

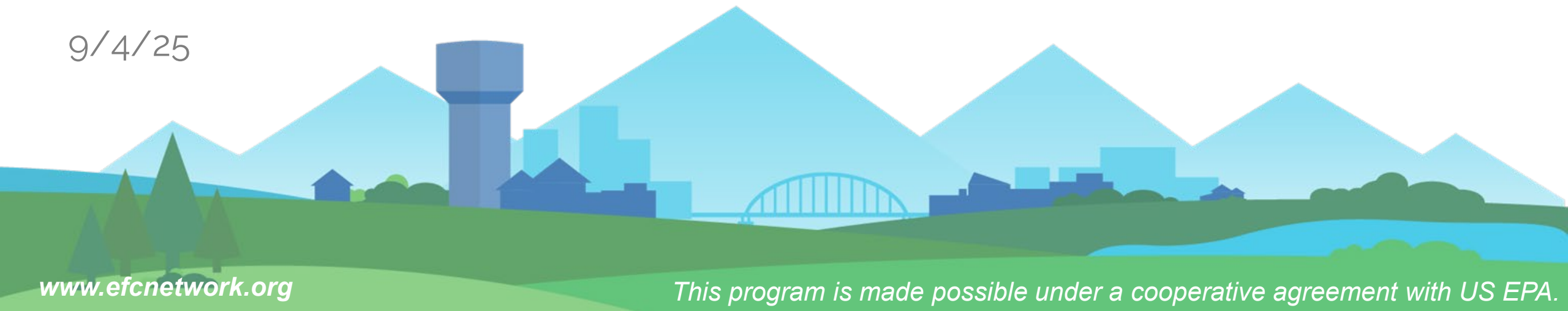


SOUTHWEST
ENVIRONMENTAL
FINANCE CENTER

US Territories Water Operator Training Series

Session 6: Source Water Characteristics

9/4/25



Tucker Colvin

Research Scientist

tcovin@unm.edu



SOUTHWEST
ENVIRONMENTAL
FINANCE CENTER





SOUTHWEST
ENVIRONMENTAL
FINANCE CENTER



SCHOOL OF
ENGINEERING



This training series is funded by the US EPA

Schedule for 2025:

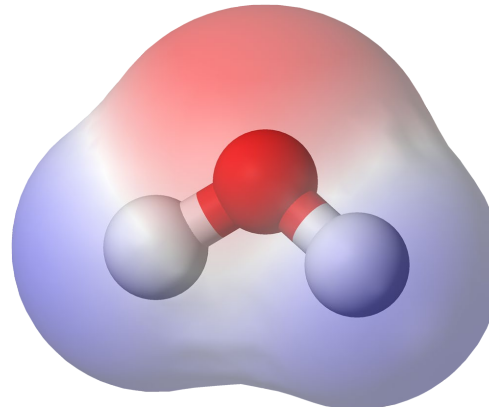
Date	Topic
6/25/25	Program Overview, Test Format, Study & Test Tips
7/9/25	Drinking Water System Overview - (Source, Treatment, & Distribution)
7/23/25	Basic Operator Math (+, -, /, x, Exponents and basic algebra)
8/6/25	Applied Operator Math (Areas, Volume, Pressure)
8/20/25	Drinking Water Regulations
9/3/25	Source Water Characteristics
9/17/25	Surface Water Intake Components, Well Components, and O&M
10/1/25	Disinfection 1: Chloramines, UV, Chlorine Dioxide, Chlorine
10/15/25	Disinfection 2: Chlorine Disinfection Application for Sodium Hypochlorite and Gas Chlorine (including storage and safety)
10/29/25	Disinfection 3: Distribution System Application, Residual Measurement, Evaluation & Adjustment,
11/12/25	Disinfection 4: Chlorine Disinfection Math
12/3/25	Surface Water Treatment 1: Coagulation, Flocculation, Sedimentation (including chemistry, process controls, operations)
12/17/25	Surface Water Treatment 2: Filtration

Links to recordings and material are available on our website at <https://swefc.unm.edu/home/op-cert-trainings/>

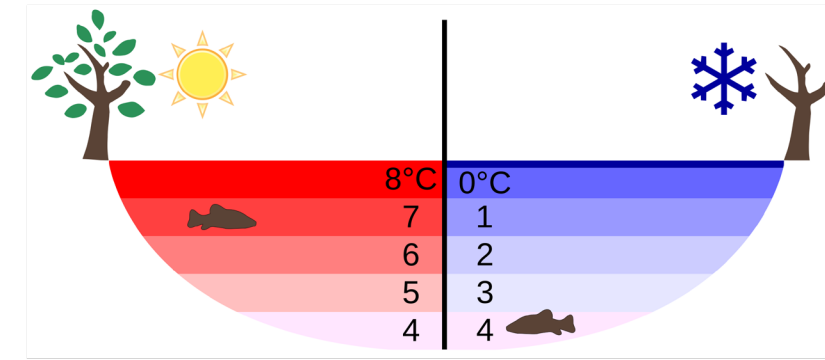
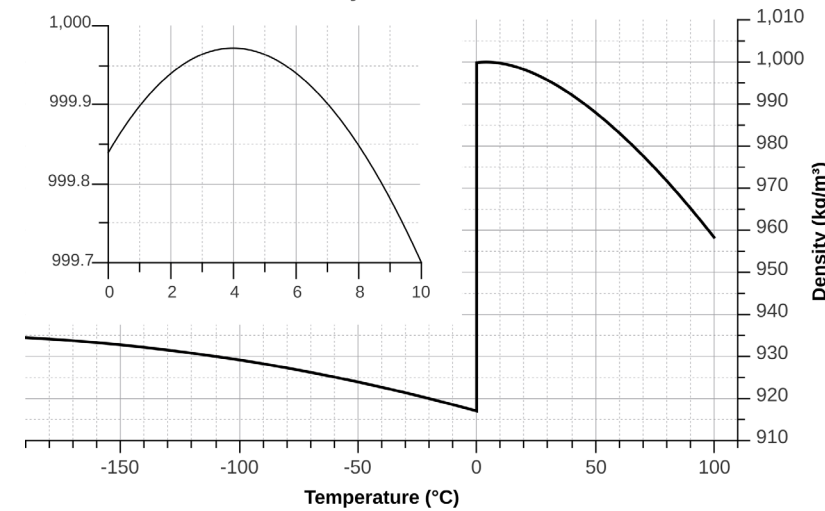
Source Water Characteristics

Physical Water Parameters

- Temperature – measurement of kinetic energy of particles in a substance
- Density – Mass per volume of a substance; water density $\approx 1\text{g/cm}^3$
- Polarity – having an electrical charge consisting of a positive and negative pole



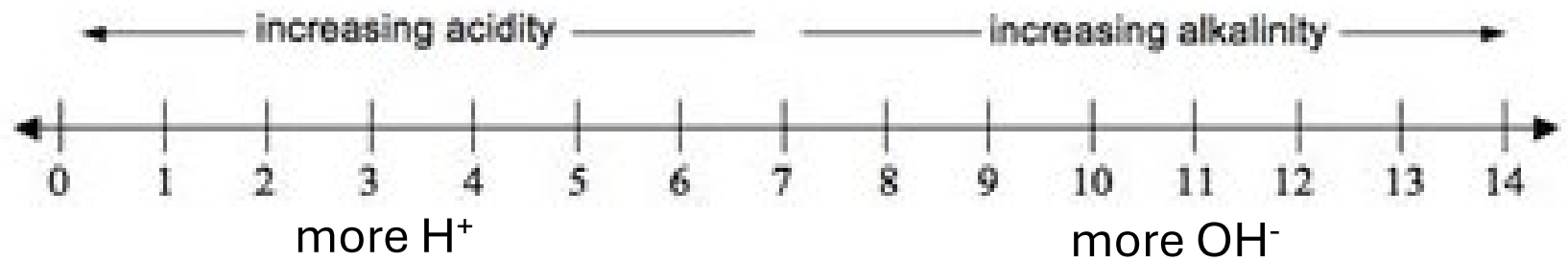
Density of ice and water



Chemical Water Parameters

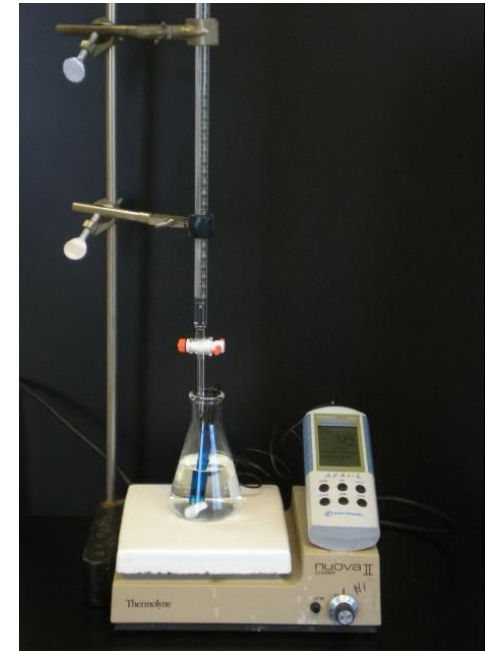
pH

- Measurement of Hydrogen ions (protons)
- $\text{pH} = -\log(\text{H}^+)$
- Changes daily for surface water due to photosynthesis by aquatic plants
- During the day, plants and algae take in CO_2 from water, increasing its pH
- At night, respiration by organisms released CO_2 , decreasing pH



