological quality limits are indicators of high quality water and water that is of low risk in terms of contamination by pathogenic organisms. Turbidity is an indicator of contamination, in some cases, and is also an indicator of how efficient the disinfection process will be. That is, turbidity can exert a chlorine demand and can shield pathogens from the disinfectant.

An **"event"** is a series of consecutive days during which at least one turbidity Measurement each day exceeds 5 NTU.



The waterborne disease issue is limited to "in current configuration." In other words, if they have made improvements that will cure the problems that caused the event, it is possible for them to meet the avoidance criteria.

TCR compliance in 11 of past 12 months <u>unless **not** caused by a treatment deficiency of Source water.</u> For example, should a backflow situation cause a coliform compliance problem, this would not cause the system to install filtration.

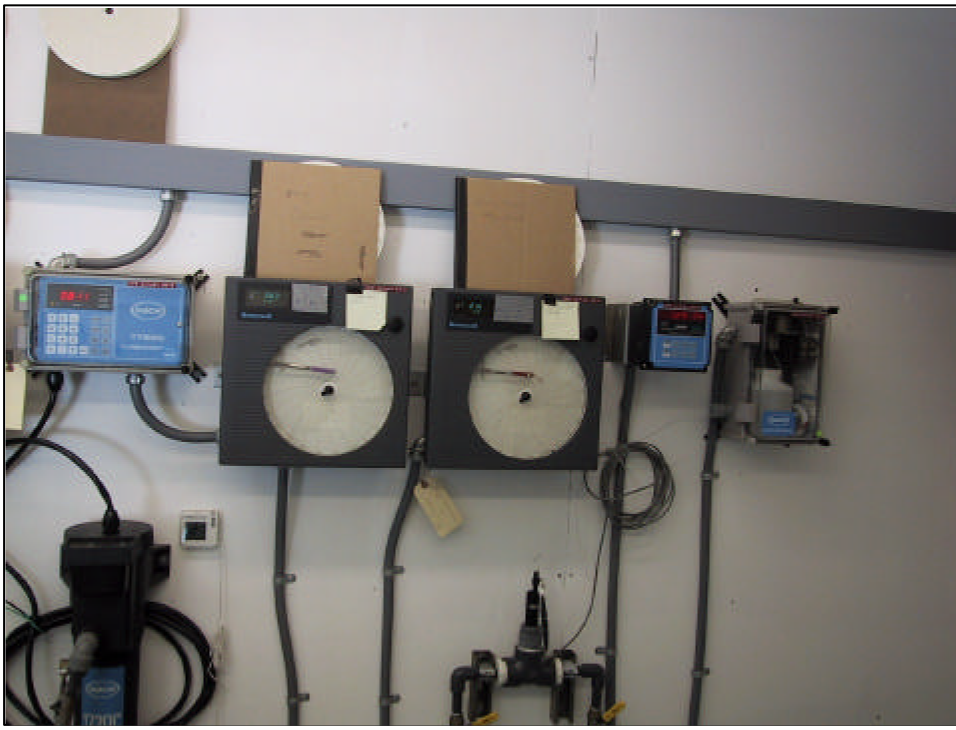
Prior to the Stage 1 DBPR, large unfiltered surface water systems were required to maintain compliance with the TTHM Rule as a part of the avoidance criteria. However, these systems must now maintain compliance with Stage 1. When LT1 becomes effective, small unfiltered systems will also have to meet this requirement.

2. *Site Specific Conditions*

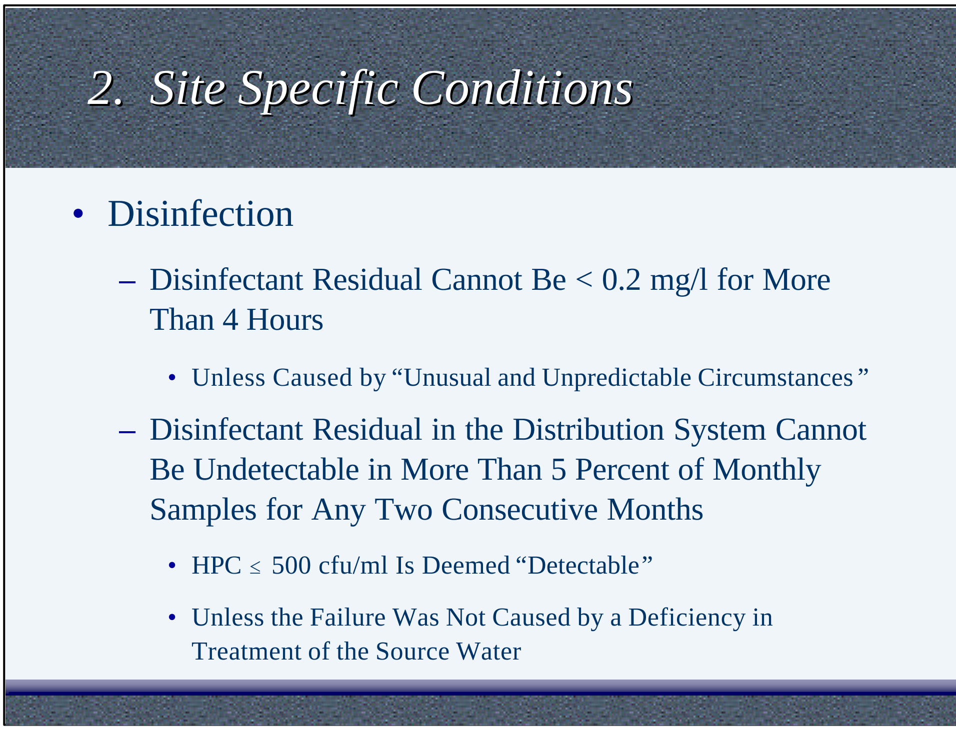
- Disinfection
  - Disinfection Must Provide 3-Log *Giardia* and 4-Log Virus Inactivation
    - Every Day of the Month Except One
    - In at Least 11 of the Past 12 Months
      - Unless Caused by "Unusual and Unpredictable Circumstances"
  - Redundant Disinfection Components
    - Auxiliary Power Including Auto Start-up and Alarm **or**
    - Auto Shut-Off When Residual Is < 0.2 mg/l

Note that *Cryptosporidium* is not mentioned. No one knew enough about it at the time the SWTR was promulgated to adequately address it in the regulation.

If the State approves automatic shut-off it must determine that shut-off will not cause unreasonable risk to health or interfere with fire protection. The system must comply with the auxiliary power/auto start/alarm requirements.



This system is set up to monitor chlorine residuals, pH, peak flows and temperature so they can, on a daily basis at peak hourly flow, show the State they meet the SWTR disinfection requirements.



$$V = \frac{c + d + e}{a + b} \text{ X } 100$$

V can't exceed 5%

Where:

A = number of disinfection residual measurements

B = number of instances where residual is not measured but HPC is measured

C = number of instances where residual is measured, but not detected and no HPC is measured

D = number of instances where residual is measured but not detected and HPC is > 500/ml

E = number of instances where residual is not measured and HPC is > 500/ml

2. *Site Specific Conditions*

- Disinfection
  - Formula For Calculating Compliance With Distribution System Residual Requirements

$$V = \frac{c + d + 3}{a + b} X\ 100$$

$$V = \frac{c + d + e}{a + b} X\ 100$$

V can't exceed 5%

Where:

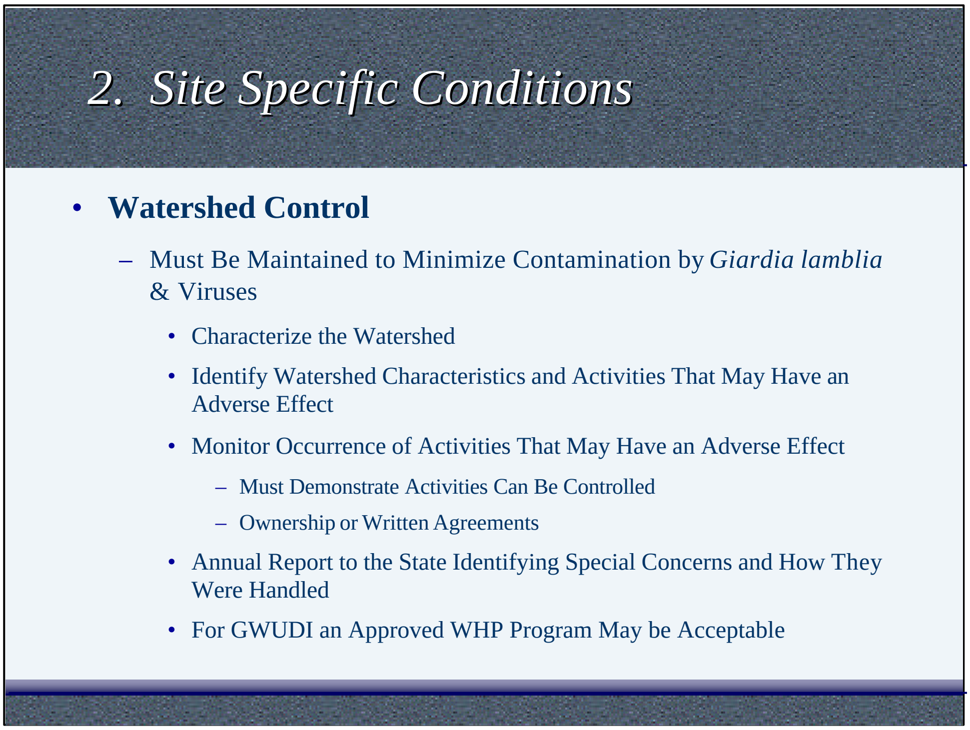
A = number of disinfection residual measurements

B = number of instances where residual is not measured but HPC is measured

C = number of instances where residual is measured, but not detected and no HPC is measured

D = number of instances where residual is measured but not detected and HPC is > 500/ml

E = number of instances where residual is not measured and HPC is > 500/ml



Watershed control programs vary from system to system based on site-specific conditions. All, however, must have these components.

Again, *Crypto* is not mentioned for reasons discussed previously, however, systems must now comply with the *Crypto* requirements of the IESWTR and LT1ESWTR (beginning 1/14/05).

In most cases, the annual on-site inspection is conducted by personnel of the primacy agency.

2. Site Specific Conditions

- Annual On-Site Inspection
  - Review Effectiveness of WCP
  - Review Intake
  - Review Systems Equipment Maintenance Program
  - Inspect Disinfection Equipment
  - Review Operating Procedures
  - Review Data Records
  - Identify Needed Improvements

The rule specifically requires, in section §141.71, that the on-site inspection include, at a minimum, the above items.

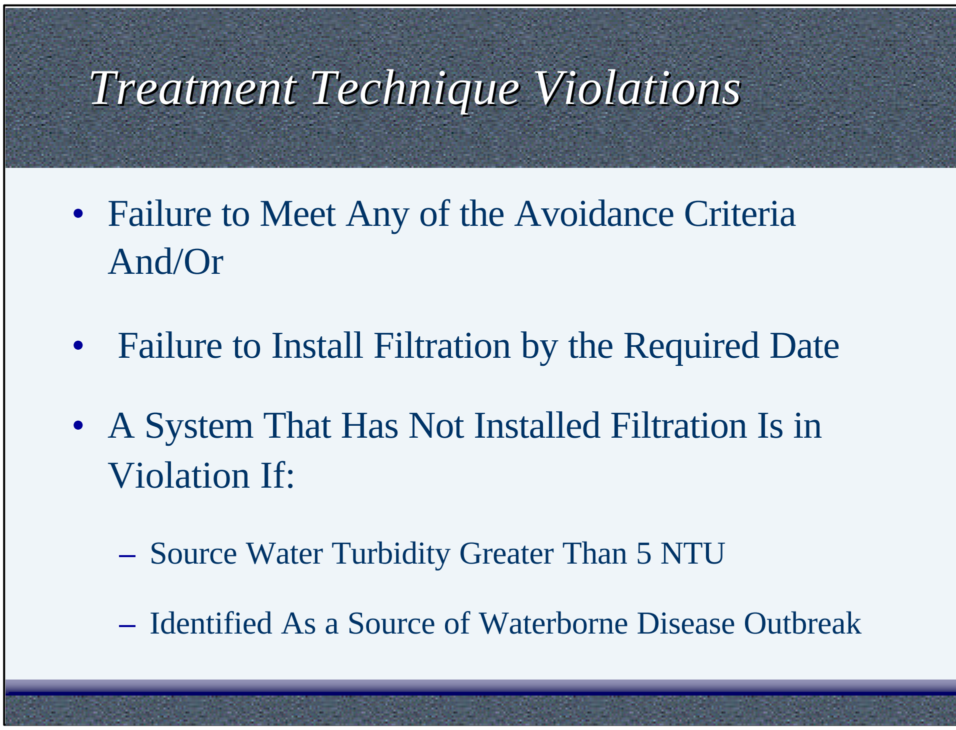
2. Site Specific Conditions

- Must Not Have Had an Identified Waterborne Disease Outbreak in Its Current Configuration
- Must Comply With Coliform MCL for 11 of Past 12 Months
  - Or Failure to Do So Was Not Caused by a Treatment Deficiency
- Must Comply With Requirements for TTHMs

The waterborne disease issue is limited to "in current configuration." In other words, if they have made improvements that will cure the problems that caused the event, it is possible that they still could meet the avoidance criteria.

TCR compliance in 11 of past 12 months unless **not** caused by a treatment deficiency of Source water. For example, should a backflow situation cause a coliform compliance problem, this would not cause the system to install filtration.

Note: As of Jan. 1, 2002 large (>10,000 persons) systems must comply with the Stage 1 requirements subpart H to maintain filtration avoidance. The remaining unfiltered systems will have to comply with the Stage 1 DBPR beginning January 14, 2005.



"Systems that have not installed filtration" here means those that are meeting the avoidance criteria and checking turbidities with proper meters, before the point of application of disinfectant, every 4 hours or more frequently.

Again, if avoidance criteria are not met the system must install filtration.

§141.72—Disinfection of Unfiltered Systems

- Unfiltered Must Meet Disinfection Requirements By:
  - December 30, 1991
- Ground Water Under the Direct Influence of Surface Water (GWUDI)
  - December 30, 1991 or
  - 18 Months After State's Determination

unfiltered

These were the dates by which the systems had to be in compliance.

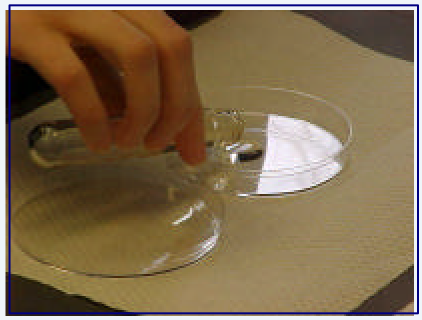
§141.74—Unfiltered Analytical and Monitoring Requirements

- Measurements Must Be Performed by State Approved Party for
  - pH
  - Temperature
  - Turbidity
  - Residual Disinfectant

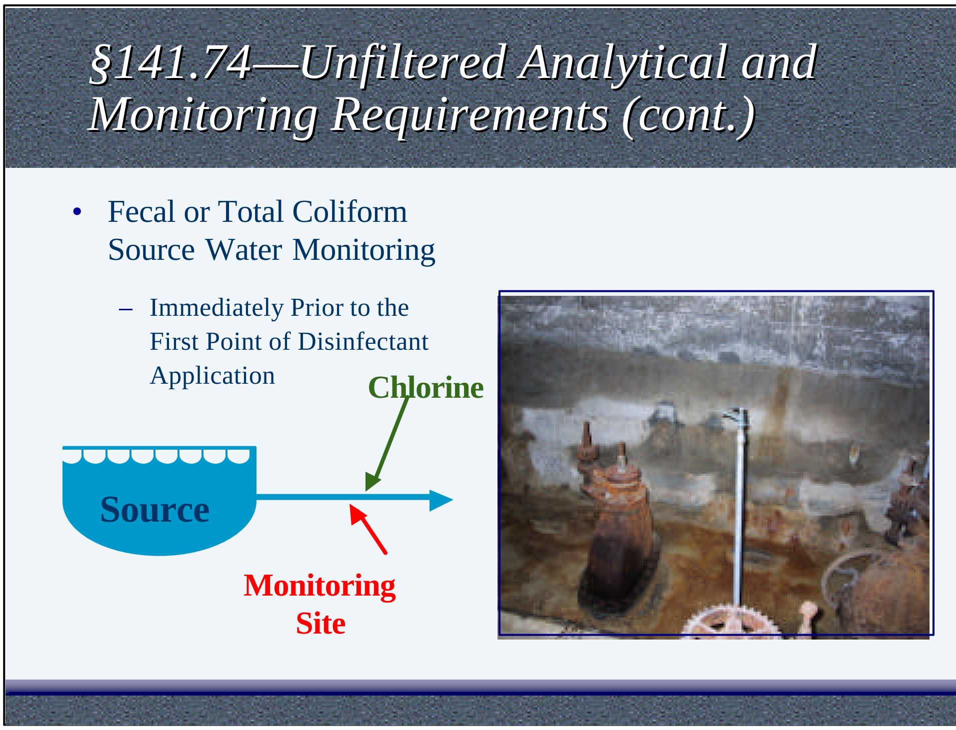
The SWTR is designed so that properly trained operators can perform the daily tests that are required. In these cases certified laboratories are not required.

§141.74—Unfiltered Analytical and Monitoring Requirements (cont.)

- Measurements Must Be Performed by a Certified Laboratory for
  - Total Coliforms
  - Fecal Coliforms
  - HPC
- Methods Established by Rule



On the other hand, some tests have to be performed by certified laboratories.



The source water coliform monitoring has to be done prior to the application of chlorine. The photo shows a sampling tap in the base of a dam on an unfiltered systems source. Chlorine is introduced to the raw water about 20 yards down stream of this sampling point.

§141.74—Unfiltered Analytical and Monitoring Requirements (cont.)

