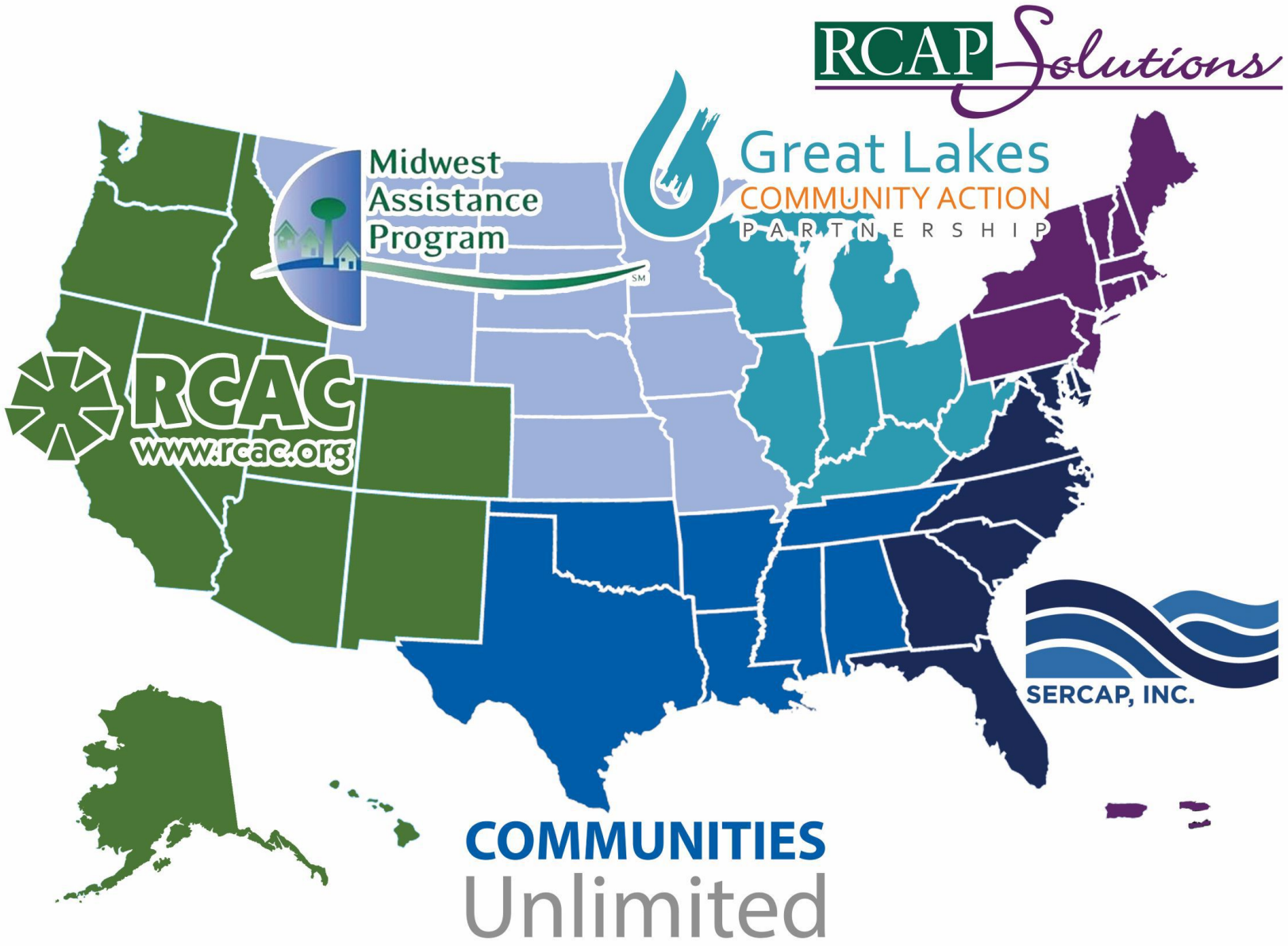
Septic 101

Please complete your pre-test NOW

RCAP Solutions Massachusetts

RCAP Solutions

Today's Presenters: RCAP Solutions

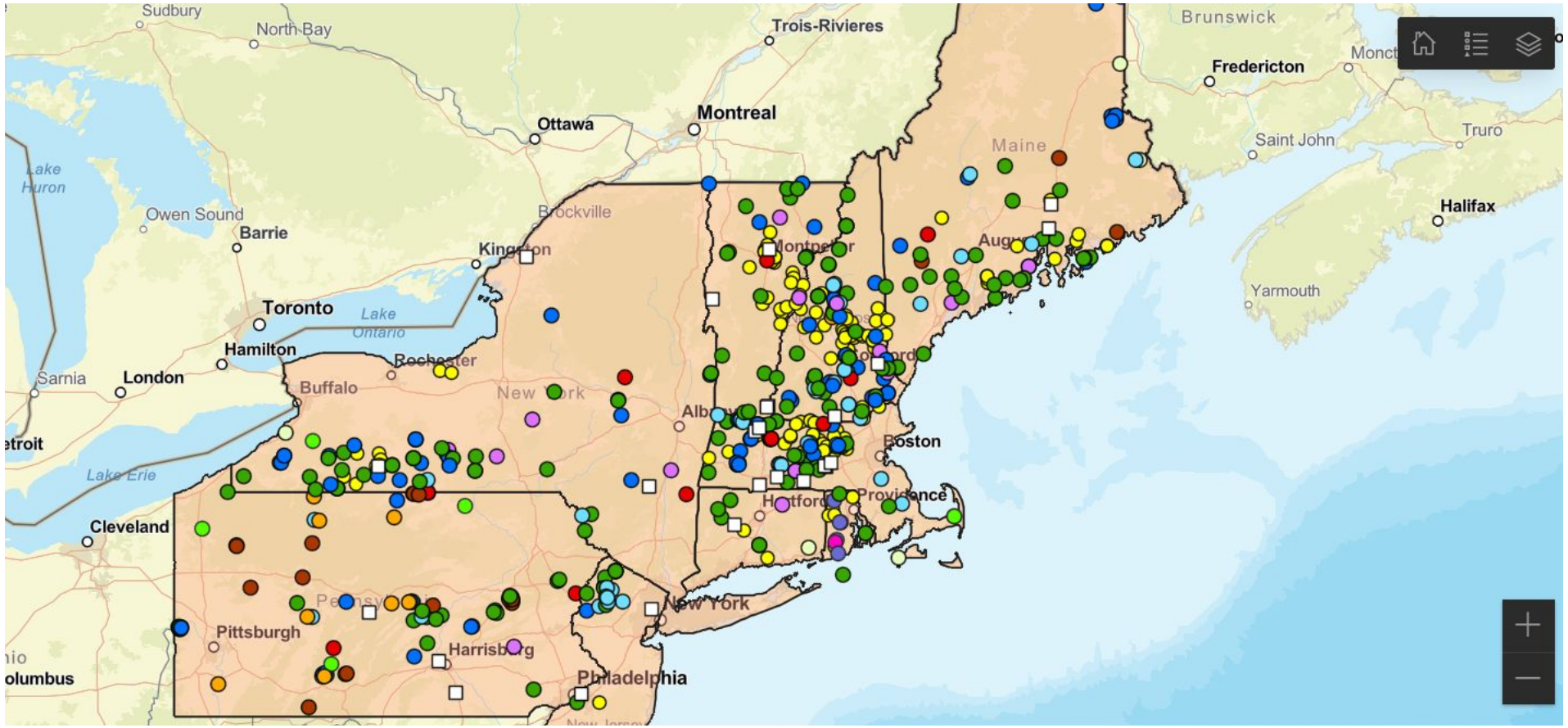


Rebekah Novak, E.I.T.
Water Compliance Specialist (MA)
rnovak@rcapsolutions.org

Andrew Evans
Environmental Technician
aevans@rcapsolutions.org

https://rcapnational.maps.arcgis.com/apps/webappviewer/index.html?id=61b5505cf4fb4026ac6cf1345321b1e8

RCAP Solutions Impact



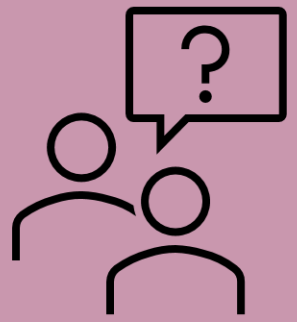
RCAP Solutions

Acknowledgement

This project has been funded wholly or in part by the United States Environmental Protection Agency under an EPA Training and Technical Assistance for Small Drinking Water Systems to Achieve and Maintain Compliance.

The contents of this document do not necessarily reflect the views and policies of the Environmental Protection Agency, nor does the EPA endorse trade names or recommend the use of commercial products mentioned in this document.

RCAP Solutions



How long have you been in the Wastewater/ septic System field?

1. 0-5 years
2. 5-10 years
3. 10-15 years
4. 15-30 years
5. Over 30 years

RCAP Solutions

Wastewater Basics, Biology & Solids

RCAP Solutions

"Improving Rural Quality of Life"

Wastewater Terms

Temperature, pH, Alkalinity

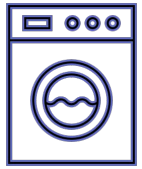
Organic/Inorganic

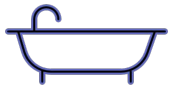
BOD

TSS

Nitrogen

Phosphorus





RCAP Solutions

Greywater

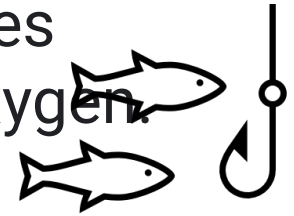
- Water from sinks, showers, washing machines
- Has not come in contact with human waste
- Contains traces of food, grease, hair
- Cleaning products
  - Body care
  - Dish detergent
  - Laundry detergent
  - Bleach/antibacterial cleaners
- Leachfield may still be needed for safe treatment and disposal (MA)

RCAP Solutions

How does temperature affect Wastewater?

In general, microbial activity increases as the temperature increases.

Warm wastewater causes microbial activity to increase and generally require more oxygen. Conversely microbial activity decreases at lower temperatures slowing the rate of treatment requiring more time for treatment but less oxygen.

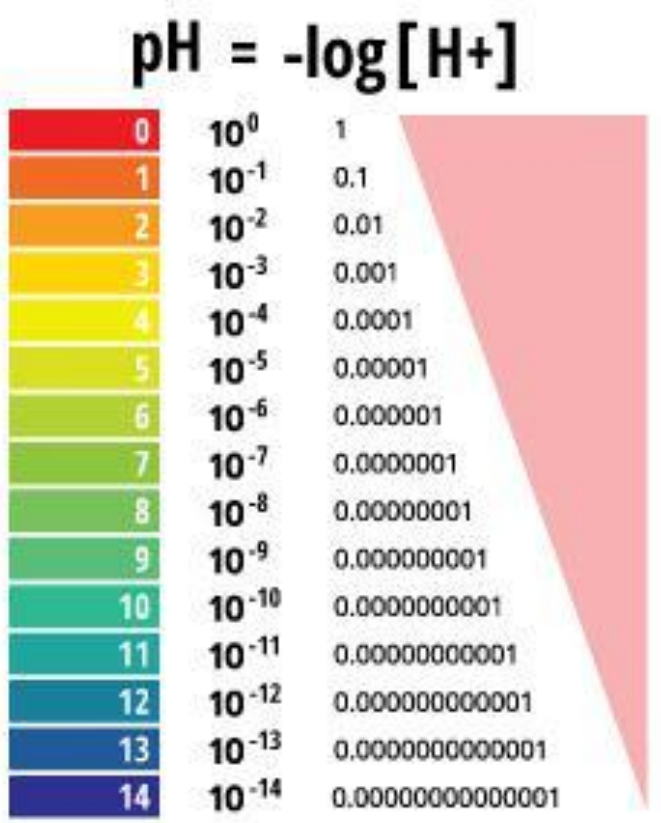


[And Don’t forget the frost-line!]

pH

The term “pH” refers to how acidic or basic (alkaline) a solution on a **logarithmic** scale, or the hydrogen ion [H+] concentration

- *a pH of 4 is TEN times more acidic than a pH of 5*
- A pH of 4 is ONE HUNDRED times more acidic than 6



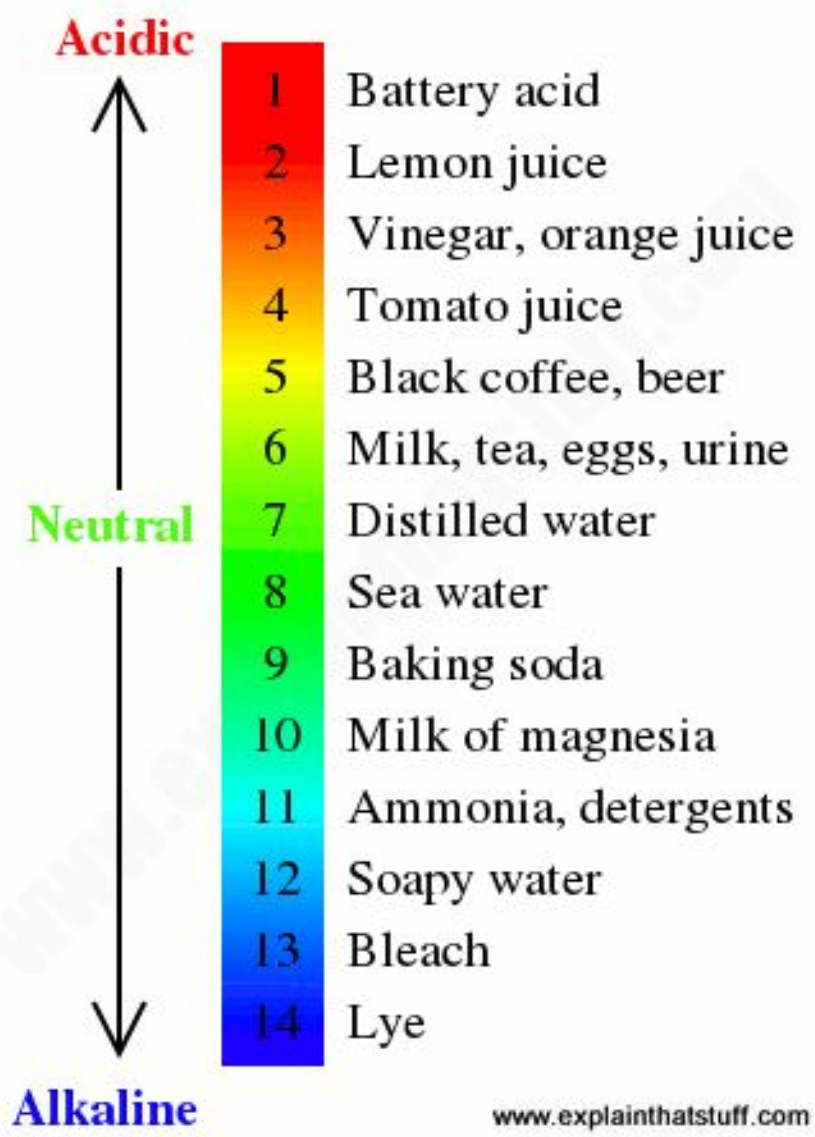
RCAP Solutions

Corrosion

RCAP Solutions

Alkalinity:

- A water's resistance to change in pH
- The **buffering capacity** or the ability of the water sample to **neutralize** acids and bases and maintain a fairly **stable** pH level.
- Measured by how much acid can be added to a liquid **without causing a large change** in pH. The higher the number, the more **resistant** it is to a change in pH



RCAP Solutions

Organic & Inorganic Solids

Organic Solids

- Contains *Carbon*
- Decomposed by bacteria in the presence of oxygen
- Large molecules are broken into smaller molecules and eventually into carbon dioxide and water