Alkalinity

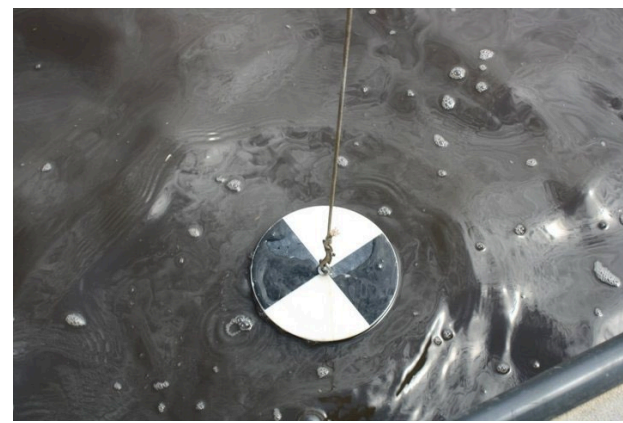
- Measurement of water's ability to resist acidification
- Alkalinity decreases corrosivity
- Important to treatment processes



Chemical Water Parameters

Turbidity

- Measurement of water cloudiness
- Measured in Nephelometric Turbidity Units (NTU)
- Measured with Secchi Disk in surface water or optically with water sample or within treatment process



Suspended Solids

- Total Suspended Solids (TSS)
- Particles suspended in water that can be filtered out with 2 micron filter



Chemical Water Parameters

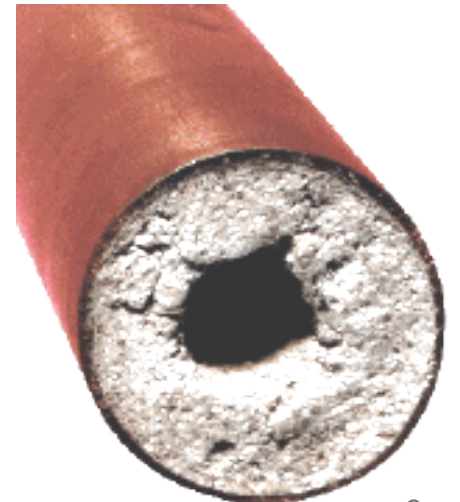
Dissolved Solids

- Total Dissolved Solids (TDS)
- Minerals, metals, salts & organic matter dissolved in water
- Cannot be filtered out with 2 micron filter
- Measured by conductivity meter or evaporating water



Hardness

- Amount of dissolved calcium and magnesium salts in water
- Creates scale and difficulty to create soap suds



Chemical Water Parameters

Corrosivity

- Ability of water to dissolve metals
- Complex chemical reactions related all other water quality parameters
- Models to predict corrosivity



Oxidation Reduction Potential (ORP)

- Ability to receive or give electrons
- Indicated water's ability to break down contaminants or support biological processes

Chemical Water Parameters

Dissolved Oxygen (DO)

- Oxygen available to aquatic organisms
- Indicator of aquatic health



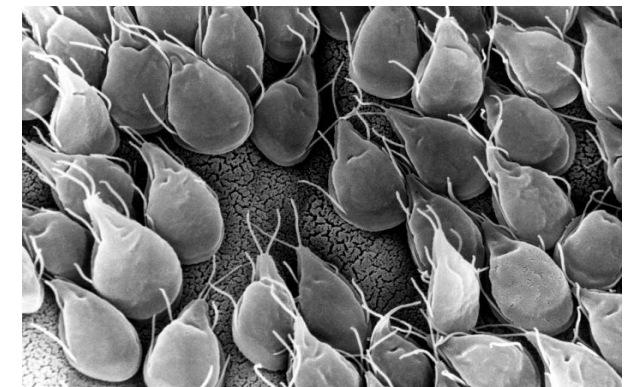
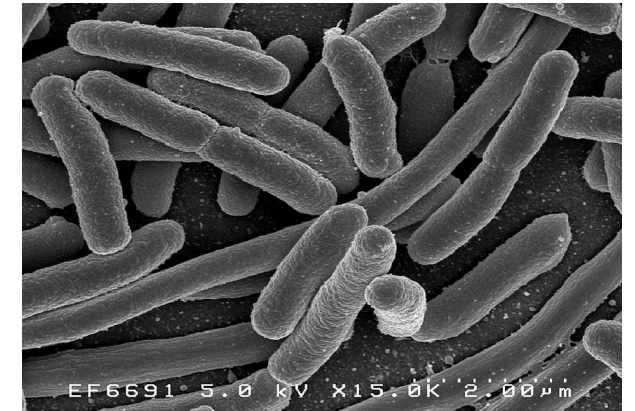
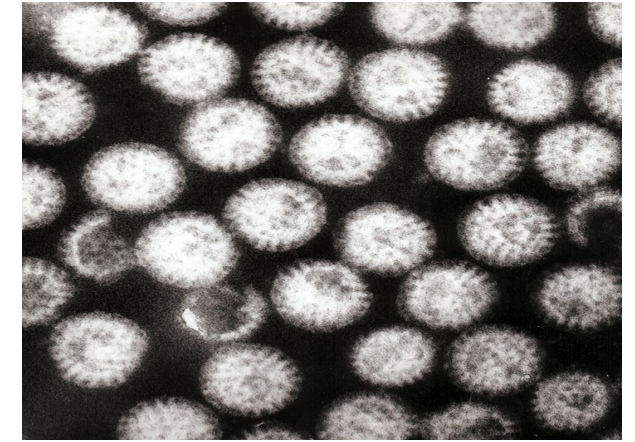
Color

- Created by:
 - Dissolved organic material
 - Algae
 - Sediment or dissolved solids
- Unpleasant for customers



Biological Water Parameters

- Pathogens
 - Viruses – Norovirus, rotavirus, hepatitis A, etc.
 - Bacteria – Escherichia coli, Shigella dysenteriae, Salmonella typhi, Vibrio cholerae, Mycobacterium tuberculosis, etc.
 - Protozoa – Giardia lamblia, Cryposporidium, etc.
- Indicator organisms
 - Total coliform - colony forming units

