



*2006 Microbial, Disinfection  
Byproduct Rule Training:*

*The Surface Water Treatment Rule*

*Anchorage, Alaska*

*October 31 – November 2, 2006*

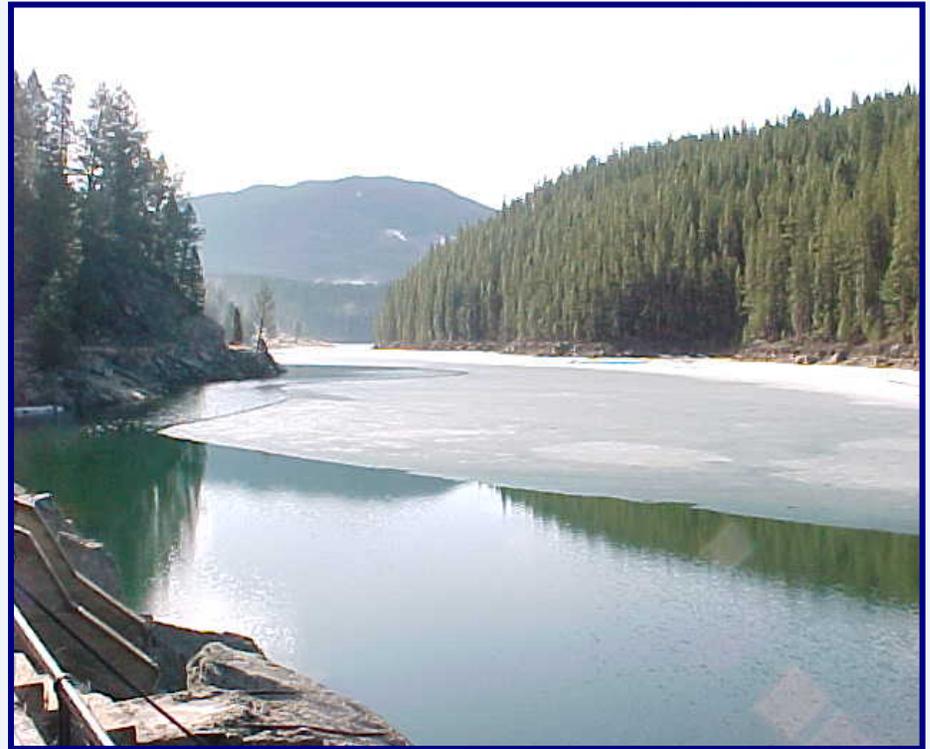
2. SWTR ALASKA 2006 TRAINING

# *Summary of Training*

- History
- The Rule
  - Structure
  - Unfiltered Requirements
  - Filtered Requirements
- Discussion
  - Multiple Barrier Approach
  - Inactivation/Removal Credits and CT
    - Unfiltered
    - Filtered

# *History*

- National Interim Primary Drinking Water Regulation (NIPDWR)
  - Turbidity MCL
    - Point of Entry
    - No Filtration Required
    - No Disinfection Required



## *History (cont.)*



- Waterborne Disease
  - Giardiasis
  - Cryptosporidiosis
- Unfiltered Surface Water Sources

## *History (cont.)*



- Filtered Water Sources
  - Usually in Compliance
  - Still Public Health Risks Exist

# *Need for Regulation*

- Vulnerability
- Coliform Monitoring Weaknesses
  - Bacteria
  - Viruses
  - Cysts
- Alternative Monitoring Weaknesses
  - Cysts
    - Poor Method
    - Discontinuous Occurrence of Organisms

## *History (cont.)*

- Advance Notice of Proposed Rulemaking (October 5, 1983)
  - Discussion Of:
    - Turbidity
    - *Giardia lamblia*
    - Viruses
    - *Legionella*
    - Heterotrophic Plate Count (HPC)

## *History (cont.) -- 1986 Amendments*

- The 1986 Amendments to the SDWA
  - .....propose and promulgate a NPDWR Specifying Criteria Under Which “Filtration” Is Required As a Treatment Technique for PWSs Supplied by Surface Water Sources
  - The Administrator Shall Consider:
    - Source Water Quality
    - Watershed Management
    - Treatment Practices Including Disinfection, Length of Storage, etc.

## *History (cont.) -- 1986 Amendments*

- 1986 Amendments to the SDWA
  - “Promulgate a NPDWR Requiring Disinfection As a Treatment Technique for PWSs and Specifying Criteria by Which Variances Can Be Granted.”
  - National Primary Drinking Water Regulations (NPDWRs) for 83 Contaminants

# *Questions and Considerations*

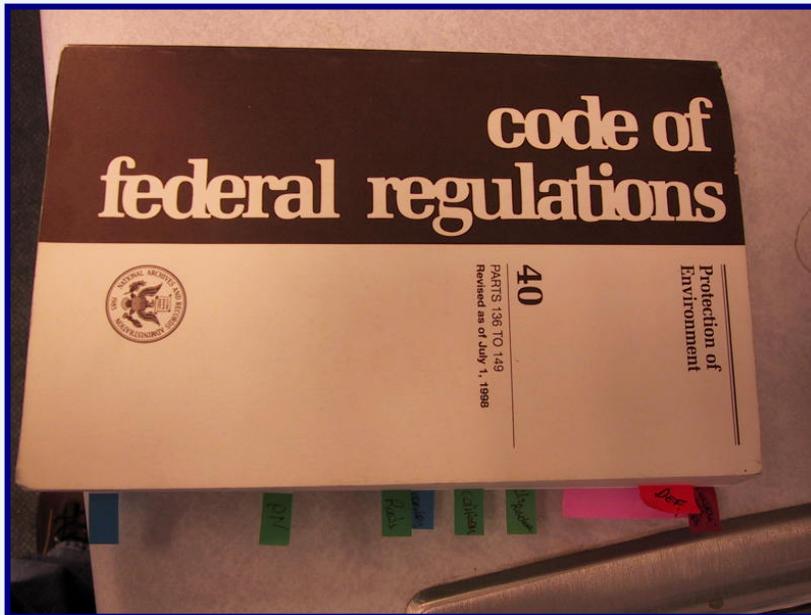
- Should All Surface Sources be Filtered?
- Should All Surface Sources be Disinfected?
- What Technologies Should be Allowed For Filtration?
- For Disinfection?
- MCLs or Treatment Techniques?
  - Or Both?
- What Monitoring Should be Required?

# *History (cont.)*

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



# 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*

# *Part 141—National Primary Drinking Water Regulations*

- 141.2 Definitions
- 141.13 Maximum Contaminant Level (MCL) for Turbidity
- 141.22 Turbidity Sampling and Analytical Requirements
- 141.32 Public Notification
- 141.52 Maximum Contaminant Level Goals (MCLGs) for Microbiological Contaminants

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

- A New Subpart H - Filtration and Disinfection
  - 141.70 General Requirements
  - 141.71 Criteria for Avoiding Filtration
  - 141.72 Disinfection
  - 141.73 Filtration
  - 141.74 Analytical and Monitoring Requirements
  - 141.75 Reporting and Recordkeeping Requirements

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

- 141.2 Definitions
  - Coagulation
  - Conventional Filtration Treatment
  - CT or CT<sub>calc</sub>
  - Diatomaceous Earth Filtration
  - Direct Filtration
  - Disinfection Contact Time
  - Disinfection
  - Filtration

# *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

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

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

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

- 141.52 MCLGs for Microbiological Contaminants

<b>Contaminant</b>	<b>MCLG</b>
<i>Giardia lamblia</i>	Zero
Viruses	Zero
<i>Legionella</i>	Zero

# *Subpart H—Filtration and Disinfection*

- 141.70 General Requirements
  - Establish Criteria Under Which Filtration Is Required
  - Establish Treatment Techniques in Lieu of MCLs for:
    - *Giardia Lamblia*
    - *Legionella*
    - Viruses
    - HPC
    - Turbidity

# *Subpart H—Filtration and Disinfection*

- 141.70 General Requirements
  - Subpart H Establishes Criteria Under Which Filtration is Required For Surface and GWUDI Sources
  - Establishes **Treatment Techniques** That Must Achieve:
    - At Least 99.9 Percent Removal And/or Inactivation of *Giardia Lamblia* Cysts
    - At Least 99.99 Percent Removal And/Or Inactivation of Viruses
      - Between a Point Where the Water Is Not Subject to Contamination by Surface Water Runoff and a Point Before the First Customer

# *Treatment Technique Approach*

- Compliance Based on
  - Proper Use of **Treatment Technique** and
    - 99.9 Percent *Giardia Lamblia* Removal/Inactivation
    - 99.99 Percent Virus Removal/Inactivation

# *Subpart H—Filtration and Disinfection*

- 141.70 General Requirements
  - A System Is in Compliance With the Treatment Technique Requirements If It:
    - Meets the Avoidance Criteria and Unfiltered Disinfection Requirements
    - Meets the Filtration and Disinfection Requirements for Filtered Systems
  - Each System Must Be Operated by Qualified Personnel