$Example: \mathbf{C}_6H_{12}O_6$

Inorganic Solids

- Do NOT contain carbon
- Dissolved inorganics flow to the leachfield, settled inorganics are stored in the septic tank until it is pumped
- *Sand, silt, minerals, phosphates, some forms of nitrogen, metals*

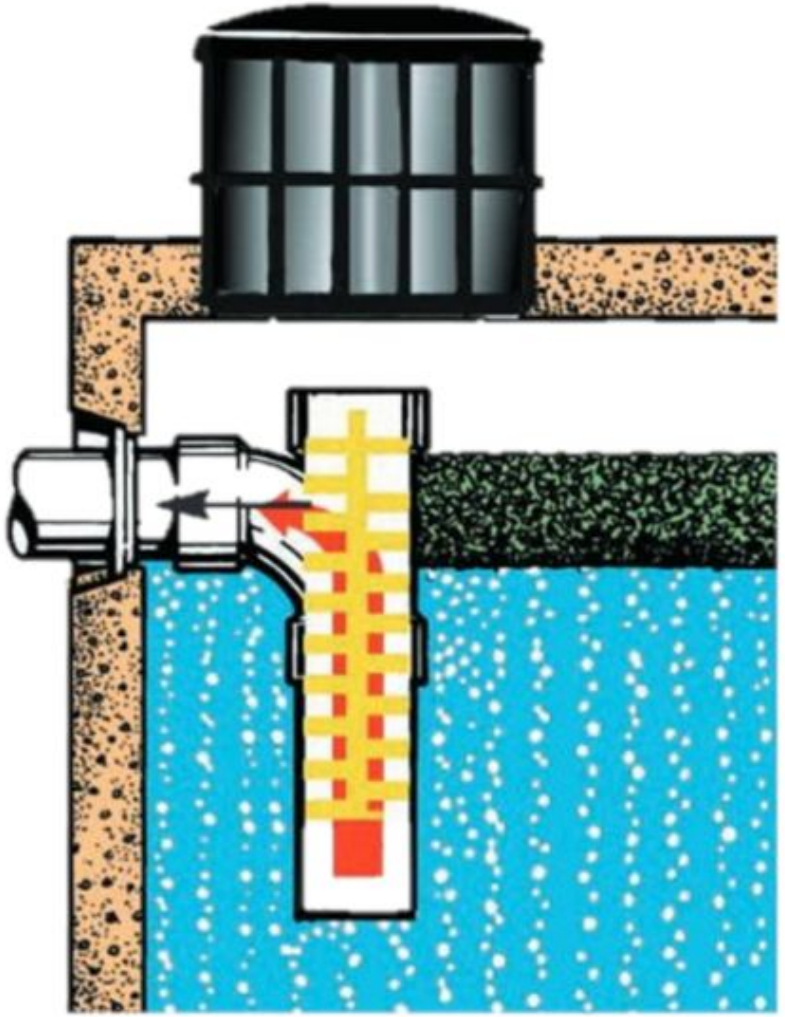
$Example: N_2$

RCAP Solutions

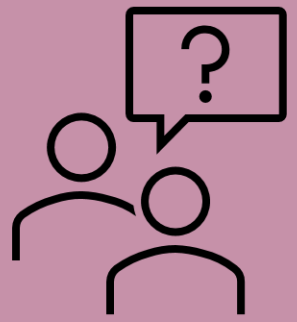
TSS

Total **S**uspended **S**olids

- Organic and inorganic
- “Suspended” – neither sink nor float
- Carried with the wastewater to the leachfield
- Can clog the small pore spaces between the soil grains in the leachfield
- Reduced by settling compartments, effluent filters or sand or other media



RCAP Solutions

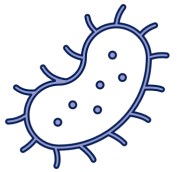


"*Organic*" implies that _____ is present:

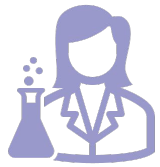
1. Phosphorus
2. Carbon
3. Nitrogen
4. Oxygen

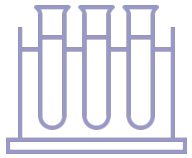
RCAP Solutions

BOD

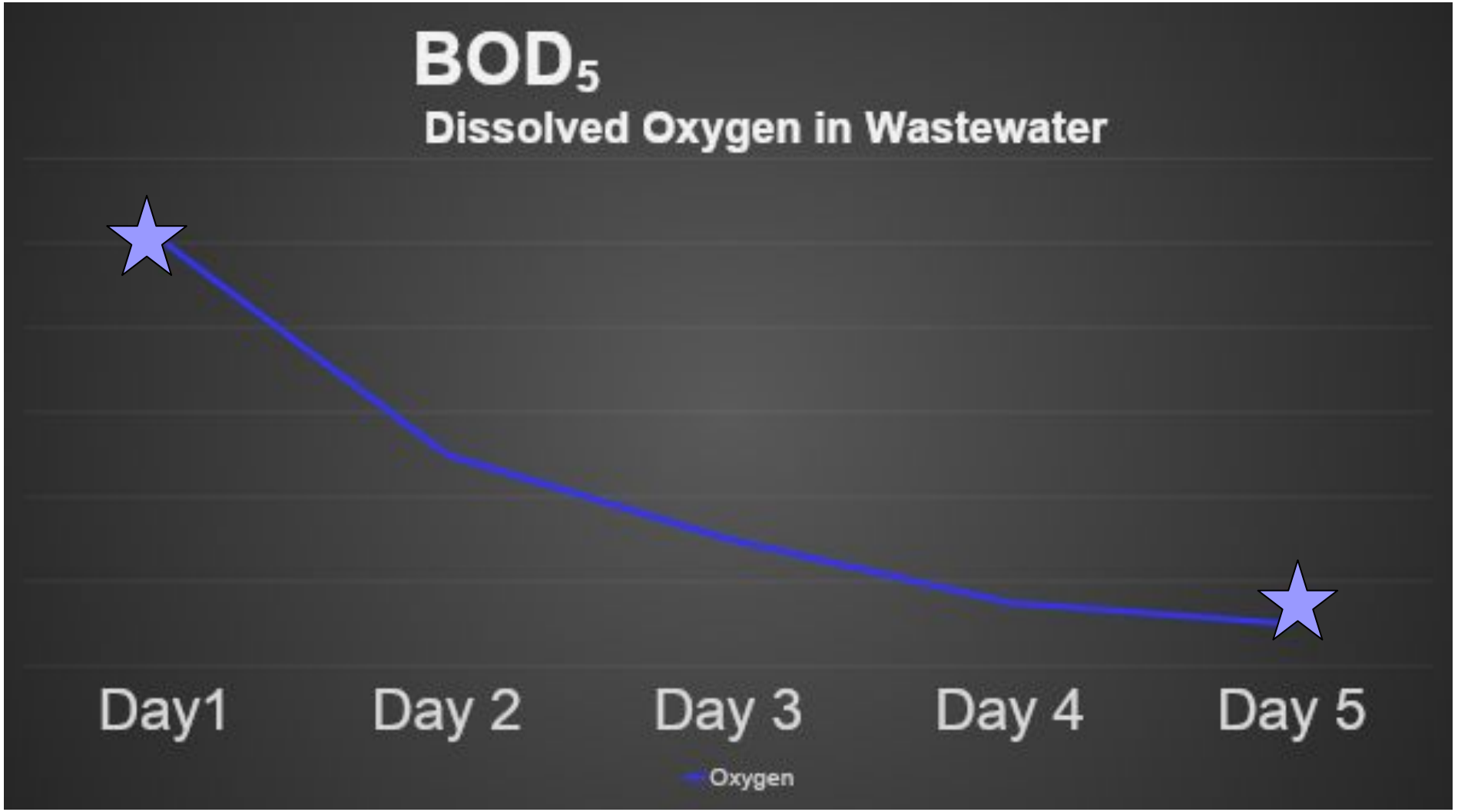


- **B**iological/**B**iochemical **O**xygen **D**emand **(BOD)**
- The amount of oxygen consumed by bacteria while they remove waste **organic** matter in the process of decomposition (by **aerobic** bacteria)
- lots of organic matter =lots of oxygen needed and consumed
- BOD is considered food for Aerobic Bacteria
- Units = mg/L, or milligrams per Liter
- The difference in dissolved oxygen in a sample between day 1 and day 5
- With food and oxygen, bacteria will reproduce, creating more bacteria to continue breaking down waste



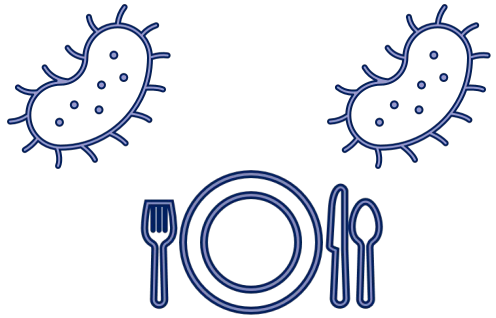


RCAP Solutions



RCAP Solutions

BOD = Food



- Used to measure/express the strength of waste
- Food source for microbes that break down waste
- Typical household wastewater is 200-300 mg/L
  - ≈ 65-95% is removed in a well functioning septic system

- "High strength waste" = high BOD = lots of oxygen needed/consumed to break down the organic waste

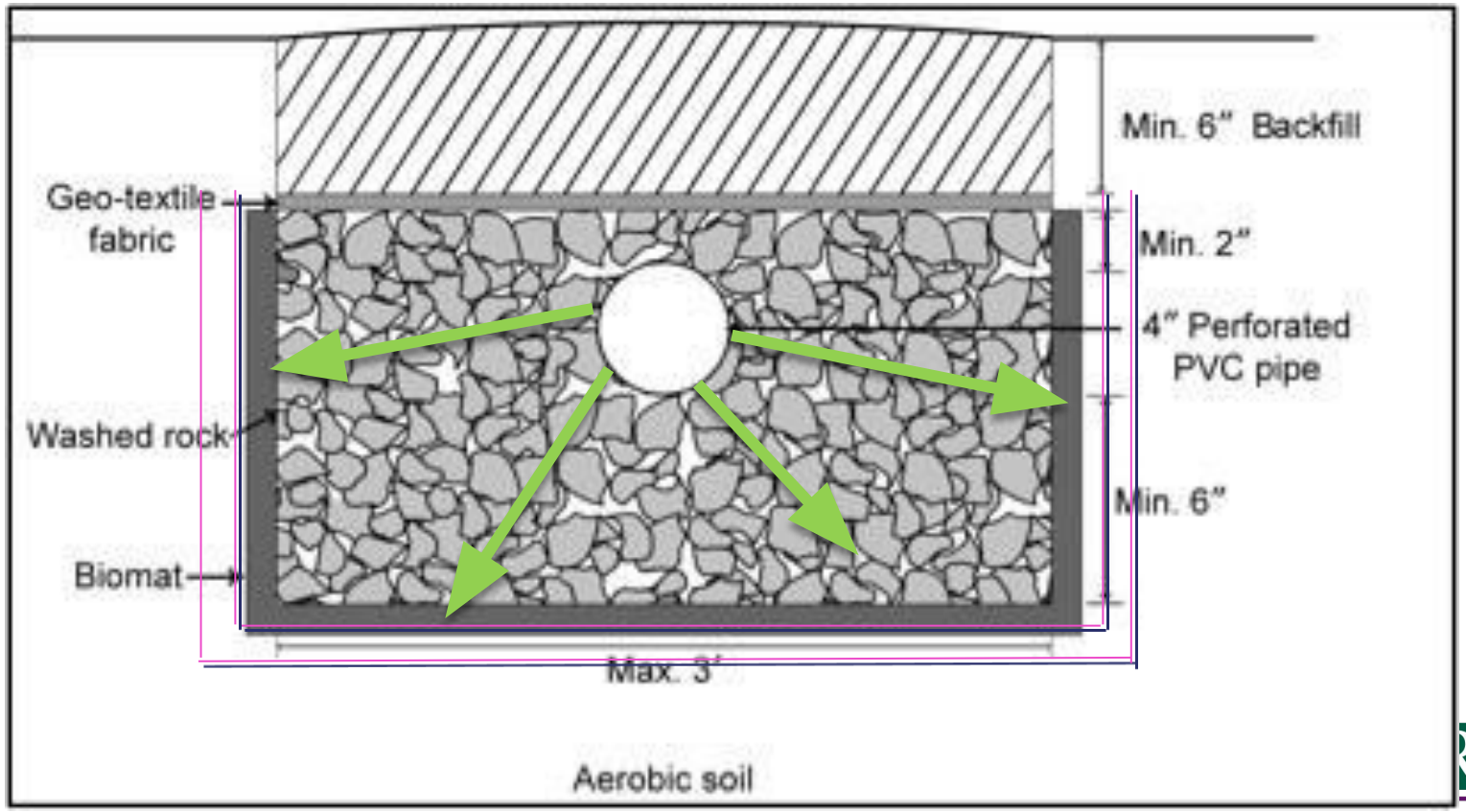
RCAP Solutions

Biomat / Zoogleal Film

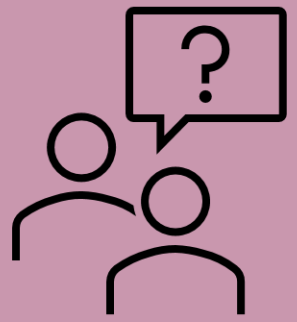
- Slimy permeable layer that forms on surfaces (dirt, sand, or media) made up of partially decomposed organic waste and bacteria.
  - The slime is a chemical compound secreted by bacteria to anchor themselves
  - Aerobic bacteria grows on the surface (uses oxygen to stay alive)
  - Anaerobic bacteria grows on the inside

RCAP Solutions

Leachfield Biomat



RCAP Solutions



What does TSS stand for?

1. Total Solids Separation
2. Total Soil Saturation
3. Transitional Soil Section
4. Total Suspended Solids

RCAP Solutions

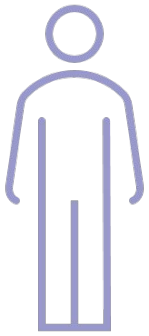
Nutrients

RCAP Solutions

Nitrogen : Organic & Inorganic

Ammonia: NH_4
Nitrite: NO_2
Nitrate: NO_3
Nitrogen gas: N_2

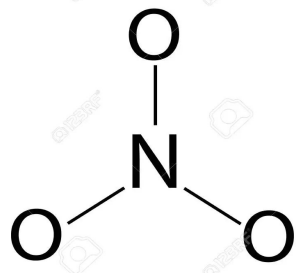
- Dissolved Nitrogen
- Most nitrogen excreted by humans is **organic** nitrogen
- **Organic** nitrogen is converted to **inorganic** nitrogen (ammonia) by bacteria in the septic tank
- The goal is to remove inorganic nitrogen from wastewater using bacteria to convert ammonia to nitrate then to nitrogen gas, N_2.
- Nitrate can enter drinking water wells and cause serious health effects



RCAP Solutions

Nitrate-nitrogen - NO_3

- Occurs naturally in soil and water
- Sources of excess nitrate: fertilizers, on-site sewage system, wastewater treatment effluent, animal wastes, industrial wastes, and food processing.
- High levels of nitrate in water can pose a potential health risk
  - Infants' digestion does not excrete the nitrogen and so oxygen in the blood does not get carried to vital tissues of the body. This can lead to *Methemoglobinemia or “blue baby syndrome.”