Persons Served	Fecal or Total Samples/Week[1, 2]
< 500	1
501 – 3,300	2
3,301 – 10,000	3
10,001 – 25,000	4
> 25,000	5

[1] Must be taken on separate days.
2 Also one must be done on days when turbidity is > 1 NTU

These are the source water coliform monitoring requirements.

In addition, one total coliform or fecal coliform measurement must be made every day the system serves water to the public and the turbidity of the source water exceeds 1NTU. These samples count towards the weekly coliform requirement.

§141.74—Unfiltered Analytical and Monitoring Requirements (cont.)

- Turbidity
  - Same Location
  - Every Four Hours (Minimum)
  - Continuous Monitoring May Be Substituted If Regularly Validated Using State-approved Protocol

The required turbidity samples have to be collected as representative grab samples every four hours at the same location the coliform samples the raw water fecal or total coliform samples are collected (i.e. immediately prior to the introduction of disinfectant. The State may allow systems to substitute the results from continuous monitoring turbidimeters.

§141.74—Unfiltered Analytical and Monitoring Requirements (cont.)

- Total Inactivation Ratio Must Be Determined Each Day of Operation
- Based on $CT_{99.9}$ Values From
  - Tables 1.1 - 1.6 Chlorine
  - Table 2.1 Chlorine Dioxide & Ozone
  - Table 3.1 Chloramines

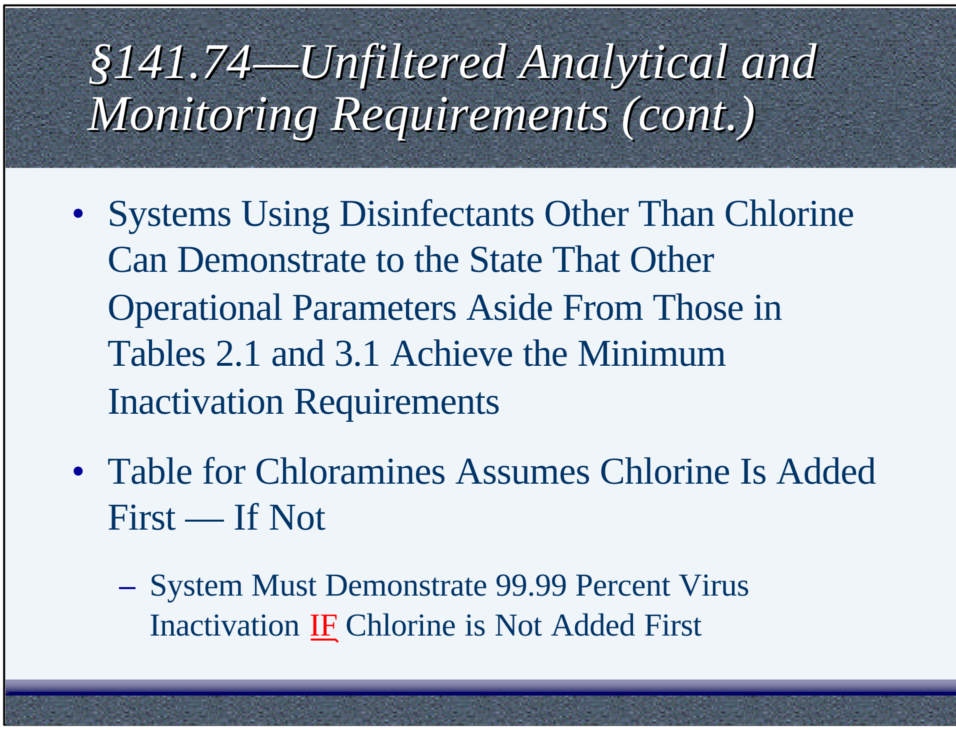
Unfiltered systems obviously have no way of removing *Giardia lamblia* cysts or viruses, therefore, the 3 and 4 log removal and/or inactivation requirements must be met totally by disinfection inactivation. Each day of operation the system must show its inactivation ratio at peak hour flow. The SWTR itself outlines the procedure for doing so and the Guidance Manual for Compliance With the SWTR expands upon this area in great detail.

See: http://www.epa.gov/safewater/mdbp.guidsws.pdf

§141.74—Unfiltered Analytical and Monitoring Requirements (cont.)

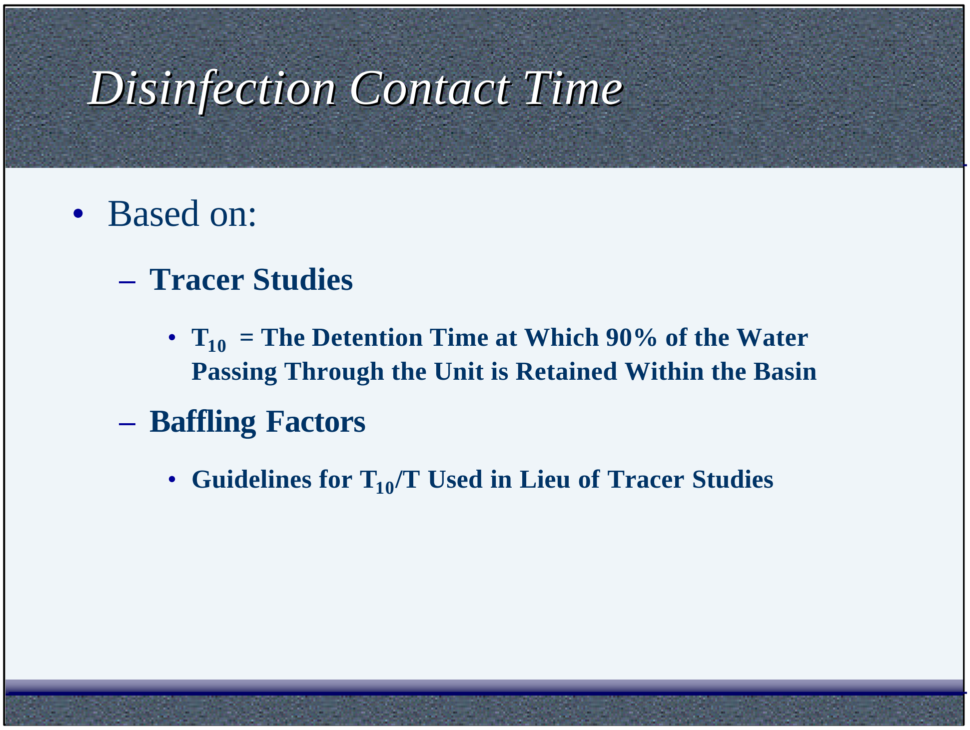
Parameter	Location	Frequency
Temperature	Residual Sampling Point	1/Day Minimum
PH (if Cl_2)		
Contact Time	Sampling Point	1/Day
Residual Concentration	First Customer	

This table shows a summary of the monitoring requirements.



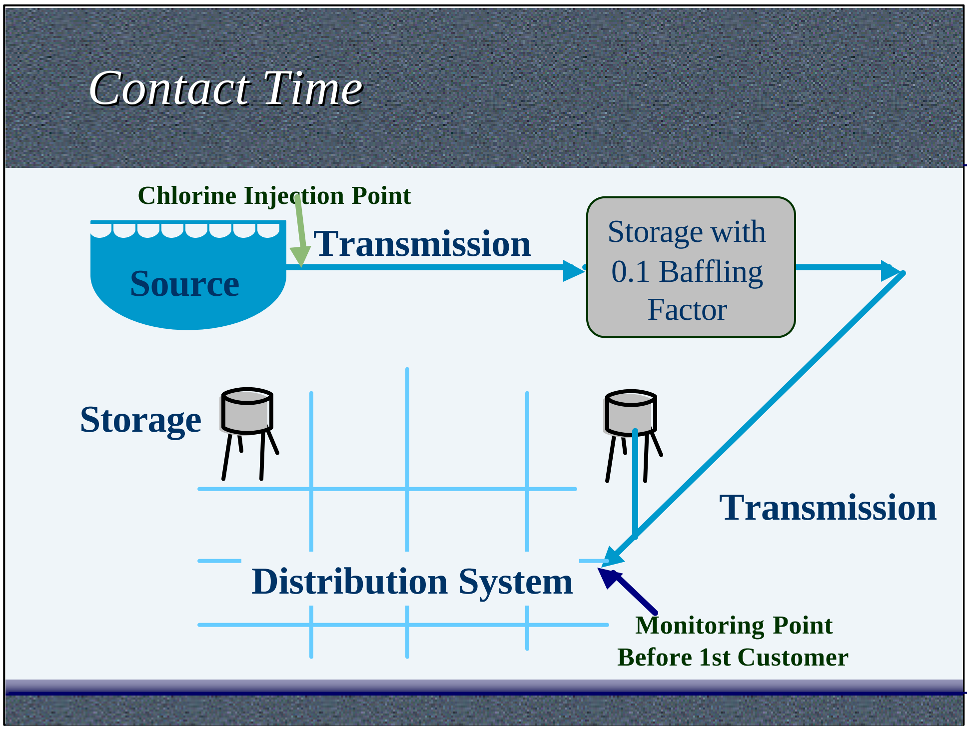
The rule allows systems to show that disinfectants, other than chlorine, can meet the inactivation requirements using operational parameters other than those in the rule.

The tables in the rule for chloramines assume that chlorine is added ahead of ammonia, thus providing a short time with the added disinfection capability of free chlorine. If chlorine is not added first, the system must show the State it can meet the disinfection requirements for 4 log virus inactivation.



The time that the disinfectant is in contact with the water prior to the first customer is a critical component when determining CT. Because short circuiting is common in many water treatment and storage basins, estimates of actual contact time must be made. For regulatory purposes the term T_{10} is used for contact time. This is defined as the time in minutes at which 90% of the water entering a basin is still retained in the basin or, conversely, the time at which 10% of the water has passed through the basin.

Baffling factors are used for some common basin configurations where studies have determined typical T_{10}s. The SWTR Guidance Manual has guidelines for baffling factors (T_{10} /T). In many cases, however, the T_{10} is determined based on tracer studies.



This schematic shows an unfiltered system that adds the disinfectant at the intake. The water then travels through a transmission main, then through a storage tank with separate inlet and outlet, then on to the first user via another transmission main. The transmission mains are expected to have "plug flow" and, thus, are afforded a baffling factor of 1.0 or 100% of the calculated contact time at peak hour flow. The storage tank will only get a baffling factor of 0.1 or 10% of the theoretical contact time. For the storage tank the volume used has to be the minimum volume, or worst case scenario. The final elevated storage tank shown in the schematic, rides or "floats" on the line with common inlet/outlet. No contact time is granted for this type of situation as produced water may or may not go to the tank depending upon where the demand is.

TABLE C-1

Clearwell Data: Step-dose Tracer Test*

	Fluoride Concentration		
t, minutes	Measured, mg/L	Tracer, mg/L	Dimensionless, C/Co
0	0.20	0	0
3	0.20	0	0
6	0.20	0	0
9	0.20	0	0
12	0.29	0.09	0.045
15	0.67	0.47	0.24
18	0.94	0.74	0.37
21	1.04	0.84	0.42
24	1.44	1.24	0.62
27	1.55	1.35	0.68
30	1.52	1.32	0.66
33	1.73	1.53	0.76
36	1.93	1.73	0.86
39	1.85	1.65	0.82
42	1.92	1.72	0.86
45	2.02	1.82	0.91
48	1.97	1.77	0.88
51	1.84	1.64	0.82
54	2.06	1.86	0.93
57	2.05	1.85	0.92
60	2.10	1.90	0.95
63	2.14	1.94	0.96

* Baseline conc. = 0.2 mg/L, fluoride dose = 2.0 mg/L
Measured conc. = Tracer conc. + Baseline conc.
Tracer conc. = Measured conc. - Baseline conc.

This slide and the following two slides can be used by the instructor to explain one way the results of tracer studies can be used to determine the T_{10} of a basin. The SWTR Guidance Manual has a full discussion on procedures for doing the tracer studies and determining T_{10} for basins. Other references are also referenced in the Guidance Manual.

This procedure is too complicated to cover in speaker's notes, therefore, the Guidance Manual should be used should the instructor wish to go into this subject in any detail.

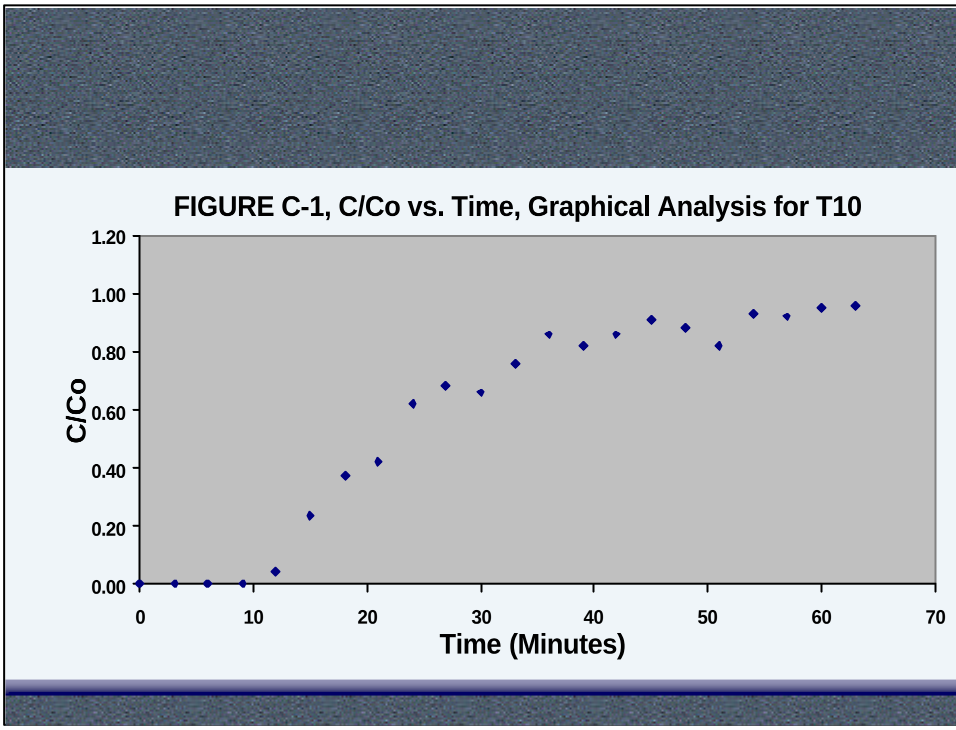


FIGURE C-1, C/Co vs. Time, Graphical Analysis for T10
C/Co
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0
10
20
30
40
50
60
70
Time (Minutes)

