

**Student Workbook**  
**Small Treated Water Systems**

# **Student Workbook**

## **Small Treated Water Systems**



**ALASKA NATIVE  
TRIBAL HEALTH  
CONSORTIUM**

**Worksheet 1** – Sources – Pages 1-2

**Worksheet 2** – Properties of Water – Pages 3-5

**Worksheet 3** – Wells – Pages 6-9

**Worksheet 4** – Operations and Maintenance (O&M) – Pages 10-12

**Worksheet 5** – Treatment 2 – Pages 13-15

**Worksheet 6** – Disinfection – Pages 16-18

**Worksheet 7** – Regulations, Safety and Total Coliforms – Pages 19-22

**Math 1** – Background Concepts - Classroom Activity – Pages 23 – 26

**Math 1** – Homework – Pages 27 – 28

**Math 2** - Area, Volume and Conversions – Classroom Activity – Pages 29 – 30

**Math 2** – Homework – Page 31

**Math 3** – Hydraulics and Chlorine – Pages 32 - 34

**Math 3** – Homework – Page 35

**Practice Test 1** – Pages 36-44

**Practice Test 2** – Pages 45-53

**Sample Well Log** – Page 54

**Chlorine Concepts** – Pages 55 – 56

**Sample Revised Total Coliform Plan** – Pages 57 – 60

**EPA Primary Drinking Water Standards** – Pages 61 – 67

**ADEC Revised Total Coliform Rule Fact Sheet** – Pages 68 – 69

**Sample Calcium Hypochlorite SDS** – Pages 70 – 77

**Small Treated Water Systems Exam Description** – Page 78

**Formula Sheet** – Pages 79 – 80

**Formula Sheet (to rip out)** – Pages 81-82

# Worksheet #1 - Sources

## Definitions:

*Potable:*

*Waterborne pathogen:*

*Watershed:*

*Permeable:*

*Unconfined aquifer:*

*GWUDISW:*

**1) What Federal Regulation governs drinking water?**

- A. Safe Drinking Water Act
- B. Clean Water Act
- C. Water Disinfection Act
- D. Occupational Health and Safety Act

**2) Rainwater recharges (refill) aquifers through \_\_\_\_\_.**

- A. Percolation
- B. Evaporation
- C. Transpiration
- D. Runoff

**3) Which water source is the easiest to contaminate?**

- A. Groundwater
- B. Spring
- C. Surface water
- D. Confined aquifer

**4) A small treated water system serves less than \_\_\_\_\_ people a day and adds \_\_\_\_\_ chemical(s).**

- A. 300, 1
- B. 500, 2
- C. 300, 2
- D. 500, 1

## **Worksheet #1 - Sources**

- 5) A groundwater source located in the permeable layer is a(n) \_\_\_\_\_.  
A. Confined aquifer  
B. Unconfined aquifer  
C. Confined spring  
D. Both A and C
- 6) Wells drilled into confined aquifers are \_\_\_\_\_.  
A. Confined wells  
B. Cleaner than unconfined aquifers  
C. Unconfined aquifers  
D. Both A and B
- 7) Groundwater under the direct influence of surface water (GWUDISW) has:  
A. The same testing requirements as surface water  
B. A high possibility of containing Giardia and Cryptosporidium  
C. More organic material than groundwater  
D. All of the above
- 8) Groundwater has \_\_\_\_\_ dissolved minerals than surface water.  
A. More  
B. Less
- 9) Surface water has \_\_\_\_\_ issues with bacteria and turbidity than groundwater.  
A. More  
B. Less
- 10) Which water source is *least likely* to become contaminated?  
A. Unconfined aquifer  
B. Confined aquifer  
C. Surface water  
D. Ground water under the direct influence of surface water (GWUDISW)
- 11) The \_\_\_\_\_, is the ground above an unconfined aquifer. In this area, water enters the ground and recharges the water table.  
A. Confined aquifer  
B. Wellhead  
C. Recharge area  
D. Spring

## **Worksheet #2 – Properties of Water**

### **Definitions:**

*Biological Contaminant:*

*Inorganic Material:*

*Coliform Bacteria:*

- 1) **Given enough time, water will \_\_\_\_\_ anything it comes in contact with.**
  - A. Dissolve
  - B. Stain
  - C. Grease
  - D. Lubricate
- 2) **Water with \_\_\_\_\_ often appears cloudy due to presence of suspended material.**
  - A. High turbidity
  - B. Low turbidity
  - C. High conductivity
  - D. Low conductivity
- 3) **Iron, sodium, arsenic and hydrogen sulfide are all examples of \_\_\_\_\_.**
  - A. Suspended solids
  - B. Dissolved solids
  - C. Palatable water
  - D. Coliform bacteria
- 4) **\_\_\_\_\_ is a group of chemical contaminants that often comes from petroleum fuels.**
  - A. Synthetic Organic Compounds (SOCs)
  - B. Volatile Organic Compounds (VOCs)
  - C. Soda ash
  - D. pH
- 5) **pH is a measure of how \_\_\_\_\_ or \_\_\_\_\_ a liquid is.**
  - A. Hot or cold
  - B. Potable or non-potable
  - C. Palatable or unpalatable
  - D. Acidic or basic

## **Worksheet #2 – Properties of Water**

- 6) Water with a pH of 9 is considered to be \_\_\_\_\_.  
A. Acidic  
B. Basic
- 7) Hardness is caused by both \_\_\_\_\_ and \_\_\_\_\_.  
A. Calcium and magnesium  
B. Chlorine and potassium permanganate  
C. Hydrogen sulfide and copper  
D. Bacteria and viruses
- 8) \_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_ are all pathogens found in drinking water.  
A. Bacteria, virus and protozoa  
B. Bacteria, algae and hydrogen sulfide  
C. Bacteria, color and turbidity  
D. All of the above.
- 9) Coliform bacteria are good indicators of pathogenic contamination because:  
A. Testing methods are simple and cheap  
B. They are present in large numbers in human feces  
C. They are hardy (strong) bacteria  
D. All of the above
- 10) \_\_\_\_\_ are larger particles that are easily removed with filters.  
A. Dissolved solids  
B. Suspended solids  
C. Colloidal solids  
D. Inorganic material
- 11) \_\_\_\_\_ is defined as the acid neutralizing capability of water. It helps to keep pH stable.  
A. Conductivity  
B. Turbidity  
C. Alkalinity  
D. Corrosiveness
- 12) \_\_\_\_\_ water can lead to issues with scale formation in pipes and boilers and causes soaps and detergents to be less effective.  
A. Hard  
B. Soft  
C. Turbid  
D. Chlorinated

## **Worksheet #2 – Properties of Water**

**13) \_\_\_\_\_ are materials through which electrons do not flow freely.**

- A. Insulators
- B. Conductors
- C. Relays
- D. Electromagnets

**14) In \_\_\_\_\_ flow, both the current and direction of travel are able to change and reverse.**

- A. Household
- B. Utility
- C. Direct Current (DC)
- D. Alternating Current (AC)

**22) When a light bulb is powered, the circuit it is connected to is:**

- A. Open
- B. Closed
- C. Reversed
- D. Insulated

## **Worksheet #3 – Wells**

- 1) Which type of well is least likely to become contaminated?
  - A. Dug
  - B. Drilled
  - C. Bored
  - D. Driven
  
- 2) A \_\_\_\_\_ is protected by impermeable underground formations and therefore less likely to become contaminated.
  - A. Spring
  - B. Confined aquifer
  - C. Unconfined aquifer
  - D. Hand dug well
  
- 3) A \_\_\_\_\_ is a written report produced by the well driller that includes information about the well parts and aquifer.
  - A. Well log
  - B. Well report
  - C. Sanitary survey
  - D. Well schematic
  
- 4) \_\_\_\_\_ pumps are most often used to extract groundwater in rural Alaska.
  - A. Turbine
  - B. Sump
  - C. Positive displacement
  - D. Submersible
  
- 5) The \_\_\_\_\_ protects well parts and should extend 12 inches above the ground.
  - A. Screen
  - B. Casing
  - C. Grout
  - D. Sanitary seal
  
- 6) The well pad should \_\_\_\_\_ from the well head.
  - A. Slope away
  - B. Drain towards
  - C. Be 100 feet away
  - D. None of the above



## **Worksheet #3 – Wells**

- 7) A \_\_\_\_\_ extends from the sanitary seal and prevents the well from collapsing by allowing air into the casing as the water levels drops.
- A. Grout
  - B. Screen
  - C. Vent
  - D. Packers
- 8) A \_\_\_\_\_ is placed at the bottom of a submersible pump to prevent debris from entering the well.
- A. Grout
  - B. Screen
  - C. Vent
  - D. Sanitary seal
- 9) Groundwater is more likely to have issues with \_\_\_\_\_ than surface water.
- A. Organics
  - B. Direct contact with wild animals
  - C. Minerals (iron and manganese)
  - D. Total coliform bacteria
- 10) A \_\_\_\_\_ is placed on the bottom of the drop pipe above the pump to prevent water from flowing back down the drop pipe when the pump shuts off.
- A. Grout screen
  - B. Check valve
  - C. Well pad
  - D. Casing
- 11) A community sewer line or septic tank should be at least \_\_\_\_\_ feet from a well.
- A. 100
  - B. 300
  - C. 400
  - D. 200
- 12) A private sewer line or fuel storage should be at least \_\_\_\_\_ feet from a well.
- A. 100
  - B. 300
  - C. 400
  - D. 200

## **Worksheet #3 – Wells**

**13) A \_\_\_\_\_ allows the drop pipe (raw water transmission line) to emerge from the well below the ground to help prevent freezing.**

- A. Drop pipe
- B. Pitless adapter
- C. Master meter
- D. Check valve

**14) A \_\_\_\_\_ can tell an operator how much raw water has been produced by a well.**

- A. Drop pipe
- B. Pitless adapter
- C. Flow meter
- D. Check valve

**15) The difference between static (non-pumping) and pumping water level is known as \_\_\_\_\_.**

- A. Borehole
- B. Drawdown
- C. Aquifer
- D. Water table

**16) A \_\_\_\_\_ can be used to isolate a well from the water system.**

- A. Gate valve
- B. Air release
- C. Master meter
- D. Check valve

**17) \_\_\_\_\_ seals the space between the borehole and casing and is required in the first 20 feet of the well and anytime the casing passes through an impermeable layer.**

- A. Screen
- B. Casing
- C. Grout
- D. Vent

**18) \_\_\_\_\_ are common well house components:**

- A. Water meters
- B. Pressure gauges
- C. Raw water sample taps
- D. All of the above

## **Worksheet #3 – Wells**

- 19) \_\_\_\_\_ valves allow air to exit the system while water lines are being filled and allow air into the system when lines are being drained.
- A. Reduced pressure
  - B. Gate
  - C. Globe
  - D. Air/vacuum release
- 20) In surface water systems, weirs, flumes and gauging stations are all methods of measuring \_\_\_\_\_.
- A. Turbidity
  - B. Water quality
  - C. Flow
  - D. Pressure
- 21) In an unconfined aquifer, the \_\_\_\_\_ is the above ground area located above the cone of depression. Contamination in this area can directly impact water quality.
- A. Water table
  - B. Watershed
  - C. Zone of influence
  - D. All of the above
- 22) What is the ***last step*** in closing a well?
- A. Pull the pump, motor and all electrical wires
  - B. Rip the casing out of the ground
  - C. Fill the hole with cement
  - D. None of the above

## Worksheet #4 - O&M

What are a few routine O&M activities?

List wellhead components that should be visually inspected routinely:

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

List routine maintenance activities for a chemical feed system:

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

- 1) It is important to have \_\_\_\_\_ for pumps and other system components.
  - A. Maintenance manuals
  - B. Operations manuals
  - C. Spare parts
  - D. All of the above
- 2) Operators should frequently \_\_\_\_\_ all water system components.
  - A. Look at
  - B. Touch to detect heat and vibration
  - C. Listen and smell
  - D. All of the above
- 3) Problems with water system parts are generally \_\_\_\_\_ or \_\_\_\_\_ related.
  - A. Chemical or physical
  - B. Electrical or mechanical
  - C. Physical or mechanical
  - D. Electrical or chemical
- 4) A \_\_\_\_\_ is an electrical safety device that prevents chlorine from being injected into a system when no water is flowing.
  - A. Check valve
  - B. Flow switch
  - C. Injector unit
  - D. Foot valve
- 5) \_\_\_\_\_ valves are commonly installed at high points in a system and are designed to release air that builds in the system.
  - A. Gate release
  - B. Double check
  - C. Air release

## **Worksheet #4 - O&M**

- D. Well head
- 6) **Valves in the distribution system should be exercised and inspected for leaks how often?**
- A. Daily
  - B. Monthly
  - C. Biannually
  - D. Annually
- 7) **Storage tanks can be used to:**
- A. Help maintain pressure in the system
  - B. Provide flow during peak demand periods and emergencies
  - C. Provide contact time for chlorine
  - D. All of the above
- 8) **The \_\_\_\_\_ water level, describes how much water is in a well when no water is being pumped.**
- A. Static
  - B. Pumping
  - C. Yield
  - D. Submersible
- 9) **Generally, hydropneumatic tanks should be \_\_\_\_\_ air and \_\_\_\_\_ water.**
- A. 1/2, 1/2
  - B. 1/3, 2/3
  - C. 1/4, 3/4
  - D. 2/5, 3/5
- 10) **\_\_\_\_\_ is how much water (gallons) a well can produce over a period of time (generally minutes).**
- A. Drawdown
  - B. Specific capacity
  - C. Well yield
  - B. Pressure
- 11) **\_\_\_\_\_ is how much water a well can produce per foot of drawdown.**
- A. Drawdown
  - B. Specific capacity
  - C. Well yield
  - B. Pressure

## **Worksheet #4 - O&M**

- 12) When seasonal \_\_\_\_\_ occurs, it may be necessary to change the water intake depth.
- A. Flow
  - B. Turnover
  - C. Demand
  - D. None of the above
- 13) The best way to avoid \_\_\_\_\_ is to maintain positive pressure (20 psi) at all times in a distribution system.
- A. Backsiphonage
  - B. Backpressure
  - C. Air gaps
  - D. Distribution system leaks
- 14) An air gap should be \_\_\_\_\_ the diameter of the outlet supply line.
- A. The same as
  - B. Two times
  - C. Three times
  - D. Four times
- 15) Butterfly, ball, and plug valves can all be used to isolate a portion of a system and control \_\_\_\_\_.
- A. Turbidity
  - B. Flow
  - C. Residual
  - D. Alkalinity
- 16) \_\_\_\_\_ can occur when the pressure in a contaminated source is greater than the pressure in a potable water source.
- A. Backsiphonage
  - B. Backpressure
  - C. Air gaps
  - D. Distribution system leaks

## **Worksheet #5 - Treatment #2**

- 1) **Cartridge filters in series \_\_\_\_\_ in pore size.**
  - A. Decrease
  - B. Increase
  - C. Stay the same
  - D. Expand
- 2) **Direct sand filtration can remove \_\_\_\_\_, which decreases turbidity.**
  - A. Suspended solids
  - B. Dissolved solids
  - C. Raw water
  - D. Sodium hypochlorite
- 3) **When \_\_\_\_\_ is too high a \_\_\_\_\_ needs to be completed.**
  - A. Chlorine demand, backwash
  - B. Pressure differential, backwash
  - C. Pressure differential, cleaning
  - D. Chlorine demand, forehead
- 4) **\_\_\_\_\_ is more likely to have high iron and manganese.**
  - A. Groundwater
  - B. Surface water
  - C. Spring
  - D. GWUDISW
- 5) **Iron causes \_\_\_\_\_ colored stains on fixtures/clothing and manganese leaves \_\_\_\_\_ colored stains.**
  - A. Blueish-green, purple
  - B. Greenish-black, purple
  - C. Orange/red, greenish-black
  - D. Purple, orange/red
- 6) **Fluoride helps prevent \_\_\_\_\_.**
  - A. Tooth decay
  - B. Brain development
  - C. Bone deterioration
  - D. Eye deterioration
- 7) **Fluoride residuals should be \_\_\_\_\_ mg/L.**
  - A. 0.5 to 1.0
  - B. 0.7
  - C. 0.2 to 1.5
  - D. 0.3 to 2.0