# *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**
    - **Microbial Contamination**
    - **Turbidity**
  - 2. Site-Specific Conditions**
    - **Disinfection Requirements**
    - **Watershed Control**
    - **Annual On-Site Inspection**
    - **TCR and TTHM Compliance**
    - **Not a Source of Waterborne Disease**

# §141.71—Criteria For Avoiding Filtration

## 1. Source Water Quality Conditions

- Fecal Coliforms  $\leq$  20/100 ml
- Total Coliforms  $\leq$  100/100 ml
  - In at Least 90 Percent of the Measurements Made for the Previous 6 Months
  - If Both Are Measured, the Fecal Criterion Must Be Met
- Turbidity Cannot Exceed 5 NTU in Any Readings on 2 Consecutive Days
  - For More Than 2 Events in 12 Months or
  - 5 Events in Past 10 Years
    - Unusual and Unpredictable Circumstances





# *§141.71—Criteria For Avoiding Filtration (cont.)*

## 2. Site-Specific Conditions

- Compliance With Disinfection Requirements
- Watershed Control Program
- Annual On-Site Inspection
- Can Not be Identified as a Source of Waterborne Disease Outbreak
- Compliance with TCR MCL
- Compliance with TTHM Requirements

## 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

## 2. *Site Specific Conditions*

- Disinfection
  - Disinfectant Residual Cannot Be  $< 0.2$  mg/l for More Than 4 Hours
    - Unless Caused by “Unusual and Unpredictable Circumstances”
  - Disinfectant Residual in the Distribution System Cannot Be Undetectable in More Than 5 Percent of Monthly Samples for Any Two Consecutive Months
    - HPC  $\leq 500$  cfu/ml Is Deemed “Detectable”

## 2. *Site Specific Conditions*

- **Watershed Control**
  - Must Be Maintained to Minimize Contamination by *Giardia lamblia* & Viruses
    - Characterize the Watershed
    - Identify Watershed Characteristics and Activities That May Have an Adverse Effect
    - Monitor Occurrence of Activities That May Have an Adverse Effect
      - Must Demonstrate Activities Can Be Controlled
      - Ownership or Written Agreements
    - Annual Report to the State Identifying Special Concerns and How They Were Handled
    - For GWUDI an Approved WHP Program May be Acceptable

## 2. *Site Specific Conditions*

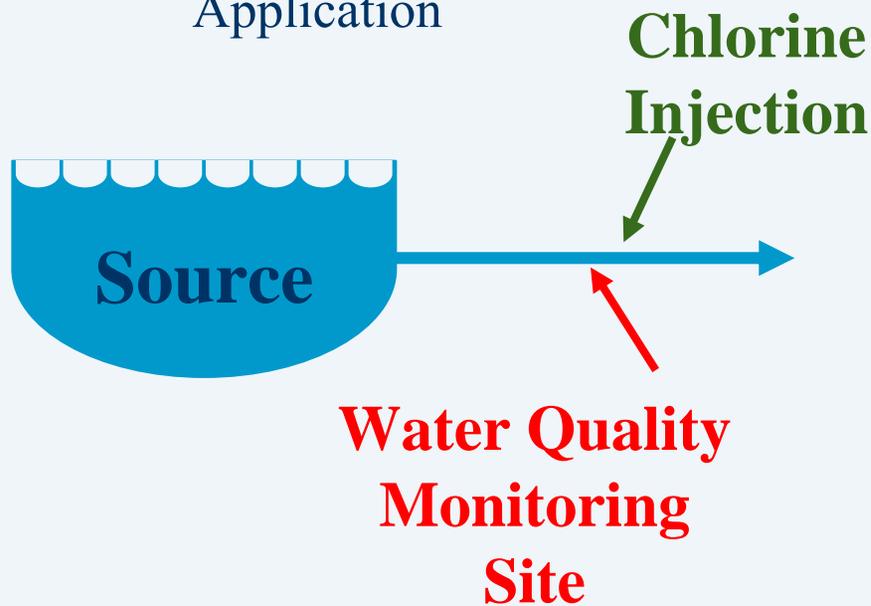
- Annual On-Site Inspection
  - Subject to an Annual On-Site Inspection
    - Conducted by Competent Individuals
    - A Report Must Be Provided to the State and Show
      - The Watershed Protection Program and Disinfection Treatment Process Are Adequately Designed and Maintained

## 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

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

- Fecal or Total Coliform Source Water Monitoring
  - Immediately Prior to the First Point of Disinfectant Application



## *§141.74—Unfiltered Source Water Monitoring Requirements (cont.)*

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

<sup>1</sup> Must be taken on separate days.

<sup>2</sup> Also one must be done on days when turbidity is > 1 NTU

# §141.74—Unfiltered Source Water Monitoring Requirements (cont.)



- Turbidity
  - Same Location
  - Every Four Hours (Minimum)
  - Continuous Monitoring May Be Substituted

## *§141.74—Residual Monitoring -- Entry Point*

- Residual Entering the Distribution System Must Be Monitored Continuously
  - Record Lowest Value Each Day
  - Take Grab Samples Every 4 Hours If Equipment Fails
    - No More Than 5 Working Days
  - Grab Samples Are Acceptable for Systems Serving 3,300 or Fewer

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

- If the Residual Falls Below 0.2 mg/l Grab Samples Must Be Collected Every 4 Hours Until the Concentration Is Back to 0.2 mg/l

## *§141.74—Determining Compliance With Inactivation Requirements*

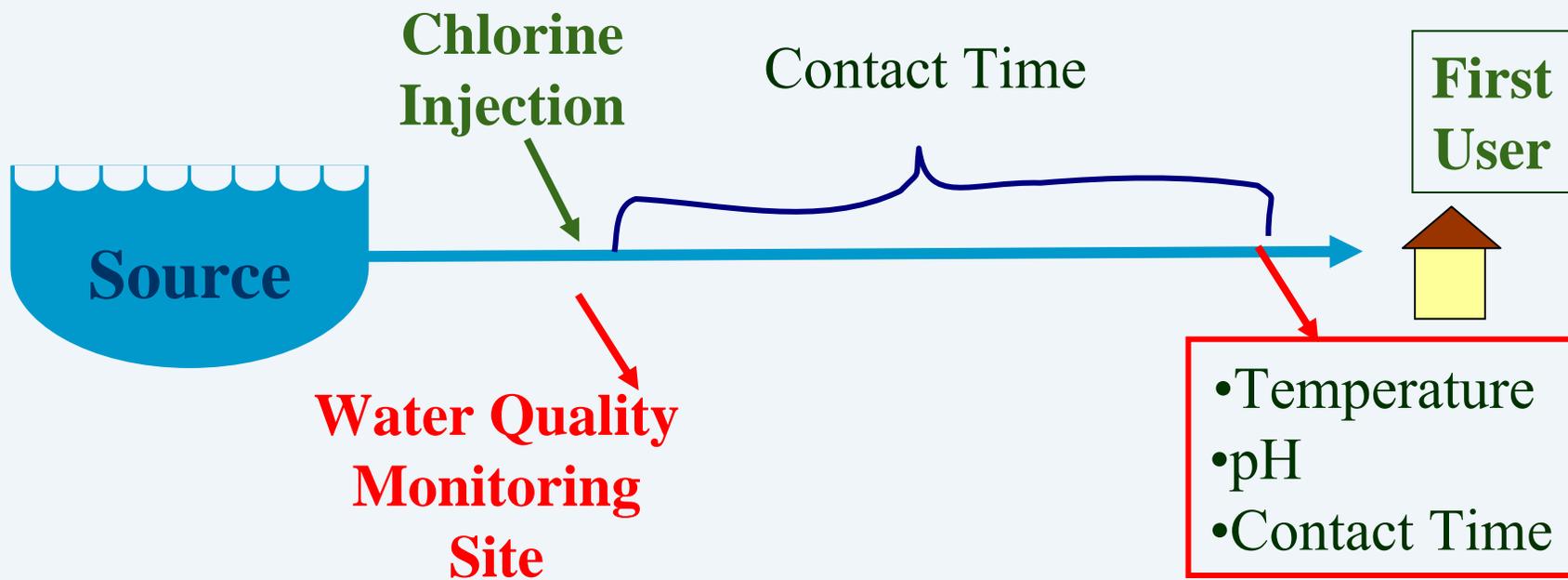
- Total Inactivation Ratio Must Be Determined Each Day of Operation
- Based on  $CT_{99.9}$  Values From
  - Tables 1.1 - 1.6                      Chlorine
  - Table 2.1                                Chlorine Dioxide & Ozone
  - Table 3.1                                Chloramines

