Protecting Your Drinking Water: Wells and Septic Systems

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Jeff Grugel, MDH

Sara Heger, UMN

DEPARTMENT OF NATURAL RESOURCES

Funding for this program
Minnesota Department of Health and
the University of Minnesota, Onsite Sewage
Treatment Program

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Please turn off or silence your cell phone

Thanks!

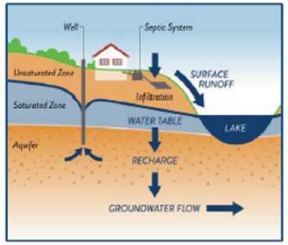
Presentation overview

- What are chemicals of emerging concern?
- What is a good septic system?
- What is a good drinking water system?
- What can you do to protect our water?

Protecting our Water Takes Good Drinking Water and Septic Systems

Sara Heger and Craig Gilbertson

There is growing concern about new chemicals in our groundwater, drinking water, lakes, rivers and streams. These "chemicals of emerging concern" (CEC) include products we use every day around our homes—cleaning products, over-the-counter medicines, and pharmaceuticals. CECs can present a health risk and are more likely to get into our drinking water if we do not have good drinking water or septic systems. Properly constructed and maintained drinking water and septic systems can provide safe and reliable drinking water and wastewater treatment for decades.



Good Septic System Includes

- A watertight septic tank.
- A soil treatment area – typically a drainfield or a mound with the appropriate soil conditions for treatment of wastewater.
- Proper operation being conservative with water use and cleaners.
- Maintained appropriately with an evaluation at least every three years.

Failing Septic System

- Failing septic systems can cause sewage to back-up in the home or come to the surface. Failing systems are more likely to release CECs and harmful bacteria, viruses, and other microorganisms into the environment. Failing systems
- Do not have watertight tanks and may have cracked tanks, seepage pits and drywells.
- Do not have the required soil conditions beneath the soil treatment area.

Good Drinking Water System Includes

- Proper well construction and maintenance.
- Proper installation, back siphon protection, and maintenance of distribution systems, including water treatment devices, water lines, and fixtures.
- Maintaining isolation distances from contamination sources.
- Leaking or dripping fixtures and pipes.

Drinking Water System Posing Health Risks

- Wells in pits.
- Shallow uncased wells.
- Unused wells that are not sealed.
- Wells with damaged casing or openings.
- Cross connections between water lines and potential sources of contamination without protection-plumbing device or air gap
- Sources of contamination stored or unmanaged near your well

https://septic.umn.edu/septic-system-owners/trainingevents

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What are chemicals of emerging concern?

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What are chemicals of emerging concern (CEC)?

- A contaminant is generally a substance that is in a place where it doesn't belong
- CECs are substances that have been released to, found in, or have the potential to enter waters (groundwater or surface water) and:
  - do not have human health-based guidance (how much of a substance is safe to drink)
  - pose a real or perceived health threat
  - have new or changing health or exposure information
- They can include pharmaceuticals, pesticides, industrial effluents, personal care products that are washed down drains

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CECs continued

- New contaminants are being found in our waters. This is due, in part, because:
  - there are better methods for finding substances at lower levels
  - additional substances are being looked for
  - new substances are being used
  - old substances are being used in new ways

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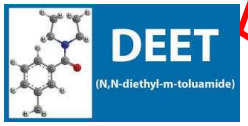
Examples of CECs



Antibiotics
Hormones (synthetic and natural)
Metabolites (cotinine)
Psychoactive drugs
Lipid regulators
Pain relievers
Fragrances
Chemotherapy drugs
Fire retardants
Cleaning products
others

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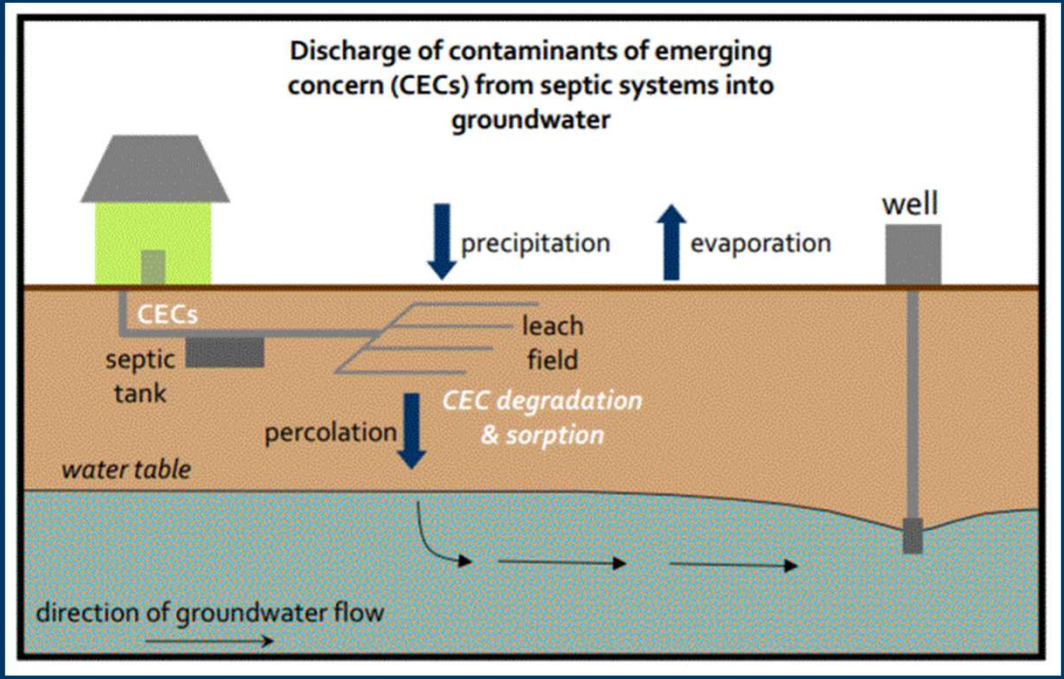

What is a good subsurface sewage treatment system (SSTS)?

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Good septic systems

- Do not backup into home
- Do not surface in the yard or into a water body
- Have watertight septic tanks
- Protect ground water by having adequate vertical separation to saturated zone or confining layer

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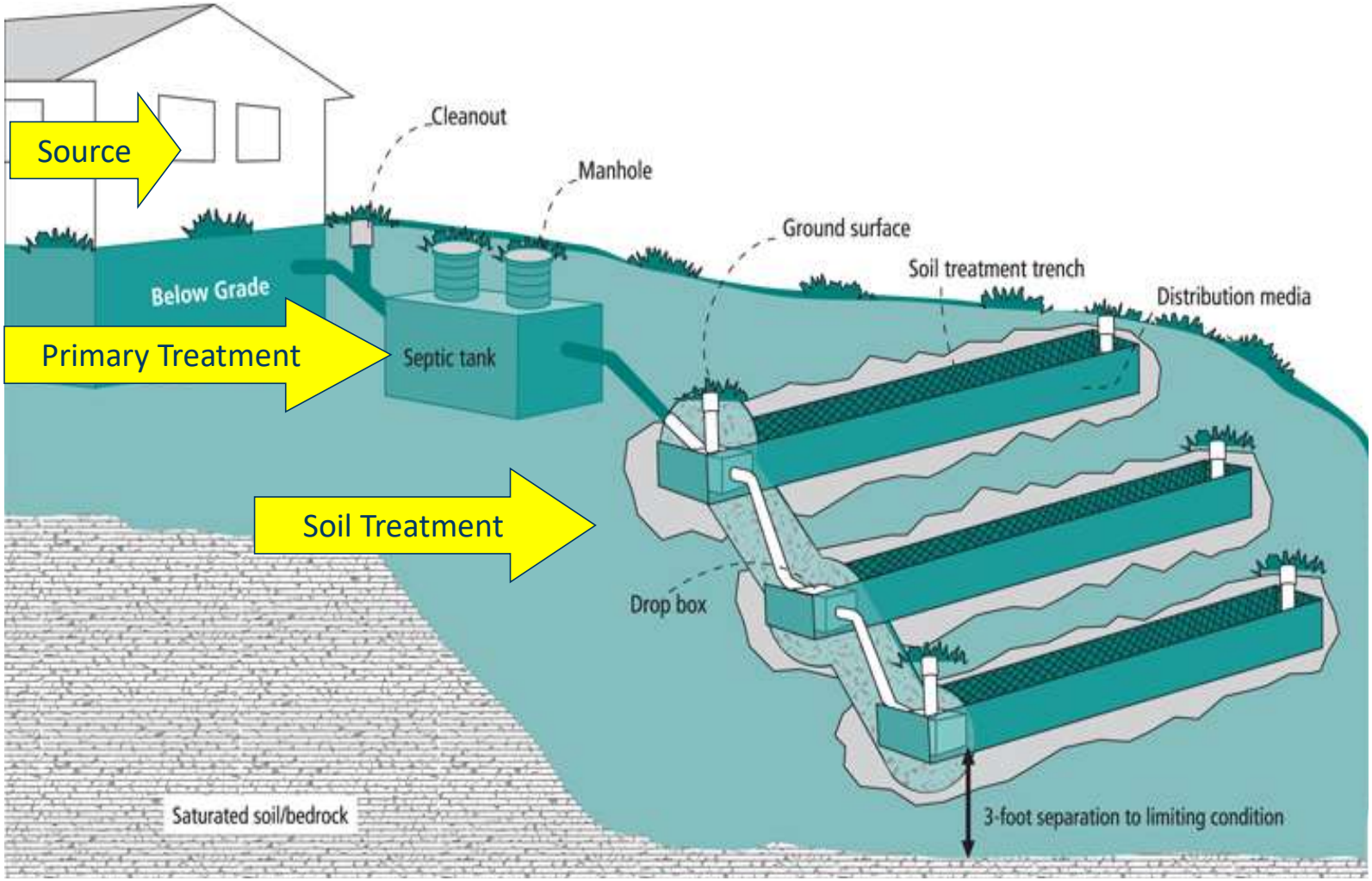
Components of a Septic System



Septic Tank: Primary Treatment

- Job of tank: catch the solids
  - Decompose organic solids
  - Store inorganic solids
- Layers in tank
  - Scum layer: floating soap, grease, toilet paper, etc
  - Liquid layer: water, liquid, and suspended solids
  - Sludge: heavy organic and inorganic materials in the bottom of the tank
- Anaerobic bacteria breakdown organic solids

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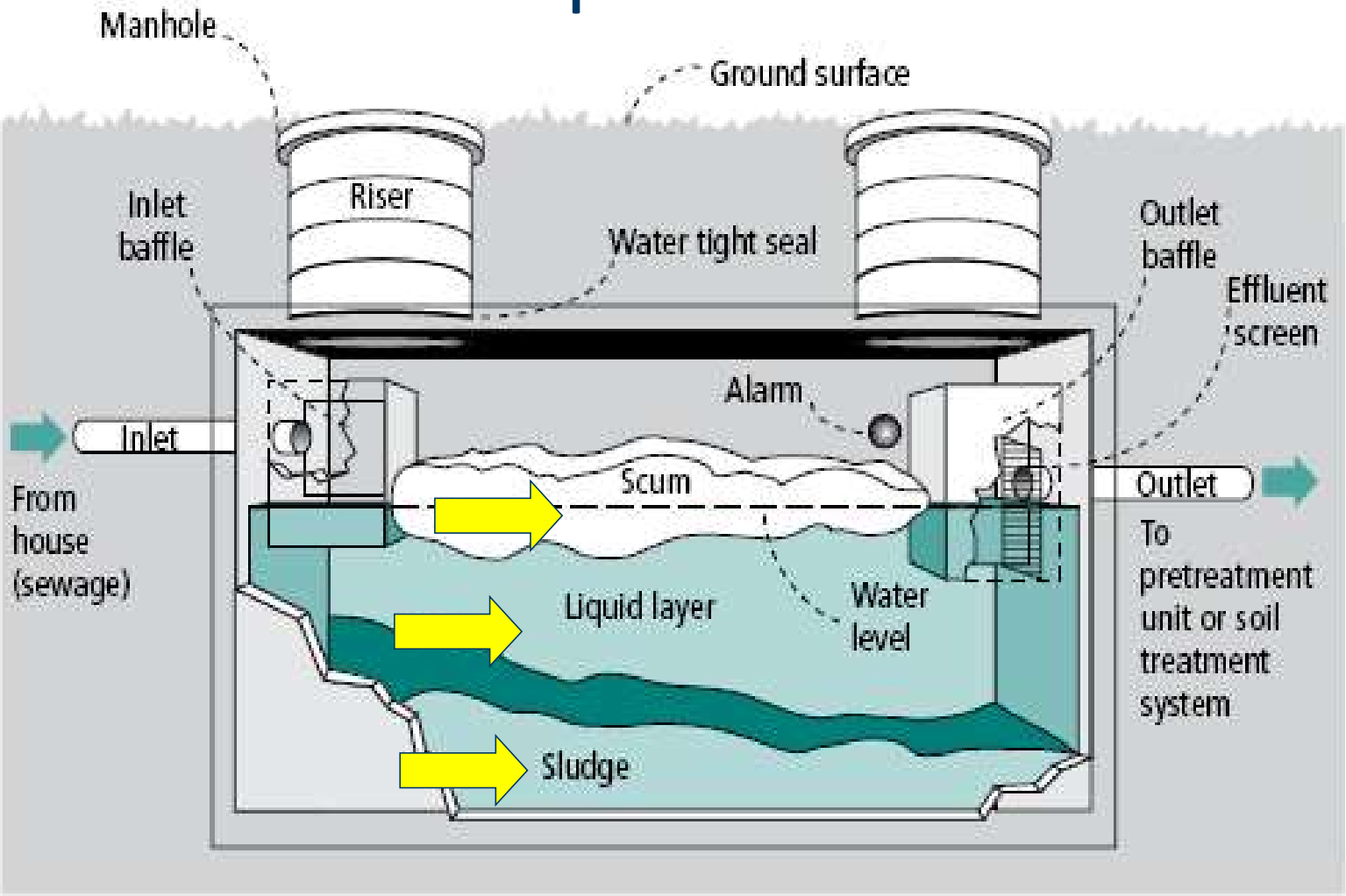
Septic Tank