## **Worksheet #5 - Treatment #2**

- 8) High levels of calcium and magnesium creates \_\_\_\_\_ water.
- A. Soft
  - B. High pH
  - C. Hard
  - D. Corrosive
- 9) \_\_\_\_\_ water can be corrosive.
- A. Hard
  - B. Soft
  - C. Turbid
  - D. Chlorinated
- 10) The \_\_\_\_\_ process exchanges sodium ions with calcium and magnesium ions.
- A. Sand filtration
  - B. Post-chlorination
  - C. Ion exchange
  - D. Rapid sand
- 11) A \_\_\_\_\_ is a direct or indirect connection between a public water supply and a non-potable water source.
- A. Backflow prevention
  - B. Cross connection
  - C. Ion exchange
  - D. Water purifier
- 12) The reversal of flow is called \_\_\_\_\_.
- A. Backflow
  - B. Upflow
  - C. Downflow
  - D. Backwards
- 13) The best way to prevent backsiphonage is to maintain \_\_\_\_\_ in potable water lines.
- A. Negative pressure
  - B. Neutral pressure
  - C. Back pressure
  - D. Positive pressure



## **Worksheet #5 - Treatment #2**

- 14) In the ion exchange process calcium and magnesium ions are exchanged with \_\_\_\_\_ ions.
- A. Chlorine
  - B. Iron
  - C. Sodium
  - D. Alkalinity
- 15) During the \_\_\_\_\_ process, water comes in contact with oxygen and taste and odor causing material is released from the water into the air.
- A. Disinfection
  - B. Sequestration
  - C. Aeration
  - D. Ion exchange
- 16) Water is corrosive when it has \_\_\_\_\_.
- A. Low pH and low alkalinity
  - B. Low hardness
  - C. High dissolved oxygen
  - D. All of the above

## Worksheet #6 - Disinfection

- 1) Testing for \_\_\_\_\_ is a good way to see if disinfection has worked.
  - A. Coliforms
  - B. Arsenic
  - C. VOCs
  - D. Suspended solids
- 2) Which form of chlorine disinfectant is the most effective at killing organisms?
  - A. Hypochlorite Ion ( $\text{OCl}^-$ )
  - B. Hypochlorous Acid ( $\text{HOCl}$ )
  - C. Chloramines
  - D. Chlor-organics
- 3) Which term describes the amount of chlorine left in water after demand is met?  
(Hint:  $\text{DOSAGE} - \text{DEMAND} = \text{_____}$ )
  - A. Dosage
  - B. Demand
  - C. Residual
  - D. Contact time
- 4) To protect against pathogenic organisms, chlorine residual of \_\_\_\_\_ must be present at the entry to the distribution system.
  - A. 0.5 mg/L
  - B. 0.03 mg/L
  - C. 0.2 mg/L
  - D. 0.02 mg/L
- 5) Disinfection with chlorine works better with a slightly \_\_\_\_\_ pH.
  - A. Lower
  - B. High
  - C. Zero
  - D. pH doesn't matter.
- 6) Bacteria are \_\_\_\_\_ to kill with chlorine than viruses and protozoa.
  - A. Easier
  - B. Harder
- 7) \_\_\_\_\_ chlorine is the most effective form of chlorine.
  - A. Free
  - B. Combined
  - C. Used
  - D. They are all the same.

## Worksheet #6 - Disinfection

- 8) Organic material (turbidity) \_\_\_\_\_ the effectiveness of chlorine?
- A. Decreases
  - B. Increases
  - C. Has no effect on
  - D. Dissolves
- 9) Chlorine and organics can produce \_\_\_\_\_.
- A. Arsenic
  - B. Volatile Organic Compounds (VOCs)
  - C. Disinfection by-products (TTHMs and HAA5)
  - D. Iron bacteria
- 10) A \_\_\_\_\_ helps maintain prime on a chlorinator pump.
- A. Check valve
  - B. Injector unit
  - C. Foot valve
  - D. Gate valve
- 11) A \_\_\_\_\_ is an electrical device that prevents chlorine from being injected into a system when no water is flowing.
- A. Check valve
  - B. Flow switch
  - C. Injector unit
  - D. Foot valve
- 12) \_\_\_\_\_ boils at room temperature, is yellow in color, 2.5 times heavier than air and can destroy lung tissue if inhaled?
- A. Sodium hypochlorite
  - B. Calcium hypochlorite
  - C. Chlorine gas
  - D. Disinfection by-products
- 13) \_\_\_\_\_ is made up of chloramines and chlor-organic compounds.
- A. Combined residual
  - B. Free residual
  - C. Total residual
  - D. Dosage
- 14) Free residual + Combined residual = \_\_\_\_\_
- A. Dosage
  - B. Total residual
  - C. Pre-residual
  - D. Post-residual

## **Worksheet #6 - Disinfection**

- 15) When dosages are high enough to achieve \_\_\_\_\_ chlorination, chlor-organic compounds and chloramines have been destroyed and any remaining chlorine is free chlorine.
- A. Total
  - B. Combined
  - C. Breakpoint
  - D. Background
- 16) \_\_\_\_\_ is equal to Concentration (mg/L) x Contact Time (minutes).
- A. Chlorine metabolism
  - B. Contact time
  - C. Giardia deactivation
  - D. Free residual
- 17) A disadvantage to both UV and Ozone disinfection is they do not \_\_\_\_\_.
- A. Disinfect
  - B. Sanitize
  - C. Leave a residual
  - D. All of the above
- 18) Disinfection by-products can cause \_\_\_\_\_.
- A. Learning disabilities in children
  - B. Increased corrosion in plumbing
  - C. Improved disinfection
  - D. Cancer
- 19) If a distribution system line has been contaminated, you should \_\_\_\_\_ the pipes.
- A. Break
  - B. Super-chlorinate
  - C. Dechlorinate
  - D. Lubricate

## **Worksheet #7 - Regulations, Safety and Total Coliforms**

### **Definitions:**

- *Primary Standards:*
  
- *Secondary Standards:*

**What are a few things that must be included on a RTCR site sampling plan?**

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- 1. What Federal Regulation governs drinking water?**
  - A. Safe Drinking Water Act
  - B. Clean Water Act
  - C. Water Disinfection Act
  - D. Occupational Health and Safety Act
- 2. Who is responsible for enforcing the Safe Drinking Water Act in Alaska?**
  - A. EPA (Environmental Protection Agency)
  - B. ARUC (Alaska Rural Utility Collaborative)
  - C. THO (Tribal Health Organizations)
  - D. ADEC (Alaska Department of Environmental Conservation)
- 3. What government agency is responsible for worker safety?**
  - A. EPA (Environmental Protection Agency)
  - B. ADEC (Alaska Department of Environmental Conservation)
  - C. OSHA (Occupational Safety and Health Administration)
  - D. THO (Tribal Health Organization)
- 4. The \_\_\_\_\_ features safety information about chemicals and needs to be kept onsite.**
  - A. ADEC (Alaska Department of Environmental Conservation)
  - B. Safety Data Sheet (SDS) – formerly known as MSDS
  - C. OSHA (Occupational Health and Safety Act)
  - D. All of the above
- 5. Maximum Contaminant Levels (MCLs) are set for contaminants which lead to health effects. These are covered by \_\_\_\_ standards.**
  - A. Primary
  - B. Secondary
  - C. Both
  - D. Neither

## **Worksheet #7 - Regulations, Safety and Total Coliforms**

6. **Lead and copper samples must be taken \_\_\_\_\_.**
- A. After water has been sitting in the pipes for 6 and 8 hours
  - B. After lines are flushed
  - C. Whenever
  - D. Every 15 years
7. **Class A community water systems in Alaska are required to take total coliform samples how often?**
- A. Daily
  - B. Monthly
  - C. Quarterly
  - D. Annually
8. **\_\_\_\_\_ needs to be stored in a clean, dry, cool and dark area.**
- A. Calcium hypochlorite
  - B. Circulation pumps
  - C. Flow switch
  - D. All of the above
9. **When possible, water samples should not be taken from:**
- A. Hoses
  - B. Lines with private water softener
  - C. Drinking fountains
  - D. All of the above
10. **You should sanitize the faucet with bleach and let the water run for 2 to 3 minutes before taking a coliform sample?**
- A. True
  - B. False
11. **High nitrate levels can cause \_\_\_\_\_.**
- A. Purple face syndrome
  - B. Blue baby syndrome
  - C. Green child syndrome
  - D. Learning disabilities
12. **Drinking water containing arsenic can lead to \_\_\_\_\_.**
- A. Diabetes
  - B. Cancer
  - C. Hepatitis
  - D. High blood pressure

## **Worksheet #7 - Regulations, Safety and Total Coliforms**

- 13. If you receive a positive total coliform test, you must take \_\_\_\_\_ repeat samples within 24 hours.**
- A. 3
  - B. 4
  - C. 2
  - D. 1
- 14. Operations records can be used to \_\_\_\_\_.**
- A. Assist in making operational decisions and establish O&M schedules
  - B. Help predict the need for equipment replacement
  - C. Prove compliance with regulations
  - D. All of the above
- 15. The maximum residual disinfectant level for chlorine and chloramines is \_\_\_\_\_.**
- A. 0.2 mg/l
  - B. 2.0 mg/l
  - C. 0.4 mg/l
  - D. 4.0 mg/l
- 16. When mixing calcium hypochlorite, you should always add the powder to the liquid.**
- A. True
  - B. False
- 17. When taking electrical measurements, you should \_\_\_\_\_.**
- A. Wear metal jewelry
  - B. Wear shirts with loose fitting sleeves
  - C. Remove safety glasses so you can see better and rubber gloves so you have better grip
  - D. Take measurements with one hand, keep the other hand in your pocket
- 18. A(n) \_\_\_\_\_ is trained to identify potential hazards and must be onsite anytime a trench is dug for construction or repair.**
- A. OSHA certified contractor
  - B. HAZMAT certified person
  - C. Competent person
  - D. Trench specialist
- 19. If you get \_\_\_\_\_ on your eyes or skin, the area should be rinsed for 15 minutes.**
- A. Iron
  - B. Bacteria
  - C. Chlorine
  - D. Ion exchange media

## **Worksheet #7 - Regulations, Safety and Total Coliforms**

20. General use fire extinguishers have a(n) \_\_\_\_\_ rating. They can be used on ordinary combustibles like wood, flammable liquids and electrical equipment.
- A. A
  - B. B
  - C. C
  - D. ABC
21. A \_\_\_\_\_ program ensures that operators working with electrical equipment do so, when the device is not energized.
- A. Competent person
  - B. Lock out, tag out
  - C. Safety data sheet (SDS)
  - D. First aid
22. A \_\_\_\_\_ is an annual report to consumers required by all community water systems.
- A. Consumer confidence report
  - B. Consumer complaint report
  - C. Consumer copy report
  - D. Consumer chlorine report



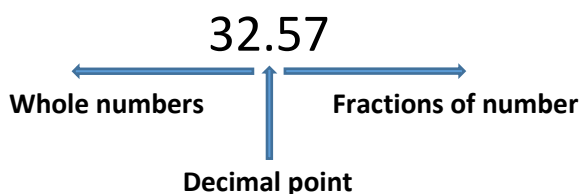
# Math 1 – Background Concepts

Common Symbols:

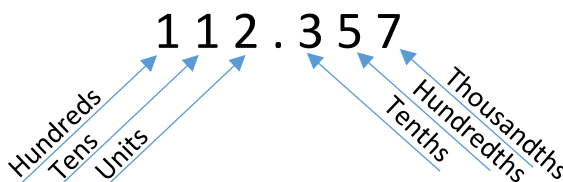
Math Operations	Common Symbols	Examples
Multiply	X	$A = B \times C$
	.	$A = B \cdot C$
	( ) ( )	$A = (B)(C)$
	No Spaces	$A = BC$
Divide	$\div$	$A = B \div C$
	—	$A = \frac{B}{C}$
	/	$A = B/C$

**Decimals:** A decimal is made of two sets of numbers.

- The numbers to the left of the decimal are whole numbers.
- The numbers to the right of the decimal are parts of a whole numbers. I.e. fractions of number. 2.5 is the same thing as  $2 \frac{1}{2}$  or two and a half.



- **Example:** Think about construction.
  - 45.75 inches = 45 and  $\frac{3}{4}$ <sup>th</sup> inch
    - $\frac{3}{4}$  is 3 of 4 parts
    - $\frac{4}{4}$  is equal to 1
- Each unit has a particular value. The more numbers there are after the decimal, the more exact the measurement is.



**Rounding:** Rounding is used to simplify numbers for convenience, not accuracy. At times, answers on the Small Treated Exam may be rounded. Rounding should only be carried out at the end of a problem and works according to two rules:

- **Rule 1** – If the number next to the right of the desired place is 0-4, leave the last digit as is and drop the remaining digits (round down).

## Math 1 – Background Concepts

- **Rule 2** – If the number next to the right of the desired place is 5-9, change the last place to the next highest digit (round up).
- Examples:
  - Round 23.68987 to 2 places (hundredths)
    - 23.69
    - This is because the number to the left of the hundredth value is 9, so you round up.
      - 23.68987
- **Rounding Practice Problems**

- 1) Round 33.33567 to the tenth place –
- 2) Round 514.7665 to the hundredth place –
- 3) Round 45.8432353 to the thousandth place –
- 4) Round 5.555 to the nearest whole number –

**Averages:** To find the average of a set of numbers, add the numbers together and divide by the amount of numbers present. Round answers to the tenth place (first decimal place).

4) 6 4 7 1 3 2 6 1 \_\_\_\_\_

5) 2.7 3.4 6.7 1.2 3.5 3.2 \_\_\_\_\_

6) 1.1 2.0 2.1 1.9 2.4 1.7 1.8 \_\_\_\_\_

7) 672 68 214 518 4 \_\_\_\_\_

**Reducing Fractions:** To reduce a fraction to lowest terms, find the largest number that will divide evenly into both the numerator (top number – whole number) and the denominator (bottom number – part or decimal). Reducing the fraction will not change its value; the reduced fraction will be an equivalent.

Example:

- Reduce 6/18 to lowest terms.
  - The largest number that will divide evenly into both the numerator and the denominator is 6.

$$\begin{array}{rcccl} 6 & 6/6 & 1 & & \\ \hline & = & & = & \\ 18 & 18/6 & 3 & & \end{array}$$

Thus, the fraction 6/18 is the same as the fraction 1/3 when reduced to lowest terms.

*\*Note – any number over 1 is a whole number. For instance, 3 is the same thing as 3/1*

## Math 1 – Background Concepts

8)  $4/8$  \_\_\_\_\_

9)  $32/48$  \_\_\_\_\_

10)  $10/5$  \_\_\_\_\_

11)  $7/8$  \_\_\_\_\_

12)  $15/27$  \_\_\_\_\_

**Powers:** Powers tell you how many times you multiply a number by itself.

- Examples

- $2^2 = 2 \times 2 = 4$
- $4^3 = 4 \times 4 \times 4 = 64$
- $3^5 = 3 \times 3 \times 3 \times 3 \times 3 = 243$

13)  $4^4$

14)  $3^2$

15)  $2^5$

16)  $16^2$

**Solving for an unknown:** There will be times when you need to reorganize a given formula to solve for an unknown. The easiest way to do this is to separate (isolate) the value you need to solve for (the unknown) from the rest of the problem. This is done differently depending on what type of equation you are using. You will add, subtract, multiply or divide to get the unknown number by itself (on one side of equal sign)

- **Addition:** To isolate an unknown in an addition problem, you will subtract the accompanying value from each side of the equal sign. Solve for A.

a)  $X = A + B$

b) Subtract B from each side of the equals sign to get A by itself.

$$X = A + B$$

$$-B = -B$$

$$X - B = A$$

c)  $X - B = A$  - Now that A has been isolated, you can solve for it.

## Math 1 – Background Concepts

- **Subtraction:** To isolate an unknown in a subtraction problem, you will add the accompanying value to each side of the equal sign. Solve for A.

a)  $X = A - B$

b) Add B to each side of the equal sign to get A by itself.

$$X = A - B$$

$$+B = +B$$

$$X + B = A$$

c)  $X + B = A$  - Now that A has been isolated, you can solve for it.