Most Use Tables From SWTR Guidance Manual

## *§141.74—Monitoring Requirements to Determine Inactivation Requirements*

<b>PARAMETER</b>	<b>LOCATION</b>	<b>FREQUENCY</b>
Temperature	Residual Sampling Point	Once/Day
pH (if Using Cl <sub>2</sub> )	Residual Sampling Point	Once/Day
Contact Time	Residual Sampling Point	Once/Day (During Peak Hourly Flow)
Residual Concentration	Before 1 <sup>st</sup> User	During Peak Hourly Flow

# § 141.74—Monitoring Requirements to Determine Inactivation Requirements



## §141.74—*Distribution Residuals*

- Must Monitor Residual at the Same Time and Place As Coliforms<sup>1</sup>
- 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

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<sup>1</sup>Other sites may be approved by the State

# *Surface Water Treatment Rule*

## *Filtered Systems*

43

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

## *§141.74—Monitoring of Filtered Systems*

- CFE Turbidity Every 4 Hours
  - Continuous May be Substituted
  - May be Reduced by State to 1/Day for Systems  $\leq 500$
- Continuous Disinfectant Residual Monitoring
  - Grab Sampling for Systems  $\leq 3,300$

## §142.16—*Special Primacy Requirements*

- States Have To Show How They Will Ensure That Filtered Systems Will Achieve The Required Removal/Inactivation Requirements of the Rule (i.e., 99.9 % *Giardia lamblia* and 99.99% Viruses)
  - Temperature
  - pH (for chlorine)
  - Contact Time
  - Residual

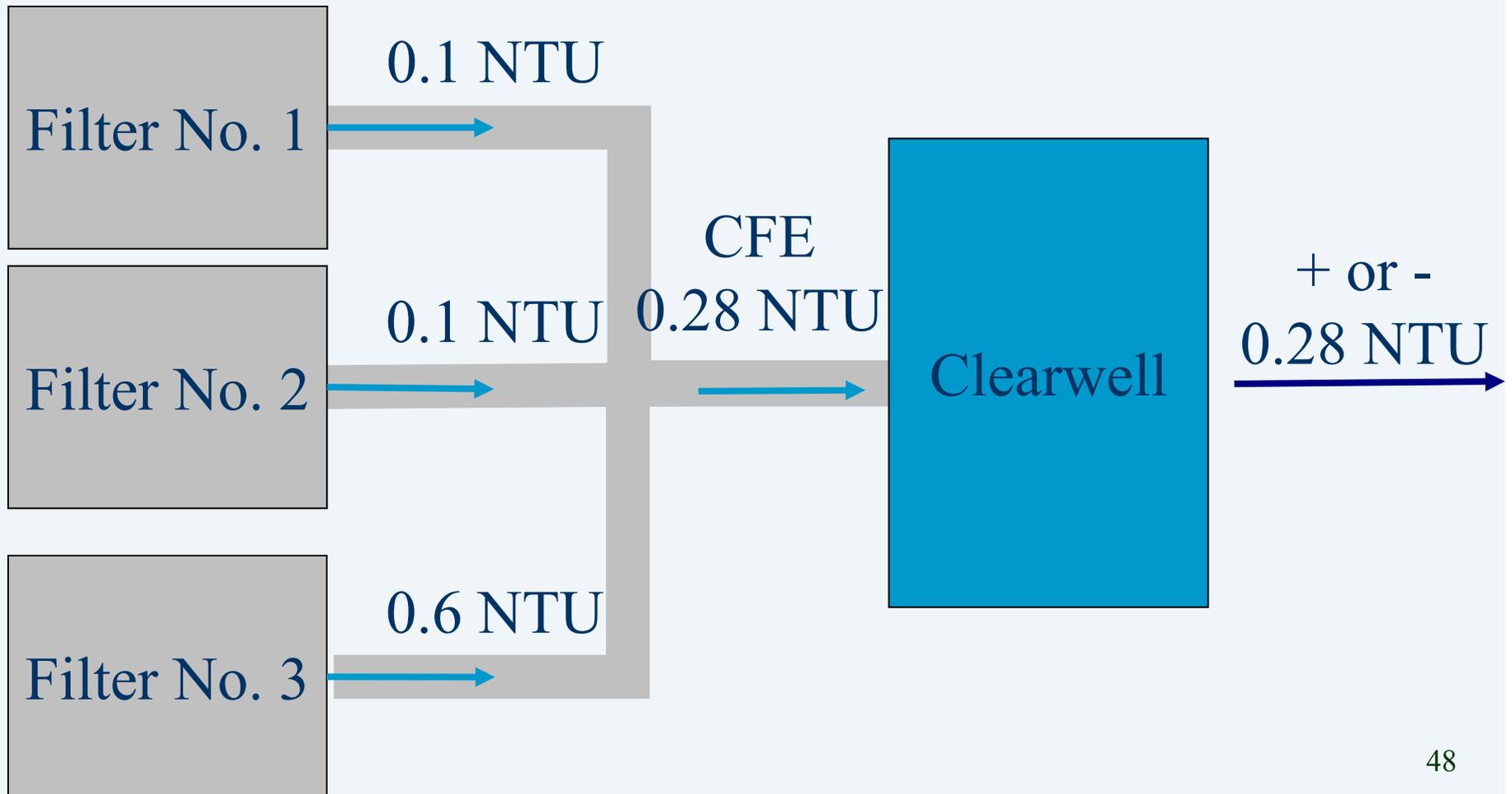
**NOTE: Not Spelled  
Out in the Rule**

## §141.73—*Filtration: Conventional or Direct*

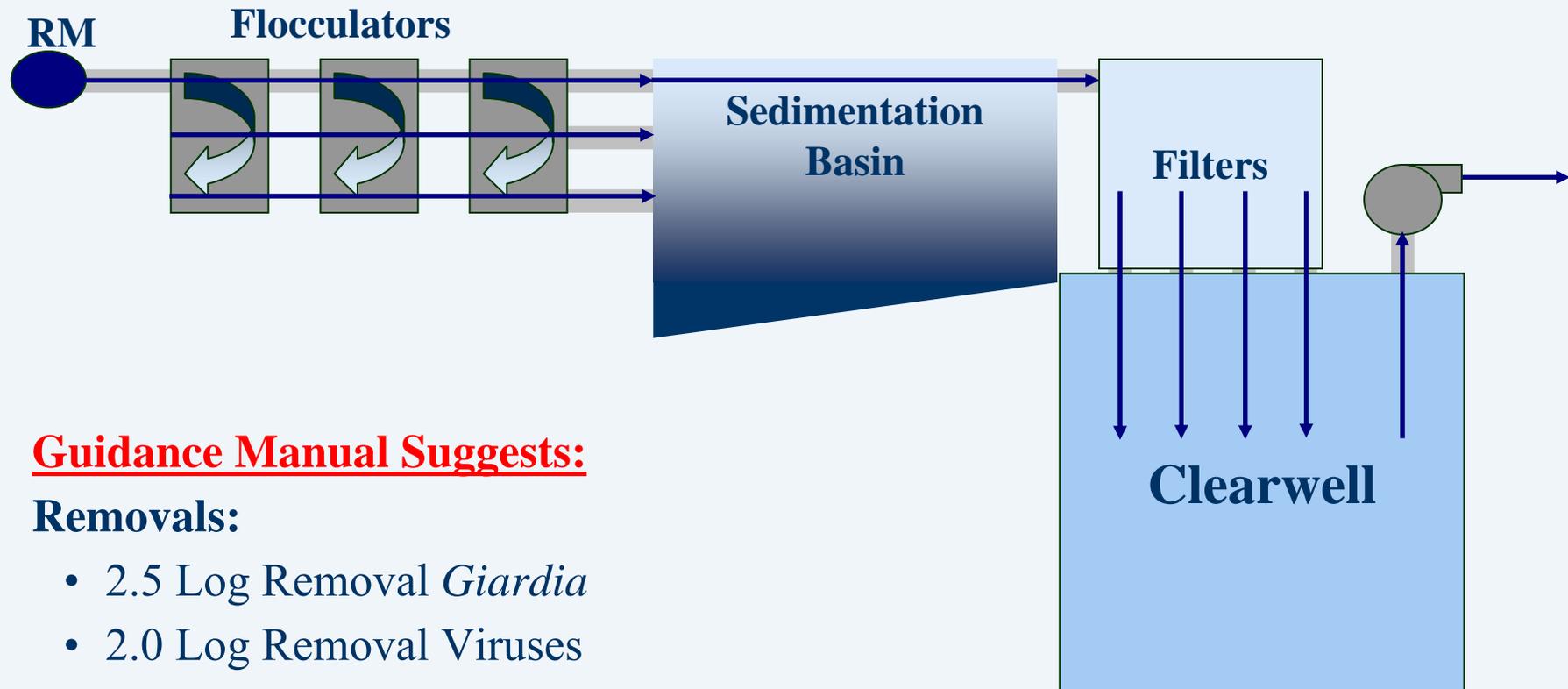
- At Least 95 Percent of the CFE<sup>1</sup> Turbidity Samples Must Be  $\leq 0.5$  NTU Each Month Except That
  - The State Can Determine That Some Level Higher Than 0.5 NTU is Appropriate
- May At No Time Exceed 5 NTU

<sup>1</sup>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;  
Some Apply the Limit to the Water Leaving the Clearwell.