Manhole
Ground surface
Riser
Inlet baffle
Water tight seal
Outlet baffle
Effluent screen
Alarm
Inlet
From house (sewage)
Scum
Outlet
To pretreatment unit or soil treatment system
Liquid layer
Water level
Sludge

Effluent screen/filter

- Typically replace the outlet baffle
- Must have riser to grade for access

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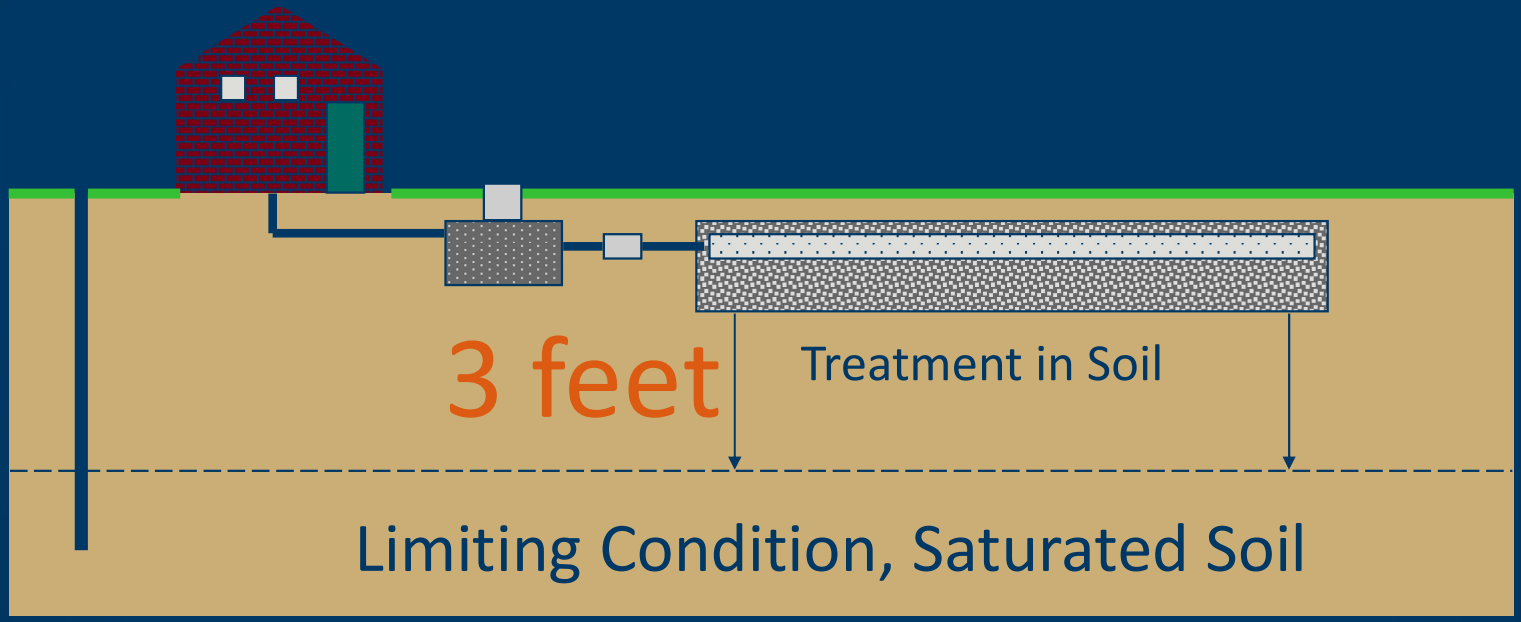
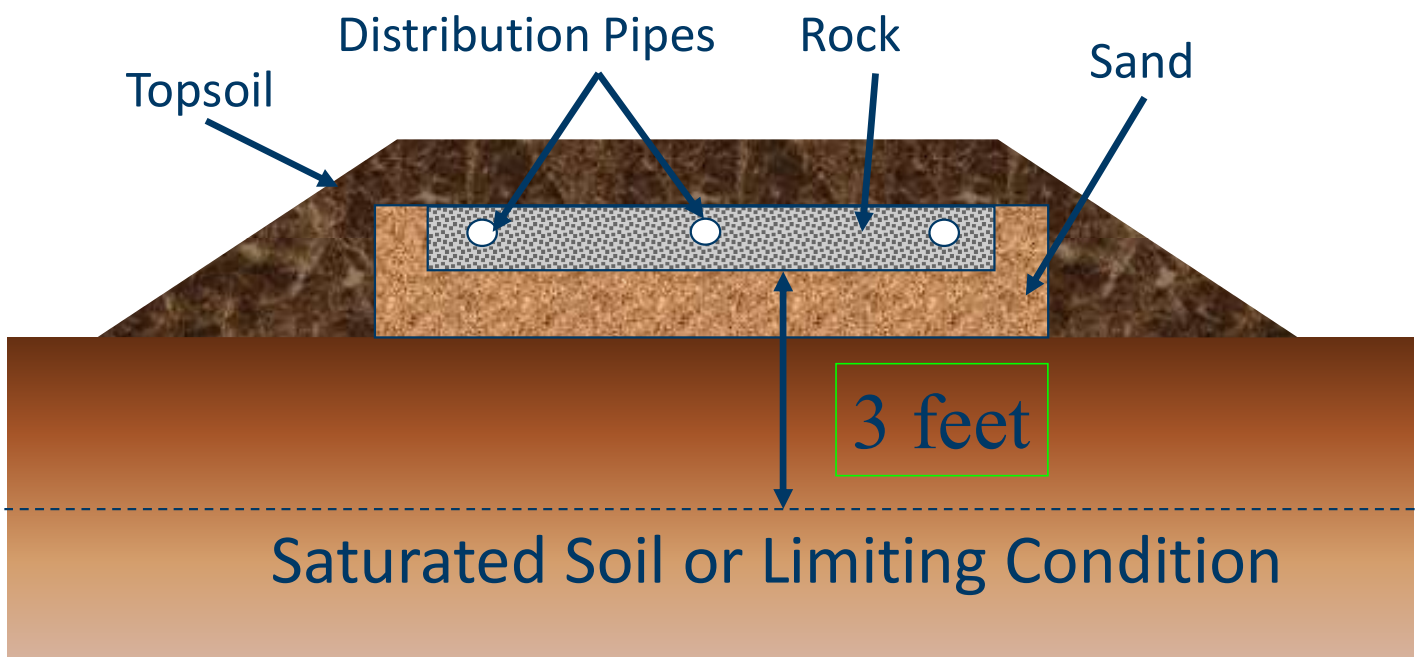
Septic System Components

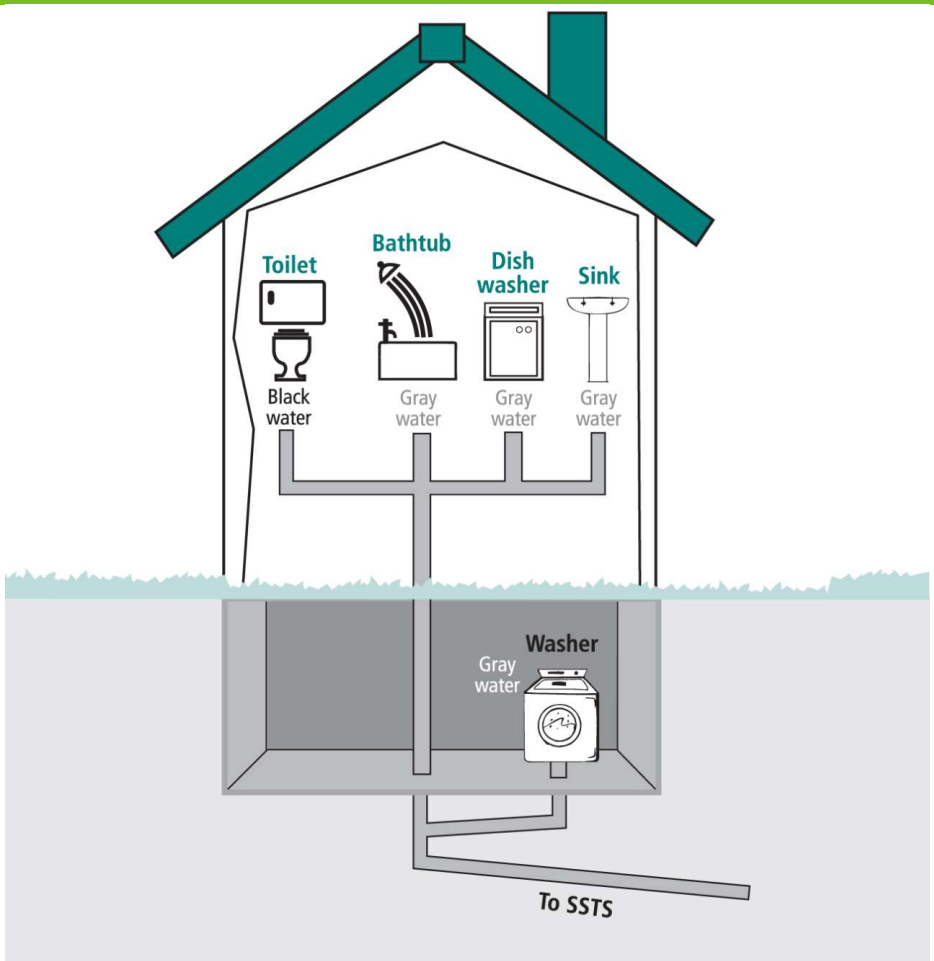


Mound Soil Treatment System



What do we add to the water?

- **Pathogens**
  - Virus, Bacteria
- **Solids**
  - Organic
  - Inorganics
- **Nutrients**
  - Phosphorus
  - Nitrogen
  - Micro-Nutrients
- **Chemicals**
  - Cleaning products
  - Water treatment
  - Medications



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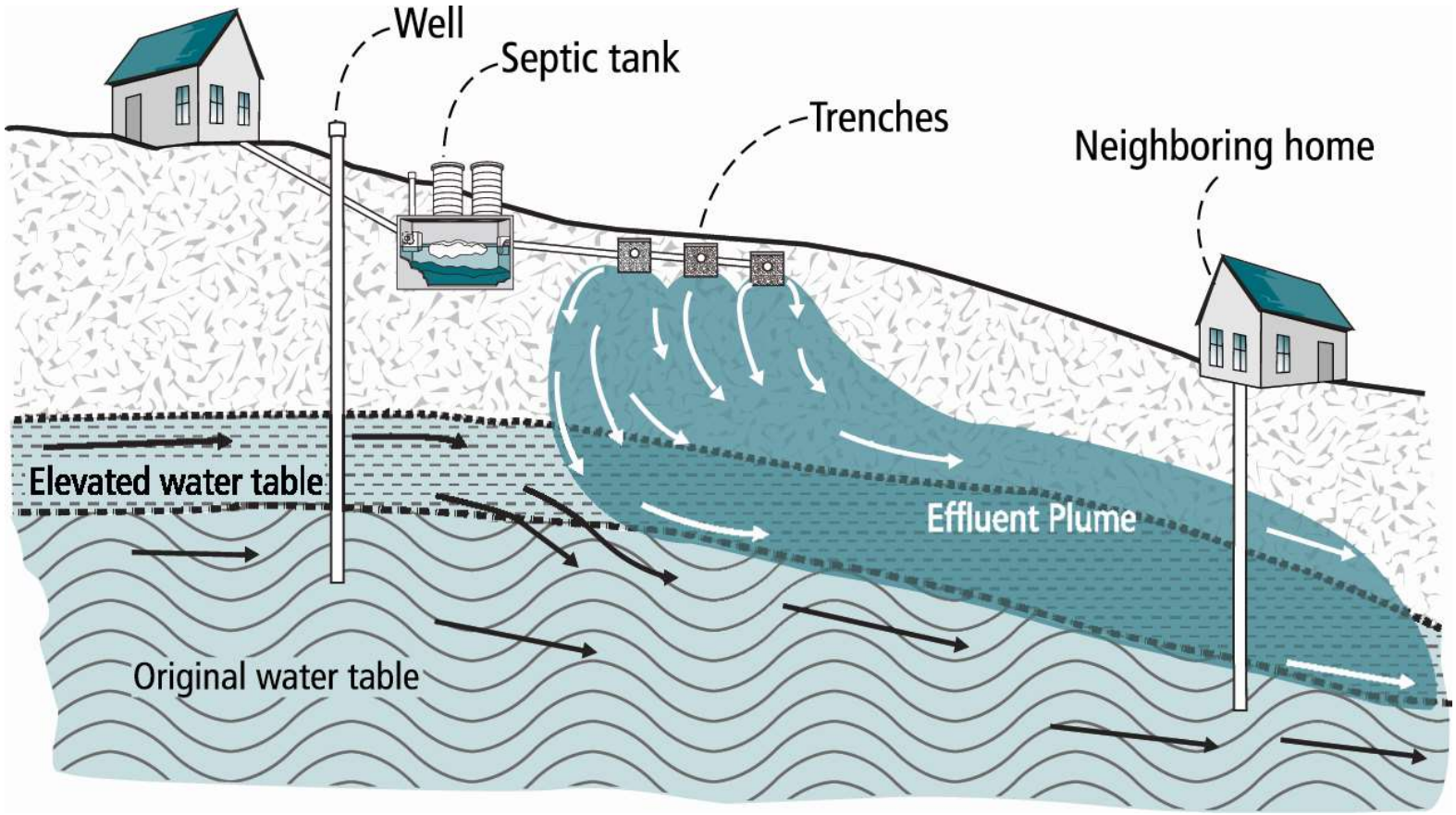
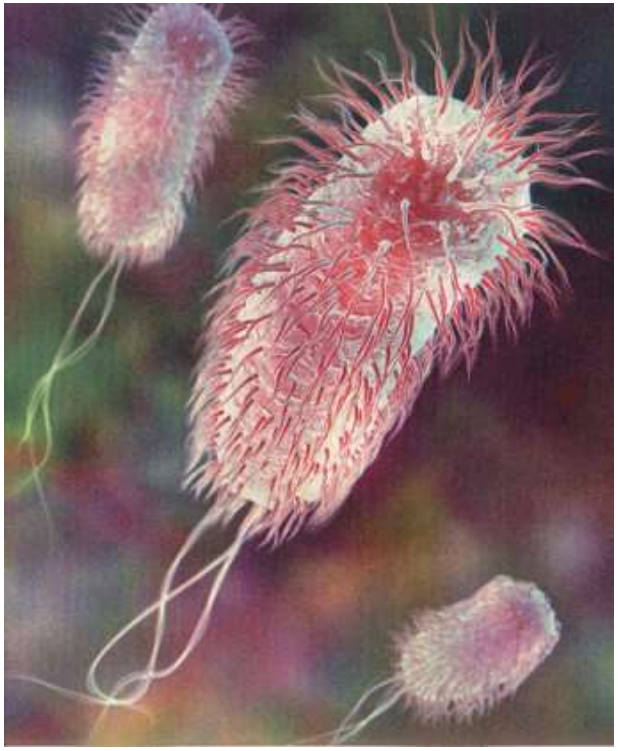
Where are these problems treated?