- **Multiplication:** To isolate a value in a multiplication problem you will divide the accompanying value from each side of the equal sign. Solve for A.

a)  $X = A \times B$

b) Divide both sides by B to get A by itself.

$$\frac{X}{B} = \frac{A \times B}{B}$$

$$\frac{X}{B} = A$$

c)  $\frac{X}{B} = A$

$$B$$

**Division:** To isolate a value in a division problem you will multiply the accompanying value from each side. Solve for A.

a)  $X = \frac{A}{B}$

$$B$$

b) Multiply both sides by B to get A by itself

$$X \times B = \frac{A}{B} \times B$$

$$B$$

c)  $X \times B = A$

**Solve for X:**

17)  $X - B = A$  \_\_\_\_\_

18)  $A = X + B$  \_\_\_\_\_

19)  $A = X \times B$  \_\_\_\_\_

20)  $A = \frac{X}{B}$  \_\_\_\_\_

# Math 1 Homework

**Rounding:** Round the following numbers.

1) Round 33.333 to 2 places (hundredths) =

2) Round 345.26 to 1 place (tenths) =

3) Round 10,000.678643 to 3 places (thousandths) =

**Averages:** Find the averages. Round answers to the tenth place.

4) 5 8 12 11 33 25 16 \_\_\_\_\_

5) 2.5 3.7 6.7 1.1 3.6 3.2 \_\_\_\_\_

6) 5.569 425.6 66.5 7.545 \_\_\_\_\_

**Reducing Fractions:** Reduce the following fractions to their lowest terms.

7)  $50/100 =$

8)  $25/200 =$

9)  $9/8 =$

**Powers:** Solve the following.

10)  $4^5 =$

11)  $2^2 =$

12)  $2^2 + 4^5 =$

**Isolate the unknown:**

13) Isolate X in  $X+B = C$

14) Isolate X in  $X \times B = C$

## **Math 1 Homework**

15) Given the formula below, isolate tank capacity.

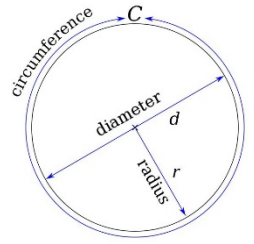
$$\text{Detention Time} = \frac{\text{Tank Capacity}}{\text{Flow}}$$

16) Given the formula below, isolate concentration.

$$\text{Dosage (lbs)} = \text{Concentration (mg/l)} \times \text{Volume (MG)} \times 8.34$$

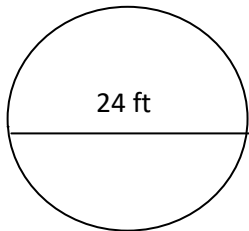
## Math 2 – Area, Volume and Conversions

**Area and Volume:** To find area and volume etc. plug the numbers given in the problem into the correct formula on your formula sheet. Area answers will be in  $\text{ft}^2$  and Volume answers will be in  $\text{ft}^3$ .

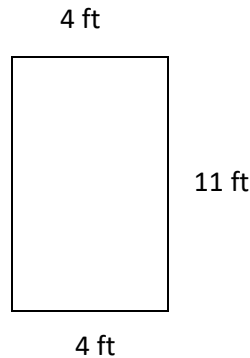


Find the area of the following:

1)



2)



3) What is the volume of a cylindrical water tank that is 25 feet in diameter and 16 feet high?

4) What is the volume of a box 2 feet in width, 3 feet in length and 10 feet in depth? Give answer in  $\text{ft}^3$ .

**Conversions:** Multiply and divide by your conversion factors to obtain desired units.

**Step 1:** Look for desired unit in problem.

**Step 2:** Look at formula sheet to find appropriate conversion factor from given to desired unit.

Step 3: Set up fractions to multiply or divide and cancel diagonal units.

**Example:** How many minutes are in 3 days?

$$\text{Step 1: } \frac{3 \text{ days}}{1} \times \frac{24 \text{ hours}}{1 \text{ day}} = 72 \text{ hours}$$

$$\text{Step 2: } \frac{72 \text{ hours}}{1} \times \frac{60 \text{ minutes}}{1 \text{ hour}} = 4,320 \text{ minutes}$$

## **Math 2 – Area, Volume and Conversions**

- 5) Convert 630 ft<sup>3</sup> of water to gallons. Round to the nearest tenth.
- 6) Convert 75 gallons of water to pounds. Round to the nearest tenth.
- 7) Convert 79ft<sup>3</sup> of water to weight in pounds. Round answer to the third decimal place (thousandth).
- 8) How many gallons are there in 2 pounds of water? Round answer to second decimal place (hundredth).
- 9) How many ppm of free chlorine is there in 1.2 mg/L?
- 10) How many ft<sup>3</sup> of water is there in 19 lbs of water? Round to one decimal place (tenth).
- 11) The pressure gauge at the base of a 30 ft tank will read how many psi? Round to the third decimal place (thousandth).

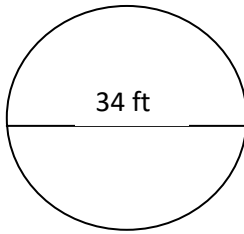


## Math 2 – Homework

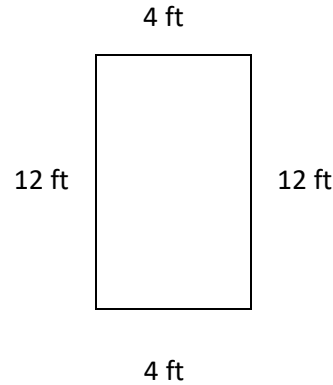
**Area and Volume:** To find area and volume etc plug the numbers given in the problem into the correct formula on your formula sheet. Area answers will be in  $\text{ft}^2$  and Volume answers will be in  $\text{ft}^3$ .

Find the area of the following:

1)



2)



3) What is the volume of a cylindrical chlorine vat that is 2 feet in radius and 4 feet tall?

**Conversions: Multiply and divide by your conversion factors to obtain desired units.**

4) Convert  $360 \text{ ft}^3$  of water to gallons. Round to the nearest tenth.

5) Convert 75 gallons of water to pounds. Round to the nearest tenth.

6) Convert  $30 \text{ ft}^3$  of water to weight in pounds. Round to the nearest thousandth.

7) Convert 45 lbs of water to  $\text{ft}^3$ . Round answer to the nearest tenth.

8) The pressure tank at the base of a 10 ft deep water tank will read \_\_\_\_\_ psi? Round answer to nearest hundredth.

## Math 3 – Hydraulics and Chlorine

### Word Problems

**Step 1)** Look for key words. WHAT IS THE QUESTION ASKING FOR? WHAT FORMULA DO YOU NEED? Draw a box around this.

**Step 2)** Circle the numbers and units in the question.

**Step 3)** Complete conversions, plug the numbers and solve.

### Basic Hydraulics Formula

Detention Time =  $\frac{\text{Tank Capacity}}{\text{Flow Rate}}$  or Time =  $\frac{\text{Volume}}{\text{Flow}}$

The question is asking for time.



Gallons = Tank Capacity or Volume



GPM = Flow Rate or Flow



- 1) How long will it take to fill at 200-gallon tank if the flow is 8 gpm?

- 2) If a boiler uses 20 gallons of fuel per day, how many days will a 500 gallon tank last?

- 3) What is the tank capacity of a contact chamber with a detention time of 50 minutes and a flow rate of 25 gallons per minute?

- 4) What is the volume of a contact chamber with a contact time of 50 minutes and a flow 280 gallons per minute?

## Math 3 – Hydraulics and Chlorine

### Dosage Formulas

$$\text{Dose} - \text{Demand} = \text{Residual}$$

The question  
is asking for  
the residual.

The dosage is  
given.

- 5) What is the Chlorine residual in a system that has a chlorine dosage of 2.75 mg/L and a chlorine demand of 2.35 mg/L ?



The demand  
is given

- 6) What is the chlorine dose used if there is a demand of 2.13 mg/L and a residual of .2 mg/L left in the system?

$$\text{Dosage (lbs)} = \text{Concentration (mg/L)} \times \text{Volume (MG)} \times 8.34 \text{ lbs/gal}$$

The question is asking for the dosage in (lbs).

Volume in million gallons (MG) is  
given.

- 7) How many pounds are needed to treat 38.75 MG, if the concentration is .4 mg/L?



Concentration (mg/L) is given.

- 8) How many pounds are needed to treat 2 MG, if the water has a concentration of 1 mg/l.?

### **Math 3 – Hydraulics and Chlorine**

9) How many pounds of chlorine is needed to treat 200,000 gallons of water if the concentration is .5 mg/l? Round answer to the second digit (hundredth).

10) What is the chlorine concentration (mg/l) if you are treating 5 MG with 14 pounds of chlorine? Round answer to the third decimal place (thousandth).

11) What is the chlorine concentration (mg/l) if you are treating 200,000 gallons with 1.5 lbs pounds of chlorine? Round the answer to the second decimal place (hundredth).

## **Math 3 - Homework**

- 1) What is the volume in  $\text{ft}^3$  of a pipe that is 4 feet in diameter and 50 ft long?
- 2) How long will it take to fill a 300 gallon tank if the flow is 5.5 gpm? Round answer to second decimal place (hundredth).
- 3) What is the volume of a tank that flows at 9 gpm and has a detention time on 45 minutes?
- 4) What is the chlorine dosage if there is a demand of 2.15 mg/l and a residual of 0.2 mg/l in the distribution system?
- 5) What is the chlorine residual if the dose is 2 mg/l and the demand is 1.25 mg/l?
- 6) How many lbs of chlorine are needed to treat 6 MG if the concentration is .5mg/l?
- 7) How many lbs of chlorine are needed to treat 70,000 gallons if the concentration is .2 mg/l? Round answer to the third decimal place (thousandth).
- 8) What is the chlorine concentration (mg/l) if you are treating 2 MG with 4 lbs of chlorine? Round the answer to the second decimal (hundredth).

# Small Treated Water Systems – Practice Exam 1

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1. **A confined space\_\_\_\_\_.**
  - a. Has limited access and exit points
  - b. May contain a potentially dangerous atmosphere
  - c. Is too small for a person to fit in.
  - d. Both a and b.
2. **Why do coliform sample bottles have Sodium Thiosulfate (white powder) in them?**
  - a. It neutralizes the chlorine (stops the chlorine from disinfecting)
  - b. To lower the pH
  - c. Eliminates the need to incubate the sample
  - d. To kill pathogens in the sample
3. **After a positive total coliform water sample, a system must take how many repeat samples within 24 hours?**
  - a. One
  - b. Two
  - c. Three
  - d. Four
4. **What is commonly used as an indicator of contamination and is found in plants, soil, water and warm blooded animals?**
  - a. Total coliform bacteria
  - b. Viruses
  - c. E. coli
  - d. Fecal coliform bacteria
5. **The slow passage of water through the soil is called**
  - a. Precipitation
  - b. Percolation
  - c. Transpiration
  - d. Evaporation

6. Water with high turbidity is typically \_\_\_\_\_ difficult to disinfect.
- More
  - Less
  - Equally
  - None of the above
7. The amount of chlorine remaining in the water after the demand is satisfied is called \_\_\_\_\_.
- Chlorine demand
  - Chlorine residual
  - Chlorination
  - Chlorine dosage
8. If a leaking fuel storage tank is near a well, which type of contamination would be most likely?
- Microbial
  - Inorganic chemicals
  - Volatile organic chemicals (VOCs)
  - Radiological
9. A steady decline in well yield could be the result of \_\_\_\_\_.
- Increased rainfall in the aquifer recharge zone.
  - Pump wear
  - A lack of media in a greensand filter
  - Percolation
10. When water is being pumped from a well, the water in the water table slopes toward the well. This formation is called the \_\_\_\_\_.
- Cone of depression
  - Zone of influence
  - Stratum sag
  - Aquifer depression

**11. In order to minimize backsiphonage and backpressure, what minimum distribution system pressure is recommended?**

- a. 15 psi
- b. 20 psi
- c. 10 psi
- d. 40 psi

**12. Coliform bacteria are used as indicator organisms because they are\_\_\_\_\_.**

- a. Hardier (tougher) than most waterborne pathogens
- b. Difficult to culture in a laboratory
- c. Easy to observe with the naked eye
- d. Always toxic to humans

**13. What is the area of a circular reservoir if it has a diameter of 680ft.?**

- a. 125,000 ft.<sup>2</sup>
- b. 275,000 ft.<sup>2</sup>
- c. 315,000 ft.<sup>2</sup>
- d. 362,984 ft.<sup>2</sup>

**14. Chemicals should be stored in a location that is \_\_\_\_\_.**

- a. Cool
- b. Dry
- c. All of these options
- d. Clean

**15. Hydropneumatic or pressure tanks \_\_\_\_\_.**

- a. Are open to atmospheric pressure when full
- b. Are used to maintain water piping pressure for small water systems
- c. Serve as water storage in case of a major fire
- d. Must be located well above the system to maintain adequate pressure head



- 16. Backflow is defined as \_\_\_\_\_.**
- a. Surface water influencing groundwater
  - b. Reversed flow of liquid in a piping system
  - c. Reversal of impeller rotation
  - d. None of the above
- 17. A \_\_\_\_\_ can be used to collect water from an aquifer below a river bed.**
- a. Infiltration gallery
  - b. Dug well
  - c. Driven well
  - d. Drilled well
- 18. A check valve is designed to \_\_\_\_\_.**
- a. Permit air to escape from the pipe
  - b. Prevent water from reversing direction in a line
  - c. Regulate the rate of flow through the discharge pipe
  - d. Prevent clogging the suction line
- 19. Why have a preventative maintenance program?**
- a. Save money and cut down on electricity costs
  - b. Increase the use of generators
  - c. Lengthen the life of a water plant and prevent costly problems
  - d. Repair equipment after breakdowns
- 20. A positive displacement pump is used to feed \_\_\_\_ into a water supply.**
- a. Calcium hypochlorite
  - b. Chlorine gas
  - c. Filter media
  - d. Both a and c

**21. Which of the following groups are disease causing organisms?**

- a. Bacteria
- b. Protozoa
- c. Viruses
- d. All of the above

**22. Wells should be disinfected after \_\_\_\_\_.**

- a. After initial construction
- b. A pump has been removed and repaired
- c. The wellhead has been flooded
- d. All of the above

**23. Coliform organisms are most common in \_\_\_\_\_.**

- a. Raw meat
- b. Groundwater
- c. The intestinal tracts of warm-blooded animals, including man
- d. The soil

**24. The cloudy appearance of water caused by the presence of suspended matter is \_\_\_\_\_.**

- a. Hardness
- b. Alkalinity
- c. Turbidity
- d. pH

**25. CCR stands for \_\_\_\_\_.**

- a. Consumer contamination report
- b. Calcium carbonate resistance
- c. Consumer confidence report
- d. Chlorine constant residual

**26. Why do you need continuous positive pressure throughout a distribution system?**

- a. To keep water meters reading correctly
- b. To prevent leaks in the distribution system
- c. To prevent contamination from backflow
- d. To reduce turbidity

**27. Which contaminant has a rotten egg odor?**

- a. Arsenic
- b. Hydrogen sulfide
- c. Iron
- d. Nitrate

28. To maintain proper disinfection in the distribution system, an entry point residual of \_\_\_\_\_ mg/l is needed.
- a. 2.0
  - b. 1.0
  - c. 0.5
  - d. 0.2
29. Calculate the detention time of a 350 gallon tank when water is flowing at 112 gpm.
- a. 1 minute
  - b. 3 minutes
  - c. 17 minutes
  - d. 24 minutes
30. Monthly Coliform samples should be taken from \_\_\_\_\_.
- a. Right after chlorine injection
  - b. The operators home
  - c. The watering point
  - d. The distribution system, after the storage tank
31. After a positive total coliform reading, you need to resample at \_\_\_\_\_ within 24 hours.
- a. The same location as the positive sample
  - b. Within 5 service connections upstream of positive sample
  - c. Within 5 service connections downstream of the positive sample
  - d. All of the above
32. Lead and copper samples should be \_\_\_\_\_.
- a. Taken from kitchen sink after flushing for 5 minutes
  - b. Collected at the end of the day before going to bed
  - c. Collected twice during the day and mixed together
  - d. Taken after water has been sitting in the piping for 6 - 8 hours
33. Small Class A public water systems in Alaska are required to take total coliform samples \_\_\_\_\_.
- a. Daily
  - b. Monthly
  - c. Quarterly
  - d. Weekly

