Safe Drinking Water Act (SDWA) Federal Regulations

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Safe Drinking Water Act - Federal Regulations

7 contact hours

9 CC10 hours

The Safe Drinking Water Act (SDWA) was established to protect public health by regulating the nation's public drinking water supply. The SDWA authorizes the United States Environmental Protection Agency (U.S. EPA) to set national health-based standards for drinking water to protect against both naturally-occurring and man-made contaminants that may be found in drinking water. Working together, Federal agencies, state agencies and water system personnel make sure that these standards are met. This course will introduce water supply system personnel to the most recent SDWA revisions, including Maryland regulations, the National Primary Drinking Water Regulations, and review of the 1996 amendments which greatly enhanced the existing law by recognizing source water protection, operator training, funding for water system improvements, and public information as important components of safe drinking water. Information about updated monitoring requirements, recordkeeping, emergency planning and response, and certification will be covered. **Please register early; this class is limited to 15 participants.**

1. Describe in general terms the regulatory and environmental intent of the Safe Drinking Water Act;
2. Discuss the most recent revisions in the Federal drinking water regulations, including how treatment and operations requirements have been increased;
3. State the potable water monitoring requirements for which water supply personnel are accountable, and how to apply this information in order to maintain compliance; and
4. Understand future treatment changes to consider for surface water systems.

Agenda

- Introductions, pre-test (60 minutes)
- Definitions and Terminology (60 minutes)
- SDWA History and Overview (60 minutes)
- Current Regulations and Rules (60 minutes)
- Lunch (60 minutes)
- Drinking Water Contaminants & MCLs (60 minutes)
- Sampling, Monitoring, and Record Keeping (60 minutes)
- Summary and Closing (30 minutes)
- Post Test and Evaluations (30 minutes)

Safe Drinking Water Act (SDWA) Federal Regulations

Eddie Cope, CET

1

SDWA Class Outline

- Introductions and Class Objectives
- Terminology
- SDWA History and Overview
- Drinking Water Contaminants & MCLs
- Current Regulations and Rules
- Sampling, Monitoring, and Record Keeping
- Summary and Closing

2

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3

Acronyms

- PWS ----- Public Water System
- MCLG---- Maximum Contaminant Level Goal
- MCL------ Maximum Contaminant Level
- TT -------- Treatment Technique
- DS ------- Distribution System
- IDSE----- Initial Distribution System Evaluation
- DBPs---- Disinfection Byproducts
  - ✓ THMs – Trihalomethanes
  - ✓ HAA – Haloacetic Acids
- NOM---- Natural Organic Matter
- TOC/DOC---Total/Dissolved Organic Carbon
- UV-------- Ultraviolet Light
  - ✓ UV254 – Ultraviolet Absorbance at 254nm
  - ✓ SUVA – Specific UV Absorbance

4

SDWA Definitions

- PWS: Public Water System
  - 15 or more connections
  - 25 or more people per day
  - at least 60 days per year
  - three subcategories
    - Community Water System
    - Non-Transient Non-Community Water System
    - Transient Non-Community Water System

5

SDWA Definitions

- Community Water System (CWS)
  - A PWS that supplies water to the same residential population year-round.
  - Examples:
    - Cities
    - Towns
    - Rural Water Systems
    - Trailer Parks (not seasonal)

6

SDWA Definitions

- Non-Transient Non-Community Water Systems (NTNSWS)
  - Regularly supplies water to at least 25 people at least 6 months per year but not to their residences
  - Examples include:
    - Schools
    - Factories

7

SDWA Definitions

- Transient Non-Community Water Systems
  - Provides water in a place where people do not stay for long periods of time
  - Examples include:
    - Restaurants
    - Rest stops
    - Campgrounds

8

Types of Contaminants

- Chemicals (organic and inorganic)
  - Naturally occurring
  - Man-made
- Microbiological
- Disinfectants and disinfection byproducts
- Radiological

9

Regulation Terminology

- **National Primary Drinking Water Regulation (NPDWR)**
  - Sets legal levels (MCLs) of specific contaminants that can adversely affect public health
  - Recommends Maximum Contaminant Level Goals (MCLG)
  - Treatment Technique (TT) in lieu of MCLs
- **National Secondary Drinking Water Regulation (NSDWR)**
  - Non-enforceable guidelines
  - Covers contaminants that may cause cosmetic or aesthetic effects

10

Treatment Technique (TT)

- Alternative to an MCL when it is not economically and technologically feasible to ascertain the level of the contaminant
- The TT is also an enforceable standard involving a measurable procedure or level of technological performance (e.g., “Action Level” like “turbidity”)

11

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12

Drinking Water Sources

1. Surface Water
2. Ground Water
3. Ground Water Under the Direct Influence of Surface Water (GWUDISW)

13

Source Water Characteristics

Surface Water (and GWUDISW)

- **Low to high turbidity and NOM (Natural Organic Matter)**
- **Low to high biological pathogens**

Ground water

- **Low to no turbidity and NOM**
- **Low to no biological pathogens**

All three can:

1. **Be corrosive**
2. **Contain calcium (Ca)/magnesium (Mg) hardness**
3. **Contain iron (Fe)/manganese (Mn)**
4. **Have taste and odors**

14

Source Water Quality

- Substances that impact quality
  - Organic
  - Inorganic
  - Biological
  - Radiological
- Sources of impurities
- Proximity to contamination

15

Earliest Records of Drinking Water Treatment

- Alum used by Egyptians for clarifying water ~ 1500 BC
- Hippocrates advised people to boil and strain water ~ 400 BC

16

Early U.S. Water Treatment Milestones

1871: First slow sand filter in U.S.

1896: First rapid sand filter in U.S.

1908: First use of chlorine as a primary disinfectant

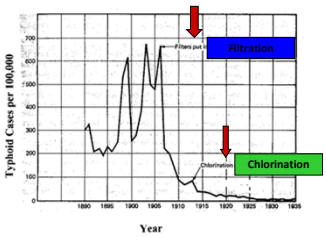
1920s: Filtration and chlorination used widely in large cities

17

Filtration and Chlorination

- In 1908, a water treatment plant in Jersey City, New Jersey, used chlorine as primary disinfectant
- US typhoid cases began to drop dramaticlly
- In early 1900s most U.S. water treatment systems were using filtration and chlorine disinfection to remove microbial contaminants.

Figure 1 Typhoid Cases 1890-1935 Philadelphia



From McGhee, 6th Ed., 1991

18

More Recent U.S. Water Treatment Milestones

1940s: Treatment for inorganic contaminants

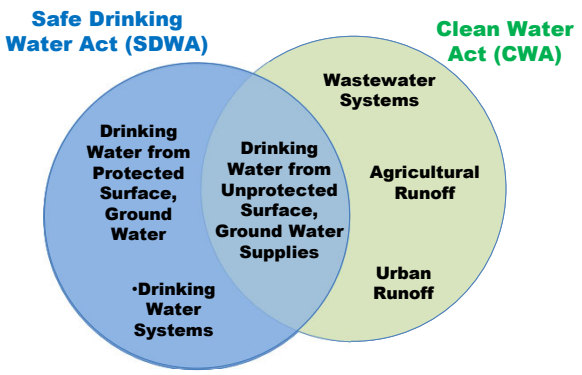
1970s: Treatment for organic contaminants

1980s: Advanced water treatment methods employed

19

Regulations

Flagship U.S. Water Quality Regulations



20

SDWA History

- Federal SDWA introduced in 1974 (Nixon)
- Resulted from increased concern and awareness of contaminated drinking water
- Amended: 1986, 1996
- Establishes MCL levels (or TTs in lieu of MCLs), monitoring, and reporting requirements
- Regulates >90 contaminants
  - Microbial
  - Chemical/Radiological