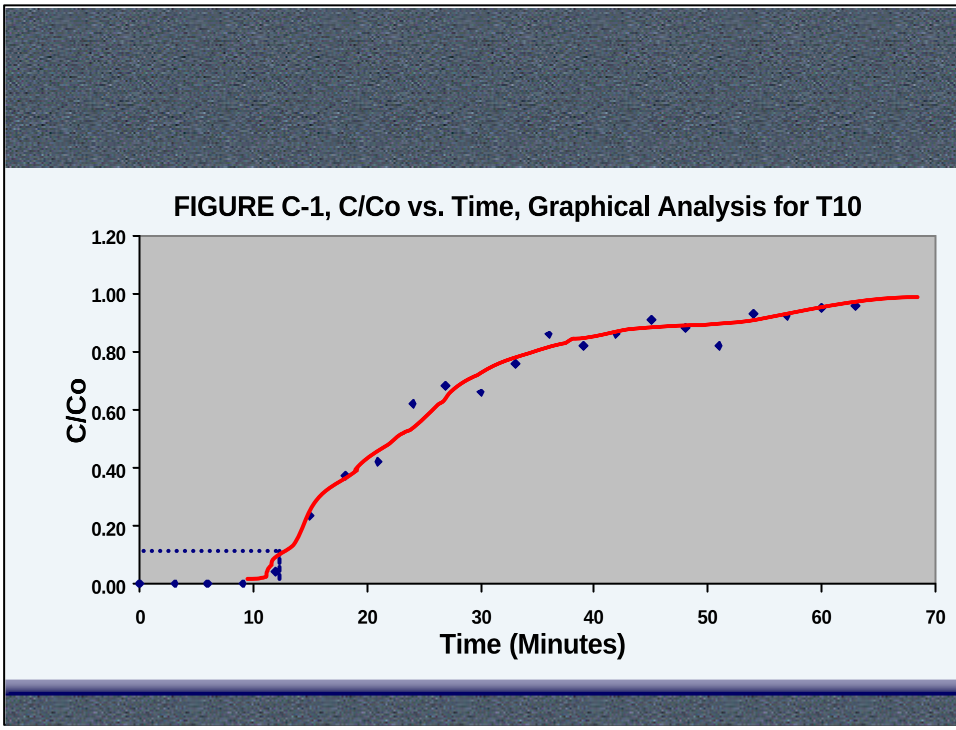
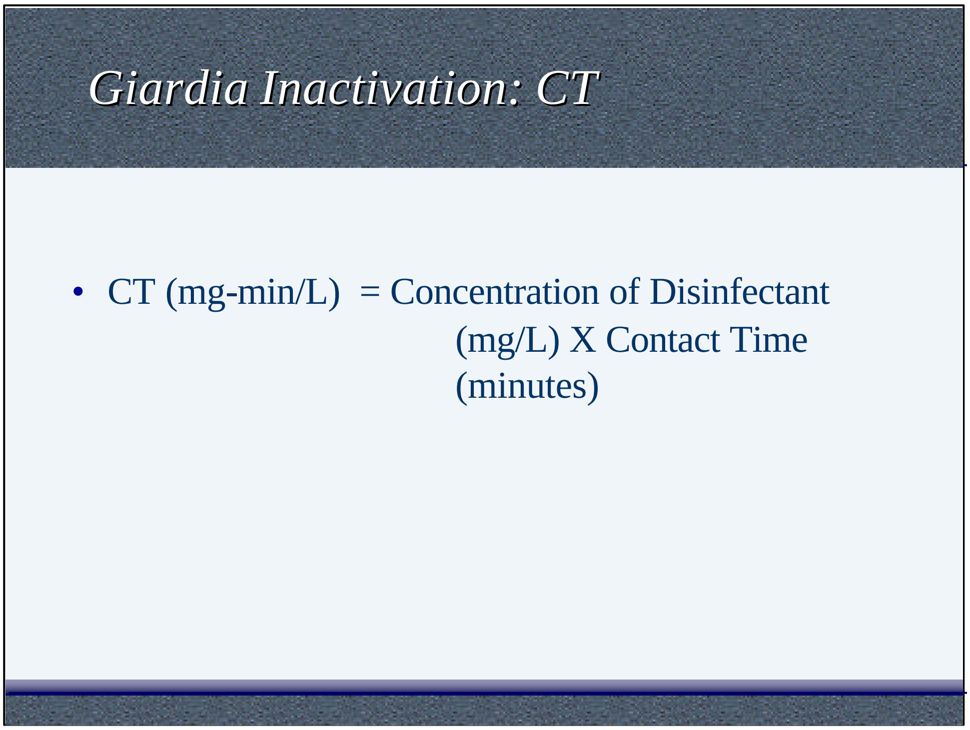
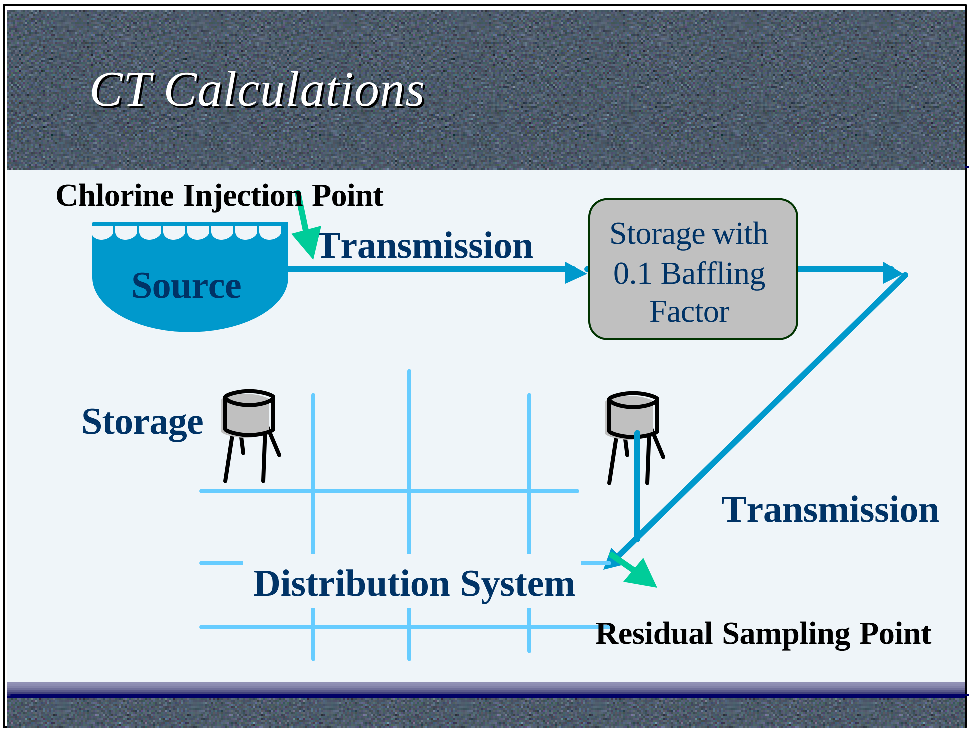


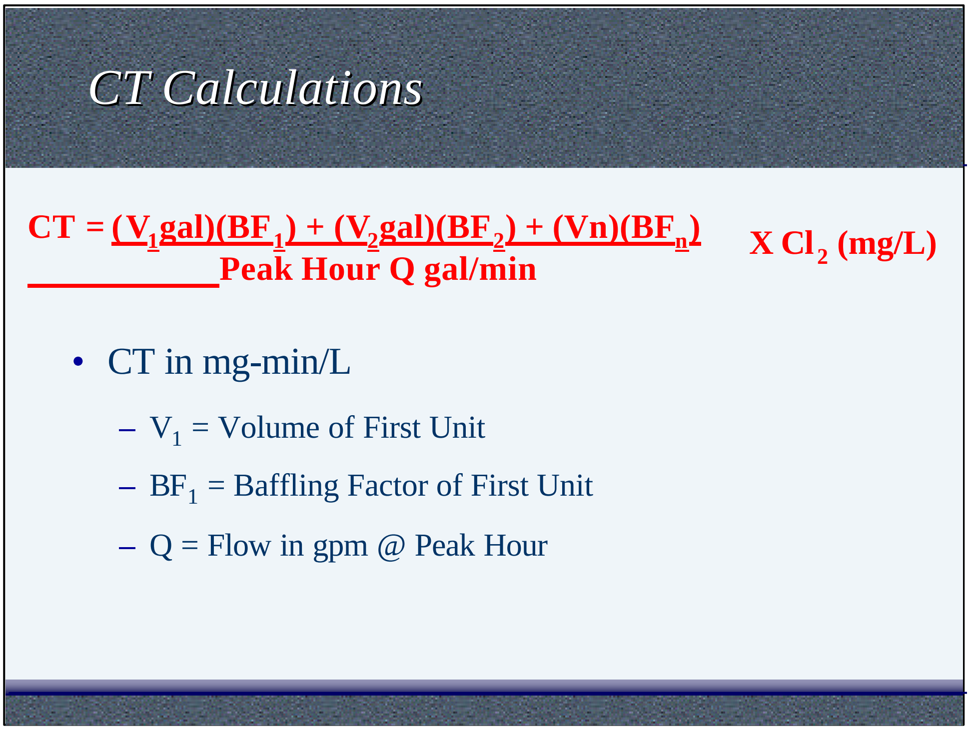
FIGURE C-1, C/Co vs. Time, Graphical Analysis for T10
C/Co
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0
10
20
30
40
50
60
70
Time (Minutes)



CT is defined in the rule as the concentration of disinfectant in mg/L multiplied by the time in minutes. CT, then must be measured in mg-min/L.



At this slide the instructor should discuss the procedure for determining theoretical contact time for each segment in the treatment scheme. Then determine T_{10} by multiplying the theoretical contact time by the baffling factor. The total time credited for T_{10}s in all units is then multiplied times the disinfectant residual in mg/L as measured before the first customer.



This generic equation can be used to show how the CT can be calculated for the previous slide.

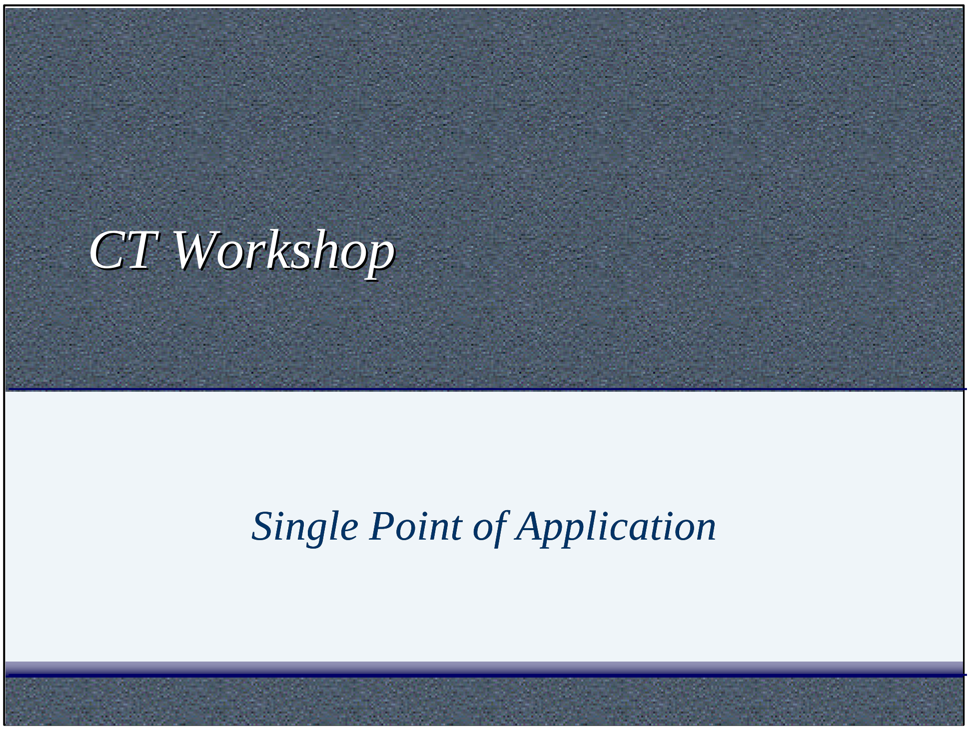
CT Calculations

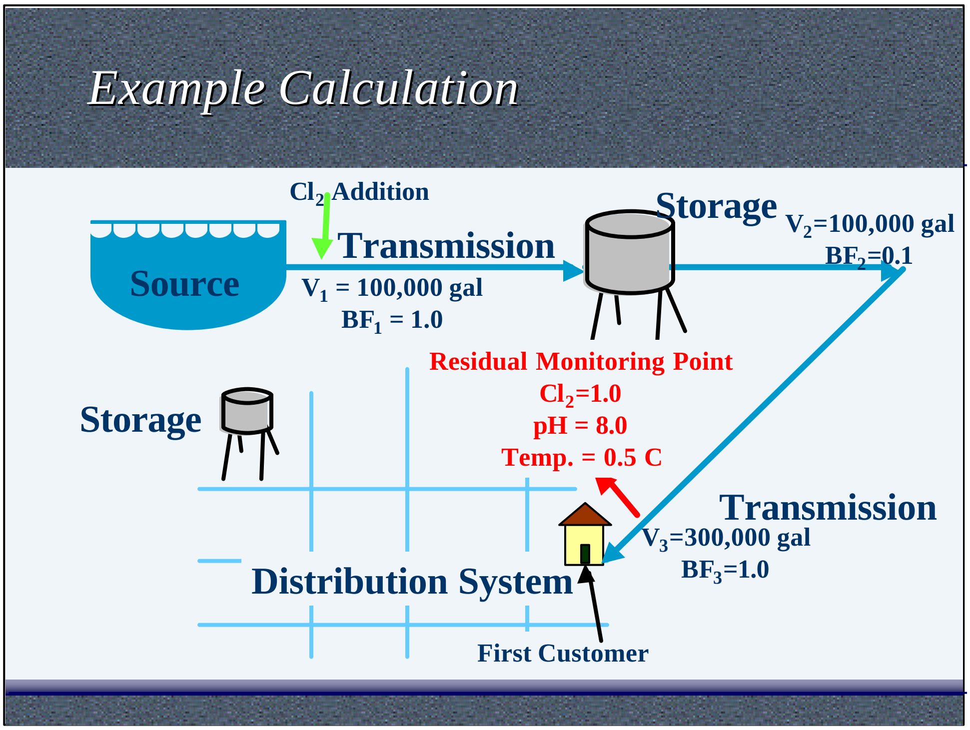
$$CT = \frac{\text{Vol. Trans. (gal.)(1)} + \text{Vol. Tank (gal)(.1)}}{\text{Peak hour flow rate (gpm)}} \text{ X } Cl_2 \text{ (mg/L)}$$

- CT Is in mg-min/L
- Use Tables in SWTR Guidance Manual to Determine How Many Logs of Inactivation You Have.
  - Interpolate or
  - Use Conservative Numbers

At this slide the instructor should use the CT tables from the rule or from the Guidance Manual and discuss how they are used. First select the tables for the disinfectant the system is using, then select the table with the correct water temperature. Use the table with the next lowest temperature if there is no table for the exact water temperature in order to be conservative. Then go the to part of the table with the correct pH, then read across from the proper disinfectant residual. For 3 log *Giardia lamblia* inactivation the CT required can then be read from the table.

Point out that it is possible to use straight line interpolation between different temperatures and pHs.


CT Workshop
Single Point of Application

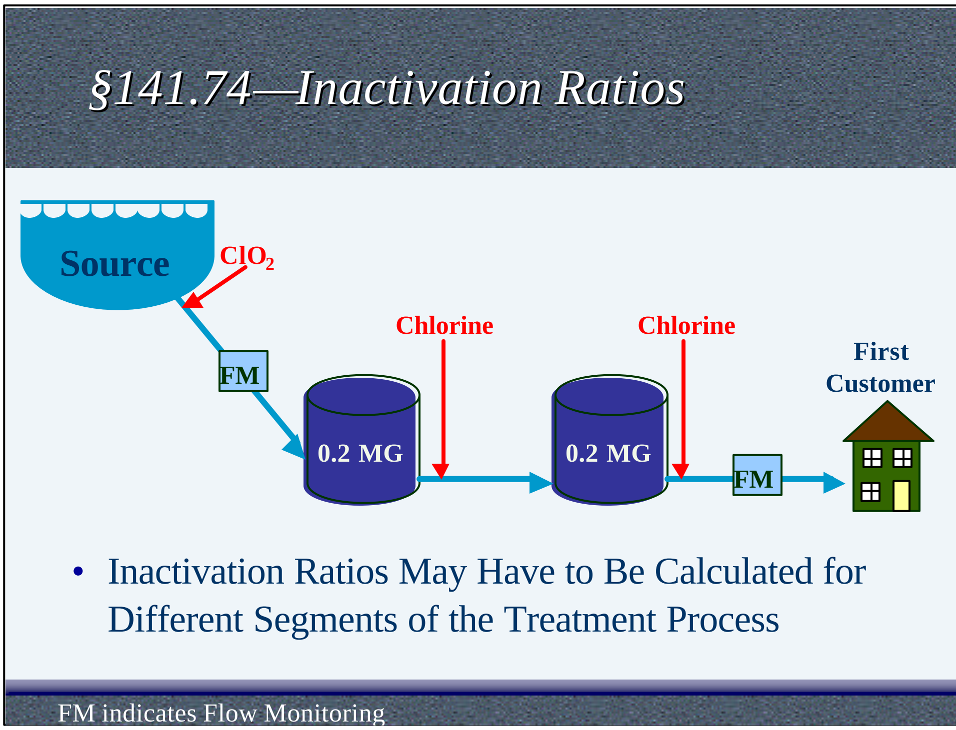


Have the class break into groups and calculate the $CT_{calculated}$ available for this particular situation assuming the peak hour flow is 1,000 gpm. Then determine whether the system is in compliance with the 3 log *Giardia lamblia* inactivation requirement by dividing CTcalculated by CT required for 3 log inactivation (CT required being the number derived from the table).

If CT calculated divided by CT required is $\geq$ 1.0, the system is in compliance.

Part 2:

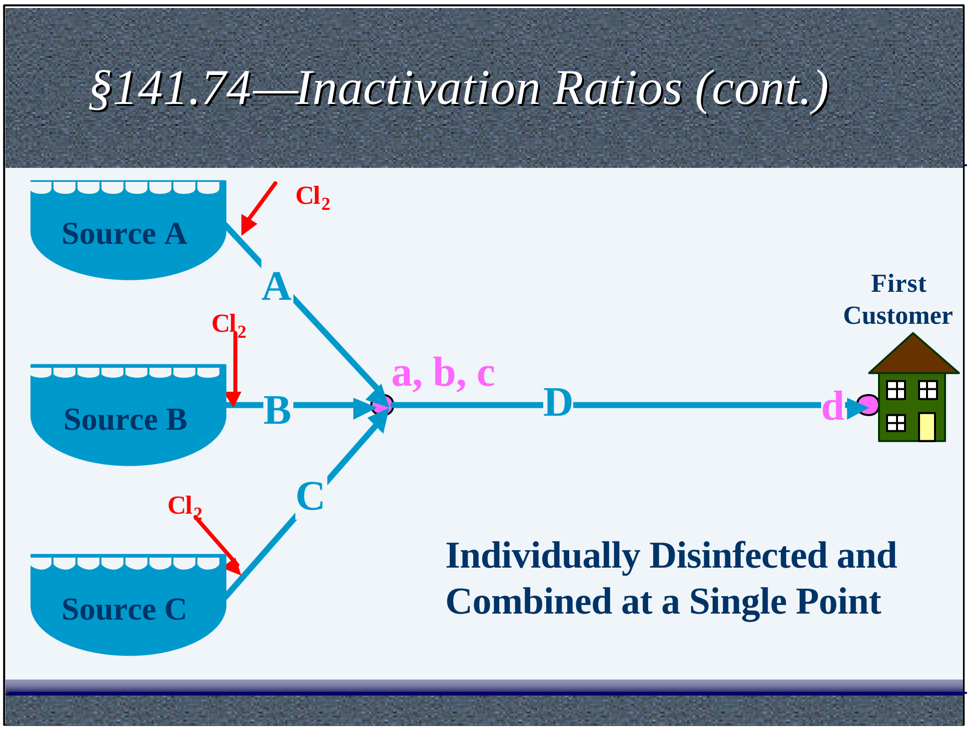
Point out to the class that the system would have the opportunity to measure the residual disinfectant at points along the line and determine log inactivation for each segment. Because the residual disinfectant will be greater upstream (because of chlorine demand), this will offer them the opportunity to more fully take advantage of the actual inactivation the system is providing.