- 34. A chemical added to drinking water to help prevent tooth decay is\_\_\_\_\_.**
- a. Potassium Permanganate
  - b. Chlorine
  - c. Fluoride
  - d. Soda Ash
- 35. The volume of a water tank that is 12 feet deep, 80 feet long, and 20 feet wide is \_\_\_\_\_cubic feet.**
- a. 19,200
  - b. 12,400
  - c. 18,200
  - d. 24,800
- 36. Softening water means \_\_\_\_\_.**
- a. More soap will be needed to make lather
  - b. Removing dissolved gases
  - c. Removing suspended materials
  - d. Removing calcium and magnesium
- 37. Pathogenic bacteria cause drinking water to be \_\_\_\_\_.**
- a. Palatable
  - b. Unsafe
  - c. Colored
  - d. Potable
- 38. Water in a tank is 10 ft. deep. A pressure gauge at the base of the tank will read \_\_\_\_\_psi.**
- a. 1.1
  - b. 4.3
  - c. 8.7
  - d. 12.4
- 39. How many lbs of chlorine are needed to treat 15 MG of water if the concentration is .2 mg/l?**
- a. 25.02 lbs
  - b. 50.04 lbs
  - c. 20 lbs
  - d. 26 lbs

**40. \_\_\_\_\_ material is usually mineral based and does not originate from plants and animals.**

- a. Inorganic
- b. Organic
- c. Living
- d. Colloidal

**41. Water with a pH of 4 is considered to be \_\_\_\_\_.**

- a. Acidic
- b. Neutral
- c. Basic

**42. \_\_\_\_\_ results from the combination of chlorine and nitrogen and causes taste and odor issues.**

- a. Free residual
- b. Chlor-organics
- c. Chloramines
- d. Demand

**43. A \_\_\_\_\_ is an electrical device capable of changing voltage, up or down.**

- a. Relay
- b. Conductor
- c. Transformer
- d. Voltage meter

**44. After a backwash cycle is complete, the first portion of water passed through the filter should be sent to \_\_\_\_\_.**

- a. The storage tank
- b. The distribution system
- c. Waste
- d. The hypochlorinator

**45. \_\_\_\_\_ rotate inside a pump in order to move water.**

- a. Pump bowl
- b. Volute
- c. Mechanical seals
- d. Impellers

46. \_\_\_\_\_ are important to have on hand to ensure valves can easily be located for repairs and annual exercise.
- a. Source records
  - b. Distribution system maps
  - c. Operations records
  - d. Treatment system maps
47. When a tier 1 violation (i.e. positive fecal coliform sample, high nitrates or disease outbreaks) occurs, notice needs to be provided to consumers in \_\_\_\_\_.
- a. 24 hours
  - b. 30 days
  - c. Annually
  - d. There is no need to inform consumers
48. Arsenic is covered by \_\_\_\_\_ standards.
- a. Primary
  - b. Secondary
49. Which type of disinfection uses high powered lights?
- a. UV
  - b. Ozone
  - c. Calcium hypochlorite
  - d. Sodium hypochlorite
50. \_\_\_\_\_ are all sources of coliform bacteria.
- a. Decaying animals
  - b. Feces of warm blooded animals
  - c. Tree shrubs
  - d. All of the above

# Small Treated Water Systems - Practice Exam 2

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1. Disease causing bacteria are known as \_\_\_\_\_.
  - a. Pathogenic
  - b. Virus
  - c. Protozoa
  - d. Palatable
2. Which of the following is least likely to cause a taste and odor problem?
  - a. Hydrogen sulfide
  - b. Hardness
  - c. Algae
  - d. Chlorine byproducts
3. What is commonly used as an indication of contamination and is found in plants, soil, water and warm blooded animals?
  - a. Total coliform bacteria
  - b. Viruses
  - c. E. coli
  - d. Fecal coliform bacteria
4. Before taking a coliform sample from a faucet you should \_\_\_\_\_.
  - a. Cup your hands under the faucet and run the water.
  - b. Wipe down the inside of the bottle
  - c. Wash your hands thoroughly and remove the faucet aerator
  - d. Pour bleach into the sample bottle
5. A connection between a potable and non-potable water source is called a \_\_\_\_\_.
  - a. Cross connection
  - b. Raw water transmission line
  - c. Service connection
  - d. Bleeder valve

6. Bacteria are \_\_\_\_\_.  
a. Single-celled organisms  
b. Potentially pathogenic  
c. Larger than viruses  
d. All of these options
7. To prevent backflow, water pressure in the distribution system should never drop below \_\_\_\_\_.  
a. 100 psi  
b. 30 psi  
c. 20 psi  
d. 80 psi
8. In water treatment, filters are for removing or reducing \_\_\_\_\_.  
a. Turbidity  
b. Chloramines  
c. Rocks  
d. Tastes and odors
9. The well component that reduces the amount of debris and sand that enters the submersible pump is called a \_\_\_\_\_.  
a. Well screen  
b. Riser  
c. Venture nozzle  
d. Baffle
10. Generally, a lower pH \_\_\_\_\_.  
a. Makes chlorine more effective  
b. Makes chlorine less effective  
c. Makes no difference on chlorine effectiveness  
d. Results in a lower free chlorine residual
11. The device that prevents contamination from entering the top of the well casing is the \_\_\_\_\_.  
a. Sanitary seal  
b. Packing  
c. Well screen  
d. Check valve



**12. Which source of water has the least protection from bacterial contamination?**

- a. Groundwater
- b. Surface water
- c. Spring
- d. Drilled Well

**13. Ion exchange treatment is used to remove \_\_\_\_\_.**

- a. E. coli
- b. Coliform bacteria
- c. Lead and copper
- d. Calcium and magnesium

**14. When a customer complains about their drinking water, the operator should record the complaint and \_\_\_\_\_.**

- a. Do nothing until more complaints are received
- b. Explain to the customer why you feel the water is safe
- c. Investigate the issue
- d. Inform the customer that the water should be boiled

**15. A rectangular tank is 3 ft. wide, 8 ft. long and 2 ft. high. What is the volume of the tank in gallons?**

- a. 360 gallons
- b. 48 gallons
- c. 359 gallons
- d. 22 gallons

**16. Your storage tank contains 3000 gallons of water. Water is being withdrawn at 1000 gallons per day. How many days will it take to empty the tank?**

- a. 9
- b. 3
- c. 5
- d. 8

**17. Calculate the area of a circle with a diameter of 6 ft?**

- a. 30 ft<sup>2</sup>
- b. 28.26 ft
- c. 28.26 ft<sup>2</sup>
- d. 30ft

**18. Why should you have a preventative maintenance program?**

- a. To increase the use of generators
- b. To fix broken equipment
- c. To avoid premature equipment breakdown
- d. So you can order more spare parts

**19. If a total coliform test comes back positive, you must \_\_\_\_\_.**

- a. Hope the next one is negative
- b. Contact DEC and take another sample
- c. Contact ADEC and take 3 repeat samples within 24 hours
- d. Take 2 samples from the same point the next day

**20. Consumer Confidence Reports (CCR's) are required \_\_\_\_\_.**

- a. Every 5 years
- b. Every two years
- c. Every year
- d. Every three years

**21. \_\_\_\_\_ water can destroy a piping system, deteriorate plumbing and allow lead and copper to easily dissolve into the water.**

- a. Chlorinated
- b. Turbid
- c. Corrosive
- d. Alkaline

**22. \_\_\_\_\_ pumps are most often used for groundwater systems in rural Alaska.**

- a. Filter
- b. Submersible
- c. Vertical Turbine
- d. Peristaltic

**23. Backflow is \_\_\_\_\_.**

- a. A connection between a potable and non-potable water source
- b. Surface water influencing groundwater
- c. The dirt you use to fill in an open ditch
- d. Reversed flow of liquid in a piping system

**24. How many pounds are there in 1 ft.<sup>3</sup> of water?**

- a. 24.8 lbs.
- b. 32.6 lbs.
- c. 62.4 lbs.
- d. 78.1 lbs.

**25. A positive E. coli test indicates that \_\_\_\_\_.**

- a. Water has been contaminated with human fecal matter
- b. The water is safe to consume
- c. The water supply has high iron levels
- d. There is nothing to be concerned about

**26. In a direct sand filtration system backwash water would come from what source?**

- a. Safe untreated water
- b. Treated water
- c. The raw water source
- d. The backwash well

**27. Which of the following is used to describe the clarity of water?**

- a. pH
- b. Chlorine residual
- c. Turbidity
- d. Bacteriological

**28. Water in a tank is 50 ft. deep. A pressure gauge at the base of the tank will read \_\_\_\_\_ psi.**

- a. 116.5
- b. 28
- c. 21.6
- d. 12.4

**29. Fluoride is added to water to prevent \_\_\_\_\_.**

- a. Development
- b. Tooth decay
- c. Cancer
- d. Stomach problems

**30. What federal law regulates public water supplies?**

- a. Clean Water Act
- b. Alaska Native Claims Settlement Act
- c. Safe Drinking Water Act
- d. Standards Methods

**31. Chlorine consumption and chlorine residual should be checked and recorded \_\_\_\_\_.**

- a. Weekly
- b. Monthly
- c. Daily
- d. Annually

**32. A household faucet must remain unused for how many hours before a first draw sample is collected for analyses of lead and copper?**

- a. 3-4 hours
- b. 6-8 hours
- c. 9 hours
- d. 12 hours

**33. The acidic or basic nature of a solution is expressed as \_\_\_\_\_.**

- a. Turbidity
- b. Ionic strength
- c. pH
- d. Alkalinity

**34. What is the primary source of lead in drinking water?**

- a. Lakes
- b. Rivers near lead mines
- c. Corrosion of plumbing systems
- d. Groundwater

**35. Rapid fluctuations in water pressure due to a valve being closed quickly is called \_\_\_\_\_.** This often results in pipes banging together and can cause breakage.

- a. Volatile movement
- b. Water hammer
- c. Cavitation
- d. Oscillation vibration

**36. OSHA stands for \_\_\_\_\_.**

- a. Organization for Safe Health Administration
- b. Occupational Safety and Health Administration
- c. Occupation, Safety and Health Advertising
- d. Organization of State Health Administrators

**37. It is desirable to remove iron and manganese from drinking water because \_\_\_\_\_.**

- a. They cause diarrhea at very low concentrations
- b. They cause staining of fixtures and clothing and bad tastes
- c. They react with chlorine forming disinfection by-products
- d. They make water taste better

**38. Which of the following is a waterborne disease?**

- a. Hepatitis A
- b. Giardia
- c. Gastroenteritis
- d. All of the above

**39. The primary role of water plant operators is to provide water free of \_\_\_\_\_.**

- a. Objectionable taste and odor
- b. Pathogenic contamination
- c. Color and turbidity
- d. Hardness and iron

**40. Organisms that cause disease in humans are called \_\_\_\_\_.**

- a. Anaerobic
- b. Atypical
- c. Typical
- d. Pathogenic

- 41. Chlorine is used most often in the water/wastewater field to \_\_\_\_\_.**
- a. Disinfect
  - b. Adjust pH
  - c. Stabilize aggressive water
  - d. Prevent or reduce the rate of corrosion
- 42. Power is measured in \_\_\_\_\_.**
- a. Watts
  - b. Amps
  - c. Volts
  - d. Ohms
- 43. \_\_\_\_\_ are commonly used for chlorine injection in Alaska.**
- a. Centrifugal pumps
  - b. Positive displacement pumps
  - c. Vertical turbine pumps
  - d. Altitude valves
- 44. Corporation stops, angle stops, service lines and water meters are all part of \_\_\_\_\_.**
- a. The well house
  - b. Individual service connections
  - c. Firefighting equipment
  - d. Storage tanks
- 45. \_\_\_\_\_ are periodic checkups of water systems meant to identify problems (deficiencies) that may affect drinking water safety. They are required every 3 years.**
- a. Consumer confidence reports
  - b. Monthly coliform samples
  - c. Sanitary surveys
  - d. Annual samples
- 46. \_\_\_\_\_ occurs when the pressure in a contaminated source is greater than the pressure in a potable water line.**
- a. Backsiphonage
  - b. Backpressure
  - c. Leaks
  - d. Water hammer

**47. Ground water under the direct influence of surface water (GWUDISW) systems are subject to the same regulations as surface water.**

- a. True**
- b. False**

**48. Weirs, flumes and gauging stations are used in surface water sources to measure \_\_\_\_\_.**

- a. Turbidity**
- b. Copper sulfate**
- c. Flow**
- d. pH**

**49. Primary standards are concerned with \_\_\_\_\_.**

- a. Potentially harmful substances**
- b. Aesthetic (looks, taste) qualities of water**
- c. Iron bacteria**
- d. Hydrogen sulfide**

**50. What is the chlorine concentration (mg/l) if you treat 5 MG with 4 lbs of chlorine. Round answer to the second decimal place (hundredth).**

- a. 953**
- b. 0.95**
- c. 0.10**
- d. 0.96**



STATE OF ALASKA  
DEPARTMENT OF NATURAL RESOURCES  
DIVISION OF MINING, LAND & WATER  
Alaska Hydrologic Survey

WATER WELL LOG Revised 08/18/2016

Drilling Started: 10/2/20 Completed: 10/3/20 Pump Install: 10/4/20

City/Borough <u>Safe Water Village</u>	Subdivision	Block	Lot	Property Owner Name & Address <u>Safe water Village</u> <u>PO Box 28</u> <u>Safe water Village, AK 99240</u>
Well location: Latitude <u>+60.7598</u> Longitude <u>-142.7598</u> Meridian _____ Township _____ Range _____ Section _____ 1/4 of _____ 1/4 of _____ 1/4 of _____ 1/4				

<b>BOREHOLE DATA:</b> (from ground surface) Suggest T.M. Hanna's hydrogeologic classification system* <a href="https://my.ngwa.org/NC/Product?id=a18500000BYub3AAD">https://my.ngwa.org/NC/Product?id=a18500000BYub3AAD</a>			Drilling method: <input type="checkbox"/> Air rotary, <input checked="" type="checkbox"/> Cable tool, <input type="checkbox"/> Other _____		
Well use: <input checked="" type="checkbox"/> Public supply, <input type="checkbox"/> Domestic, <input type="checkbox"/> ReInjection, <input type="checkbox"/> Hydrofracking <input type="checkbox"/> Commercial, <input type="checkbox"/> Observation/Monitoring, <input type="checkbox"/> Test/Exploratory, <input type="checkbox"/> Cooling, <input type="checkbox"/> Irrigation/Agriculture, <input type="checkbox"/> Grounding, <input type="checkbox"/> Recharge/Aquifer Storage, <input type="checkbox"/> Heating, <input type="checkbox"/> Geothermal Exploration, <input type="checkbox"/> Other _____			Fluids used: _____		
Depth From To			Depth of hole: <u>425</u> ft Casing stickup: <u>3</u> ft		
<u>Brown Sand /organics</u> 0 99			Casing type: <u>Steel</u> Casing thickness: <u>0.28</u> inches		
<u>Brown Sand /Gravel</u> 100 149			Casing diameter: <u>6</u> inches Casing depth: <u>400</u> ft		
<u>Clay (Brown)</u> 150 199			Liner type: <u>NA</u> Depth: _____ ft Diameter: _____ inches		
<u>Washed Sand + Gravel</u> 200 249			Note: _____		
<u>Clay (Gray)</u> 250 299			Well intake opening type: <input checked="" type="checkbox"/> Open end, <input type="checkbox"/> Open hole, <input type="checkbox"/> Other _____		
<u>Consolidated Formation</u> 300 399			Screen type: <u>mesh</u> Screen mesh size: <u>1mm</u>		
<u>Gravel</u> 400 425			Screen start: <u>420</u> ft, Screen stop: <u>422</u> ft, Perforated <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		
			Perforation description: _____ Perf from: _____ ft, Perf to: _____ ft, Perf from: _____ ft, Perf to: _____ ft		
			Gravel packed <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Gravel start: _____ ft, Gravel stop: _____ ft		
			Note: _____		
			Static water (from top of casing): <u>250</u> ft on <u>10/3/20</u> Artesian well <input type="checkbox"/>		
			Pumping level & yield: <u>300</u> feet after <u>5</u> hours at <u>20</u> gpm		
			Method of testing: <u>Electric Sounder</u>		
			Development method: _____ Duration: _____		
			Recovery rate: _____ gpm		
			Grout type: <u>Bentonite</u> Volume _____		
			Depth: From <u>5</u> ft, To <u>20</u> ft		