21

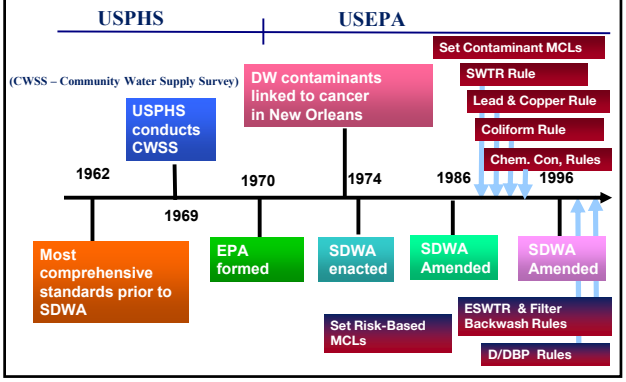
SDWA Contaminants

Microbial Risks
- Turbidity (Water quality indicator)
- Coliform Bacteria (Total, Fecal & E. coli)
- Enteroviruses
- Protozoa (Giardia, Cryptosporidium)
- Bacterial Pathogens (Legionella)

Chemical & Radiological Risks
- Inorganic chemicals (IOCs)
- Volatile organic chemicals (VOCs)
- Synthetic organic compounds (SOCs)
- Disinfectants & Disinfection by products (DBPs)
- Radionuclides (Radium 226/228, Uranium)

22

Federal Drinking Water Program



23

Steps for Developing Drinking Water Standards

- Setting the MCLG
  - Health effects information
  - Exposure information
  - Relevant information and procedures developed by EPA for risk assessment and characterization

24

First Objective

- Provide an understanding of the **risk** reduction goals of SDWA and the chemical monitoring under the drinking water regulations

25

What is an Adverse Health Effect?

- **EPA definition (from Integrated Risk Information System):**

  "… any biological, physiological, anatomical, pathological, and/or behavioral change that may affect the performance of the whole organism or reduce the ability of the organism to respond to additional challenges."

26

Maximum Contaminant Level Goals (MCLG)

- Considerations in setting an MCLG:
  - End-point – cancer or noncancer
  - Acute or chronic exposure concerns
  - Sensitive populations
- Data obtained from epidemiological and toxicological studies

27

Federal Rules

I. Regulations to decrease Microbial Risk

- SWTR - Surface Water Treatment Rule
- ESWTR – Enhanced Surface Water Treatment Rules
  - Long-Term 1 (LT1ESWT)
  - Long-Term 2 (LT2ESWT)
- Filter Backwash Rule
- (Rev.) Total Coliform Rule (2013/2016)
- Ground Water Rule

28

Waterborne Diseases

Viruses	Norovirus (gastroenteritis) Rotavirus (gastroenteritis) Hepatitis A virus (infectious hepatitis) Adenovirus (respiratory, gastroenteritis)
Bacteria	*Escherichia coli* (gastroenteritis) *Salmonella typhi* (typhoid fever) *Vibrio cholerae* (cholera) *Shigella* (dysentery)
Protozoa	*Giardia lamblia* (gastroenteritis) *Cryptosporidium parvum* (cryptosporidiosis) *Endamoeba histolytic* (amoebic dysentery)

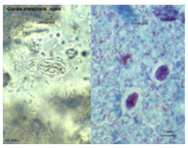
29

Waterborne Pathogens

- Disease symptoms usually are explosive emissions from either end of the digestive tract

Escherichia coli

Vibrio sp.



Giardia sp.*

30

Protozoa

Giardia

Cryptosporidium

31

Federal Rules

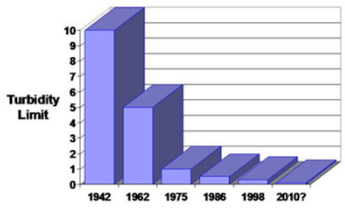
II. Regulations to decrease Chemical /Radiological Risk

- Lead & Copper Rule
- DBPR – Disinfectants/Disinfection Byproducts Rules
  - Stage 1 (Stage 1 DBPR)
  - Stage 2 (Stage 2 DBPR)
- 1986 Fluoride Rule
- Chemical Contaminant Rules, Phases I/II/IIB/V
- Arsenic Rule
- Radionuclides Rule
- Radon Rule (Proposed)

32

Treatment Goals

- Stage 2 D/DBP Rule
  - Remove natural organic matter
- Long Term 2 ESWTR
  - Remove particles/turbidity
  - Turbidity goal: 0.1 NTU



33

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34

Review of Current MCLs and TTs

- Handout of National Primary Drinking Water Regulations from: www.epa.gov/safewater
  - Microorganisms
  - Disinfection Byproducts
  - Disinfectants
  - Inorganic Chemicals
  - Organic Chemicals
  - Radionuclides

35

UCMR

- EPA uses the **Unregulated Contaminant Monitoring Rule (UCMR)** to collect data for suspected contaminants
  - UCM Program 1988 – 1997
  - UCMR1 from 2001 – 2005
  - UCMR2 from 2007 – 2010
  - UCMR3 from 2012 - 2015
  - UCMR4 from 2018 - 2021
  - UCMR5 from 2023 - 2026 (29 PFAS, Lithium)

36

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37

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- Ground Water Rule

38

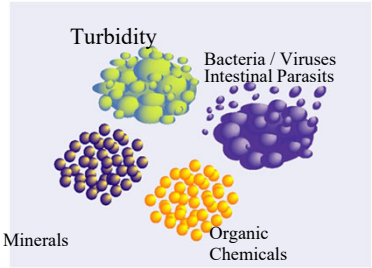
SDWA Individual Rules

- SWTR
  - Surface Water Treatment Rule
  - Protects against exposure to viruses, Legionella, Giardia and other pathogens by requiring certain types of treatment for surface water sources

39

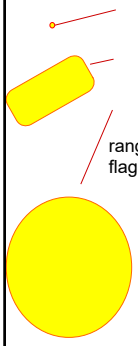
SURFACE WATER TREATMENT

"The water treatment plant is the primary barrier against unsafe water…any malfunction in the treatment process could result in water quality problems."



40

Classes of Microorganisms: The Microbial World



Viruses: smallest (0.02-0.3 µm diameter); simplest: nucleic acid + protein coat (+ lipoprotein envelope)

Bacteria: 0.5-2.0 µm diameter; prokaryotes; cellular; simple internal org.; binary fission.

Protozoa: most >2 µm - 2 mm; eucaryotic; uni-cellular; non-photosynthetic; flexible cell membrane.; wide range of flagellates sizes and shapes; hardy cysts and oocysts; (*Giardia* sp.), amoebae, ciliates, sporozoans (*Cryptosporidium* sp.) and microsporidia.

***Cryptosporidium parvum* oocyst**

~5 um

41

Multiple Barriers

"Barriers" prevent the passage of microorganisms into the distribution system…

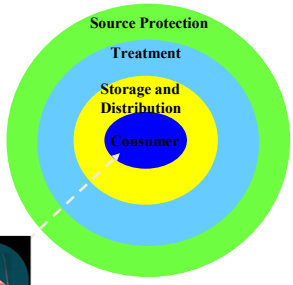
Cryptosporidium

Giardia

42

Multiple Barriers In Water Supply Protection

- Sources
  - Watershed management programs
  - Intake and wellhead protection
- Treatment
  - Coagulation, flocculation, sedimentation
  - Filtration
  - Disinfection
- Storage
  - Disinfectant contact time
  - Screens
- Distribution
  - Pressure
  - Disinfection



43

Surface Water Treatment Options

Surface Water Treatment Rule (SWTR - 1989)

- Surface water sources must receive filtration and disinfection
- Finished water **turbidity standard of ≤ 0.5 NTU**
- Concentration and time (C x T) requirements for disinfection

Enhanced Surface Water Treatment Rules (ESWTR – 1998 - 2006)

- Finished water turbidity standard of ≤ 0.3 NTU
- Benchmarking / **profiling for Cryptosporidium** removal

