Surface Water Treatment Rules

ADH Compliance Short School

Surface Water Treatment Rules Overview

- **Applies to all Public Water Systems (PWS) that use:**

- **Surface Sources**
  - **Lakes**
  - **Rivers/Streams**
  - **Reservoirs**
  - **Springs**

- **Ground Water Under the Direct Influence of surface water (GWUDI)**

- **Referred to as Subpart H systems**

Surface Water Treatment Rules Overview

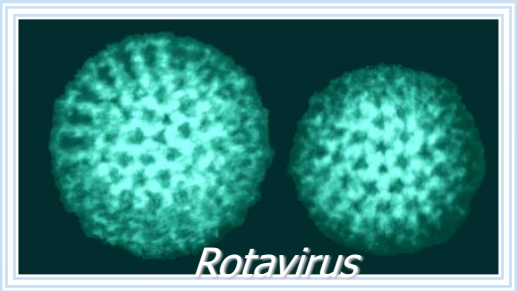
- There are 5 rules that have been issued to address surface water source systems including GWUDI systems.

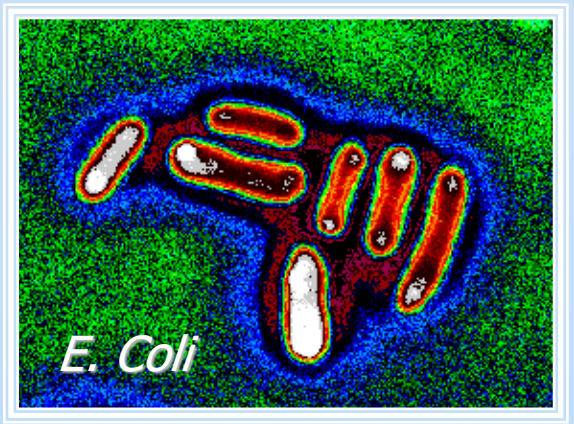
- Surface Water Treatment Rule (SWTR), 1993
- Interim Enhanced Surface Water Treatment Rule, 2002
- Filter Backwash Recycling Rule (FBRR), 2004
- Long Term 1 Enhanced Surface Water Treatment Rule, 2005
- Long Term 2 Enhanced Surface Water Treatment Rule, 2006

Goal of SWTRs

To improve public health protection from pathogens:

- Protozoans
- Bacteria
- *Viruses*



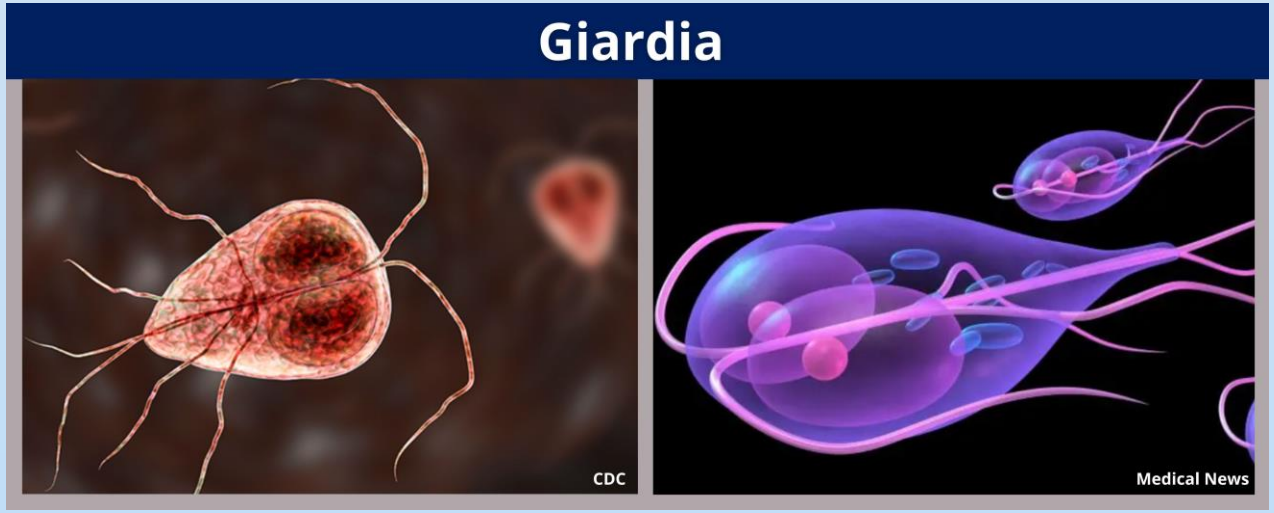


What is *Giardia*?

- **A small, protozoan parasite which causes the intestinal illness giardiasis.**

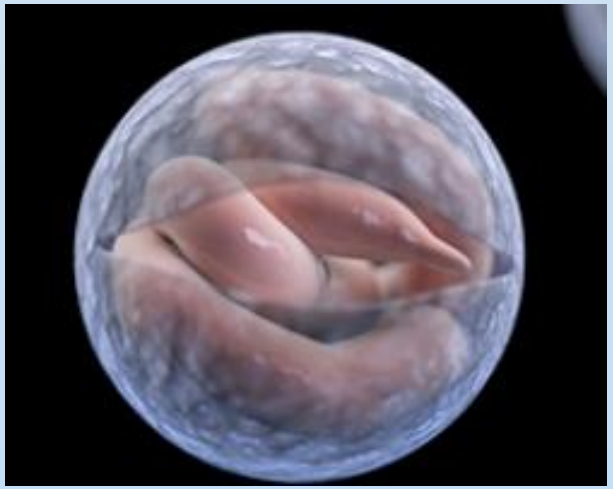
- **Normally spread by feces contaminated water or food.**

- **Disinfection with chlorine takes more time to inactivate giardia in drinking water than viral or bacterial contamination. Drinking water filtration is an important step in elimination of giardia.**



What is *Cryptosporidium*?

- **A small, single celled protozoan parasite which causes the intestinal illness cryptosporidiosis.**
- **Found and transmitted in soil, food, water, or surfaces that have been contaminated with infected human or animal feces.**
- **Protected by an outer shell (oocyst) that allows it to survive in the environment for long periods of time and makes it very resistant to chlorine- based disinfectants. Removal of cryptosporidium relies on proper functioning of sedimentation and filtration processes.**



Recorded *Cryptosporidium* Outbreaks in the U.S.

1984	Texas	1st recorded outbreak
1987	Carrolton, Georgia	13,000 infected
1993	Milwaukee, Wisconsin	400,000 infected
1994	Las Vegas, Nevada	unknown
2005	Upstate, New York	35,000 infected
2013	Baker City, Oregon	2,800 infected

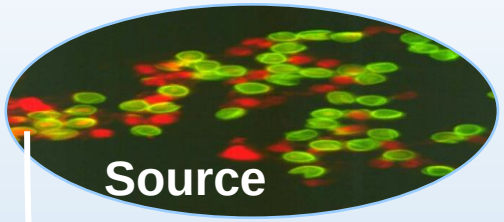
Gastroenteritis (Viral and Bacterial)

- Usually acquired via fecal contaminated water or food. Hand to mouth transmission is also an infection route.
- Can be caused by either certain bacteria or viruses.
- Usually, in healthy people, runs its course with discomfort, fever, and dehydration. Less healthy people can be at greater risk.
- Less common types such as cholera can be life threatening.
- Bacteria and viruses in drinking water are effectively eliminated by chlorine disinfection.

SWTR Requirements, Applicability

- Applies to all Subpart H water systems..
- Unless otherwise noted, the information that follows pertains to water systems using conventional surface water treatment plants that include gravity filtration (typically multimedia).
- Some treatment types, other than conventional treatment, such as cartridge filters and slow sand filtration, are treated differently in the federal Safe Drinking Water Act. Requirements for other types of treatment will be specifically noted when appropriate in this presentation.

Conventional Surface Water Treatment



Source Protection

Filtration

Disinfection

Flash Mix

Floc Basin

Sedimentation Basin

Filters

Coagulation/Sedimentation

Contact Basin / Clearwell

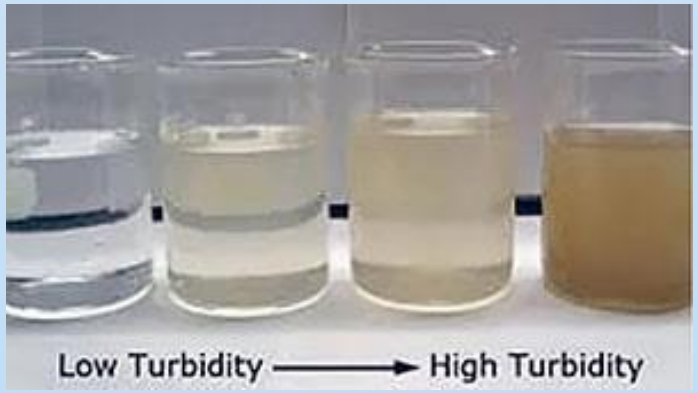
To Dist.