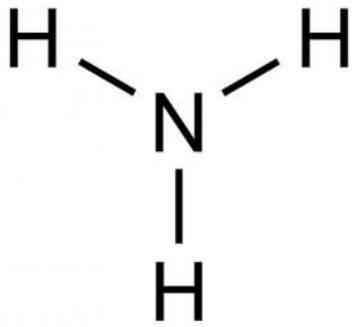


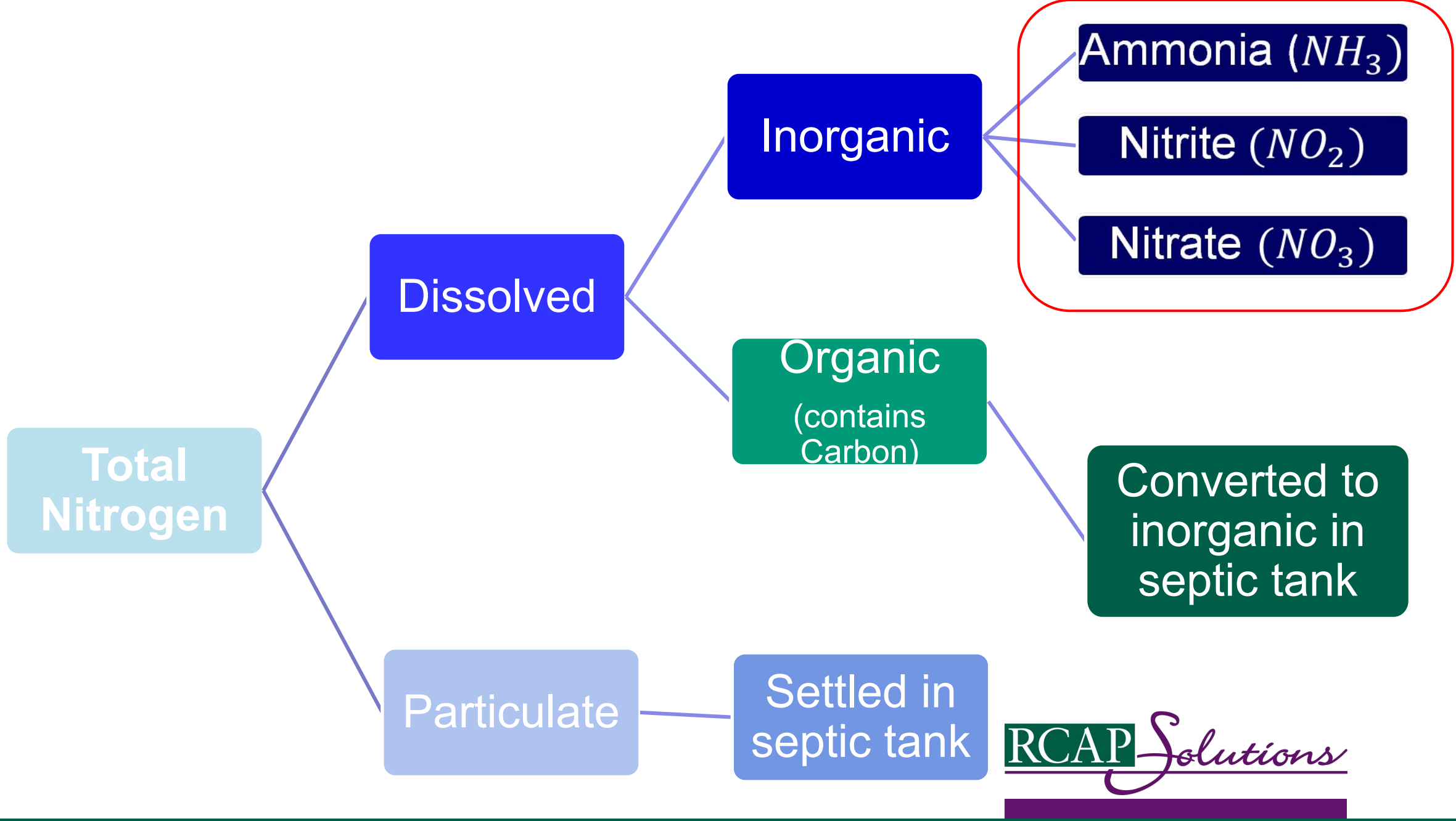
Nitrate

*Met-hee-muh-glow-buh-nee-mee-uh

Ammonia-nitrogen = Ammonia - NH_3

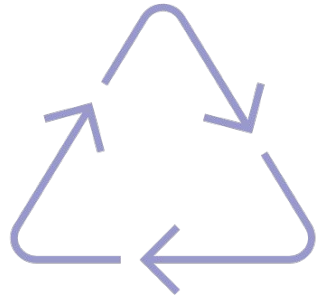
- Ammonia is created by degradation of naturally occurring organic matter and can be found in groundwater
- Ammonia also comes from nitrogen-fertilizer application, livestock operations, industrial processes, sewage infiltration
- The presence of ammonia at higher than normal naturally occurring levels is an important indicator of fecal pollution
- Ammonia at high levels
  - Poisonous to humans
  - Upset the natural equilibrium in lakes and streams.





RCAP Solutions

Nitrogen Cycle



Nitrification

Denitrification

NH_3 Aerobic bacteria

NO_2 Aerobic bacteria

NO_3 anaerobic bacteria

N_2 to the atmosphere

Ammonia

Nitrite

Nitrate

RCAP Solutions

Nitrogen Cycles in the Environment

▪These reactions require different environments to convert nitrogen, in separate areas of the system.

•**Nitrification** - the biological conversion of ammonia to nitrite to nitrate by **aerobic** bacteria

•**Denitrification** - the biological reduction of nitrate to nitrogen gas by **anaerobic** bacteria

•Optimum pH values for denitrification are **between 7.0 and 8.5**

*A carbon source is required for this process

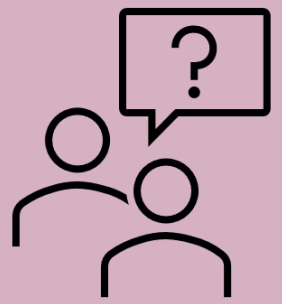
- Surface waters
- Algal bloom
- Fish health?
- Bacteria
- plants
- Invasive plants

RCAP Solutions

Phosphorus

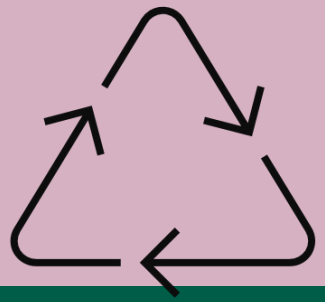
- An essential nutrient for all plant and microorganism growth
- **Sources:**
  - Organically-bound phosphorus from body and food waste
  - Some household detergents
- **In the septic system**
  - Some is bound in solids and settles in the septic tank
  - Remaining phosphorus is treated in the soil of the leachfield
    - Bacteria, chemical reactions, plant uptake, transported to groundwater
- **Eutrophication**
  - Phosphorus and/or nitrogen runoff near freshwater river or lakes
  - Causes a dense growth of certain plant life(algae), which can produce toxins or deplete the dissolved oxygen in the water, causing other organisms to die.

RCAP Solutions

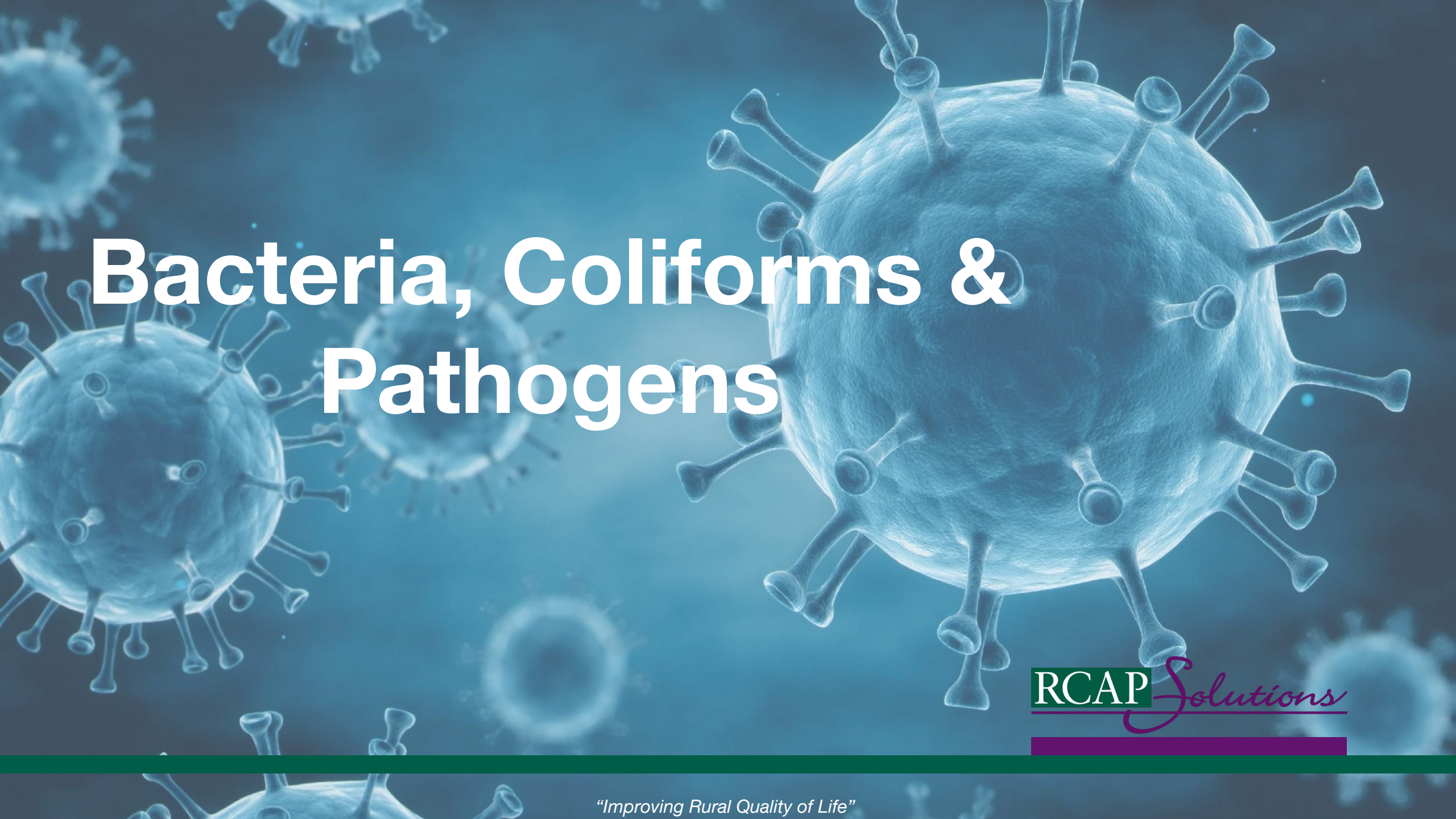


What is the end-product of the Nitrogen Cycle?

1. Nitrogen Gas
2. Ammonia
3. Nitrate
4. Pure Oxygen



RCAP Solutions



Bacteria, Coliforms & Pathogens

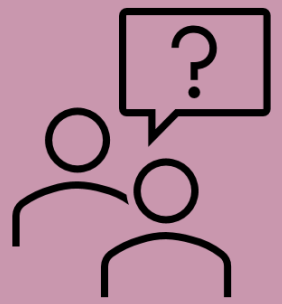
RCAP Solutions

"Improving Rural Quality of Life"

Bacteria Categories/types

- **Aerobic** bacteria use dissolved oxygen for food. They require Free oxygen for survival and reproduction.
- **Anaerobic** bacteria break down wastes in the Absence of Oxygen. The oxygen they require is not absorbed through dissolved oxygen in water. They require already bound oxygen within other microorganisms for survival and reproduction.
- **Facultative** bacteria can use both available or consumed oxygen.

RCAP Solutions



What type of bacteria can consume both free and bound oxygen for survival?

1. Anaerobic
2. Aerobic
3. Pathogenic
4. Facultative

RCAP Solutions

Coliform bacteria:

- Found in the environment:
  - Plants, soil, sediment
  - Microbial growth
- Found in intestinal tract & waste of humans & warm-blooded mammals
- INDICATOR organism which encompasses MANY bacteria species
- 3 different groups of coliform bacteria:
  - **Total coliform** – large collection
  - **Fecal coliform** – mostly exist in feces
  - **E. coli** – subgroup of fecal coliform

RCAP Solutions

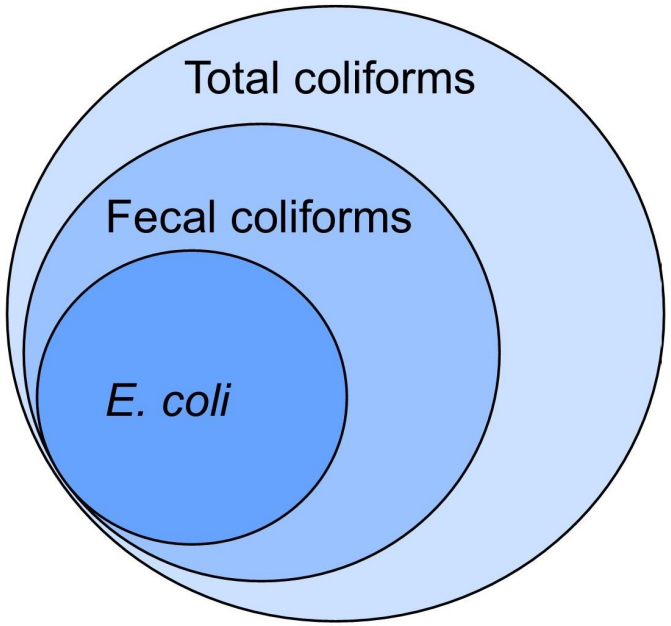
Coliform Bacteria

- Coliform bacteria naturally occur in:
  - Animal and Human digestive tracts (feces)
  - Plant and soil material
  - Sediment
  - Biofilms
  - Untreated water

RCAP Solutions

Total coliform vs. E. coli

- Total coliform is a common bacteria
- Not a health threat in itself
- It may indicate that other, more dangerous bacteria are present



- E. coli is a subset of total coliform
- Potential presence of waterborne pathogens
- Indicates contamination fro mammal fecal waste

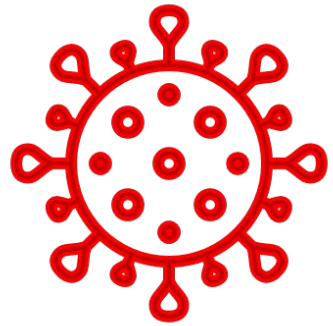
RCAP Solutions

Transported

- By rain flowing over the surface of the ground in the yard
- nearby agricultural run-off
- or a nearby failing septic system

RCAP Solutions

Pathogens



- Disease-causing microorganisms:
  - Virus: hepatitis, COVID-19
  - Bacteria: E. coli, Salmonella
  - Fungus: Mycosis
  - Parasite: cryptosporidium
    - There are HUNDREDS of species
- Detected by testing for a single microbial indicator instead of testing for all possible pathogens
- Most inactivated by bacteria in a functioning septic system

*Inactivated : DNA has been disrupted so that it cannot replicate

RCAP Solutions

Total Coliform: As an Indicator

- For drinking water, testing for **total coliforms** is the standard because their presence ***indicates*** coliform contamination by an outside source.
- If the total coliform count is high, then it is very possible that harmful pathogens like viruses, bacteria and parasites might also be found in the water
- If a sample is total coliform positive, it is followed up my more specific tests such as fecal coliform or E. coli

RCAP Solutions

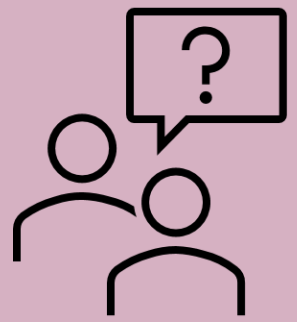
Private Well Guidelines

<u>Recommended Sampling For Existing Wells:</u>

"Each year, preferably in the spring, all private wells, should be tested for **total coliform bacteria** and **nitrate/nitrite**. If total coliform bacteria is detected, the well water should be sampled for E.-coli to determine if wastewater has contaminated the well."