Include description or sketch of well location (include road names, buildings, etc.):



AS 41.08.020(b)(4) and AAC 11 AAC 93.140(a) require that a copy of the well log be submitted to the Department of Natural Resources within **45 days of well completion**. Well logs may be submitted using the online well log reporting system available at:

<https://dnr.alaska.gov/wells/>

OR email electronic well logs to

[dnr.water.reports@alaska.gov](mailto:dnr.water.reports@alaska.gov)

Final pump intake depth: <u>424</u> ft Model: <u>Grundfos X9200</u>	
Pump size: <u>3</u> hp Brand name: <u>Grundfos</u>	
Was well disinfected upon completion? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
Method of disinfection: _____	
Was water quality tested? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
Water quality parameters tested: <u>Total Coliform, Iron</u>	
Well driller name: <u>Luke Short</u>	
Company name: <u>Shorty's Drilling</u>	
Mailing address: <u>P.O. Box 4208</u>	
City: <u>Anchorage</u>	State: <u>AK</u> Zip: <u>99508</u>
Phone number: <u>(907) 907-9079</u>	
Driller's signature: <u>Luke Short</u>	
Date: <u>10/4/20</u>	
Anchorage Municipal Code 15.55.060(I) and North Pole Ordinance 13.32.030(D) require that a copy of this well log be submitted to the Development Services Department/City within <b>30 days of well completion</b> .	
City Permit Number: _____	
Date of Issue: <u>1/1</u>	
Parcel Identification Number: _____	

\*Guide for Using the Hydrogeologic Classification System for Logging Water Well Boreholes by Thomas M. Hanna NGWA Press



# Chlorine Concepts

$$\text{Dose} - \text{Demand} = \text{Residual}$$

$$\text{Paycheck} - \text{Bills} = \text{Extra Money}$$

$$\text{Dose} - \text{Demand} = \text{Residual}$$

Chlorine added  
(mg/L or ppm)

Chlorine used by  
microorganisms,  
turbidity, iron, etc.

Total Residual

Free  
Residual

Combined  
Residual

Free residual is  
better at  
disinfection  
than combined  
residual

Hypochlorous  
Acid (HOCl)

Hypochlorite  
Ion (OCl)

Chlororganics

Chloramines

100-300 times  
more effective  
than OCl

More is  
made at  
lower pH

Less  
effective  
than HOCl

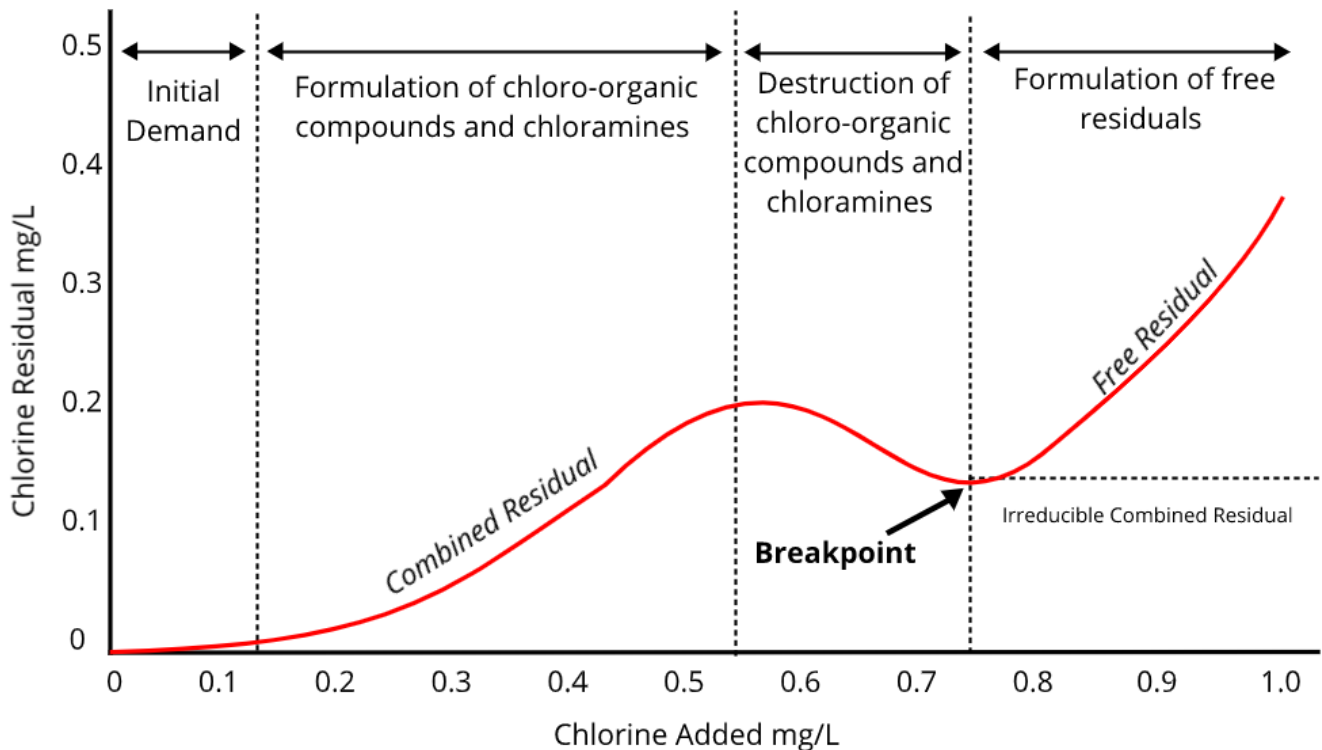
Chlorine +  
Organic  
Material

Some of  
these are  
disinfection  
by-products  
(TTHM &  
HAA5)

Chlorine  
combined  
with nitrogen

Leads to  
taste and  
odor issues

## Reaction of Chlorine in water



## Disinfection Factors

Disinfection works better at **slightly lower** pH

Disinfection generally works better at **warmer temperatures** (This is why you have a heat exchanger in your water plant)

Bacteria are **easier** to kill than viruses or protozoa

Interfering agents like iron and turbidity reduce the effectiveness of chlorine

## Chlorine needs time to work

Contact Time = concentration (mg/L) X contact time (minutes)

This is why you should always take your monthly sample and chlorine reading after the storage tank



# Alaska Department of Environmental Conservation

## Revised Total Coliform Rule- Sample Siting Plan for Systems Operating Year-Round

All public water systems (PWS) are required to have an approved sample siting plan. These plans are required to be updated when changes occur that could alter the number of samples collected or the sample locations. *Examples: population increase or decrease, water line extensions, changes in monitoring frequency, etc.*

I. General Information	
PWS Name: <b>Safe Water Village</b>	PWSID #: <b>AK2266772</b>
PWS Address: <b>PO Box 29, Safe Water Village, Alaska,</b>	
Contact Name: <b>Joe Water</b>	Phone #: <b>907-545-1111</b>
E-mail: <b>Joe_Water_Man@Safewatervillage.org</b>	Fax #:
Water System Type: <input checked="" type="radio"/> Community <input type="radio"/> Non-Transient Non-Community <input type="radio"/> Transient Non-Community	
Population Served (# of): <b>400</b> Residents <input type="text"/> Non-Transient <input type="text"/> Transient <input type="text"/> Total Pop	
Number of Service Connections: <b>25</b>	
Number of Routine Samples Required: <b>1</b> per <input checked="" type="radio"/> Month <input type="radio"/> Quarter	
Source Types: <input checked="" type="checkbox"/> Ground Water <input type="checkbox"/> Purchased Ground Water (Check all that apply) <input type="checkbox"/> Surface Water <input type="checkbox"/> Purchased Surface Water or GWUDISW* <input type="checkbox"/> GWUDISW* <input type="checkbox"/> Filtration Avoidance System (Surface Water)	
*Ground Water Under Direct Influence of Surface Water	

### Guidelines for Sample Site Selection

- \* Identify total coliform sample locations that adequately represent the entire distribution system(s)
- \* Swivel taps, automatic/motion-sensing faucets, and water treatment devices should be avoided
- \* Do NOT collect samples from outside taps or hoses
- \* Routine sample sites should be accessible for routine and repeat testing
- \* Three Repeat samples are required following each total coliform positive routine sample (Systems with wells must also collect a raw source water sample from each active well). Repeat sampling sites should be selected as follows:
  - \* One must be collected from the original routine site that tested total coliform positive
  - \* One must be collected from within five service connections upstream
  - \* One must be collected from within five service connections downstream
- \* For systems on quarterly monitoring, you will be required to collect 3 samples the month following a total coliform positive sample. Since the sample site selection will depend on the specific circumstances surrounding the positive sample(s) these sample sites do not need to be included in this plan
- \* Ground water source samples must be taken from raw water sample taps

Please return this form to your DEC Drinking Water Program Office.

A copy of this completed sample siting plan must be maintained on file at the PWS.

**Anchorage DEC Office**  
 555 Cordova Street  
 Anchorage, AK 99501  
 Fax: 269-7650  
[DEC.DWData.Anchorage@alaska.gov](mailto:DEC.DWData.Anchorage@alaska.gov)

**Fairbanks DEC Office**  
 610 University Ave.  
 Fairbanks, AK 99709  
 Fax: 451-2188  
[DEC.DWData.fairbanks@alaska.gov](mailto:DEC.DWData.fairbanks@alaska.gov)

**Soldotna DEC Office**  
 43335 K-Beach Road, Suite 11  
 Soldotna, AK 99669  
 Fax: 262-2294  
[dec.dwdata.soldotna@alaska.gov](mailto:dec.dwdata.soldotna@alaska.gov)

**Wasilla DEC Office**  
 1700 E. Bogard Road  
 Building B, Suite 103  
 Wasilla, AK 99654  
 Fax: 376-2382  
[DEC.DWData.wasilla@alaska.gov](mailto:DEC.DWData.wasilla@alaska.gov)

**II. Sampling Information****A. Routine Sample Rotation Schedule**

Routine Sample Site	1st Quarter			2nd Quarter			3rd Quarter			4th Quarter		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1. Joe Water's Home (WPO)	✓					✓					✓	
2. School Kitchen Sink		✓					✓					✓
3. Clinic Exam Room 1			✓					✓				
4. Tribal Office Sink				✓					✓			
5. City Office Sink					✓					✓		

**B. Routine and Repeat Sample Locations**

Routine Sample Sites Location/Address	Repeat Sample Sites Location/Address
1. Joe Water's Home (WPO) 123 Toms Way, Safe Water Village, 98989	1-1 Joe Water's Home (WPO) <small>Original sample site</small> 1-2 Brian Berube's Home <small>Upstream</small> 1-3 Bob White's Home <small>Downstream</small>
2. School Kitchen Sink 123 School Street, Safe Water Village, 98989	2-1 School Kitchen Sink <small>Original sample site</small> 2-2 Teachers Lounge Sink <small>Upstream</small> 2-3 Teacher Housing Sink <small>Downstream</small>
3. Clinic Exam Room 1 123 Clinic Ave, Safe Water Village, 98989	3-1 Clinic Exam Room 1 <small>Original sample site</small> 3-2 VPSO Office Sink <small>Upstream</small> 3-3 Tribal Store Office Sink <small>Downstream</small>
4. Tribal Office Sink 123 Tribal Office Ave, Safe Water Village, 98989	4-1 Tribal Office Sink <small>Original sample site</small> 4-2 Allan Paukan's Home <small>Upstream</small> 4-3 Billy Westlock's Home <small>Downstream</small>
5. City Office Sink 123, City Office Ave, Safe Water Village, 98989	5-1 City Office Sink <small>Original sample site</small> 5-2 Luke Smith's Home <small>Upstream</small> 5-3 Theo Graber's Home <small>Downstream</small>

**C. Reasons for Choosing Routine Sample Locations**

1. Representative of Loop 1 - easy access to location
2. Representative of Loop 1 - Water consumed by children in community
3. Representative of Loop 2 - Water consumed by patients
4. Representative of Loop 2
5. Representative of Loop 2



**D. System Schematic**

Provide a line drawing in the space below or attach a separate sheet or map of this public water system that **identifies** water system facilities (sources, storage, treatment, distribution, and pressure zones) and sample point locations.

Safe Water Village Community Map



1) Joe Water's Home

1-2) Brian Berube's House

1-3) Bob White's House

2) School Kitchen Sink

2-2) Teacher's Lounge Sink

2-3) Teacher Housing

3) Clinic Exam Room 1

3-2) VPSO Office Sink

3-3) Tribal Store Office Sink

4) Tribal Office Sink

4-2) Allan Paukan's House

4-3) Billy Westlock's House

5) City Office Sink

5-2) Luke Smith's House

5-3) Theo Graber's House

6) Water Plant

7) Storage Tank

**E. Sample Interval Description**

Describe below how you plan to ensure that samples are collected at evenly spaced time intervals:

Example for systems collecting 1 sample/month - We plan to collect our routine sample the first week of each month

Example for systems collecting multiple samples/month - We plan to collect our routine samples every Tuesday throughout the month

Example for systems collecting 1 sample/quarter - We plan to collect our routine sample the first month of each quarter

We plan to collect our samples at the beginning of the week, at the beginning of the month. We will be sure to call our lab prior to shipping samples and try to take samples on days where weather is good so we can have as quick a turnaround time as possible.

**F. Groundwater Rule Triggered Source Water Monitoring**

If you answer "No" to the question below, you are required to perform source water monitoring, from each active well under the Groundwater Rule in the event of a routine total coliform positive sample. This sampling is in addition to the repeat sampling required by the RTCR. Enter your source sample site information in the table below. If you need more space, attach additional sheets.

Do you provide DEC-approved 4-log treatment of viruses for all your groundwater sources?

☐ Yes

☒ No

☐ N/A- We do not have any wells or all of our water is treated as SW or GWUDISW  
(There are no wells in the distribution system that bypass surface water treatment.)

Groundwater Rule Triggered Source Water Monitoring	
Source ID/Name	Description of location of raw water sample tap
Raw Water Tap	Tap is located before the master meter where the raw water line enters the water plant.

DEC Area Office: \_\_\_\_\_

Date Received: \_\_\_\_/\_\_\_\_/\_\_\_\_

Was a dual purpose sample approved? ☐ Yes ☐ No

Date discussed with Supervisor: \_\_\_\_/\_\_\_\_/\_\_\_\_

NOTE: The only systems eligible for using a dual purpose sample are Groundwater systems, serving 1,000 or fewer people, that only have 1 well, and serve a single building with 2 or fewer sample taps.