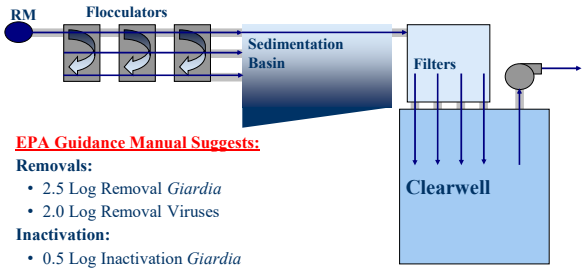
44

Percentage vs. Log Reductions

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

45

Filtration: Conventional



EPA 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

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

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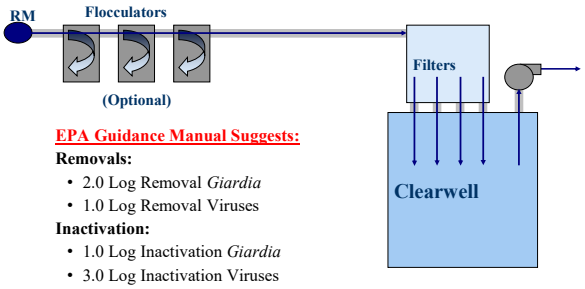
46

Filtration: Direct



EPA 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

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

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47

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- **ESWTR – Enhanced Surface Water Treatment Rules**
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  - **Long-Term 2 (LT2ESWT)**
- Filter Backwash Rule
- Total Coliform Rule
- Ground Water Rule

48

SDWA Individual Rules

- LT1ESWTR
  - Long Term 1 Enhanced Surface Water Treatment Rule
  - Applies to systems serving <10,000 people.
  - Sets Cryptospiridium removal and turbidity requirements
  - Requires disinfection benchmarking and covers on new finished water reservoirs

49

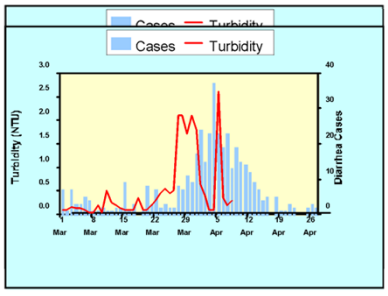
Waterborne Disease Outbreaks Cause Irreparable Damage to Public and PWSs

Year	State/Territory	Cause of Disease	No. of People Affected
1985	Massachusetts	*Giardia lamblia* (protozoan)	703 illnesses
1987	Georgia	*Cryptosporidium parvum* (protozoan)	13,000 illnesses
1987	Puerto Rico	*Shigella sonnei* (bacterium)	1,800 illnesses
1989	Missouri	*E. coli* 0157 (bacterium)	243 illnesses / 4 deaths
1991	Puerto Rico	*Unknown*	9,847 illnesses
1993	Missouri	*Salmonella typhimurium* (bacterium)	650 illnesses / 7 deaths
1993	Wisconsin	*Cryptosporidium parvum* (protozoan)	400,000 illnesses 50+ deaths
1998	Texas	*Cryptosporidium parvum* (protozoan)	1,400 illnesses
1999	New York	*E. coli* 0157 (bacterium)	150 illnesses / 1 death
2000	Ontario	*E. coli* 0157 (bacterium)	1,000 illnesses / 7 deaths

Source: HDR's Handbook of Public Water Systems

50

Milwaukee Disease Outbreak - 1993



403,000 illnesses (out of 1.6 million population)

Ineffective coagulation, flocculation, and filtration

51

Monitoring Requirements for Individual Filters

- Rule establishes new requirements to continuously monitor individual filter performance
- Individual filter monitoring requirements are not part of the treatment technique
- Exceedance of the performance requirement triggers other actions—it is not a violation
- Designed to raise awareness of individual filter performance (informational)

52

Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR)

January 24, 2005

53

LT2ESWTR Requirements

- Purpose: to limit exposure by requiring microbial disinfection based on source water quality
- Monitoring – "bins"
- Required disinfection levels –
  - *Cryptosporidium* 3.0 log - 5.5 log (99.9% - 99.9997%)
  - viruses (IESWTR) 4.0 log (99.99%)
  - *Giardia* (IESWTR) 3.0 log (99.9%)

54

Rule Background

- Builds on existing Surface Water Treatment Rules
- Flexible, risk-based Rule based on new *Cryptosporidium* (*Crypto*) data
- Accounts for
  - Current level of treatment
  - Source water quality
  - System size
- Offers range of compliance options
- Improves public health protection

55

Crypto Monitoring

- Applies to system ≥ 10,000
- Sample at least monthly for 2 years for crypto, turbidity and *E. coli*
- **Initial Distribution System Evaluation (IDSE)** and Compliance Monitoring
- Monthly reporting of results to EPA HQ

56

E. coli Monitoring

- Applies to systems < 10,000
- Sample at least once every two weeks for 1 year
- Crypto monitoring initiated if annual mean *E. coli* concentration is greater than…
  - 10 *E. coli* /100 mL for lake/reservoir sources
  - 50 *E. coli* /100 mL for flowing stream sources
- Crypto monitoring at least twice per month for 1 year or monthly for 2 years
- Monthly reporting to state

57

Population Based Monitoring

- Required for **Initial Distribution System Evaluation (IDSE)** and Compliance Monitoring
- Monitoring based on population and source water type
- Targets problem areas based on better understanding of DBP, Crypto, E. coli occurrence and formation
- Greater equity of public health protection

58

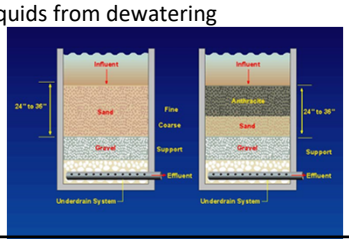
The IDSE

- Purpose: to select new monitoring sites that more accurately reflect sites representing high TTHM and HAA5 levels
- Approach: standard monitoring program or system-specific study

59

SDWA Individual Rules

- **Filter Backwash Recycling Rule (FBRR)**
  - Reduces risks from recycling contaminants removed during filtration
  - Affects systems that recycle spent filter backwash water, thickener supernatant, or liquids from dewatering



60

Background

- Filter backwash recycle reintroduces contaminants back into the treatment process
- 1996 SDWA Amendments require EPA to promulgate a regulation that "governs" recycle of filter backwash water within a treatment plant

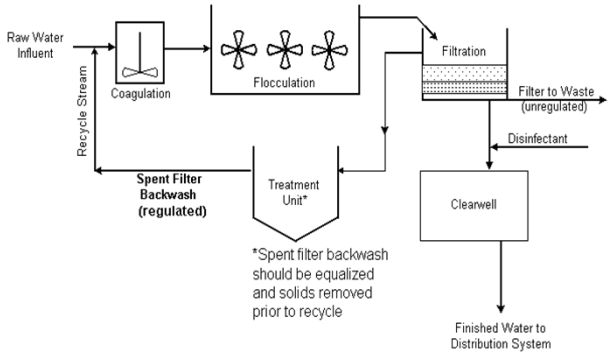
61

Systems Covered by FBRR §141.76(a)

- SW and GWUDI (Subpart H) systems that employ conventional or direct filtration and
- Recycles one or more of the following:
  - Spent Filter Backwash Water
  - Thickener Supernatant
  - Liquids from Dewatering Processes