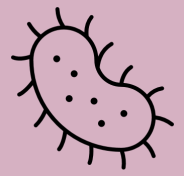
By MassDEP, Bureau of Water Resources Drinking Water Program, July 2018
Water Quality and Water Testing, Page 82

https://www.mass.gov/service-details/private-well-guidelines



Which of the following is a true statement

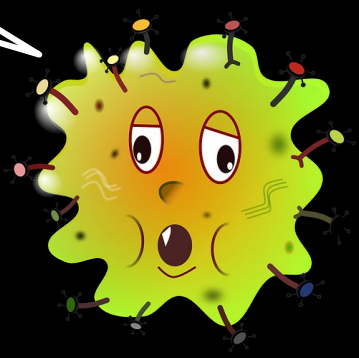
1. E-coli is a subset of Fecal Coliform only
2. E-coli is a subset of Total Coliform only
3. Fecal coliform is a subset of E-coli
4. E-Coli is a subset of both Fecal and Total Coliform



RCAP Solutions

Questions?

Don’t forget to take your Post-Test!



RCAP Solutions

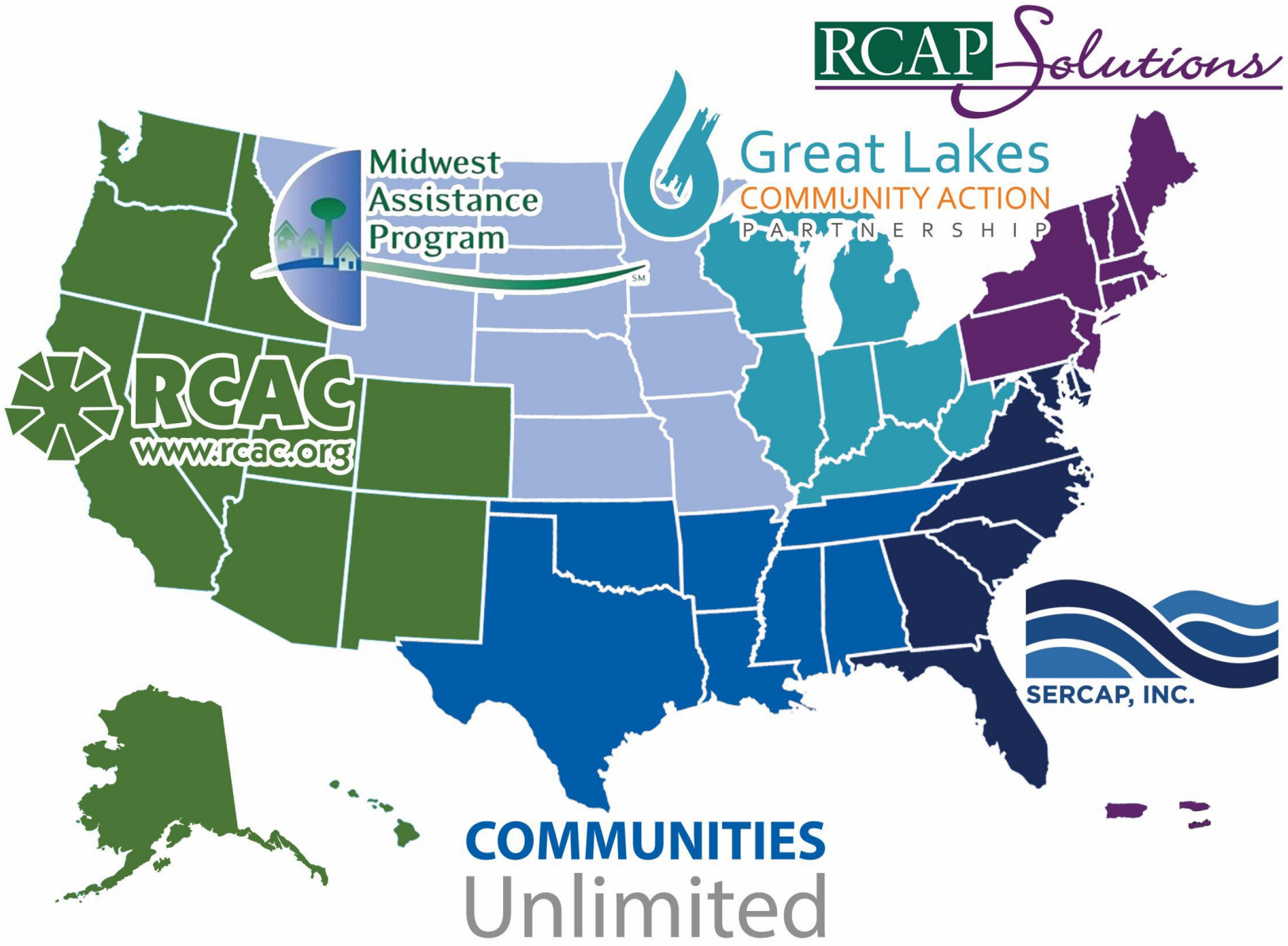
Septic 101

Please complete your pre-test NOW

RCAP Solutions Massachusetts

RCAP Solutions

Today's Presenters: RCAP Solutions

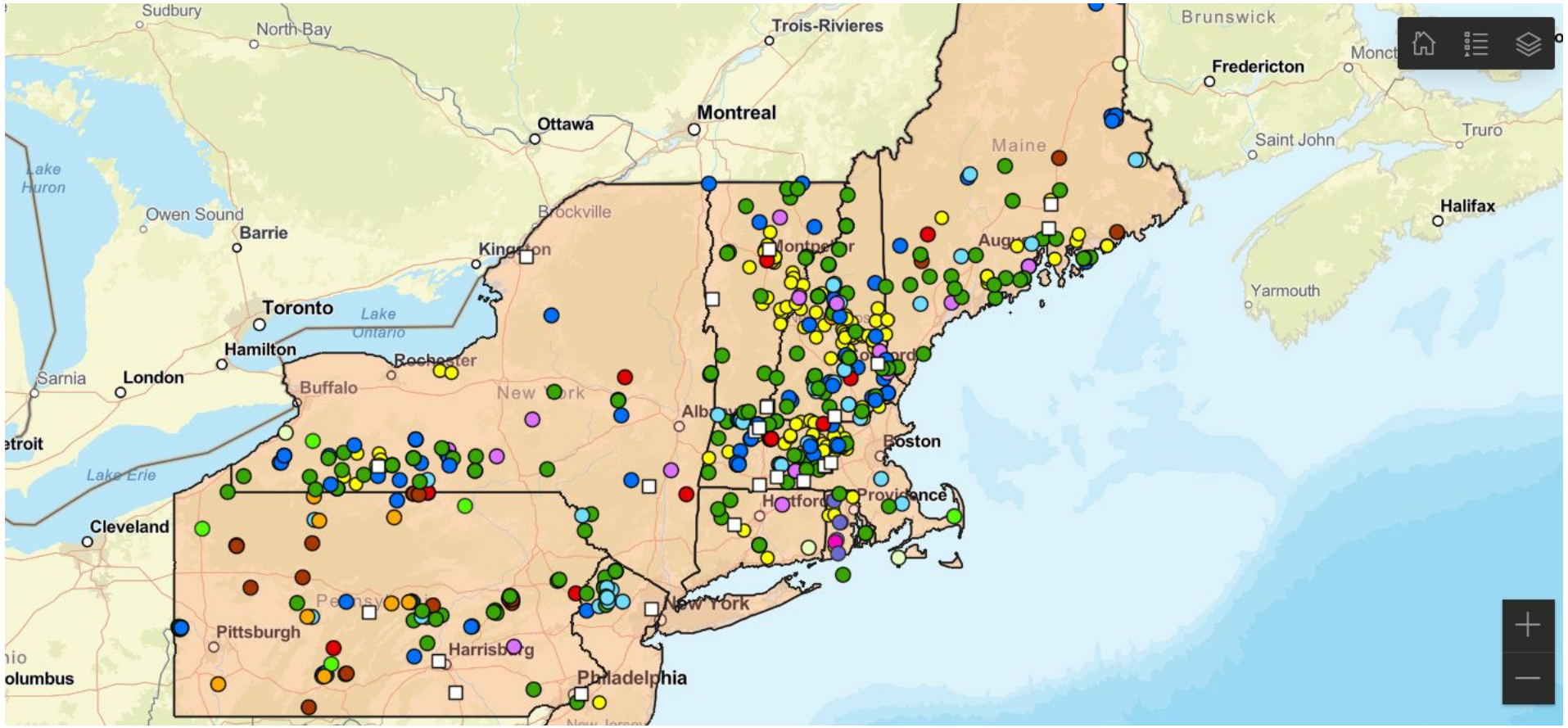


Rebekah Novak, E.I.T.
Water Compliance Specialist (MA)
rnovak@rcapsolutions.org

Andrew Evans
Environmental Technician
aevans@rcapsolutions.org

https://rcapnational.maps.arcgis.com/apps/webappviewer/index.html?id=61b5505cf4fb4026ac6cf1345321b1e8

RCAP Solutions Impact



RCAP Solutions

Acknowledgement

This project has been funded wholly or in part by the United States Environmental Protection Agency under an EPA Training and Technical Assistance for Small Drinking Water Systems to Achieve and Maintain Compliance.

The contents of this document do not necessarily reflect the views and policies of the Environmental Protection Agency, nor does the EPA endorse trade names or recommend the use of commercial products mentioned in this document.

For more information on this topic please visit: https://www.epa.gov/septic/septicsmart-homeowners

RCAP Solutions

Soils

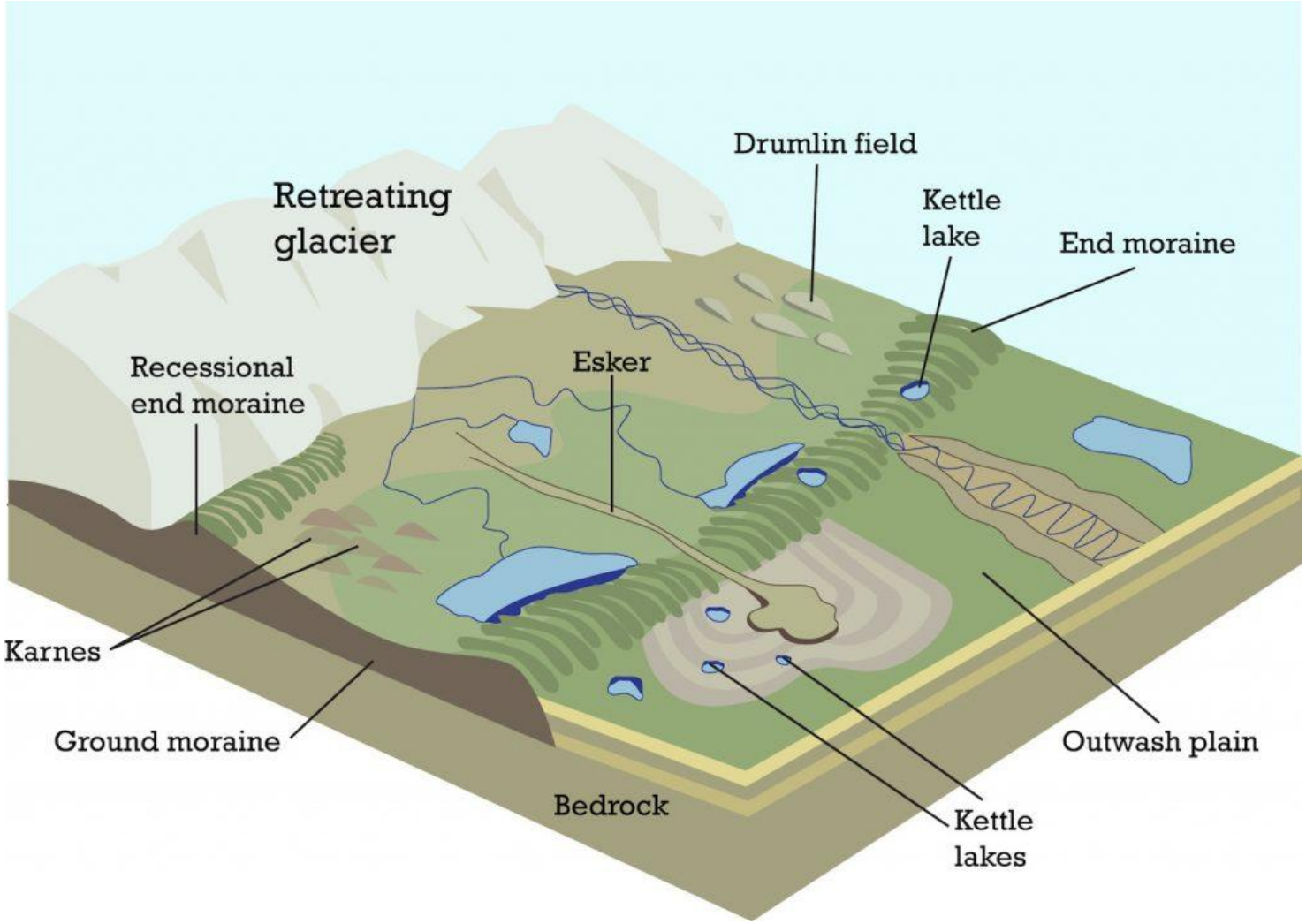
RCAP Solutions

Soil Absorption System (SAS)

The final system that disperses effluent back to the earth (drainfield, leachfield, disposal field)

RCAP Solutions

Glaciers & Soil formation

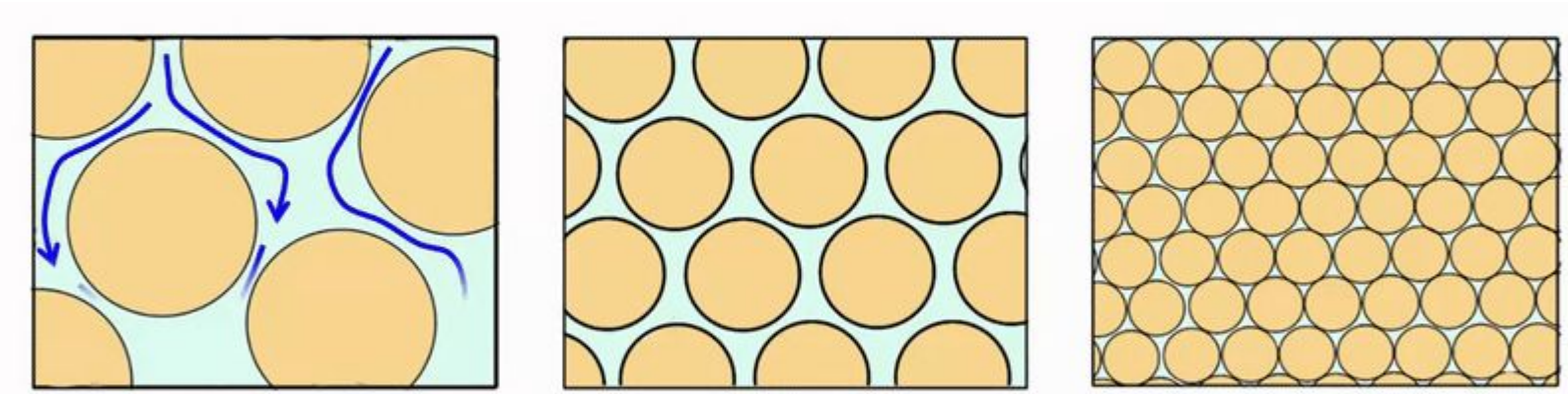


- Glaciers pushed land, picked up and deposited what was on land surface.
- Wind, water, heat and cold loosen the rock surfaces and minerals break free, combined with organic matter, and bacteria and made soil