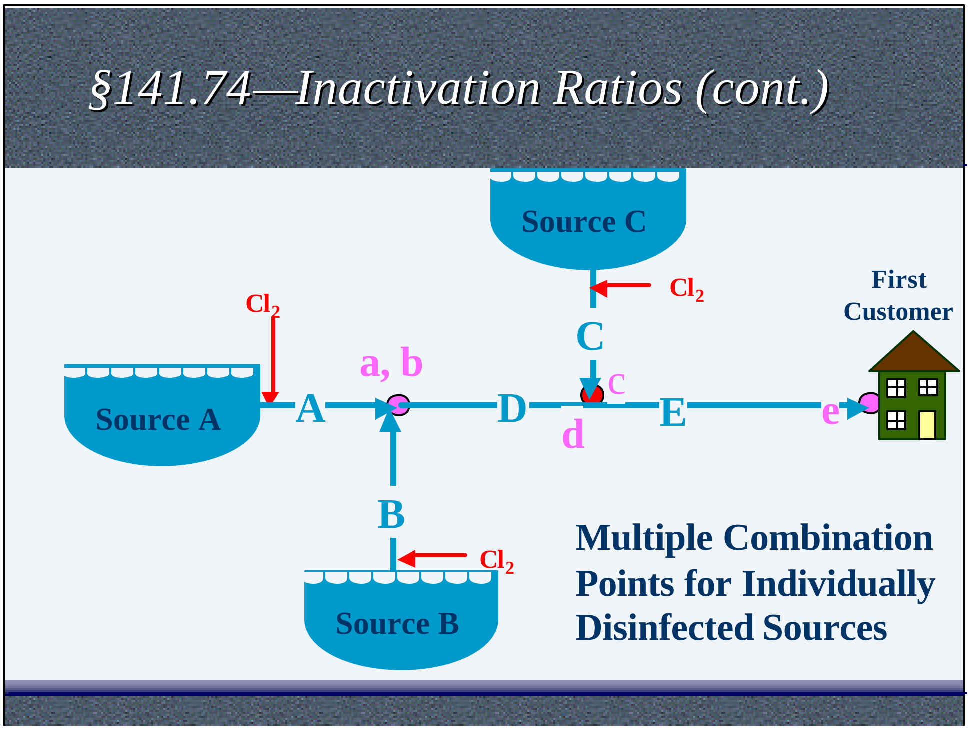
The next 3 slides show examples from the SWTR Guidance Manual. More information can be obtained by referring to this manual.

When disinfectants are added at multiple points, the log inactivation must be calculated in segments unless one segment meets the requirements of the SWTR. In the above situation the system could calculate the CT for the segment nearest the first customer and it if provided 3 and 4 log *Giardia lamblia* and virus inactivation respectively, report compliance. If the CT in the first segment was inadequate for compliance the next step would be to calculate CT for the next segment upstream, and the next, etc. until compliance is achieved.

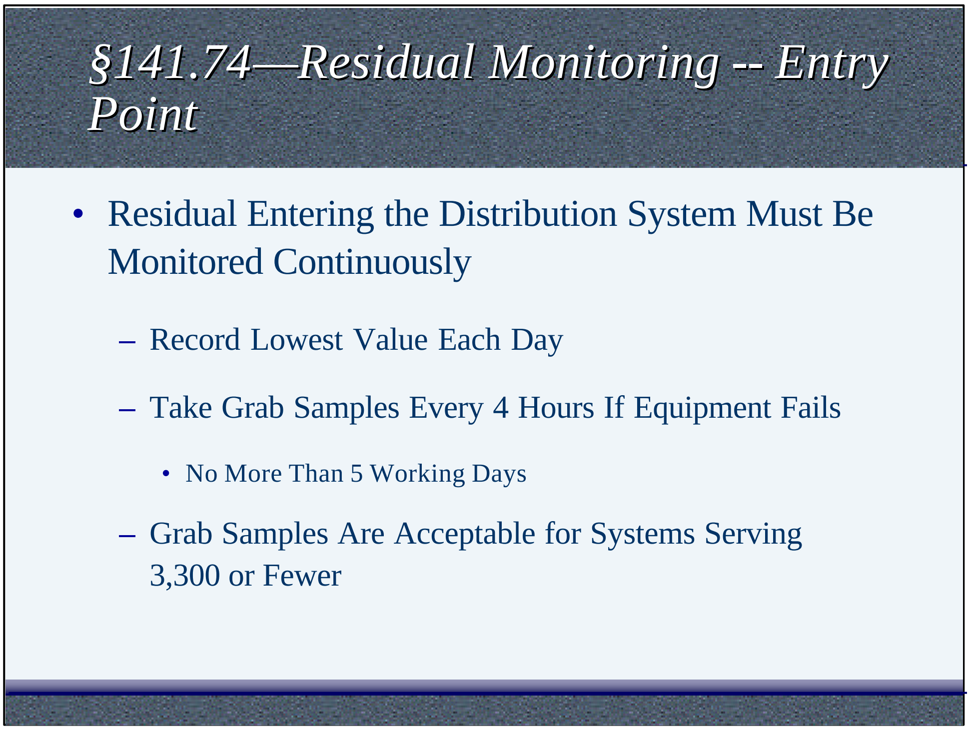
The SWTR doesn't require the system to show all the inactivation they have. The system simply has to show adequate CT to achieve compliance.



In this case the system would calculate CT for segment D first. If compliance is achieved, report to the State. If the CT of D is inadequate, A, B, and C calculations must be performed and the log inactivation of each individually, must be added to D's log inactivation to ensure that water from each source is receiving adequate treatment.



In this case the system, to show compliance, would calculate CT for segment E first, C and D second, then A and B third to show all water provided from both sources would meet the requirements.



The rule has requirements for disinfectant residual monitoring to help ensure continuous and adequate disinfection.

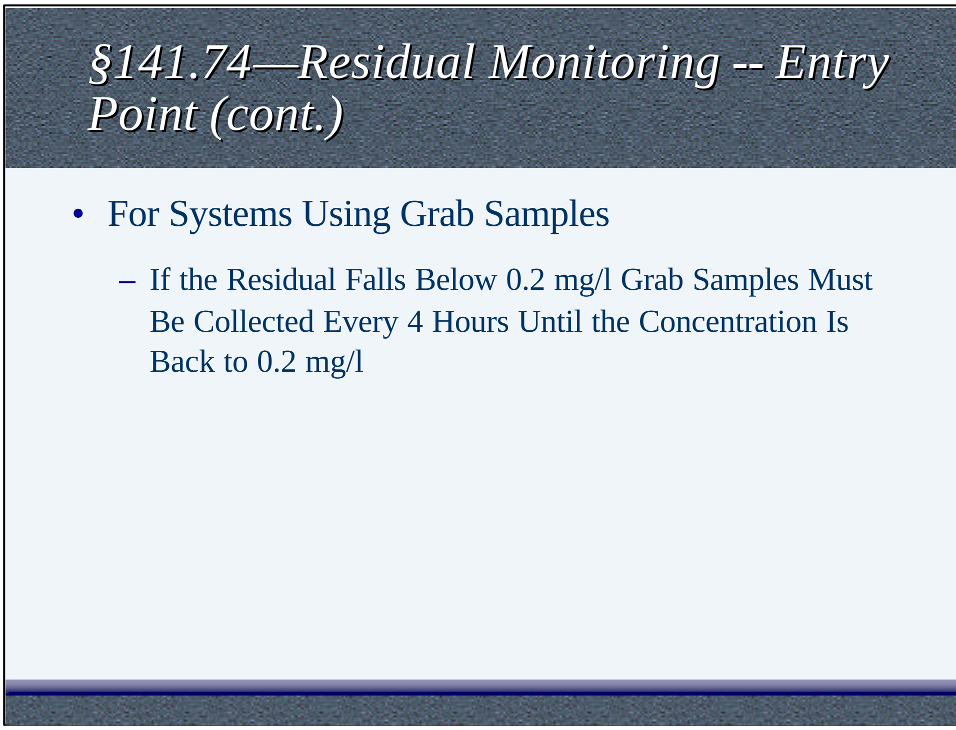
§141.74—Residual Monitoring -- Entry Point (cont.)

- Entry Point Monitoring for Small PWSs

Population	Residual Samples/Day
< 500	1
501 – 1,000	2
1,001 – 2,500	3
2,501 – 3,300	4

Small systems can get approval for grab sampling entry point residual disinfectant. The number of grab samples/day is dependent upon the size of the system. Many States required continuous residual disinfectant monitoring for all surface water systems.

The day's samples cannot be taken at the same time. Sampling intervals are subject to State review and approval.



This requirement ensures the system using grab samples in lieu of continuous monitoring will take action to correct problems that are causing the low entry point residual.

§141.74—Distribution Residuals

- Must Monitor Residual at the Same Time and Place As Coliforms[1]
- HPC May Be Monitored in Lieu of Disinfectant Residual
  - If HPC Monitoring Is Not Practical the State May Determine the System's Disinfection Is Adequate

[1]Other sites may be approved by the State

The disinfectant residual must be monitored in the distribution system at the same time and place as coliform samples are collected. Section §141.72 of the SWTR requires that no more than 5% of these measurements may be undetectable for any two consecutive months.

Should a sample not show detectable residual disinfectant the system may have a heterotrophic plate count performed on a sample of water from the location (same time and place) and if the HPC is less than or equal to 500 colony forming unit (cfu) per ml, it can be treated as if residual was detected.

Note: The Stage 1 DBPR sets MRDLs in the distribution systems for disinfectants. For chlorine and/or chloramines the MRDL is 4 mg/L and the MRDL for chlorine dioxide is 0.8 mg/L.


Surface Water Treatment Rule
Filtered Systems
Filtered

§141.72—Disinfection of Filtered Systems

- Subpart H Systems Not Meeting Avoidance Criteria Must Provide
  - Disinfection
    - Sufficient to ensure a total of
      - 3 log *Giardia lamblia* Inactivation
      - 4 log Virus Inactivation AND
  - A Suitable Filtration Technology
    - Conventional or Direct
    - Slow Sand or DE
    - Other Technologies

Filtered

Systems that do not meet the avoidance criteria must provide an acceptable method of filtration as well as full-time disinfection. The two, in combination, must then meet the 3 and 4 log removal and/or inactivation requirements.

Conventional and direct granular media filtration as well as slow sand and diatomaceous earth filtration are specifically mentioned in the rule as being acceptable technologies.

Other technologies can be approved by the primacy agency when shown to be acceptable. The burden to show the acceptability of alternative technologies lies upon the systems that use them.

Note: The IESWTR and LT1ESWTR (beginning Jan. 14, 2005) require 2 log removal of *Cryptosporidium*.

§141.73—Filtration: Conventional or Direct

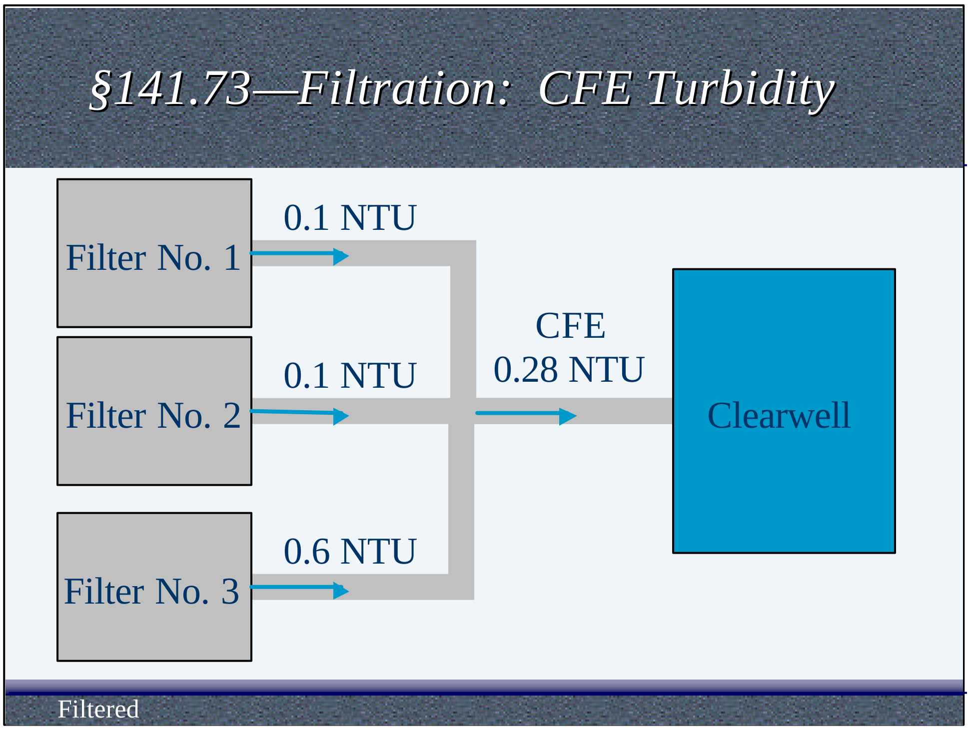
- At Least 95 Percent of the CFE[1] Turbidity Samples Must Be ≤ 0.5 NTU Each Month Except That
  - The State Can Determine That Some Level Higher Than 0.5 NTU but ≤ 1 NTU Will Inactivate And/Or Remove 99.9 Percent of *Giardia lamblia* Cysts
- The CFE Turbidity Must at No Time Exceed 5 NTU

[1]The Rule Says "Representative Samples of a System's Filtered Water." EPA Considers This to Be CFE, Some States Apply the Limit to Individual Filters.

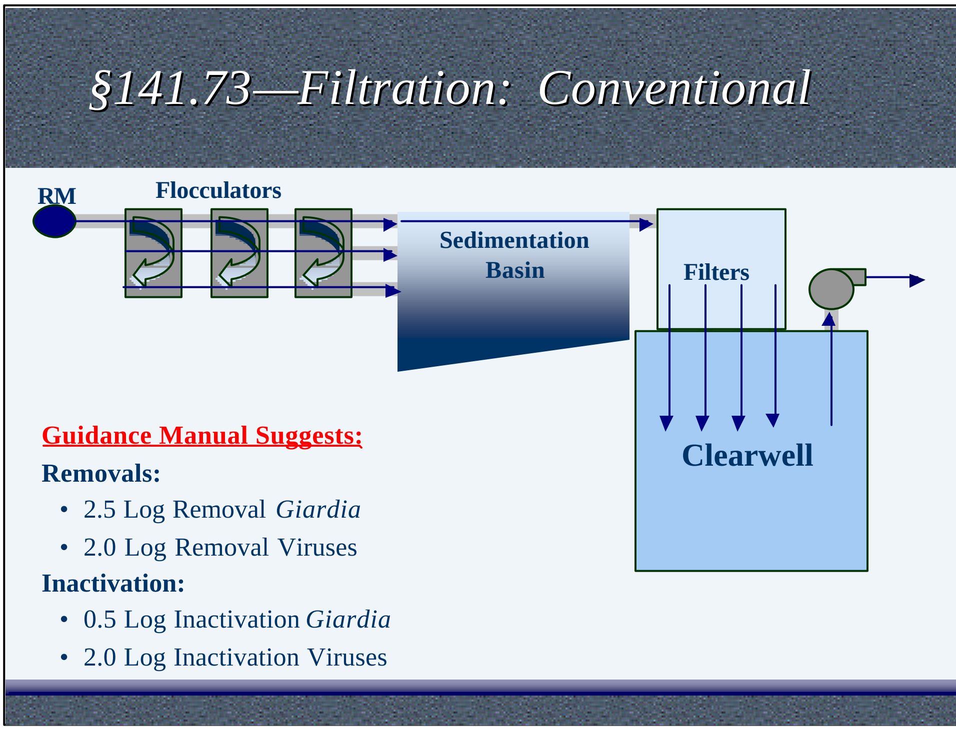
Filtered

These are the performance standards that are applied to conventional and direct filtration plants. They are based upon the measurements taken at least once every 4 hours, unless reduced by the State for systems serving 500 or fewer people.

Note: The IESWTR and LT1 (beginning January 14, 2005) supersede the combined filter effluent requirements (CFE) for conventional and direct filtration plants by requiring 95% of CFE turbidity measurements to be less than or equal to 0.3 NTU each month with a maximum level not to exceed 1 NTU.



The SWTR requires that turbidity "of representative samples of the system's filtered water" be monitored. EPA considers the proper site for monitoring to be the combined filter effluent. Some States may allow monitoring to be conducted out of the clearwell. In any event it is important to note that, as shown above, the blended water that is monitored in plants with multiple treatment trains can mask problems of individual trains (filters). This risk is addressed in the IESWTR and LT1ESWTR by requiring monitoring of individual filter effluent of conventional and direct filtration plants.

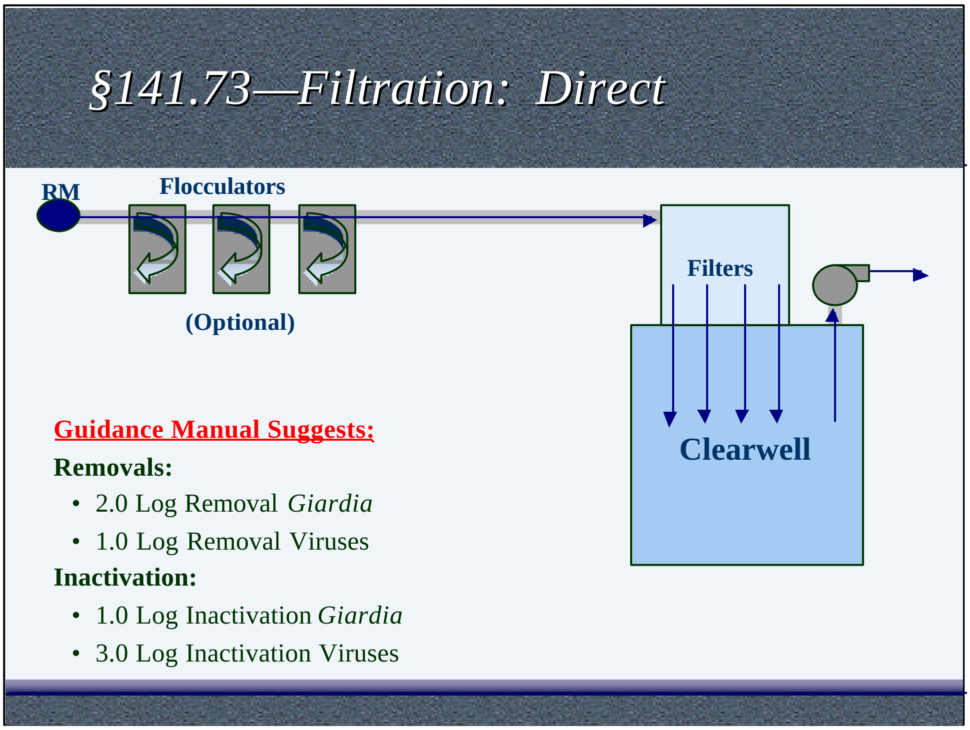


The SWTR does not have specific requirements for how much cyst and/or virus removal credit the State should allow for various types of filtration technologies. However, guidance is provided in the SWTR Guidance Manual.