Tank? Soil?



Pathogens

- What?
  - Virus, bacteria, helminths (worms), protozoa
- Impacts?
  - Human health
- How treated?
  - Difficulty living in oxygen rich environments
  - Removal and die off in soil treatment system
    - 3 feet of soil treatment key



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Organic solids

- What?
  - Digested and undigested animal and vegetable material
  - Synthetic (artificial) organic compounds
- Impacts?
  - Requires oxygen to be broken down
    - Biochemical Oxygen Demand (BOD)
  - Reduces dissolved oxygen (DO) in lakes, rivers, and streams
- How treated?
  - Stored in septic tank and removed when septic tank is pumped
  - Effluent screen/filter limits passage to soil treatment area
  - Serves as food source for good soil bacteria in soil treatment system

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Inorganic solids

- What?
  - Fibers from synthetic clothing (lint from washing machine), minerals, metals and salts from soil material, plumbing, make-up
- Impacts?
  - Inert and not subject to decay
  - Causes clouding of water (turbidity)
  - Plugging of soil pores
- How treated?
  - Stored in septic tank and removed when septic tank is pumped
  - Effluent screen/filter limits passage to soil treatment area
  - Overtime may cause soil pores to plug

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Phosphorus

- What?
  - Nutrient
  - From:
    - Urine
    - Food
    - Household detergents
- Impacts?
  - Weed & algal growth in lakes, ponds, and streams
- How treated?
  - Removed in the soil treatment system

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Nitrogen

- What?
  - Nutrient
  - From
    - Urine and food breakdown
    - Household cleaners and chemicals
- Impacts?
  - Drinking water quality, weed and algal growth
- How treated?
  - Variable removal in septic tank and soil treatment system
  - Diluted in groundwater (well setbacks)
  - Advanced systems need in sensitive areas

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Chemicals

- What?
  - Cleaners
  - Medications
- Impacts?
  - Can harm your septic system
  - Aquatic food chain, species reproduction, drinking water quality
- How treated?
  - Stored in tank until pumped
  - Variable removal in septic tank and soil system

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What is a good drinking water system?

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Today's Topics

- Well construction and what typical wells look like.
- Groundwater protection.
- What you can do to protect your well's water quality.
- Water testing.

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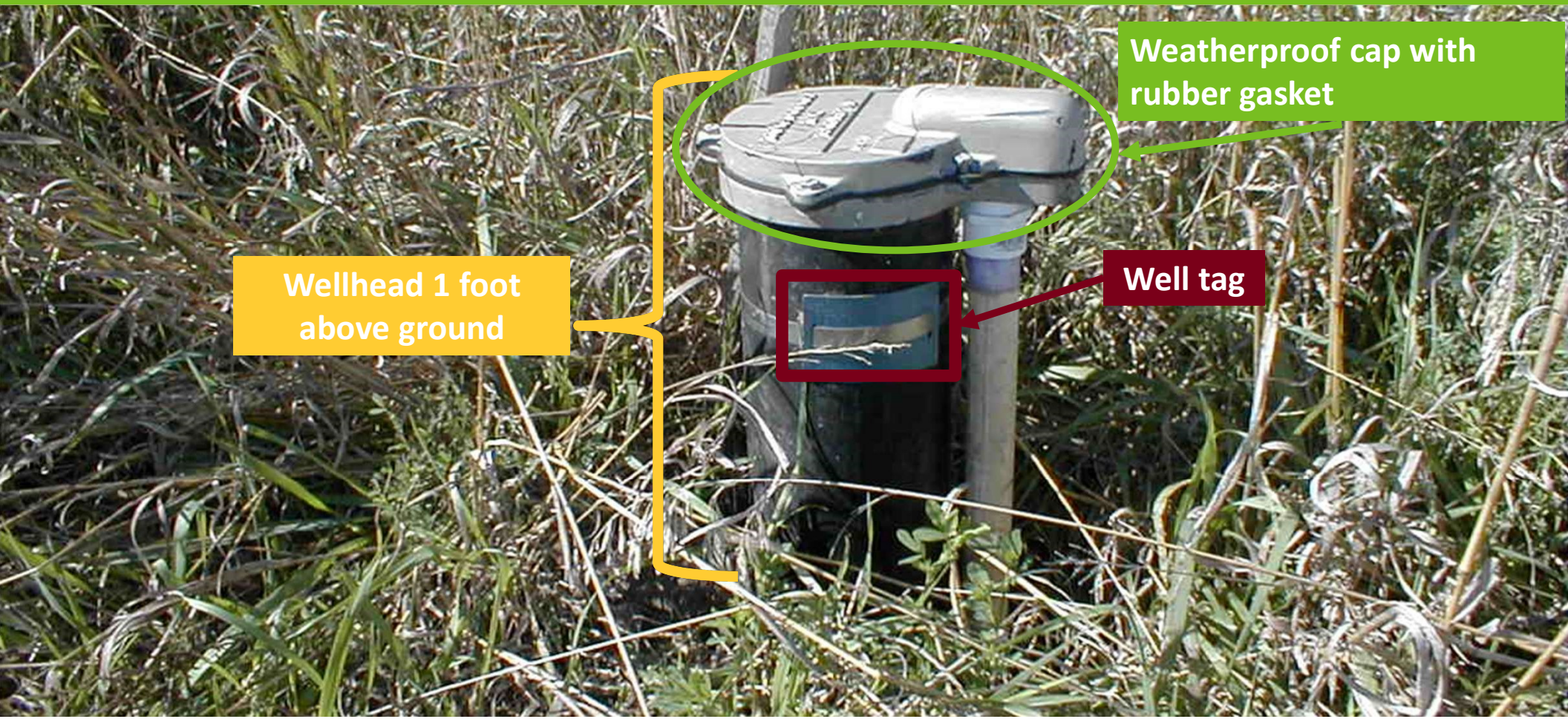
Newer Wells


Weatherproof cap with rubber gasket
Well tag
Wellhead 1 foot above ground

Older Wells

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Dug Wells/Pit Wells

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Well Construction Methods

- Mud Rotary – most common
- Air Rotary
- Cable Tool

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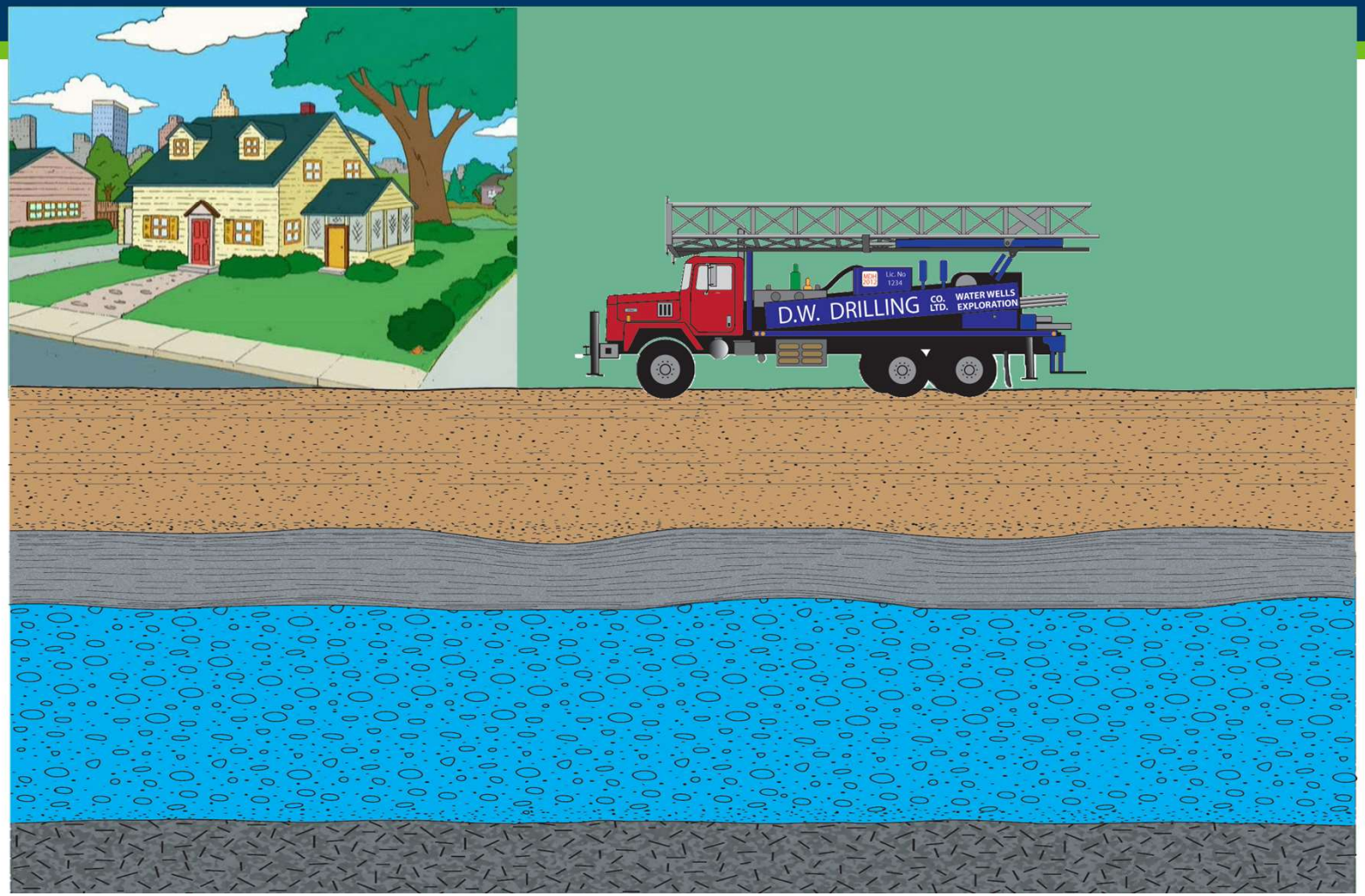
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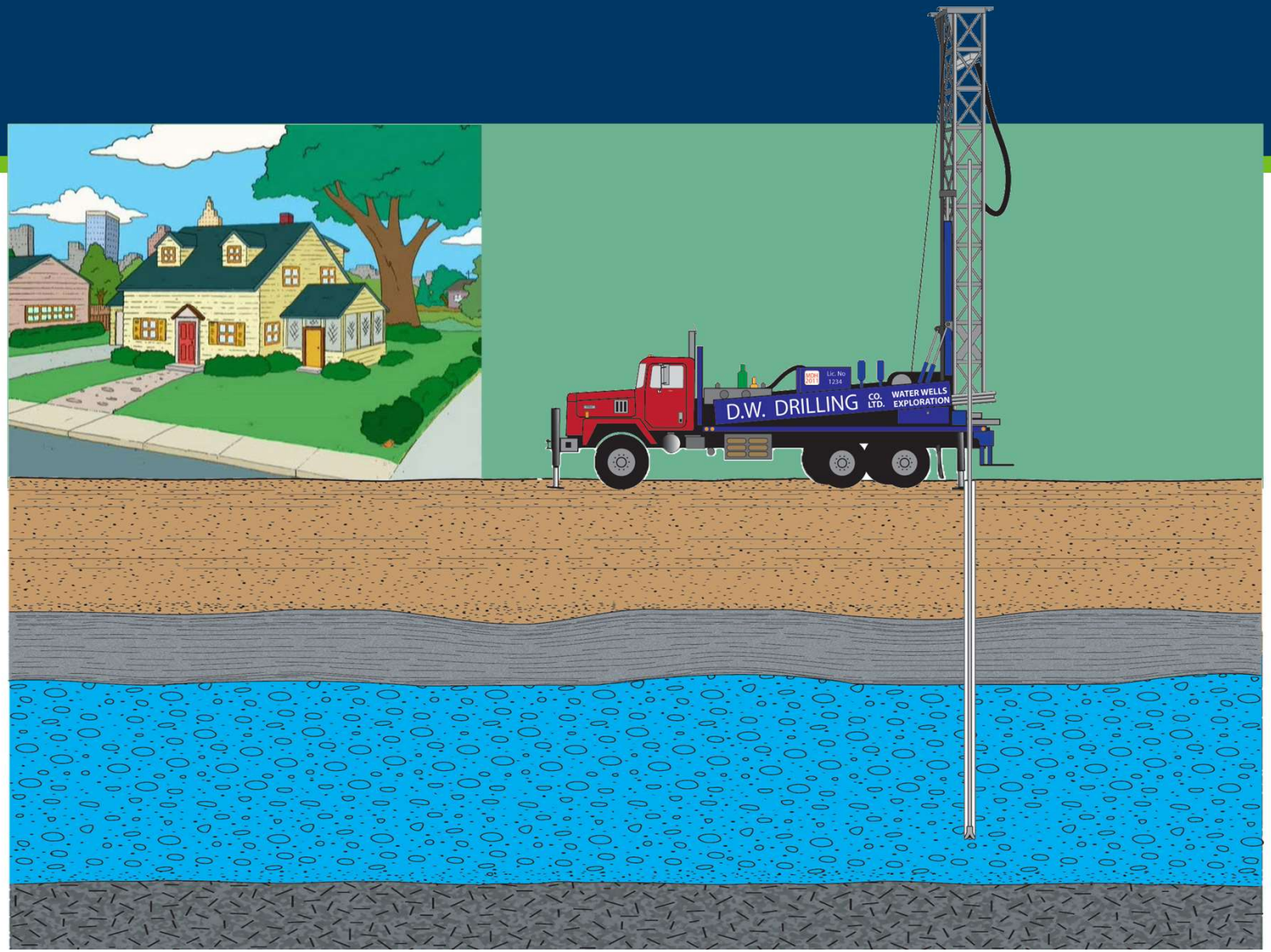
WATER WELLS
EXPLORATION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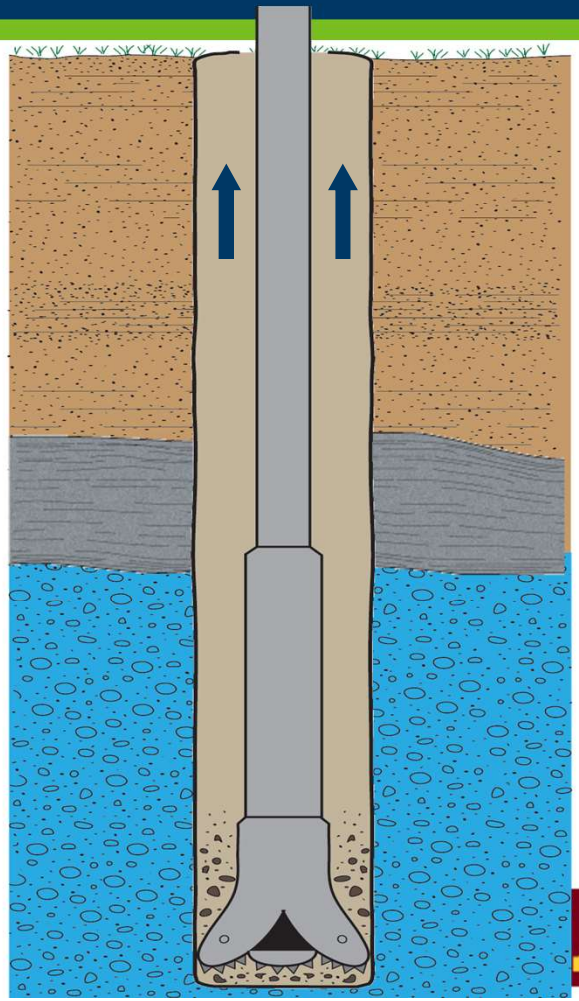
WATER WELLS EXPLORATION