RCAP Solutions

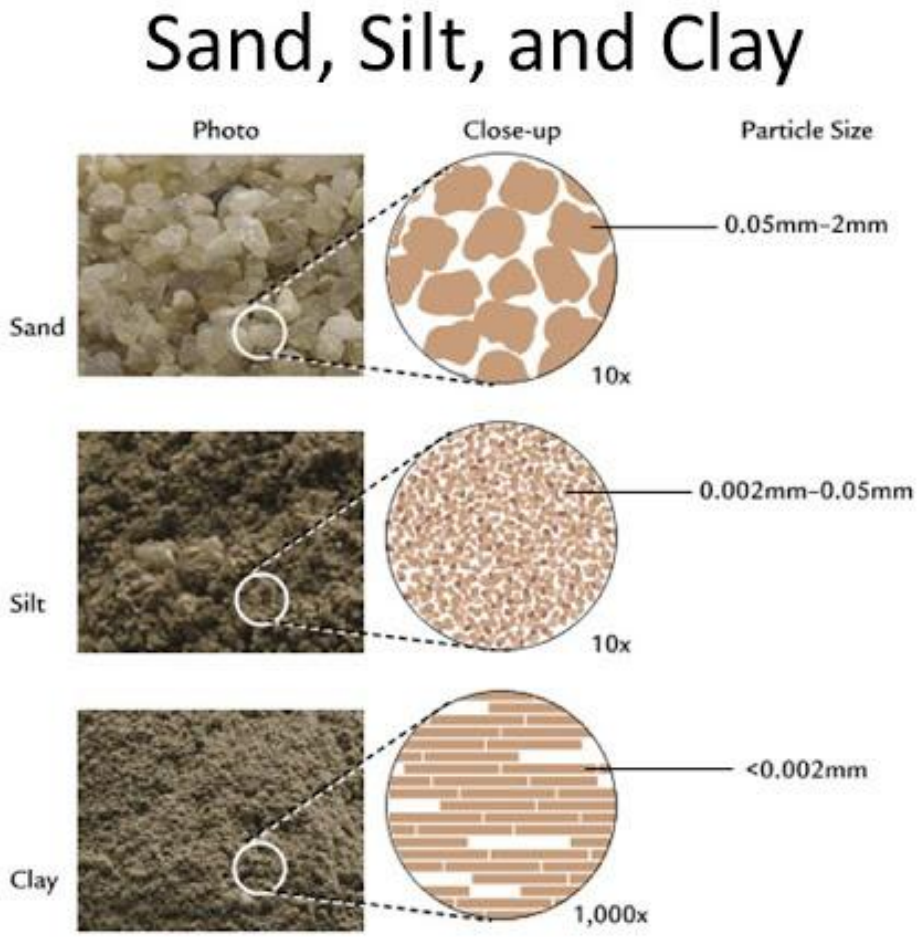
Soil Composition

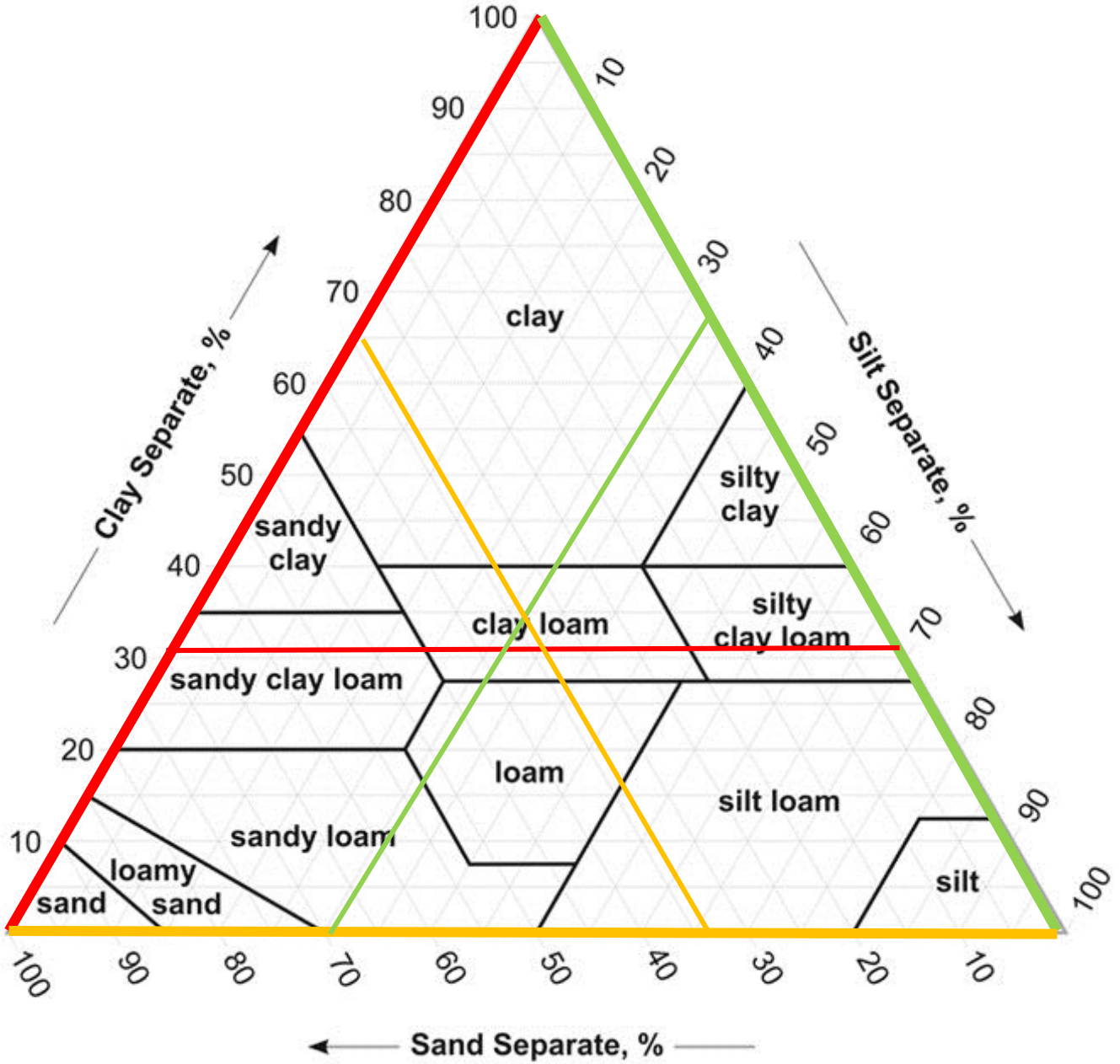
- The relative percentage of sand, silt and clay affects the rate at which wastewater percolates through the soil
- Soils with lots of silts and clays have small pore space between them, so water moves through the soil slowly
- Soil color has no bearing on texture



RCAP Solutions

Soil Texture





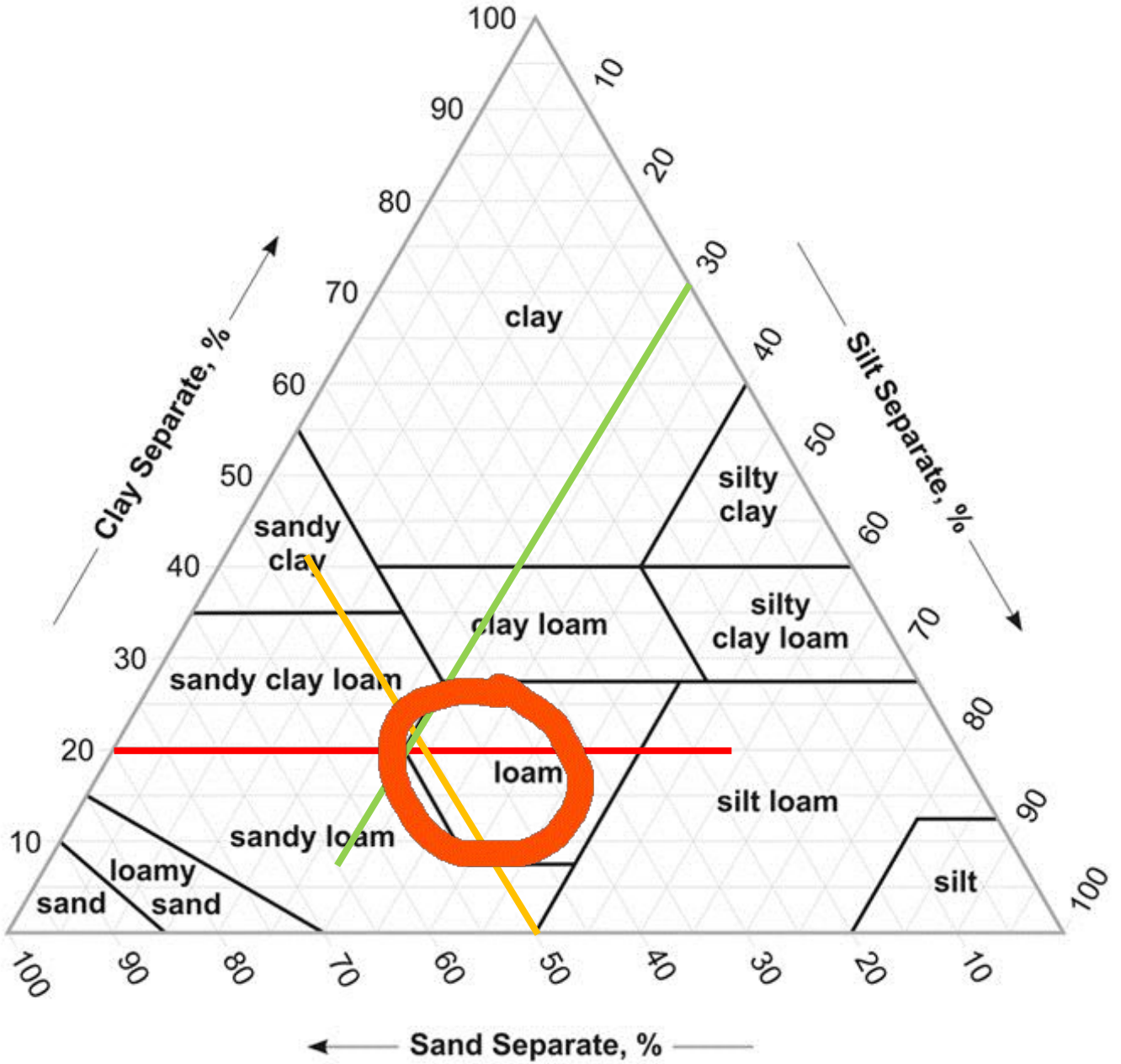
Textural Class

Class I – Sands, Loamy Sands

Class II – Sandy Loams, Loams

Class III – Silt Loams, Sandy Clay Loams with less than 27% clay, Silt

Class IV – Clays, Silty Clay Loams, Sandy Clay Loams, with 27% of more Clay, Clay Loams and Silty Clays



Soil Color: Color Chart

- **Organic matter:** Brown to black
  - will mask other colors
- **Manganese:** purplish-black
- **Iron:** yellow, orange, red
  - Well-drained soils have bright colors due to iron oxide stains
  - Fluctuating high-water table has blotchy grey colors

High-groundwater

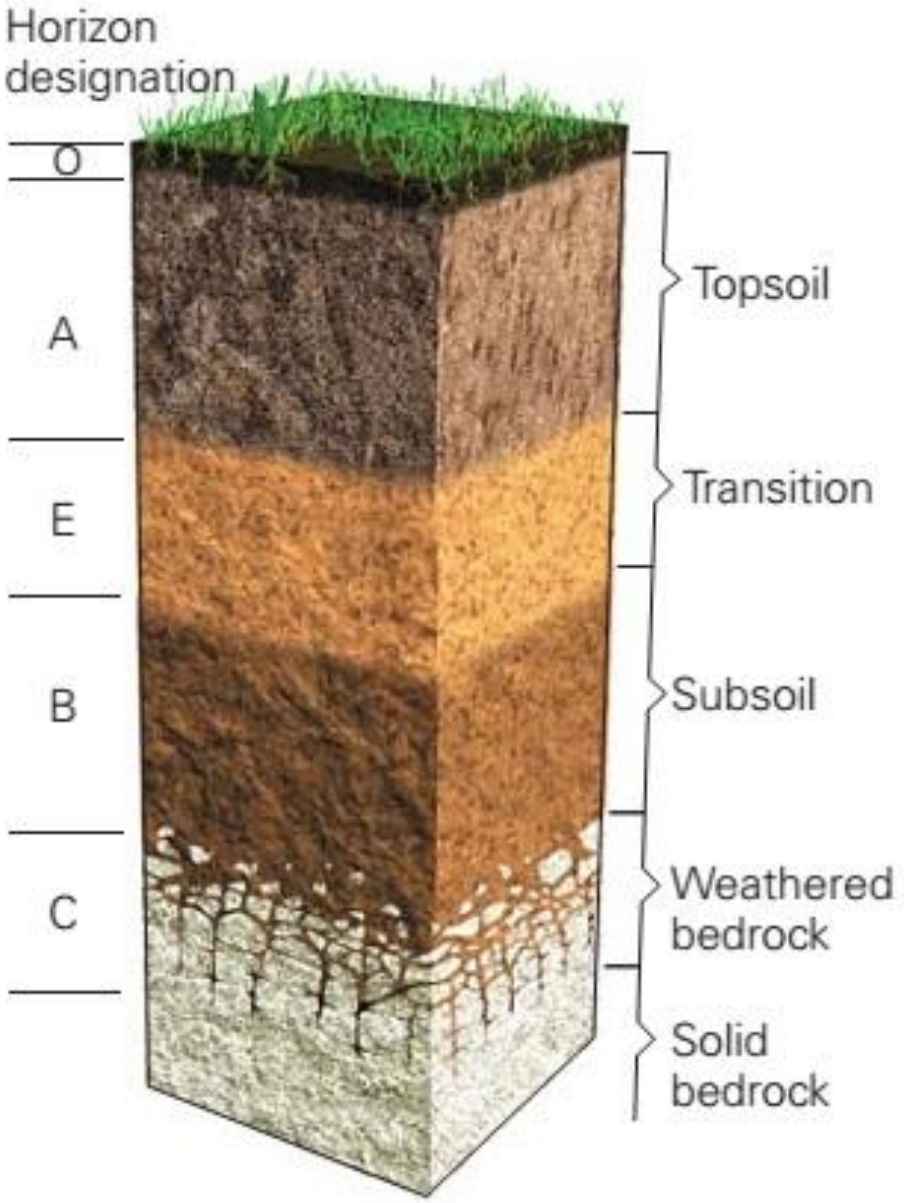
Redoximorphic Features

- Percolating water transports color
- Soil color patterns resulting from seasonal fluctuation in the water table
- Formed by oxidation and reduction
- Re-distribution of Iron oxide stains
- Takes 2-3 for saturated soil to become anoxic, and colors depleted to grey