# §141.73—Filtration: CFE Turbidity



# §141.73—Filtration: Conventional



## Guidance Manual Suggests:

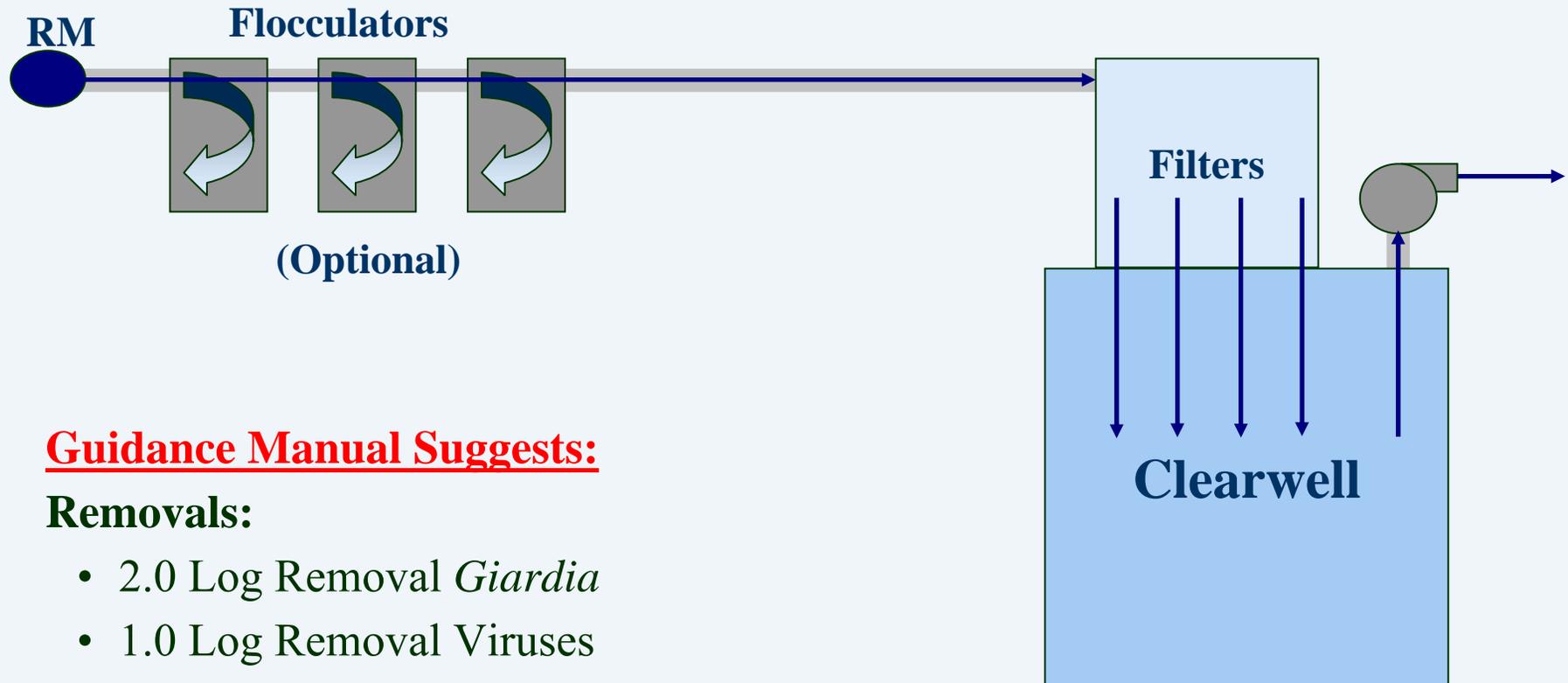
### Removals:

- 2.5 Log Removal *Giardia*
- 2.0 Log Removal Viruses

### Inactivation:

- 0.5 Log Inactivation *Giardia*
- 2.0 Log Inactivation Viruses

# §141.73—Filtration: Direct



## Guidance Manual Suggests:

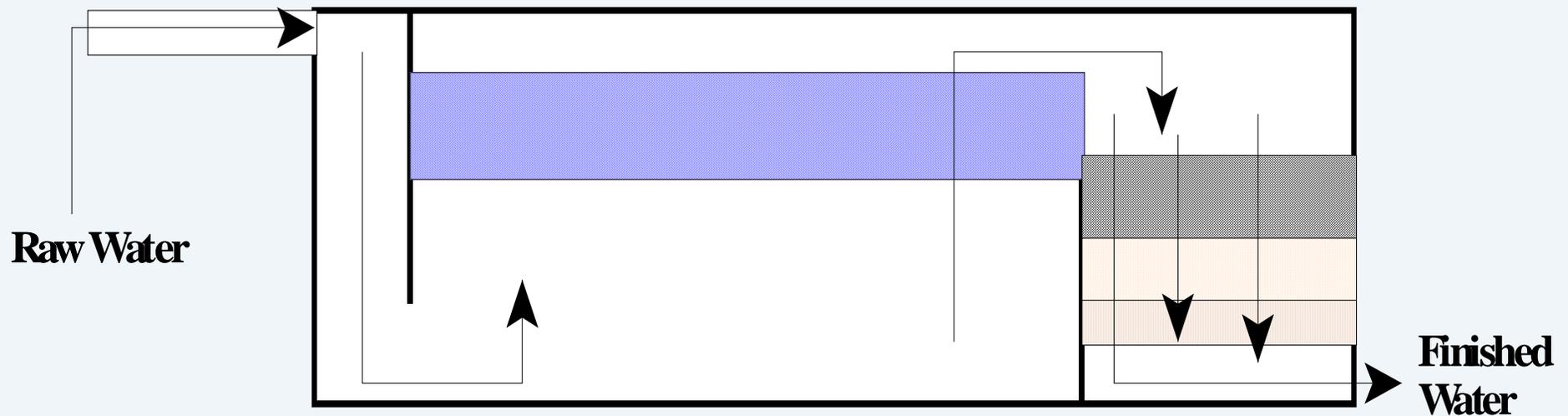
### Removals:

- 2.0 Log Removal *Giardia*
- 1.0 Log Removal Viruses

### Inactivation:

- 1.0 Log Inactivation *Giardia*
- 3.0 Log Inactivation Viruses

# Contact Adsorption Clarifier (CAC)



**Contact Adsorption  
Clarification**

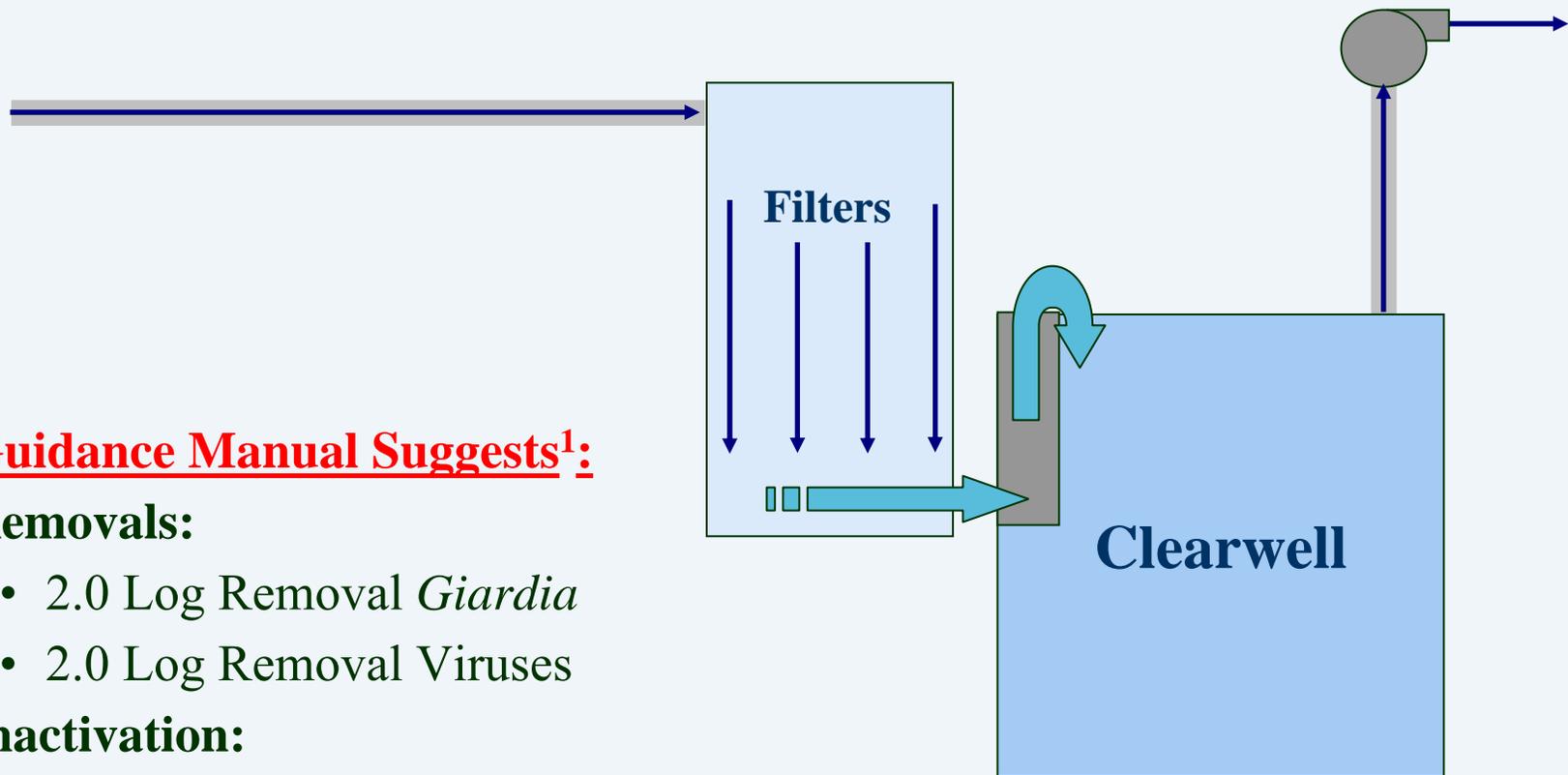
**Filtration**

**Clearwell**

## §141.73—*Filtration: Slow Sand*

- At Least 95 Percent of the CFE Turbidity Samples Must Be  $\leq 1$  NTU Each Month Except That
  - The State Can Determine There Is No Interference With Disinfection at Some Higher Level Than 1 NTU
- Turbidity Can at no Time Exceed 5 NTU

# §141.73—Filtration: Slow Sand



## Guidance Manual Suggests<sup>1</sup>:

### Removals:

- 2.0 Log Removal *Giardia*
- 2.0 Log Removal Viruses

### Inactivation:

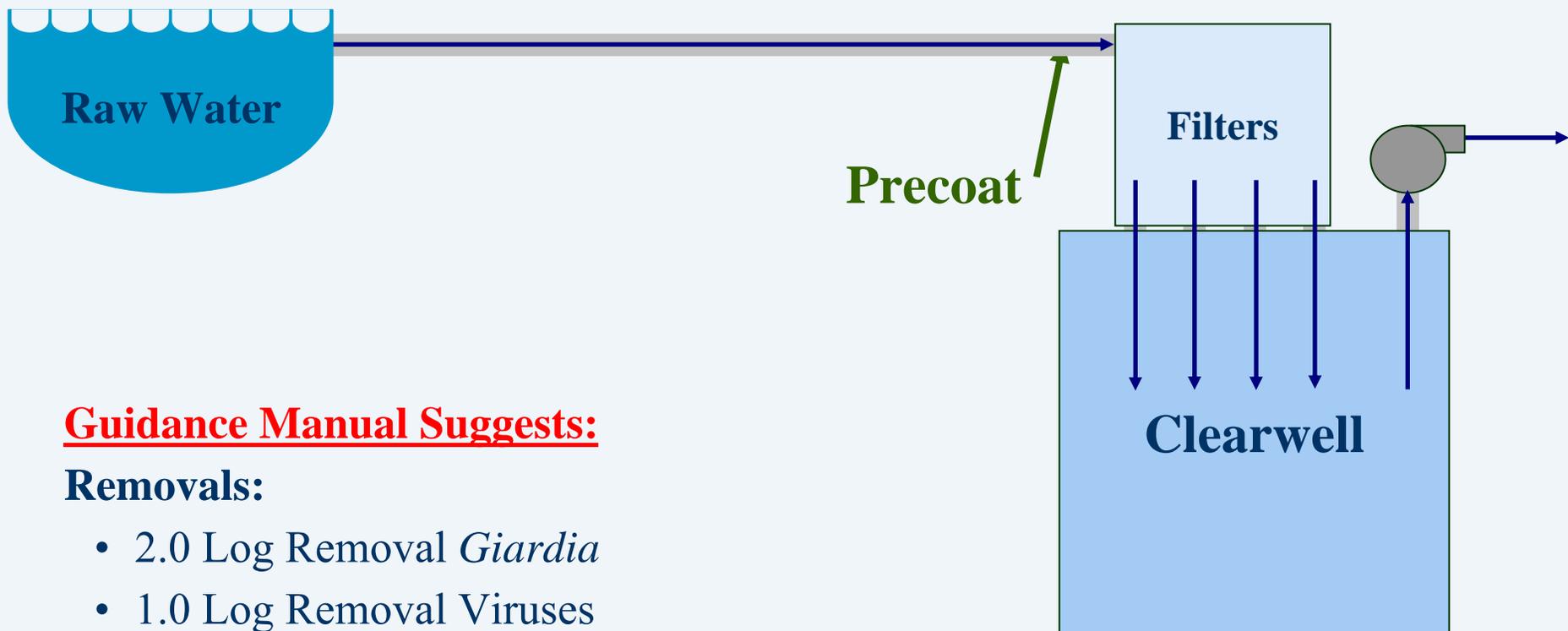
- 2.0 Log Inactivation *Giardia*
- 2.0 Log Inactivation Viruses



## *§141.73—Filtration: Diatomaceous Earth*

- At Least 95 Percent of the CFE Turbidity Samples Must Be  $\leq 1$  NTU Each Month
- The Turbidity Must at No Time Exceed 5 NTU

# §141.73—Filtration: DE



## Guidance Manual Suggests:

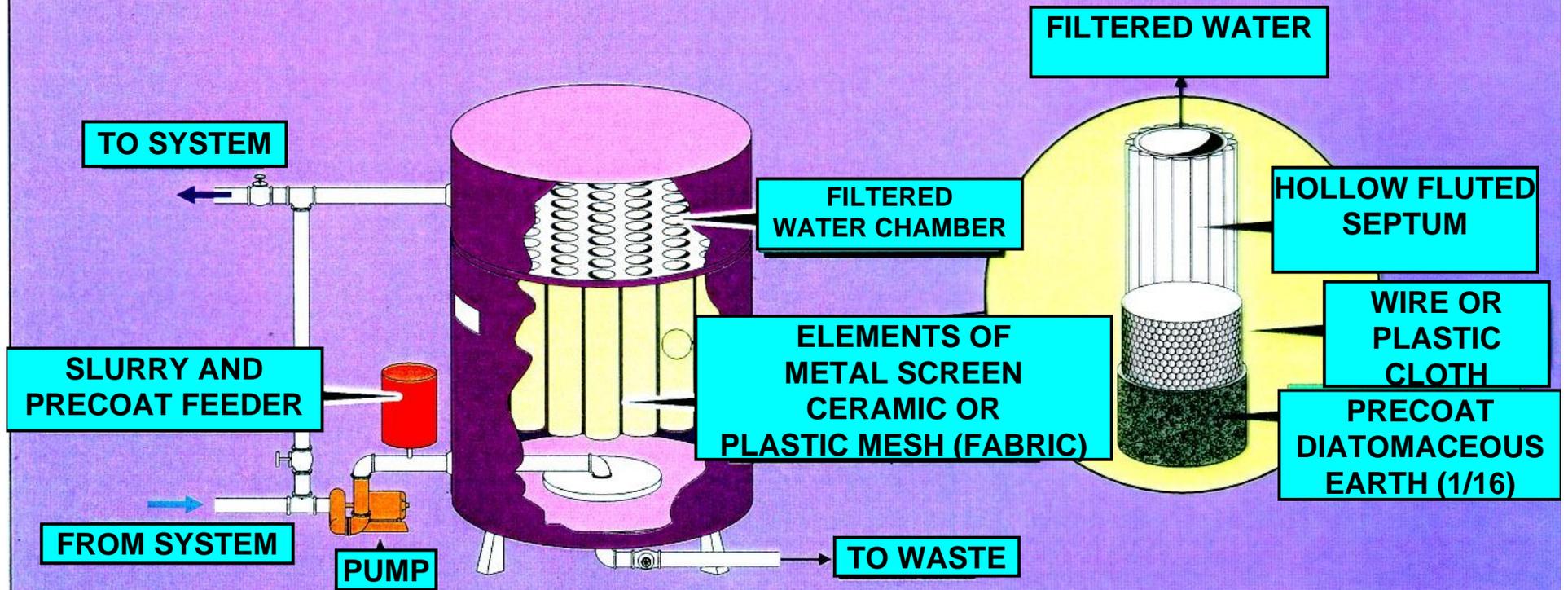
### Removals:

- 2.0 Log Removal *Giardia*
- 1.0 Log Removal Viruses

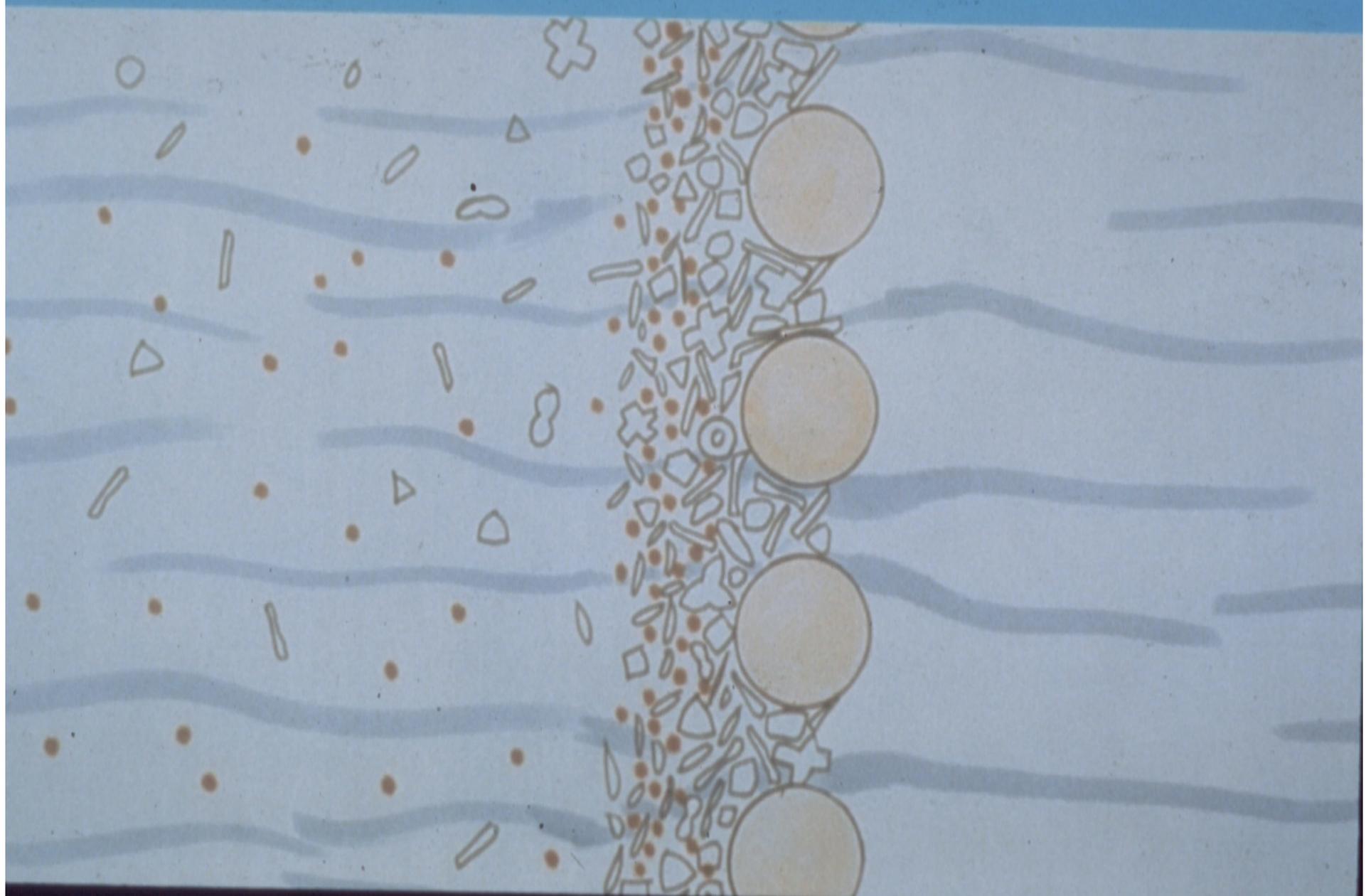
### Inactivation:

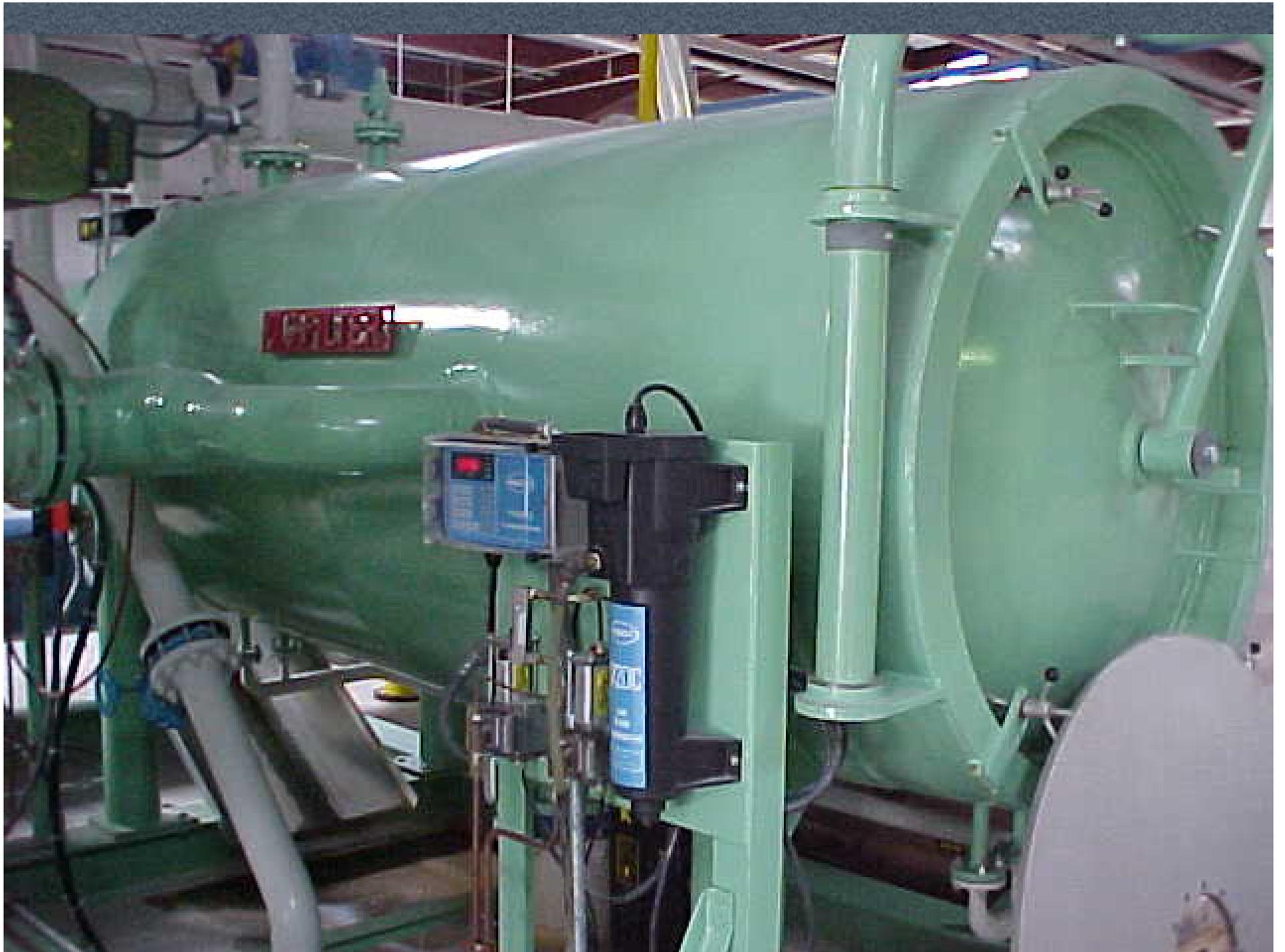
- 1.0 Log Inactivation *Giardia*
- 3.0 Log Inactivation Viruses