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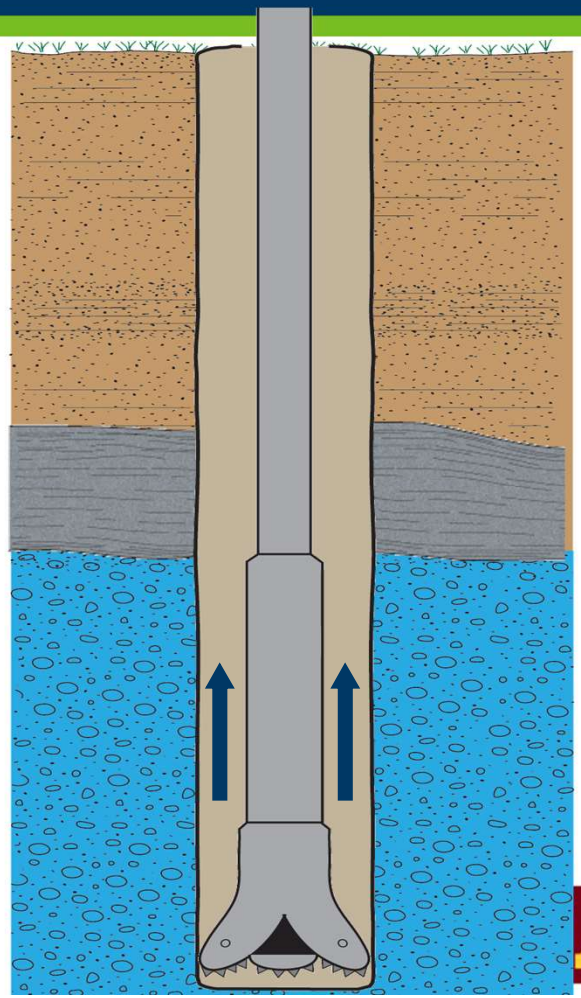

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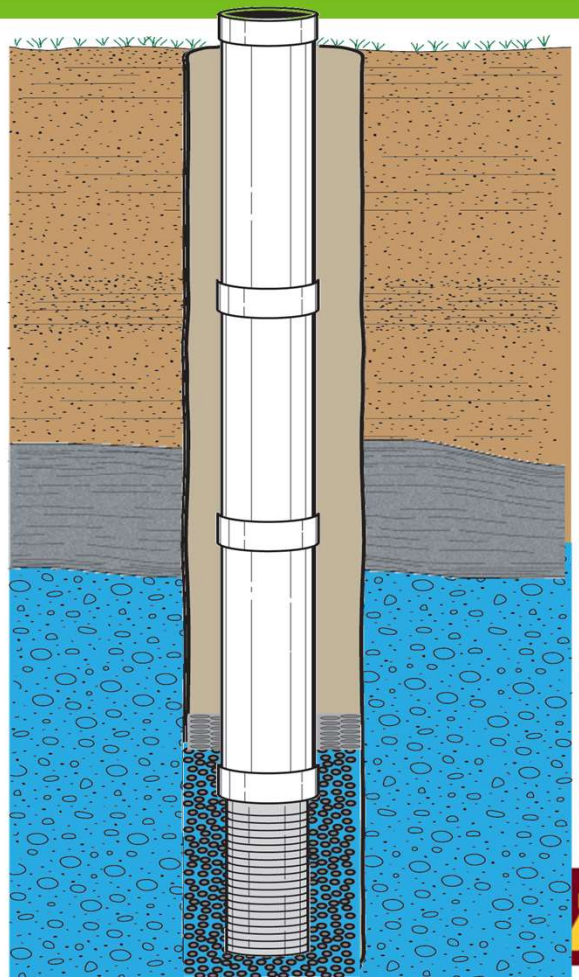

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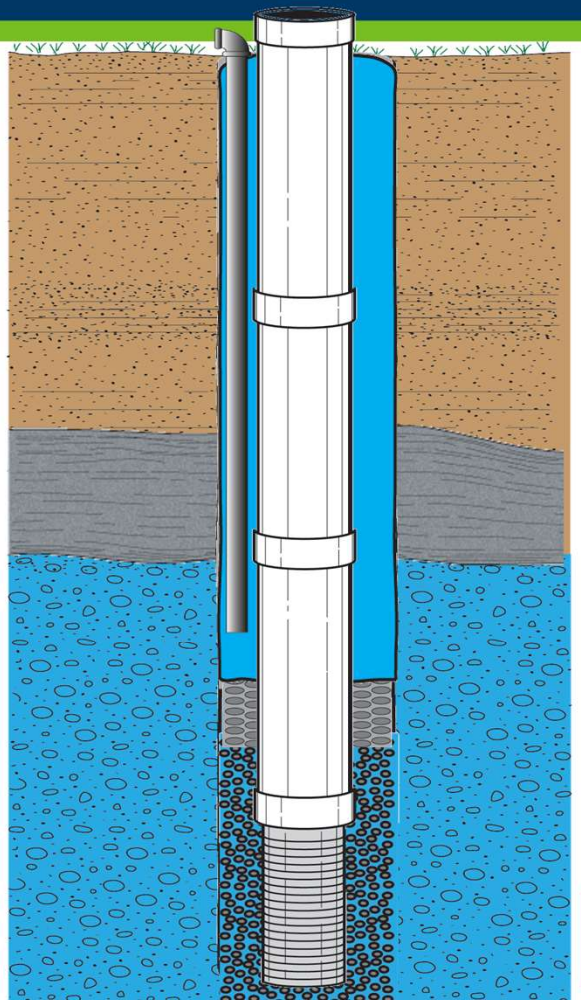

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Screen Development

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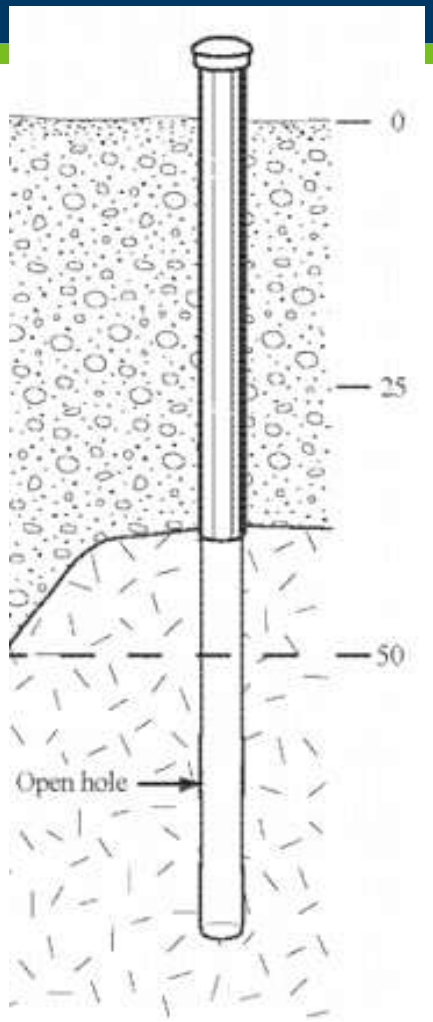
Wells Drilled in Rock



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Groundwater

- **Groundwater**: Water that is contained in soil or bedrock.
- **Aquifer**: Soil or rock that stores and transmits water.
- **Confining Layer**: Soil or rock that restricts water movement.

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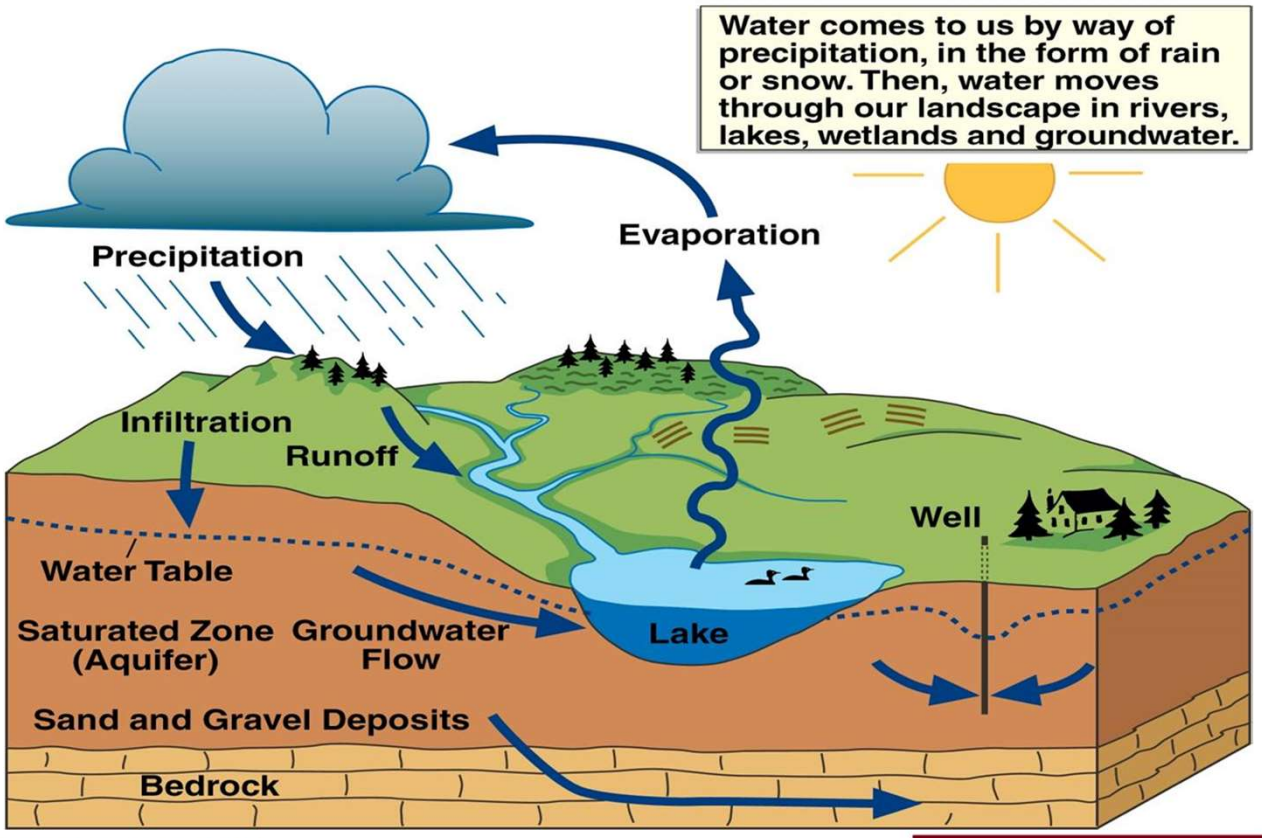
The Hydrologic (Water) Cycle