RCAP Solutions

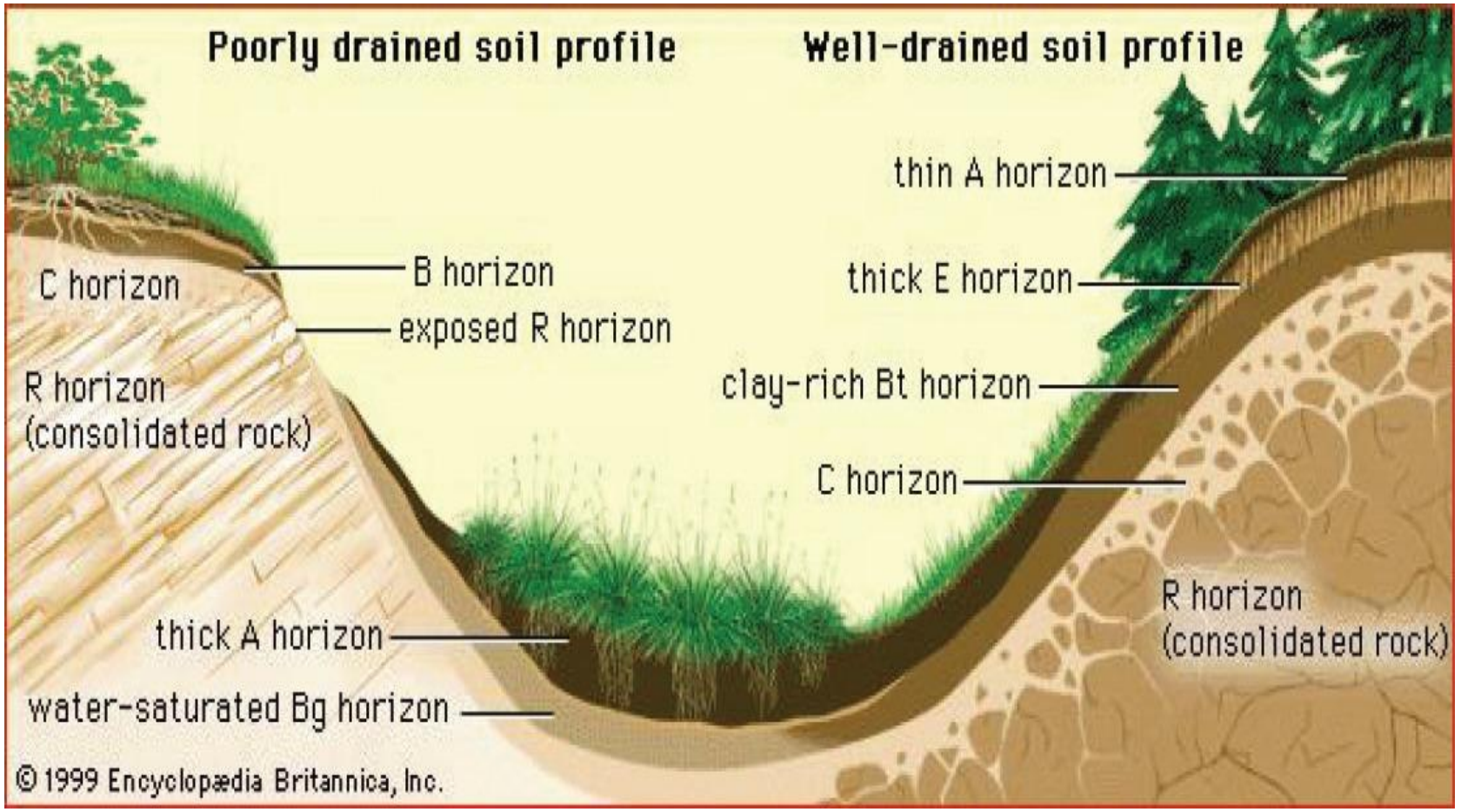
Soil Profile

- **O Horizon** – partially decomposed leaves, pine needles, twigs
- **A Horizon** – *topsoil* –dark color resulting from mixing of decomposed organic matter and mineral material
- **E Horizon** – may be absent – zone of leaching color
- **B Horizon** – *subsoil* – evidence of soil formation
- **C Horizon** – *substratum* - un-weathered geologic sediments



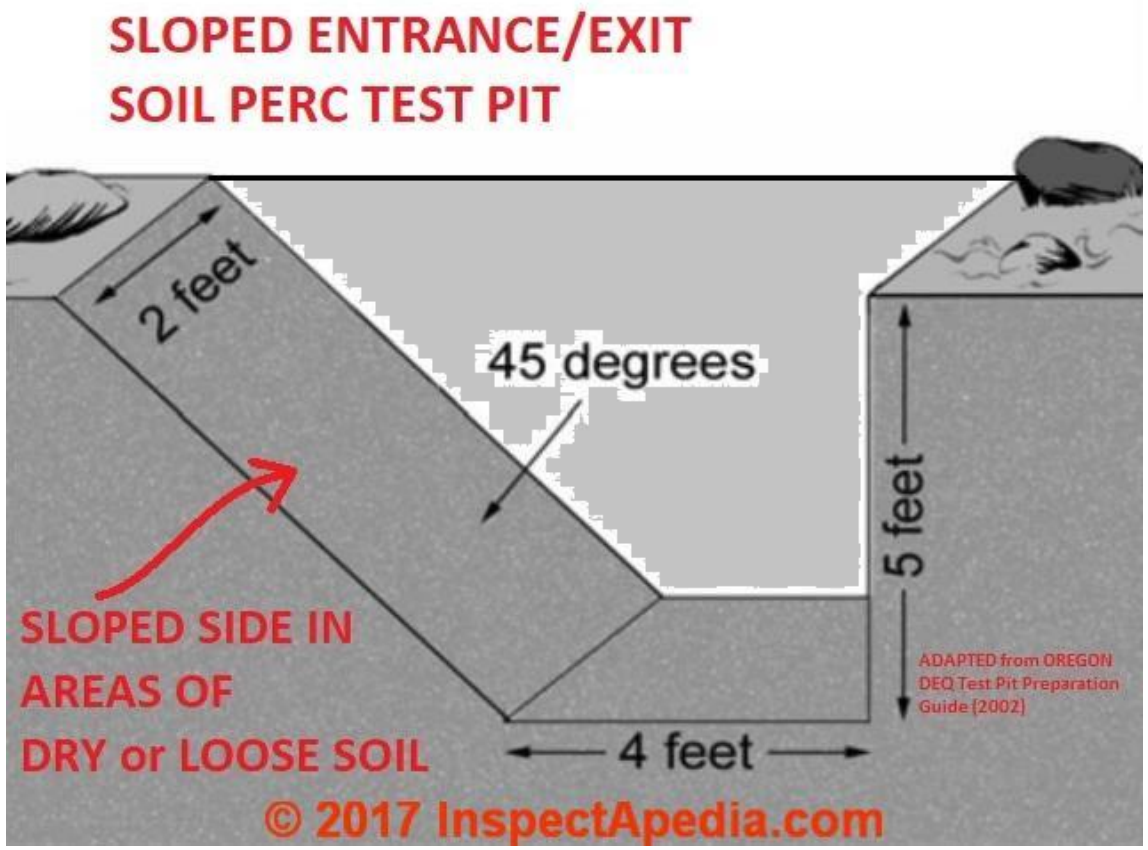
Soil Evaluation

- Test Pit and perc test performed by **Certified Soil Evaluator, PE, etc.**
- Characteristics of ALL soil layers beneath the field



RCAP Solutions

Test Pit: Deep Observation Hole

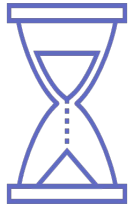


RCAP Solutions

Percolation (Perc) Test

RCAP Solutions

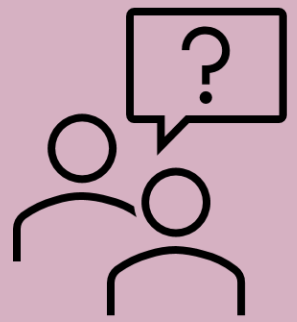
Design: Effluent Loading Rate



- Soil evaluations determine the effluent loading rate
- Based on perc rate and soil Class
- Used to calculate area of SAS

EFFLUENT LOADING RATE gpd/sq.ft (cm/day)

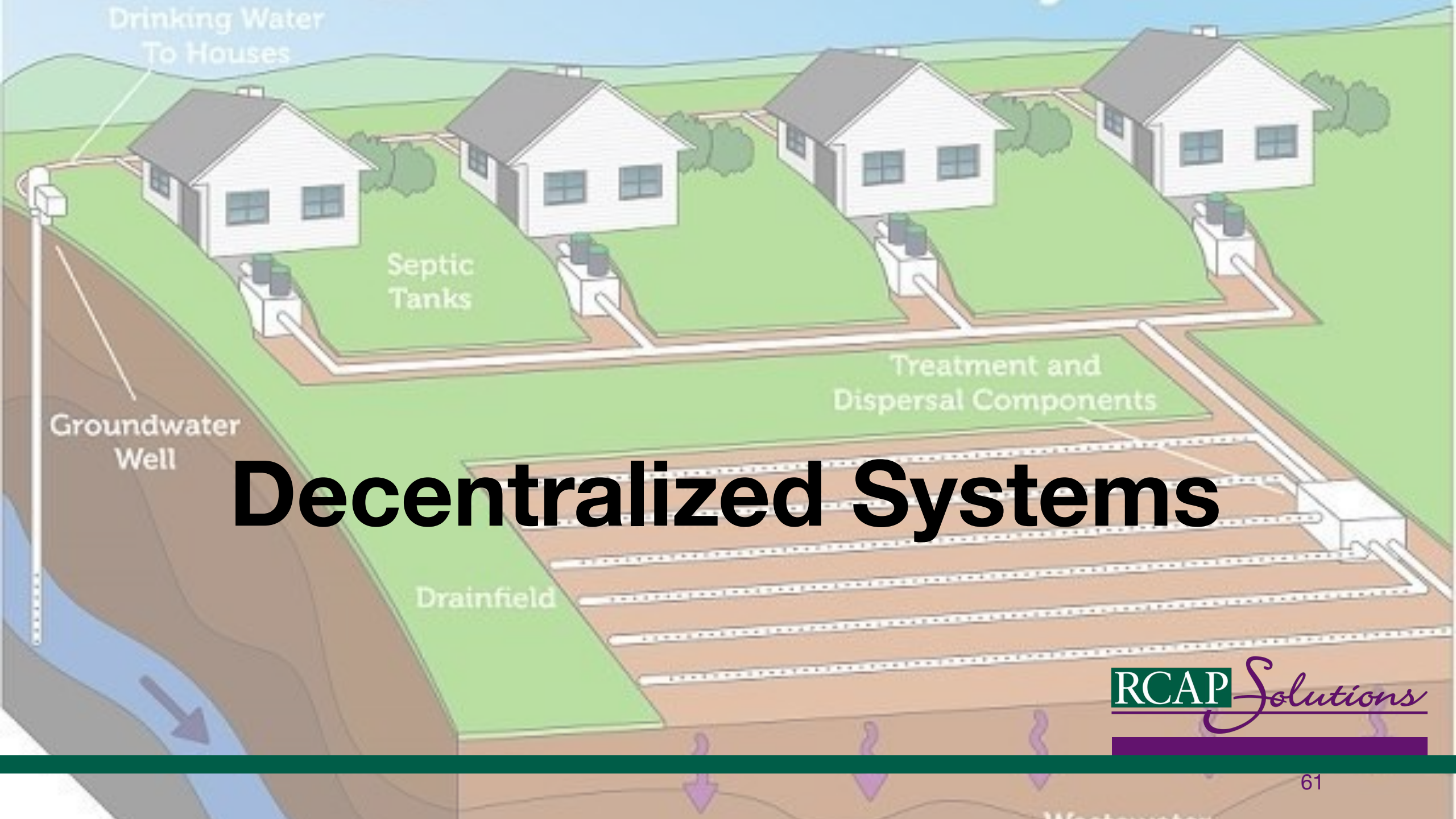
PERC. RATE (min./inch)	SOIL CLASS CLASS I	CLASS II	CLASS III	CLASS IV
≤5	.74 (3.0)	0.60 (2.5)	-	-
6	0.70 (2.9)	0.60 (2.5)	-	-
7	0.68 (2.8)	0.60 (2.5)	-	-
8	0.66 (2.7)	0.60 (2.5)	-	-
10	-	0.60 (2.5)	-	-
15	-	0.56 (2.3)	0.37 (1.5)	-
20	-	0.53 (2.2)	0.34 (1.4)	-
25	-	0.40 (1.6)	0.33 (1.3)	-
30	-	0.33 (1.3)	0.29 (1.2)	-
40	-	-	0.25 (1.0)	-
50	-	-	0.20 (0.8)	0.20 (0.8)
60	-	-	0.15 (0.6)	0.15 (0.6)



Which of the following site conditions would be the least suitable for a leachfield?

1. High ground water table next to a swamp
2. Steep Slope with moderate perc rate in a field
3. Lots of Silt and Clay with slow perc rate in a wooded area
4. Loose Sandy Soil with fast perc rate and visible bedrock outcropping nearby

RCAP Solutions



Decentralized Systems

RCAP Solutions

~~Centralized~~ Vs. Decentralized/On-Site Treatment

On-Site system: Wastewater is treated on-site or near the source

Collects wastewater and delivers it to a nearby site (sub-surface) or surface waters *(NPDES) for treatment and dispersal.

- In rural, suburban and urban settings.
- Industrial or institutional
- Clusters of homes/businesses
- Small communities.
- *Systems that discharge to the surface (water or soil surfaces) require a National Pollutant Discharge Elimination System (NPDES) permit.

RCAP Solutions

Economic Benefits

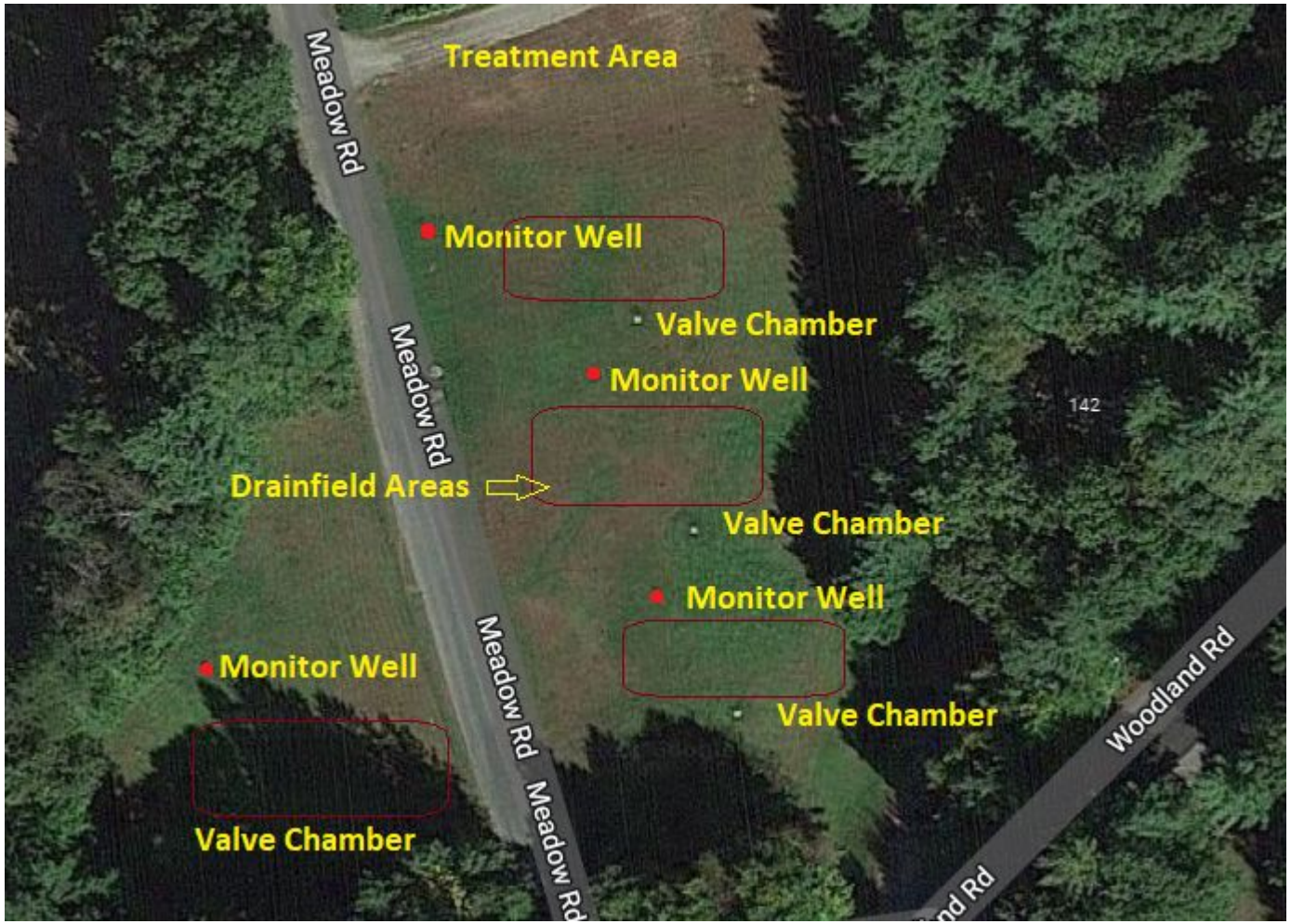
A smart alternative for communities considering new systems or modifying, replacing, or expanding existing wastewater treatment systems.