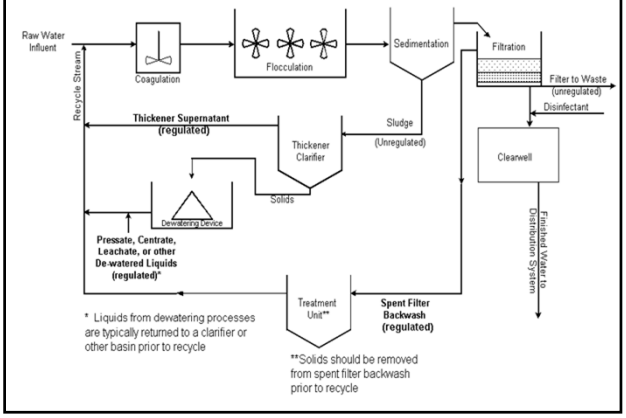
62

Direct Filtration



63

Conventional Treatment Plant



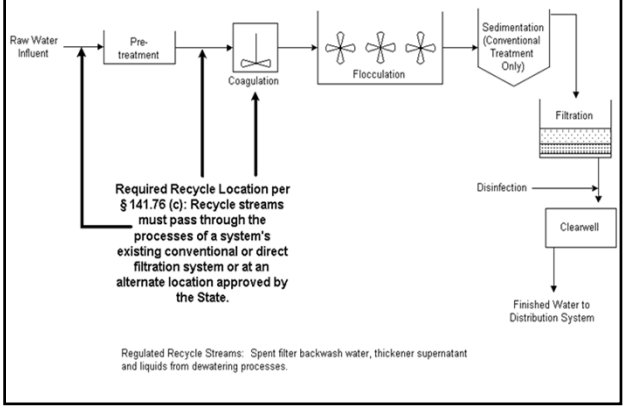
64

What is Thickener Supernatant?
What are Liquids from Dewatering Processes?

- Thickener Supernatant
  - The "clear water" that exits sedimentation basins and clarifiers after particles have been allowed to settle out
- Liquids from Dewatering Processes
  - Dewatering processes remove water from waste solids "sludge" in order to reduce the solids volume to be disposed

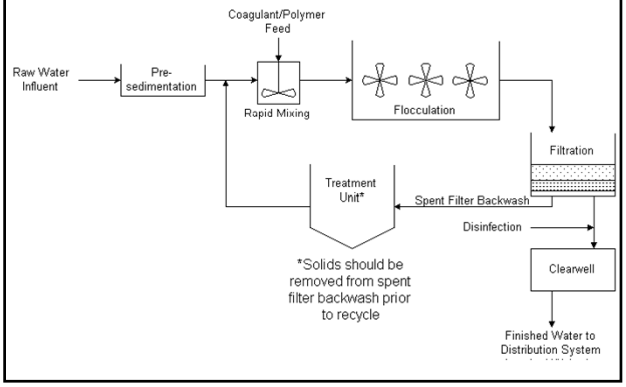
65

Recycle Return Location



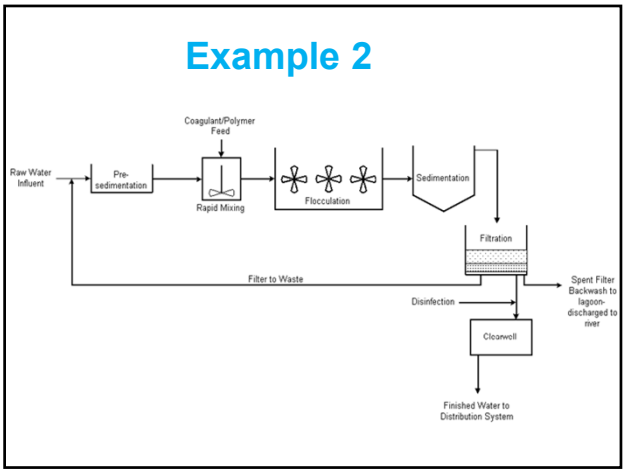
66

Example 1



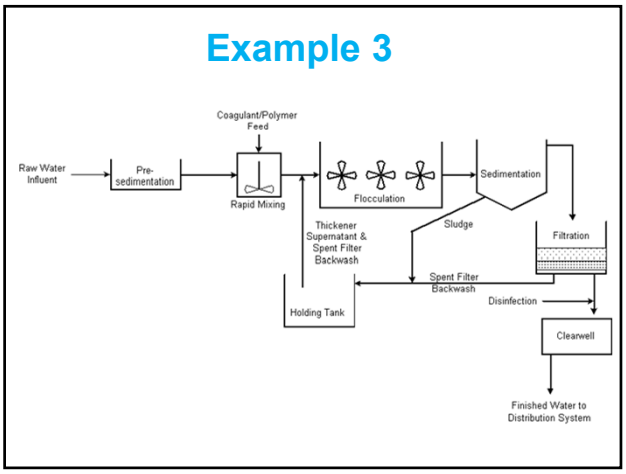
67

Example 2



68

Example 3



69

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  - Long-Term 2 (LT2ESWT)
- Filter Backwash Rule
- **(Revised) Total Coliform Rule**
- Ground Water Rule

70

SDWA Individual Rules

- Total Coliform Rule
  - Establishes monitoring requirements and MCLs for indicator bacteria

71

Fecal Coliform Bacteria Traditional Definition

- Total Coliform Bacteria That:
  - Ferment Lactose at an Elevated Temperature When Using Standard (FC) Media
    - 44.5 +/- 0.2 C (Body Temperature)
- Short-Lived but Fecal Indicator
- *E. Coli* Is a Fecal Coliform

72

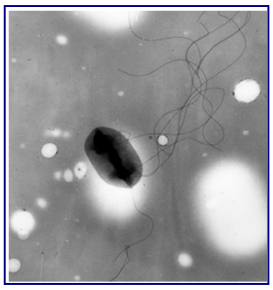
New Approach: Enzyme - Based Methods

- Lactose Fermentation Determined, In Part, By The Presence of *B*-galactosidase.
- Total Coliform's *B*-galactosidase Metabolizes ONPG or CNPG -- color reaction.
- E. coli's B-glucuronidase Metabolizes MUG – UV Fluorescence.

73

Escherichia coli

- Hundreds of Strains Known
- Most Strains Are Harmless and Live in the Intestines of Healthy Humans and Animals
- Strain O157:H7
  - Produces a Powerful Toxin
  - Causes Bloody Diarrhea and Occasionally Leads to Kidney Failure



74

E. coli 0157:H7

- Sources of Outbreaks
  - Undercooked Beef, Dairy Products, Raw Vegetables, Drinking Water
- Symptoms
  - Occur in 1-9 Days (3 Average); Recover in ~ 8 Days
  - Watery Diarrhea With Abdominal Pain/ Bloody Diarrhea; Little or No Fever
  - Some Develop Haemolytic Uremic Syndrome (HUS)
    - Kidney Failure May Occur, Some Cases are Fatal

75

Revised Total Coliform Rule (RTCR)

- Final February 2013
- Applies to all PWSs
  - Maximum Contaminant Level (MCL)
  - Treatment Technique Triggers (TTT)
    - Level 1 – Total Coliform MCL violations
    - Level 2 – E. coli MCL violations
- Effective April 1, 2016
- **Sampling siting plan NLT March 31, 2016**
- Beginning CY 2017, annual site visits

76

Federal Rules

I. Regulations to decrease Microbial Risk

- SWTR - Surface Water Treatment Rule
- ESWTR – Enhanced Surface Water Treatment Rules
  - Long-Term 1 (LT1ESWT)
  - Long-Term 2 (LT2ESWT)
- Filter Backwash Rule
- Total Coliform Rule
- **Ground Water Rule**

77

Ground Water Rule

- Final October 2006
- Periodic Sanitary Surveys
- Rule applies to groundwater systems only
- Source water monitoring for E. coli
- Sets trigger and action levels
- Take corrective actions where necessary
- Compliance monitoring

78

Federal Rules

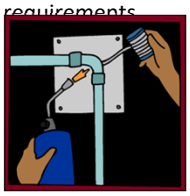
II. Regulations to decrease Chemical /Radiological Risk

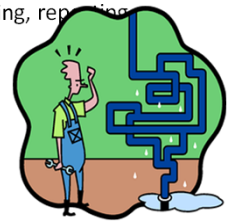
- **Lead & Copper Rule**
- DBPR – Disinfectants/Disinfection Byproducts Rules
  - Stage 1 (Stage 1 DBPR)
  - Stage 2 (Stage 2 DBPR)
- 1986 Fluoride Rule
- Chemical Contaminant Rules, Phases I/II/IIB/V
- Arsenic Rule
- Radionuclides Rule
- Radon Rule (Proposed)

79

SDWA Individual Rules

- Lead & Copper Rule
  - Sets action levels for lead and copper that prompt corrosion control measures if exceeded
  - Sets monitoring, testing, rep[illegible] requirements





80

What is the Lead and Copper Rule?