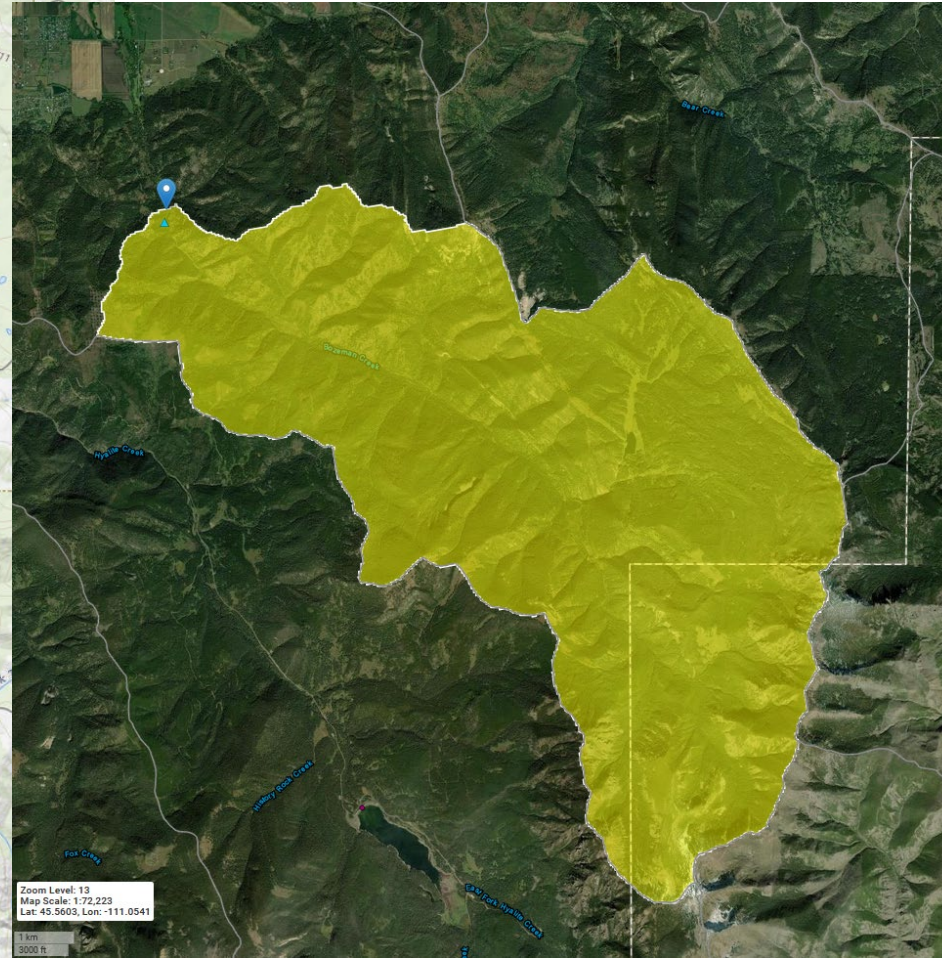
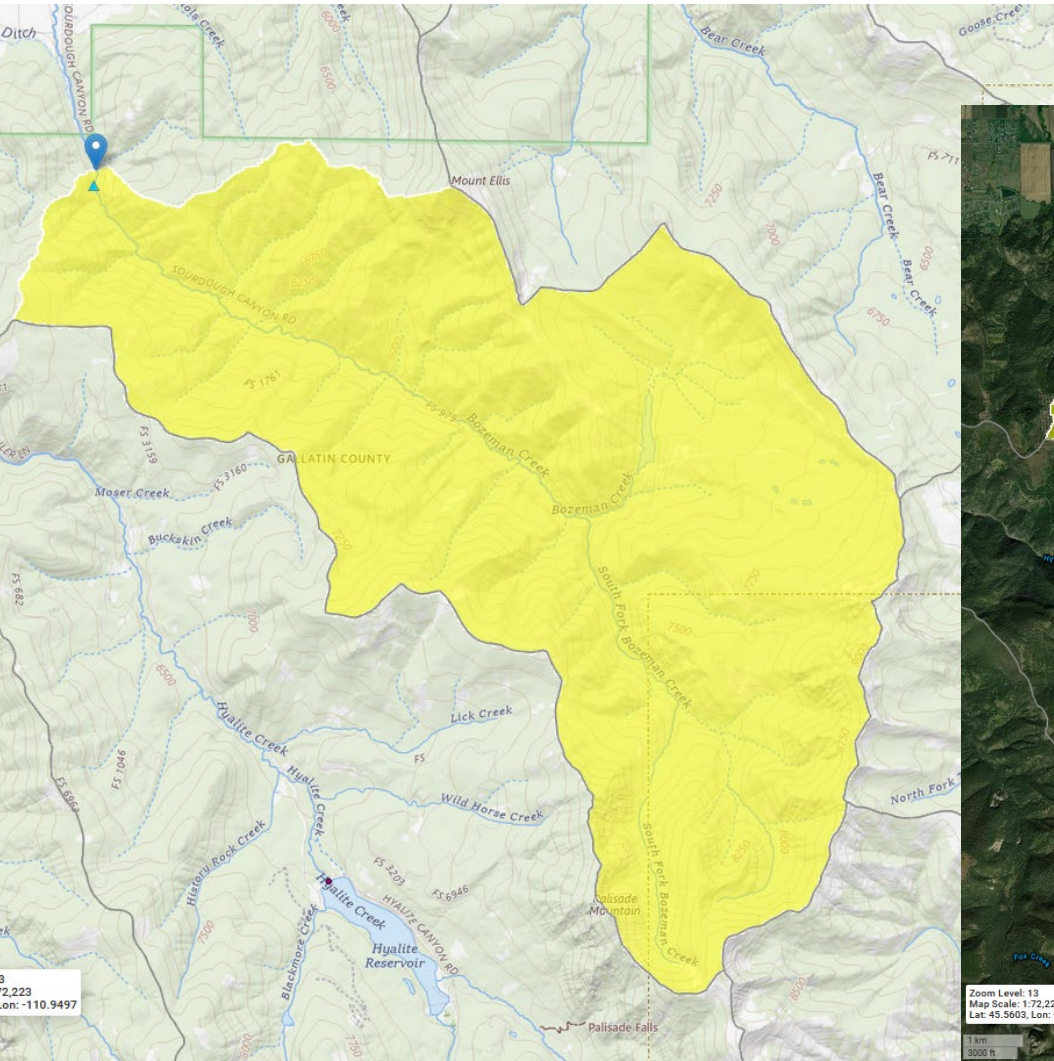


Surface Water vs. Groundwater vs. GUDI



Surface Water - Rivers & Streams

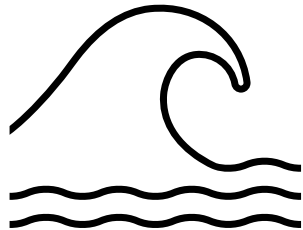
Watershed



Surface Water

Advantages vs. groundwater

- Can be less likely to have dissolved contaminants
- Softer water than groundwater
- Can be more accessible (no need for groundwater surveys and drilling)

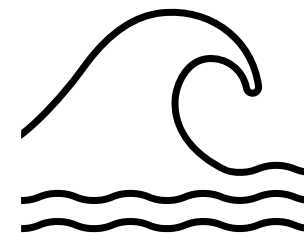


Surface Water



Disadvantages vs. groundwater

- More suspended solids and organics
- Living organisms present
- Pathogen percentage removal requirement
- More expensive treatment
- Seasonal variability
- Yearly variability



Surface Water - Lakes

- Advantages (compared to streams)
 - Water quality is more constant
 - pH, temp, turbidity fluctuate less
 - Length of detention time aids in natural removal of bacteria and suspended solids/sediment



Surface Water - Lakes



- Disadvantages (compared to streams)
 - Concentrates minerals (iron, manganese...), highest concentration near bottom
 - Effected by turnover (change in water density/specific gravity)
 - Effected by stratification
 - Algal blooms
 - Eutrophication

Taste & Odors

Caused by two main types of algae

- Green algae (grassy/musty)
- Blue-green algae (rotten fish)
 - Actually a bacteria (cyanobacteria) not an algae
 - Can produce toxins (Microcystins)

Blooms occur during hot dry weather

Kill algae with copper sulphate (CuSO_4) in lakes/reservoirs

- 0.5-1.0 mg/L dosage



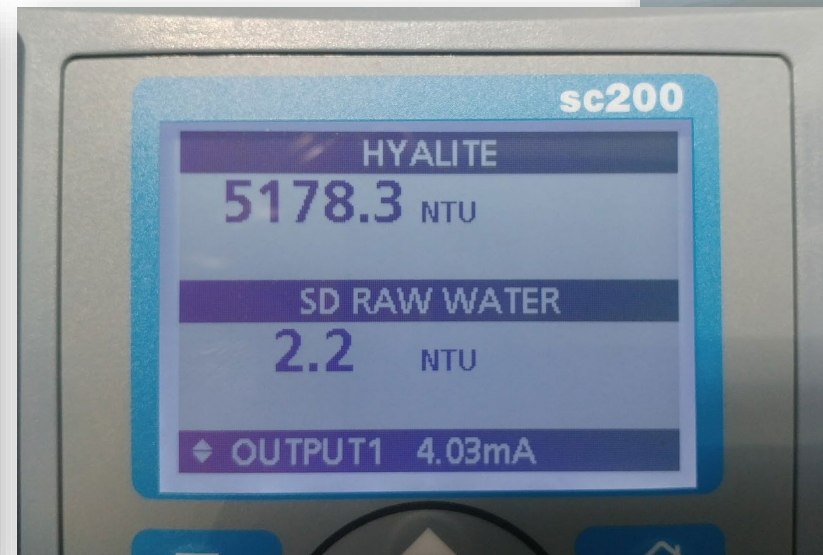
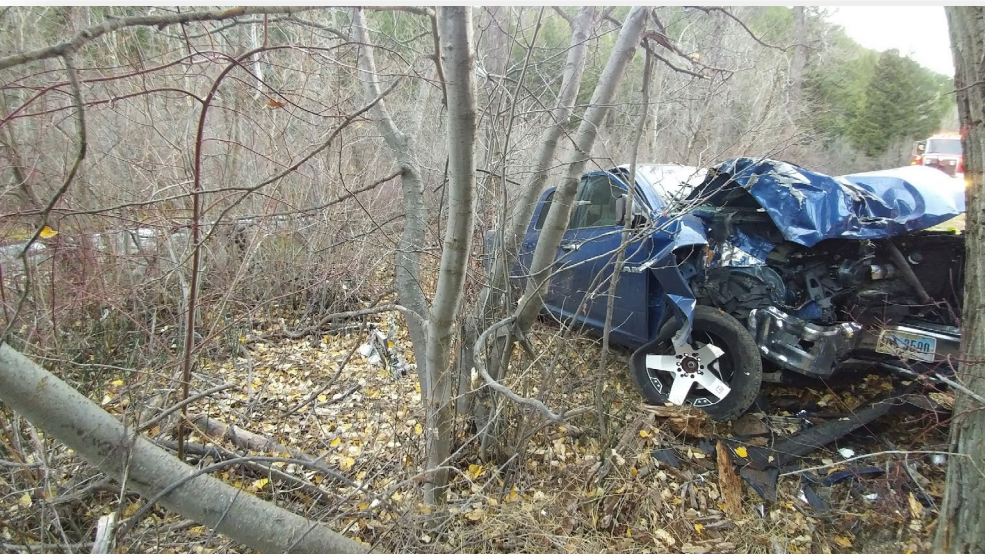
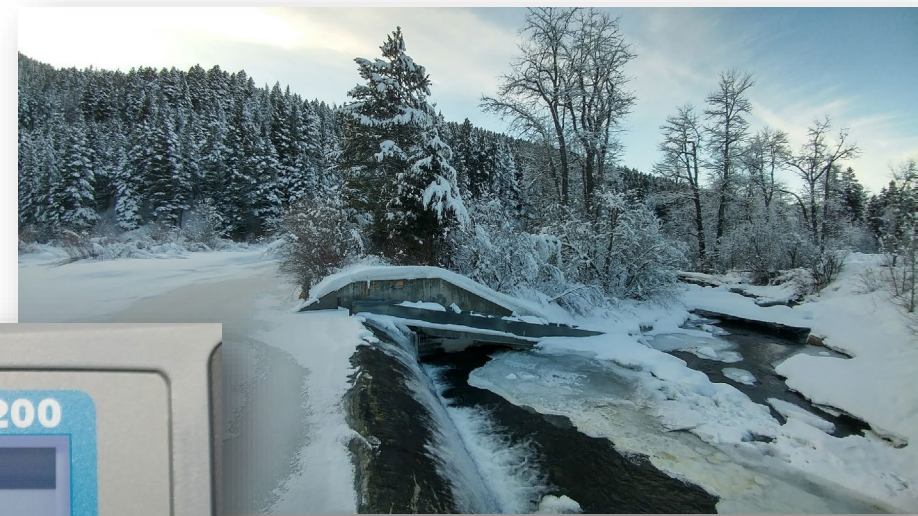
Surface Water - Rivers & Streams