Sample Siting Plan deemed complete and satisfactory? ☐ Yes ☐ No
















Comments: \_\_\_\_\_

State Reviewer Signature: \_\_\_\_\_

Date: \_\_\_\_/\_\_\_\_/\_\_\_\_

# National Primary Drinking Water Regulations



Contaminant	MCL or TT <sup>1</sup> (mg/L) <sup>2</sup>	Potential health effects from long-term <sup>3</sup> exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal (mg/L) <sup>2</sup>
 Acrylamide	TT <sup>4</sup>	Nervous system or blood problems; increased risk of cancer	Added to water during sewage/wastewater treatment	<b>zero</b>
 Alachlor	0.002	Eye, liver, kidney, or spleen problems; anemia; increased risk of cancer	Runoff from herbicide used on row crops	<b>zero</b>
 Alpha/photon emitters	15 picocuries per Liter (pCi/L)	Increased risk of cancer	Erosion of natural deposits of certain minerals that are radioactive and may emit a form of radiation known as alpha radiation	<b>zero</b>
 Antimony	0.006	Increase in blood cholesterol; decrease in blood sugar	Discharge from petroleum refineries; fire retardants; ceramics; electronics; solder	<b>0.006</b>
 Arsenic	0.010	Skin damage or problems with circulatory systems, and may have increased risk of getting cancer	Erosion of natural deposits; runoff from orchards; runoff from glass & electronics production wastes	<b>0</b>
 Asbestos (fibers >10 micrometers)	7 million fibers per Liter (MFL)	Increased risk of developing benign intestinal polyps	Decay of asbestos cement in water mains; erosion of natural deposits	<b>7 MFL</b>
 Atrazine	0.003	Cardiovascular system or reproductive problems	Runoff from herbicide used on row crops	<b>0.003</b>
 Barium	2	Increase in blood pressure	Discharge of drilling wastes; discharge from metal refineries; erosion of natural deposits	<b>2</b>
 Benzene	0.005	Anemia; decrease in blood platelets; increased risk of cancer	Discharge from factories; leaching from gas storage tanks and landfills	<b>zero</b>
 Benzo(a)pyrene (PAHs)	0.0002	Reproductive difficulties; increased risk of cancer	Leaching from linings of water storage tanks and distribution lines	<b>zero</b>
 Beryllium	0.004	Intestinal lesions	Discharge from metal refineries and coal-burning factories; discharge from electrical, aerospace, and defense industries	<b>0.004</b>
 Beta photon emitters	4 millirems per year	Increased risk of cancer	Decay of natural and man-made deposits of certain minerals that are radioactive and may emit forms of radiation known as photons and beta radiation	<b>zero</b>
 Bromate	0.010	Increased risk of cancer	Byproduct of drinking water disinfection	<b>zero</b>
 Cadmium	0.005	Kidney damage	Corrosion of galvanized pipes; erosion of natural deposits; discharge from metal refineries; runoff from waste batteries and paints	<b>0.005</b>
 Carbofuran	0.04	Problems with blood, nervous system, or reproductive system	Leaching of soil fumigant used on rice and alfalfa	<b>0.04</b>

## LEGEND



DISINFECTANT



DISINFECTION  
BYPRODUCT



INORGANIC  
CHEMICAL




















MICROORGANISM



ORGANIC  
CHEMICAL



RADIONUCLIDES

Contaminant	MCL or TT <sup>1</sup> (mg/L) <sup>2</sup>	Potential health effects from long-term <sup>3</sup> exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal (mg/L) <sup>2</sup>
 Carbon tetrachloride	0.005	Liver problems; increased risk of cancer	Discharge from chemical plants and other industrial activities	<b>zero</b>
 Chloramines (as Cl <sub>2</sub> )	MRDL=4.0 <sup>1</sup>	Eye/nose irritation; stomach discomfort; anemia	Water additive used to control microbes	<b>MRDLG=4<sup>1</sup></b>
 Chlordane	0.002	Liver or nervous system problems; increased risk of cancer	Residue of banned termiticide	<b>zero</b>
 Chlorine (as Cl <sub>2</sub> )	MRDL=4.0 <sup>1</sup>	Eye/nose irritation; stomach discomfort	Water additive used to control microbes	<b>MRDLG=4<sup>1</sup></b>
 Chlorine dioxide (as ClO <sub>2</sub> )	MRDL=0.8 <sup>1</sup>	Anemia; infants, young children, and fetuses of pregnant women: nervous system effects	Water additive used to control microbes	<b>MRDLG=0.8<sup>1</sup></b>
 Chlorite	1.0	Anemia; infants, young children, and fetuses of pregnant women: nervous system effects	Byproduct of drinking water disinfection	<b>0.8</b>
 Chlorobenzene	0.1	Liver or kidney problems	Discharge from chemical and agricultural chemical factories	<b>0.1</b>
 Chromium (total)	0.1	Allergic dermatitis	Discharge from steel and pulp mills; erosion of natural deposits	<b>0.1</b>
 Copper	TT <sup>5</sup> ; Action Level=1.3	Short-term exposure: Gastrointestinal distress. Long-term exposure: Liver or kidney damage. People with Wilson's Disease should consult their personal doctor if the amount of copper in their water exceeds the action level	Corrosion of household plumbing systems; erosion of natural deposits	<b>1.3</b>
 <i>Cryptosporidium</i>	TT <sup>7</sup>	Short-term exposure: Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste	<b>zero</b>
 Cyanide (as free cyanide)	0.2	Nerve damage or thyroid problems	Discharge from steel/metal factories; discharge from plastic and fertilizer factories	<b>0.2</b>
 2,4-D	0.07	Kidney, liver, or adrenal gland problems	Runoff from herbicide used on row crops	<b>0.07</b>
 Dalapon	0.2	Minor kidney changes	Runoff from herbicide used on rights of way	<b>0.2</b>
 1,2-Dibromo-3-chloropropane (DBCP)	0.0002	Reproductive difficulties; increased risk of cancer	Runoff/leaching from soil fumigant used on soybeans, cotton, pineapples, and orchards	<b>zero</b>
 o-Dichlorobenzene	0.6	Liver, kidney, or circulatory system problems	Discharge from industrial chemical factories	<b>0.6</b>
 p-Dichlorobenzene	0.075	Anemia; liver, kidney, or spleen damage; changes in blood	Discharge from industrial chemical factories	<b>0.075</b>
 1,2-Dichloroethane	0.005	Increased risk of cancer	Discharge from industrial chemical factories	<b>zero</b>

## LEGEND



















DISINFECTANT

DISINFECTION  
BYPRODUCTINORGANIC  
CHEMICAL

MICROORGANISM

ORGANIC  
CHEMICALRADIONUCLIDES  
62



Contaminant	MCL or TT <sup>1</sup> (mg/L) <sup>2</sup>	Potential health effects from long-term <sup>3</sup> exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal (mg/L) <sup>2</sup>
 1,1-Dichloroethylene	0.007	Liver problems	Discharge from industrial chemical factories	<b>0.007</b>
 cis-1,2-Dichloroethylene	0.07	Liver problems	Discharge from industrial chemical factories	<b>0.07</b>
 trans-1,2-Dichloroethylene	0.1	Liver problems	Discharge from industrial chemical factories	<b>0.1</b>
 Dichloromethane	0.005	Liver problems; increased risk of cancer	Discharge from industrial chemical factories	<b>zero</b>
 1,2-Dichloropropane	0.005	Increased risk of cancer	Discharge from industrial chemical factories	<b>zero</b>
 Di(2-ethylhexyl) adipate	0.4	Weight loss, liver problems, or possible reproductive difficulties	Discharge from chemical factories	<b>0.4</b>
 Di(2-ethylhexyl) phthalate	0.006	Reproductive difficulties; liver problems; increased risk of cancer	Discharge from rubber and chemical factories	<b>zero</b>
 Dinoseb	0.007	Reproductive difficulties	Runoff from herbicide used on soybeans and vegetables	<b>0.007</b>
 Dioxin (2,3,7,8-TCDD)	0.00000003	Reproductive difficulties; increased risk of cancer	Emissions from waste incineration and other combustion; discharge from chemical factories	<b>zero</b>
 Diquat	0.02	Cataracts	Runoff from herbicide use	<b>0.02</b>
 Endothall	0.1	Stomach and intestinal problems	Runoff from herbicide use	<b>0.1</b>
 Endrin	0.002	Liver problems	Residue of banned insecticide	<b>0.002</b>
 Epichlorohydrin	TT <sup>4</sup>	Increased cancer risk; stomach problems	Discharge from industrial chemical factories; an impurity of some water treatment chemicals	<b>zero</b>
 Ethylbenzene	0.7	Liver or kidney problems	Discharge from petroleum refineries	<b>0.7</b>
 Ethylene dibromide	0.00005	Problems with liver, stomach, reproductive system, or kidneys; increased risk of cancer	Discharge from petroleum refineries	<b>zero</b>
 Fecal coliform and <i>E. coli</i>	MCL <sup>6</sup>	Fecal coliforms and <i>E. coli</i> are bacteria whose presence indicates that the water may be contaminated with human or animal wastes. Microbes in these wastes may cause short term effects, such as diarrhea, cramps, nausea, headaches, or other symptoms. They may pose a special health risk for infants, young children, and people with severely compromised immune systems.	Human and animal fecal waste	<b>zero<sup>6</sup></b>

## LEGEND


















DISINFECTANT

DISINFECTION  
BYPRODUCTINORGANIC  
CHEMICAL

MICROORGANISM

ORGANIC  
CHEMICALRADIONUCLIDES  
63

Contaminant	MCL or TT <sup>1</sup> (mg/L) <sup>2</sup>	Potential health effects from long-term <sup>3</sup> exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal (mg/L) <sup>2</sup>
 Fluoride	4.0	Bone disease (pain and tenderness of the bones); children may get mottled teeth	Water additive which promotes strong teeth; erosion of natural deposits; discharge from fertilizer and aluminum factories	<b>4.0</b>
 <i>Giardia lamblia</i>	TT <sup>7</sup>	Short-term exposure: Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste	<b>zero</b>
 Glyphosate	0.7	Kidney problems; reproductive difficulties	Runoff from herbicide use	<b>0.7</b>
 Haloacetic acids (HAA5)	0.060	Increased risk of cancer	Byproduct of drinking water disinfection	<b>n/a<sup>9</sup></b>
 Heptachlor	0.0004	Liver damage; increased risk of cancer	Residue of banned termiticide	<b>zero</b>
 Heptachlor epoxide	0.0002	Liver damage; increased risk of cancer	Breakdown of heptachlor	<b>zero</b>
 Heterotrophic plate count (HPC)	TT <sup>7</sup>	HPC has no health effects; it is an analytic method used to measure the variety of bacteria that are common in water. The lower the concentration of bacteria in drinking water, the better maintained the water system is.	HPC measures a range of bacteria that are naturally present in the environment	<b>n/a</b>
 Hexachlorobenzene	0.001	Liver or kidney problems; reproductive difficulties; increased risk of cancer	Discharge from metal refineries and agricultural chemical factories	<b>zero</b>
 Hexachloro-cyclopentadiene	0.05	Kidney or stomach problems	Discharge from chemical factories	<b>0.05</b>
 Lead	TT <sup>5</sup> ; Action Level=0.015	Infants and children: Delays in physical or mental development; children could show slight deficits in attention span and learning abilities; Adults: Kidney problems; high blood pressure	Corrosion of household plumbing systems; erosion of natural deposits	<b>zero</b>
 <i>Legionella</i>	TT <sup>7</sup>	Legionnaire's Disease, a type of pneumonia	Found naturally in water; multiplies in heating systems	<b>zero</b>
 Lindane	0.0002	Liver or kidney problems	Runoff/leaching from insecticide used on cattle, lumber, and gardens	<b>0.0002</b>
 Mercury (inorganic)	0.002	Kidney damage	Erosion of natural deposits; discharge from refineries and factories; runoff from landfills and croplands	<b>0.002</b>
 Methoxychlor	0.04	Reproductive difficulties	Runoff/leaching from insecticide used on fruits, vegetables, alfalfa, and livestock	<b>0.04</b>
 Nitrate (measured as Nitrogen)	10	Infants below the age of six months who drink water containing nitrate in excess of the MCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue-baby syndrome.	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits	<b>10</b>

## LEGEND



DISINFECTANT

DISINFECTION  
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CHEMICAL

MICROORGANISM

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RADIONUCLIDES

Contaminant	MCL or TT <sup>1</sup> (mg/L) <sup>2</sup>	Potential health effects from long-term <sup>3</sup> exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal (mg/L) <sup>2</sup>
 Nitrite (measured as Nitrogen)	1	Infants below the age of six months who drink water containing nitrite in excess of the MCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue-baby syndrome.	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits	<b>1</b>
 Oxamyl (Vydate)	0.2	Slight nervous system effects	Runoff/leaching from insecticide used on apples, potatoes, and tomatoes	<b>0.2</b>
 Pentachlorophenol	0.001	Liver or kidney problems; increased cancer risk	Discharge from wood-preserving factories	<b>zero</b>
 Picloram	0.5	Liver problems	Herbicide runoff	<b>0.5</b>
 Polychlorinated biphenyls (PCBs)	0.0005	Skin changes; thymus gland problems; immune deficiencies; reproductive or nervous system difficulties; increased risk of cancer	Runoff from landfills; discharge of waste chemicals	<b>zero</b>
 Radium 226 and Radium 228 (combined)	5 pCi/L	Increased risk of cancer	Erosion of natural deposits	<b>zero</b>
 Selenium	0.05	Hair or fingernail loss; numbness in fingers or toes; circulatory problems	Discharge from petroleum and metal refineries; erosion of natural deposits; discharge from mines	<b>0.05</b>
 Simazine	0.004	Problems with blood	Herbicide runoff	<b>0.004</b>
 Styrene	0.1	Liver, kidney, or circulatory system problems	Discharge from rubber and plastic factories; leaching from landfills	<b>0.1</b>
 Tetrachloroethylene	0.005	Liver problems; increased risk of cancer	Discharge from factories and dry cleaners	<b>zero</b>
 Thallium	0.002	Hair loss; changes in blood; kidney, intestine, or liver problems	Leaching from ore-processing sites; discharge from electronics, glass, and drug factories	<b>0.0005</b>
 Toluene	1	Nervous system, kidney, or liver problems	Discharge from petroleum factories	<b>1</b>
 Total Coliforms	5.0 percent <sup>8</sup>	Coliforms are bacteria that indicate that other, potentially harmful bacteria may be present. See fecal coliforms and <i>E. coli</i>	Naturally present in the environment	<b>zero</b>
 Total Trihalomethanes (TTHMs)	0.080	Liver, kidney, or central nervous system problems; increased risk of cancer	Byproduct of drinking water disinfection	<b>n/a<sup>9</sup></b>
 Toxaphene	0.003	Kidney, liver, or thyroid problems; increased risk of cancer	Runoff/leaching from insecticide used on cotton and cattle	<b>zero</b>
 2,4,5-TP (Silvex)	0.05	Liver problems	Residue of banned herbicide	<b>0.05</b>
 1,2,4- Trichlorobenzene	0.07	Changes in adrenal glands	Discharge from textile finishing factories	<b>0.07</b>

## LEGEND


















DISINFECTANT

DISINFECTION  
BYPRODUCTINORGANIC  
CHEMICAL

MICROORGANISM

ORGANIC  
CHEMICALRADIONUCLIDES  
65

Contaminant	MCL or TT <sup>1</sup> (mg/L) <sup>2</sup>	Potential health effects from long-term <sup>3</sup> exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal (mg/L) <sup>2</sup>
 1,1,1-Trichloroethane	0.2	Liver, nervous system, or circulatory problems	Discharge from metal degreasing sites and other factories	<b>0.2</b>
 1,1,2-Trichloroethane	0.005	Liver, kidney, or immune system problems	Discharge from industrial chemical factories	<b>0.003</b>
 Trichloroethylene	0.005	Liver problems; increased risk of cancer	Discharge from metal degreasing sites and other factories	<b>zero</b>
 Turbidity	TT <sup>7</sup>	Turbidity is a measure of the cloudiness of water. It is used to indicate water quality and filtration effectiveness (e.g., whether disease-causing organisms are present). Higher turbidity levels are often associated with higher levels of disease-causing microorganisms such as viruses, parasites, and some bacteria. These organisms can cause short term symptoms such as nausea, cramps, diarrhea, and associated headaches.	Soil runoff	<b>n/a</b>
 Uranium	30µg/L	Increased risk of cancer, kidney toxicity	Erosion of natural deposits	<b>zero</b>
 Vinyl chloride	0.002	Increased risk of cancer	Leaching from PVC pipes; discharge from plastic factories	<b>zero</b>
 Viruses (enteric)	TT <sup>7</sup>	Short-term exposure: Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste	<b>zero</b>
 Xylenes (total)	10	Nervous system damage	Discharge from petroleum factories; discharge from chemical factories	<b>10</b>
<div> <div>  <b>LEGEND</b> </div> <div>  <b>DISINFECTANT</b> </div> <div>  <b>DISINFECTION BYPRODUCT</b> </div> <div>  <b>INORGANIC CHEMICAL</b> </div> <div>  <b>MICROORGANISM</b> </div> <div>  <b>ORGANIC CHEMICAL</b> </div> <div>  <b>RADIONUCLIDES</b> </div> </div>				

## NOTES

### 1 Definitions

- Maximum Contaminant Level Goal (MCLG):** The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety and are non-enforceable public health goals.
- Maximum Contaminant Level (MCL):** The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to MCLGs as feasible using the best available treatment technology and taking cost into consideration. MCLs are enforceable standards.
- Maximum Residual Disinfectant Level Goal (MRDLG):** The level of a drinking water disinfectant below which there is no known or expected risk to health. MRDLGs do not reflect the benefits of the use of disinfectants to control microbial contaminants.
- Maximum Residual Disinfectant Level (MRDL):** The highest level of a disinfectant allowed in drinking water. There is convincing evidence that addition of a disinfectant is necessary for control of microbial contaminants.
- Treatment Technique (TT):** A required process intended to reduce the level of a contaminant in drinking water.