The Lead and Copper Rule was first published in the Federal Register June 7, 1991 and became effective December 7, 1992.

Lead enters drinking water mainly from the corrosion of lead-containing household plumbing.

This rule can trigger treatment requirements when lead and/or copper in drinking water exceed certain action levels.

The Lead Action Level is point 0.015 mg/L or 15 parts per billion 15ppb.

The copper action level is one point three milligrams per liter (1.3 mg/L) Which is sometimes referred to as 1.3 parts per million or 1.3ppm

81

Federal Rules

II. Regulations to decrease Chemical /Radiological Risk

- Lead & Copper Rule
- **DBPR – Disinfectants/Disinfection Byproducts Rules**
  - **Stage 1 (Stage 1 DBPR)**
  - **Stage 2 (Stage 2 DBPR)**
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- Arsenic Rule
- Radionuclides Rule
- Radon Rule (Proposed)

82

Monitoring Requirements

Monitoring Frequency and Number of Sites

Stage 1 DBPR:
- *Plant-based*
- *Dependent on number of treatment plants or wells*

Stage 2 DBPR:
- *Population-based*
- *Dependent on population served*

83

Disinfection

- Goal
  - To destroy or inactivate pathogenic microorganisms including bacteria, cysts, algae, spores and viruses.
- Problem
  - Can Form **disinfection byproducts**

84

Comparative Effectiveness of Disinfectants

	Crypto	Giardia	Viruses	Residual
Chlorine	NE	G	E	G
Chlorine dioxide	P/F	G	G	F
Ozone	P/F/G	E	G/E	P
Chloramines	NE	P	P	G
UV	E	E	F	NONE

NE – not effective, P – poor, F – fair, G – good, E - excellent

85

Potential Health Issues?

- Microbial Health Concerns
  - Cryptosporidiosis and Giardiasis
    - Vomiting and diarrhea, potentially life threatening for immune compromised, elderly and young
- Disinfection By-Product Health Concerns
  - Cancer
    - Bladder, colon and rectal
  - Reproductive
    - Neural tube defects and miscarriages
  - Brominated compounds are thought to pose a greater health risk than chlorinated compounds
  - Nitrogenated compounds may be even worse???

86

Disinfection By-products (DBPs)

- By-products of reactions between disinfectant (chlorine, ozone, etc.) and natural organic matter present in source water

87

Disinfectants Form DBPs

- Chlorine – TTHMs, HAA5, other chlorinated DBPs (haloacetonitriles, haloketones, etc)
- Chloramines – N-nitrosodimethylamine (NDMA), other nitrogenous DBPs
- Chlorine dioxide – chlorite, chlorate
- Ozone – bromate, aldehydes, keytones, etc.
- UV - None

88

Disinfectants and Disinfection Byproducts (DBPs)

Regulated DBP Contaminants	MCL (mg/L)	MCLG (mg/L)	Regulated Disinfectants	MRDL* (mg/L)	MRDLG* (mg/L)
Total Trihalomethanes (TTHMs)	0.080		Chlorine	4.0 as Cl_2	4
Chloroform		-			
Bromodichloromethane		Zero			
Dibromochloromethane		0.06			
Bromoform		zero			
Five Haloacetic Acids (HAA5)	0.060		Chloramines	4.0 as Cl_2	4
Monochloroacetic acid		-			
Dichloroacetic acid		Zero	Chlorine dioxide	0.8	0.8
Trichloroacetic acid		0.3			
Bromoacetic acid		-			
Dibromoacetic acid		-			

89

Disinfectants and Disinfection Byproducts (DBPs)

Regulated DBP Contaminants	MCL (mg/L)	MCLG (mg/L)		MRDL* (mg/L)	MRDLG* (mg/L)
Bromate (plants using ozone)	0.010	Zero	*Stage 1 DBPR includes maximum residual disinfectant levels (MRDLs) and goals (MRDLGs) which are similar to MCLs and MCLGs but for disinfectants		
Chlorite (plants using chlorine dioxide)	1.0	0.8			
Treatment Technique					
Enhanced coagulation/enhanced softening to improve removal of DBP precursors (See Step 1 TOC Table for systems using conventional filtration treatment)					

90

Natural Organic Matter (NOM)

- Present in all natural waters
- Consists of living organisms:
  - algae, protozoa, bacteria, viruses
- Consists of non-living material:
  - decayed vegetation, humic substances
- Usually measured as TOC or DOC
- Largest fraction of DOC is usually humic substances
- Can only identify about 20 % of the DOC

91

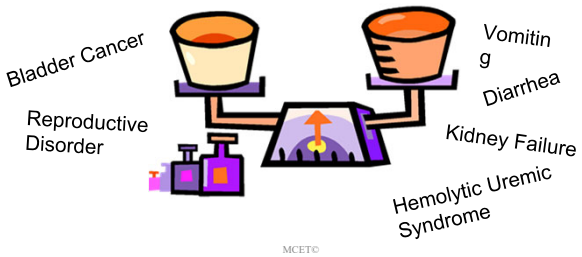
Sources of Organic Matter

92

Risks Must be Balanced

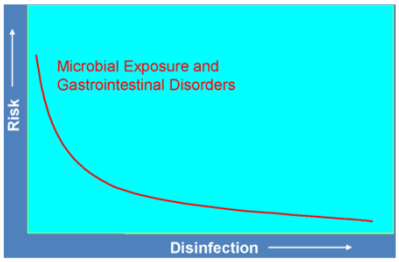
Increase Chlorine = Increase DBPs

Decrease Chlorine = Increase Microbial Risk



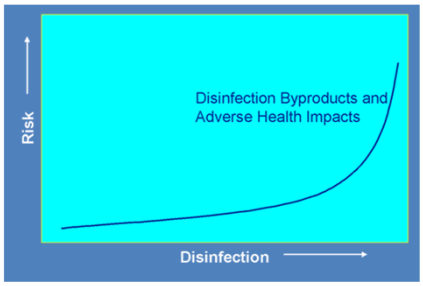
93

Microbial Risks



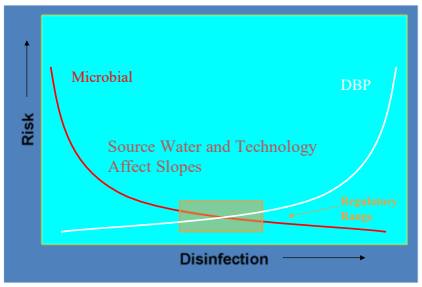
94

Disinfection Byproduct Risks



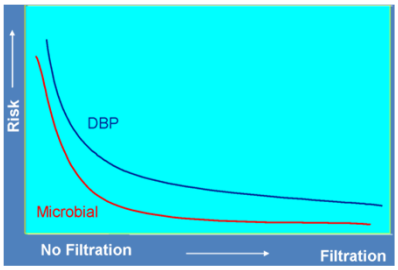
95

Microbial vs. DBP Risk Trade-Offs



96

Filtration Reduces both Microbial and DBP Risks



97

Disinfectants and Disinfection Byproducts (D/DBP) Rules

- Applies to any CWS/NTNC system that adds a disinfectant
- Effective dates:
  - Stage 1 D/DBP Rule - January 2002 (>10,000 SW)
  - Stage 1 D/DBP Rule - January 2004 (SW<10,000 and GW)
  - Stage 2 D/DBP Rule – January 2006 – October 2013 (all populations; SW and GW)
- Balance benefits of acute microbial protection against risks of chronic exposure to disinfection byproducts