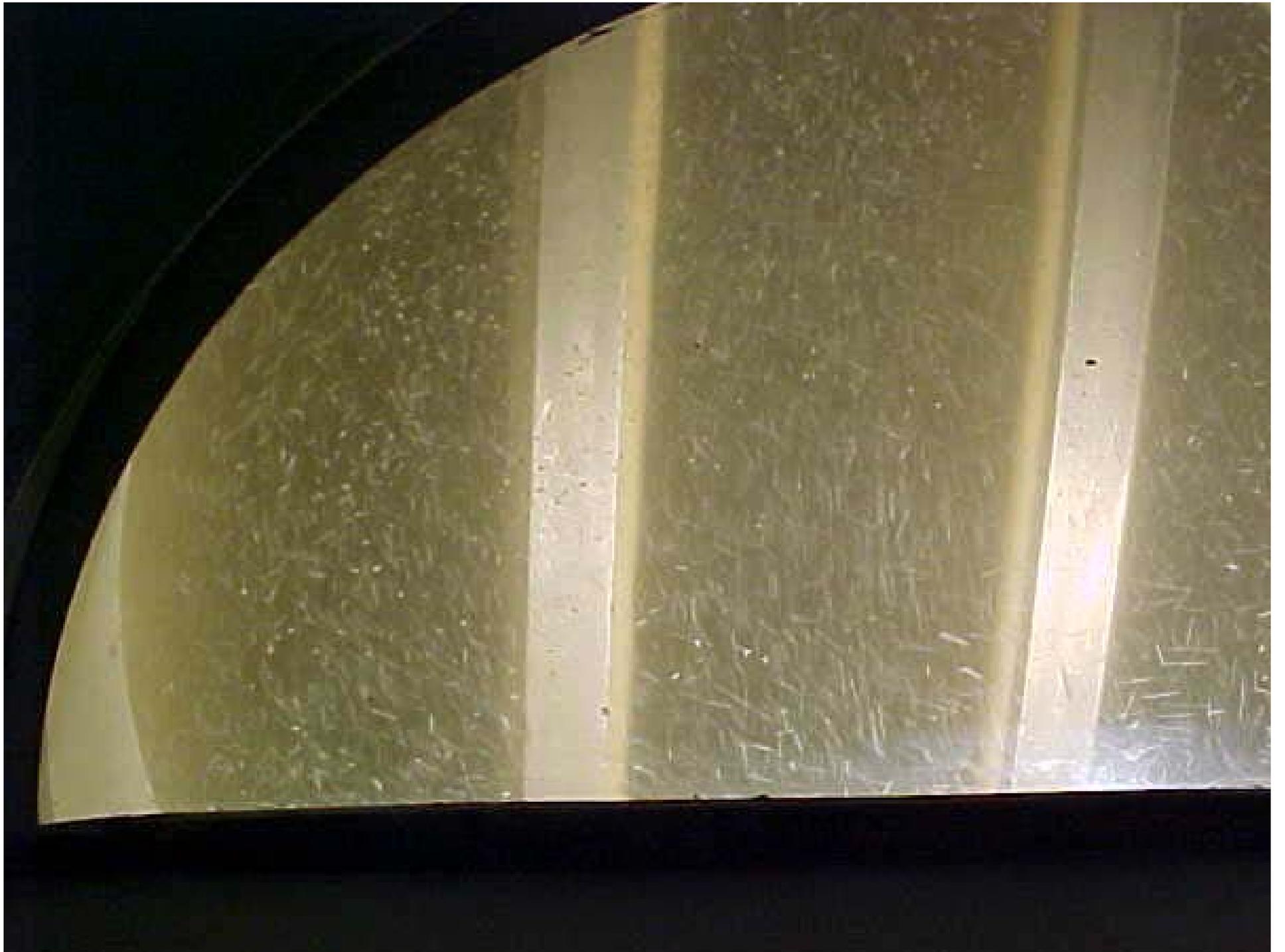
# Diatomaceous Earth Filtration



# Diatomaceous Earth Filter



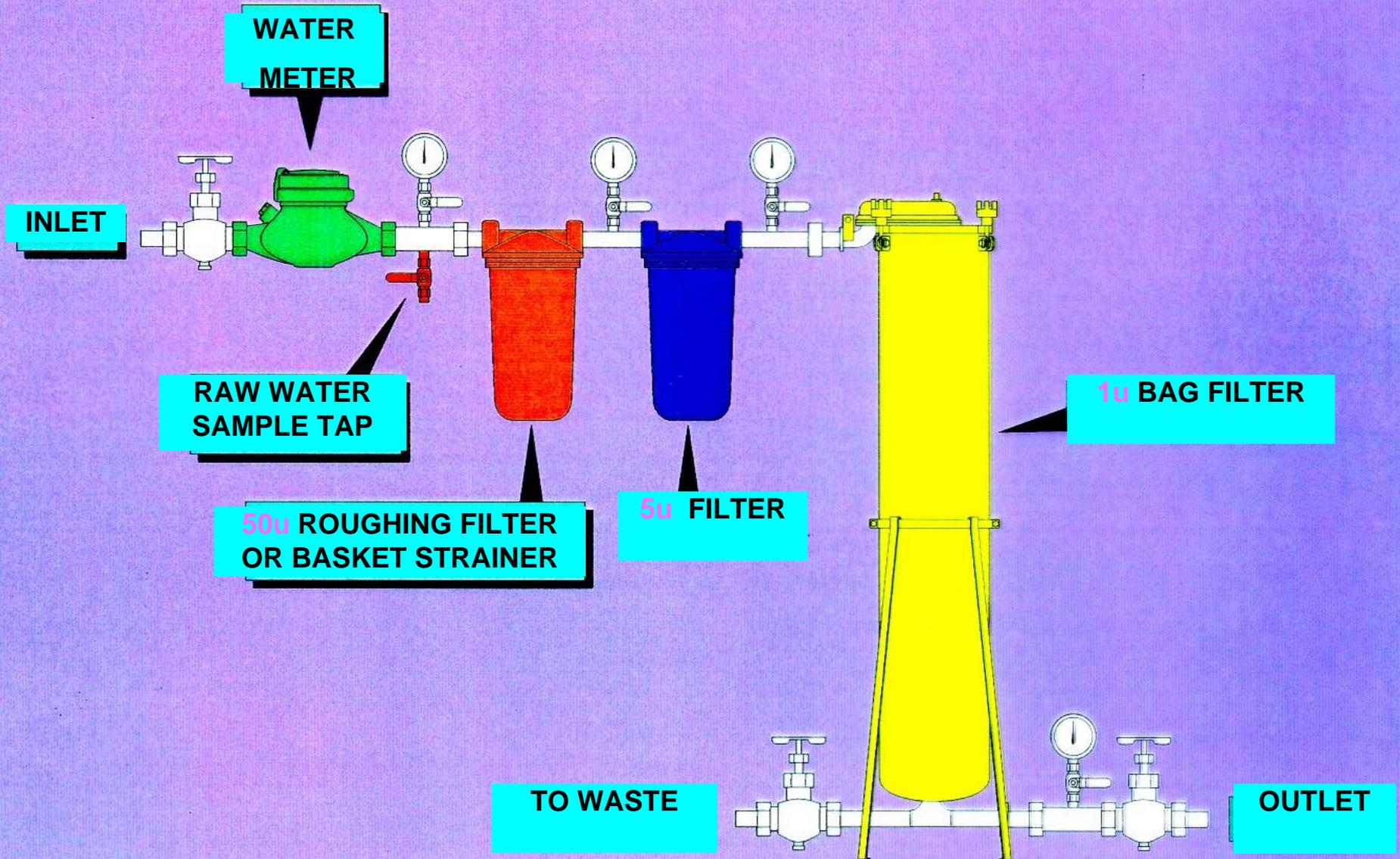




## §141.73—*Filtration: Other Technologies*

- Must Demonstrate to the State Using Pilot Plants or Other Means the Alternative Technology Provides
  - 3-Log *Giardia Lamblia* and
  - 4-Log VirusRemoval and/or Inactivation
- Slow Sand Turbidity Limits Apply