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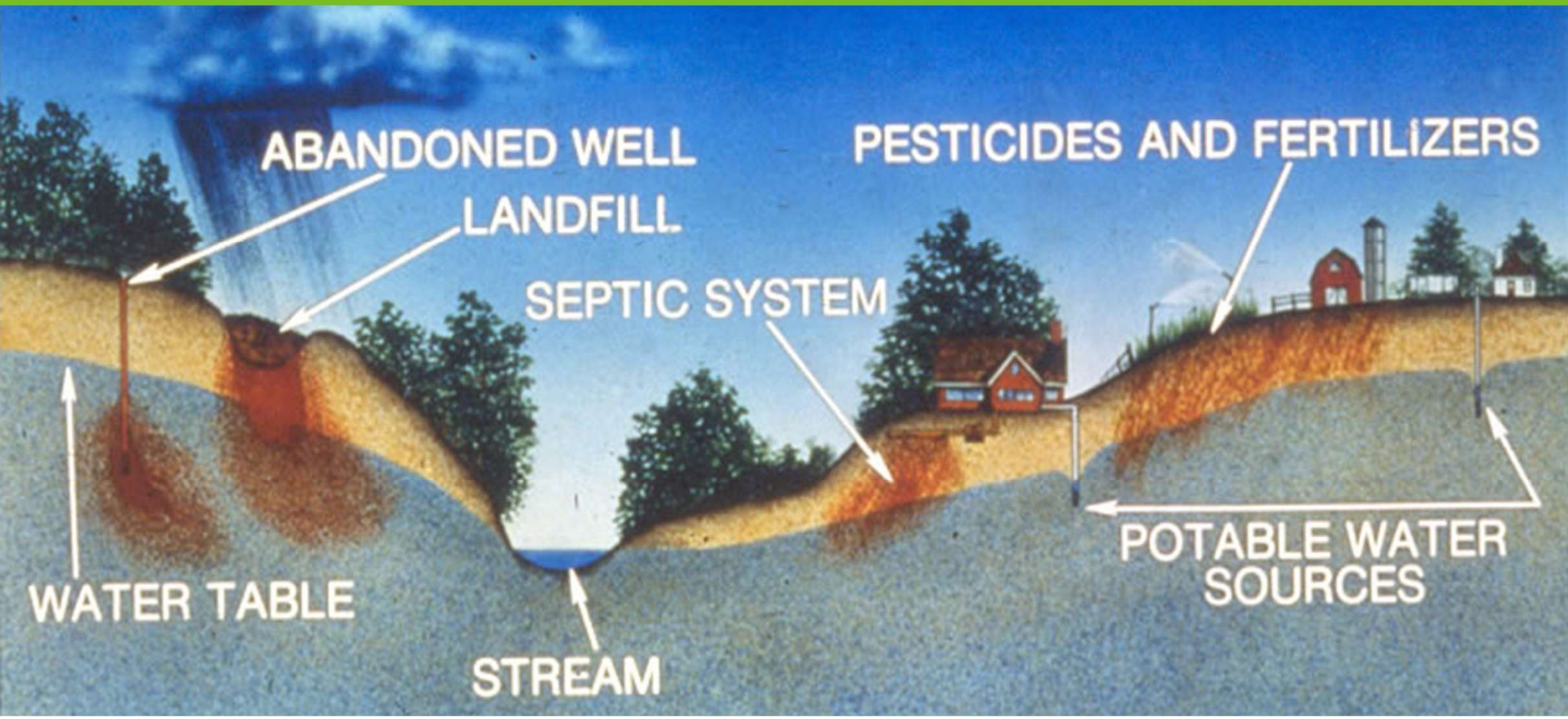
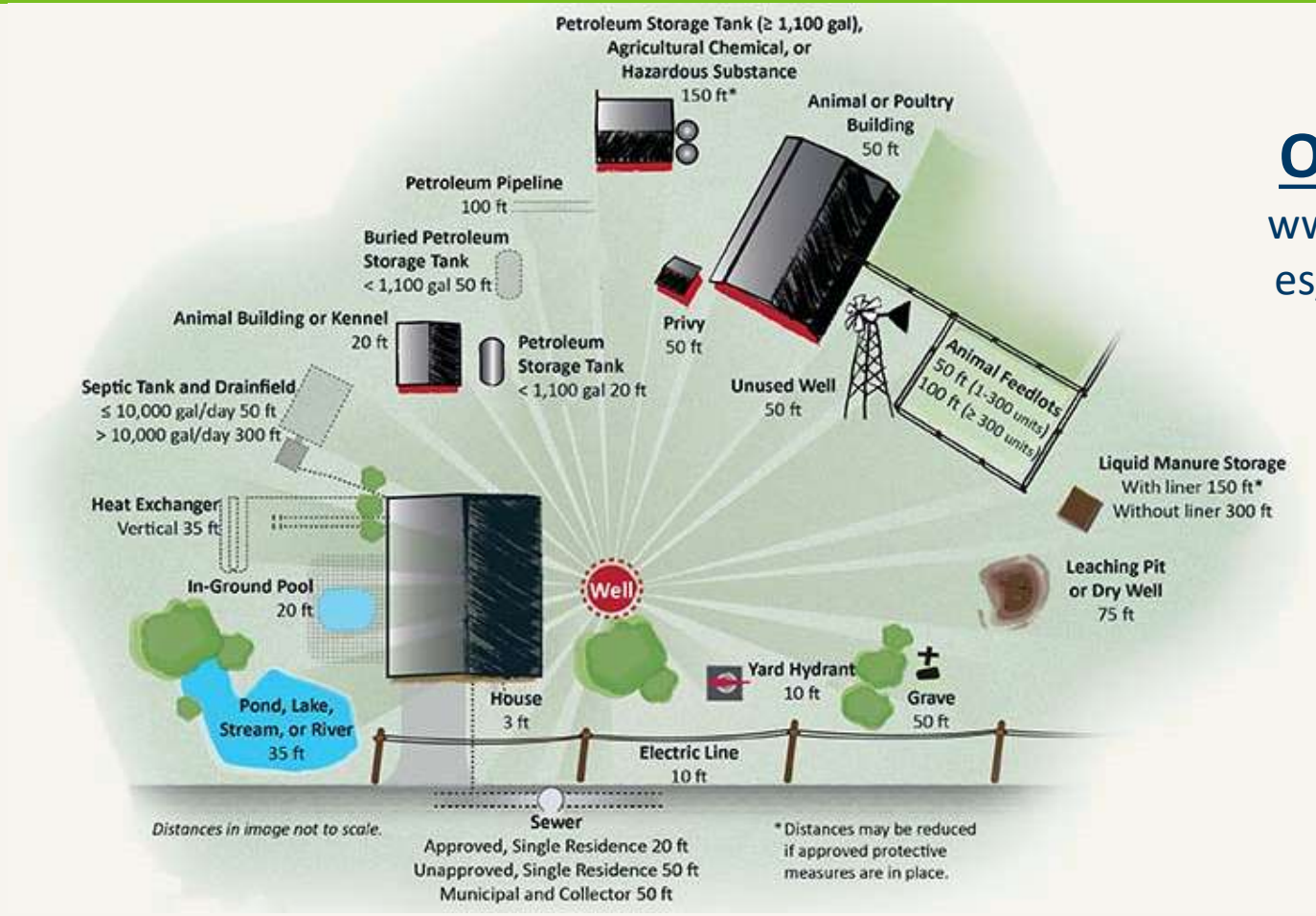
Contamination Sources



Your Wellhead Protection Zone



Owner's Guide to Wells

www.health.state.mn.us/communities/environment/water/wells/waterquality/test.html

Groundwater Contamination

- **Water easily dissolves contaminants** on the ground and carries them downward.
- **Shallow wells and wells near contamination** sources have the most potential to be contaminated.
- **Nitrate is the most common** human-controlled groundwater contaminant and moves readily with water.

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The Good News

- **Soils filter** out most forms of contamination.
- **Confining layers**, such as clay, **limit downward movement** of water and surface contaminants.

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Well and Plumbing Maintenance

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Electrical Conduit Connection

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Wellhead Vent & Screen

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Wellhead/Casing Protection

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Adequate Maintenance Is Needed

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Your Well's Vulnerability- Flooding

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Your Well's Vulnerability- Plumbing Cross Connections

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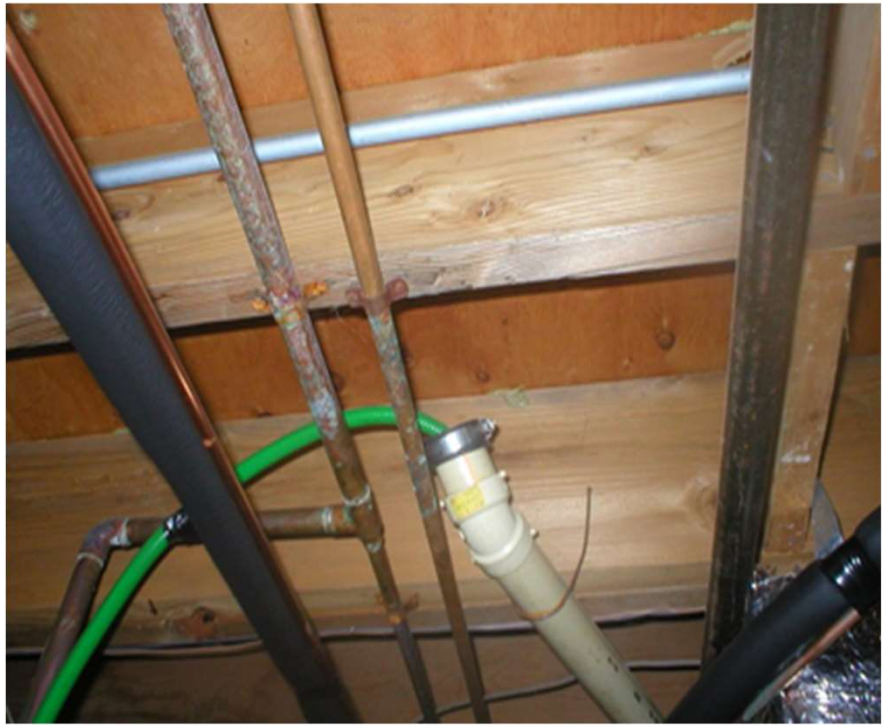
Plumbing Backflow Prevention



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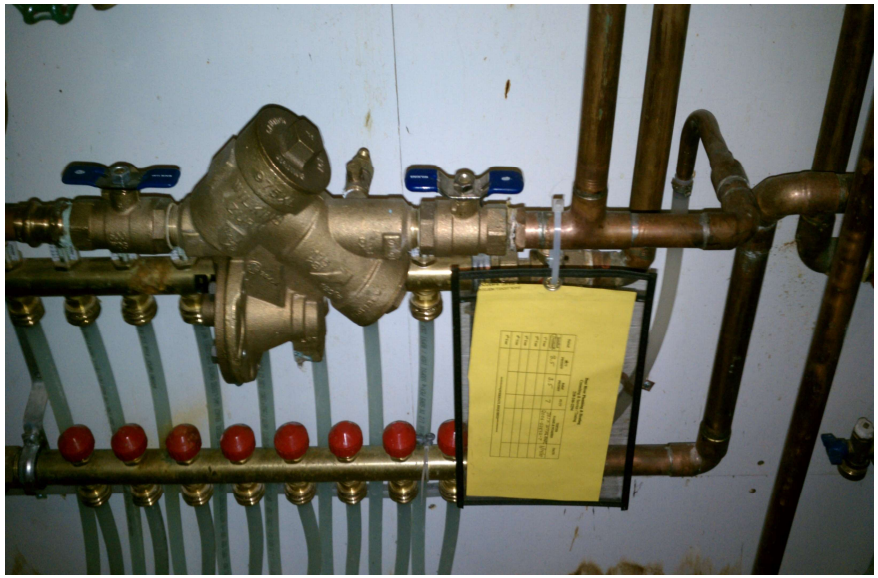
Boiler Backflow Protection



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Water Testing

Protect your health!

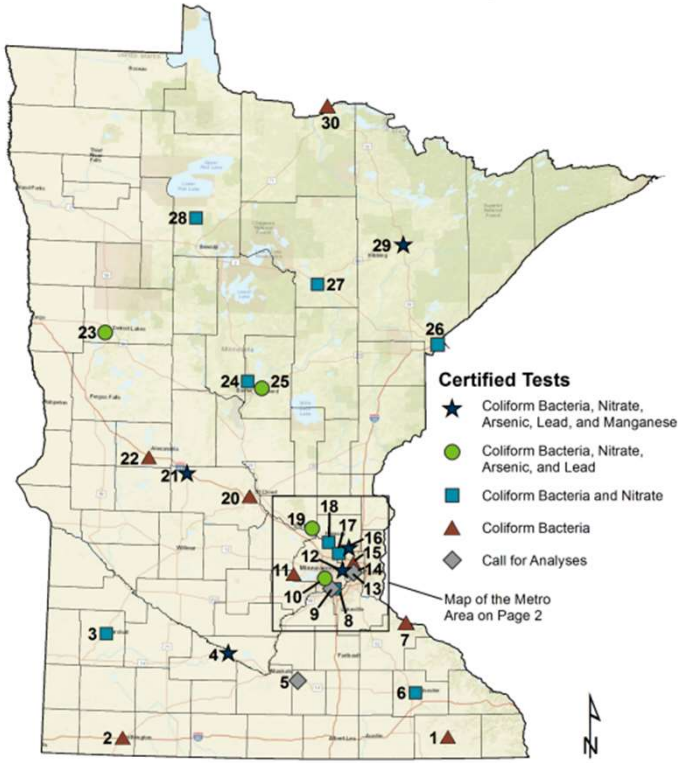
Test your well water for:

- **Coliform Bacteria** (Every year)
- **Nitrate** (Every other year)
- **Arsenic** (At least once)
- **Lead** (At least once)
- **Manganese** (Before a baby drinks the water)

Testing is even more important if young children drink the water.