For many communities, decentralized treatment can be:

- Cost-effective and economical
  - Avoiding large capital costs compared to centralized systems
  - Reducing operation and maintenance costs
  - Promoting business and job opportunities
  - Build a large system rather than lots of small ones

RCAP Solutions

Environmental Benefits



- Green and sustainable
- Benefit water quality and availability
- Creates green space
- **Replenishes groundwater/aquifers**
- Uses energy and land wisely
- Responds to growth
- Build a large system rather than lots of small ones

RCAP Solutions

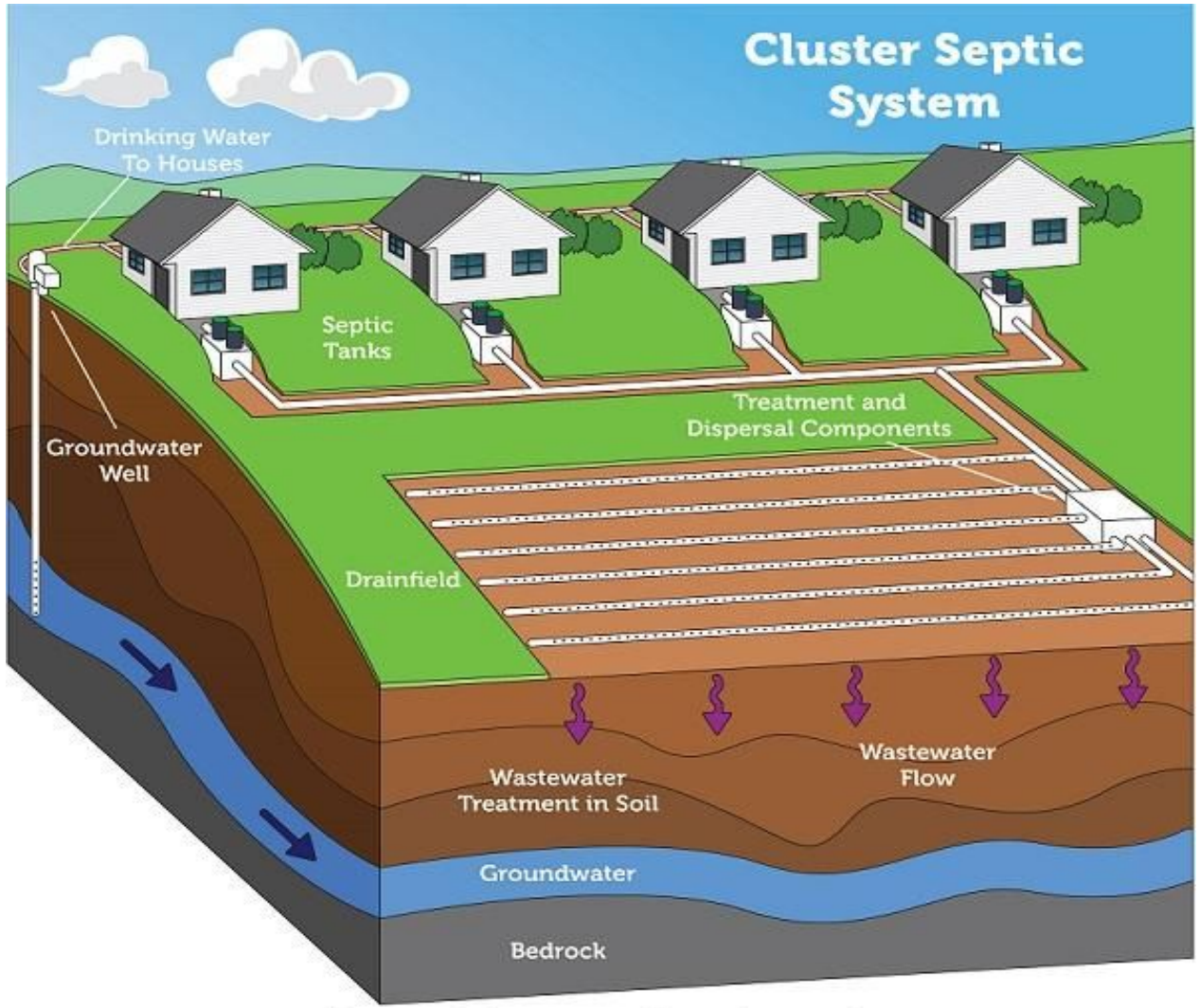
Public Health Benefits

- Protecting the community's health
- Reducing conventional pollutants, nutrients, and emerging contaminants
- Mitigating contamination and health risks associated with wastewater
- Can be constructed according to site specific influent wastewater characteristics

RCAP Solutions

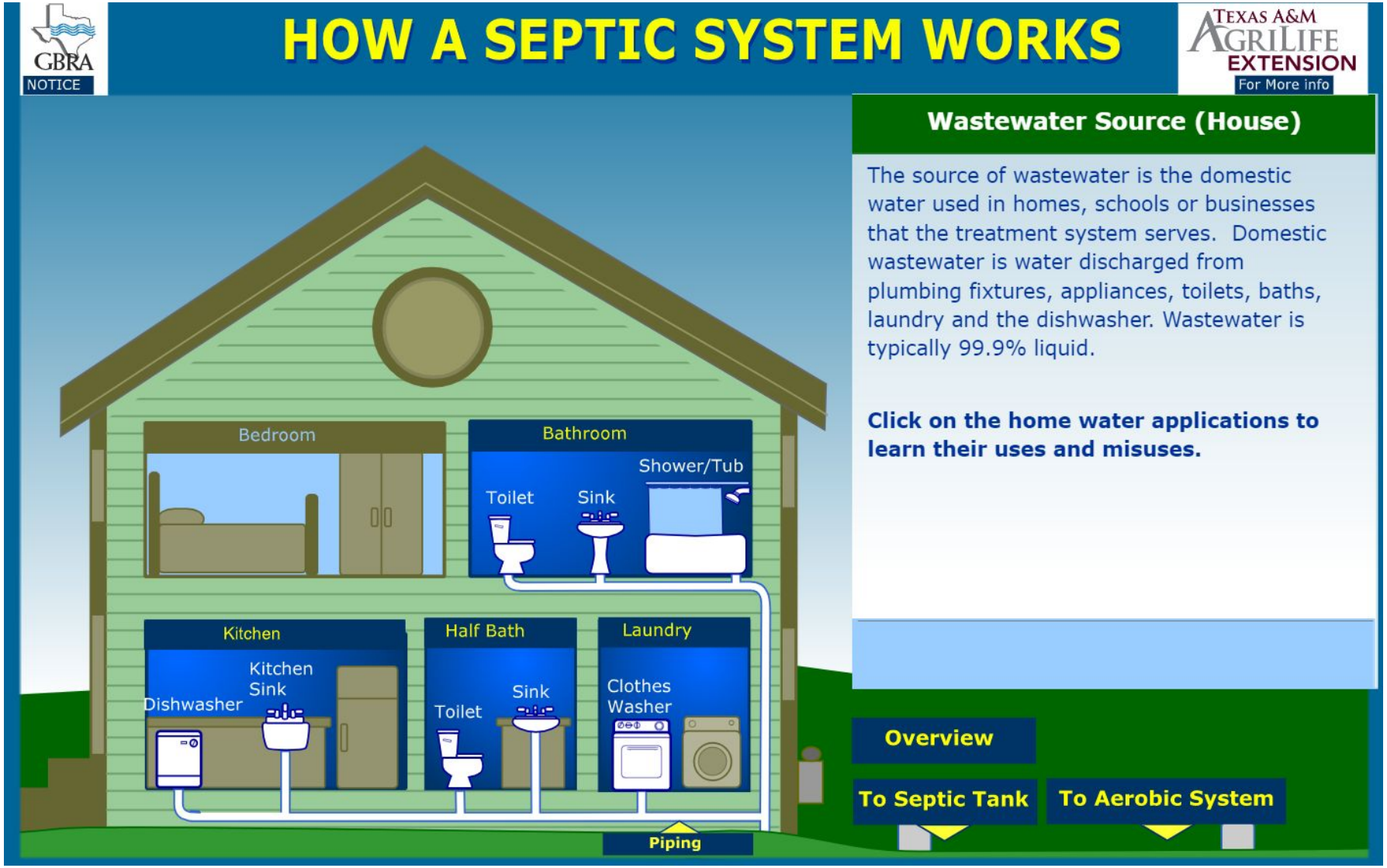
Conventional Cluster

- Some form of common ownership
- Collects wastewater from two or buildings and conveys it to a treatment and dispersal system
- Common to find cluster systems in places like rural subdivisions



Please note: Septic systems vary. Diagram is not to scale.

RCAP Solutions

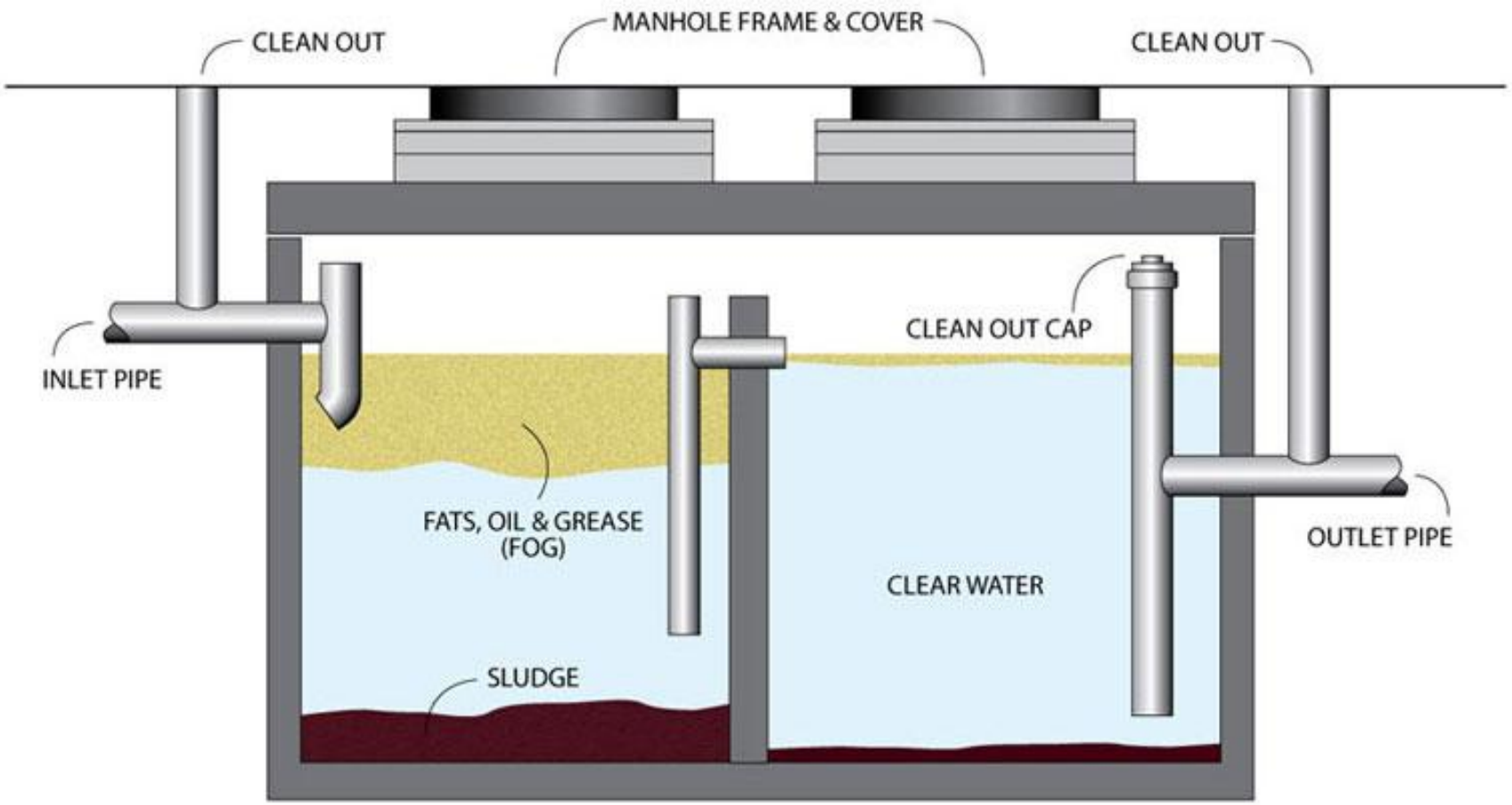


https://www.gbra.org/presentations/septic/index.html

- Quick Tip Videos
- Brochures
- Posters
- Mailers
- SepticSmart for Tribal Communities
- SepticSmart Community Case Studies
- Webinars about Decentralized Wastewater Treatment

