Proposed Long Term 2 Enhanced Surface Water Treatment Rule (LT2)

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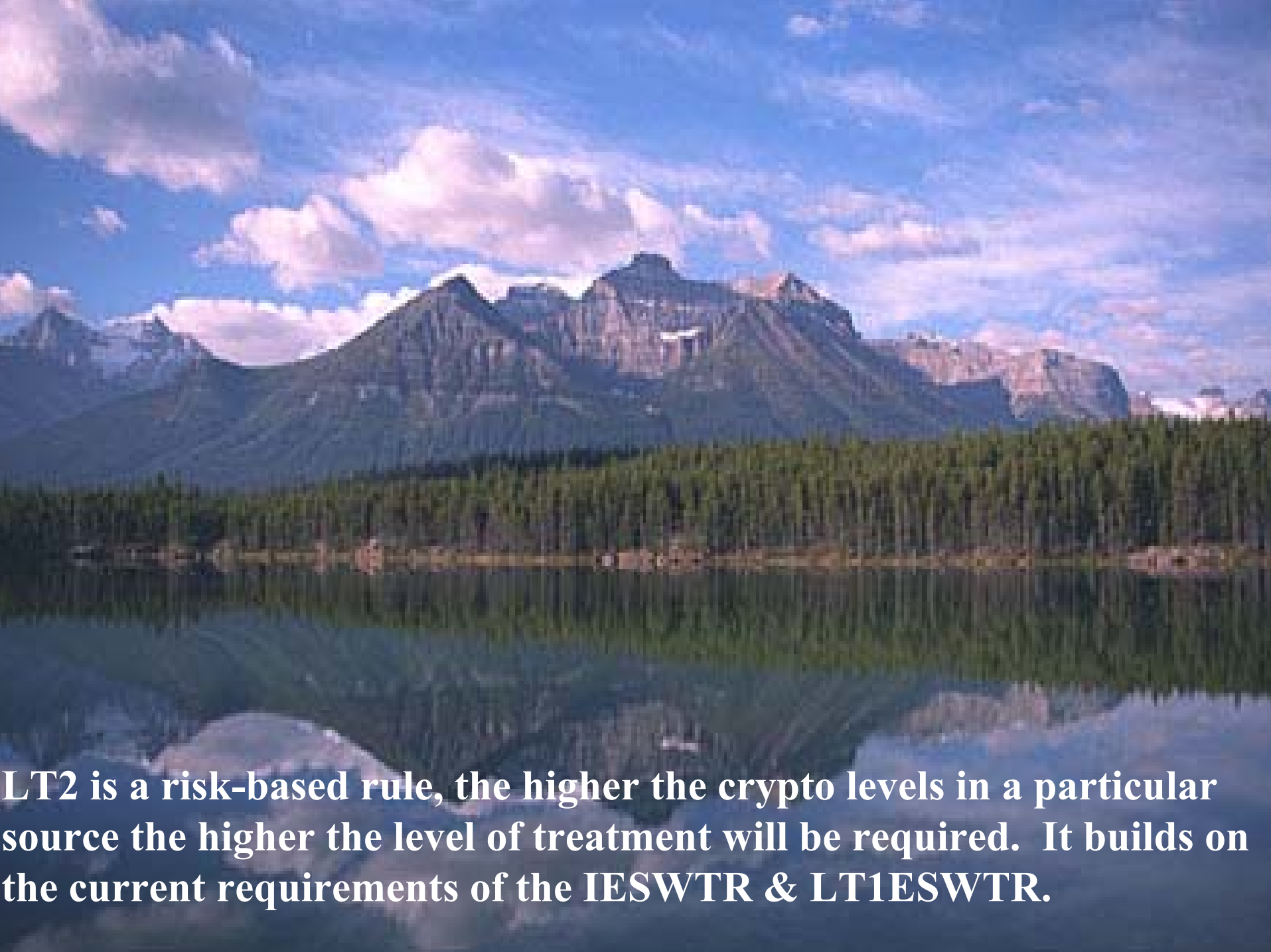
LT2 M-DBP Federal Advisory Committee

- Convened in March 1999 to develop recommendations for the Stage 2 DBPR and LT2ESWTR
  - 21 members representing: **utilities**; chemical and equipment manufacturers; federal, state and local governments; tribes; environmental, rate payer, and public health groups
  - 14 meetings over 18 months
- Agreement in Principle with consensus recommendations signed in September 2000



LT2 is a risk-based rule, the higher the crypto levels in a particular source the higher the level of treatment will be required. It builds on the current requirements of the IESWTR & LT1ESWTR.

LT2 Focus is on Cryptosporidium

- Monitoring: Crypto, E. coli, turbidity
- Crypto treatment: a toolbox of options
- Profiling: CT requirements for Giardia Lamblia & viruses
- Requirements for existing uncovered finished water reservoirs

LT2 Applicability

- **Applies to all subpart H (SW & GWUI) water systems**
- **Applicability issues**
  - **How should LT2 apply to small and large systems that use surface water for only part of the year?**
    - **Small systems that operate seasonally**

LT2 Waiver

- Filtered systems already achieving at least **≥ 5.5 logs** treatment (removal & inactivation) and unfiltered systems providing at least **≥ 3.0 logs** of inactivation for crypto are waived from:
  - Crypto monitoring requirements and subsequent bin classification
  - Profiling and benchmarking

LT2 Large system monitoring

- Large filtered systems: (serving > 10,000 people)
  - At least monthly source sampling for *Cryptosporidium*, *E. coli*, and turbidity for 2 years
- Large unfiltered systems: (>10,000)
  - At least monthly source sampling for Cryptosporidium for 2 years
- Monitoring for both begins: 6 months after final rule (2nd round 9 years)

LT2 Small system monitoring

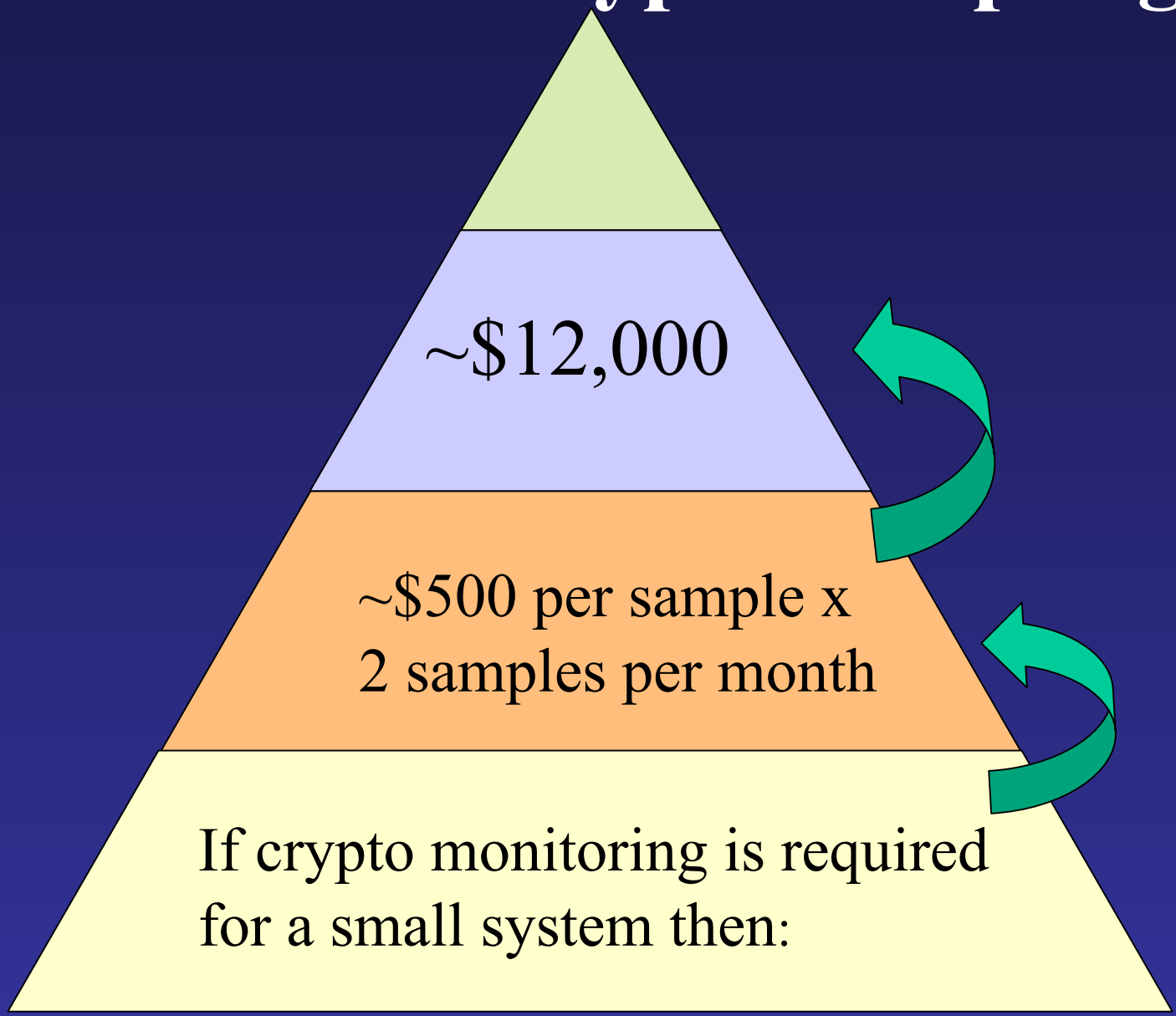
- Small filtered systems: (serving < 10,000 people)
  - *E. coli* source sampling for 1 year performed once every two weeks
    - Starting: 2.5 years after final rule (2nd round 11.5 years)
    - If the mean > 10/100 mL for lakes/reservoirs or > 50/100 mL for flowing streams then crypto monitoring is triggered
    - Twice-per-month source sampling for *Cryptosporidium* for one year if system exceeds *E. coli* trigger level
    - Starting: 4 years after final rule (2nd round 13 years)
- Small unfiltered systems (<10,000)
  - Twice-per-month source sampling for *Cryptosporidium* for 1 year
    - Starting: 4 years after final rule (2nd round 13 years)

LT2 Small system monitoring

If the mean > 10/100 mL for lakes/reservoirs or > 50/100 mL for flowing streams then crypto monitoring is triggered

So what is the E. coli trigger for a GWUI well that is drawing their water from fractured granite, karst, limestone or a mountainside that yields its infiltrated water in a spring?