SWTRs Requirements, Categories

- For the purpose of this presentation, SWTRs requirements will be presented and discussed as categories which are:
  - Turbidity Removal
  - Turbidity Monitoring and Reporting
  - Giardia Removal/Inactivation
  - Cryptosporidium Removal/Inactivation
  - Virus Removal/Inactivation
  - Legionella Removal/Inactivation
  - CT Monitoring and Reporting
  - Distribution System Monitoring and Reporting, Covered Tanks
  - Filter Backwash Recycle Requirements
  - Operator Licensure/Certification
  - Groundwater Source Evaluations
  - Sanitary Surveys and Significant Deficiencies

Turbidity Removal

- Turbidity is the “cloudiness” of the water. Reducing the turbidity is an important public health drinking water requirement.
- Reducing turbidity, making it clearer, is more than just making the water more visually acceptable.
- Reducing turbidity is the main method for reducing pathogenic organisms in the water and ensuring that the disinfection process that follows will be effective.



Turbidity Removal

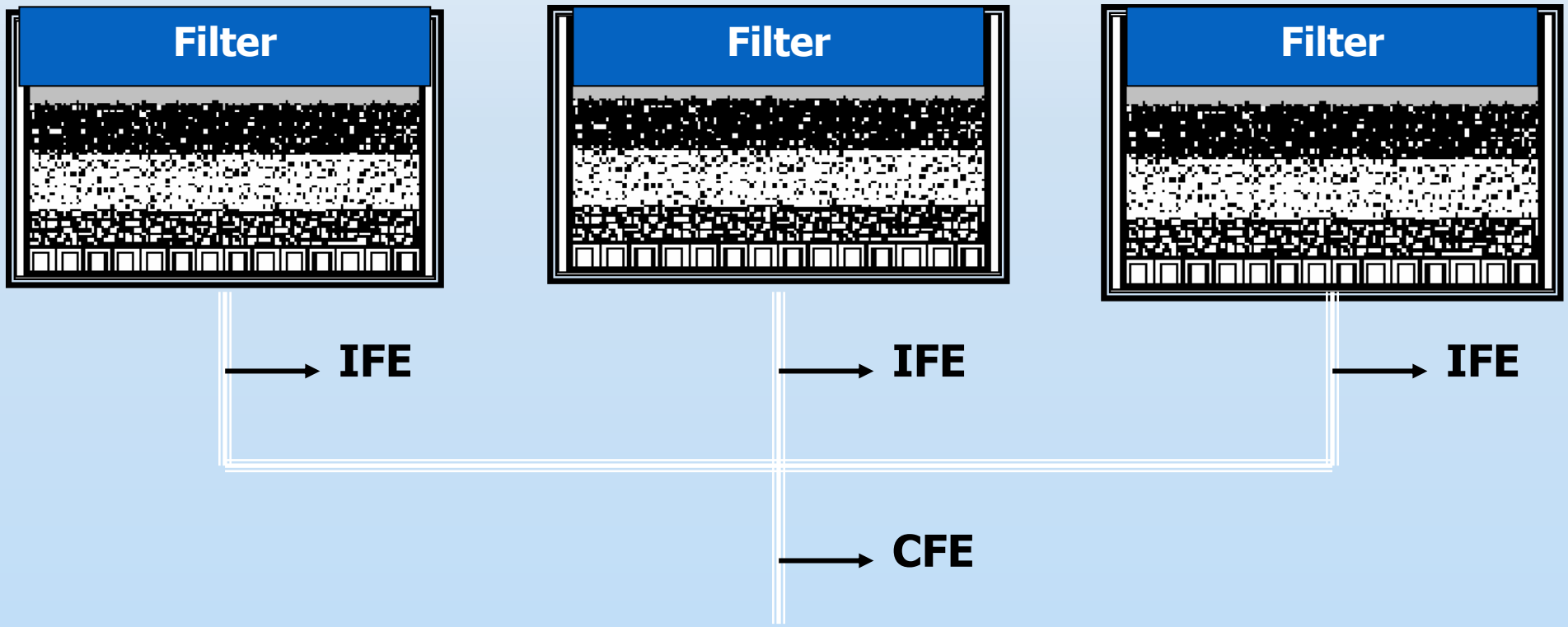
- Coagulation and sedimentation reduces turbidity and removes over half of the pathogens originally present in the water.
- Filtration further reduces turbidity and properly filtered water has had 90+% of pathogens removed.
- Disinfection then inactivates the small portion of remaining pathogens that remain in the water after filtration.
- The multiple treatment processes that remove or inactivate pathogens are part of the “multi-barrier approach” to drinking water treatment.

Turbidity Removal

IFE vs. CFE

Combined Filter Effluent (CFE)

Individual Filter Effluent (IFE)



Turbidity Removal

- Combined Filter Effluent Turbidity (CFE) must be ≤ 0.3 NTU ≥ 95% of readings.

- Combined Filter Effluent Turbidity (CFE) must be ≤ 1.0 NTU at all times.
- While most systems are using “continuous” turbidity instruments, “readings” are values that are officially recorded every 4 hours.

- Note: NTU is a synonym for Nephlometric Turbidity Units and is measured with instrumentation designed and manufactured for that purpose.

Turbidity Removal

- Individual Filter Effluent must be (IFE) ≤ 1.0 NTU at all times.

- Note: Most control systems in water treatment plants are able to shut down and take offline any filter that equals or exceeds 1.0 NTU filtered water turbidity.

Turbidity Removal, Other Technologies

Bag and Cartridge Filters

- All bag and cartridge filters must be NSF 61 certified.
- Bag and cartridge filters must be specified as comprised of material that is either 1 micron nominal or 1 micron absolute pore size.
- 1 micron nominal: Will remove the majority of particles greater than 1 micron in size.
- 1 micron absolute: Will remove 99.9 % (3-log) of particles greater than 1 micron in size.
- Note: By comparison the size of giardia is about 8+ micron and cryptosporidium about 4+ micron. For a bag or cartridge filter to work effectively, appropriate prefilter treatment is required so that the bag or cartridge filtration will be effective.

Turbidity Removal, Other Technologies
Bag and Cartridge Filters

- Filtered water turbidity requirements differ based upon nominal vs. absolute type of bag or cartridge filters.
- 1 micron nominal turbidity limitations:
  - Filtered turbidity ≤ 0.3 NTU 95% of monthly measurements.
  - Filtered turbidity ≤ 1.0 NTU 100% of monthly measurements.
- 1 micron absolute turbidity limitations:
  - Filtered turbidity ≤ 1.0 NTU 95% of monthly measurements.
  - Filtered turbidity ≤ 5.0 NTU 100% of monthly measurements

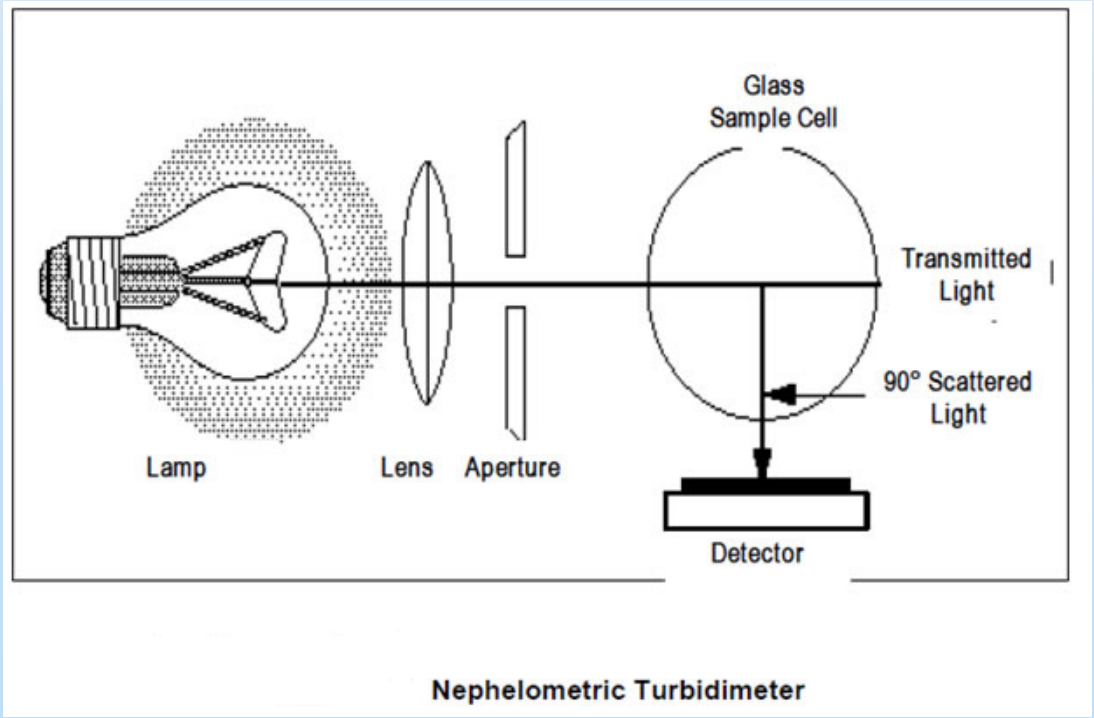
Turbidity Removal, Other Technologies
Slow Sand and Diatomaceous Earth

- Some other filtration technologies including slow sand filtration or diatomaceous earth filtration must produce filtered water turbidity of ≤ 1.0 NTU ≤ 95% of readings and ≤ 5.0 NTU 100% of monthly measurements.