- Advantages
 - Minerals do not accumulate
 - Decreased need for treatment of dissolved contaminants



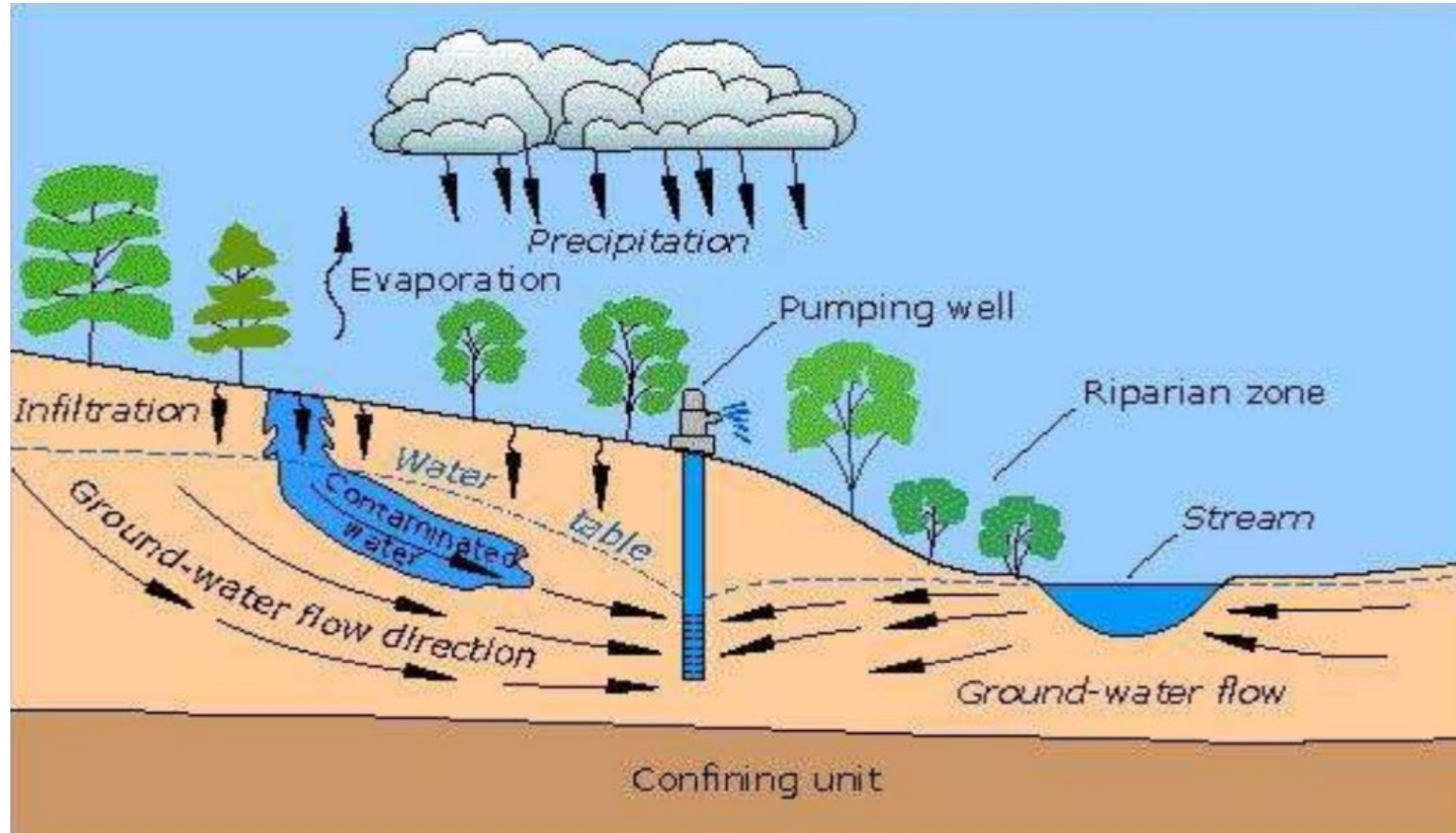
Surface Water – Rivers & Streams

- Disadvantages
 - Temperature fluctuations
 - pH fluctuations
 - Flow variability
 - Turbidity fluctuate daily/hourly
 - Potential for acute water quality issues



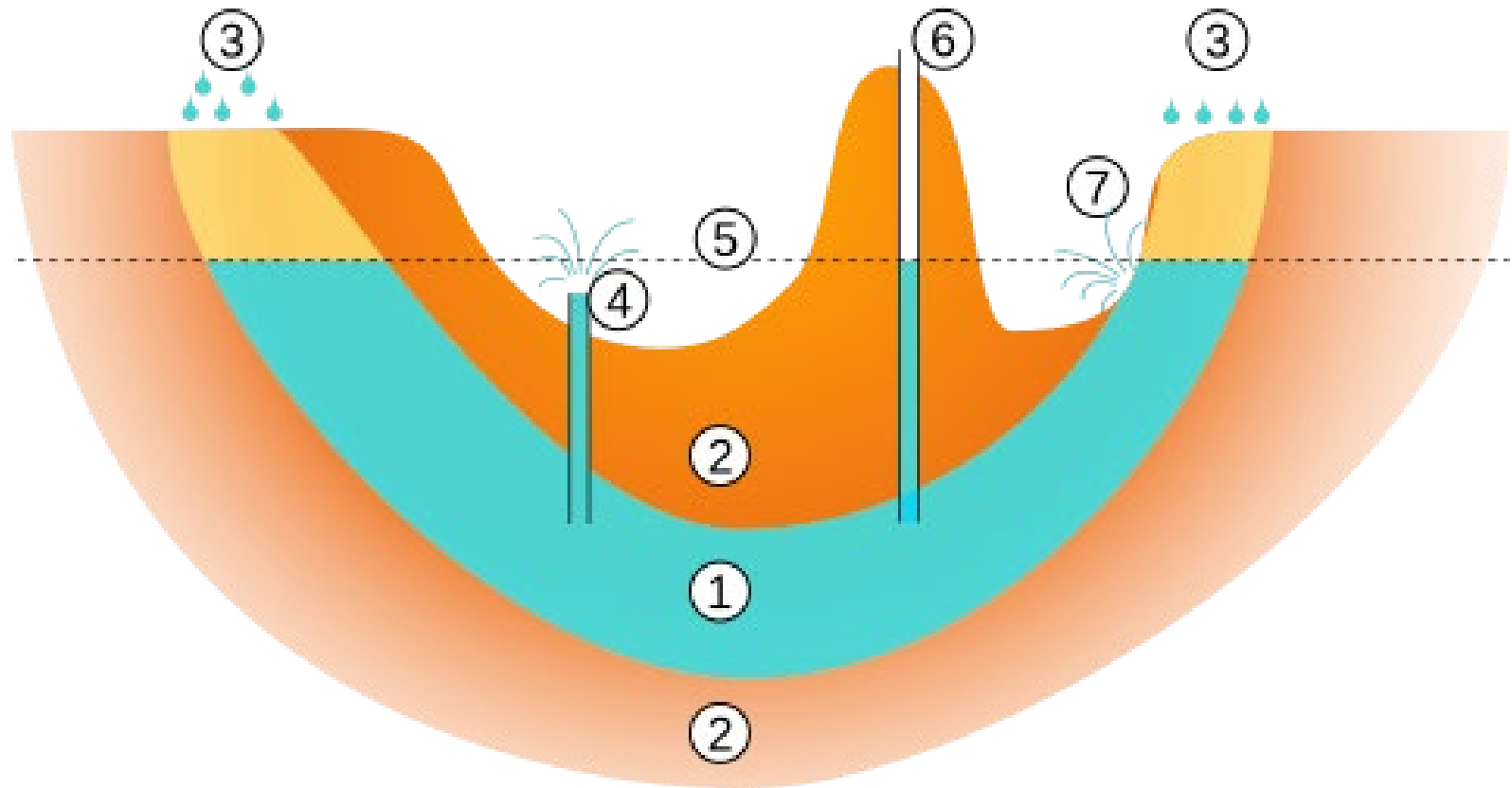
GWUDI (Groundwater Under Direct Influence of Surface Water)