For conventional filtration plants the Guidance Manual suggests that no more than 2.5 log *Giardia lamblia* cyst removal and 2.0 log virus removal be provided to systems that are meeting the performance requirements of the rule. The balance of the required removal/inactivation would then have to be provided by disinfection with adequate contact time.

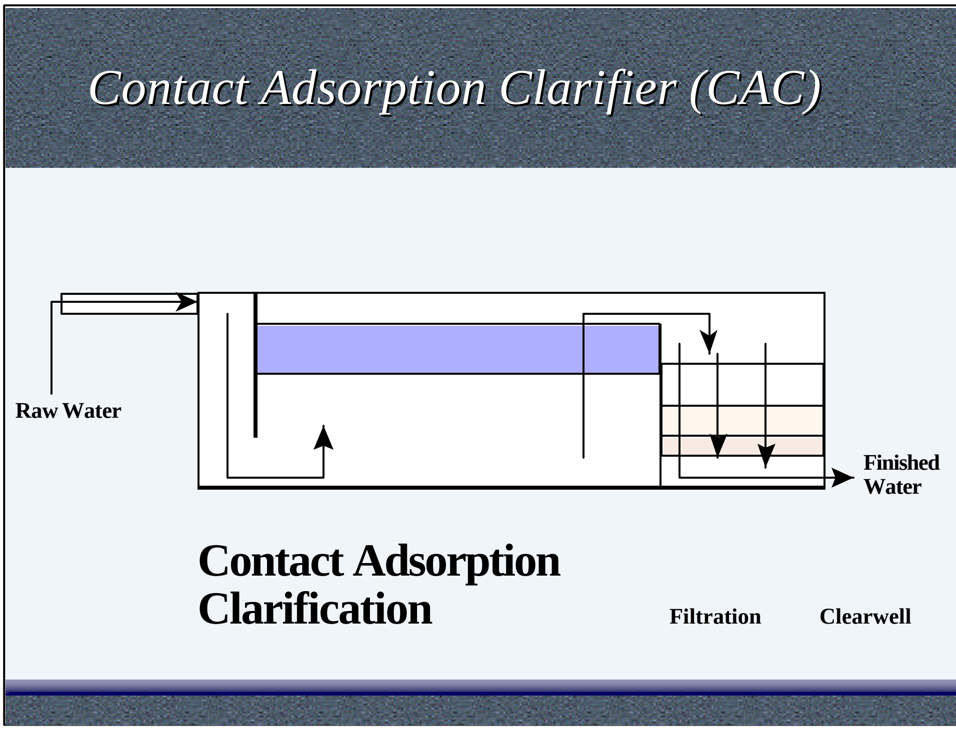
The Guidance Manual suggests that the State always requires at least 0.5 log *Giardia lamblia* inactivation as a minimum.

Note: Conventional and direct filtration plants are assumed to remove 2 logs of *Cryptosporidium*.



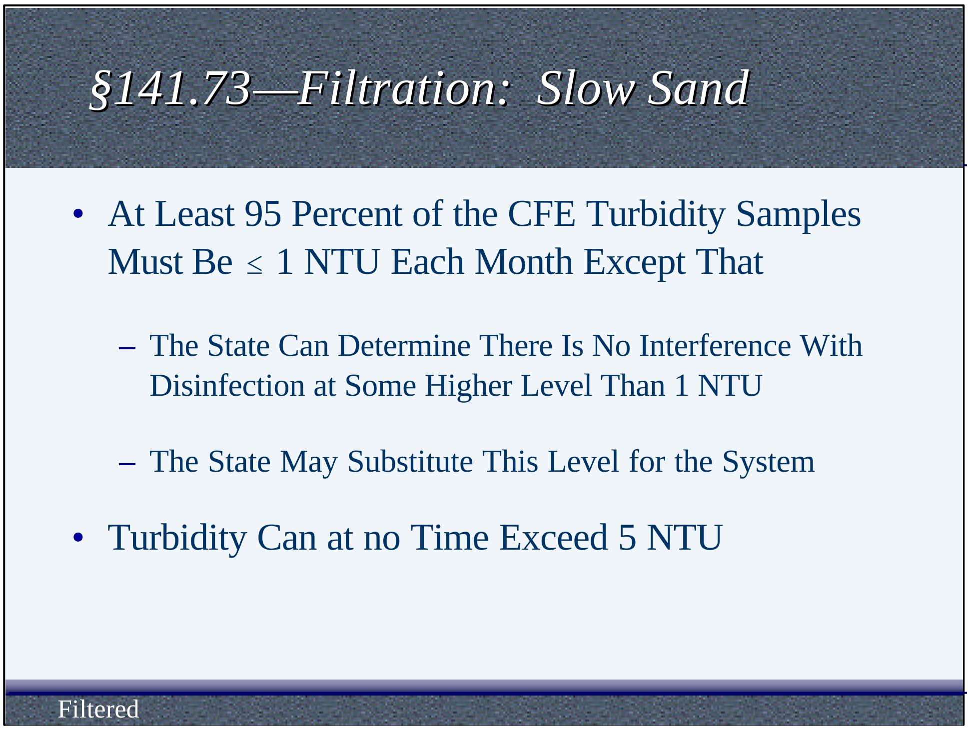
These are the suggested numbers for direct filtration plants meeting performance standards of the rule.

Note: Conventional and direct filtration plants are assumed to remove 2 logs of *Cryptosporidium*.



Many systems installed subsequent to the promulgation of the SWTR are referred to contact adsorption clarifiers or CAC systems. Guidance for removals credits is not provided in the SWTR Guidance Manual. States have flexibility to make their own determinations for these (and all other) systems.

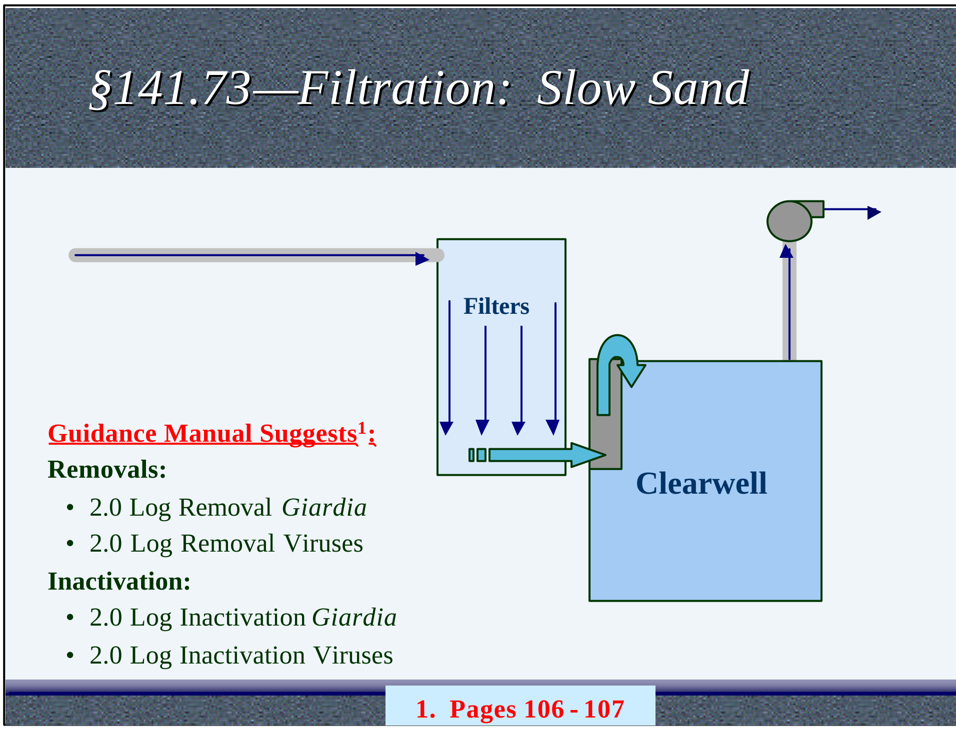
This is a photograph of a CAC being backwashed. One advantage to these systems is that backwash of the clarifier is provided with untreated water. This minimizes the use of treated water and saves treatment costs.



These are the performance standards for slow sand filters. The performance standards have been established based upon research showing actual removal efficiencies. Slow sand will sometimes pass inorganic colloidal particles while removing cysts and viruses. Therefore, States may allow higher turbidities when they are convinced disinfection will not be impacted negatively.

Once again , CFE monitoring is based on measurements taken at least every 4 hrs unless reduced by the State.

Note: Under the IESWTR and LT1ESWTR, these requirements are maintained.



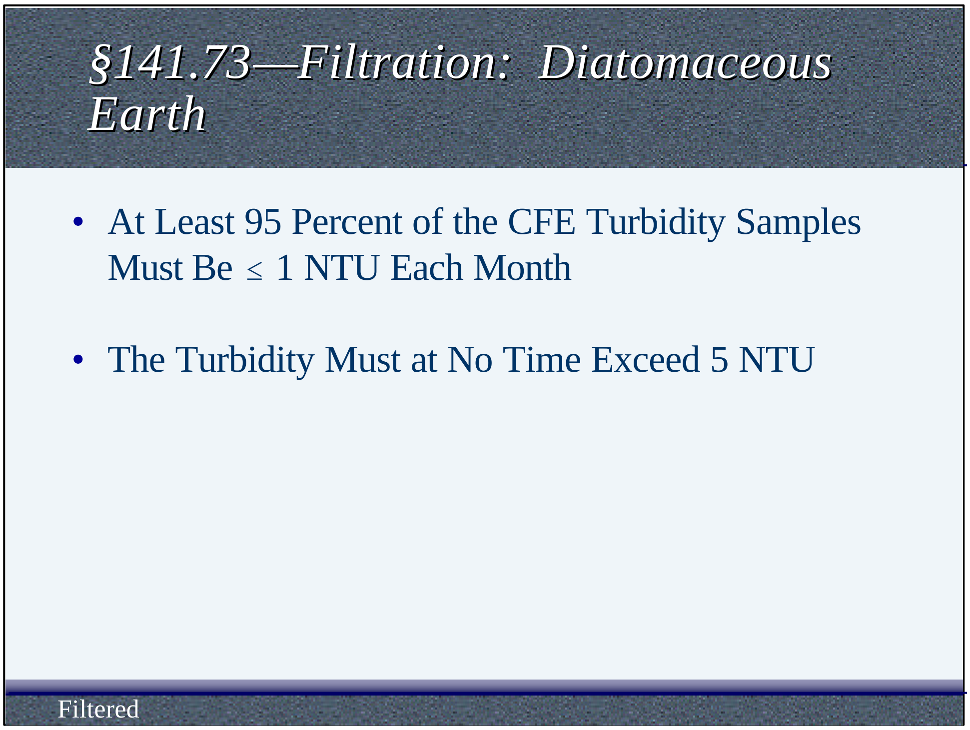
These are the suggested removal credits for slow sand.

Note: Slow sand filtration, when properly operated, is assumed to remove 2 log *Cryptosporidium*.

This is a slow sand filter that treats a high quality, low turbidity, surface water source in northern Idaho.

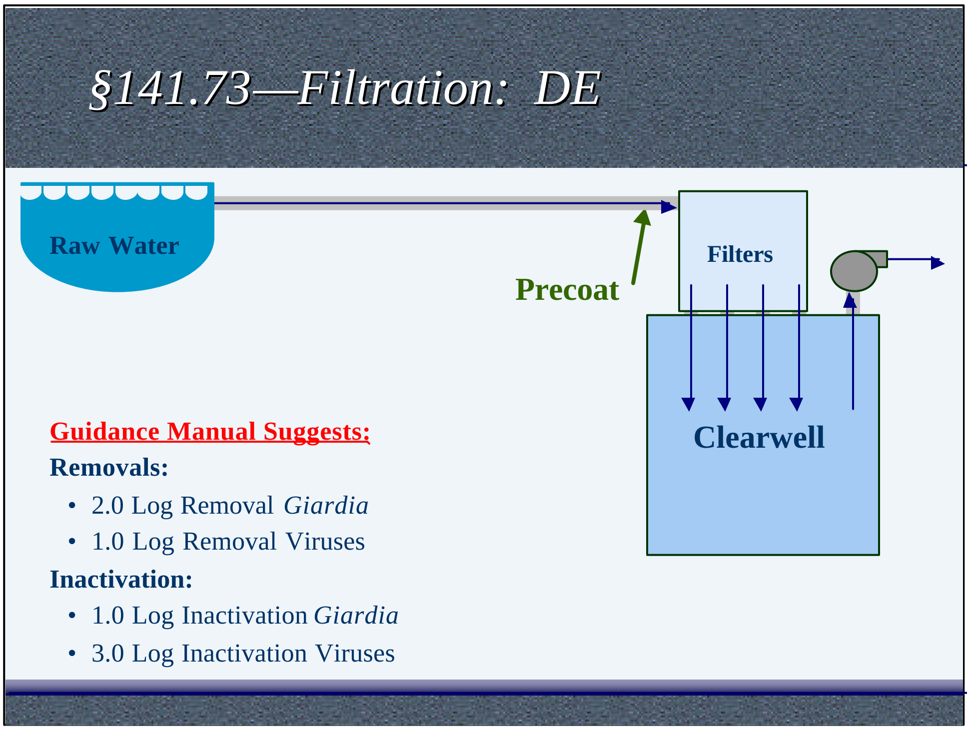
Much of the removal of viruses, bacteria and cysts is accomplished in biological layer that forms on and in the first few millimeters of sand. Eventually the biological growths will accumulate to the point that flow will be greatly diminished through the filter and it must be cleaned. Cleaning is accomplished by removing a thin layer of sand with much of the biological material.

After cleaning the filter must be allowed to filter to waste for a period of time until enough biological growth accumulates to accomplish proper filtration.



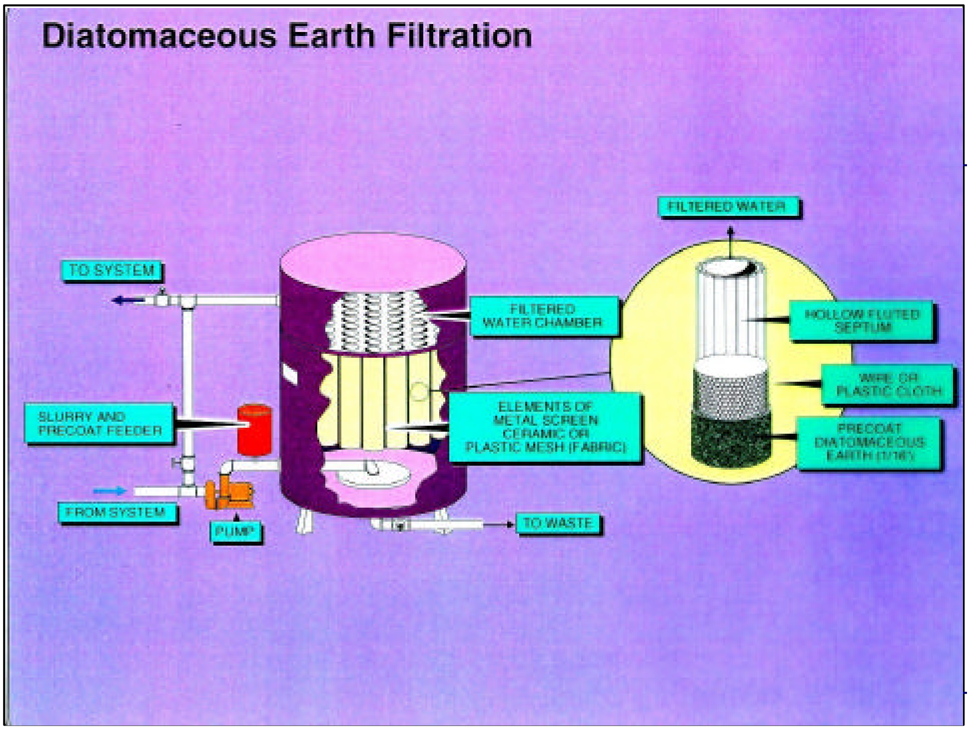
These are the performance standards for DE filters based on measurements every 4 hrs, unless reduced.by the State for systems serving 500 or fewer.

Note: Under the IESWTR and LT1ESWTR, these requirements are maintained.