98

SDWA Individual Rules

- Stage 1 Disinfectants/Disinfection Byproducts Rule (DBP)
  - Increases requirements for some regulated DBPs
  - Sets new requirements for haloacetic acids, chlorite, and bromate

99

D/DBP Rule: Stage 2

- Compliance Monitoring
  - Locational Running Annual Average (LRAA)
    - MCLs: 80/60
  - Monitoring for Large SW systems (> 10,000)
    - Quarterly sampling
    - At least one quarterly sample at peak month
    - 4-20 DS locations determined by IDSE *and* stage 1 locations
      - 2-8 at high THM sites, and 1-7 at high HAA sites
  - Monitoring for small SW systems (< 10,000)
    - 2 locations as determined by IDSE

100

Stage 2 D/DBP Rule

- Provides greater public health and protection through:
  - Identifying locations with highest Disinfection Byproducts (DBPs)
  - Basing Compliance on Locational Running Annual Average (LRAA)
  - Requiring tests for connected and consecutive water systems
- Population Based Monitoring for all systems with disinfection

101

IDSE – 40/30 Certification

- For systems with consistently low DBP levels, the IDSE requirements may be waived. States will identify the waiver status in the system's monitoring schedule.
- Eligibility
  - All required Stage 1 DBPR (Subpart L) compliance samples have been taken
  - No individual sample exceeded 0.040 mg/L for TTHM.
  - No individual sample exceeded 0.030 mg/L for HAA5
  - No TTHM or HAA5 monitoring violations.
- MDE will review data & Determine 40/30 waivers, if applicable
  - Refer to monitoring schedules each year for changes.

102

141.605

Stage 2 DBPR
Compliance Monitoring Location

- **Surface water and GWUDI systems and systems that purchase surface or GWUDI**

Population Size Category	Monitoring Frequency	Distribution System Monitoring Location			
		Total per monitoring period	Highest TTHM Locations	Highest HAA5 Locations	Existing Stage 1 DBPR Locations
< 500	Per year	2	1	1	
500-3,300	Every 90 days	2	1	1	
3,301-9,999	Every 90 days	2	1	1	
10,000-49,999	Every 90 days	4	2	1	1
50,000-249,999	Every 90 days	8	3	3	2
250,000-999,999	Every 90 days	12	5	4	3
1,000,000-4,999,999	Every 90 days	16	6	6	4
>5,000,000	Every 90 days	20	8	7	5

103

141.605

Stage 2 DBPR
Compliance Monitoring Location

- **Ground water systems and systems that purchase ground**

Population Size Category	Monitoring Frequency[1]	Distribution System Monitoring Location			
		Total per monitoring period	Highest TTHM Locations	Highest HAA5 Locations	Existing Stage 1 DBPR Locations
< 500	Per year	2	1	1	
500-9,999	Per year	2	1	1	
10,000-99,999	90 days	4	2	1	1
100,000-499,999	90 days	6	3	2	1
>500,000	90 days	8	3	3	2

104

Standard Monitoring Plan

- Plan will identify monitoring locations expected to have high TTHMs/HAA5s
- System will utilize maps, water quality data and operational data to locate sites
- IDSE Standard Monitoring Plan must include:
  - Schematic of distribution system
    - Entry points and sources
    - Locations and dates of the projected standard monitoring
    - All projected Stage 1 DBPR compliance monitoring
  - Justification of standard monitoring location selection and all additional data used to justify site selection
  - Population served and system type

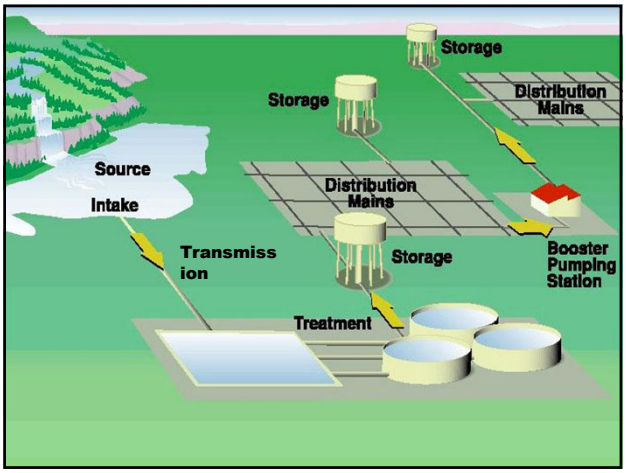
105

141.600

Combined Distribution Systems

- What is a Combined Distribution Systems (CDS)?
  - Defined as the interconnected distribution system consisting of the distribution systems of wholesale systems and consecutive systems that receive finished water from those wholesale system(s).
- What is a Consecutive system?
  - Defined as a public water system that receives some or all of its finished water from one or more wholesale systems.
    - NOTE: In addition to buying finished water, some consecutive systems also operate a treatment plant (meaning a plant that treats source water to produce finished water).

106



107

Combined Distribution Systems

- What is a Wholesale system?
  - Defined as a public water system that treats source water as necessary to produce finished water and then delivers some or all of that finished water to another public water system. Delivery may be made through a direct connection or through the distribution system of another consecutive system.
    - NOTE: Under this definition, a consecutive system that passes finished water from a wholesaler to another consecutive system, and that does not also treat source water, is not a wholesale system. Rather, the system that actually produces the finished water is responsible for any wholesale system requirements.

108

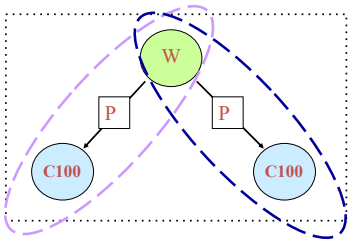
CDS Example #1

Symbol Key

W-Wholesaler

P-permanent connections

C100-consecutive system that receives all finished water from one or more W systems



Determination: All 3 systems are part of same CDS

Rationale: The connections between systems are permanent.

109

Federal Rules

II. Regulations to decrease Chemical /Radiological Risk

- Lead & Copper Rule
- DBPR – Disinfectants/Disinfection Byproducts Rules
  - Stage 1 (Stage 1 DBPR)
  - Stage 2 (Stage 2 DBPR)
- **1986 Fluoride Rule**
- Chemical Contaminant Rules, Phases I/II/IIB/V
- Arsenic Rule
- Radionuclides Rule
- Radon Rule (Proposed)

110

SDWA Individual Rules

- 1986 Fluoride Rule
  - Sets 4.0 mg/L MCL
  - Sets non-enforceable guideline of 2.0 mg/L for fluoride in drinking water

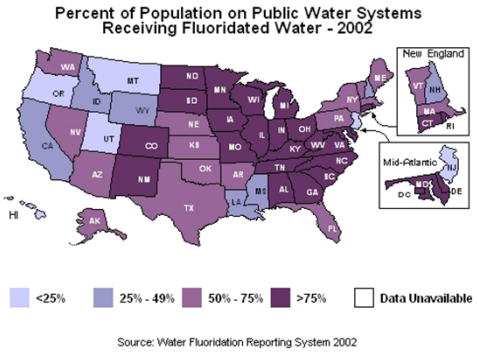
111

Fluoridation in Maryland

- 4,218,000 people are on community water systems that add fluoride to the drinking water (54 systems)
- 4, 269,000 people are on community water systems that have fluoride levels above 0.8 milligrams per liter (this includes 83 community water systems with naturally occurring fluoride).
- 4,845,000 people are served by community water systems in Maryland.

112

Fluoridation in the U.S.