Find a laboratory

- Ask county environmental or public health services if they provide well water testing.
- **Well Testing, Results, and Options** (www.health.state.mn.us/welltesting)



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Coliform Bacteria

Harmful level: Any coliform bacteria are detected.

Health impacts

- Indicates other infectious bacteria, viruses, or parasites may be in water.
- Pathogens can cause diarrhea, vomiting, cramps, nausea, headaches, fever, and fatigue.

Sources

- Recent work done on your plumbing?
- Well/plumbing damage.

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If Coliform Bacteria are Detected

1. Get your drinking water from a safe source until you address the problem.

2. Inspect your drinking water system.

3. Disinfect your well and water system. Hire a licensed well contractor or use MDH instructions.

Well Testing, Results, and Options (www.health.state.mn.us/welltesting)

Nitrate

Harmful level: Above 10 milligrams per liter (mg/L)

Health impacts

- Bottle-fed infants under six months at highest risk.
- Affects how blood carries oxygen and can cause blue baby syndrome, which can be deadly.

Sources

- Agricultural and residential fertilizer
- Human and animal waste (feedlots/sewers)

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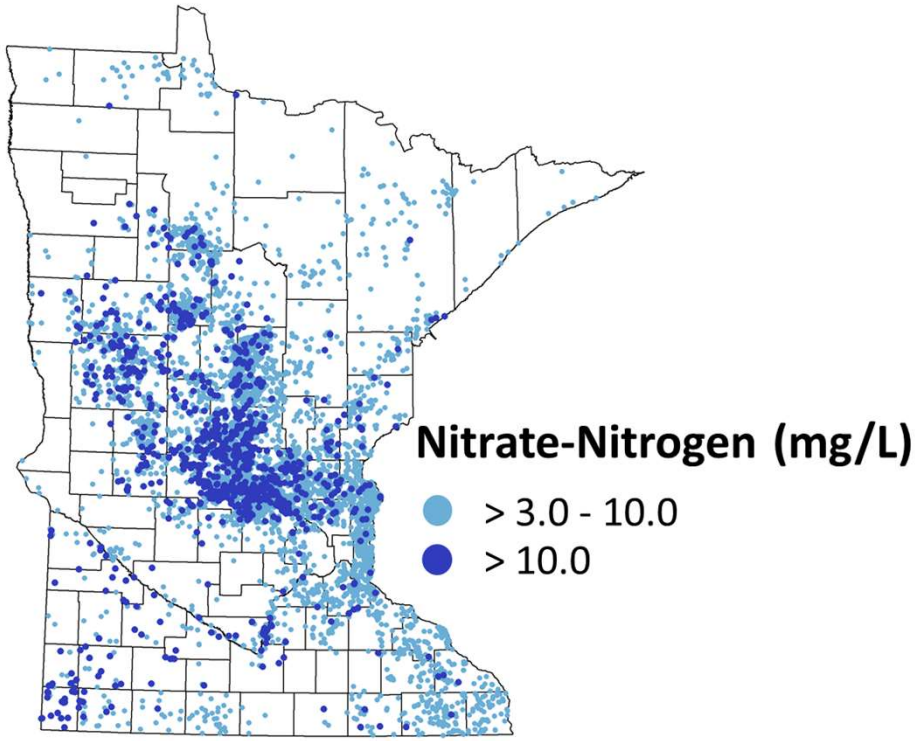
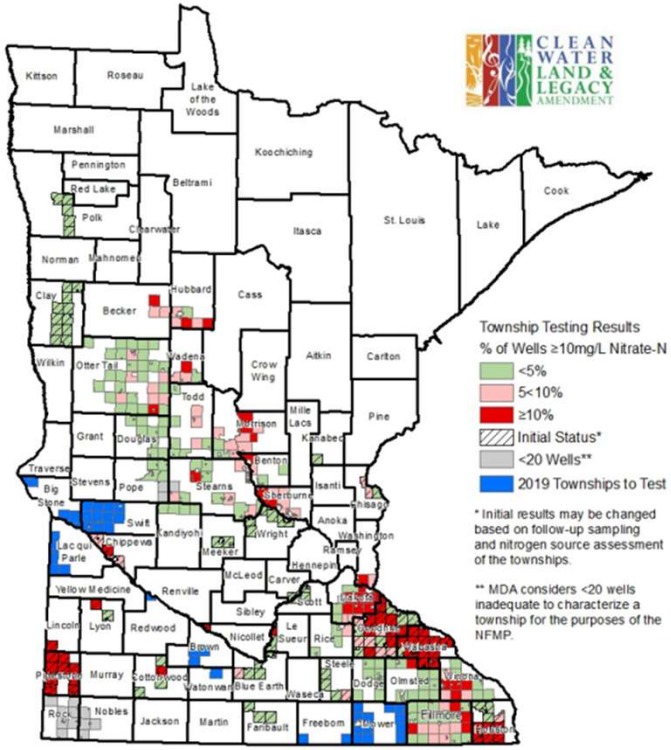
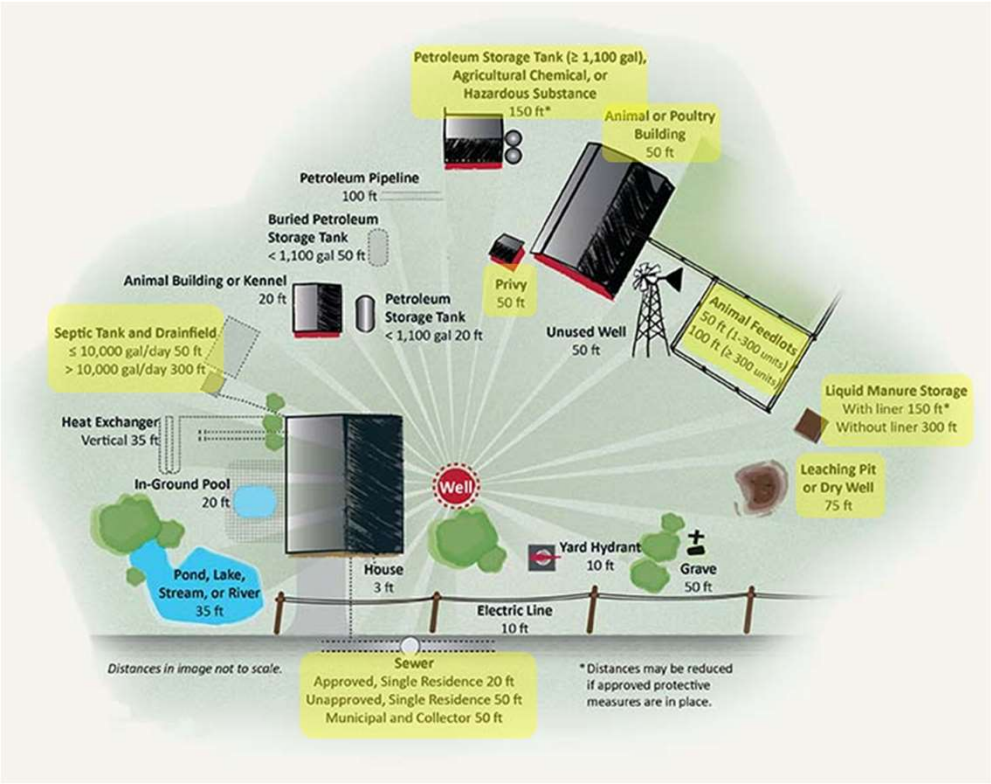
Where Nitrate has Been Detected





If Nitrate is Above 10 mg/L

1. Get drinking water from a safe source until you address the problem.
2. Do not give water to infants under six months.
3. Inspect your drinking water system.
4. Remove potential sources of nitrate near your well
5. Consider drilling a new well or home water treatment (reverse osmosis, distillation, anion exchange



Well Testing, Results, and Options (www.health.state.mn.us/welltesting)

Arsenic

Harmful level: Any level, especially if it is above 10 micrograms per liter (µg/L)

Health impacts

- Risk is from drinking water over a long period of time.
- Increased risk of cancer (bladder, lungs, liver), reduced intelligence in children, diabetes, and heart disease.

Sources

- Occurs naturally in soil and rock
- Formerly used in some pesticides and to preserve wood

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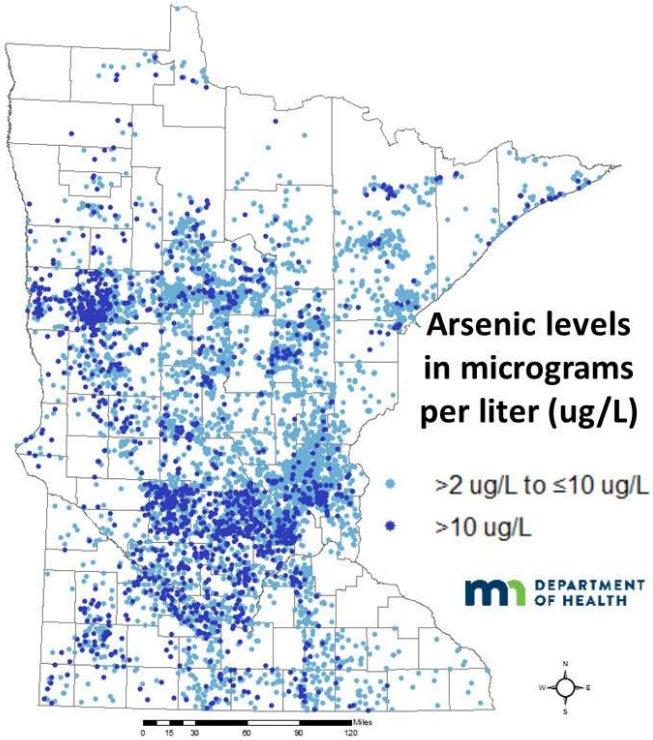
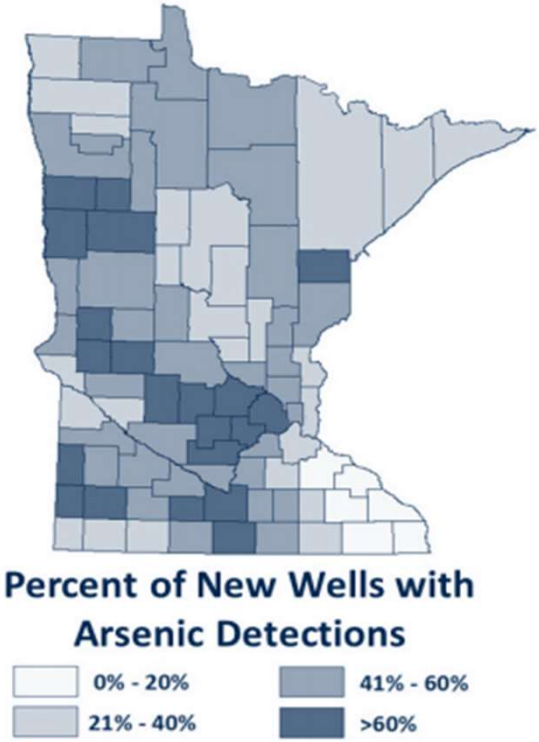
Where Arsenic has Been Detected





Arsenic is in about **4 out of 10 wells** in MN

If Arsenic is Detected

Consider home water treatment

- Reverse Osmosis (RO)
- Distillation
- Adsorptive Media-Iron oxide most common

Well Testing, Results, and Options (www.health.state.mn.us/welltesting)

Lead

Harmful level: Any level

Health impacts

- Babies, children under six years, and pregnant women at highest risk.
- Damage to the brain, kidneys, and nervous system.
- Can slow development and cause learning, behavior, and hearing problems.

Sources

- Lead pipes
- Lead solder
- Brass components faucets and valves
- Lead "packers" above the well screen
- Some submersible pumps manufactured before 1995
- Other plumbing components

If Lead is Detected

1. Let the water run 30-60 seconds
2. Use cold water for drinking and cooking
3. Replace the lead component if possible
4. Home water treatment
   - Reverse osmosis
   - Distillation
   - Some carbon pitcher filters

Well Testing, Results, and Options (www.health.state.mn.us/welltesting)

Manganese

Harmful level

- For babies under one year old: 100 micrograms per liter (µg/L).
- For everyone else: 300 µg/L.

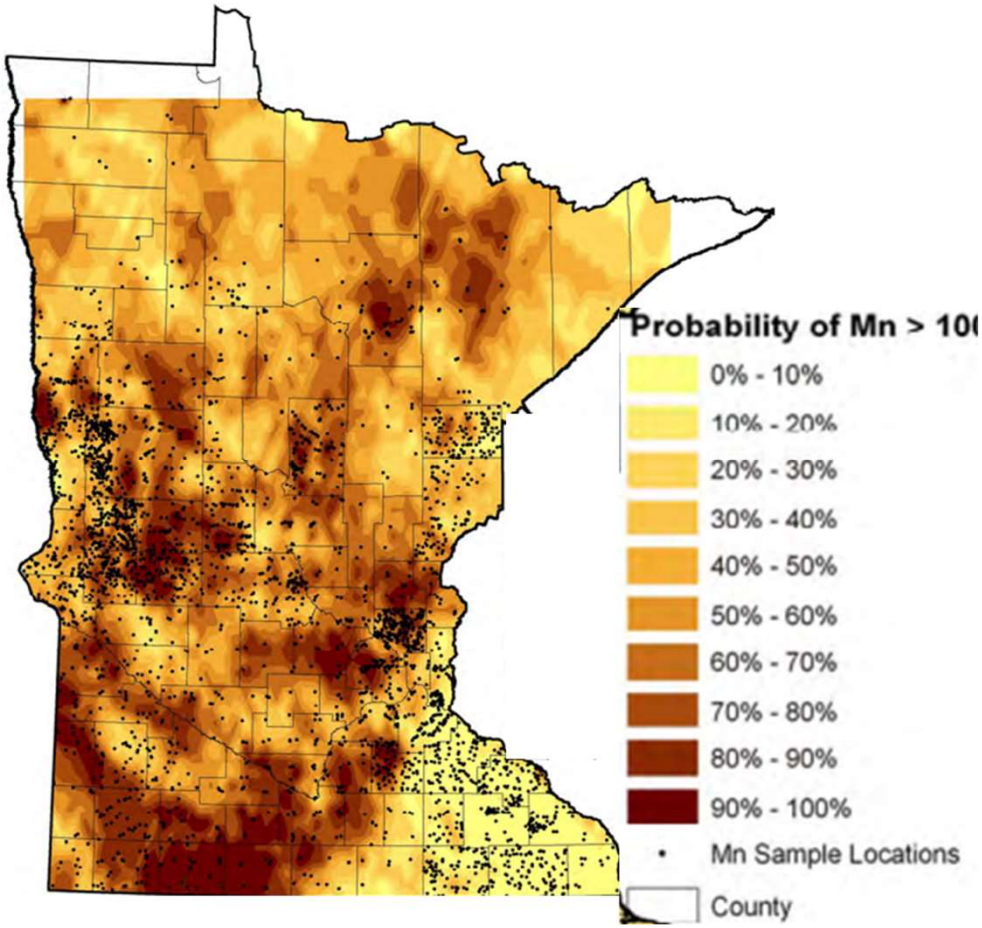
Health and aesthetic impacts

- May stain fixtures black
- Risk is from drinking water over a long period of time.
- Can cause problems with memory, attention, and motor skills.
- Can cause learning and behavior problems in children.