- Note: Arkansas does not have any water systems that utilize slow sand filtration or diatomaceous earth filtration.

Turbidity Monitoring

- Turbidity is monitored by instruments designed and manufactured for this purpose. There is many models and more than one manufacturer to choose from. The instrument selected must be using an analytical method that EPA has determined to be acceptable.



Nephelometric Turbidimeter

Turbidity Monitoring

- At a typical water treatment plant, combined filtered water turbidity must be measured and recorded on reports every 4 hours. Continuous monitoring equipment can be used in lieu of grab sampling if calibration of the monitoring equipment is regularly checked.
- Individual filters must be equipped with continuous turbidimeters which typically record turbidity values at least every 15 minutes. Readings from the individual filter continuous turbidimeters must be recorded. (There is an exception in the federal law if a plant only has two filters and the combined filter effluent is monitored continuously.)
- Water operators are expected to record on operational reports turbidity results that are representative for each 4-hour period. Operators are not expected to record turbidity spikes resulting from air bubbles in the sampling line or other nonrepresentative spikes. Operators are also not expected to search for low readings that are also not representative of the filter's performance during the time period.

Turbidity Monitoring

- The Arkansas Department of Health (ADH) provides each water system with Operation and Chemical Report forms that must be completed each month, signed by the licensed water operator in responsible charge, and sent back to the ADH by the 10th of the following month.
- The licensed water operator is in a position of public trust. By signing the operation report form he/she is attesting to the accuracy and truthfulness of the data.

Turbidimeter Calibration

- Turbidimeter calibration requirements:
  - Must use procedure specified by manufacturer
  - ADH recommends calibration w/ primary standards at least every 3 months.

Assessing Individual Filter Performance

		Condition	Action
1		2 consecutive measurements >0.5 NTU taken 15 minutes apart at the end of the first 4 hours of continuous filter operation after backwash/offline	Produce filter profile within 7 days (if cause is not known)
2		2 consecutive measurements >1.0 NTU taken 15 minutes apart during normal operation	Produce filter profile within 7 days (if cause is not known)
3		2 consecutive measurements >1.0 NTU taken 15 minutes apart at the same filter for 3 months in a row	Conduct a filter self-assessment within 14 days
4		2 consecutive measurements >2.0 NTU taken 15 minutes apart at the same filter for 2 months in a row	Arrange for a CPE within 30 days and submit report within 90 days

Filter Profile

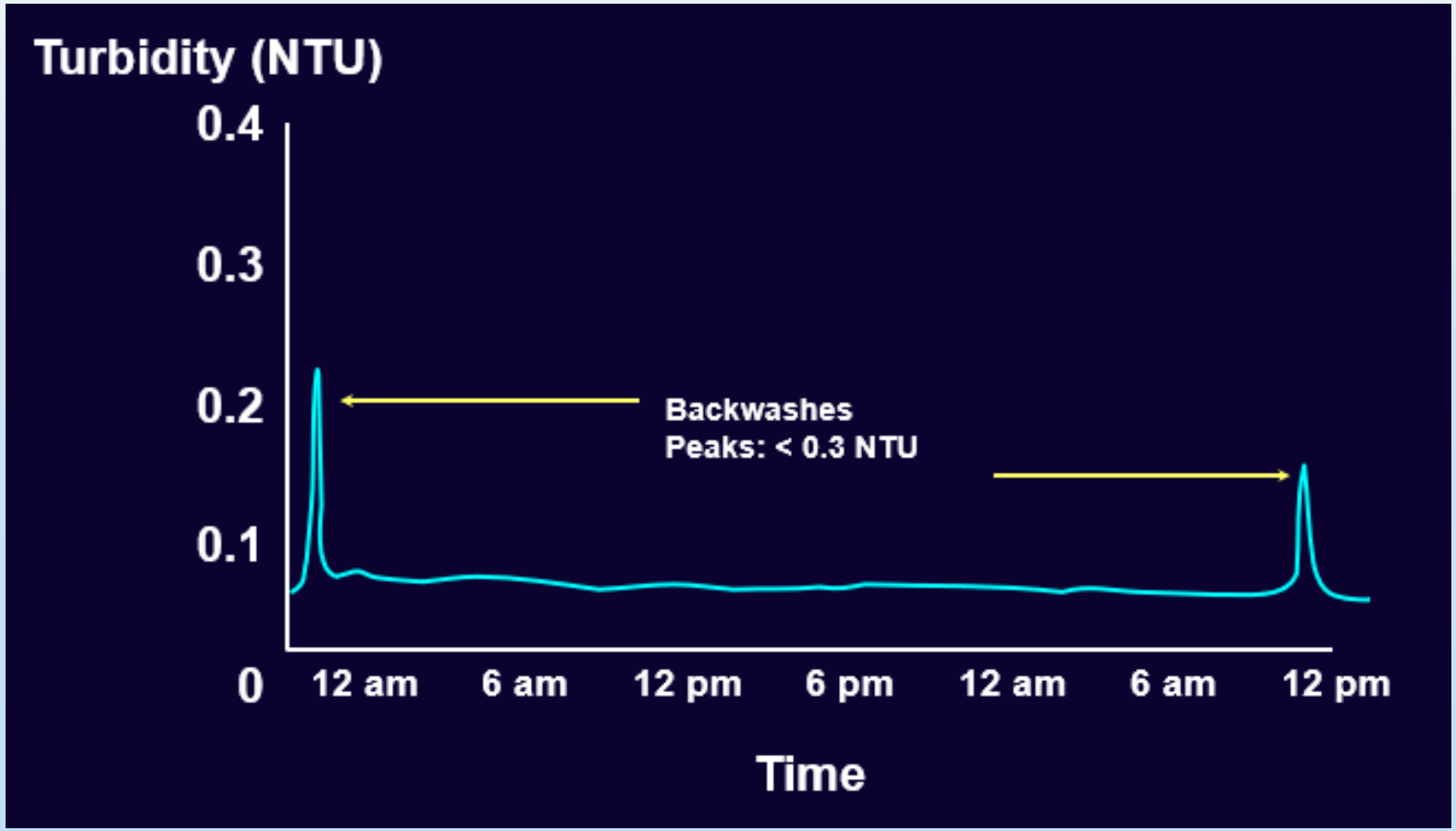
Continuous turbidity measurements of a typical filter run in graphical form.

- Starting at filter startup after backwash
- Ending at filter startup after next backwash