LT2 Cost of crypto sampling



LT2 Sampling schedule

- Must submit a sampling schedule
  - 3 months prior to when sampling begins
  - The schedule needs to specify the calendar dates that all samples are going to be taken
  - 3 months prior to 2nd round of monitoring

LT2 Sampling schedule requirements

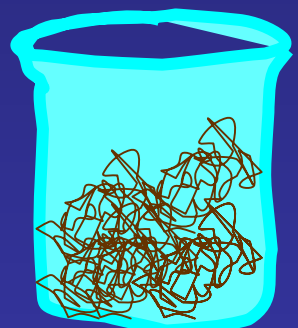
- Must collect samples within 2 days of the dates on the schedule
- Extreme conditions or unforeseen situations sample as close as feasible to scheduled date and provide written explanation
- Must collect replacement sample within 14 days of being notified by the lab or state that the requirements for meeting the analytical method have not been met including Quality Assurance

LT2 Analytical methods for crypto 1622 or 1623

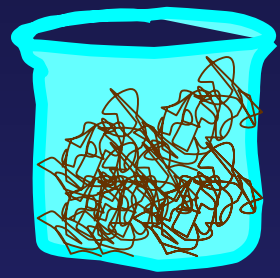
- The methods are inter-laboratory validated and were used to analyze approximately 3,000 field and QC samples during the Information Collection Rule Supplemental Survey
- Method 1622 analyzes for Crypto in water by filtration, immunomagnetic separation (IMS), and immunofluorescence assay (FA)
- Method 1623, simply adds Giardia and is discussed further

LT2 Method 1623: Summary

Starting from the time
the sample is collected in the field
the lab has 4 days to
filter the sample and
initiate washing the material off
of the filter



LT2 Method 1623

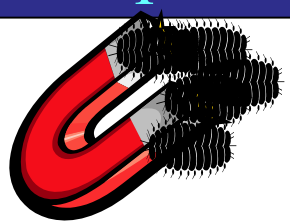


In one work day the lab must:

Step 1 Wash the material off the filter

Step 2 Concentrate it by centrifugation,

Step 3 Purify the sample. The protozoans are magnetized by attachment of magnetic beads joined together with anti-Crypto and anti-Giardia antibodies. Using a magnet the oocysts and cysts are separated from the extraneous material. The magnetic bead complex is then detached and the purified sample is applied to a slide.



LT2 Method 1623: Summary

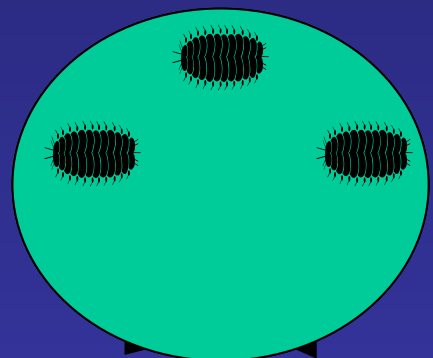
Step 4 Once the purified sample is applied to a slide the lab has 3 days to stain the slide

The oocysts and cysts are stained with fluorescently labeled monoclonal antibodies and 4`, 6 diamidino-2-phenylindole(DAPI). The DAPI stains nuclei in the protozoa to help the microscopist see the internal features of a target organism

LT2 Method 1623: Summary

The lab has 7 days to examine the slide after staining

- Each slide is analyzed for objects that meet the size, shape and flourescence typical of oocysts and cysts
- Any atypical organisms identified through FITC or DAPI staining and differential interference contrast (DIC) microscopy are left out of a total count
- A final count is derived from the total number of objects less atypical organisms



LT2 Method 1623: Limitations

- 1623 will not identify:
  - The species of crypto:
    - C. parvum (mammals, including humans); C. baileyi and C. meleagridis (birds); C. muris (rodents); C. serpentis (reptiles); C. nasorum (fish)
  - The species of Giardia:
    - G. Lamblia (humans/mammals) and G. muris (mice)
  - The host species of origin
  - The viability or infectivity

LT2 Method 1623: Limitations

- The average recovery rate for 1623 is ~40% meaning that 40% of the oo/cysts present would be detected.
- Compared to other methods for isolating and detecting Cryptosporidium and Giardia, this is a good recovery
- It underestimates the total number, but counts oo/cysts that may not be viable and infectious. These two factors are offsetting so no correction is made for low recovery.
- Nonetheless, all systems are categorized on this same basis
- This is the state of science at this time

LT2 Method 1623: Interferences

- Interferences with detection and identification of oocysts and cysts:
  - Turbidity
  - High levels of algae and bacteria
  - Other protozoa
  - Organisms and debris that autofluoresce which may cause false positives

LT2 1623 Sample collection

- For bulk samples completely fill a 10 liter (2.64 gal) LDPE container
- Must be shipped via overnight mail (22 lbs plus ice and container) on the day they are collected
- Refrigerate or put into a cooler with ice
- Samples must arrive < 10°C and must not be allowed to freeze
- Lab records the temp upon receipt, samples >10°C are rejected by the lab

LT2 1623 Sample collection

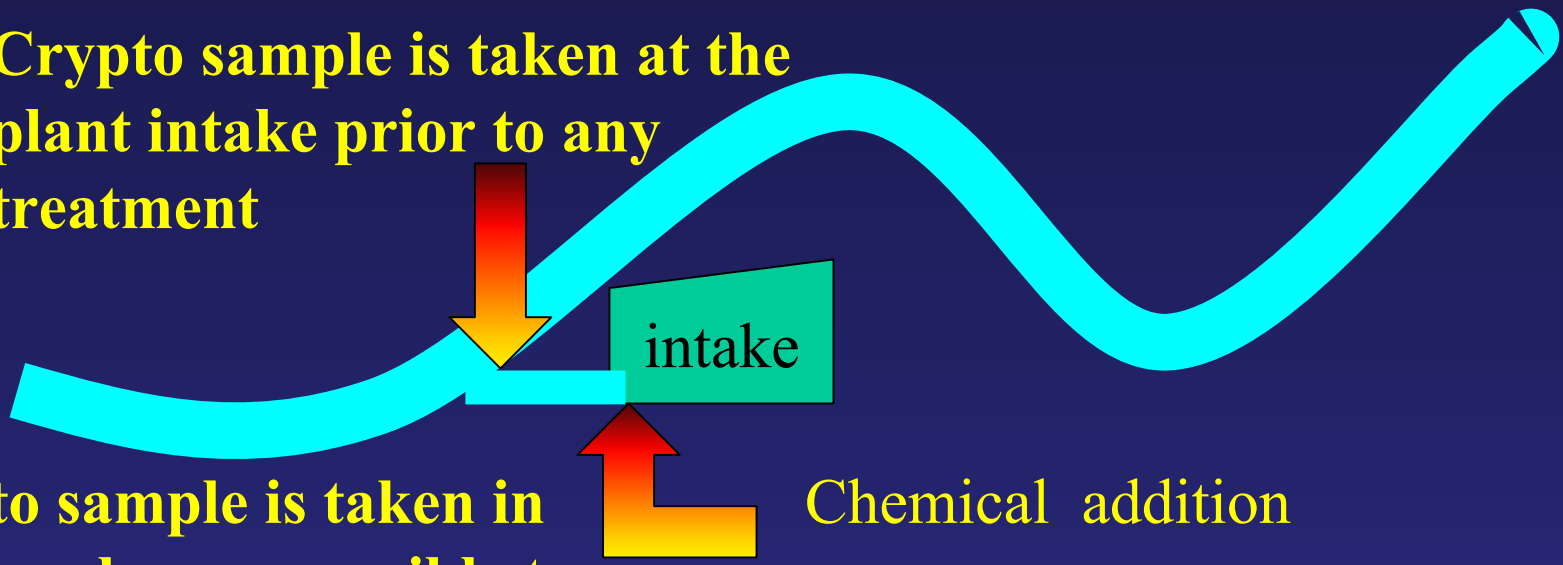
- The system is allowed to filter in the field and mail the filter. However the method has strict QA requirements for filtration that may not be feasible for small systems.
- A duplicate sample must be sent with the 1st (or as soon as possible) and 21st sample, which the lab will spike with a known number of oo/cysts, called a matrix spike

LT2 1623 Sample collection

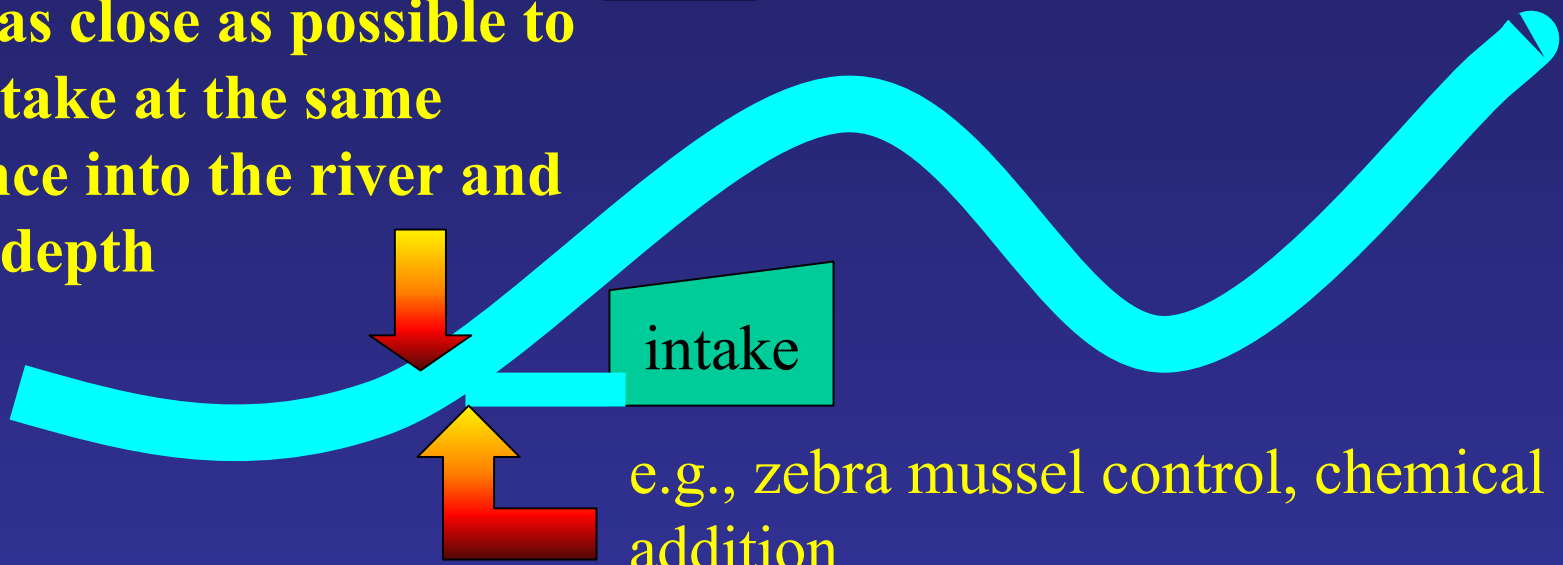
- Systems are required to analyze at least a 10 L sample or a packed pellet volume of at least 2 mL.
- Systems unable to process a 10 L sample must analyze as much sample volume as can be filtered by two filters (approved for 1623) up to a packed pellet volume of 2 mL