Sources

- Occurs naturally in soil and rock.

Probability of Manganese >100 µg/L



If Manganese Level is Unsafe

1. Use safe water source from making formula or juice for baby
2. Consider home water treatment
   - Water softening
   - Some carbon pitcher filters
   - Distillation

Water Sample Collection

- As close to well as possible from regularly used faucet
- Before water treatment device
- Remove faucet screens and rubber washers
- Flame faucet if possible or disinfect with rubbing alcohol
- Run cold-water tap for at least 5 minutes

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What can I do to help assure I have a good drinking water system?

Contamination entry points

- Groundwater
- Broken or inadequate wellhead construction
- Plumbing components - Lead
- Plumbing cross connection

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Help protect your private drinking water system

Remember TIPS:

T est your water.

I nspect your well.

P rotect your well.

S eal unused wells.

Well Testing, Results, and Options (www.health.state.mn.us/welltesting)

Where can you get information on your well?

Minnesota Well Index

(www.health.state.mn.us/communities/environment/water/mwi)

- Search based on well number, address, township/range/section
- Contact the company that drilled your well

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What can I do to have a good septic system?

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#1 Understand what you have

- Tank or tanks?
- Effluent filter, pump and alarm
- Review your design/as-built
- Contact you county or permitting authority for records
- Ask your installer or pumper

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Septic system maintenance

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Mandatory maintenance

- Clean the tank(s)
- Clean effluent screens
- Check that alarms are working
- Walk the drainfield/mound

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Measuring scum & sludge

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Pumping – tank cleaning

- Remove accumulated sludge and scum layers
- Done by licensed and bonded professional only (MPCA Maintainer)
- Flushing and back flushing is usually required

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Tank pumping

- Only allow cleaning from manholes
- Never from inspection pipes
- Report should be provided to property owner including:
  - date, gallons removed, any tank leakage, the access point used to remove the septage, the method of disposal, the reason for pumping, any safety concerns with the maintenance hole cover, and any troubleshooting or repairs conducted.

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Where does the septage go?

- Majority is a land applied following Federal EPA requirements although some is taken to wastewater treatment plants
- Includes:
  - Limed to raise pH to kill bacteria and viruses or injected below the surface
  - Applied at rates that vegetation can use the nitrogen
  - Setbacks
  - Restrictions on grazing and removal of crops

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Effluent screen cleaning

- Screen is washed off directly into the septic tank
- This is being done at the inlet end of the tank to protect against cleanings going directly out the outlet

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How often?

- As needed – scum or sludge build up
- Impacted by water & product use
- MAXIMUM time period = 3 years without pumping or inspection – state code requirement
- Rule of Thumb
  - Every 1 to 3 years
  - Seasonal home/cabin – same as above

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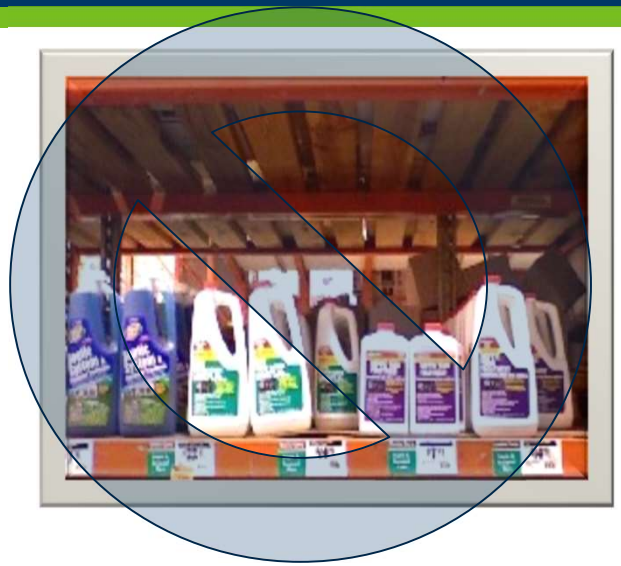
Additives: not needed!!

- Starters - Bacteria are abundant in existing wastewater
- Feeders – Wastewater contains a lot of food for bacteria
- Cleaners - State regulations actually BAN the use of these products in systems
- Never add these products to your system! They can actually damage your soil treatment system



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Pump tank maintenance

- During maintenance confirm that pump is:
  - Accessible
  - Elevated
  - Replaceable
  - Operable
  - Alarmed
- Tank may need pumping if sludge present

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How to hire a Pumper/Maintainer or Inspector

- Word of mouth - referrals
- List of licensed professionals from the local unit of government or go to MPCA website
  - Google “mpca SSTS license search”, select counties nearby
- Response to interview questions over the phone. Do you:
  - Pump through the manhole?
  - Do you have a sludge judge?
  - Backflush?
  - Recommend additives?
  - How much will it cost? Etc.

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Soil treatment system maintenance

- Replace cracked or missing inspection pipe caps
- Channel rain and snow melt runoff away from drainfield
- Inspect regularly for changes

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Soil treatment system maintenance

- Compaction is BAD – keep traffic (vehicles, animals) off system
- Inspection pipes can be cut to ground level after finished grade is established
- Newer mound/pressure systems have cleanouts to flush laterals which should be checked/cleaned at the same time as the septic tank

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Vegetation

- Use plants that prefer dry soils near the septic system, turf grass recommended
  - This will prevent their root systems from interfering with the septic system
  - The larger the plant, the more extensive (through not necessarily deeper) the root system
  - Do not plant edible plants such as vegetables and herbs (need watering and leave bare soil
  - Do not place trees and shrubs on the soil dispersal system

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Vegetation cont'd

- Frame the system with trees and shrubs at a distance, but use only herbaceous (non-woody) plants on the system itself
  - Trees should be planted a minimum of 20 feet from the edge of the mound
  - Trees known for seeking water reservoirs, such as poplar, maple, willow, and elm, should be planted at least 50 feet from the mound
  - Factsheet on website regarding other landscaping options (septic.umn.edu)

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Example problems

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Homeowner tips

What YOU can do to extend the life of your septic system and protect the environment:

- Conserve water
- Time water usage to spread out over day and week
- Be mindful of the products you use and limit cleaners
- Do not use system as a garbage can
- Call your Maintainer/Installer/Service Provider if alarm signals or other problems arise

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Product issues in general

#1 Problem -

- Sanitizing products

- Antibiotic soaps and wipes are now used by 75% of American households
- They have cumulative effects on system performance

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Cleaning Product Labels

- POISON/DANGER: Means the chemical will kill the bacteria, and its use should be minimized or eliminated
- WARNING: Means limited use should have a minimal impact on the system
- CAUTION: Typically means the product will have little effect

Look out for words on labels and choose the least hazardous product.

Less toxic	Caution	mild/moderate
	Warning	moderate hazard
	Danger	extremely flammable corrosive or highly toxic
More toxic	Poison	highly toxic

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Environmental working group

- Non-profit organization
- Has a comprehensive website which rates the full range of household products
- http://www.ewg.org

Know your environment.
Protect your health.
ewg

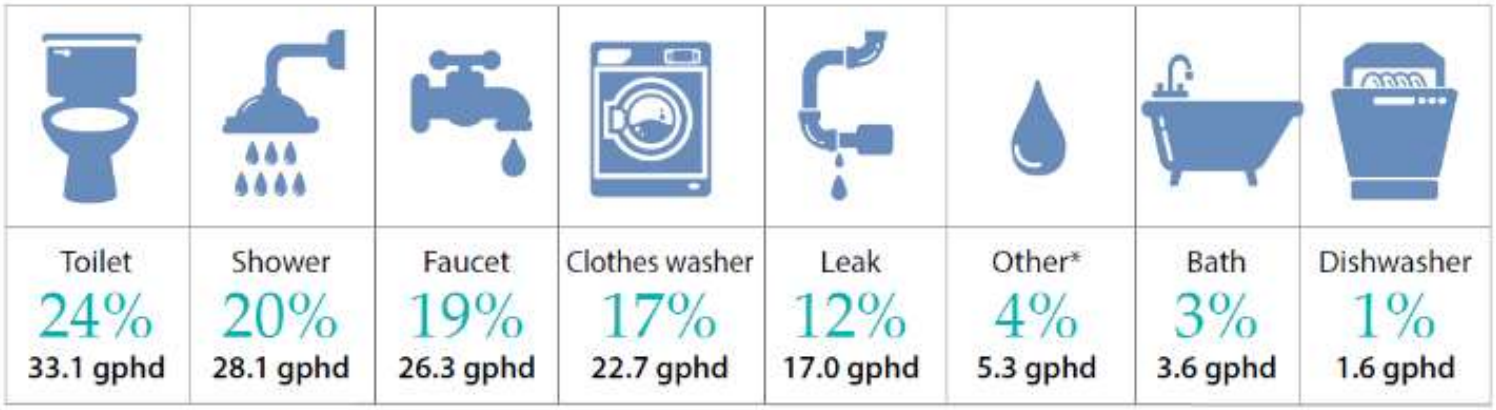
Typical water use

- 150 gallons per day per bedroom
  - Assumes 2 people per bedroom
- 50-80 gallons/person/day
- Annual estimates of use
  - Per person per year = 28,000 gal
  - Typical home ~ 3 persons = 70,000 gal/yr
  - 250 homes in a township = 15 million gallons/year

Where do we use it?

1. Bathroom = 57%
   - Toilet = 24%
   - Bathing = 23%
   - Faucets = 10%
2. Laundry = 17%
3. Leaks = 12%
4. Kitchen = 11%

Figure 1. Indoor household use by fixture



* The "Other" category includes evaporative cooling, humidification, water softening, and other uncategorized indoor uses.

DeOreo, et al. Residential End Uses of Water. 2016.

Toilet - 24%

- Replace old 5+ gallon flush toilets
- Recent advancements allow toilets to use 1.28 gallons per flush or less while still providing equal or superior performance
- Fix leaking problems
  - Gaskets & “running”

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Recommended toilet cleaners

- NOT automatic sanitizers
- Small amount with "elbow grease"
- Sprinkle baking soda or Bon Ami, then scrub with a toilet brush
  - Bon Ami is non-scouring, biodegradable, nontoxic and hypoallergenic
- Lime and hard-water deposits can sometimes be removed with hot white vinegar, Bar Keepers Friend, Shaw's pad or a pumice stick

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What should go in the bowl

- Toilet paper
- No lotions
- No wipes
- Human waste
- Nothing else! No kleenex, q-tips, cigarettes, hair, cotton balls, wipes, condoms, feminine products, unused medication

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Septic safe?