# Bag and Cartridge Filtration





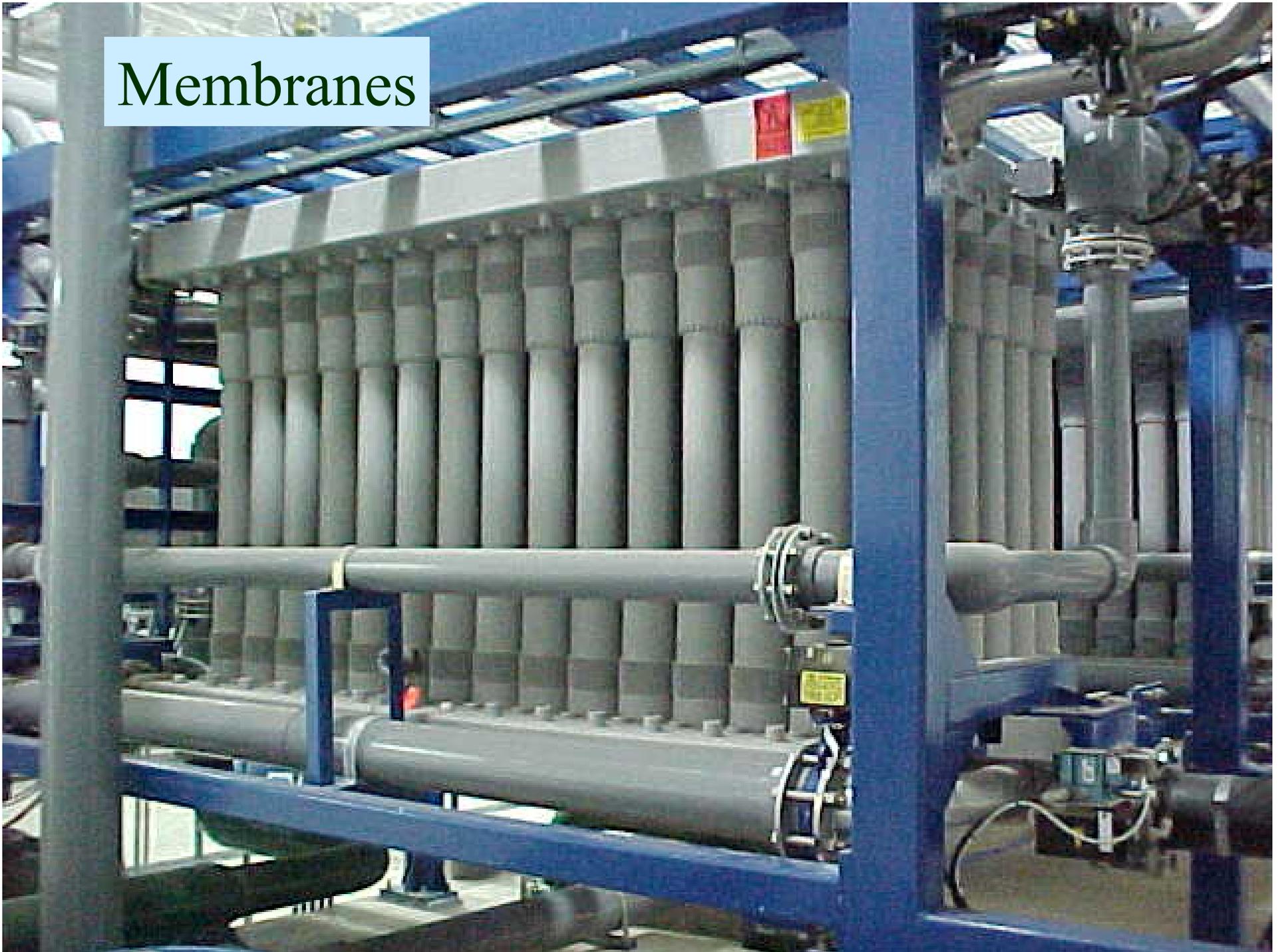
# *Pressure Dual Media Filter*



# *Cartridge & Bag Filters*



# Membranes



# *Log Removal and/or Inactivation<sup>1</sup>*

	Log	Removal	Recom.	Inact.
	<i>Giardia</i>	Viruses	<i>Giardia</i>	Viruses
Filters				
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**

# *Giardia/Virus Inactivation: CT*

- CT Is a Regulatory Threshold That Must Be Met.
- Calculated Using:
  - pH
  - Peak Hourly Flows
  - Disinfectant Residual
  - Contact Time
    - Baffling Factors
    - Tracer Studies

# *Treatment Technique Requirements*

- 3-Logs Removal/Inactivation of *Giardia*
- 4-Logs Removal/Inactivation of Viruses
- Compliance Achieved By:
  - Properly Designed and Operated Filtration
  - Meeting Filtration Avoidance Criteria

## *§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

# *Surface Water Treatment Rule*

*Ground Water Under the Direct  
Influence of Surface Water (GWUDI)*

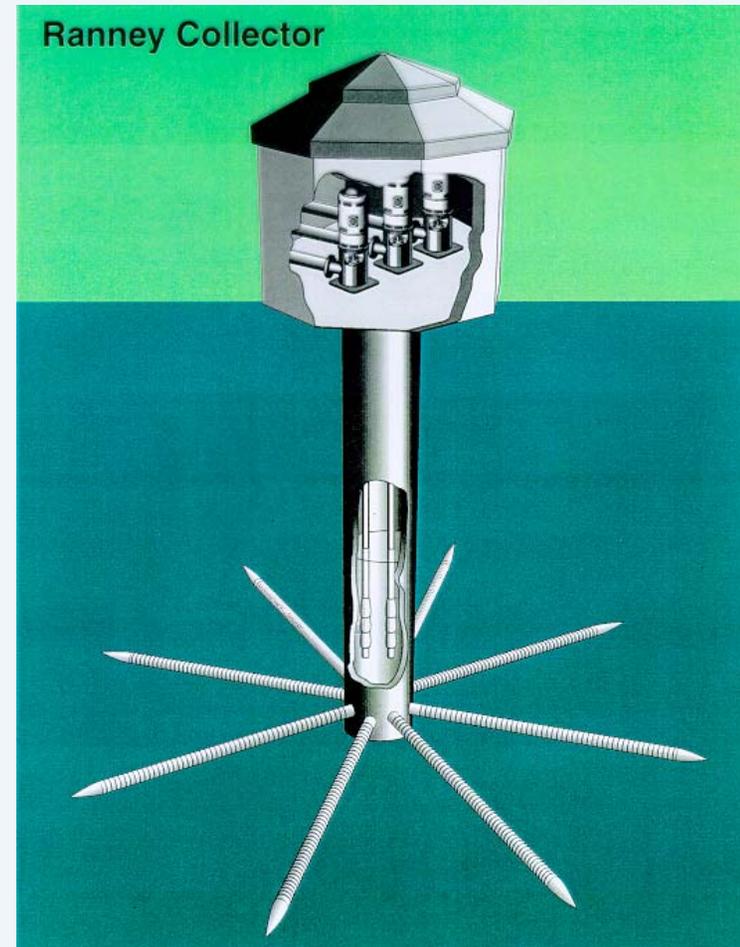
# Purpose

- To Ensure Adequate Treatment of Sources That Are Under the Direct Influence of Surface Water
  - Subject to Contamination by Macroorganisms Including Cysts
- GWUDI<sup>1</sup> 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

<sup>1</sup>Not the Exact Definition Found in 141.2

# *Potential Ground Water Sources Under the Influence*

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

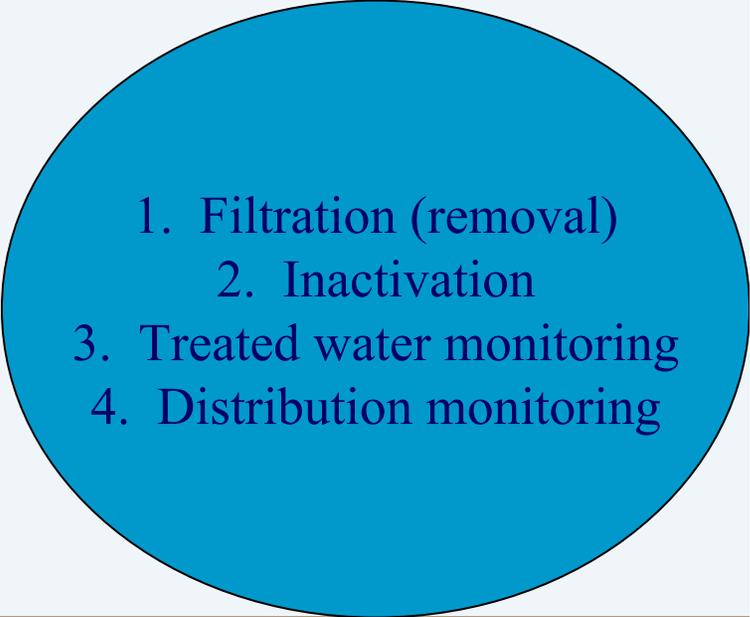


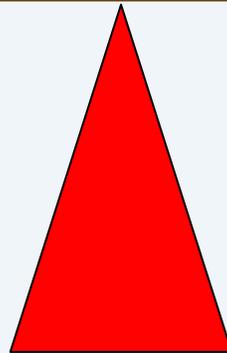
# *Considerations for GWUDI*

- Depth
- Construction
- Location (Greater Than 200 Feet)
- Water Quality Records
  - Coliforms
  - Turbidity
  - MPA
  - Seasonal Fluctuations

# *Balanced Protection Under the SWTR*

- 
1. Watershed Protection
  2. Source water quality
  3. 3 & 4 logs inactivation
  4. Redundant facilities
  5. Source monitoring
  6. Treated water Monitoring
  7. Distribution monitoring

- 
1. Filtration (removal)
  2. Inactivation
  3. Treated water monitoring
  4. Distribution monitoring



# *But is the Protection Adequate?*

- Unfiltered
  - *Cryptosporidium*
  - Variable Water Quality
  - Unknown pathogens
- Filtered
  - *Cryptosporidium*
  - Variable Water Quality
  - Unknown pathogens
  - Compliance With TT Requirement Measured in CFE