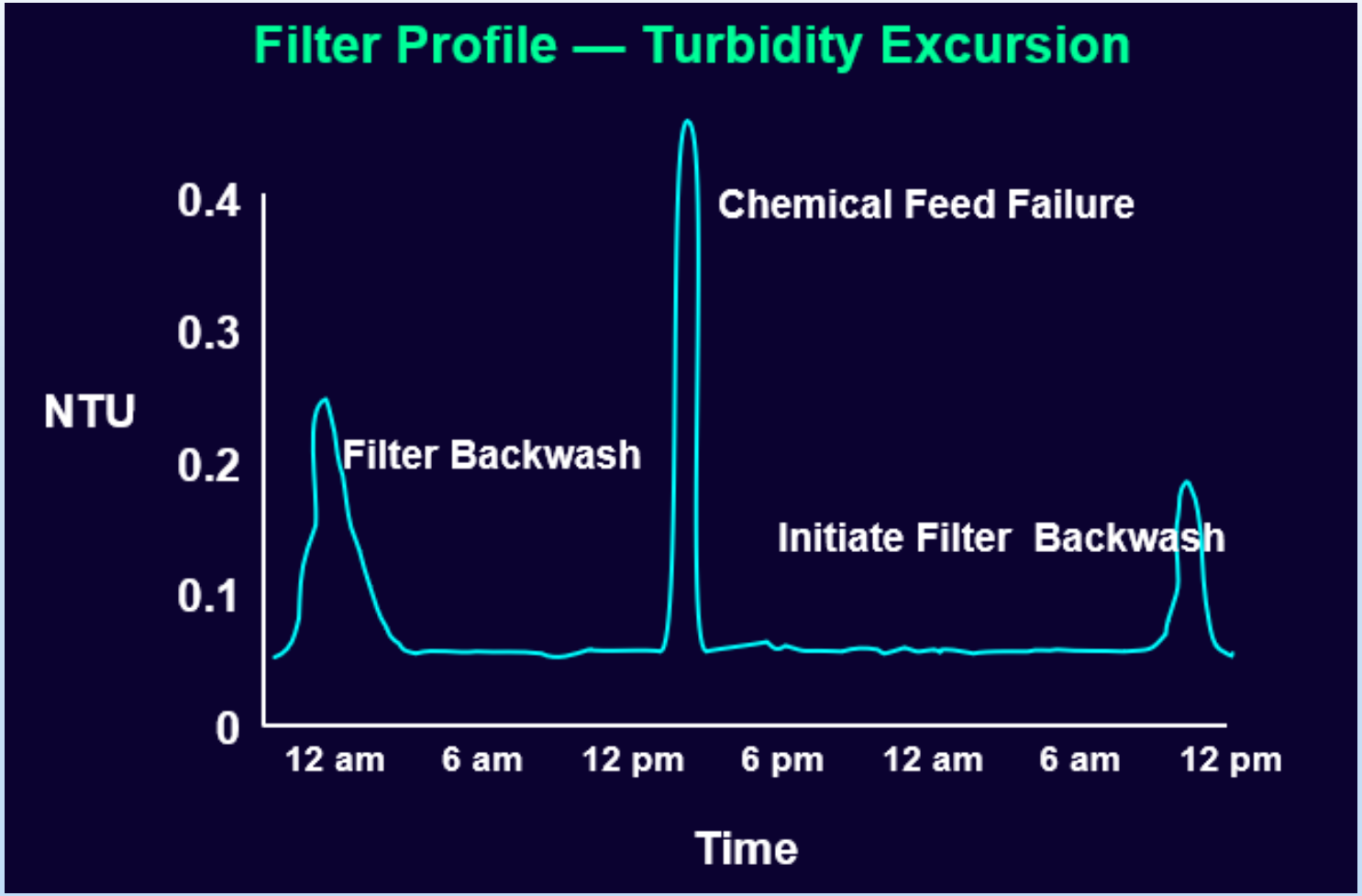
1. Must include the filter performance while another filter is being backwashed.

2. Must include explanations of the cause of performance spikes.
   - Flow rate increase, adjoining filter backwash, filter backwash, etc.

Filter Profile - Good Performance



Filter Profile – Turbidity Excursion



Filter Self Assessment

- If filter performance dictates that a filter self-assessment has to be conducted it must consist of at least the following components:
  - Assessment of filter performance.
  - Development of a filter profile.
  - Identification and prioritization of factors limiting filter performance.
  - Assessment of the applicability of corrections.
  - Preparation of a filter self-assessment report.

Comprehensive Performance Evaluation

- If filter performance dictates that a Comprehensive Performance Evaluation (CPE) must be conducted, in Arkansas the CPE will be conducted by the ADH.
- A CPE focuses on more than just filter performance.
- A CPE is very broad in scope and an in-dept analysis of treatment plant performance and identifies factors that are limiting performance from technical, operational, and financial perspectives.

Giardia Removal/Inactivation

- SWTR Rules require that surface water and GWUDI water system remove/inactivate 99.9% of giardia organisms that might be in the untreated water.
- 99.9% removal is called 3-log removal (name is a reference to base 10 logarithmic calculations, log reduction = $\log_{10}(A) - \log_{10}(B)$) where A is the untreated concentration (1.0) and in this case B is the fraction remaining after 99.9% removal (0.001)
- The end result is that 90% removal is a 1 log removal, 99% removal is a 2 log removal, 99.9% removal is a 3 log removal, and 99.99% removal is a 4 log removal.
- This log removal concept is also used with respect to required removal/inactivation of cryptosporidium and viruses.

Giardia Removal/Inactivation

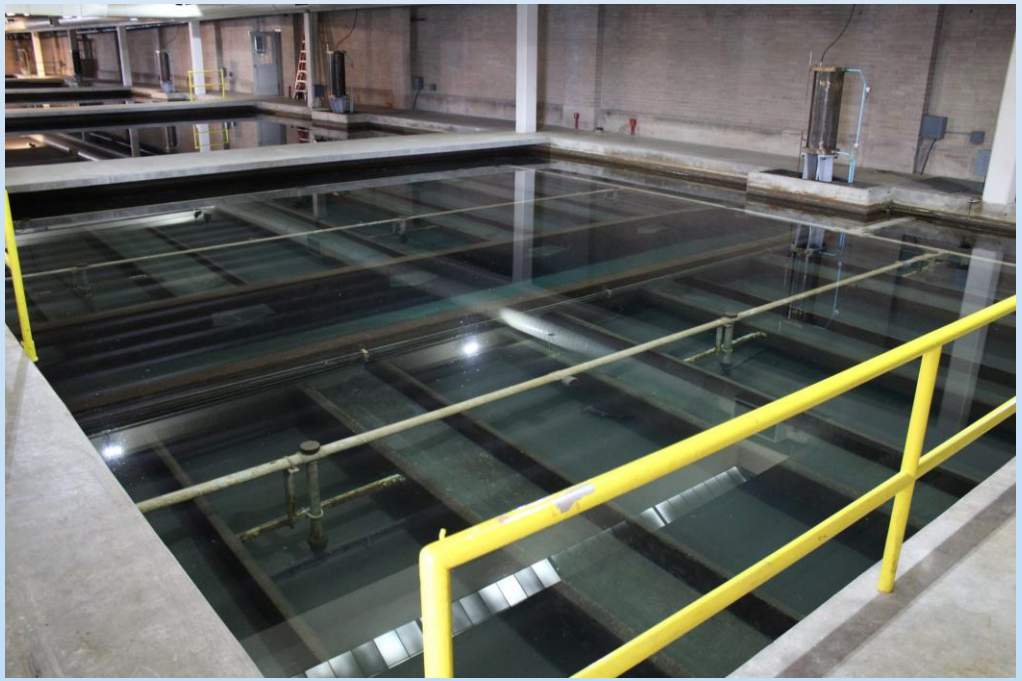
- A conventional surface water treatment plant which includes properly functioning coagulation, sedimentation and filtration is credited with achieving a 2.5 log removal of giardia organisms. The remaining required 0.5 log removal/inactivation must be accomplished via the disinfection process which is typically achieved through adequate chlorine contact time with the water (CT).
- Federal Regulations contain requirements regarding required CT for giardia inactivation and estimating contact time. This information will be covered in depth in upcoming slides.

Cryptosporidium Removal/Inactivation

- Federal regulations require that surface water sources and GWUDI sources be evaluated for the concentration of cryptosporidium organisms in the untreated source water.
- Depending upon the concentrations found, different levels of removal/inactivation of cryptosporidium is required.
- Most surface sources in Arkansas are required to remove 2.0 log cryptosporidium. A smaller number of systems, 3.0 log removal.
- A conventional surface water treatment plant which includes properly functioning coagulation, sedimentation and filtration is credited with achieving a 2.0 log removal of organisms. If source water analysis determines that there are less than 0.075 cryptosporidium organisms per liter of water, then no additional treatment is required.

Cryptosporidium Removal/Inactivation

- Effective filtration is the key to effective cryptosporidium removal and public health protection.
- Cryptosporidium's ability to form protective cysts protects it from chlorine disinfectant.



Source Monitoring Requirements

- Monitor to determine *Cryptosporidium* and/or indicator levels (2 year period – 24 samples)
- Assignment to "bins" based on monitoring results. Additional treatment based on the requirements for each bin, choosing from a set of treatment options.
- Cryptosporidium sampling of the source water must be repeated within 6 years of the completion of the first round.
- New sources are monitored once online.