LT2 Sampling location (river)

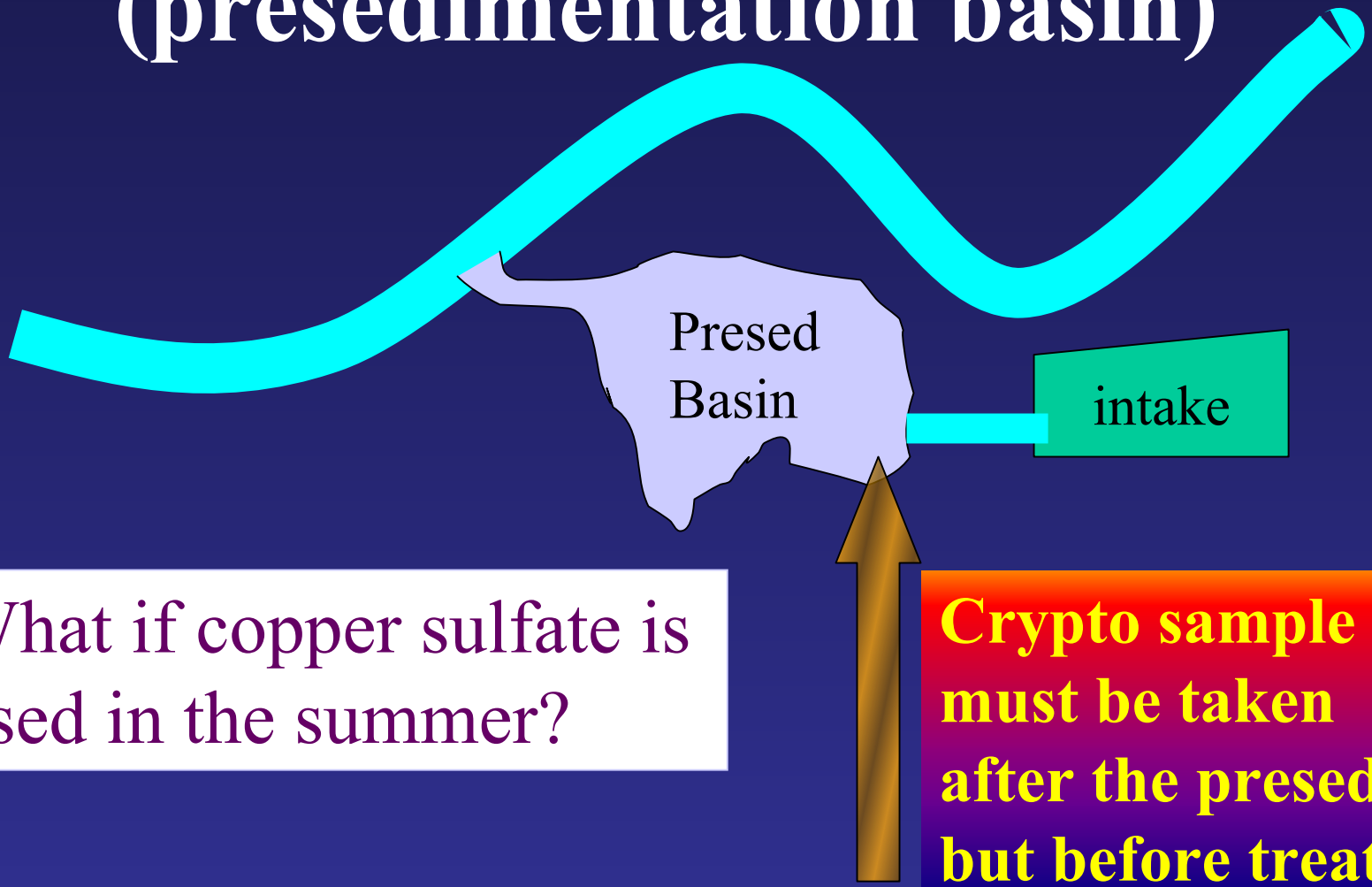
Crypto sample is taken at the plant intake prior to any treatment



Crypto sample is taken in river as close as possible to the intake at the same distance into the river and same depth



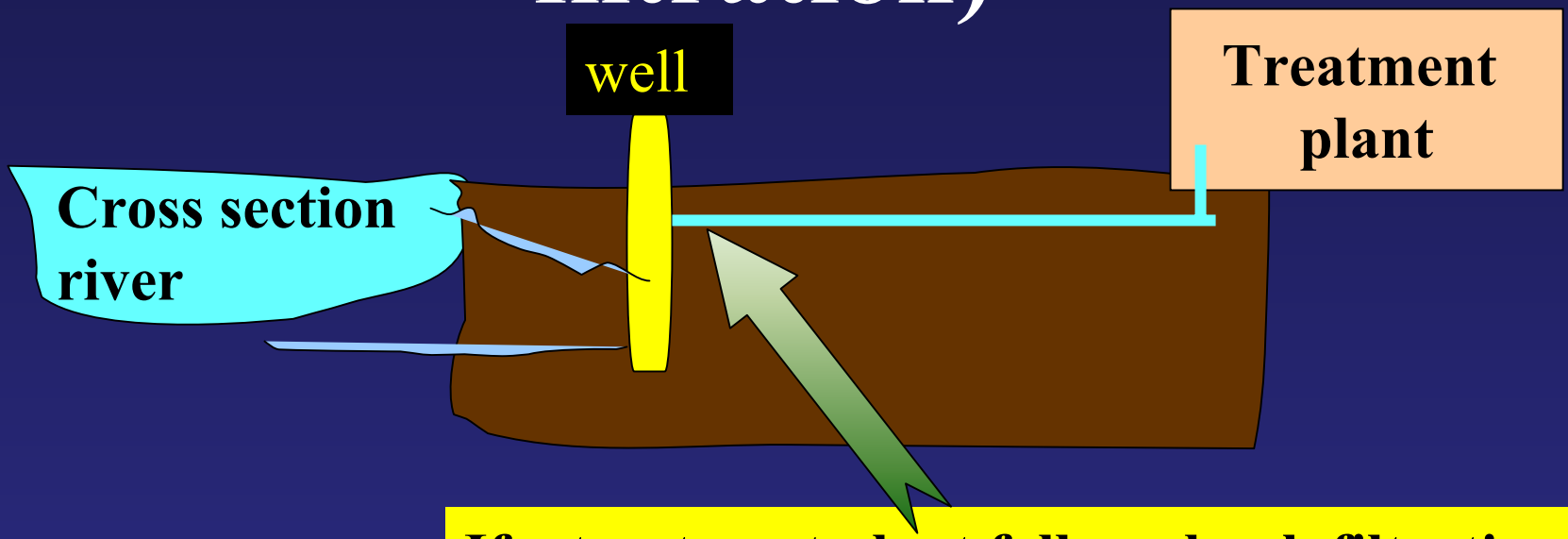
LT2 Sampling location (presedimentation basin)



What if copper sulfate is used in the summer?

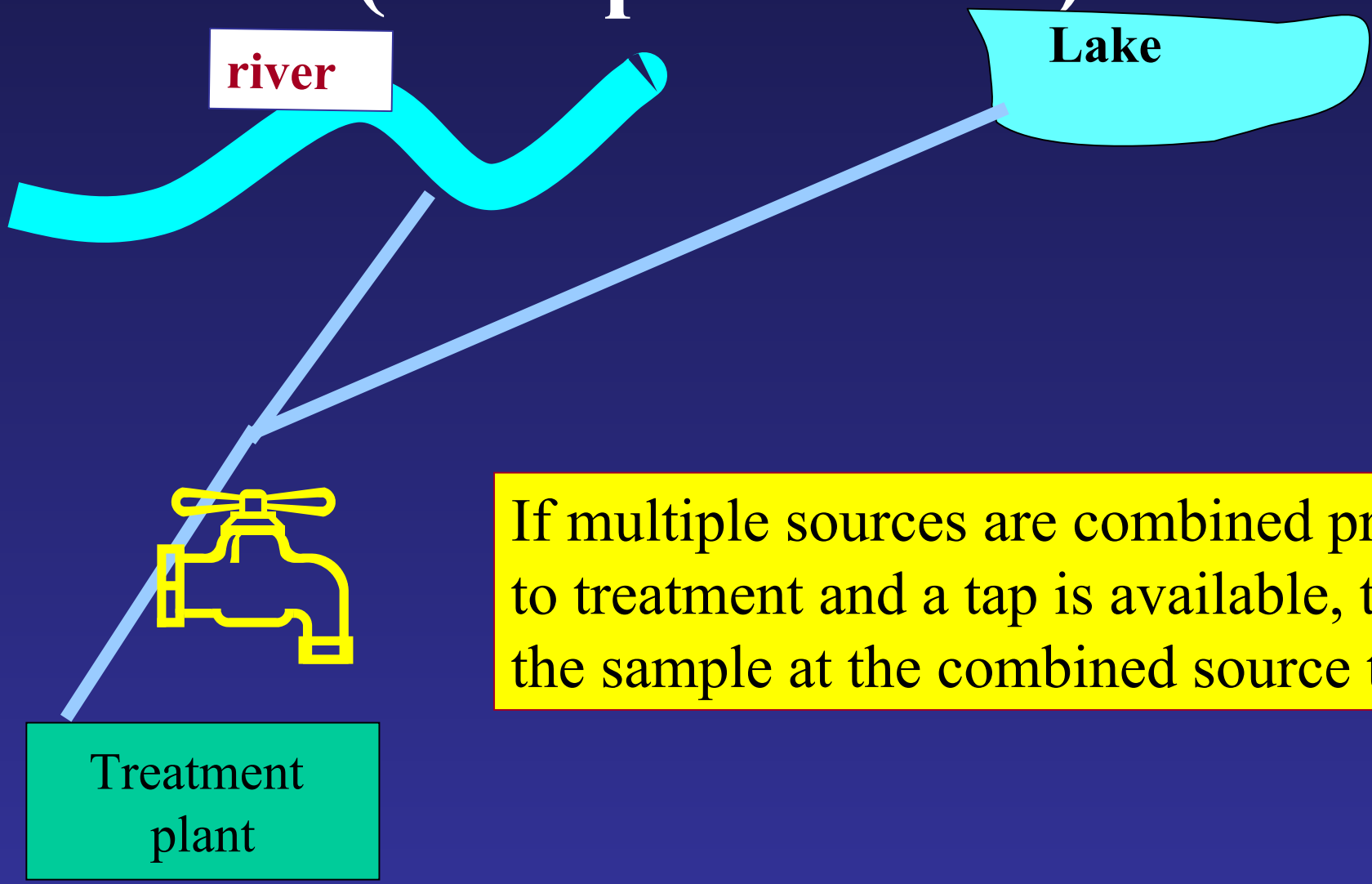
Crypto sample must be taken after the presed basin but before treatment