Source: Water Fluoridation Reporting System 2002

113

Federal Rules

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  - Stage 2 (Stage 2 DBPR)
- 1986 Fluoride Rule
- **Chemical Contaminant Rules, Phases I/II/IIB/V**
- Arsenic Rule
- Radionuclides Rule
- Radon Rule (Proposed)

114

SDWA Individual Rules

- Chemical Contaminants (Phase I/II/IIB/V) Rules
  - Protects consumers from chemical contaminants by establishing MCLs
  - Establishes monitoring and reporting requirements

115

Chemical Contaminants

- Volatile organic chemicals (VOCs)
- Synthetic organic chemicals (SOCs)
- Inorganic chemicals (IOCs)
- Radionuclides
- Disinfection byproducts (DBPs)

116

Federal Rules

II. Regulations to decrease Chemical /Radiological Risk

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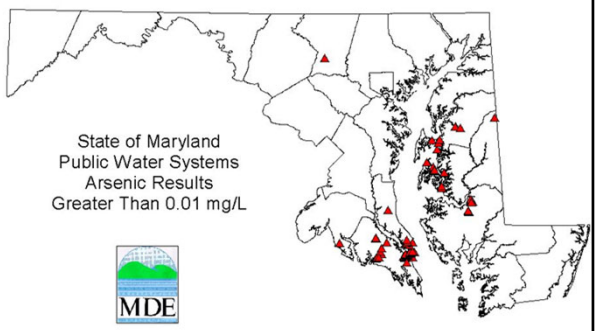
  - Stage 1 (Stage 1 DBPR)
  - Stage 2 (Stage 2 DBPR)
- 1986 Fluoride Rule
- Chemical Contaminant Rules, Phases I/II/IIB/V
- **Arsenic Rule**
- Radionuclides Rule
- Radon Rule (Proposed)

117

SDWA Individual Rules

- Arsenic Rule
  - Establishes monitoring requirements
  - Establishes MCL of 0.010 mg/L

118



119

Federal Rules

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  - Stage 1 (Stage 1 DBPR)
  - Stage 2 (Stage 2 DBPR)
- 1986 Fluoride Rule
- Chemical Contaminant Rules, Phases I/II/IIB/V
- Arsenic Rule
- **Radionuclides Rule**
- Radon Rule (Proposed)

120

SDWA Individual Rules

- Radionuclides
  - Sets uranium MCL
  - Revises monitoring requirements for combined radium 226/228, gross alpha particle and beta particle, and photon radioactivity

121

Radionuclides Rule

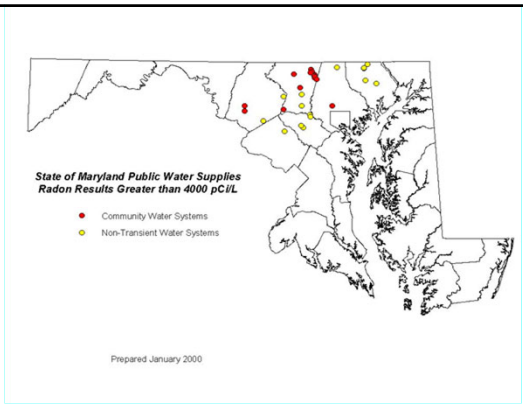
- Federal Rule Finalized 2000
  - Radon not included, will be a separate rule
- Standards for Radium 226, Radium 228,and Uranium
  - Combined Radium-226/Radium-228 5 pCi/L
  - Gross Alpha Particle activity 15 pCi/L
  - Uranium 30 ug/L
- Compliance deadline December 8, 2003

122

Radon: Exposure

- Exposure - Air
  - Most common exposure
  - Alpha radiation exposure
  - Piedmont Province
    - Montgomery Co.
    - Western Howard Co.
    - Eastern Frederick Co.
    - Carroll Co.
    - Baltimore Co.

123



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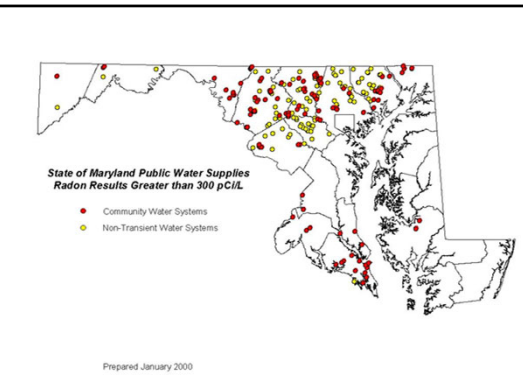


125

Two More Rules

- Public Notification Rule
  - Requires customer notification of violations
  - Specifies time frames based on seriousness of violation
- Consumer Confidence Report Rule
  - Required of all CWS
  - Yearly water quality report to customers

126

141.32 General Public Notification

- **Purpose:**
  - To Protect Public Health by Requiring Timely Public Notification When Contamination or Other Risks Occur
- **Requirements Available From EPA's Website**
  - www.epa.gov/safewater/pn.html

127

Subpart Q—Public Notification Rule

- Initial Requirements Published May 4, 2000
- Effective Dates:
  - October 31, 2000 in Direct Implementation Arenas
  - May 6, 2002 in Primacy States
- Major Changes:
  - Tier 1 - Potential for Serious Short-Term Health Effects
  - Tier 2 Serious but Not Immediate
  - Tier 3 All Other Violations

128

Subpart Q—Public Notification Rule Major Changes

- Tier 1 Violations
  - Fecal Coli MCL
  - Response Time Reduced From 72 Hours to 24 Hours
- Tier 2 Violations (Other MCLs,TTs)
  - Serious but Not Immediate
  - Response Time Extended to 30 Days From 14 Days

129

Subpart Q—Public Notification Rule Major Changes (cont')

- Tier 3 Violations (All Other Violations)
  - Less Serious and Long-Term Effects
  - Response Time and Repeats Extended to 12 Months From 3 Months
- Mandatory Health Effects Language Is Simplified

130

Recordkeeping Requirements for Public Water Systems

131

Benefits of Record Keeping

- Management Tool
- Proper Operation and Maintenance
- Education/Training
- Resolve Customer Complaints
- Document Changes
- Facilitate Communication
- Financial Analysis/Planning

132

Suggested Records to Keep

- Infrastructure historical/location information
- Equipment purchase/repair
- O&M log sheets
- Locations/dates of leak repairs
- Filter backwash logs, turbidity readings, coagulation records, corrosivity control
- Source production, static /pumping water levels, flow, water use
- Operator certifications, training records, correspondence with regulators, meter reading reports, financial information

133

PWSs General Record Keeping 3 Year Requirements

- Correction of violations of primary drinking water regulations
- Public notices your system issues

134

PWSs General Record Keeping 5 Year Requirements

- Microbiological and turbidity analyses
- Variances or exemptions

135

PWSs General Record Keeping 10 Year Requirements

- Chemical analyses: disinfectant residuals, disinfection byproducts, nitrate/nitrite, inorganic, volatile organic, synthetic organic compounds)

- Sanitary surveys and written reports and summaries

136

Additional Record Keeping Requirements by Rule

RULE	SYSTEM	DOCUMENT	KEEP
Consumer Confidence Rule	CWS	Consumer Confidence Reports	Min 3 years
Lead Copper Rule	CWS or NTNCWS with Lead Action Level Exceedance	Records of Public Education for Lead ALE	12 years

137

Additional Record Keeping Requirements by Rule

RULE	SYSTEM	DOCUMENT	KEEP
Lead Copper Rule	CWS or NTNCWS	Lead & Copper results, water quality parameters, source water sampling results, corrosion control recommendations/studies, public education materials, state determinations, schedules, letters, evaluations.	Min 12 years

138

Additional Record Keeping Requirements by Rule

RULE	SYSTEM	DOCUMENT	KEEP
Stage 1 DBPR	CWS or NTNCWS adding disinfectant or TNCWS using chlorine dioxide	Stage 1 DBPR Monitoring Plans	Min 10 years