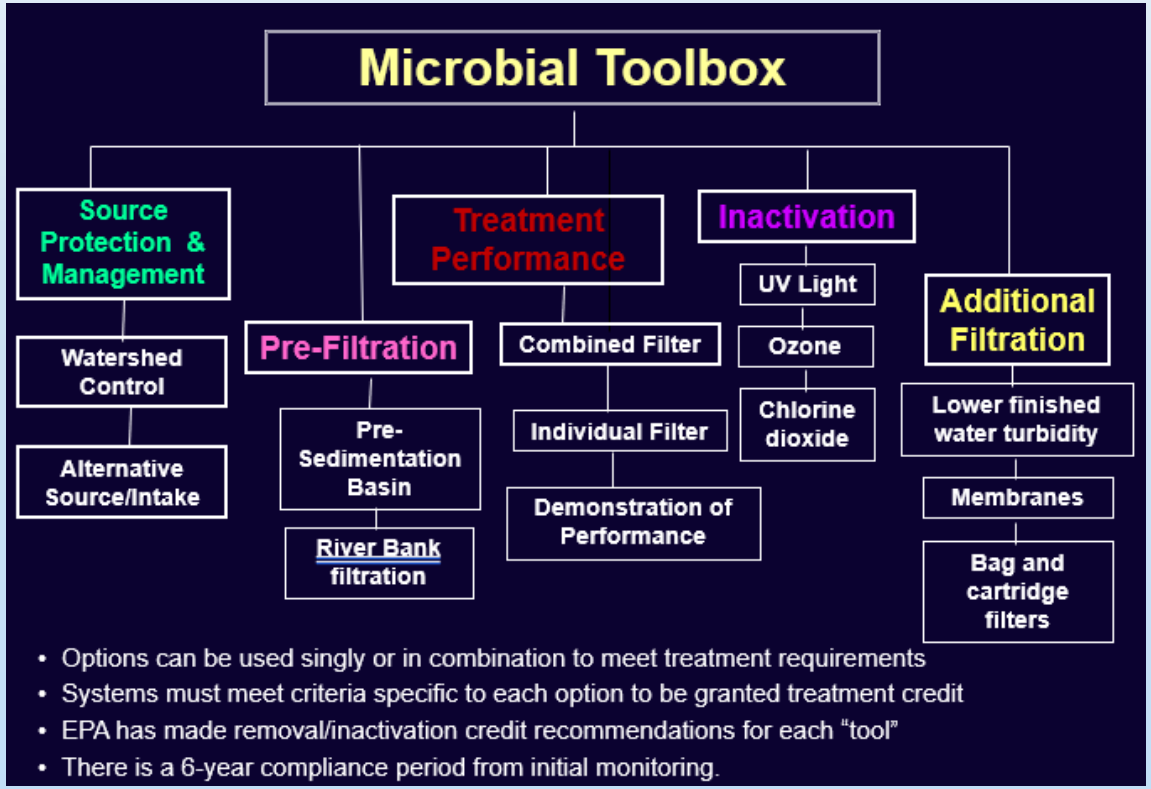
Cryptosporidium Removal/Inactivation

- **If cryptosporidium organisms are found in concentrations above 0.075/L then this table displays additional removal/inactivation that is required.**

Bin Number	*Cryptosporidium* Concentration (in oocysts/L)	Additional Treatment Required Beyond 2.0 log Removal
1	*Crypto* < 0.075	No additional treatment
2	0.075 ≤ *Crypto* < 1.0	1.0 log (90%)
3	1.0 ≤ *Crypto* < 3.0	2.0 log (99%)
4	*Crypto* ≥ 3.0	2.5 log (99.7%)

Cryptosporidium Removal/Inactivation

- **Federal regulations provide several pathways (methods) to achieve additional cryptosporidium removal/inactivation.**



Cryptosporidium Removal/Inactivation

- Only a small number of water systems are required to provide an extra 1-log cryptosporidium removal/inactivation.
- All of these systems demonstrate that extra removal/inactivation via consistently lower filtered water turbidity levels.
- Note: Cryptosporidium can form protective shells that can protect the organism from chlorine inactivation. Therefore, system need to achieve additional log removal/inactivation do not rely on the chlorine disinfection process. Other methods have to be used.

Cryptosporidium Removal/Inactivation

- **Filtration Criteria that demonstrates an additional 1.0 log cryptosporidium removal:**

Monitoring Requirement	Monitoring Frequency	Measurement
CFE	At least every 4 hours	≤ 0.15 NTU in 95% of CFE Measurements
IFE	Continuously	≤ 0.15 NTU in 95% of IFE Measurements
IFE	Continuously	NONE >0.3 NTU in 2 Consecutive 15 Min. Measurements

Virus Removal/Inactivation

- SWTR Rules require that surface water and GWUDI water system remove/inactivate 99.99% of viral organisms that might be in the untreated water.
- A conventional surface water treatment plant which includes properly functioning coagulation, sedimentation and filtration is credited with achieving a 2.0 log removal of viral organisms. The remaining required 2.0 log removal/inactivation must be accomplished via the disinfection process which is achieved through adequate chlorine contact time with the water (CT).

Virus Removal/Inactivation

- Federal Regulations contain requirements regarding required CT and estimating contact time. CT information will be covered in depth in upcoming slides.
- Although the federal regulations contain CT chlorine concentration requirements for viral inactivation, it should be noted that if chlorine is also utilized for giardia inactivation that the CT chlorine concentration requirement for 0.5 log giardia inactivation is more demanding than 2.0 log viral inactivation and thus the giardia chlorine concentration requirement dictates the level of chlorine needed to achieve compliance with both 0.5 log giardia inactivation and 2.0 log virus inactivation.

Legionella Control

- Legionella bacteria is the pathogen that causes legionnaires disease and is present in untreated surface water sources.
- The original SWTR (1989) set a maximum contaminant level goal of a zero (0) concentration of legionella in treated drinking water.
- Legionella organisms are naturally found in surface water sources. These organisms are found even when there has not been significant fecal contamination of these sources.
- Surface water treatment and disinfection can inactivate free floating legionella however legionella can parasitically infect other organisms such as amoeba and protozoa and thus be shielded from disinfection.

Legionella Control

- Legionella bacteria that survive treatment can be the source of seed bacteria that can later grow in stagnant building plumbing and pose a risk of legionnaires disease to residents of those buildings. At particular risk are older people in care facilities.
- Treatment plants that comply with the SWTR requirements of 3 log giardia removal/inactivation and 4 log virus removal/inactivation are complying with the required treatment technique that also controls legionella that may be present in the raw water source.
- Water operators should be mindful that proper operation of the filtration and disinfection process including uninterrupted maintenance of distribution system chlorine residuals assists the community in minimizing legionella risks.

UNDERSTANDING CT

- Federal regulations contain values for minimum disinfectant contact time with drinking water to ensure that various log removal/inactivation of pathogens have occurred. In this discussion we will assume use of chlorine.
- This is called “CT”, “concentration x contact time” with a disinfectant.
- These issues are relevant for systems that are using disinfection treatment (typically chlorine) for ensuring various log removal inactivation of giardia and viruses. These same concepts would be applicable for other disinfectants, such as ozone, that might be used to inactivate cryptosporidium. In those cases, different CT values will apply.

UNDERSTANDING CT

- Conventional surface water treatment plants must provide adequate CT (concentration x contact time) to achieve 0.5 log inactivation of giardia and 2.0 log inactivation of viruses.
- Required CT values are found in the federal Safe Drinking Water Act.
- Note: Operators should be mindful that lower water temperatures require more chlorine to achieve required CT. Also, water operators should not let the pH of the water rise above 9.0 or a violation will be incurred for not meeting CT requirements.

UNDERSTANDING CT

Calculating CT

$CT = C \times T$

C = concentration of disinfectant residual (mg/L)

- For systems using chlorine, C can be measured with portable or continuous monitor using an EPA-approved method.
- C must be measured before or at first customer

T = contact time (minutes)

- "T" (T_{10}) is the time it takes for 10% of the water entering the treatment unit to exit at peak flow
- Contact time is determined by tracer study or application of a baffle factor

UNDERSTANDING CT

Calculating CT

CT Calculation:

$$\frac{\text{capacity (gal) of system component (pipe, storage tank) X (baffle factor)}}{\text{system flow (gpm)}}$$