LT2 Sampling location (bank filtration)



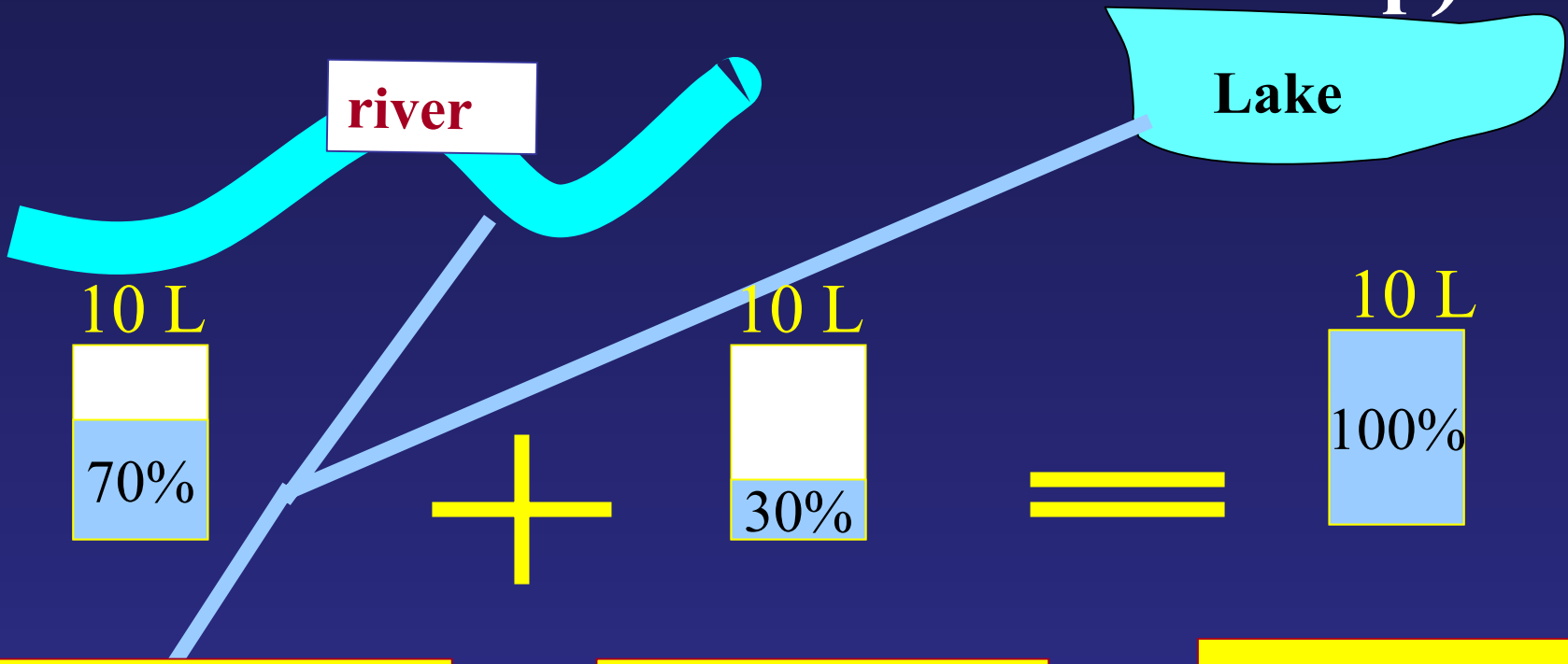
If a treatment plant follows bank filtration, take the sample after the well (also, GWUI or GWUI meeting the avoidance criteria)

LT2 Sampling location (multiple sources)



If multiple sources are combined prior to treatment and a tap is available, take the sample at the combined source tap

LT2 Sampling location (multiple sources w/o combined source tap)

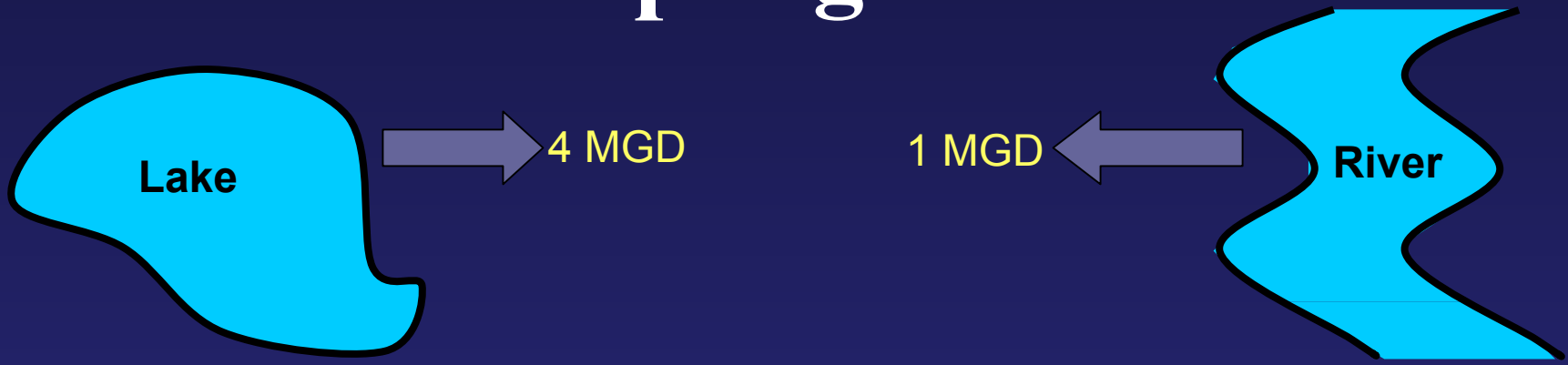


70% of flow is from the river, fill this sample 70% full

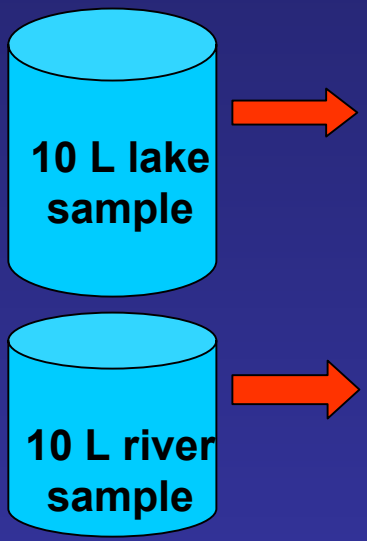
30% of flow is from the lake, fill this sample 30% full

Combine samples into one proportionally representative sample

LT2 Sampling location



Analyze each sample. Calculate a flow-weighted average.



$$1 \text{ oocyst}/10 \text{ L} = 0.1 \text{ oocysts/L} \times \frac{4 \text{ MGD}}{5 \text{ MGD}} = 0.08 \text{ oocysts/L}$$

$$+$$

$$2 \text{ oocysts}/10 \text{ L} = 0.2 \text{ oocysts/L} \times \frac{1 \text{ MGD}}{5 \text{ MGD}} = 0.04 \text{ oocysts/L}$$