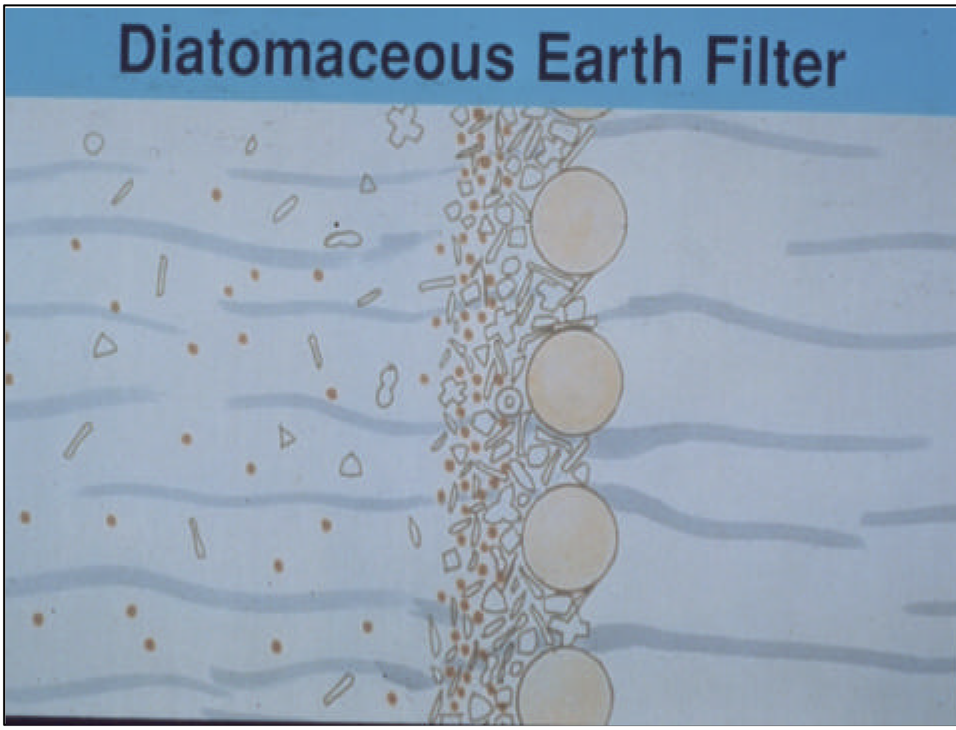


These are the recommended removal credits that States might allow for DE filters.

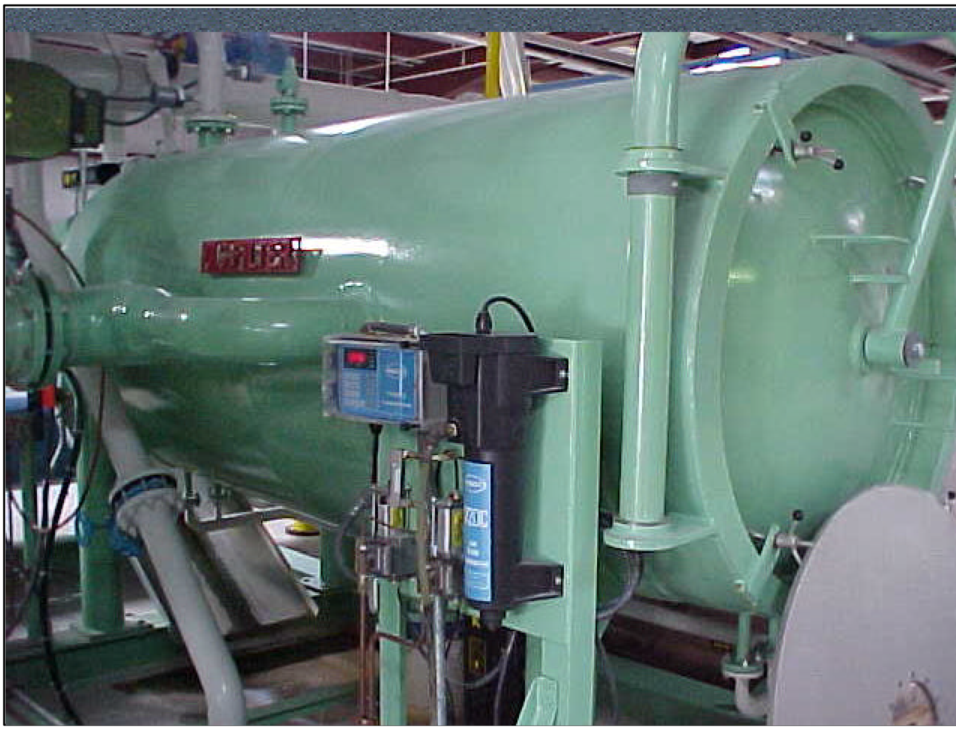
Note: Direct filtration is assumed to remove 2 logs of *Cryptosporidium*.



DE filters are typically used for low turbidity waters. They are common for treating water at swimming pools, but less common for drinking water. Some filter under pressure and some under vacuum.



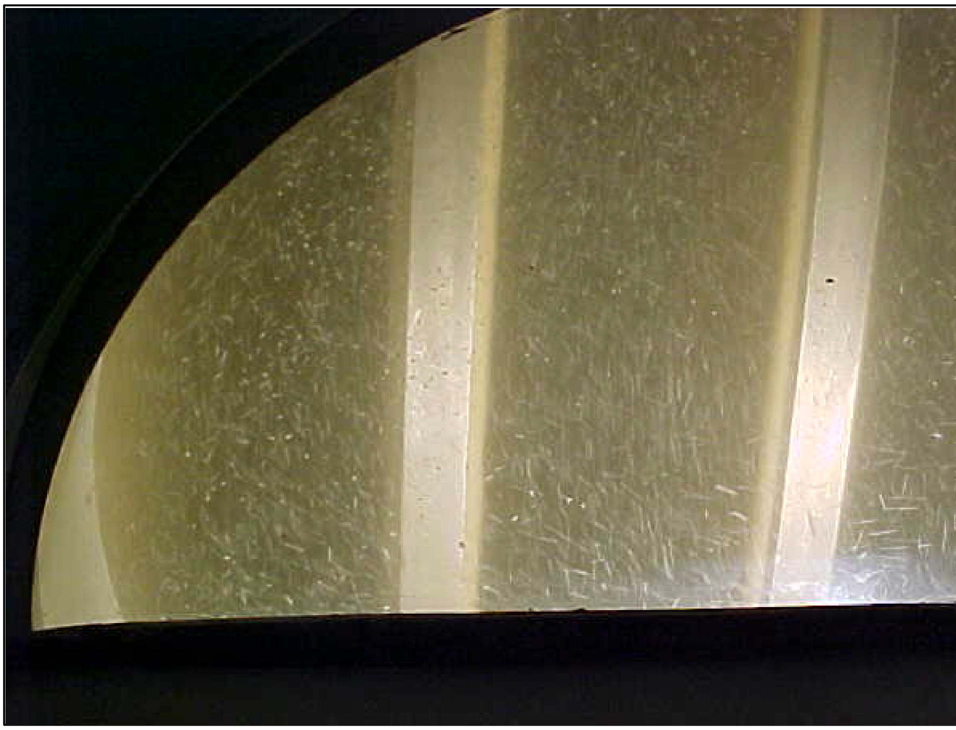
A layer of diatomaceous earth builds up on a septum and turbidity particles and pathogens are removed from the water by "sieving" as they pass through the DE layer. DE is fed continuously during the process and the DE layer keeps building up. This helps reduce the accumulating head loss and increase the filter run time.



This is a large DE unit that treats drinking water for Carson City, NV. Note one of the circular filtration units (septa) leaning against the DE filter on the right side of the photo.

This is a photo of the internal septum. There are many of these within the DE filter

and the water is filtered, through a layer of DE, through both sides and into the center, then to a collector pipe, and to the clearwell.



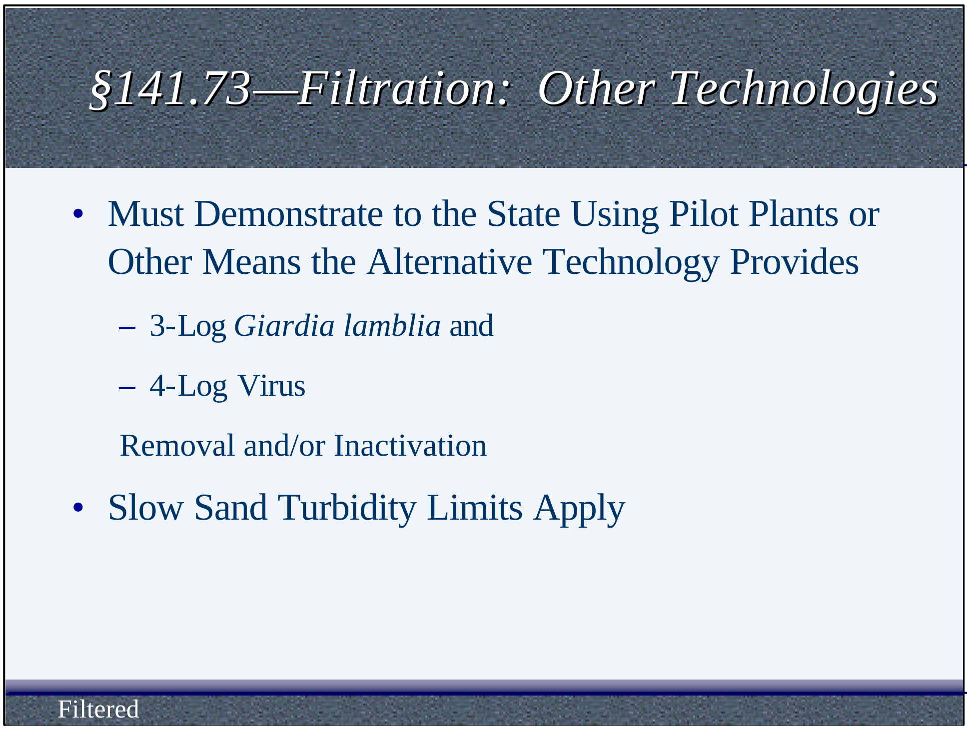
This photo is taken through a lighted porthole in the side of the DE filter. It is looking at the outer circumference of two of the circular septa. Note the layer of DE built up on both sides of each septa and the "body feed" DE that is constantly fed with the raw water.

Log Removal and/or Inactivation[1]

	Log Removal		Recom. Inact.	
Filters	***Giardia***	Viruses	***Giardia***	Viruses
Conv.	2-3	1-3	0.5	2.0
Direct	2-3	1-2	1.0	2.0
Slow Sand	2-3	1-3	2.0	2.0
DE	2-3	1-2	1.0	3.0

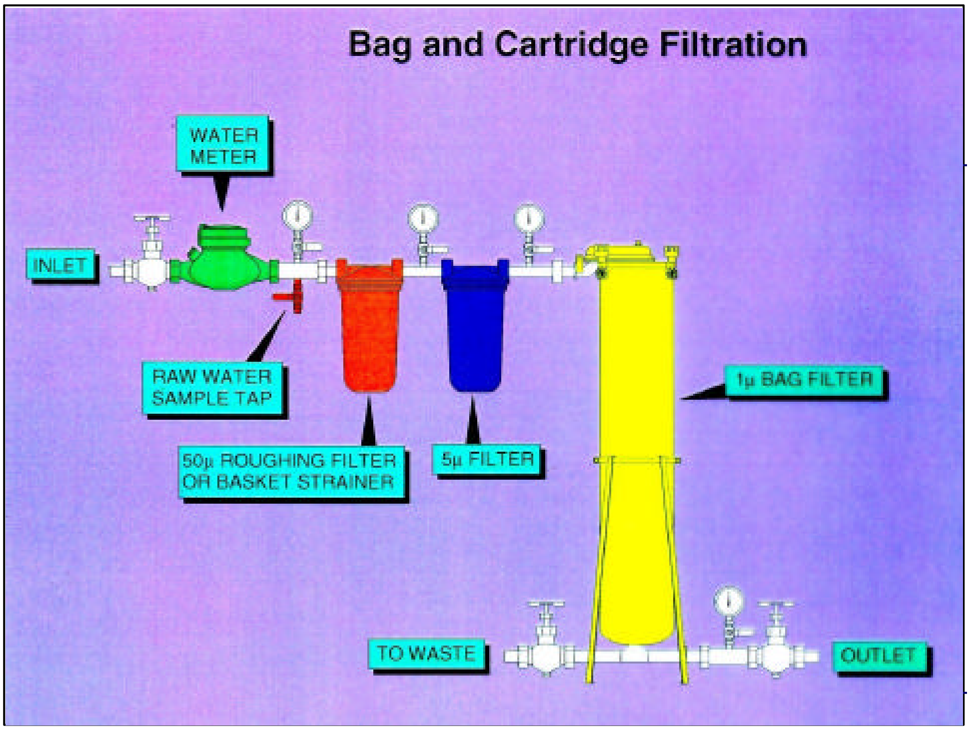
1. Pages 81 & 106-107

This is a table summarizing the suggested removal credits for the common types of filtration based on the SWTR Guidance Manual.



The SWTR applies the performance standards for slow sand filters to alternative technologies approved by the State based on measurements every 4 hrs unless reduced by the State.

Note: The IESWTR and LT1ESWTR (beginning Jan. 14, 2005) require systems to demonstrate that their alternative technology consistently removes 2 logs of *Cryptosporidium*. Based on this information, the State is required to set turbidity limits not to exceed 1 NTU for 95% of the turbidity measurements taken each month and not to exceed a maximum value of 5 NTU.



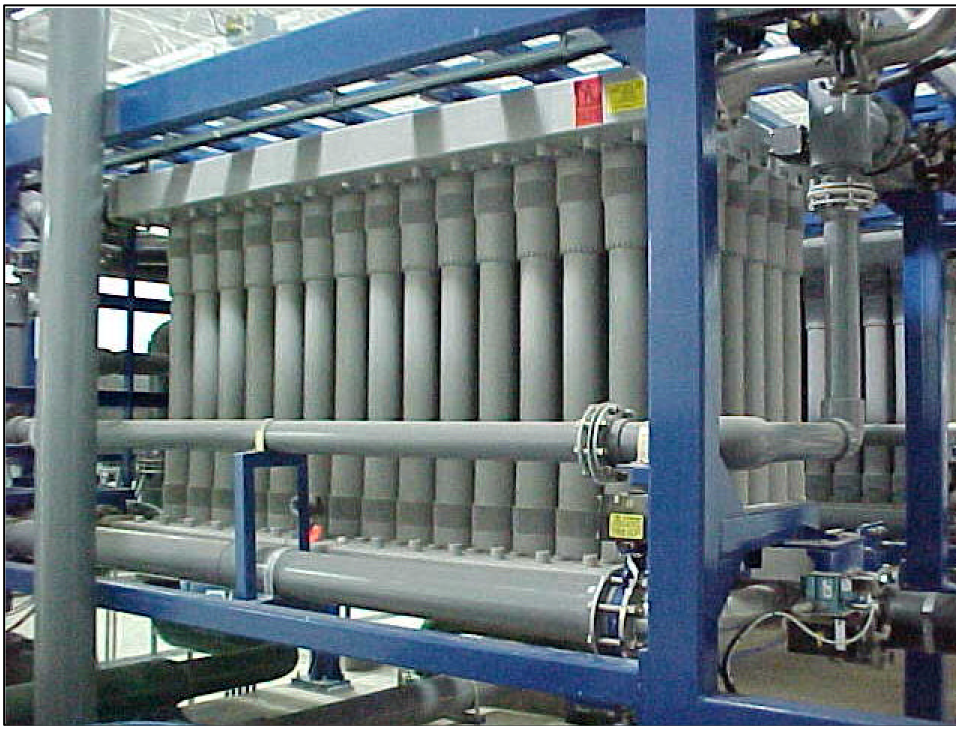
This is an example of a typical alternative technology for a small surface water system using a high quality (low turbidity) surface water. These kinds of systems are often used by noncommunity PWSs. There are usually two or more filters in series with the first filter(s) serving as roughing filters and the final filer ensuring adequate removal of cysts.

This is a system serving a small noncommunity PWS. It has a roughing filter (10 micron) followed by a 1 micron filter. Then the water is disinfected with UV light followed by chlorine with contact time sufficient for 1.0 log *Giardia lamblia* inactivation. Note the 2 parallel trains that allow the system to continuously operate while filter cartridges are changed.

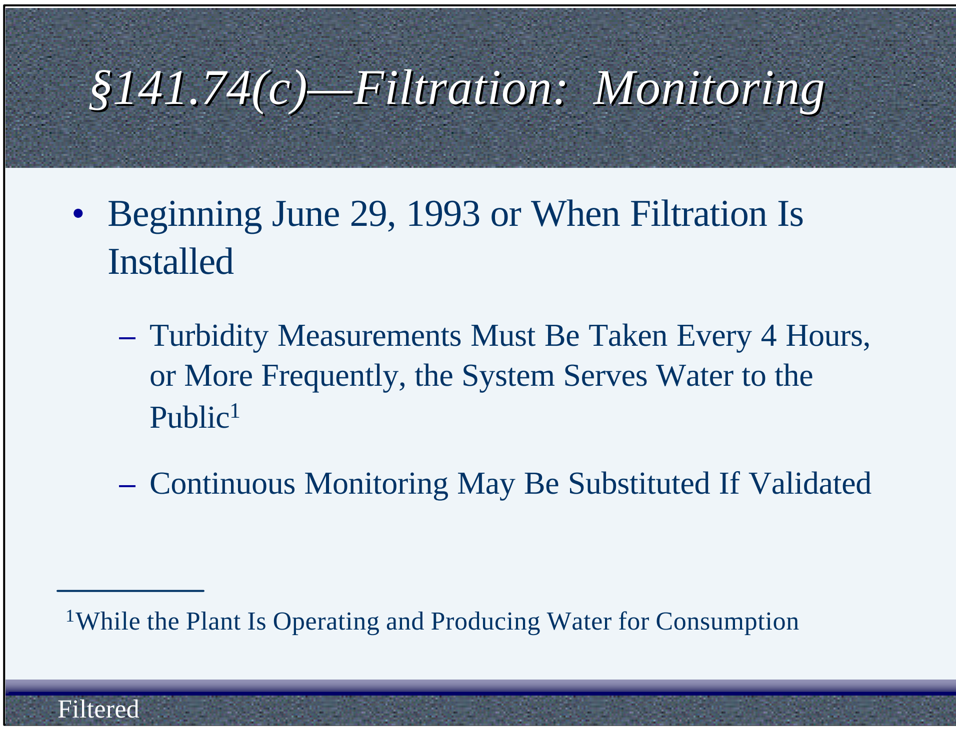
Pressure Dual Media Filter

This is a photo of a dual media pressure filter that is used as a roughing filter. No chemical is added for coagulation and the filtered water is then passed through both cartridge and bag filters.

These are the cartridge and bag filter units that are arranged in series with the dual media pressure filter shown in the previous slide. The water is then chlorinated and contact time is provided in a storage tank.