- **CT is expressed as min-mg/L**

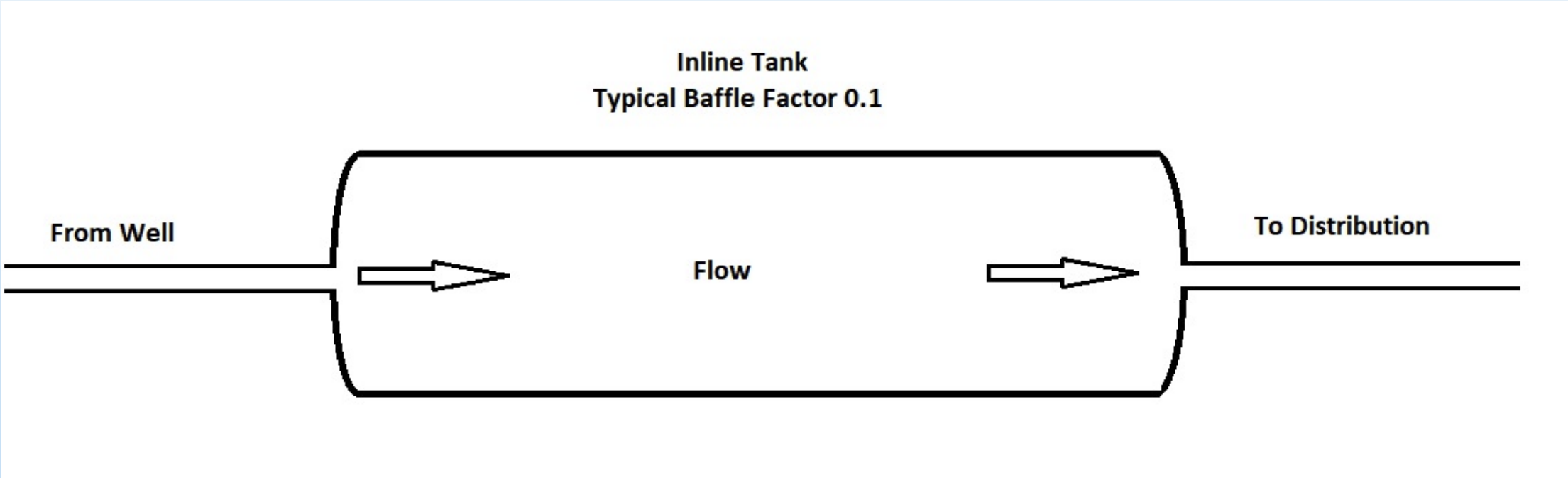
UNDERSTANDING CONTACT TIME

BAFFLE FACTORS

- Without baffles, flow inside of tanks or clearwells can short circuit and unbaffled volumes are given a low baffle factors.
- Baffle factors in baffled clear wells add “credit” to your CT by increasing the credited residence time (contact time) of the water in the clear well or tank.
- Baffles force the flow of water to utilize more of the tank or basin volume thus increasing residence time (contact time) .
- Baffle factors are assigned based upon baffle arrangement but tracer testing can be performed to verify appropriate baffle factors.
- The next several slides show types of tanks than are commonly used and the beneficial effect of baffles.