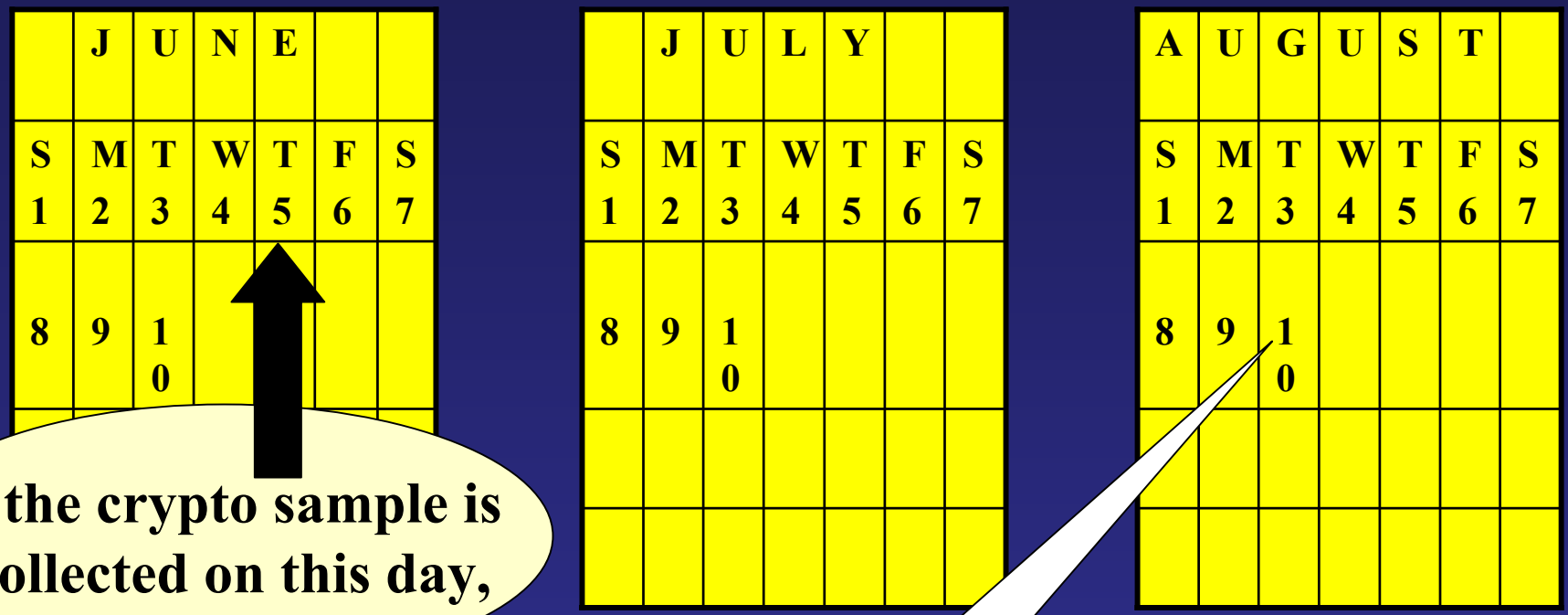
$$= \mathbf{0.12} \text{ oocysts/L}$$

LT2 Using past crypto data

Grandfathering of past crypto data back to Jan. 1999, collected at least monthly on a regular basis is allowed

If this applies to you, see 141.708 in the proposal and the draft document entitled: Guidance on Generation and Submission of Grandfathered Crypto Data for Bin Classification Under the LT2ESWTR

LT2 Reporting timeframe



If the crypto sample is collected on this day,

Must be reported no later than

LT2 E. coli sample collection

24 hours

Since this is a source water E. coli sample, the time from sample collection to initiation of analysis may not exceed 24 hours

Systems must maintain samples between 0 and 10°C during transit. There are 14 methods listed in the proposal to test for E. coli in the source water.

LT2 Crypto results to bin concentration

Monitoring:

Filtered and unfiltered systems >10,000 must sample crypto at least once per month for 2 years or 24 samples

Bin Calculation:

For systems >10,000 that collect at least 24 but not more than 47 samples, the crypto bin concentration is equal to the highest arithmetic mean of all sample concentrations in any consecutive 12 month period (a twelve month running annual average)

If 48 samples are collected, bin concentration is equal to the arithmetic mean of all samples

LT2 Crypto results to bin concentration

- Monitoring:
  - Filtered <10,000 (that trigger crypto monitoring) and unfiltered systems <10,000 must sample at least two times each month or 24 samples in one year
- Bin concentration:
  - For systems <10,000 and take at least 24 samples the bin concentration is equal to the arithmetic mean of all sample concentrations

LT2 Crypto results to bin concentration

Arithmetic mean is the number obtained by dividing the sum of a given set of quantities (e.g., concentration in oocysts per liter) by the number of quantities in the set (e.g., 24 samples)

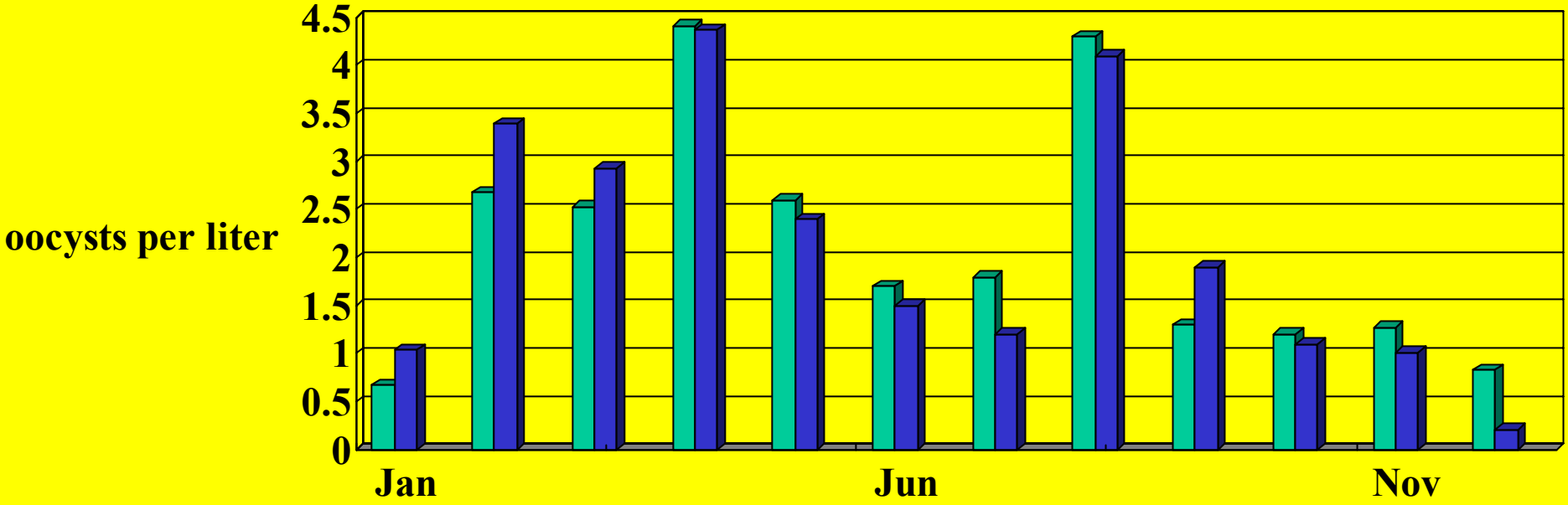
LT2 Crypto bin concentration

For a system <10,000 taking 2 samples per month for one year the oocysts per liter are calculated for each sample:

sample date	oocysts	sample volume	oocysts/L
1/4/ - -	7	10. 4 L	0. 67
1/19/ - -	10	9. 6 L	1. 04
2/4/ - -	30	11. 2 L	2. 68
2/19/ - -	42	12. 4 L	3. 39
3/4/ - -	22	8. 7 L	2. 53
3/19/ - -	27	9. 2 L	2. 93
4/4/ - -	45	10. 2 L	4. 41
4/19/ - -	55	12. 6 L	4. 37
. . .	. . .	. . .	. . .
11/4/ - -	13	10. 2 L	1. 27
11/19/ - -	10	9. 9 L	1. 01
12/4/ - -	8	9. 7 L	0. 83
12/19/ - -	2	9. 6 L	0. 21

LT2 Crypto bin concentration

Sample results <10,000, 2 samples per month for 1 year



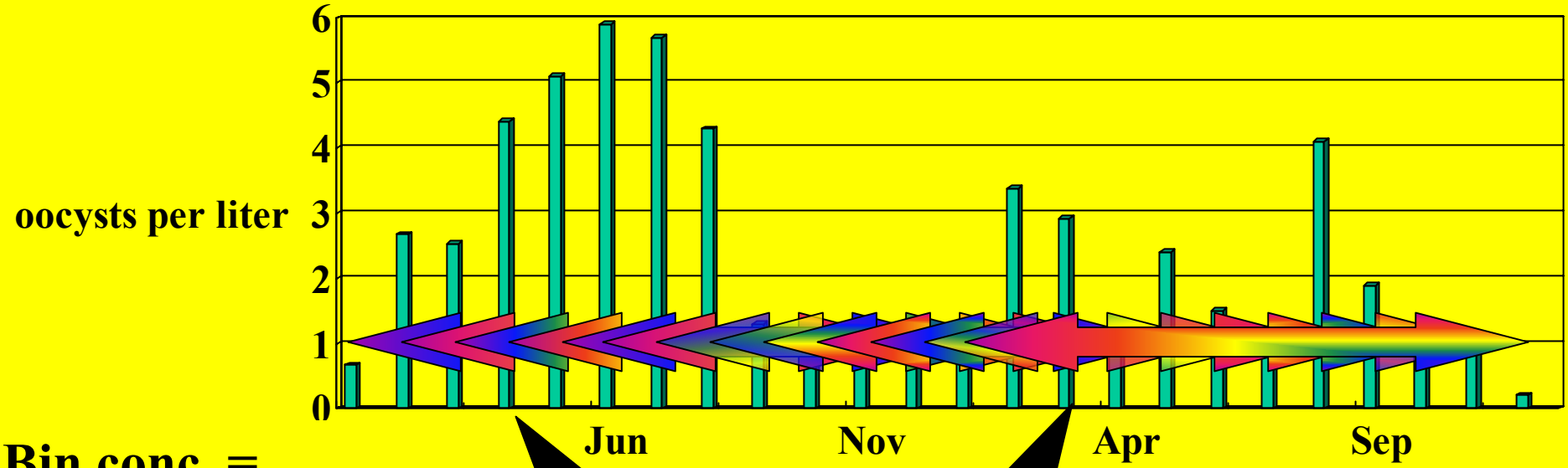
Bin concentration = arithmetic mean of all samples:
Total the oocysts per liter for each sample and divide by the number of samples or:

$$\frac{\text{50.44 oocysts/L}}{\text{24 samples}} = \text{2.1 oocysts/L}$$

Bin 3

LT2 Crypto bin concentration

For sytems >10,000, at least 1 sample per month for 2 years (collect at least 24 but not more than 47 samples)



Bin conc. = highest arithmetic mean of all sample concentrations in any consecutive 12 month. Occurs between

Apr

Mar

3.11 oocysts/L

Bin 4

LT2 Bin requirements Table

	Mean Crypto concentration
Bin 1	< 0.075 oocysts/L
Bin 2	≥ 0.075 oocysts/L but < 1.0 oocysts/L
Bin 3	≥ 1.0 oocysts/L but < 3.0 oocysts/L
Bin 4	≥ 3.0 oocysts/L

LT2 Filtered systems—How many oocysts is that per bin?