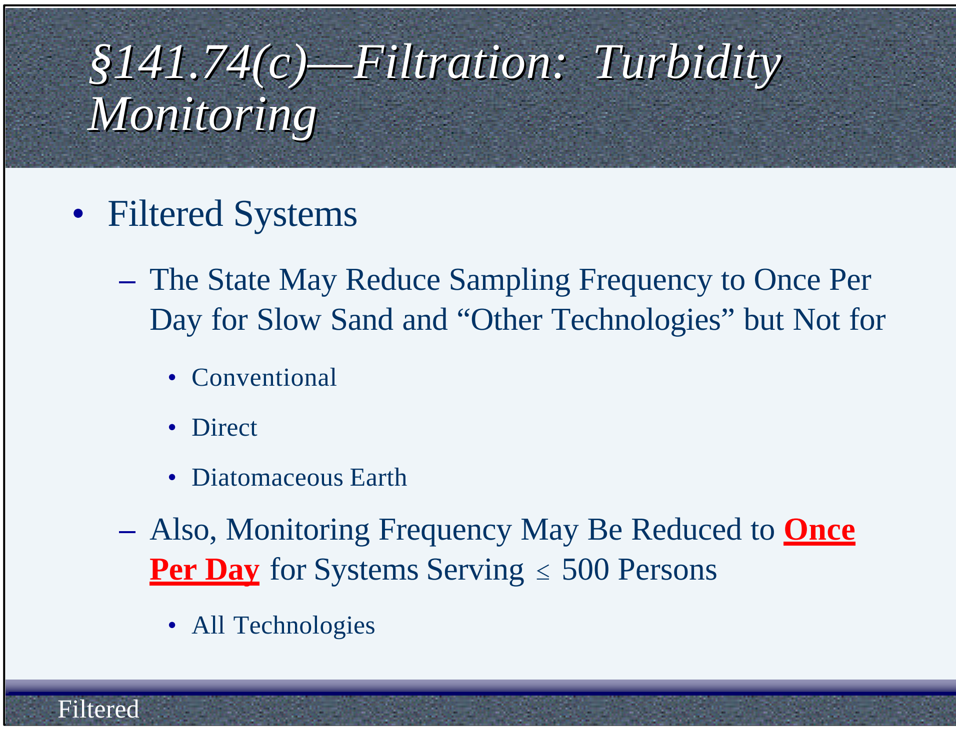


This is a photograph of a micro membrane filtration plant. These kinds of facilities are becoming more common on surface waters.



Turbidity measurements must be taken and recorded every four hours of operation. In most cases the samples are taken at the combined filter effluent. If a plant operates intermittently (start/stop) during the day, many States require one reading at the end of each operating period that is less than 4 hours.

Note: The IESWTR and LT1ESWTR (beginning Jan. 14, 2005) requires continuous individual filter monitoring with measurements recorded at least every 15 minutes for systems using conventional or direct filtration.



The rule allows for some reductions in turbidity sampling frequency.

§141.74(c)—Filtration: Disinfection Residual Monitoring

- Residual Entering the Distribution System

  Monitoring Frequency, Locations, Residual Requirements, etc. are Identical to Those For Unfiltered Systems

Filtered

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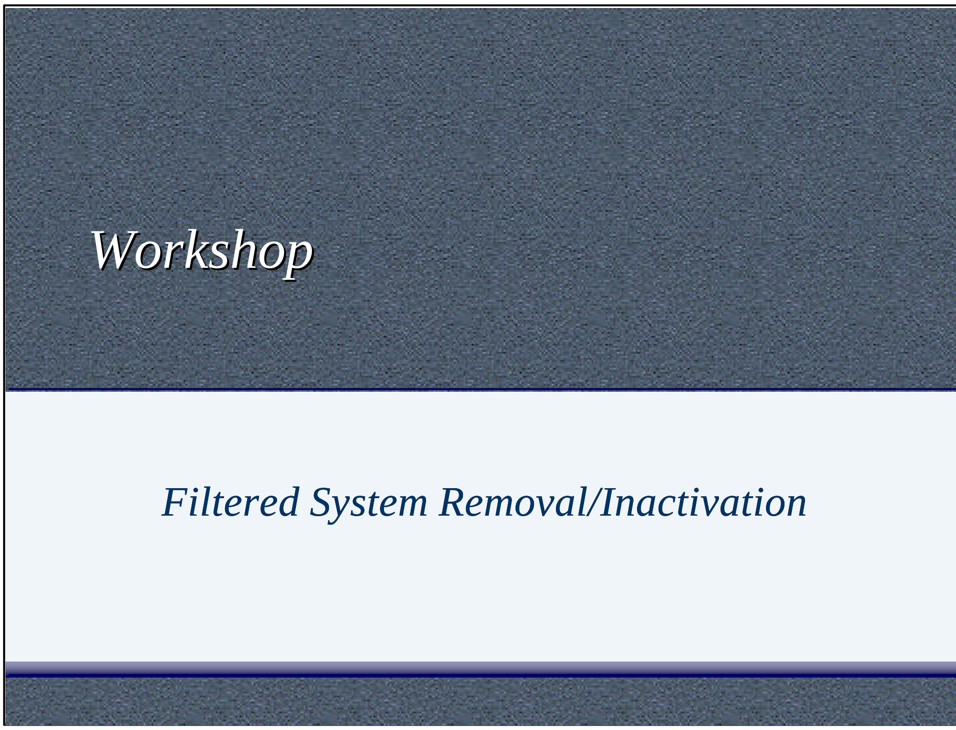
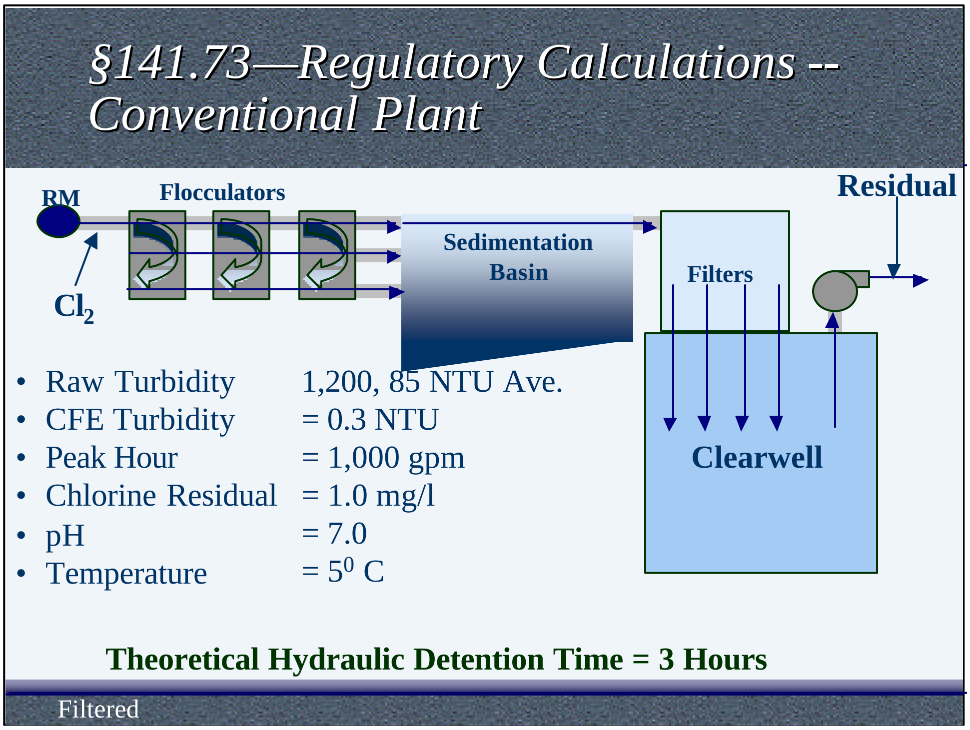
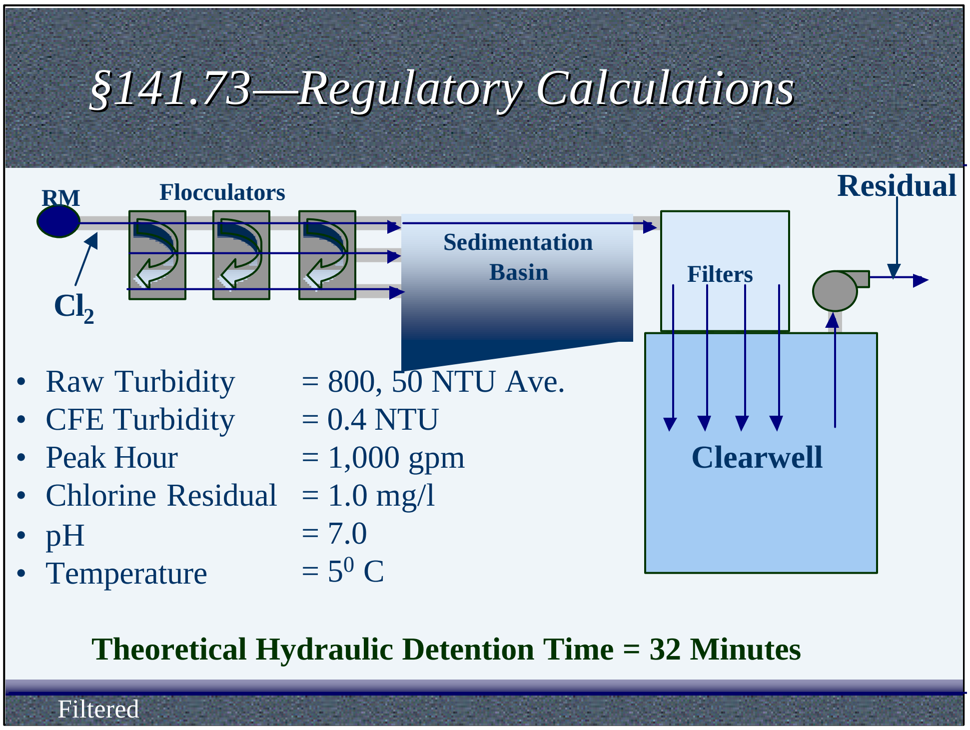


Each of the following schematics should be discussed in terms of the removal credit the State should allow and how much CT would then be necessary to provide the full regulatory requirements.

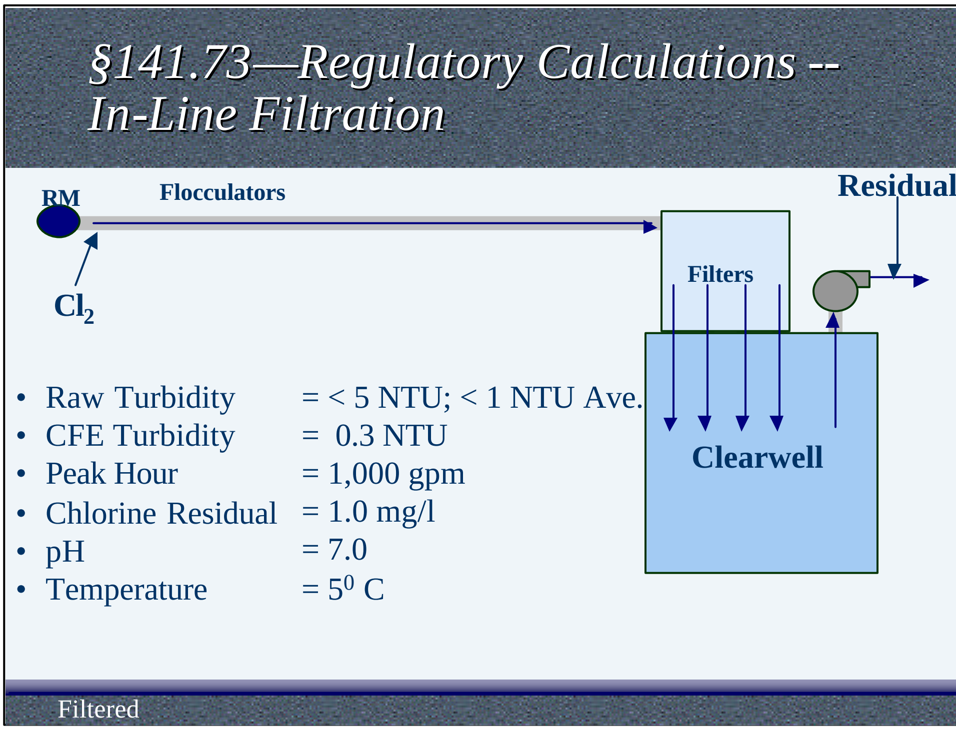


In this situation the system is a conventional plant that meets and exceeds the SWTR's performance standards. Most States would give 2.5 log *Giardia lamblia* removal credit and require at least 0.5 log inactivation by disinfection and contact time. It should be noted that, when chlorine in used, *Giardia lamblia* inactivation will be the limiting factor. In other words, if adequate cyst inactivation is occurring, more than adequate virus inactivation will be occurring simultaneously.

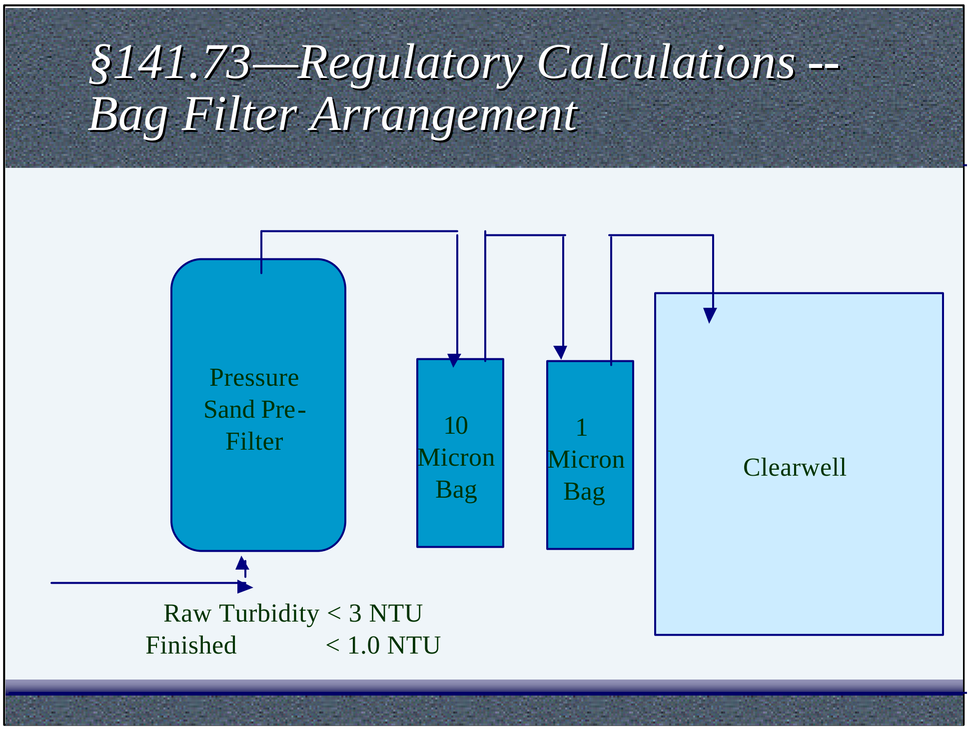
Here the instructor can walk the class though the use of the CT tables to show the system is in compliance.



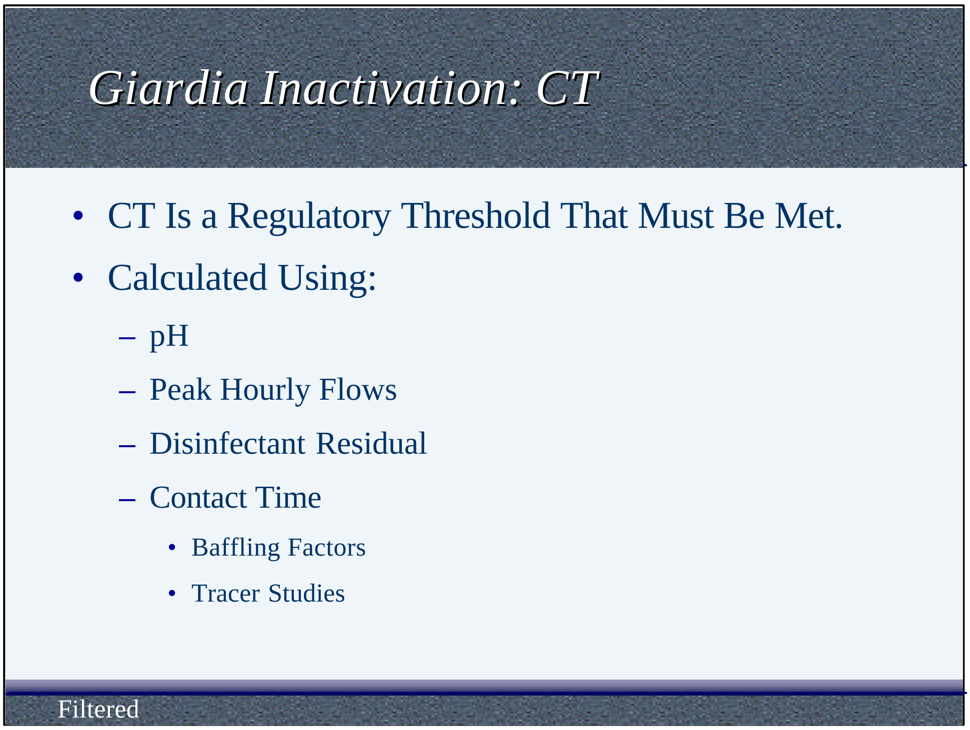
Use the same process as in the previous slide.



Discuss the removal credits that should be allowed here. Then use the CT tables to determine how much contact time the system must have to provide adequate CT given the above conditions.