139

Additional Record Keeping Requirements by Rule

RULE	SYSTEM	DOCUMENT	KEEP
Stage 2 DBPR	CWS or NTNCWS using a residual disinfectant except UV	Stage 2 DBPR monitoring plans and results	Min 10 years
LT1ESWTR	PWS using Surface Water or GWUDI	Disinfection profiling results (raw data & analysis) and benchmarking	Indefinitely

140

Additional Record Keeping Requirements by Rule

RULE	SYSTEM	DOCUMENT	KEEP
LT1ESWTR	PWS using Surface Water or GWUDI using conventional or direct filtration	Individual filter monitoring results	Min 3 years
LT2ESWTR	Subpart H PWS supplied by Surface Water or GWUDI	Results from initial and second round source water monitoring	Min 3 years

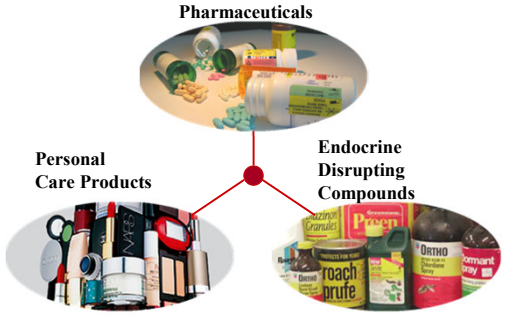
141

SAFE DRINKING WATER ACT REGULATIONS

Future Regulation Activity

142

Emerging Contaminants - Micro-constituents



143

"Emerging Contaminants"

- Pharmaceuticals and Personal Care Products (PPCPs)
- Pharmaceutically Active Compounds (PhACs)
- Trace Organic Contaminants (TOrCs)
- Endocrine Disrupting Compounds (EDCs) – Chemicals that interfere with the function of the endocrine system
- Contaminants of Emerging Concern (CECs)

144

Upcoming Federal Activities

- Fluoride - Anticipated revised Rule
- VOCs - Anticipated revised Rule
- Perchlorate - Anticipated Rule
- Revised LT2ESWTR - Anticipated revisions
- Revised Lead and Copper Rule - Anticipated Rule
- Radon Rule
- Hexavalent Chromium

145

WHAT ARE PFAS?

- Poly- and per-fluoroalkyl substances
  - Generic family of chemicals
  - Manmade and do not occur naturally
  - Used since 1940 (Critical for the Manhattan Project)
  - Can be branched or unbranched
  - Short chain or long chain
  - Used to make products that resist heat, oils, grease, stains, and water
- Most prevalent and researched: PFOA and PFOS

146

146

TOP TEN FACTS

1. Perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) are part of a larger group of chemicals known as per- and polyfluoroalkyl substances (PFASs).
2. This group of chemicals are persistent in the environment, meaning they are resistant to typical environmental degradation. Water providers suffer significant operation and maintenance costs because these chemicals never degrade, making it harder to get them out of the water systems.
3. Blood serum concentrations of PFOS and PFOA are higher in workers and individuals living near facilities that use or produce PFASs than for the general population. Pathways of exposure include ingestion of food and water, use of consumer products or inhalation of PFAS-containing particulate matter (e.g., soils and dust) or vapor phase precursors.
4. Studies have shown an association between increased PFOA and PFOS blood levels and an increased risk for several health effects, including effects on the liver and the immune system, high cholesterol, high blood pressure, thyroid disorders, pregnancy-induced hypertension and preeclampsia, and cancer (testicular and kidney).
5. The American Conference of Governmental Industrial Hygienists (ACGIH) has classified PFOA as a Group A3 carcinogen – confirmed animal carcinogen. The World Health Organization's International Agency for Research on Cancer has found that PFOA is possibly carcinogenic to humans.

147

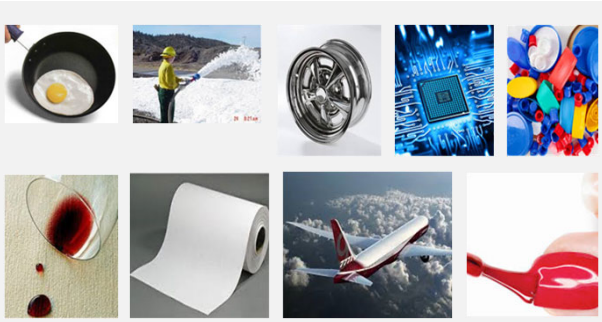
TOP TEN FACTS CONTINUED

6) Because of their unique ability to repel oil and water, these chemicals have been used in: surface protection products such as carpet and clothing treatments; coatings for paper, cardboard packaging and leather products; emulsifiers, wetting agents, additives and coatings; processing aids in the manufacture of fluoropolymers such as nonstick coatings on cookware; membranes for clothing that are both waterproof and breathable; electrical wire casing; fire and chemical resistant tubing; and plumbing thread seal tape.
7) Through 2001, PFOS and other PFAS chemicals were used in the manufacture of aqueous film forming foam (AFFF), which is used to extinguish liquid hydrocarbon fires.
8) During manufacturing processes, PFASs were released to the air, water and soil in and around manufacturing facilities. Recently, PFOS and PFOA contamination has also been observed in facilities using PFAS products to manufacture other products (secondary manufacturing facilities).
9) PFOS has been detected in surface water and sediment downstream of production facilities and in wastewater treatment plant effluent, sewage sludge and landfill leachate at many cities in the United States.
10) EPA derived oral non-cancer reference doses (RfDs) of 0.00002 mg/kg/day for both PFOS and PFOA. The RfD is an estimate of the daily exposure level that is likely to be

148

148

WHERE ARE PFAS USED?



149

149

WHAT TYPES OF SITES CAN BE SOURCES OF PFAS?

- Fire training facilities
- Fire stations
- Refineries
- DoD sites/Military bases
- Commercial and private airports
- Landfills (leaching from consumer products)
- Biosolids land application
- Rail yards
- Chemical facilities
- Plating facilities
- Textile/carpet manufacturers
- Residential areas with septic systems

150

150

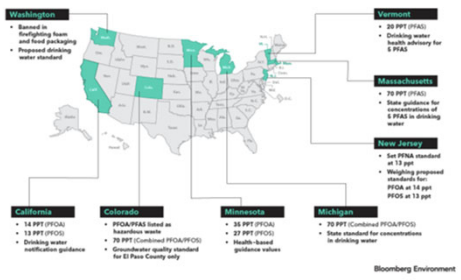
HOW CAN THIS IMPACT PEOPLE?

- BECAUSE OF THEIR WIDESPREAD USE AND ENVIRONMENTAL PERSISTENCE, MOST PEOPLE HAVE BEEN EXPOSED TO PFAS CHEMICALS.
- SOME PFAS CHEMICALS CAN ACCUMULATE AND CAN STAY IN THE HUMAN BODY FOR LONG PERIODS OF TIME.
- THERE IS EVIDENCE THAT EXPOSURE TO CERTAIN PFAS MAY LEAD TO ADVERSE HEALTH EFFECTS.

151

151

States With Numerical PFAS Limits



152

LINK TO WEBPAGE FOR EPA PFAS LAWS AND REGULATIONS

HTTPS://WWW.EPA.GOV/PFAS/PFAS-LAWS-AND-REGULATIONS

153

153

More Links

CDC - Drinking Water Standards and Contaminants
https://www.cdc.gov/healthywater/drinking/public/regulations.html#:~:text=The%20Safe%20Drinking%20Water%20Act%20(SDWA)%20was%20passed%20by%20Congress,suppliers%20who%20enforce%20those%20standards

EPA - Drinking Water Regulations and Contaminants
https://www.epa.gov/sdwa/drinking-water-regulations-and-contaminants

Drinking Water Health Advisories (HA's)
https://www.epa.gov/sdwa/drinking-water-health-advisories-has

154

Questions?

155