If every sample was exactly 10.00 liters then the max # of oocysts allowed for each bin for different means would be:

Crypto conc. oocysts per liter	Mean of 48, total oocysts allowed in 48-10.00 L samples	Mean of 24, total oocysts allowed in 24-10.00 L samples	Mean of 12, total oocysts allowed in 12-10.00 L samples
< 0.075 **(Bin 1)**	35	17	8
< 1.0 (Bin 2)	479	239	119
< 3.0 (Bin 3)	1439	719	359
≥ 3.0 (Bin 4)	1440 and up	720 and up	360 and up

LT2 Bin to treatment level

Additional logs of treatment needed per bin level

Bins	Conv.	Direct	SS/DE	Alt. Filt.*
Bin 1	None	None	None	None
Bin 2	1 log	1.5 log	1 log	Total 4.0 logs
Bin 3	2 log	2.5 log	2 log	Total 5.0 logs
Bin 4	2.5 log	3 log	2.5 log	Total 5.5 logs

***Total logs of Crypto removal and inactivation is at least the value in this column**

LT2 Bin Table

- The IESWTR grants 2 logs of removal for crypto if turbidity levels are met and is based on the minimum logs of removal
- FACA prescribed a total of 5.5 logs of crypto reduction for systems in bin 4
- The log removal credit of 3.0 (or 2.5 for direct filtration) is not necessary for bin 1 that credit applies to the total treatment requirements in bins 2-4
- So any system in Bin 4 will be providing a total of 5.5 logs of reduction

LT2 Bin Table

- Systems in Bins 3 and 4 must achieve at least 1 log of additional treatment using:
  - Bag filters
  - Cartridge filters
  - Bank filtration
  - Chlorine dioxide
  - Membranes
  - Ozone
  - UV

LT2 Failure to monitor for crypto

Any filtered system that fails to complete the monitoring or chooses not to monitor must meet the treatment requirements for Bin 4

LT2 Unfiltered systems

Mean Crypto concentration of 0.01 oocysts/L or less	Must provide at least 2 logs of Crypto inactivation
Mean Crypto concentration of greater than 0.01 oocysts/L	Must provide at least 3 logs of Crypto inactivation

Unfiltered systems must calculate the arithmetic mean of all crypto sample concentrations.

LT2 Unfiltered systems

Max # of oocysts allowed to maintain 2 logs of inactivation

Crypto conc. oocysts per liter	Mean of 48, total oocysts allowed in 48 - 10L samples	Mean of 36, total oocysts allowed in 36 - 10L samples	Mean of 24, total oocysts allowed in 24 - 10L samples
<0.01 **2 log inactivation**	4	3	2
>0.01 3 log inactivation	5 and up	4 and up	3 and up

LT2 Failure to monitor for crypto

Any unfiltered system that fails to complete the monitoring or chooses not to monitor must meet 3 logs of inactivation

LT2 Profiling and Benchmarking

Subpart H community and NTNC systems serving > 10,000 people that do not provide at least 5.5 logs of crypto treatment must develop Giardia and virus disinfection profiles

Unless a profile was developed under IESWTR and no change in disinfection practices

LT2 Profiling and Benchmarking

Subpart H community and NTNC systems serving < 10,000 people that do not provide at least 5.5 logs of crypto treatment must develop Giardia and virus disinfection profiles if any of the criteria apply:

System is required to monitor for crypto

TTHMs/HAA5s are at least 0.064 mg/L/0.048 mg/L respectively, as a locational running annual average

Unless a profile was developed in LT1

LT2 Profiling & Benchmarking

Systems >10,000 begin 2 yrs after final rule

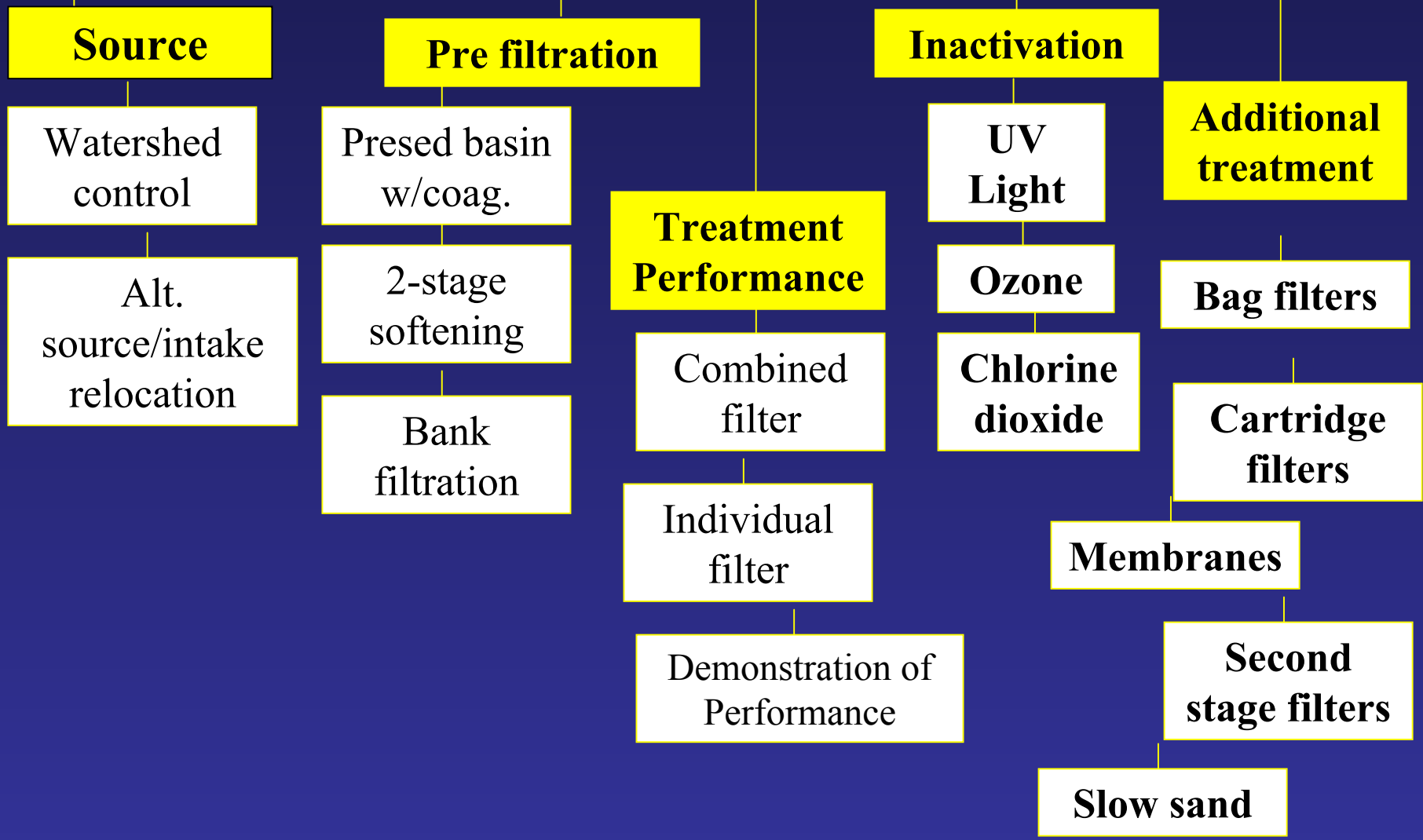
Systems <10,000 with E. coli levels below the level to trigger crypto monitoring begin 3.5 yrs after the final rule

Systems <10,000 that triggered crypto monitoring begin 4.5 yrs after final rule

Systems must monitor at least weekly for 12 consecutive months to determine log inactivation for Giardia and viruses

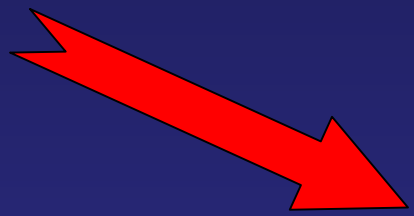
Systems must determine log inactivation for Giardia and viruses through the entire treatment plant

Microbial Toolbox*



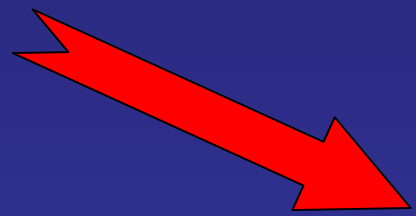
LT2 Treatment technique implementation, if triggered

Subpart H filtered/unfiltered >10,000



6 years after the final rule

Subpart H filtered and unfiltered <10,000



8.5 years after the final rule

LT2 Toolbox: source option #1

- **Watershed control program**
  - **1 yr after sampling notify State of intent**
  - **2 yrs after sampling submit proposed plan:**
    - **Vulnerability of each source to crypto**
    - **Analysis of control measures**
    - **A plan that has specific actions to reduce crypto**
  - **If approved by the State, the system is granted an additional 0.5 log removal credit and…**

LT2 Toolbox: source option #1

- **Watershed control program (cont)**
  - **Must complete actions to maintain approval:**
    - **Submit an annual watershed control program status report**
    - **Submit an annual watershed sanitary survey report**
    - **Submit a request for re-approval for a subsequent approval period**
    - **All of the above must be made available to the public (security considerations may limit information)**
  - **Valid until the 2nd round of crypto monitoring**
  - **Specific criteria 141.725(a)**

LT2 Toolbox: source option #2

- **Alternative source/intake management**
  - **If approved by the State, the system may be classified in a bin based on concurrent crypto monitoring for either:**
    - **New intake location (same or different source)**
    - **Alt. procedure for managing the level that the water is withdrawn from**
  - **If this results in a lower bin, then the new source or management strategy must be routinely used**
  - **Specific criteria 141.725(b)**

LT2 Toolbox: Prefilter option #1

- **Presedimentation basin with coagulation. Only new presed basins existing after crypto monitoring begins and meeting the criteria below are eligible for 0.5 log credit:**
  - **Continuous operation treating 100% of the flow**
  - **Continuous coagulant addition**
  - **The influent and effluent turbidity must be measured at least once per day**
  - **Must achieve 0.5 log reduction of influent turbidity in 11 of 12 months**
  - **Specific criteria 141.726(a)**