**2** Units are in milligrams per liter (mg/L) unless otherwise noted. Milligrams per liter are equivalent to parts per million (ppm).

**3** Health effects are from long-term exposure unless specified as short-term exposure.

**4** Each water system must certify annually, in writing, to the state (using third-party or manufacturers certification) that when it uses acrylamide and/or epichlorohydrin to treat water, the combination (or product) of dose and monomer level does not exceed the levels specified, as follows: Acrylamide = 0.05 percent dosed at 1 mg/L (or equivalent); Epichlorohydrin = 0.01 percent dosed at 20 mg/L (or equivalent).

**5** Lead and copper are regulated by a Treatment Technique that requires systems to control the corrosiveness of their water. If more than 10 percent of tap water samples exceed the action level, water systems must take additional steps. For copper, the action level is 1.3 mg/L, and for lead is 0.015 mg/L.

**6** A routine sample that is fecal coliform-positive or E. coli-positive triggers repeat samples—if any repeat sample is total coliform-positive, the system has an acute MCL violation. A routine sample that is total coliform-positive and fecal coliform-negative or E. coli-negative triggers repeat samples—if any repeat sample is fecal coliform-positive or E. coli-positive, the system has an acute MCL violation. See also Total Coliforms.

**7** EPA's surface water treatment rules require systems using surface water or ground water under the direct influence of surface water to (1) disinfect their water, and (2) filter their water or meet criteria for avoiding filtration so that the following contaminants are controlled at the following levels:

- Cryptosporidium:** 99 percent removal for systems that filter. Unfiltered systems are required to include Cryptosporidium in their existing watershed control provisions.

- Giardia lamblia:** 99.9 percent removal/inactivation
- Viruses:** 99.9 percent removal/inactivation
- Legionella:** No limit, but EPA believes that if *Giardia* and viruses are removed/inactivated, according to the treatment techniques in the surface water treatment rule, *Legionella* will also be controlled.
- Turbidity:** For systems that use conventional or direct filtration, at no time can turbidity (cloudiness of water) go higher than 1 nephelometric turbidity unit (NTU), and samples for turbidity must be less than or equal to 0.3 NTU in at least 95 percent of the samples in any month. Systems that use filtration other than the conventional or direct filtration must follow state limits, which must include turbidity at no time exceeding 5 NTU.
- HPC:** No more than 500 bacterial colonies per milliliter
- Long Term 1 Enhanced Surface Water Treatment:** Surface water systems or ground water systems under the direct influence of surface water serving fewer than 10,000 people must comply with the applicable Long Term 1 Enhanced Surface Water Treatment Rule provisions (e.g. turbidity standards, individual filter monitoring, *Cryptosporidium* removal requirements, updated watershed control requirements for unfiltered systems).
- Long Term 2 Enhanced Surface Water Treatment:** This rule applies to all surface water systems or ground water systems under the direct influence of surface water. The rule targets additional *Cryptosporidium* treatment requirements for higher risk systems and includes provisions to reduce risks from uncovered finished water storages facilities and to ensure that the systems maintain microbial protection as they take steps to reduce the formation of disinfection byproducts. (Monitoring start dates are staggered by system size. The largest systems (serving at least 100,000 people) will begin monitoring in October 2006 and the smallest systems (serving fewer than 10,000 people) will not begin monitoring until October 2008. After completing monitoring and determining their treatment bin, systems generally have three years to comply with any additional treatment requirements.)
- Filter Backwash Recycling:** The Filter Backwash Recycling Rule requires systems that recycle to return specific recycle flows through all processes of the system's existing conventional or direct filtration system or at an alternate location approved by the state.
- No more than 5.0 percent samples total coliform-positive in a month.** (For water systems that collect fewer than 40 routine samples per month, no more than one sample can be total coliform-positive per month.) Every sample that has total coliform must be analyzed for either fecal coliforms or E. coli. If two consecutive TC-positive samples, and one is also positive for E. coli or fecal coliforms, system has an acute MCL violation.

**9** Although there is no collective MCLG for this contaminant group, there are individual MCLGs for some of the individual contaminants:

- Halooacetic acids:** dichloroacetic acid (zero); trichloroacetic acid (0.3 mg/L)
- Trihalomethanes:** bromodichloromethane (zero); bromoform (zero); dibromochloromethane (0.06 mg/L)

## NATIONAL SECONDARY DRINKING WATER REGULATION

National Secondary Drinking Water Regulations are non-enforceable guidelines regarding contaminants that may cause cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor, or color) in drinking water. EPA recommends secondary standards to water systems but does not require systems to comply. However, some states may choose to adopt them as enforceable standards.

Contaminant	Secondary Maximum Contaminant Level
Aluminum	0.05 to 0.2 mg/L
Chloride	250 mg/L
Color	15 (color units)
Copper	1.0 mg/L
Corrosivity	Noncorrosive
Fluoride	2.0 mg/L
Foaming Agents	0.5 mg/L
Iron	0.3 mg/L
Manganese	0.05 mg/L
Odor	3 threshold odor number
pH	6.5-8.5
Silver	0.10 mg/L
Sulfate	250 mg/L
Total Dissolved Solids	500 mg/L
Zinc	5 mg/L

FOR MORE INFORMATION ON EPA'S  
SAFE DRINKING WATER:



visit: [epa.gov/safewater](https://epa.gov/safewater)



call: (800) 426-4791

### ADDITIONAL INFORMATION:

To order additional posters or other ground water and drinking water publications, please contact the National Service Center for Environmental Publications at: **(800) 490-9198**, or email: [nscep@bps-lmit.com](mailto:nscep@bps-lmit.com).



OFFICE OF GROUND WATER  
AND DRINKING WATER





## Repeat Monitoring Requirements For Small Systems

### WHO DOES THIS FACTSHEET APPLY TO?

ALL PUBLIC WATER SYSTEMS (PWSS) SERVING 1,000 OR FEWER PEOPLE THAT ARE REQUIRED TO CONDUCT REPEAT MONITORING WHEN A WATER SAMPLE IS POSITIVE FOR TOTAL COLIFORM (TC+) BACTERIA.

#### RTCR

##### What to Do?

###### Step 1

Collect 3 repeat samples after each TC+ routine sample.

###### Step 2

Conduct required actions after collecting repeat samples.

FOR ASSISTANCE, PLEASE  
CONTACT THE PROPER  
ALASKA DRINKING  
WATER OFFICE:

#### ANCHORAGE

PHONE:  
(907) 269-7623 OR  
(866) 956-7656 TOLL-  
FREE OUTSIDE OF  
ANCHORAGE

#### FAIRBANKS

PHONE:  
(907) 451-2108 OR  
(800) 770-2137 TOLL-  
FREE OUTSIDE OF  
FAIRBANKS

#### SOLDOTNA

PHONE:  
(907) 262-5210

#### WASILLA

PHONE:  
(907) 376-1850

#### ATTENTION!

Starting April 1, 2016, all public water systems (PWSS) must comply with the RTCR.

### STEP 1: COLLECT 3 REPEAT SAMPLES FOR EACH ROUTINE TC+ SAMPLE

**YOU MUST COLLECT A SET OF 3 REPEAT SAMPLES AFTER EACH TC+ ROUTINE SAMPLE.**

You must continue to collect a set of 3 repeat samples until either TC is not detected in one complete set of repeat samples or you trigger an assessment.

#### Repeat Sampling Locations

You must collect at least 3 repeat samples at the locations described in your sample siting plan: (1) 1 repeat sample at the original routine location, (2) 1 repeat sample within five service connections upstream, and (3) 1 repeat sample within five service connections downstream of the TC+ sample. You may choose alternative repeat sampling locations on a situational basis—contact the Drinking Water Program for more information.



**Site B =  
1 repeat  
upstream**



**Site A = 1 repeat**  
Original routine  
location that  
tested TC+



**Site C =  
1 repeat  
downstream**

#### ATTENTION!

**COLLECT ALL 3 REPEAT SAMPLES.**

If you do not collect and analyze at least 3 repeat samples (for each routine TC+) you will have to perform a Level 1 or Level 2 assessment.

See the **RTCR Factsheet: Level 1 & Level 2 Assessments and Corrective Actions.**

**REMINDER: ANALYZE ALL REPEAT TC+ SAMPLES FOR *E. COLI*.\***

NOTE: Systems using a Groundwater Source must also collect a triggered Source Water Sample for each source in use at time of TC+.

#### Frequency & Timing

Collect all 3 repeat samples **WITHIN 24 HOURS\*\* AFTER RECEIVING NOTIFICATION FROM THE STATE-CERTIFIED LAB OF THE TC+ SAMPLE RESULT.** The repeat samples must be taken on the same day.



- Remember the lab must begin analyzing the drinking water sample no later than the 30<sup>th</sup> hour from the collection time, unless you have an approved 48-hour waiver in place.
- If necessary, ship the sample overnight and refrigerate or ice the sample using "blue" ice (cooled to about 4° to 10° C).

#### NOTES

\*CALL the Drinking Water Program on the same day you learned of the *E. coli*-positive (EC+) result, or by the end of the next business day if the result came in after business hours and tell them you received an EC+ result.

\*\*Contact the Drinking Water Program for an approved extension if logistical problems prevent collection within 24 hours.

## STEP 2: CONDUCT ACTIONS REQUIRED AS A RESULT OF YOUR REPEAT SAMPLING

**TC+** = Total coliform-positive or present; **TC-** = Total coliform-negative or absent

**EC+** = *E. coli*-positive or present; **EC-** = *E. coli*-negative or absent; **EC?** = *E. coli* not analyzed

You must **COMPLETE AN ASSESSMENT AND SUBMIT THE FORM TO THE DRINKING WATER PROGRAM WITHIN 30 DAYS** after you learned your PWS has triggered an assessment. See the **RTCR Factsheet: Level 1 & Level 2 Assessments and Corrective Actions**.

If <u>Routine</u> Sample Is:	And	Any <u>Repeat</u> Sample Is:	Action: What do your sample results mean?	Violation
<b>TC+</b> <b>EC-</b>	<b>&amp;</b>	<b>TC+</b> <b>EC-</b>	The presence of total coliform bacteria in both your original routine sample and in your follow-up repeat sample suggests there could be a problem and your water may not be safe to use. <b>1. CONDUCT A LEVEL 1 OR LEVEL 2 ASSESSMENT.</b> Contact the Drinking Water Program for help determining which type of assessment is required.	No MCL violation
<b>TC+</b> <b>EC-</b>	<b>&amp;</b>	<b>TC+</b> <b>EC?</b>	The presence of total coliform bacteria in both your original routine sample and in your follow-up repeat sample suggests there could be a problem and because <i>E. coli</i> was not tested, it is unknown whether or not the water is safe to use. <b>1. NOTIFY THE DRINKING WATER PROGRAM</b> within 24 hours of receiving sample results. <b>2. HAVE A LEVEL 2 ASSESSMENT CONDUCTED BY AN APPROVED INSPECTOR.</b> <b>3. ISSUE A PUBLIC NOTICE (PN).</b>	<i>E. coli</i> MCL violation*
<b>TC+</b> <b>EC-</b>	<b>&amp;</b>	<b>TC+</b> <b>EC+</b>	The presence of <i>E. coli</i> bacteria in your water is an indicator of fecal contamination and your water may not be safe to use. <b>1. NOTIFY THE DRINKING WATER PROGRAM</b> within 24 hours of receiving sample results. <b>2. HAVE A LEVEL 2 ASSESSMENT CONDUCTED BY AN APPROVED INSPECTOR.</b> <b>3. ISSUE A PUBLIC NOTICE (PN).</b>	<i>E. coli</i> MCL violation*
<b>TC+</b> <b>EC-</b>	<b>&amp;</b>	Any or all repeat samples missing	The presence of total coliform bacteria in your original routine sample suggests there could be a problem and because repeat samples were not tested, it is unknown whether or not the water is safe to use. <b>1. CONDUCT A LEVEL 1 OR LEVEL 2 ASSESSMENT.</b> Contact the Drinking Water Program for help determining which type of assessment is required.	No MCL violation
<b>TC+</b> <b>EC+</b>	<b>&amp;</b>	<b>TC+</b>	The presence of <i>E. coli</i> bacteria in your water is an indicator of fecal contamination and your water may not be safe to use. <b>1. NOTIFY THE DRINKING WATER PROGRAM</b> within 24 hours of receiving sample results. <b>2. HAVE A LEVEL 2 ASSESSMENT CONDUCTED BY AN APPROVED INSPECTOR.</b> <b>3. ISSUE A PUBLIC NOTICE (PN).</b>	<i>E. coli</i> MCL violation*
<b>TC+</b> <b>EC+</b>	<b>&amp;</b>	Any or all repeat samples missing	The presence of <i>E. coli</i> bacteria in your water is an indicator of fecal contamination and your water may not be safe to use. <b>1. NOTIFY THE DRINKING WATER PROGRAM</b> within 24 hours of receiving sample results. <b>2. HAVE A LEVEL 2 ASSESSMENT CONDUCTED BY AN APPROVED INSPECTOR.</b> <b>3. ISSUE A PUBLIC NOTICE (PN).</b>	<i>E. coli</i> MCL violation*

**NOTE:** \* You are required to provide Tier 1 public notice within 24 hours in response to an *E. coli* MCL violation.



# MATERIAL SAFETY DATA SHEET

## Calcium Hypochlorite

### Section 01 - Chemical And Product And Company Information

**Product Identifier** ..... HTH® Dry Chlorine Granular

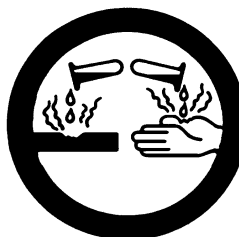
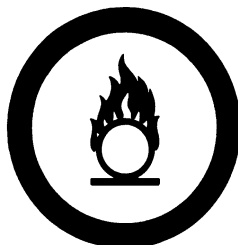
**Product Use** ..... Disinfection in swimming pools and drinking water supplies; slime and odour control.

**Supplier Name** ..... ClearTech Industries Inc.  
2302 Hanselman Avenue  
Saskatoon, SK. Canada  
S7L 5Z3

**Prepared By** ..... ClearTech Industries Inc. Technical Department  
Phone: (306)664-2522

**Preparation Date** ..... July 9, 2008

**24-Hour Emergency Phone** ..... 306-664-2522



### Section 02 - Composition / Information on Ingredients

<b>Hazardous Ingredients</b> .....	Calcium Hypochlorite	60-80%
	Sodium Chloride	10-20%
	Calcium Chloride	0-5%
	Calcium Hydroxide	0-4%
	Calcium Carbonate	0-5%
	Calcium Chlorate	0-5%
	Water	5.5-10%





<b>CAS Number</b> .....	Calcium Hypochlorite	7778-54-3
	Sodium Chloride	7647-14-5
	Calcium Chloride	10043-52-4
	Calcium Hydroxide	1305-62-0
	Calcium Carbonate	471-34-1
	Calcium Chlorate	10137-74-3
	Water	7732-18-5

**Synonym (s)**.....Calcium oxychloride; chlorinated lime; hypochlorous acid; Chlortabs

### Section 03 - Hazard Identification

**Inhalation**..... Dust and mist irritate the nose and throat. In confined areas, mechanical agitation can result in high levels of dust, and reaction with incompatibles materials (e.g., acids and water/moisture) can result in high concentrations of chlorine vapour, either of which may result in burns to the respiratory tract, producing lung edema, shortness of breath, wheezing, choking, chest pains, impairment of lung function, and possible permanent lung damage.