- Accessed via groundwater (well or spring)
- Water characteristics more similar to surface water
- Similar risk of pathogens as surface water (e.g., giardia and cryptosporidium)
- Treatment requirement of surface water



Groundwater - Accessed via well or spring

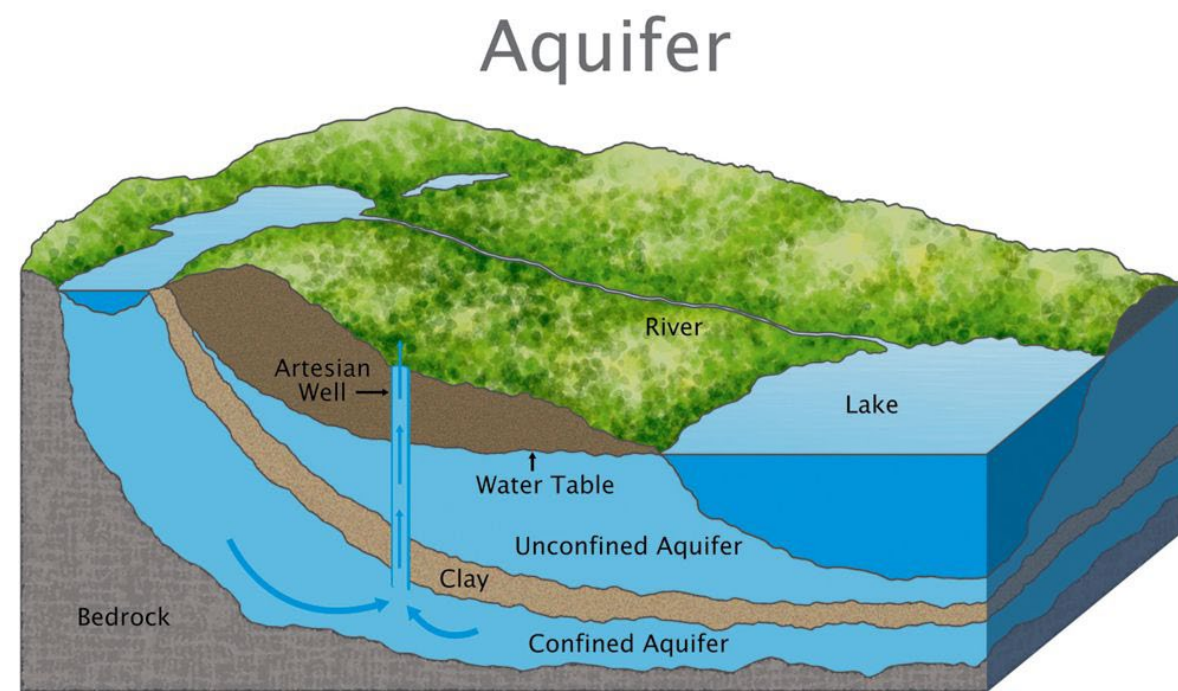
- 1) Aquifer
- 2) Impervious strata (aquiclude)
- 3) Infiltration
- 4) Artesian well
- 5) Saturation level
- 6) Well
- 7) Spring



Groundwater

Advantages vs. surface water

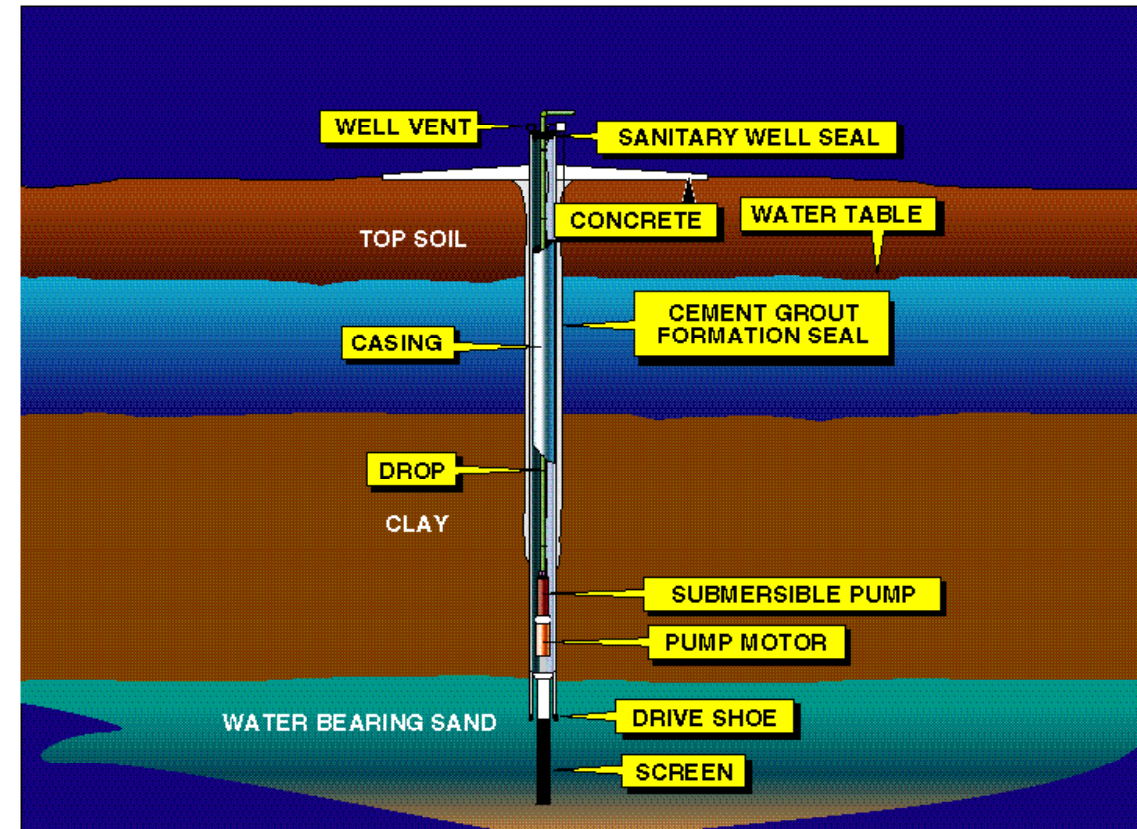
- Less suspended solids
- No organisms present
- No log removal requirement
- Less expensive treatment
- Less seasonal variability
- Less yearly variability



Groundwater

Disadvantages vs. surface water

- Can be more likely to have dissolved contaminants
- Can be harder water
- Can be less accessible (need for groundwater surveys and drilling)
- Long-term contamination risk



Source Water Protection

- Protect public health from contaminants
- Decrease treatment costs

Types of pollution:

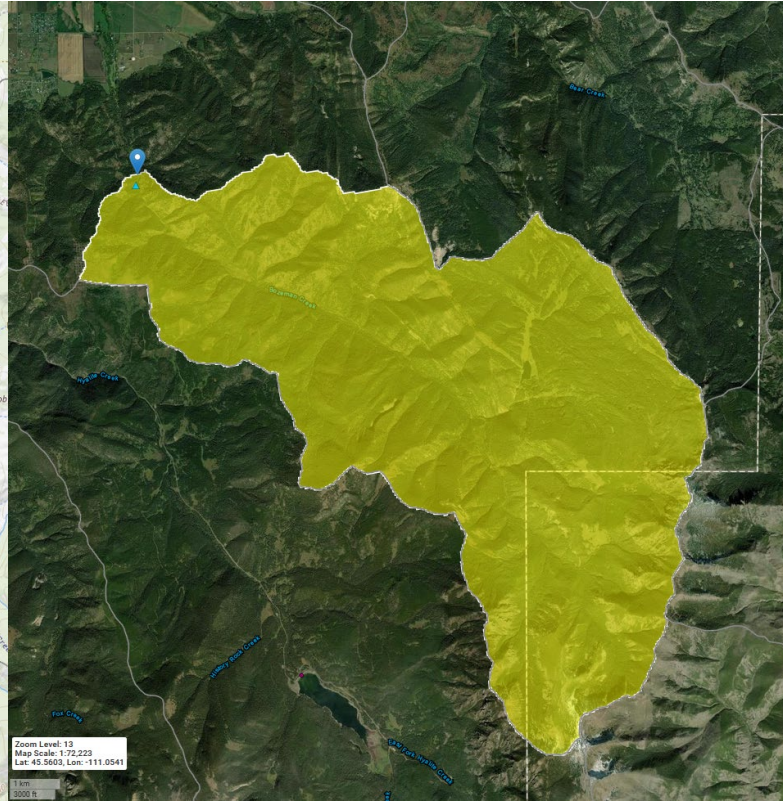
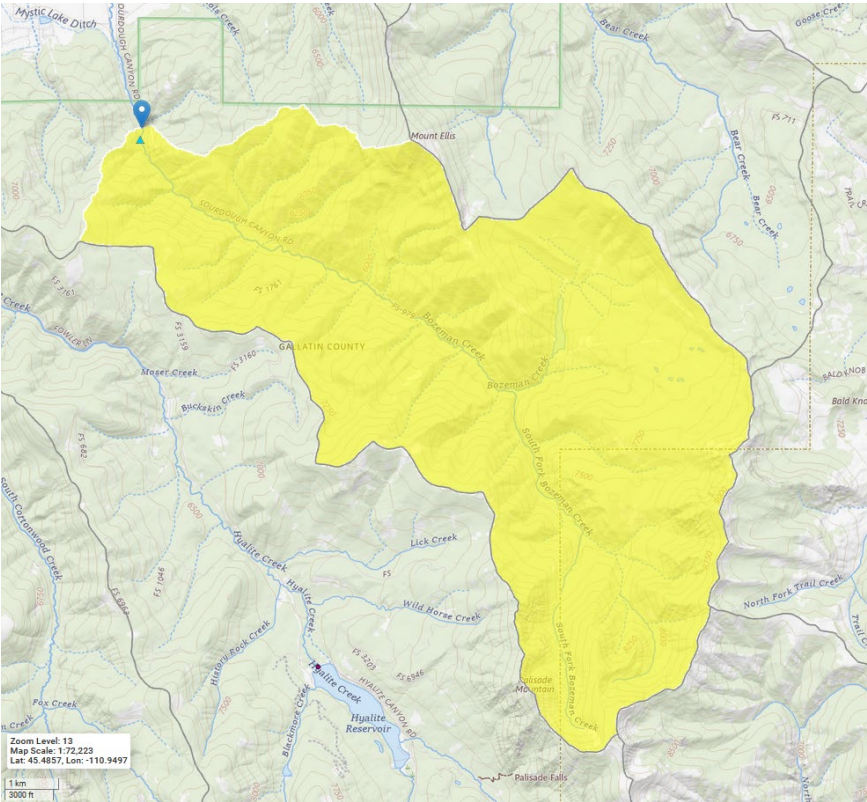
Point source pollution – contaminants discharged directly into water bodies

Non-point source pollution – contaminants that enter water bodies from runoff of places like urban area or agricultural areas

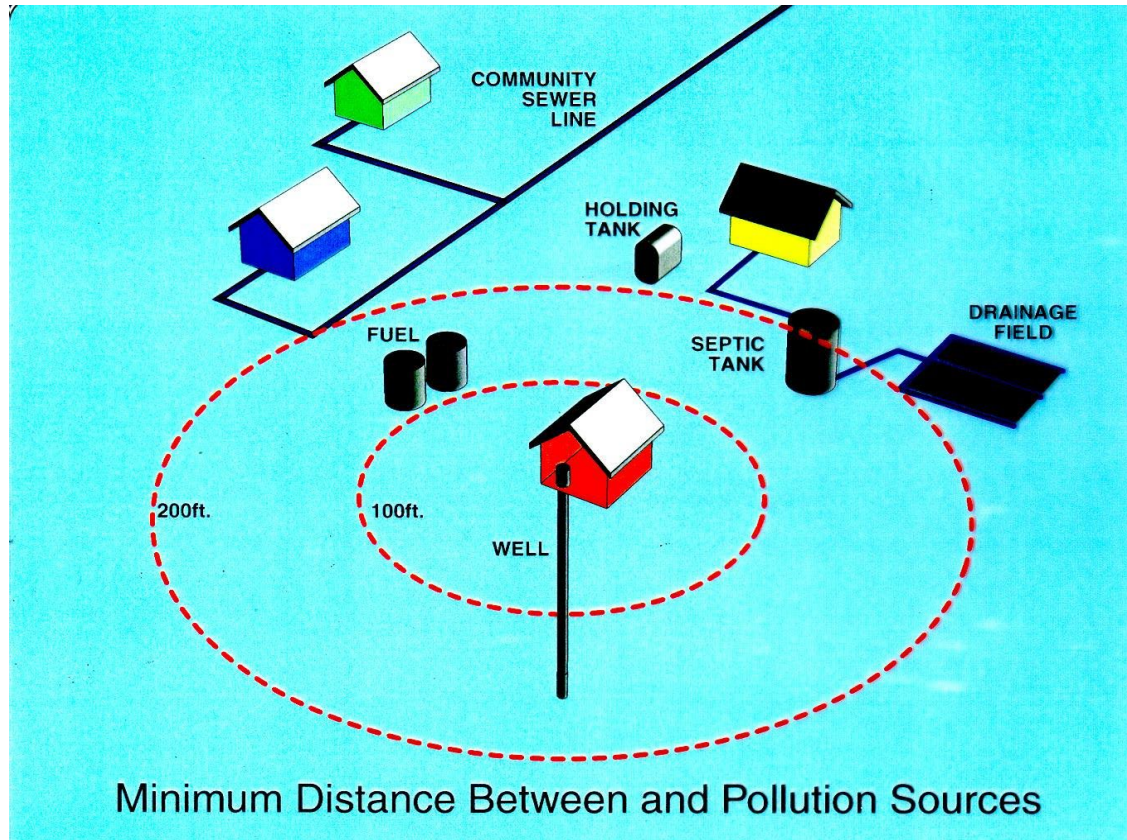
Air deposition – aerosolized contaminants that can deposit onto water bodies



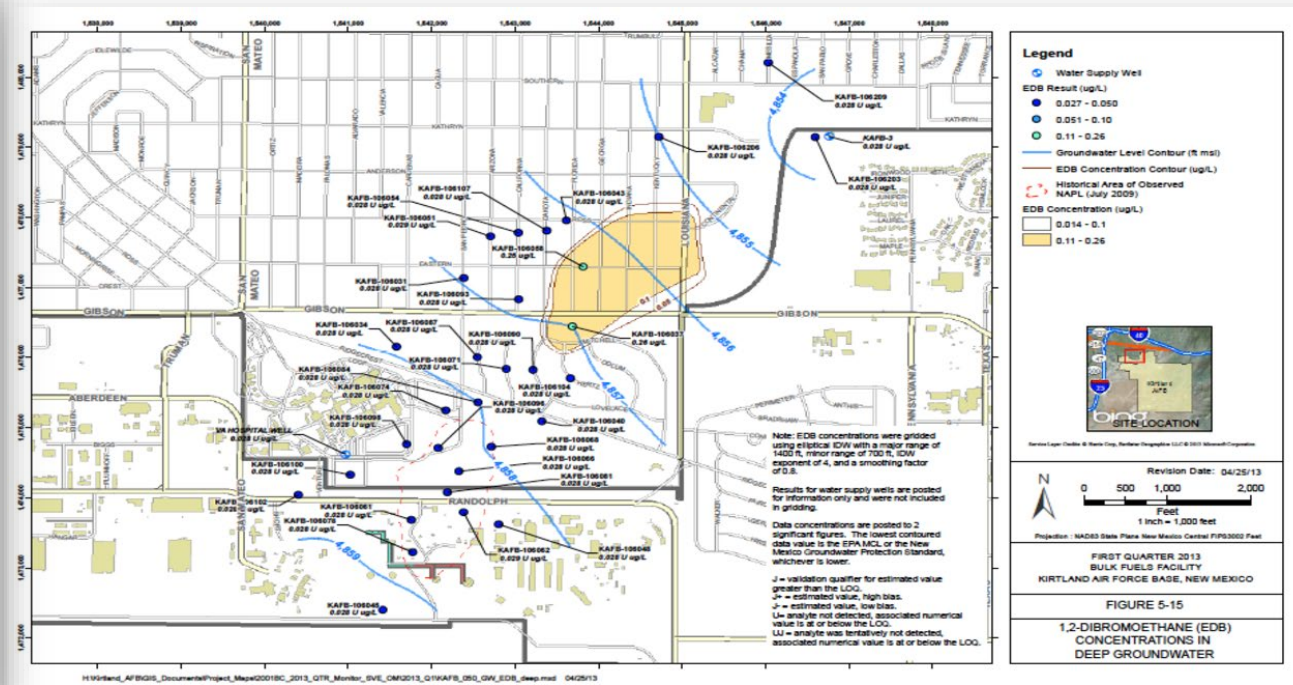
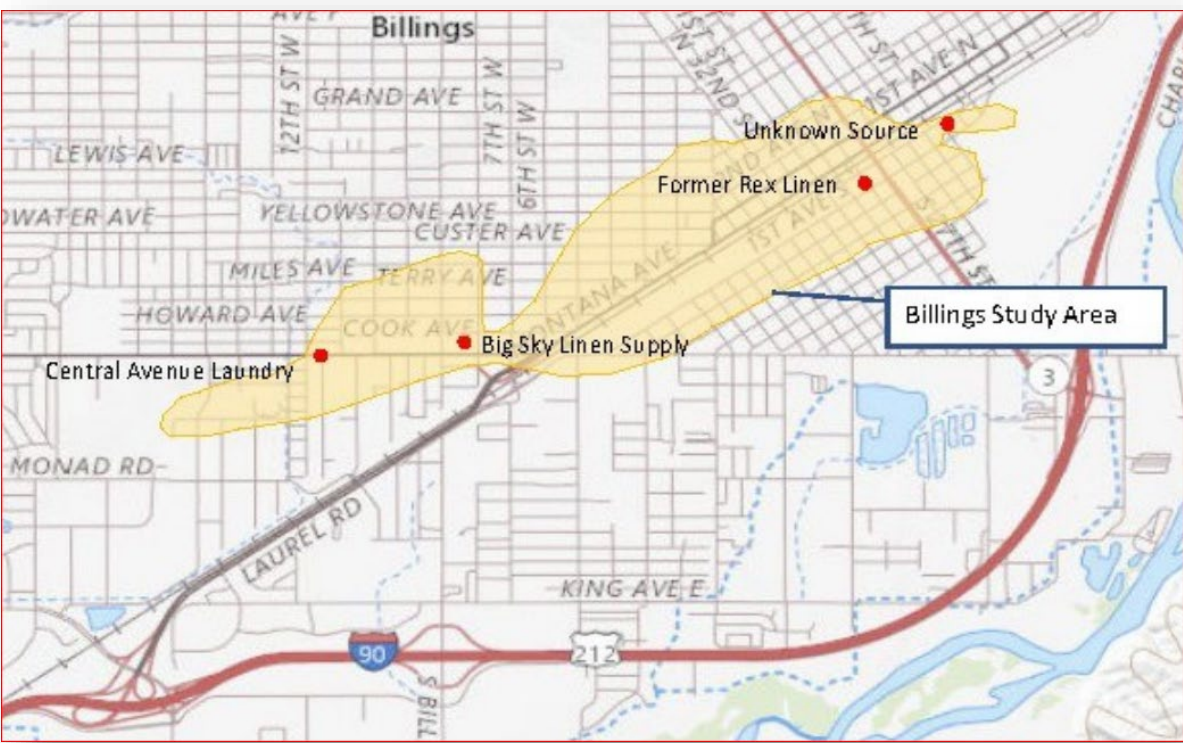
Watershed protection