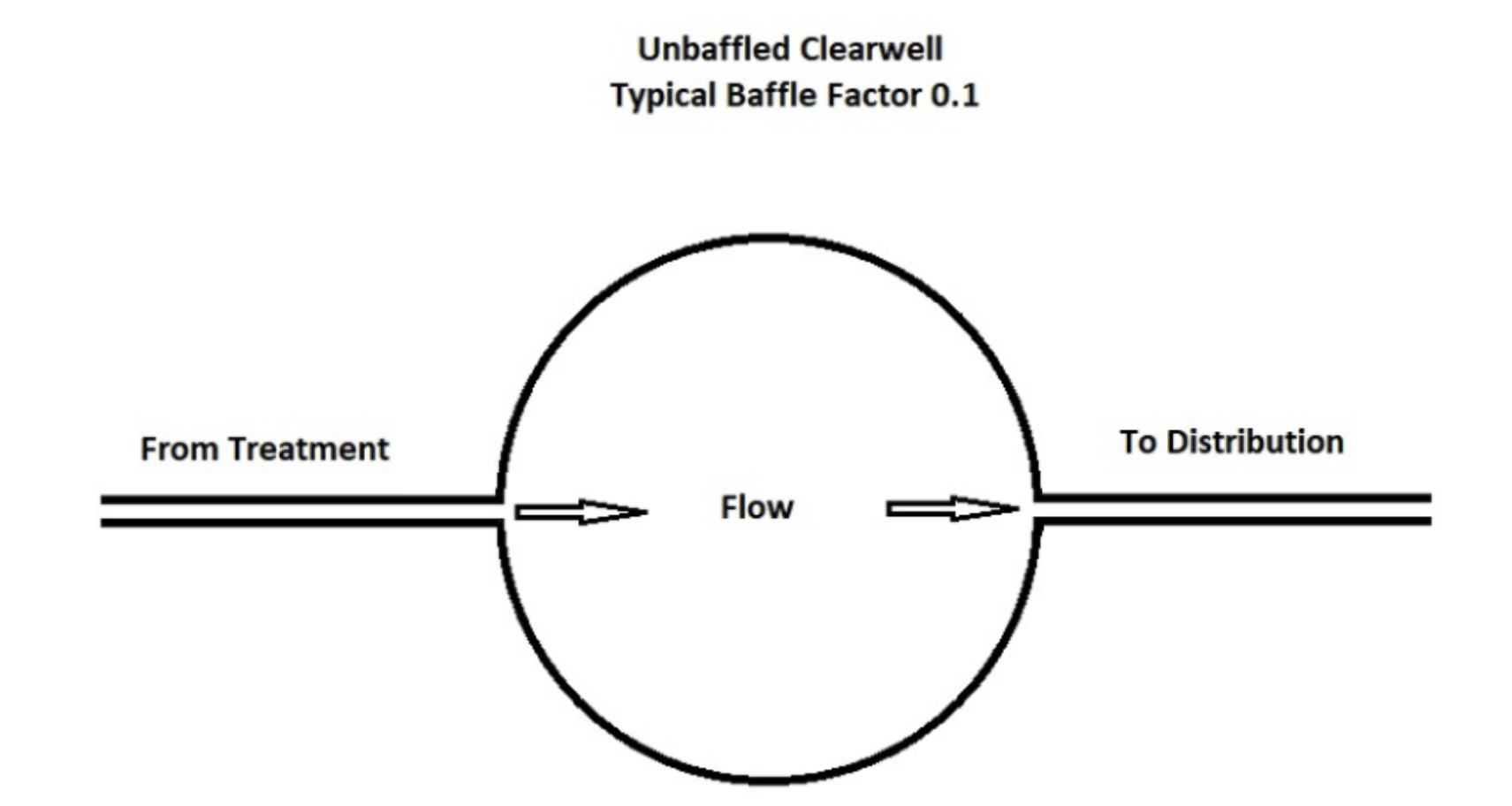
UNDERSTANDING CONTACT TIME

BAFFLE FACTORS



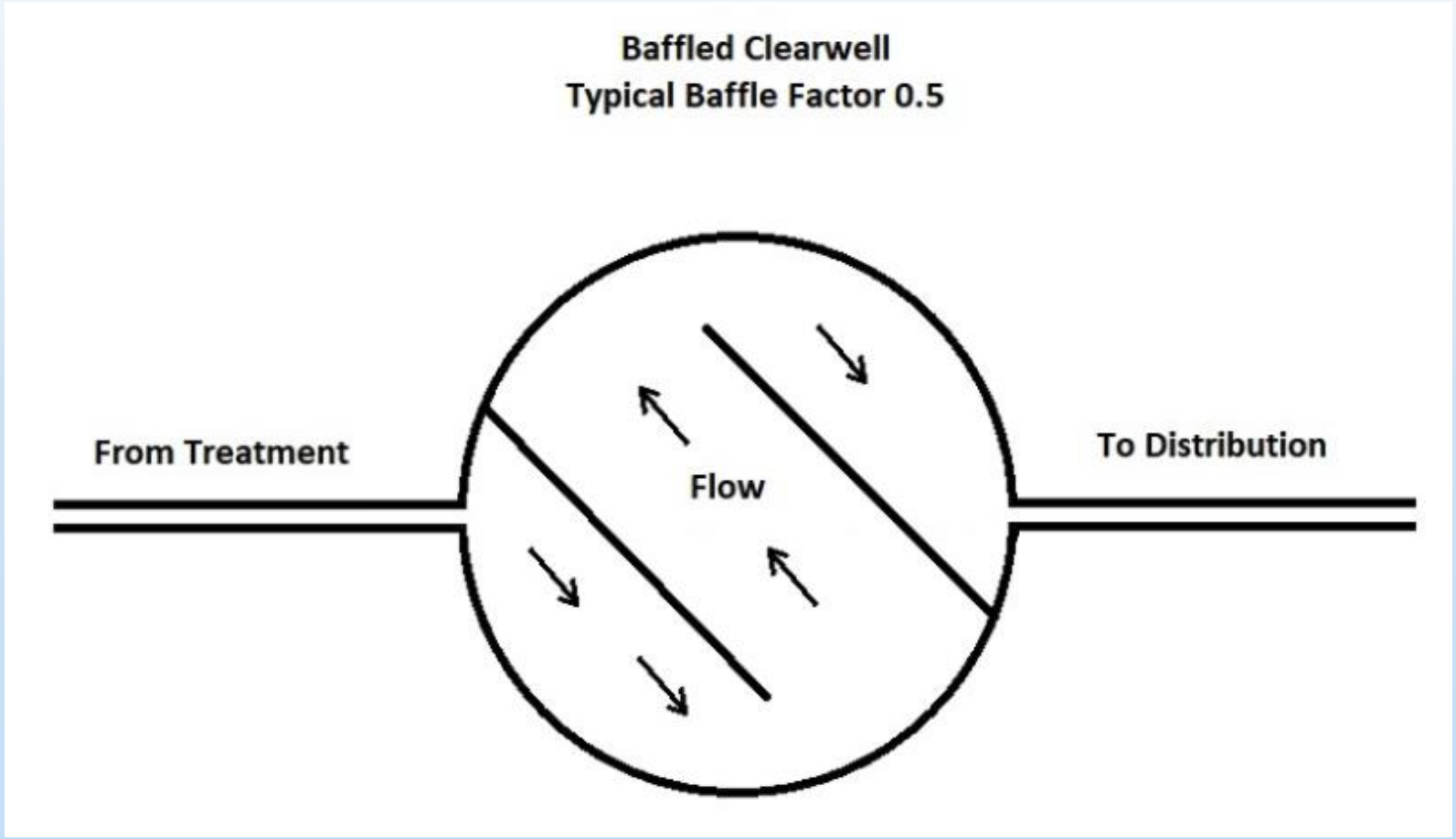
UNDERSTANDING CONTACT TIME

BAFFLE FACTORS



UNDERSTANDING CONTACT TIME

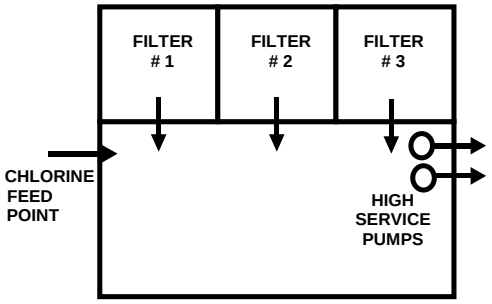
BAFFLE FACTORS



UNDERSTANDING CONTACT TIME

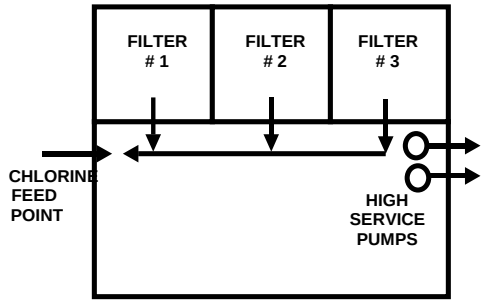
BAFFLE FACTORS

TYPICAL 0.0 BAFFLE FACTOR



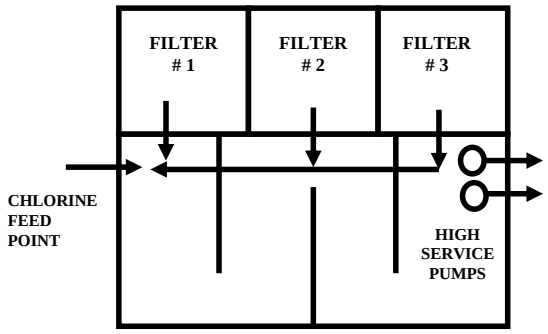
FILTER #3 EFFLUENT SHORT CIRCUITS TO PUMPS

TYPICAL 0.3 BAFFLE FACTOR



LENGTH > WIDTH - UNBAFFLED CLEARWELL

TYPICAL 0.5 BAFFLE FACTOR

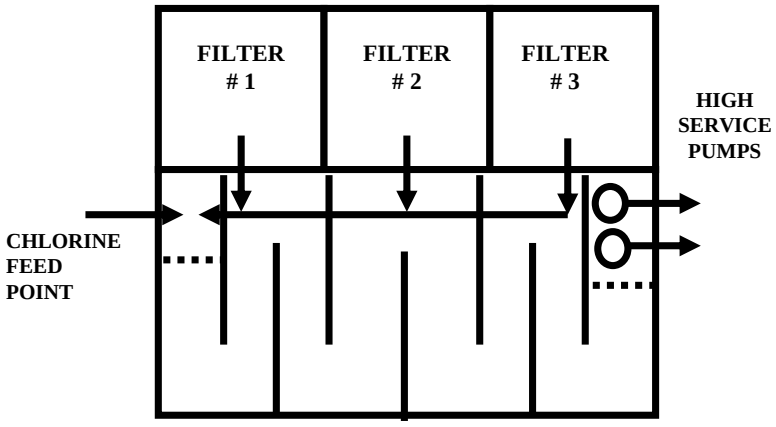


BAFFLED CLEARWELL

UNDERSTANDING CONTACT TIME

BAFFLE FACTORS

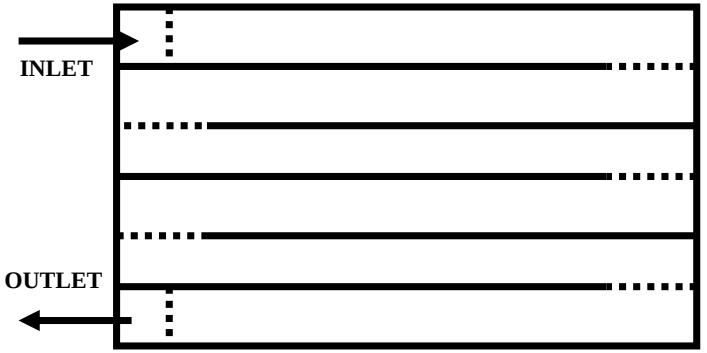
TYPICAL 0.7 BAFFLE FACTOR



HIGHLY BAFFLED CLEARWELL

TYPICAL 0.8 - 0.9 BAFFLE FACTOR

HIGHLY BAFFLED (SERPENTINE) CLEARWELL WITH PERFORATED BAFFLE WALLS

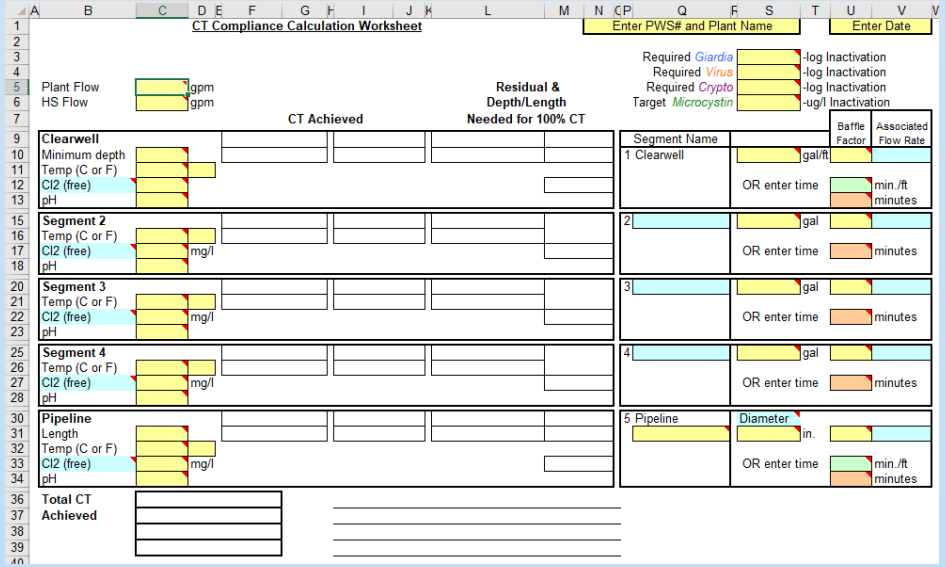


Required CT Values

- Federal Regulations contain required CT values for different pathogens (giardia, viruses, cryptosporidium) and different disinfectants (chlorine, ozone, chlorine dioxide, chloramines).
- Required CT values can also be dependent upon pH and temperature.
- Again, for plants in Arkansas that utilize chlorine to achieve required CT, the required CT for 0.5 log giardia inactivation will be greater than the required CT for 2.0 log virus inactivation.

Required CT Values

- The ADH provides an Excel spreadsheet that allows the user to determine required disinfectant concentration based upon required log removals and system specific contact times.
- That spreadsheet can be found here: https://www.healthy.arkansas.gov/programs-services/topics/drinking-water-system-forms



Covered Tanks

- SWTR Rules require that treated drinking water storage tanks be covered to protect the sanitation of the drinking water or provide surface water treatment downstream of the storage tank.
- Despite the treatment option, the purpose was to require that treated water storage tanks be covered to protect the quality of the treated drinking water from contamination.
- Prior to the SWTRs, all finished water storage tanks in Arkansas had already been required to be covered as well as providing other features designed to protect the quality of the drinking water in the tank.

Covered Tanks

- Surprisingly, there were some water systems in the nation that used uncovered treated water storage tanks or reservoirs. Here is a picture of an uncovered treated water reservoir, open to birds and located in a public park, that until recently was utilized as part of the Portland, Oregon water system.

Entry Point Monitoring and Reporting

- SWTRs require that a minimum chlorine residual of 0.2 mg/L (0.2 ppm) be present in the water at the entry point into the distribution system.
- The ADH provides Subpart H water systems with Operation and Chemical Report forms that require recording daily distribution system entry point chlorine residual data.
- Systems serving > 3300 people must monitor continuously.
- System serving ≤ 3300 can grab sample based upon the following criteria.
  - 3300 - 2501 4 samples per day
  - 1001 - 2500 3 samples per day
  - 501 - 1000 2 samples per day
  - < 500 1 sample per day

Distribution System Monitoring and Reporting

- Subpart H systems must maintain a detectable disinfectant residual in the distribution system and must be measured at same locations as RTCR bacteriological sites.
- The laboratory submission form for bacteriological samples has a field that must be completed indicating the disinfectant residual (chlorine or chloramines). Completion of this data filed during bacteriological sampling complies with the monitoring and reporting requirements found in the SWTR.
- Disinfectant residual must be present (detectable) in 95% of samples collected over any 2 month period.