LT2 Toolbox: Prefilter option #2

- **Two-stage lime softening**
  - **0.5 log credit for second stage softening operated continuously**
  - **Coagulant addition**
  - **Treats 100% of flow**
  - **Specific criteria 141.726(b)**

LT2 Toolbox: Prefilter option #3

- **Bank filtration:**
- **Credit only applies to bank filtration that serves as pretreatment to a filter plant**
- **Credit only applies to bank filtration operational after crypto monitoring has begun**
  - **Existing bank filtration has already been credited removal due to sampling occurring after the well (such as GWUI sources)**
- **Credit only applies to granular, unconsolidated aquifers comprised of silt, clay, rock fragments, pebbles, minor cement friable upon touch**
  - **Consolidated aquifers, fractured bedrock, karst limestone and gravel are not eligible**

LT2 Toolbox: Prefilter option #3

- Credit only applies to horizontal and vertical wells
  - Spring boxes and infiltration galleries are not eligible
- Systems must meet the requirements in this section and if:
  - 25 ft away from a SW source are eligible for 0.5 log crypto removal credit
  - 50 ft away from a SW source are eligible for 1.0 log crypto removal credit
- Systems must also monitor turbidity every 4 hours from each well with the monthly average < 1 NTU
- Specific criteria 141.726(c)

LT2 Toolbox: Treatment performance option #1

- **Combined filter performance (conventional and direct)**
  - **0.5 log credit for combined filter effluent of less than or equal to 0.15 NTU in 95% of samples each month**
  - **Systems may not claim credit for combined and individual filter performance in the same month**
  - **Specific criteria 141.727(a)**

LT2 Toolbox: Treatment performance option #2

- **Individual filter performance (conventional and direct)**
  - **1.0 log credit can be claimed if the individual filter effluent values are less than or equal to 0.1 NTU in 95% of the maximum daily values each month**
  - **No filter is greater than 0.3 NTU in two consecutive measurements**
  - **Specific criteria 141.727(b)**

LT2 Toolbox: Treatment performance option #3

- **Demonstration of Performance**
  - **Systems may demonstrate to the State using State-approved protocols that a plant or unit process achieves a mean crypto removal greater than presumed credits**
  - **Must be able to demonstrate that any increased removal can be achieved on a continuous basis**
  - **If tests show less than presumed credit, State may assign lower removal credit**
  - **Specific criteria 141.727(c)**

LT2 Toolbox: Additional filtration option #1

- **Bag filters**
  - **1.0 log credit**
  - **If challenge testing shows at least 2 logs crypto removal and meets the criteria in this section**
  - **Specific criteria 141.728(a)**

LT2 Toolbox: Additional filtration option #2

- **Cartridge filters**
  - **2.0 log credit**
  - **If challenge testing shows at least 3 logs crypto removal and meets the criteria in this section**
  - **Specific criteria 141.728(a)**

LT2 Toolbox: Additional filtration option 1 and 2 (cont)

- **Bag & Cartridge filters:**
- **Conducted on full-scale filter element (may be performed by manufacturer)**
  - **Conducted with crypto oocysts or a surrogate that is removed no more efficiently than crypto**
  - **Conducted at maximum design flow**
  - **Must reach 100% of terminal pressure drop**
  - **Three testing periods:**
    - **2 hrs of start-up**
    - **45% to 55% of terminal pressure drop**
    - **After 100% of terminal pressure drop**

LT2 Toolbox: Additional filtration option #3

- **Membranes (MF, UF, NF, RO)**
  - **Are eligible for a crypto removal credit equal to the lower value of:**
    - **Removal efficiency demonstrated during challenge testing**
    - **Maximum removal efficiency that can be verified through direct integrity testing**
  - **Specific criteria 141.728(b)**

LT2 Toolbox: Additional filtration option #4

- **Second stage filtration**
  - **0.5 log credit if there is a separate second stage filtration consisting of rapid sand: dual, tri or GAC media**
  - **First stage of filtration must be proceeded by a coagulation step**
  - **100% of the flow must go through second filter**
  - **Specific criteria 141.728(c)**

LT2 Toolbox: Additional filtration option #5

- **Slow sand filtration**
  - **2.5 log credit for SS if it follows existing filtration**
  - **100% of flow must go through SS**
  - **No disinfectant residual is present in the influent to SS**
  - **Specific criteria 141.728(d)**

LT2 Toolbox: Inactivation option #1

- Chlorine Dioxide
  - Log credit based on demonstration of compliance with CT tables
  - Daily calculation of CT
  - Specific criteria 141.729(b)

LT2 Toolbox: Inactivation option #2

- Ozone
  - Log credit based on demonstration of compliance with CT tables
  - Daily calculation of CT
  - Specific criteria 141.729(c)

Ct values for crypto inactivation by ozone

Log credit	1°C	5°C	10°C	15°C	20°C	25°C
0.5	12	7.9	4.9	3.1	2.0	1.2
1.0	23	16	9.9	6.2	3.9	2.5
1.5	35	24	15	9.3	5.9	3.7
2.0	46	32	20	12	7.8	4.9
2.5	58	40	25	16	9.8	6.2
3.0	69	47	30	19	12	7.4

LT2 Toolbox: Inactivation option #3

- Ultraviolet irradiation
  - Log credit based on demonstration of compliance with UV dose table
  - UV dose table is only applicable to post-filter application of UV for filtered systems and unfiltered systems meeting the avoidance criteria
  - Specific criteria 141.729(d)

LT2 Toolbox: Inactivation option #3

The numbers in the UV inactivation table are expressed as Irradiance (I) x Time (T) or (IT)

- Irradiance is measured in milliWatt/cm^2
- Time measured in seconds from detention time equations

$$\text{Detention time (seconds)} = \frac{\text{volume of the UV chamber (gal)}}{\text{flow (gal/sec)}}$$

Therefore, the units are milli Watt – sec/cm^2

Is a Joule, the units in the UV Table are mJ/cm^2

UV dose table

Log credit	Crypto UV dose mJ/cm2	Giardia UV dose mJ/cm2	Virus UV dose mJ/cm2
0.5	1.6	1.5	39
1.0	2.5	2.1	58
1.5	3.9	3.0	79
2.0	5.8	5.2	100
2.5	8.5	7.7	121
3.0	12	11	143
3.5	NA	NA	163
4.0	NA	NA	186

LT2 UV Water quality impact

- **The effectiveness of UV does not appear to be impacted by:**
  - **pH**
  - **Water temperature**
  - **Alkalinity**
  - **Turbidity no statistical difference up to 4 NTU, impacts were observed at 13 NTU**
  - **Algae up to 27,000 cells/ml did not physically interfere, higher dose needed**
  - **TOC up to 11 mg/L did not physically interfere, higher dose needed**

LT2 UV and DBP formation

- **Even at 130 mJ/cm^2 (normal dose 30 to 40) there was:**
  - **No change in TTHM levels**
  - **No change in HAA5 levels**
  - **No change in dissolved organic carbon**
  - **No change in biodegradable organic matter**
  - **No change in aldehydes**
  - **No change in nitrate or nitrite**
- **You had to increase the dose to 1,300 mJ/cm^2 to observe a 10% increase in TTHMs, HAA5s and BOM**

LT2 What can impact UV?

- Sleeve fouling and scaling due to calcium hardness, iron and other parameters affecting rate of sleeve fouling
  - Mitigated by cleaning systems and in worst case manual cleaning
- Power quality and supply
- Lamp aging
- System hydraulics
- Operation outside of validated limits (e.g., flow is over the range of flows validated for the UV unit)

LT2 UV Repair and regrowth

- **Bacteria:**
  - **Can repair under proper conditions, residual disinfection inhibits repair**
- **Cryptosporidium:**
  - **Photo repair gene sequence not present in crypto—repair will not occur**
- **Viruses:**
  - **Photo repair gene sequence not present in viruses—repair will not occur**

LT2 Uncovered finished water reservoirs

- **Must meet one of the three criteria for uncovered finished water reservoirs 3 yrs after the final rule**
  - **Cover any existing finished water reservoir**
  - **Treat the discharge from the reservoir to the distribution system to achieve a 4-log virus inactivation**
  - **Develop a risk mitigation plan which addresses physical access, surface water runoff, animal and bird waste, and ongoing water quality assessment. The plan must be approved by the State**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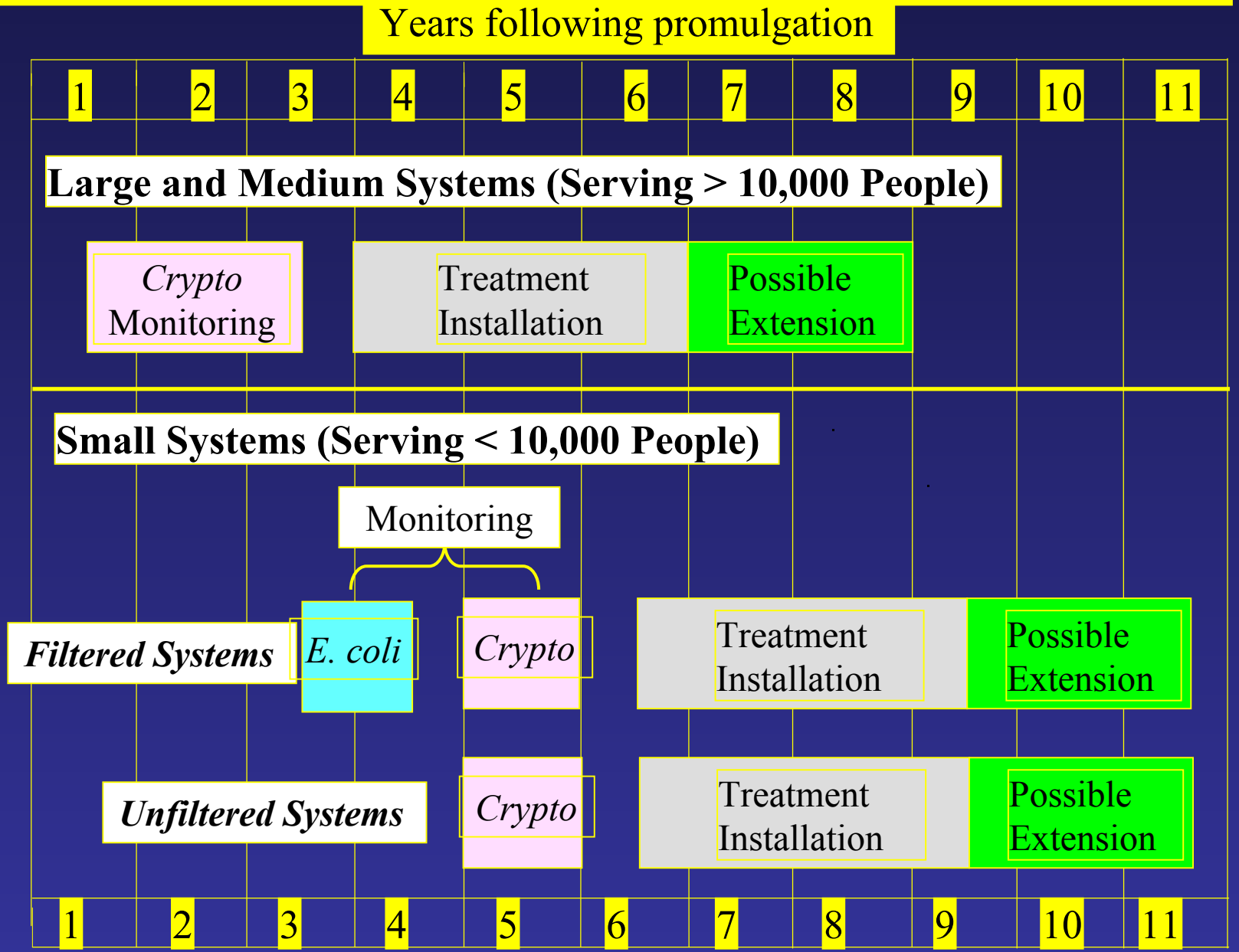
LT2 Implementation Schedule