Aquifer contamination



Aquifer contamination



Source Water Protection Planning



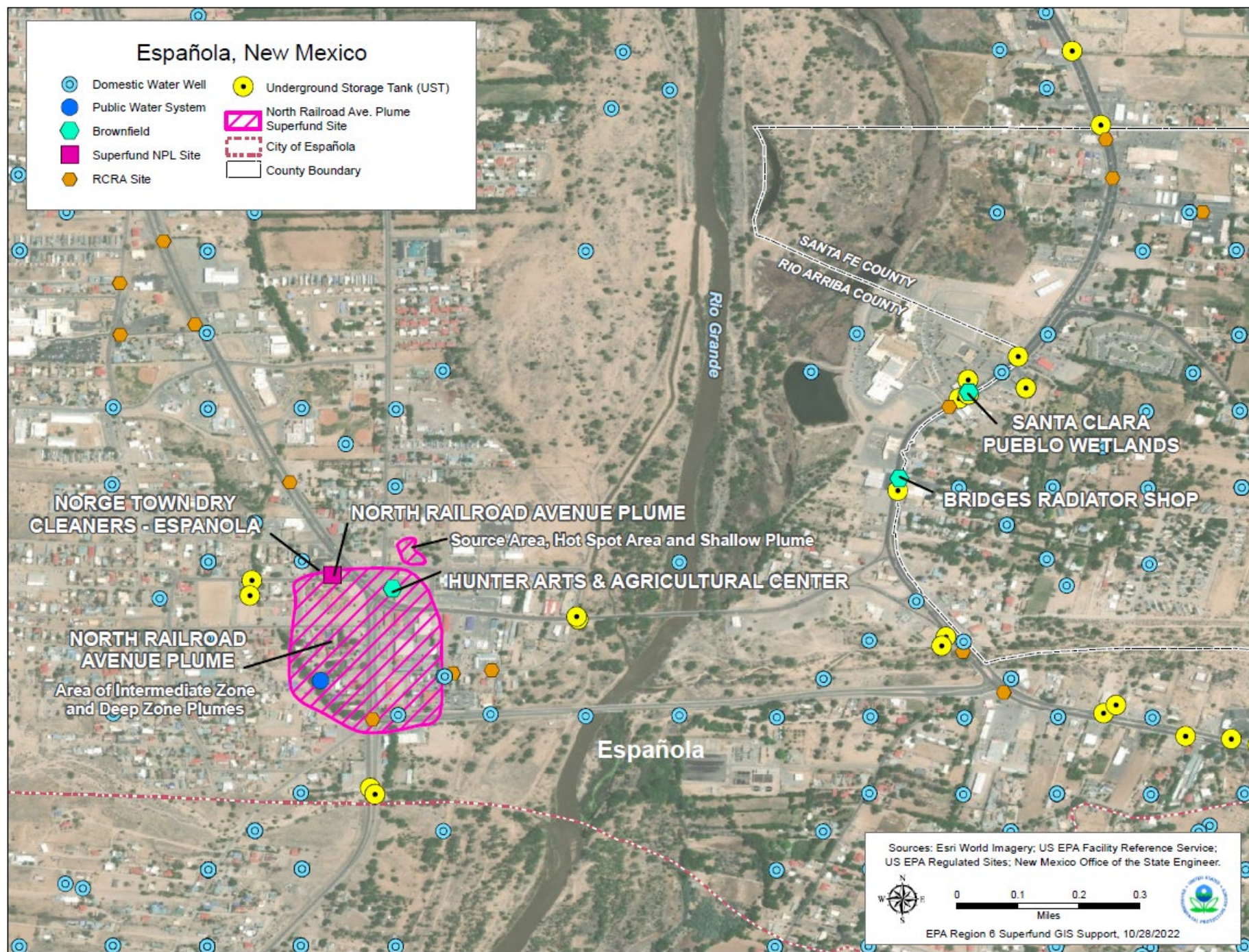


Figure 5-3
Industrial Park Wells
Potential Sources
of Contamination



Figure 5-2 All Potential Sources of Contamination

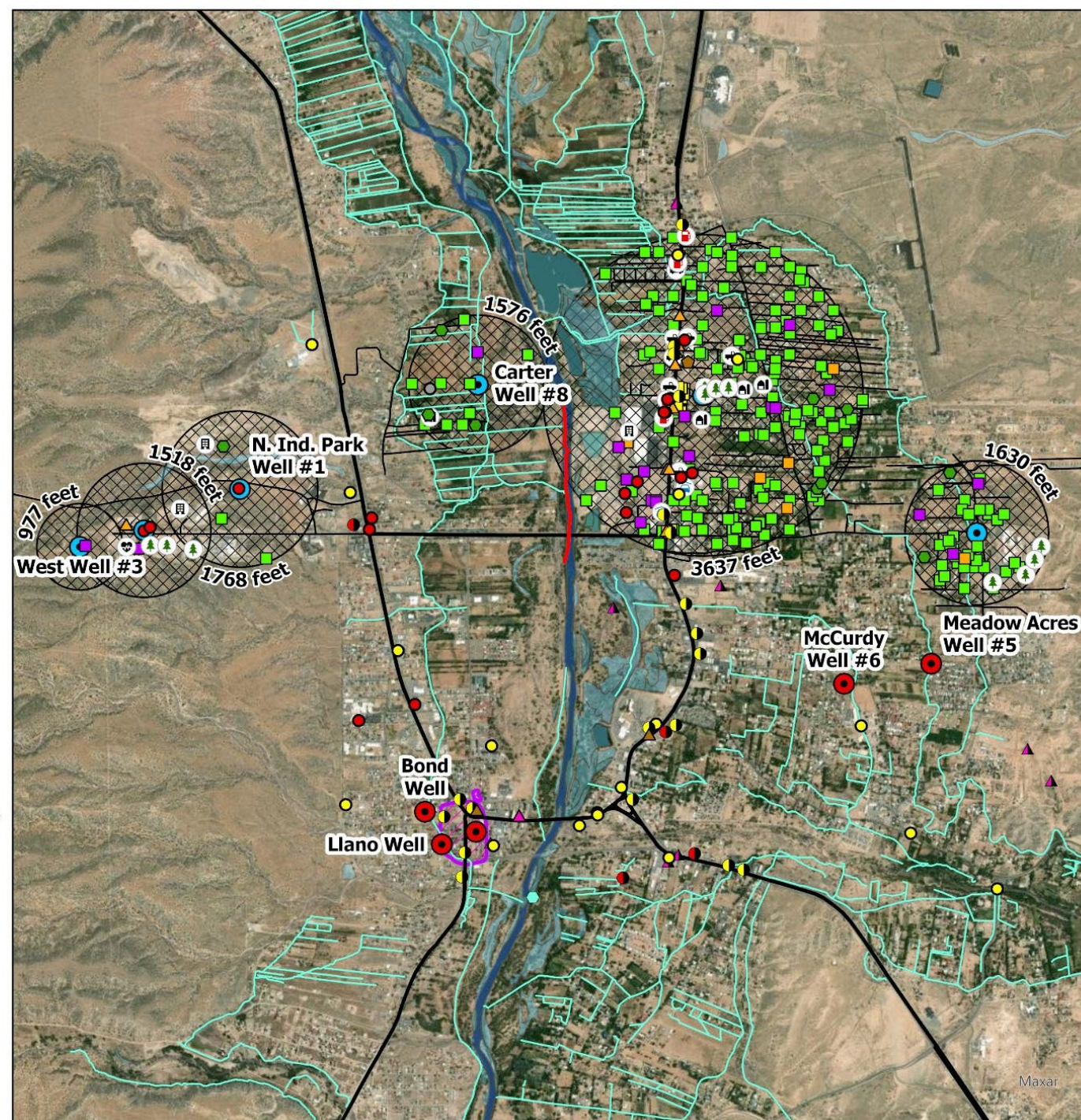
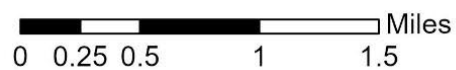
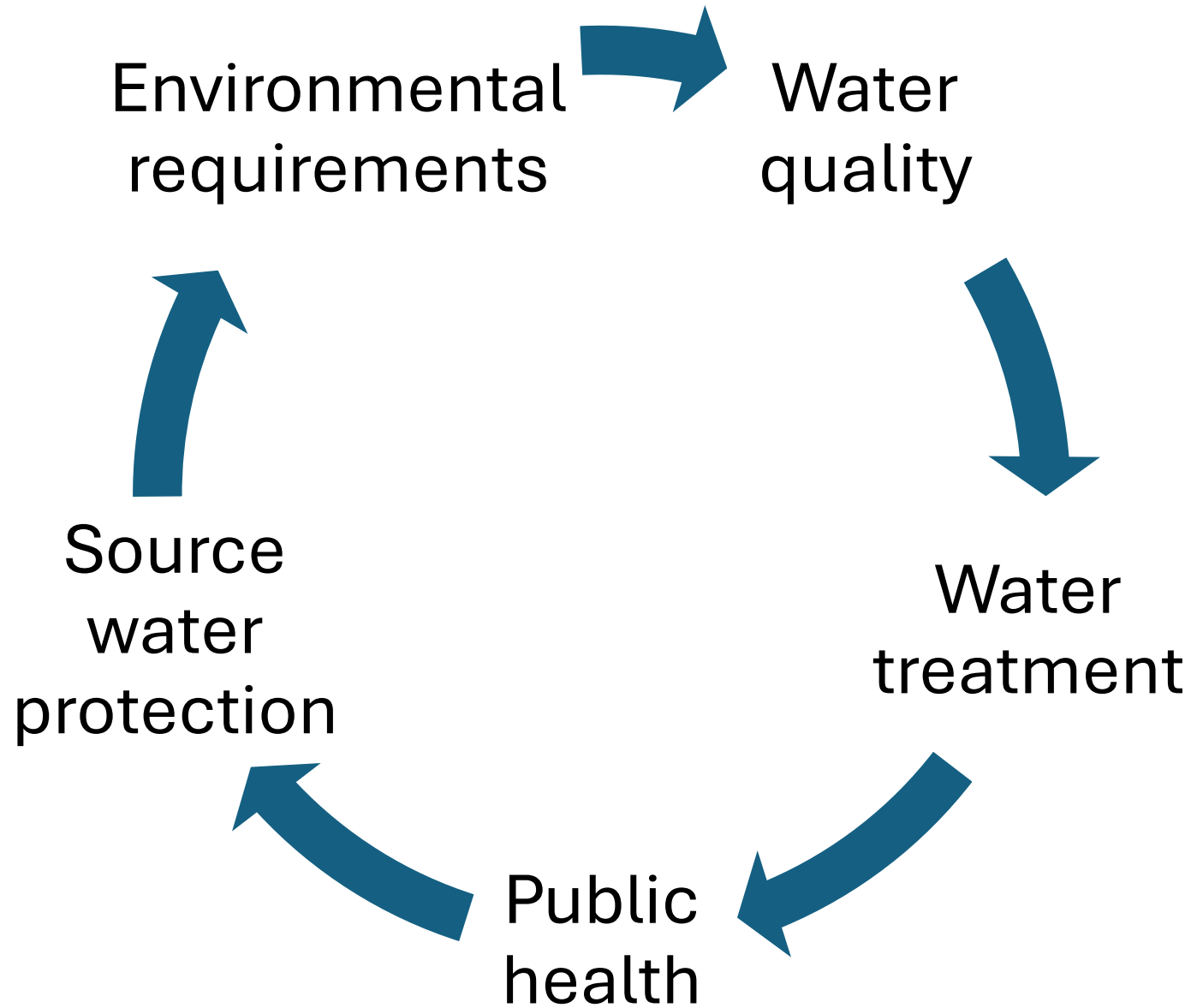


Table 5-3 Contaminant Source Inventory for City of Española Wells

Well	Contaminant Type	Contaminant Description	Quantity	Actual (A) or Potential (P)	Probability of Impact	Impact to PWS	Overall Risk	Control	Notes
North Industrial Park Well #1	Arsenic	Naturally occurring contaminant	1	A	Certain	Significant	High	None	Arsenic >10 µg/L, ferric oxide treatment
	Fluoride	Naturally occurring contaminant	1	A	Certain	Significant	High	None	Fluoride >2.0 mg/L, <4.0 mg/L
	Petroleum Storage Tank Active	Petroleum storage tank (above ground)	1	P	Unlikely	Minor	Low	Direct	Diesel fuel storage for well backup generator
	Commercial/Industrial property		2	P	Possible	Significant	Moderate	None	DTT Sand and Gravel, Nambe Foundry
	POD Domestic	Point of diversion domestic	2	P	Rare	Minor	Very Low	None	
	Septic		1	P	Rare	Insignificant	Very Low	Indirect	
	Athletic Field/Parks		1	P	Unlikely	Insignificant	Very Low	Direct	
	Dirt Road		1	P	Unlikely	Minor	Low	Indirect	
	Primary Road		1	P	Likely	Minor	Moderate	Indirect	
	Arroyo		1	P	Unlikely	Minor	Low	None	
South Industrial Park Well #2	Fluoride	Naturally occurring contaminant	1	A	Certain	Significant	High	None	Fluoride >4.0 mg/L, blend with West Well #3
	Petroleum Storage Tank Active	Petroleum storage tank (above ground)	2	P	Unlikely	Minor	Low	Direct	Diesel fuel storage for well backup generator