Filter Backwash Recycling

- The Filter Backwash Recycling Rule requires that if a Subpart H system recycles filter backwash water (or thickener supernatant or liquid from dewatering processes), the backwash water must be introduced at the beginning of the treatment plant and go through the full surface water treatment scheme.
- The filter backwash water can contain concentrated pathogens that were removed by the filters. This can pose a health threat if recycled.
- Documentation must be collected and maintained detailing the amount of backwash water recycled and the various flowrates involved.

Note: Recycle Flows are limited to no more than 10 % of the combined influent stream to the treatment plant.

Filter Backwash Recycling

- Documentation must be collected and maintained relating to filter backwash recycle practices that include:
  - List of all recycle flows and the frequency which they are recycled.
  - Average and maximum backwash flow rate through the filters and average and maximum duration of the backwash process.
  - Typical filter run length.
  - Treatment provided for the recycle flow.
  - Data on treatment units, loading rates, chemicals used and dosages, and frequency of solids removal.

Operator Licensure/Certification

- All Subpart H systems must be “operated by qualified personnel who meet requirements specified by the state.”
- In Arkansas, the licensing program is recognized by EPA as being adequate with regards to certifying (licensing) qualified water operators.
- The Arkansas program requires that any operator that can make decisions or take actions that can affect water quality should be licensed or supervised by a licensed operator.
- A component documenting adequacy of the Arkansas licensing program is use of a nationally accepted exam.

Operator Licensure/Certification

To be qualified:

- Treatment License
  - Must be Grade II or higher
    (based on system size and job duties)

- Three months to obtain license, however
  - The system will be in violation of the SWTR during this period
  - Violations must be reported to EPA

Groundwater Source Evaluations

All PWS groundwater well sources:

- Evaluated for direct surface water influence (i.e. GWUDI)

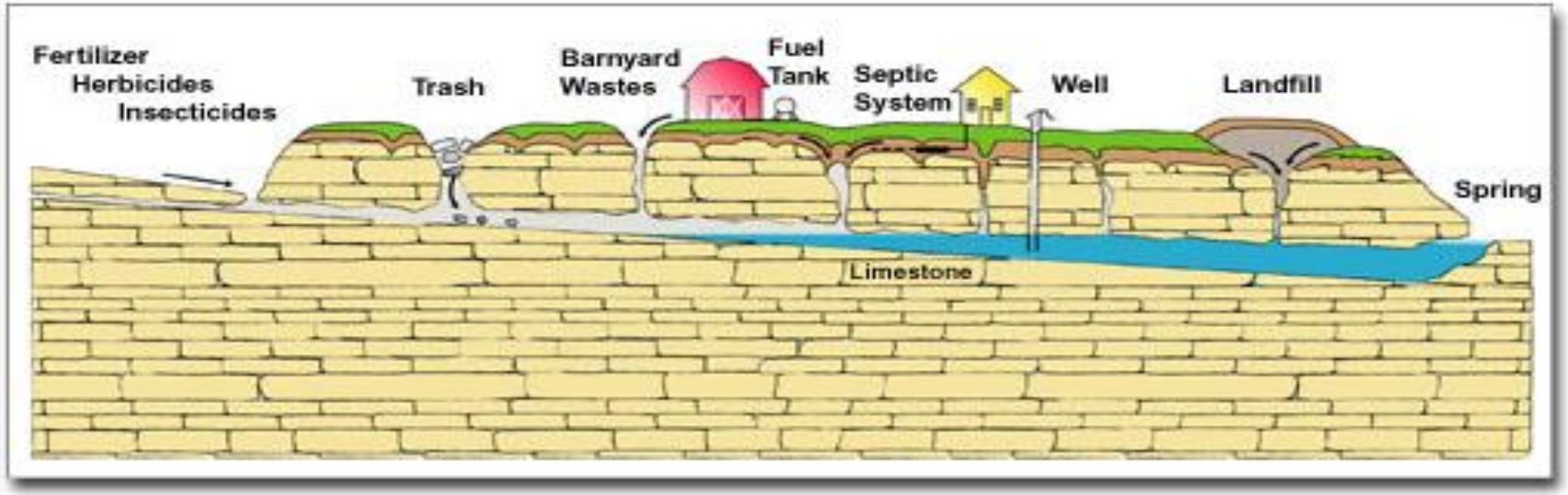
The evaluation process considers:

- Microbial and particulate analysis
- Historical water quality data
- Well construction
- Well siting with respect to:
  - Proximity to surface water sources and other potential sources of contamination
  - Surface drainage
- Subsurface geology and aquifer characteristics

Groundwater Source Evaluations

If a well is determined GWUDI:

- **Must be in full compliance with the SWTRs within 18 months after the determination has been finalized.**
- **Must comply with interim monitoring requirements and a compliance schedule set by the ADH until filtration is installed.**



SWTRs, Sanitary Surveys

- Sanitary Surveys can identify defects or deficiencies that are serious enough to be labeled “significant deficiencies”. Significant deficiencies need to be corrected without delay.
- Significant deficiencies can include:
  - Defects in a system’s design, operation, maintenance, or administration.
  - Failure or malfunction of any system component, that the State (ADH) determines to cause, or have the potential to cause, risk to health or safety.

Sanitary Surveys
Significant Deficiencies

- If determined to have significant deficiencies:
  - Respond in writing to the ADH within 45 days of written notification.
  - Provide a corrective action plan and timetable for resolving significant deficiencies.
  - Correct significant deficiencies according to timetable submitted to and approved by ADH.

Sanitary Surveys
Records and Reports

- **The System must have, at a minimum, the following records on file and available for review during Sanitary Surveys.**
  - **Sanitary Surveys**
  - **Bacteriological and Chemical Analysis Reports**
  - **Source Water Assessment Report**
  - **Sample Site Plans**
  - **Optimal Corrosion Control and Treatment Plan (If Applicable)**
  - **Disinfection Profile and Benchmark Report (If Applicable)**
  - **Individual Filter Monitoring Data (If Applicable)**
  - **Filter Profile Report (If Applicable)**
  - **Filter Self-Assessment Report (If Applicable)**
  - **CPE Report (If Applicable)**

Analytical Techniques

- Turbidity must be measured in accordance with:
  - EPA Method 180.1, or
  - Method 214A in the 18th or later edition of Standard Methods (2130 B in 23rd edition)
- Chlorine residual (free or combined) must be measured in accordance with:
  - Method 408C (Amperometric Titration Method),
  - Method 408D (DPD Ferrous Titrimetric Method), or
  - Method 408E (DPD Colorimetric Method) in the 18th, or later, edition of Standard Methods (4500-Cl X-00 (X = D, F, or G) in SM Online)
  - EPA Method 334.0 (On-line analyzer)
  - DPD colorimetric field test kits are also acceptable.

Any Questions?

- A few sample questions follow

To which of the following sources do the SWTRs NOT apply?

A. Rivers

B. Springs

C. Reservoirs

D. Wells

D. Wells

Under the *Surface Water Treatment Rule*, "CT" stand for _____.

A. Concentration X Contact Time

B. Contact Time

C. Cryptosporidium Total

D. Clearwell Turbulence

A. Concentration X Contact Time

Individual filters must be monitored for turbidity _____.

A. every 4 hours

B. continually

C. once per day

D. once per shift

B. continually

A filter with an average pore size of 1 micron is designated _____.

A. 1 micron absolute

B. 1 micron nominal

C. uniformly coefficient

D. 1 micron median

B. 1 micron nominal

If 99.9% of Giardia Lamblia is removed from a water source, that removal is rated as _____.

A. 1 log

B. 2 log

C. 3 log

D. 4 log

C. 3 log

A failure of a system component that poses a threat to health or safety is referred to as a _____.

A. significant deficiency

B. sanitary hazard

C. MRDL

D. filter profile

A. significant deficiency

The “cloudiness” of water, measured in NTUs is called _____.

A. alkalinity

B. turgor potential

C. combined filter effluent

D. turbidity

D. turbidity

If a turbidimeter fails, the system must _____.

A. repair turbidimeter within 24 hours
B. submit Tier 2 Public Notification
C. take grab samples every 4 hours
D. apply for a CPE

C. Take grab samples every 4 hours

The maximum turbidity measurement for combined or individual filter effluent (conventional or direct) is _____.

A. 5.0 NTUs

B. 1.0 NTU

C. 0.3 NTU

D. 0.5 NTU

B. 1.0 NTU

NTU stands for _____.

A. North Thornton University
B. Nonbiodegradable Turgor Units
C. Nostalgic Teletubby Union
D. Nephelometric Turbidity Unit

D. Nephelometric Turbidity Unit