EPA Implementation support

- Laboratory quality assurance program for *Cryptosporidium* analysis
- Development of data system to support reporting and analysis of microbial monitoring results
- Guidance manuals
  - **Microbial sampling**
  - **Microbial analysis**
  - **UV disinfection**
  - **Microbial toolbox**
  - **Membranes**

LT2 Unfiltered systems

The following slides are extra and were not included in the original presentation

LT2 Unfiltered systems

To meet the crypto inactivation requirements unfiltered systems must use one or more of the following disinfectants:

Chlorine Dioxide

Ultra violet

Ozone

LT2 Unfiltered systems

Unfiltered systems that use chlorine dioxide or ozone and fail to meet the 2 or 3 log inactivation more than 1 day in a calendar month

Only 1.5 log on 7/17 & 7/18 treatment technique violation

	J	U	L	Y		
S 1	M 2	T 3	W 4	T 5	F 6	S 7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

Must calculate contact time (CT) everyday

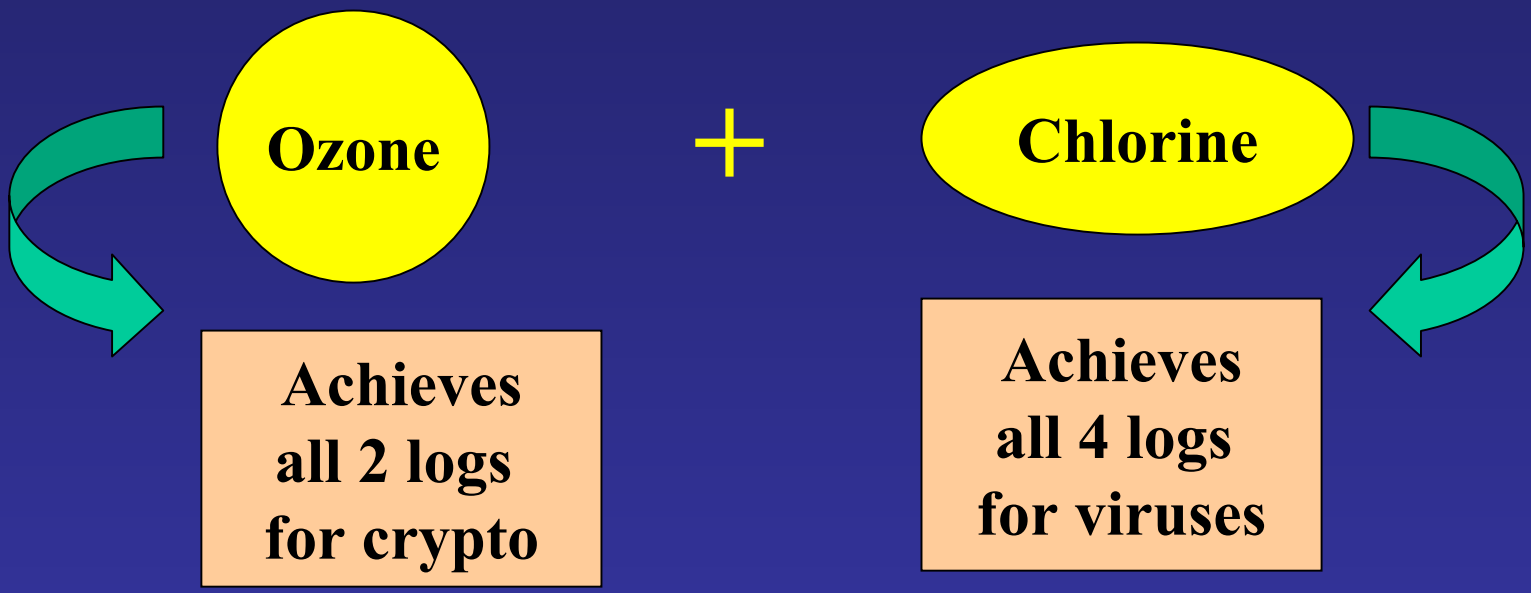
LT2 Unfiltered systems

Unfiltered systems that use UV and fail to meet the 2 or 3 log inactivation in at least 95% of the water delivered to the public each month = treatment technique violation

100,000 gals delivered in July → **94,000 gals met the 2 or 3 logs UV inactivation** → **Treatment technique violation**

LT2 Unfiltered systems

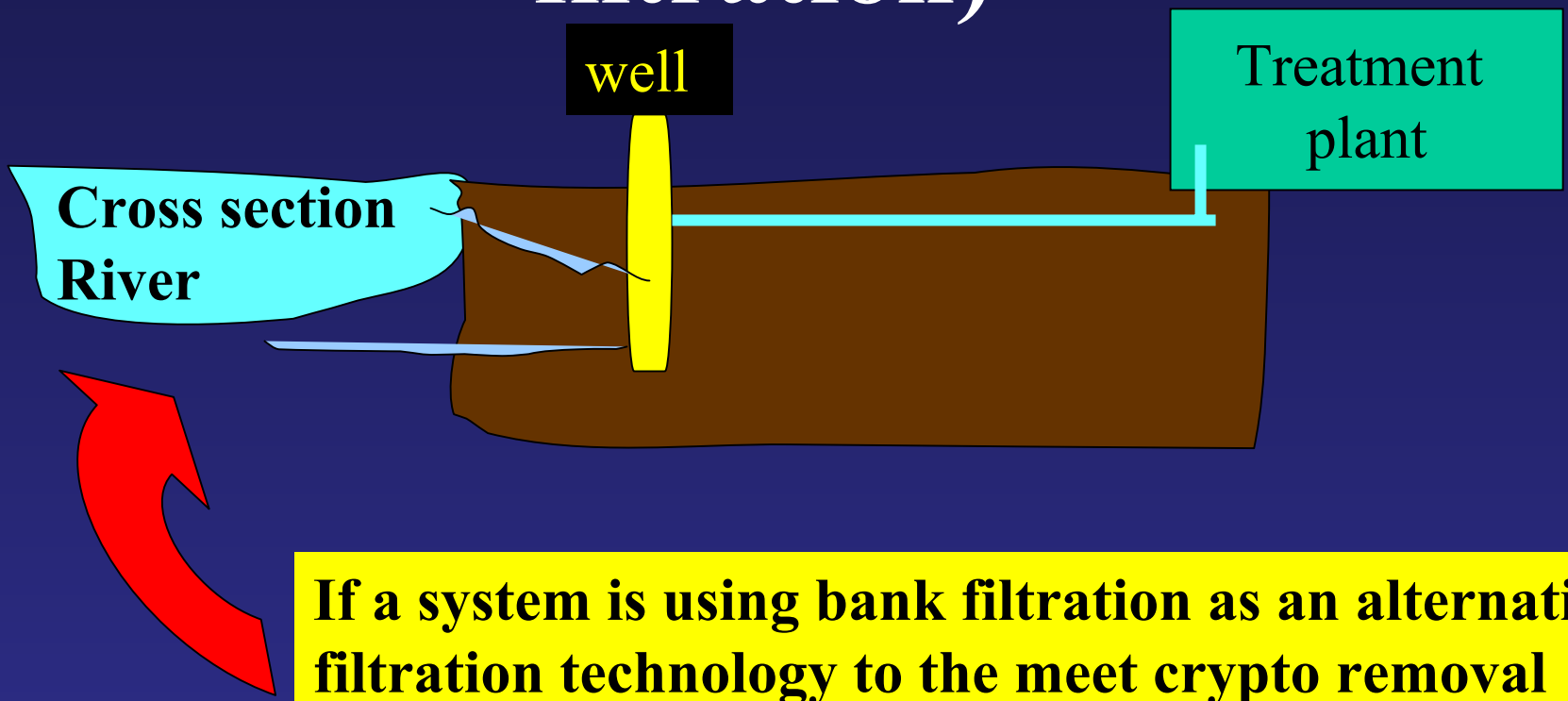
Unfiltered systems must meet the combined 2 or 3 logs Crypto, 3.0 logs Giardia & 4 logs virus with a minimum of two disinfectants where each disinfectant must separately achieve the total inactivation for either Crypto, Giardia or viruses



LT2 Definitions

- **Bag filters, bank filtration, cartridge filters, flowing stream, lake/reservoir, membrane filtration, off-stream raw water storage, plant intake, presedimentation, two-stage lime softening**

LT2 Sampling location (bank filtration)



If a system is using bank filtration as an alternative filtration technology to the meet crypto removal requirements in the IESWTR or LT1 and has no further physical removal treatment must collect the source water samples from the surface water prior to bank filtration.