	RCRA Site	Resource Conservation and Recovery Act Site	1	A	Rare	Minor	Very Low	None	Amazon.com Services LLC. Warehousing and storage. Statute: CWA, RCRA. In compliance.
	Commercial	Hospital	1	P	Unlikely	Major	Moderate	None	
	POD Commercial	Point of diversion brine production Well	1	P	Unlikely	Minor	Low	None	



Questions?

Schedule for 2025:

Date	Topic
6/25/25	Program Overview, Test Format, Study & Test Tips
7/9/25	Drinking Water System Overview - (Source, Treatment, & Distribution)
7/23/25	Basic Operator Math (+, -, /, x, Exponents and basic algebra)
8/6/25	Applied Operator Math (Areas, Volume, Pressure)
8/20/25	Drinking Water Regulations
9/3/25	Source Water Characteristics
9/17/25	Surface Water Intake Components, Well Components, and O&M
10/1/25	Disinfection 1: Chloramines, UV, Chlorine Dioxide, Chlorine
10/15/25	Disinfection 2: Chlorine Disinfection Application for Sodium Hypochlorite and Gas Chlorine (including storage and safety)
10/29/25	Disinfection 3: Distribution System Application, Residual Measurement, Evaluation & Adjustment,
11/12/25	Disinfection 4: Chlorine Disinfection Math
12/3/25	Surface Water Treatment 1: Coagulation, Flocculation, Sedimentation (including chemistry, process controls, operations)
12/17/25	Surface Water Treatment 2: Filtration

Links to recordings and material are available on our website at <https://swefc.unm.edu/home/op-cert-trainings/>

CONTACT INFORMATION



SOUTHWEST ENVIRONMENTAL FINANCE CENTER

Tucker Colvin:
tcolvin@unm.edu

SW EFC email:
swefc@unm.edu

Department of Civil Engineering MSCo1 1070
1 University of New Mexico
Albuquerque, NM 87131
505-277-0644
swefc@unm.edu
<http://swefc.unm.edu>