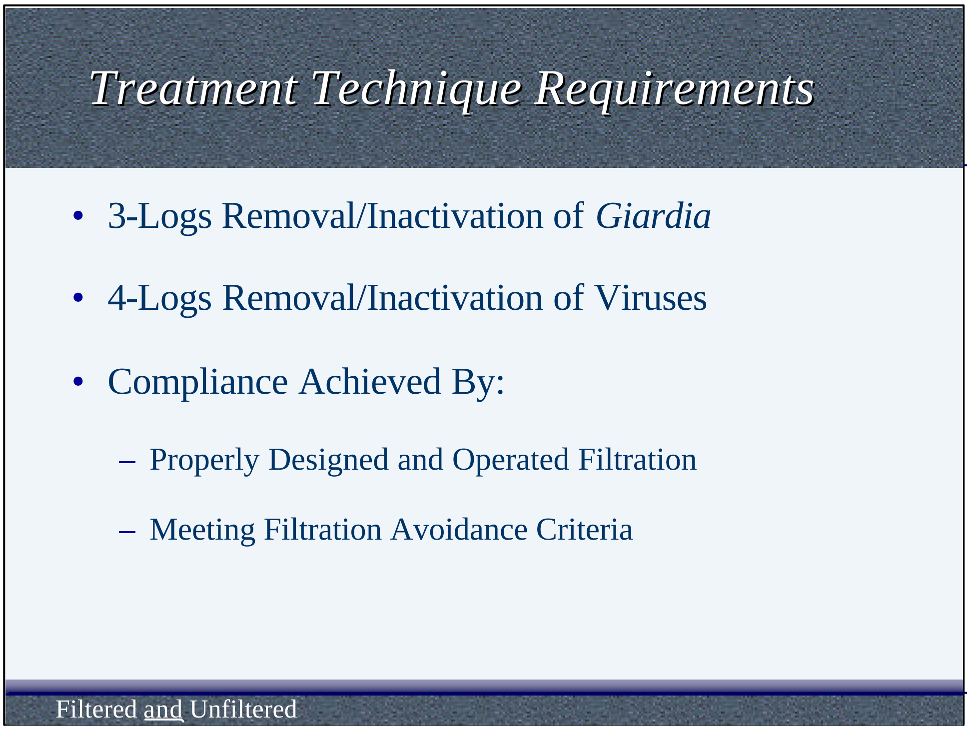


Discuss the removal credits that should be allowed here. Then use the CT tables to determine how much contact time the system must have to provide adequate CT given the above conditions.



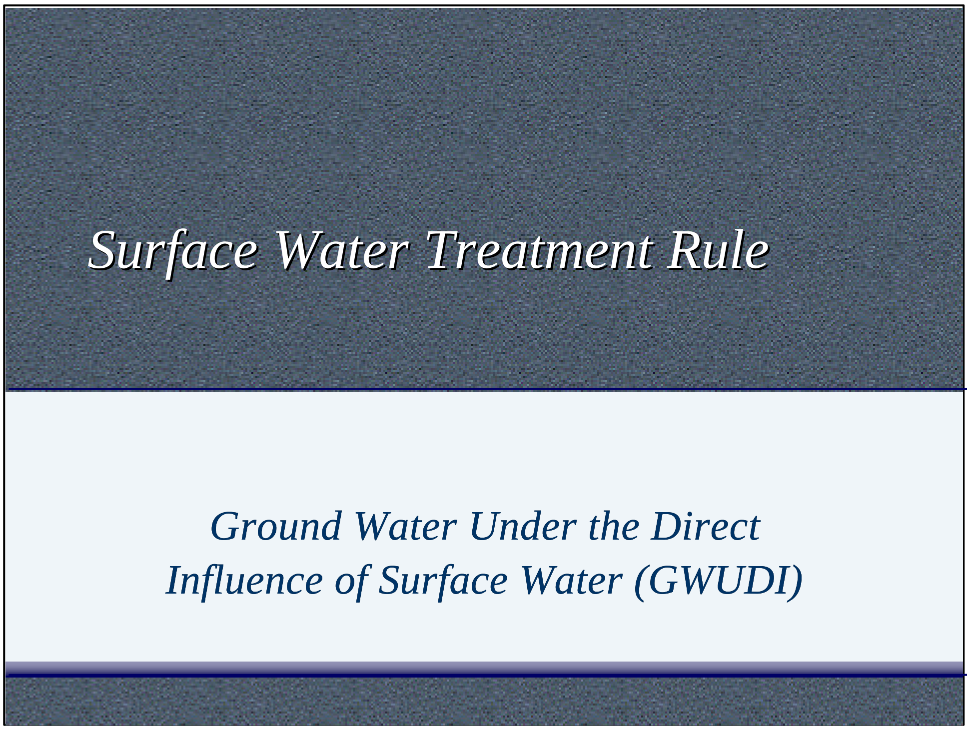
This slide should be used to summarize the CT requirements for both filtered and unfiltered surface water systems.

Remember the system only has to show they have adequate CT to meet the 3 log *Giardia lamblia* and 4 log virus removal/inactivation requirements. They, in many cases have more but don't necessarily have to show it to the primacy agency.



This slide summarized the essence of the SWTR. There are two ways to achieve compliance with the treatment technique requirements as shown in the final bullets.

Note: The IESWTR and LT1ESWTR (beginning Jan. 14, 2005) requires 2 log removal of *Cryptosporidium.*


Surface Water Treatment Rule
Ground Water Under the Direct Influence of Surface Water (GWUDI)

Purpose

- To Ensure Adequate Treatment of Sources That Are Under the Direct Influence of Surface Water
  - Subject to Contamination by Macroorganisms Including Cysts
- GWUDI[1] Means Any Ground Water With (1) Significant Occurrence of Insects or Other Macro-organisms, Algae, or Large Pathogens Such As *Giardia l.*, Or (2) Significant Shifts in Temperature, pH, Turbidity, or Conductivity That Correlate to Surface Water or Climatological Changes

[1]Not the Exact Definition Found in 141.2

The SWTR defines GWUDI and addresses its treatment. To determine whether a source is "under the direct influence" a determination must be made as to whether adequate natural filtration is available to remove macro-organisms such as *Giardia lamblia* cysts. The issue is not just that the ultimate source of water might be a surface water source. It depends upon whether there is a risk of passage of large pathogens. Other ground waters that might be vulnerable only to viruses and/or bacteria are planned to be covered by the Ground Water Rule.

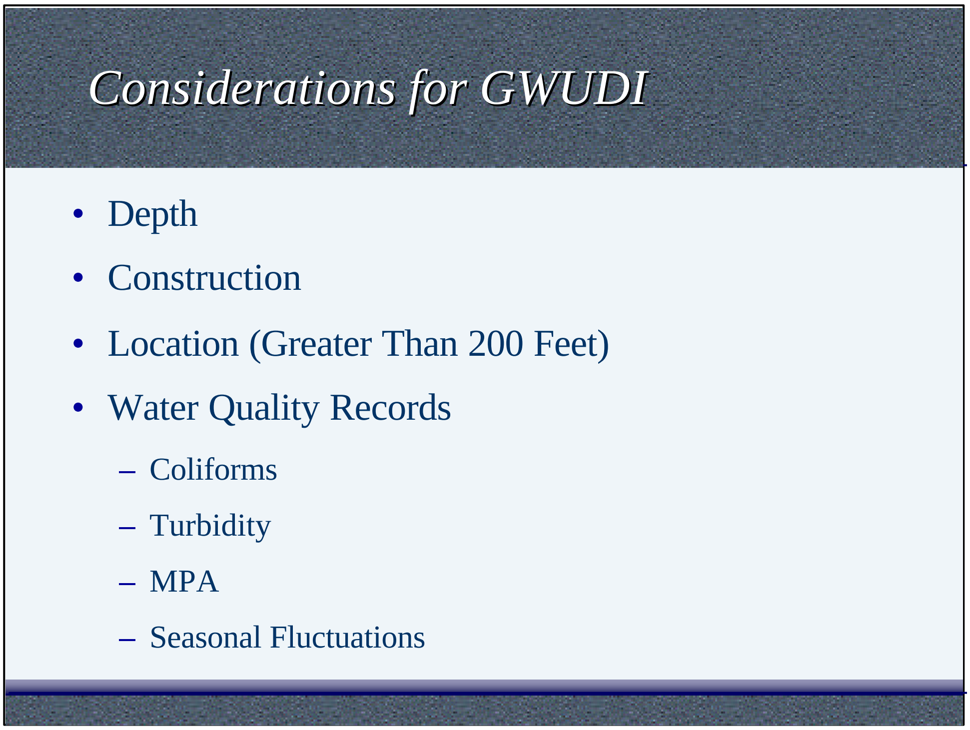
States are required by the rule to make determinations on each ground water source as to whether it is GWUDI or not. It is critical for States to get these determinations completed because of the risks that might be associated with GWUDI sources.

Potential Ground Water Sources Under the Influence

- Shallow Wells (EPA Says Less Than 50 Feet)
- Springs
- Infiltration Galleries
- Ranney Collectors
- Poorly Constructed Wells

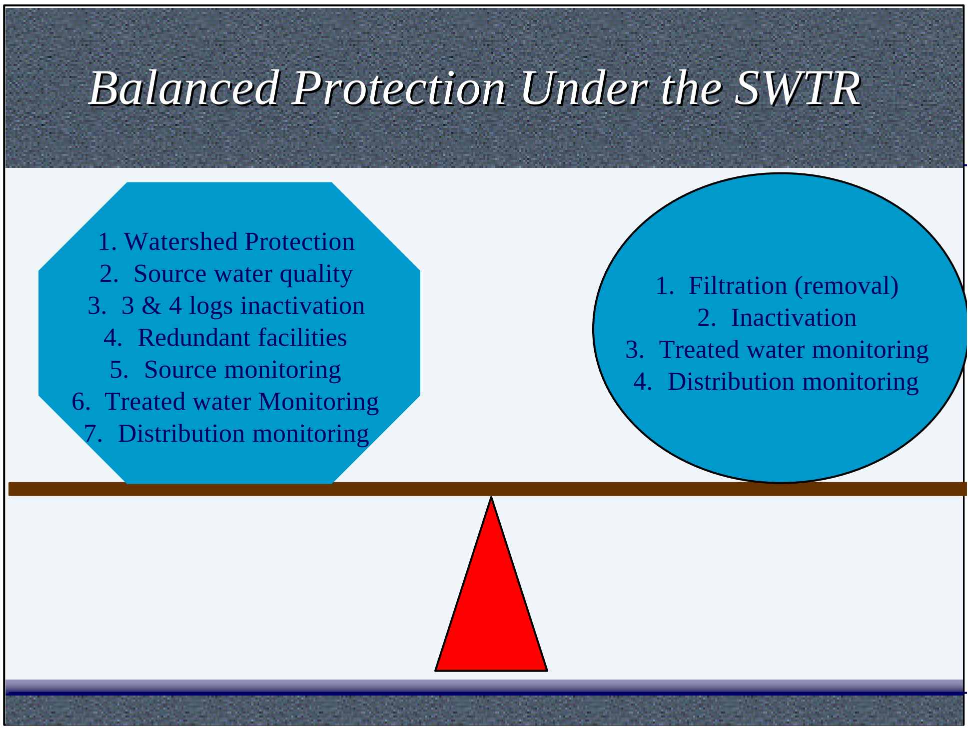
These are examples of ground water sources that might be most likely to be GWUDI.

This is a drawing of a Ranney Collector. Such systems are often installed under or near surface water sources and are generally designed to obtain surface water but after adequate treatment. The effectiveness of the natural filtration provided by the overlying soils are generally a function of the types of geological materials in the area as well as the depth and design of the lateral collectors. Some of these systems have been determined to be GWUDI, and some have been determined to be ground water.



Most States do a preliminary assessment of each of their ground water sources to determine what sources might be at risk for surface water influence. The above are some of the indicators States might use to determine if a source needs to be more closely examined to determine influence. High turbidity, occurrence of bacteria, microscopic particulate examinations showing macro-organisms, and seasonal fluctuations of temperature, pH, etc. all might be signs of surface water influence.

After a source has been determined to be under the direct influence of surface water it is treated as a surface water source and must come into compliance with the SWTR. Some of the potential alternatives for doing so are listed above.

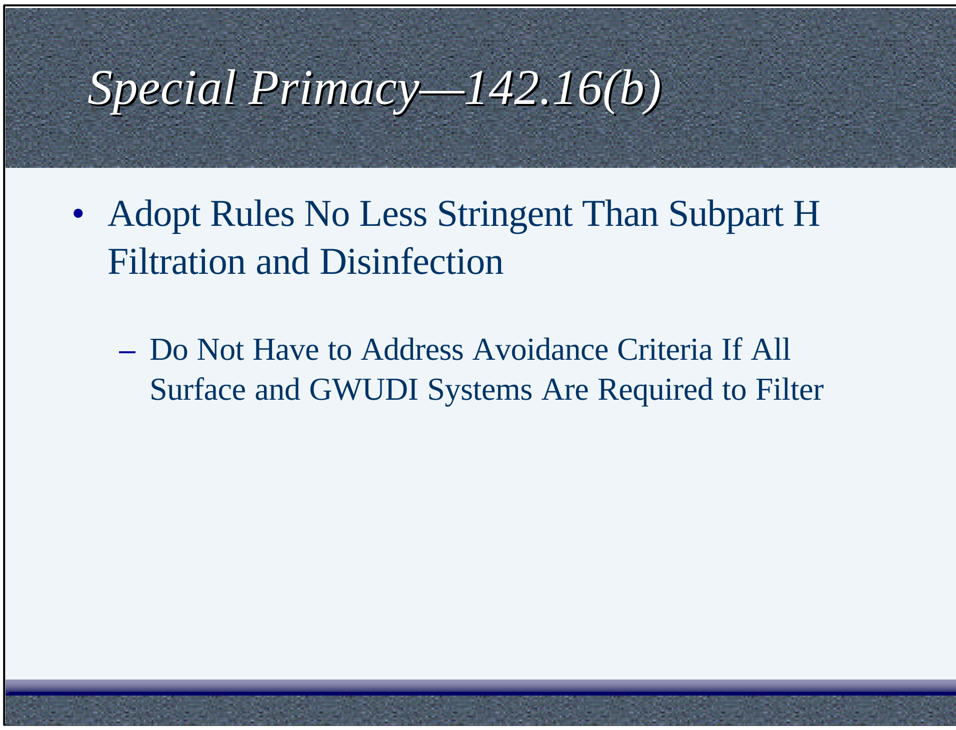


The SWTR is designed to ensure that both filtered and unfiltered surface water sources provide the public with reasonably safe and equivalent finished water. The mechanisms for doing so are, however, different.

It should be pointed out that our current understanding of *Cryptosporidium*, since it is highly resistant to disinfection, has shown us the importance of employing a multiple barrier approach.

SWTR Special Primacy Requirements

Section 142.16

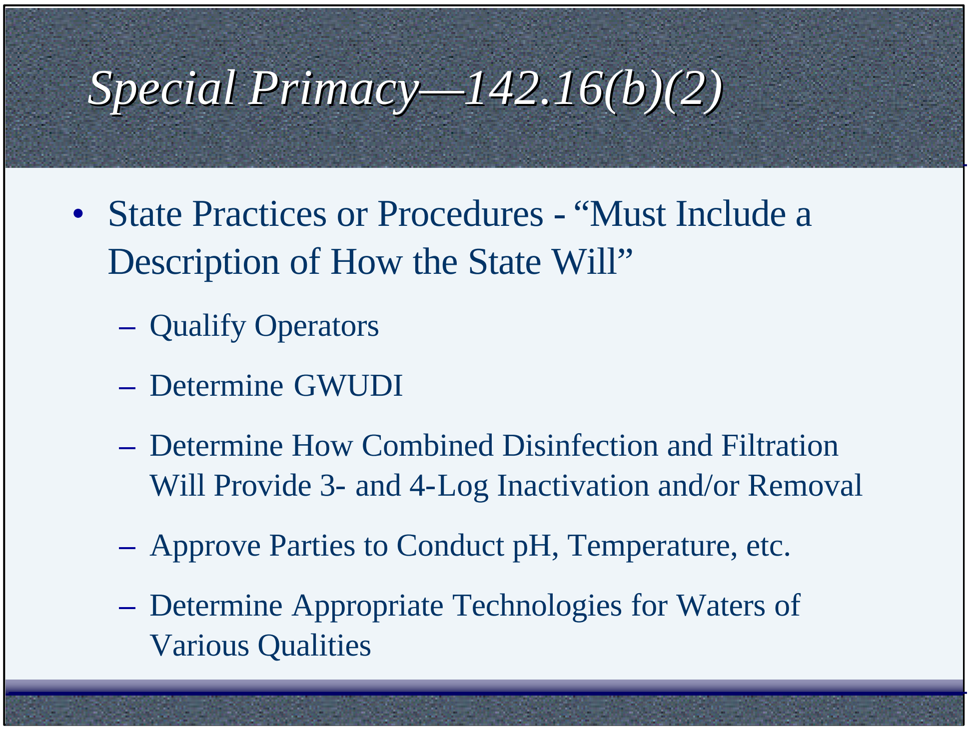


As for all EPA rules, States have to adopt rules equally or more stringent than the SWTR. Some States require filtration of all surface water sources and, thus, do not need to address unfiltered systems in their rules.

Special Primacy—142.16(b)(1)

- Enforceable Requirements
  - Must Include Enforceable Design and Operating Criteria for Each Filtration Treatment Technology Allowed or
  - A Procedure for Establishing Such on a System-by-System Basis

States have to show EPA how they will enforce the treatment technique requirements of the SWTR for each type of technology.



In the primacy applications the States had to address each of the following areas.

Special Primacy—142.16(b)(2)

- State Practices or Procedures - "Must Include a Description of How the State Will"
  - Accomplish the Following:
    - Judge Watershed Control Programs
    - Approve Inspectors and Evaluate Results of On-Site Inspections
    - For Those Adopting Discretionary Elements, Determine:
      - Interim Disinfection Requirements
      - A System Is Unable to Measure HPC but Is Providing Adequate Disinfection
      - Alternative Turbidity Limits
      - Etc. ……………………………………...