**Skin Contact / Absorption**..... Calcium hypochlorite dust and solutions can cause irritation and in severe cases, chemical burns, which are characterized by redness, swelling, and scab formation. Moisture from perspirations will accelerate tissue destruction.

**Eye Contact**..... Exposure to calcium hypochlorite can cause eye irritation and vision impairment. Contact can produce impairment of vision and corneal damage.

**Ingestion**..... When ingested, there will be burning of the mouth and throat. Can cause abdominal cramps, vomiting, diarrhea, nausea, and/or tissue ulceration which may lead to convulsions, coma, and even death.

**Exposure Limits**..... Ceiling= 3mg/m<sup>3</sup> as chlorine (manufacturer's internal standard)

### Section 04 - First Aid Measures

**Inhalation**..... Remove victim to fresh air. Give artificial respiration only if breathing has stopped. If breathing is difficult, give oxygen. Seek immediate medical attention.

**Skin Contact / Absorption**..... Remove contaminated clothing. Wash affected area with soap and water. Seek medical attention if irritation occurs or persists.

**Eye Contact**..... Flush immediately with water for at least 20 minutes. Forcibly hold eyelids apart to ensure complete irrigation of eye tissue. Seek immediate medical attention.



**Ingestion**..... Immediately give large amounts of water. Do not induce vomiting. If vomiting occurs, lean victim forward to prevent breathing in vomitus. Do not give anything by mouth to an unconscious or convulsing person. Seek immediate medical attention.

**Additional Information**..... Not available

### Section 05 - Fire Fighting

**Conditions of Flammability**..... Non-flammable. Note calcium hypochlorite is a strong oxidizing agent; may form explosive mixtures with combustibles, organic, or other oxidizable materials.

**Means of Extinction**..... Drench with water, and cool surrounding products and area with water. Avoid dry extinguishers containing ammonium compounds.

**Flash Point**..... Not Applicable

**Auto-ignition Temperature**..... Not Applicable

**Upper Flammable Limit** ..... Not Applicable

**Lower Flammable Limit**..... Not Applicable

**Hazardous Combustible Products**... Chlorine, oxygen, and chlorine monoxide at higher temperatures. Water in contact with hot calcium hypochlorite can release hydrochloric acid or chlorine gas.

**Special Fire Fighting Procedures**..... Wear NIOSH-approved self-contained breathing apparatus and protective clothing.

**Explosion Hazards**..... Not sensitive to mechanical impact or static discharge.

### Section 06 - Accidental Release Measures

**Leak / Spill**..... Wear appropriate personal protective equipment. Ventilate area. Stop or reduce leak if safe to do so. Prevent material from entering sewers. Flush with water to remove any residue.

**Deactivating Materials**..... Not available



## Section 07 - Handling and Storage

- Handling Procedures**..... Use proper equipment for lifting and transporting all containers. Use sensible industrial hygiene and housekeeping practices. Wash thoroughly after handling. Avoid all situations that could lead to harmful exposure.
- Storage Requirements**..... Store in a cool, dry, well-ventilated place. Keep container tightly closed, and away from incompatible materials. Keep out of the sun.

## Section 08 - Personal Protection and Exposure Controls

### Protective Equipment

- Eyes**..... Chemical goggles, full-face shield, or a full-face respirator is to be worn at all times when product is handled. Contact lenses should not be worn; they may contribute to severe eye injury.
- Respiratory**..... Use NIOSH-approved respirator - full facepiece with chlorine and dust/mist cartridges when dust is present. Use a self-contained breathing apparatus should be used for major spills.
- Gloves**..... Impervious gloves of chemically resistant material (rubber or PVC) should be worn at all times. Wash contaminated clothing and dry thoroughly before reuse.
- Clothing**..... Body suits, aprons, and/or coveralls of chemical resistant material should be worn at all times. Wash contaminated clothing and dry thoroughly before reuse.
- Footwear**..... Impervious boots of chemically resistant material should be worn at all times

### Engineering Controls

- Ventilation Requirements**..... Mechanical ventilation (dilution or local exhaust), process or personnel enclosure, and control of process conditions should be provided. Supply sufficient replacement air to make up for air removed by exhaust systems.
- Other**..... Emergency shower and eyewash should be in close proximity.

## Section 09 - Physical and Chemical Properties

- Physical State**..... Solid



<b>Odor and Appearance</b> .....	White, free flowing granular solid with a strong chlorine odour
<b>Odor Threshold</b> .....	~ 1.4 mg/m <sup>3</sup> based on chlorine
<b>Specific Gravity (Water=1)</b> .....	Not applicable
<b>Vapor Pressure (mm Hg, 20C)</b> .....	Not applicable
<b>Vapor Density (Air=1)</b> .....	Not applicable
<b>Evaporation Rate</b> .....	Not applicable
<b>Boiling Point</b> .....	Not applicable
<b>Freeze/Melting Point</b> .....	Decomposes at 170-180°C
<b>pH</b> .....	10.4-10.8 (1% solution)
<b>Water/Oil Distribution Coefficient</b> ....	Not applicable
<b>Bulk Density</b> .....	0.8 g/cm <sup>3</sup>
<b>% Volatiles by Volume</b> .....	Not available
<b>Solubility in Water</b> .....	18% at 25°C
<b>Molecular Formula</b> .....	Ca(OCl) <sub>2</sub>
<b>Molecular Weight</b> .....	142.98

## Section 10 - Stability and Reactivity

<b>Stability</b> .....	Stable in optimum storage conditions. Heat, sunlight and contamination could cause decomposition.
<b>Incompatibility</b> .....	Acids, reducing agents, combustible materials such as wood, cloth, or organic materials, dry powder fire extinguishers containing monoammonium phosphate, metals such as iron and copper and their alloys, water or steam, ammonia, urea, amines.
<b>Hazardous Products of Decomposition</b> ..	Water in contact with calcium hypochlorite releases chlorine gas. Contact with incompatibles presents an explosion and fire hazard. Toxic or corrosive fumes may be liberated. These include chlorine gas.
<b>Polymerization</b> .....	Will not occur



## Section 11 - Toxicological Information

- Irritancy**..... Causes irritation and burns to eyes and skin.
- Sensitization**..... Not available
- Chronic/Acute Effects**..... Skin irritation may occur from repeated or prolonged skin contact. Chronic inhalation exposure may cause impairment of lung function and permanent lung damage. Asthma, respiratory and cardiovascular disease may be aggravated by exposure to this chemical.
- Synergistic Materials**..... Not available
- Animal Toxicity Data**..... LC<sub>50</sub>(inhalation, rat, 1 hour)= 1300mg/m<sup>3</sup> based on chlorine  
LD<sub>50</sub>(oral, rat)= 850mg/kg  
LD<sub>50</sub>(dermal, rabbit)= > 2000mg/kg
- Carcinogenicity**..... Not considered to be carcinogenic as per IARC, NTP, OSHA, and ACGIH.
- Reproductive Toxicity**..... Not reported to show reproductive toxicity.
- Teratogenicity**..... Results in laboratory analysis show it is not a teratogen.
- Mutagenicity**..... Results in laboratory analysis show it is not a mutagen.

## Section 12 - Ecological Information

- Fish Toxicity**..... LC<sub>50</sub>(bluegill, 96 hour)= 0.088mg/L  
LC<sub>50</sub>(rainbow trout, 96 hour)= 0.16mg/L  
LC<sub>50</sub>(daphnia magna, 48 hour)= 0.11mg/L
- Biodegradability**..... Not available
- Environmental Effects**..... Not available

## Section 13 - Disposal Consideration

- Waste Disposal**..... Dispose in accordance with all federal, provincial, and/or local regulations including the Canadian Environmental Protection Act.

## Section 14 - Transportation Information

**TDG Classification**



Class..... 5.1

Group..... II

PIN Number..... UN 2880

Other..... Secure containers (full and/or empty) with suitable hold down devices during shipment.

### Section 15 - Regulatory Information

WHMIS Classification.....C, E

**NOTE: THE PRODUCT LISTED ON THIS MSDS HAS BEEN CLASSIFIED IN ACCORDANCE WITH THE HAZARD CRITERIA OF THE CANADIAN CONTROLLED PRODUCTS REGULATIONS. THIS MSDS CONTAINS ALL INFORMATION REQUIRED BY THOSE REGULATIONS.**

NSF Certification.....Product is certified under ANSI/NSF Standard 60 for disinfection, oxidation and algicide treatment at a maximum dosage of 15mg/L.

### Section 16 - Other Information

**Note:** The responsibility to provide a safe workplace remains with the user. The user should consider the health hazards and safety information contained herein as a guide and should take those precautions required in an individual operation to instruct employees and develop work practice procedures for a safe work environment. The information contained herein is, to the best of our knowledge and belief, accurate. However, since the conditions of handling and use are beyond our control, we make no guarantee of results, and assume no liability for damages incurred by the use of this material. It is the responsibility of the user to comply with all applicable laws and regulations.

#### Attention: Receiver of the chemical goods / MSDS coordinator

As part of our commitment to the Canadian Association of Chemical Distributors (CACD) Responsible Distribution® initiative, ClearTech Industries Inc. and its associated companies require, as a condition of sale, that you forward the attached Material Safety Data Sheet(s) to all affected employees, customers, and end-users. ClearTech will send any available supplementary handling, health, and safety information to you at your request.

If you have any questions or concerns please call our customer service or technical service department.

### ClearTech Industries Inc. - Locations

**Corporate Head Office: 2302 Hanselman Avenue, Saskatoon, SK, S7L 5Z3**

**Phone: 306-664-2522**

**Fax: 306-665-6216**

**www.ClearTech.ca**

Location	Address	Postal Code	Phone Number	Fax Number
Richmond, B.C.	12431 Horseshoe Way	V7A 4X6	604-272-4000	604-272-4596
Calgary, AB.	5516E - 40 <sup>th</sup> St. S.E.	T2C 2A1	403-279-1096	403-236-0989



Edmonton, AB.	11750 - 180 <sup>th</sup> Street	T5S 1N7	780-452-6000	780-452-4600
Saskatoon, SK.	2302 Hanselman Avenue	S7L 5Z3	306-933-0177	306-933-3282
Regina, SK.	555 Henderson Drive	S42 5X2	306-721-7737	306-721-8611
Winnipeg, MB.	340 Saulteaux Crescent	R3J 3T2	204-987-9777	204-987-9770
Mississauga, ON.	7480 Bath Road	L4T 1L2	905-612-0566	905-612-0575

**24 Hour Emergency Number - All Locations - 306-664-2522**

## Small Treated Water System/Small Untreated Water System Exam Description

Small Treated Water System	
Topic	Total
Bacteriology	3
Chemistry	4
Chlorine	3
Cross-Connection/Backflow	3
Disinfection	3
Distribution	2
Electrical	1
Filtration	1
Fluoridation	1
Math	5
Pumps	3
Record Keeping	1
Regulations	5
Roles & Responsibilities	1
Safety	1
Sampling	4
Softening	1
Source Water	3
Valves	1
Waterborne Diseases	1
Wells	3
<b>Total</b>	<b>50</b>

Small Untreated Water System	
Topic	Total
Bacteriology	3
Chemistry	4
Cross-Connection/Backflow	4
Distribution	3
Electrical	1
Filtration	1
Math	5
Pumps	5
Record Keeping	2
Regulations	5
Safety	1
Sampling	5
Softening	1
Source Water	2
Valves	3
Water Treatment	1
Wells	4
<b>Total</b>	<b>50</b>



# Formula Sheet

## Abbreviations

cfs	cubic feet per second (ft <sup>3</sup> /sec)
ft	feet
gpd	gallons per day
gpm	gallons per minute
hr	hour
in	inches
in <sup>2</sup>	square inches (sq. in.)
lb	pounds

mL	milliliter
mg/L	milligrams per liter
MG	million gallons
MGD	million gallons per day
min	minutes
ppm	parts per million
psi	pounds per square inch
sec	seconds

## Conversion Factors

### Area

$$1 \text{ ft}^2 = 144 \text{ in}^2$$

### Volume

$$1 \text{ ft}^3 = 7.48 \text{ gal}$$

$$1 \text{ yd}^3 = 27 \text{ ft}^3$$

### Weight

$$1 \text{ gallon of water} = 8.34 \text{ lbs}$$

### Concentration

$$1 \text{ ppm} = 1 \text{ mg/L}$$

### Flow rate

$$1 \text{ MGD} = 1.55 \text{ cfs} = 694.4 \text{ gpm}$$

$$1 \text{ gpm} = 60 \text{ gal/hr} = 1440 \text{ gpd}$$

### Pressure

$$1.0 \text{ psi} = 2.31 \text{ feet of water}$$

$$1.0 \text{ foot of water} = 0.433 \text{ psi}$$

## Basic Hydraulics Formulas

$$\text{Detention Time} = \frac{\text{Tank Capacity}}{\text{Flow Rate}}$$

## Dosage and Concentration Formulas

$$\text{Dosage (lbs)} = \text{Concentration (mg/L)} \times \text{Volume (MG)} \times 8.34$$

$$C_1 \times V_1 = C_2 \times V_2$$

where,  $C_1$  = beginning concentration

$V_1$  = beginning volume

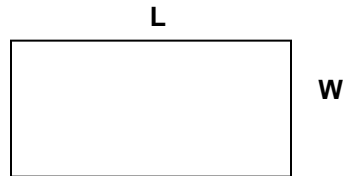
$C_2$  = diluted concentration

$V_2$  = diluted volume

## Area

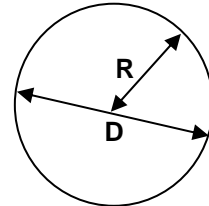
### Square or Rectangle

$$A = L \times W$$



### Circle

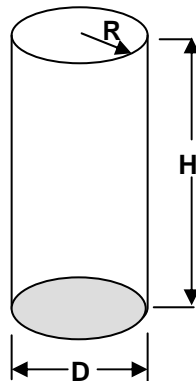
$$A = \pi R^2 \text{ or } A = 0.785 D^2$$



Where  $\pi = 3.14$

## Volume

### Cylinder



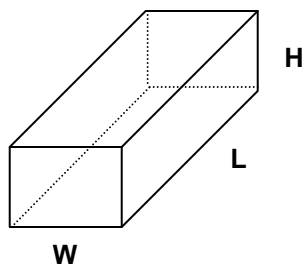
$$V = 0.785 D^2 H$$

or

$$V = \pi R^2 H$$

Where  $\pi = 3.14$

### Cube



$$V = L \times W \times H$$

# Formula Sheet

## Abbreviations

cfs	cubic feet per second (ft <sup>3</sup> /sec)
ft	feet
gpd	gallons per day
gpm	gallons per minute
hr	hour
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in <sup>2</sup>	square inches (sq. in.)
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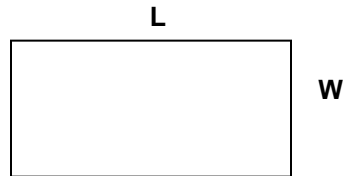
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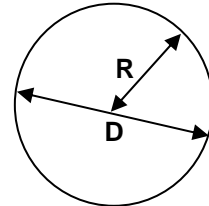
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### Circle

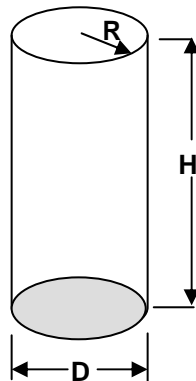
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Where  $\pi = 3.14$

## Volume

### Cylinder



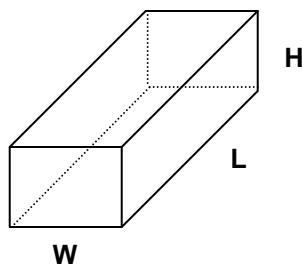
$$V = 0.785 D^2 H$$

or

$$V = \pi R^2 H$$

Where  $\pi = 3.14$

### Cube



$$V = L \times W \times H$$