- Even if items are marked as "septic safe" do not flush them
- For example, some wipes, toilet bowl cleaners and cat litter may be labeled this way
- In many instances it means they will flush

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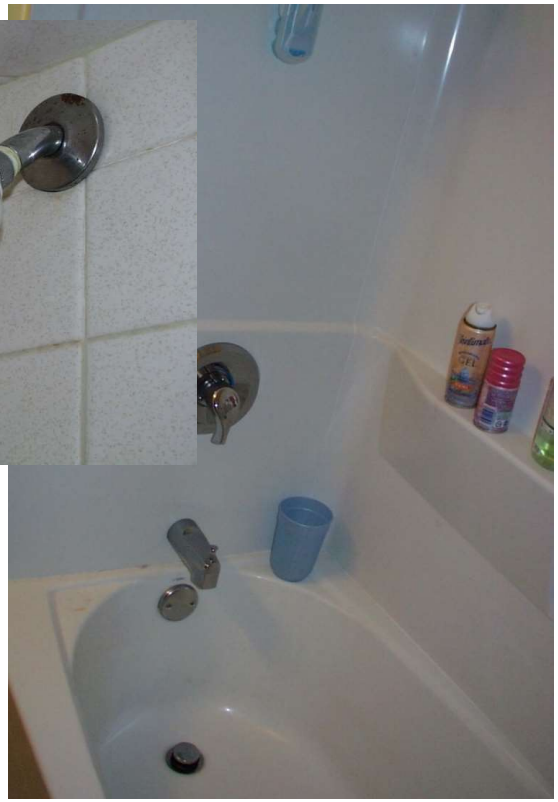
Bathing – 23%

- Fix leaks
- Use low flow fixtures
- Avoid daily cleaners
  - Daily cleaners are hard on system
- Avoid anti-bacterial soaps
  - NO more effective than regular soap
- Limit shaving, bath oils
- Liquid soaps tend to be overused



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Drain cleaner recommendations

- Use adequate catch basins in all drains from sinks, showers, tubs, laundry, etc.
  - Inexpensive metal or plastic drain screens
- When drains do plug usually in trap below sink
  - Take it apart, use a plunger or snake
- Call a professional
- DIY
  - Pour 1/2 cup salt and 1/2 cup baking soda down drain
  - Then, pour 6 cups of boiling water after it
  - Allow to sit overnight and then flush with hot water

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Laundry – 17%

- Install front loading machines
  - –65% less water
  - –12 – 20 gallons
  - –Less electricity to dry clothes
- Spread out loads
  - –think even
  - –throughout week
  - –throughout day

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Laundry continued

- Add a washing machine lint filters:
  - Washing clothing releases a lot of lint much of which is inorganic
  - Options:
    - Simple screen/pantyhose on discharge line
    - Purchase an after market lint filter

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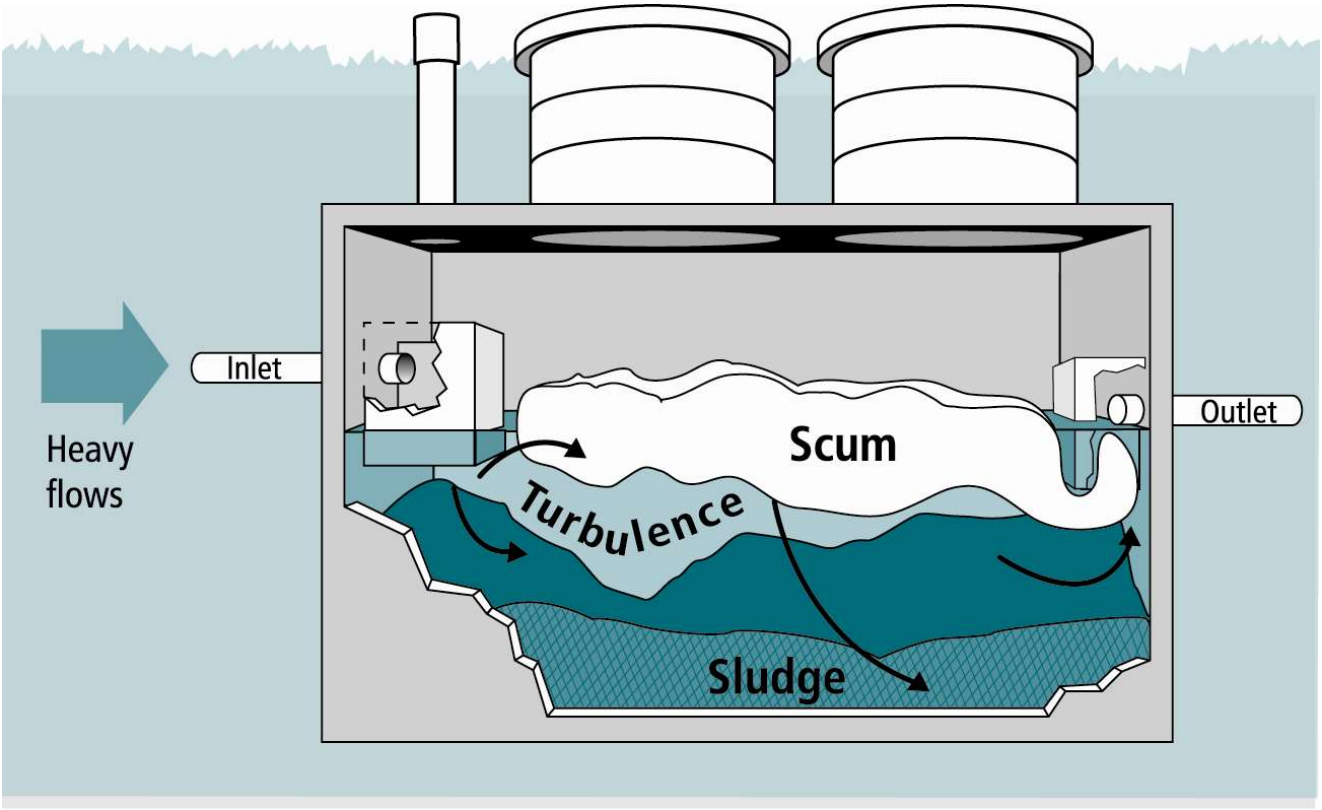
Problem with high flows



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Laundry soap, bleach and liquid fabric softeners

- Limit bleach (less than 1 load/week)
- Limit detergent to the minimal amount need to get clothing clean (start with ½)
- Inexpensive powders contain clay as a filler

- Do not use liquid fabric softeners
  - Petroleum, salt based sanitizer
- Can cause tank to not naturally stratifying into 3 layers
- Recommendations:
  - Add a ½ cup of baking soda or vinegar or both
  - Drier balls
  - Anti-static- aluminum foil ball

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Kitchen – 11%

- Pods for laundry and dishwasher?
  - May use more soap than you need
  - No studies to date on the pod material

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Dishwashing - 1%

- **Dishwasher**:
  - Full loads
  - Detergents
    - Low P
    - New gels – less filler
  - Scrape plates
- **Sink**:
  - Rinsing
  - Leaks
  - Fats and Oils are solid waste!

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Garbage disposal

- Problems:
  - Adds more solids
  - Undigested food
  - Chopped into small pieces
  - More water
- Recommendation:
  - Don’t install one
  - Don’t use it if you have one
- Requirements:
  - Requires 50% more septic tank capacity
- INCREASES THE NEED FOR CARE and MAINTENANCE

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Other sources of water that should not go into the septic system

- Sump pump/tile line discharge
- Dehumidifier discharge
- High efficiency furnace discharge
- Roof runoff
- Dripping faucets/"running toilets"
- Any other sources?

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Water softener discharge

- Less chloride into your septic system is better
- Replace old units to reduce discharge amount and concentration
- Have you water softener set appropriate for your hardness and service every 5 years (maximum)
- If possible, route out of system:
  - Separate drainfield/rock pit
  - Surface (can have freezing and vegetation issues)

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Other water treatment devices

- Iron filters – divert out of septic system whenever possible due to solid nature of iron filtrate, if not pump more often
- Reverse osmosis – only really an issue with whole home systems (~3 gallons of wasted water for every gallon of clean water made)

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Smell your septic system?

- Outside:
  - Raise vent stack
  - Charcoal or carbon filter on stack
    - Can freeze as catch condensation in winter
    - Lasts about 1 season
- Inside:
  - Plumbing problem
    - May be frozen vent or dry trap
    - Seals on sump pumps & baskets

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Freezing of septic systems

- Causes
  - Lack of cover, compaction, irregular system use, leaking plumbing, cold air into system, poor drainage
- Remedies
  - Figure out why and where; fix the problem
  - May need to use tank as a holding tank
- Prevention
  - Let your grass grow long in late summer-Labor Day, mulch (or styrofoam), use extra warm water, fix leaks

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Insulation blankets

- If installed prior to freezing conditions trap the heat of the soil and reduce freezing problems
- Waterproof, it sheds late fall rain and holds snow for added insulation

Seasonality issues

- Better to pump tanks in the late spring to early fall
- Very low use in winter – use tank as a holding tank?
- Leave furnace on? – may have issues with high efficiency furnace
- See section of website on seasonal care

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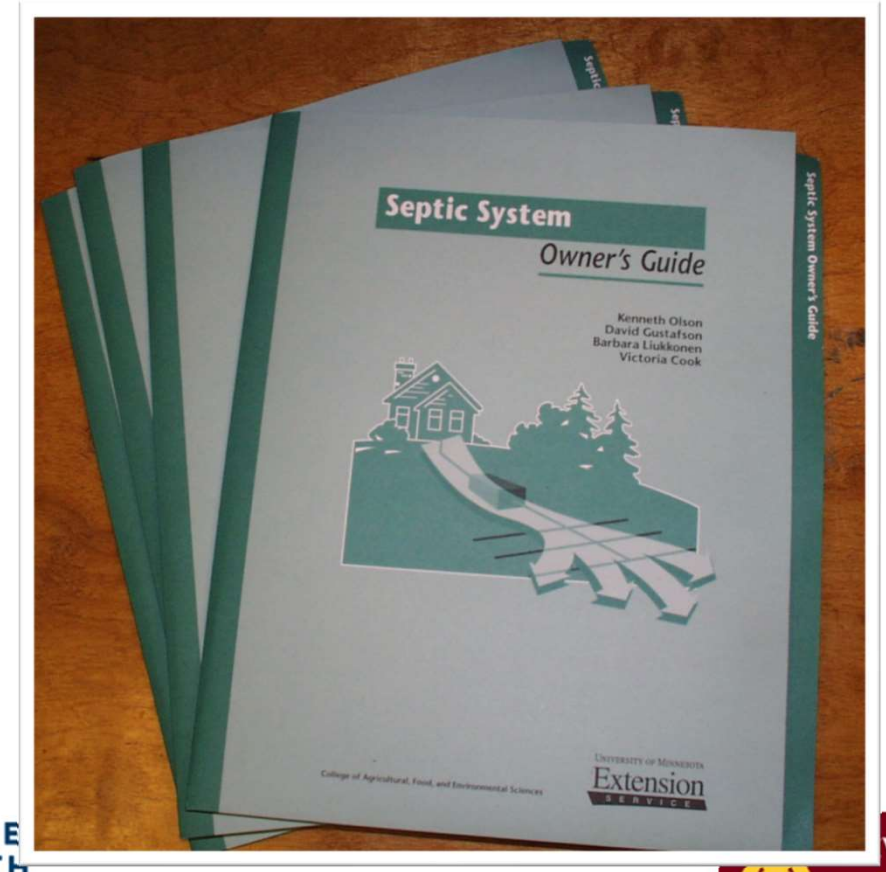
Septic System Owner's Guide



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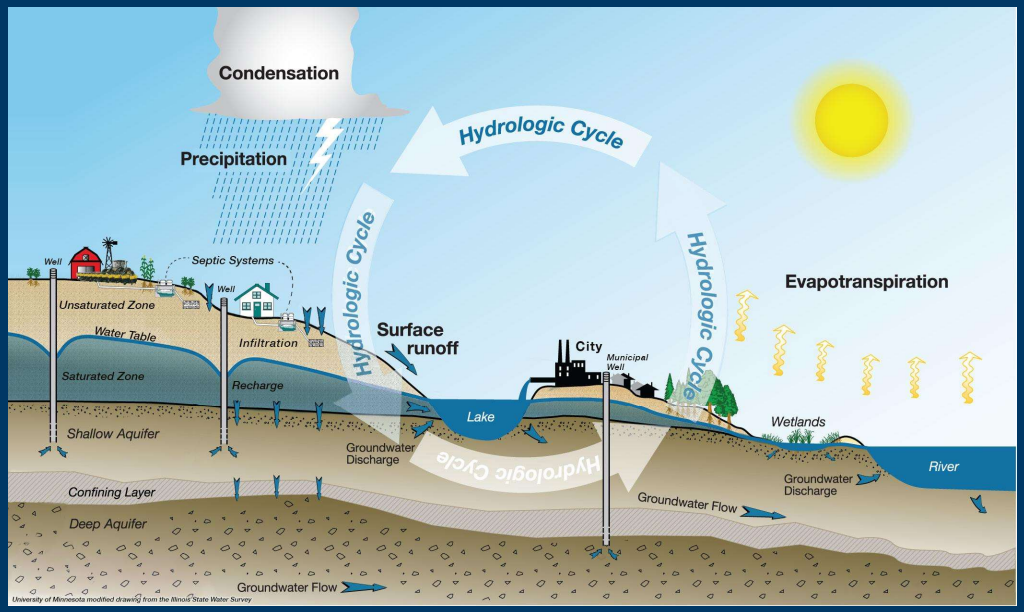

What can YOU do to help protect OUR water?

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What can you do?

- Water conservation
- Properly operation and maintenance your septic and well systems
- Proper disposal of unused pharmaceuticals and hazardous waste
- Be informed and get involved

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Well testing kits

- Must complete survey
- One per household – must be present
- Only take one if you can return it on the required date/time – 3/19/20 by 12:30 PM
- Test includes bacteria, nitrate and arsenic
- Carefully read collection instructions
- Samples must be dropped off at Anoka County Government Center, Environmental Services, 2100 3rd Ave, Suite 600, Anoka, MN 55303

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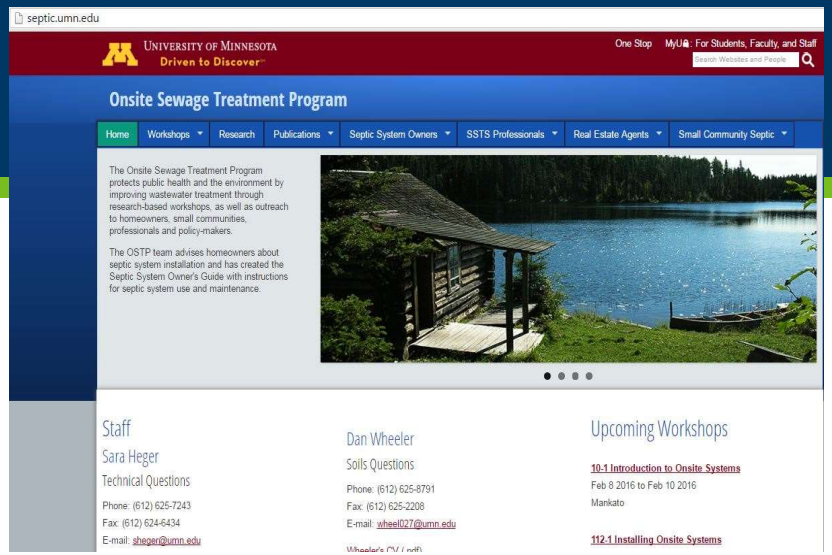
Additional resources



Wells and Borings

www.health.state.mn.us/wells

Septic Systems

www.septic.umn.edu/

EPA CEC program
http://bit.ly/29PUcFv

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Questions?

sheger@umn.edu
Sara Heger

jeff.grugel@state.mn.us
Jeff Grugel