https://www.epa.gov/septic/septicsmart-education-materials

Grease Trap



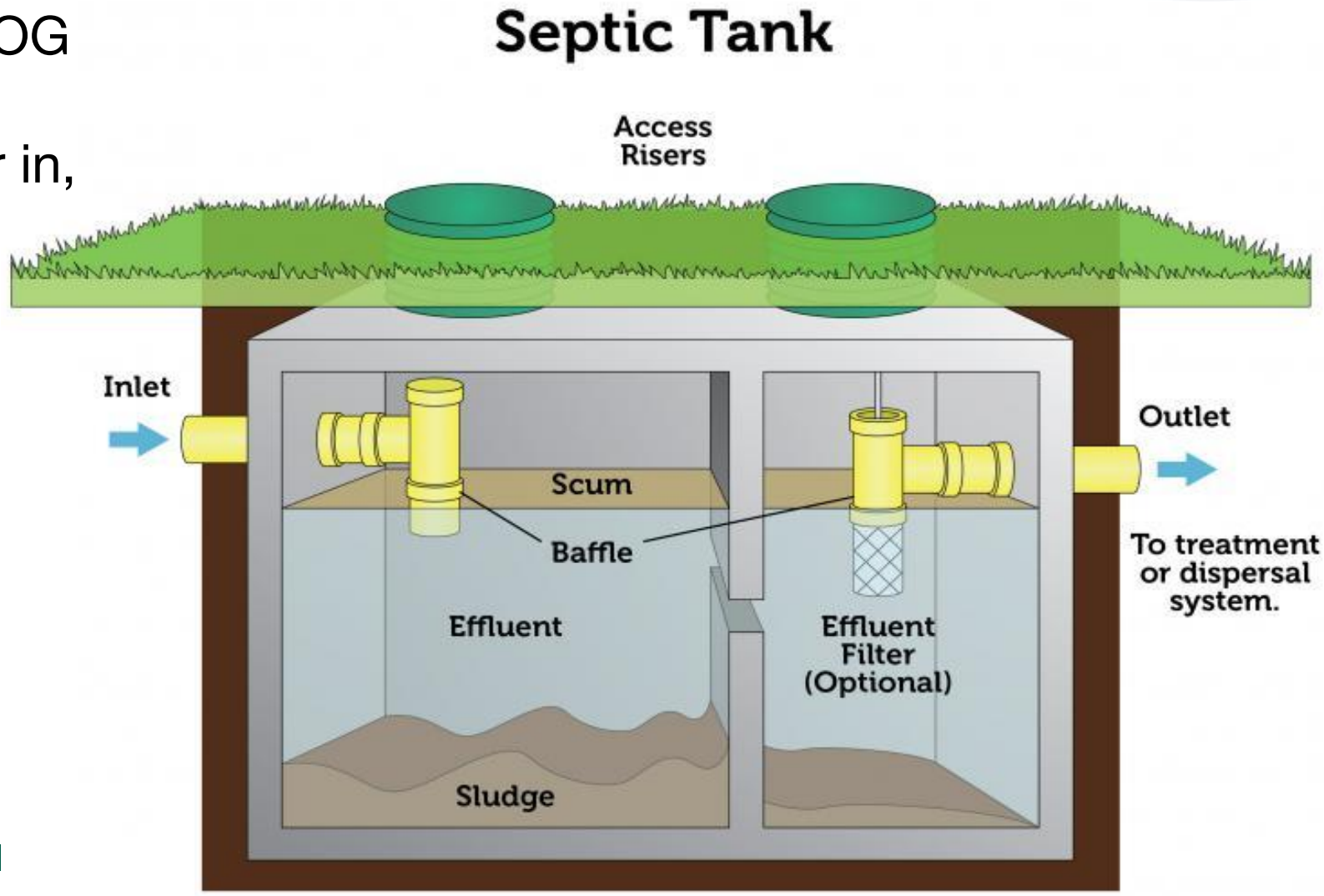
RCAC

FOG – Fats, oils & grease

RCAP Solutions

Septic Tank: Primary Treatment

- Concrete, fiberglass, polyethylene
- Solids settle to the bottom, FOG float to the top
- Watertight: keeps wastewater in, groundwater out



Cesspools and Tight tanks

- *Cesspool: stone-walled pit or perforated concrete chamber*
- *Tight tank: watertight tank that holds everything and needs to be pumped*

RCAP Solutions

Septic Tank Examples

Fiberglass

Concrete

Plastic

RCAP Solutions

Septic Tank Components

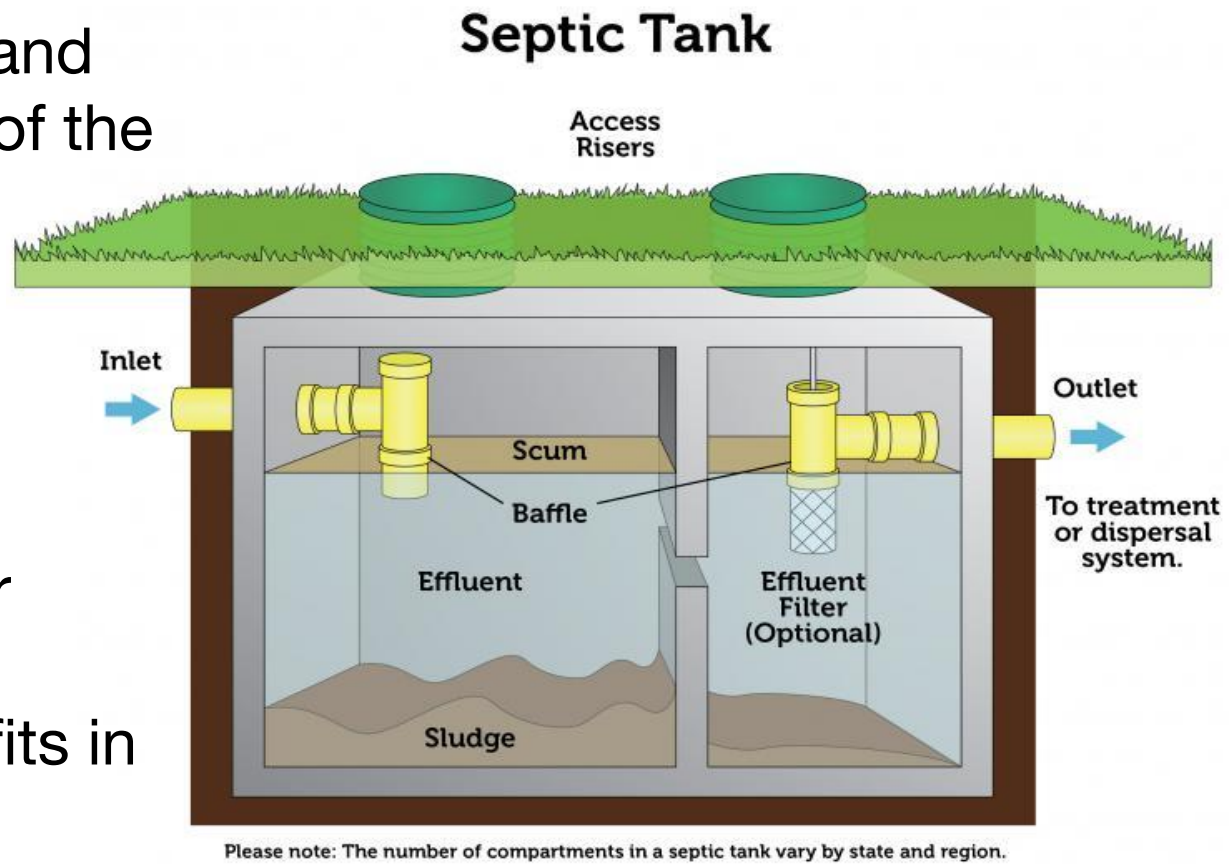
Baffles: separate liquids from the settleable and floatable solids (oil and grease), keeps most of the solids in the first compartment

Access risers: Allows for easier locating, inspections, maintenance and pump outs

Outlet tee: Draws from below the scum layer

Effluent filter: Plastic screening device that fits in the effluent tee

- Prevents solids from leaving the tank and clogging the field



RCAP Solutions

Primary Treatment

- Removal of solids by sedimentation and floatation
- About ~**80%** of the solids in the septic tank are broken down by decomposition to gasses and liquids

- Bacteria: Grows naturally in your septic tank and help break down wastes when properly maintained.
  - Antibacterial soaps, bleach, antibiotics, and other products designed to kill bacteria could all enter your tank and destroy some of the beneficial bacteria in your tank.

- Pathogens: The primary treatment process is not effective in reducing the number of pathogens present in the wastewater.

RCAP Solutions

Collection of wastewater

Individual home

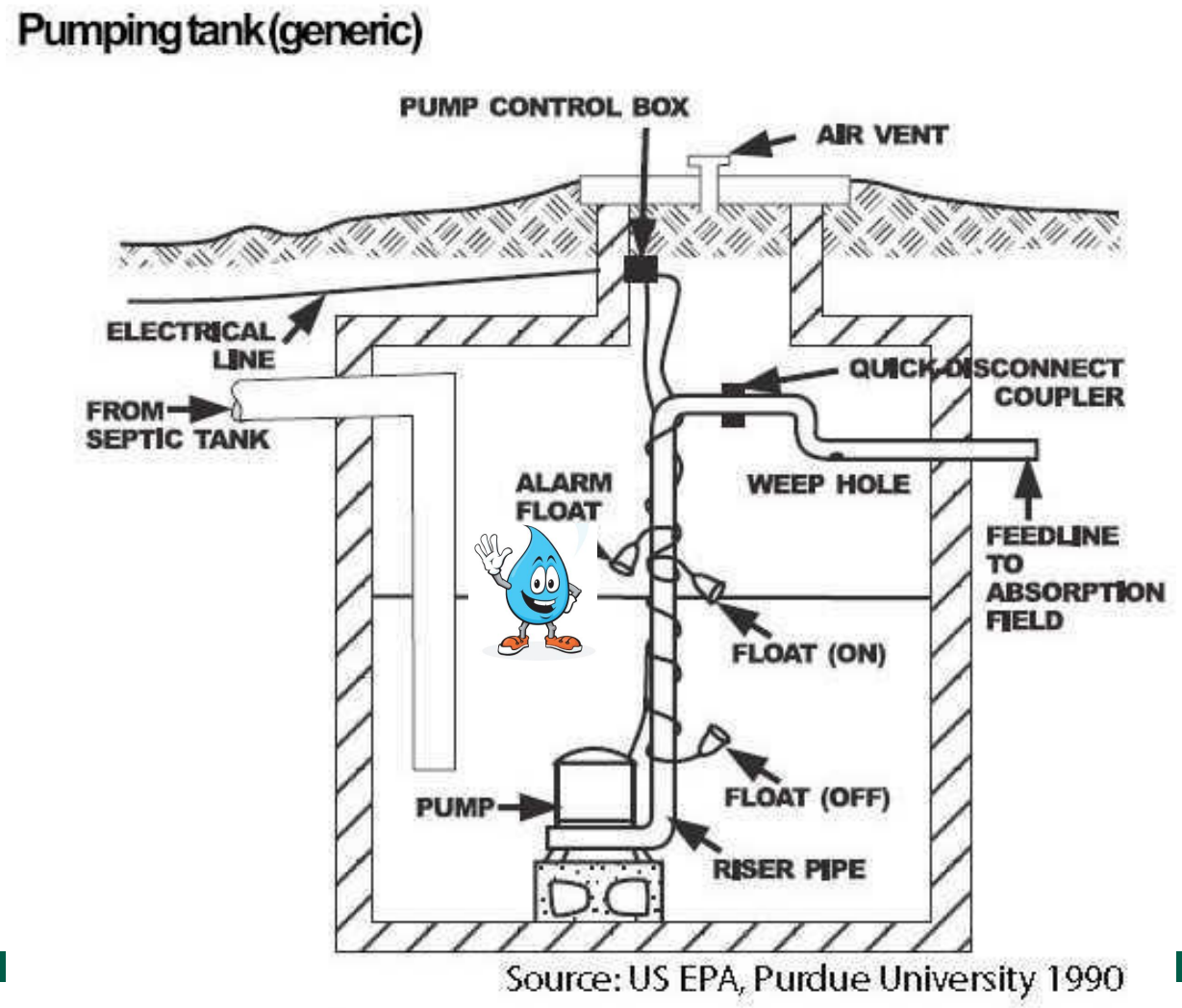
- Gravity
- Pump/pressure

Cluster/community/decentralized

- STEG: Septic Tank Effluent Gravity
- STEP: Septic Tank Effluent Pump
  - NOT a grinder pump
  - Small diameter pipe
- Vacuum

RCAP Solutions

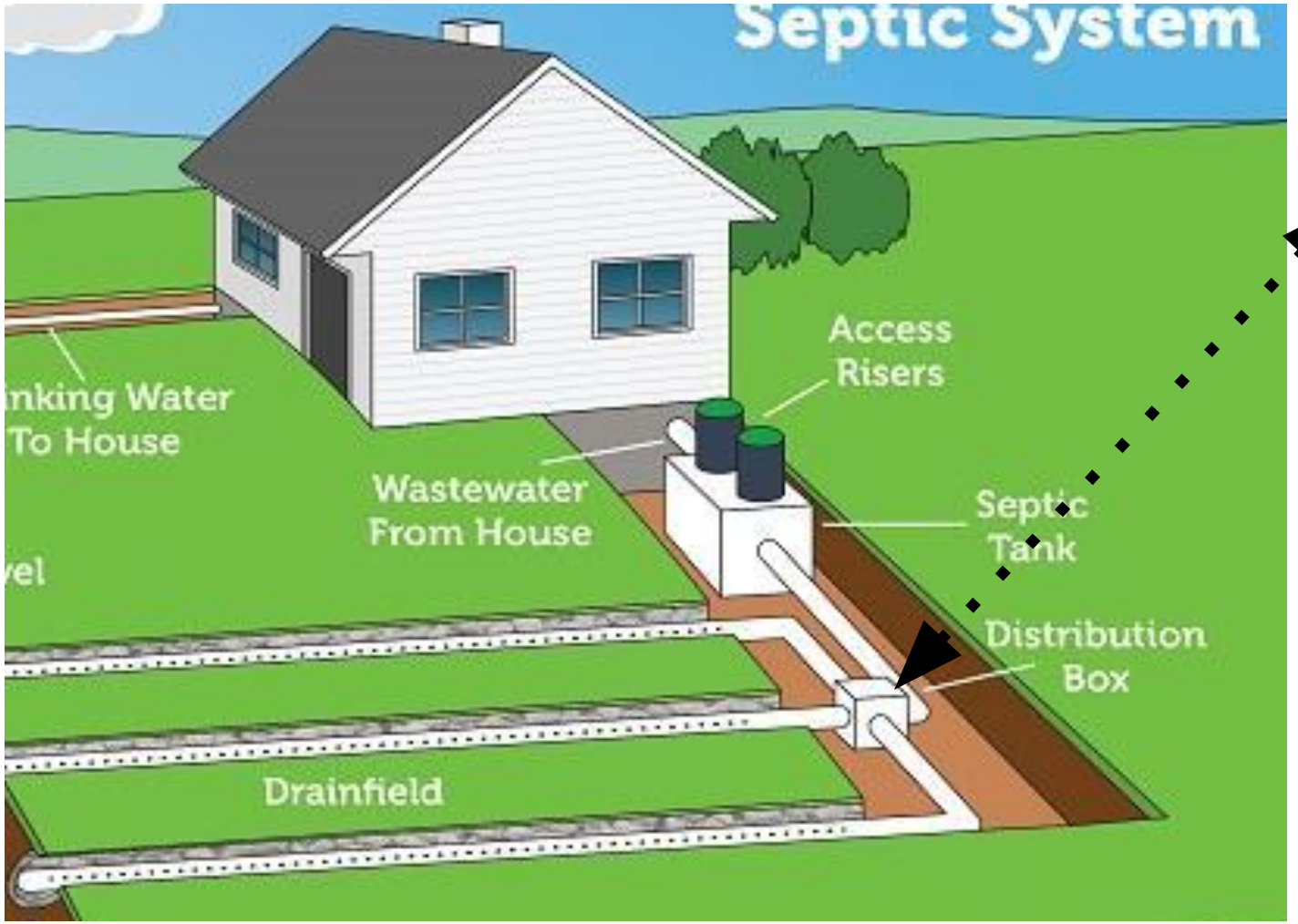
Pump Chamber/Dosing Tank (pressure system only)



- Cannot discharge by gravity
- Intermittent discharge
- Emergency storage capacity
- Possible standby power
- Sensors (high water, on/off floats)
- Watertight access cover
- Weephole in feedline to prevent the pipe from freezing

RCAP Solutions

Distribution Box (“D-box”)



D-box

- Splits flow to different pipes
- Gravity – non mechanical
  - Must be installed level
- Pumped - mechanical

RCAP Solutions

Distribution Box in the Field

RCAP Solutions

Soil Absorption System (SAS)

The final system that disperses effluent back to the earth

- drainfield, leachfield, disposal field

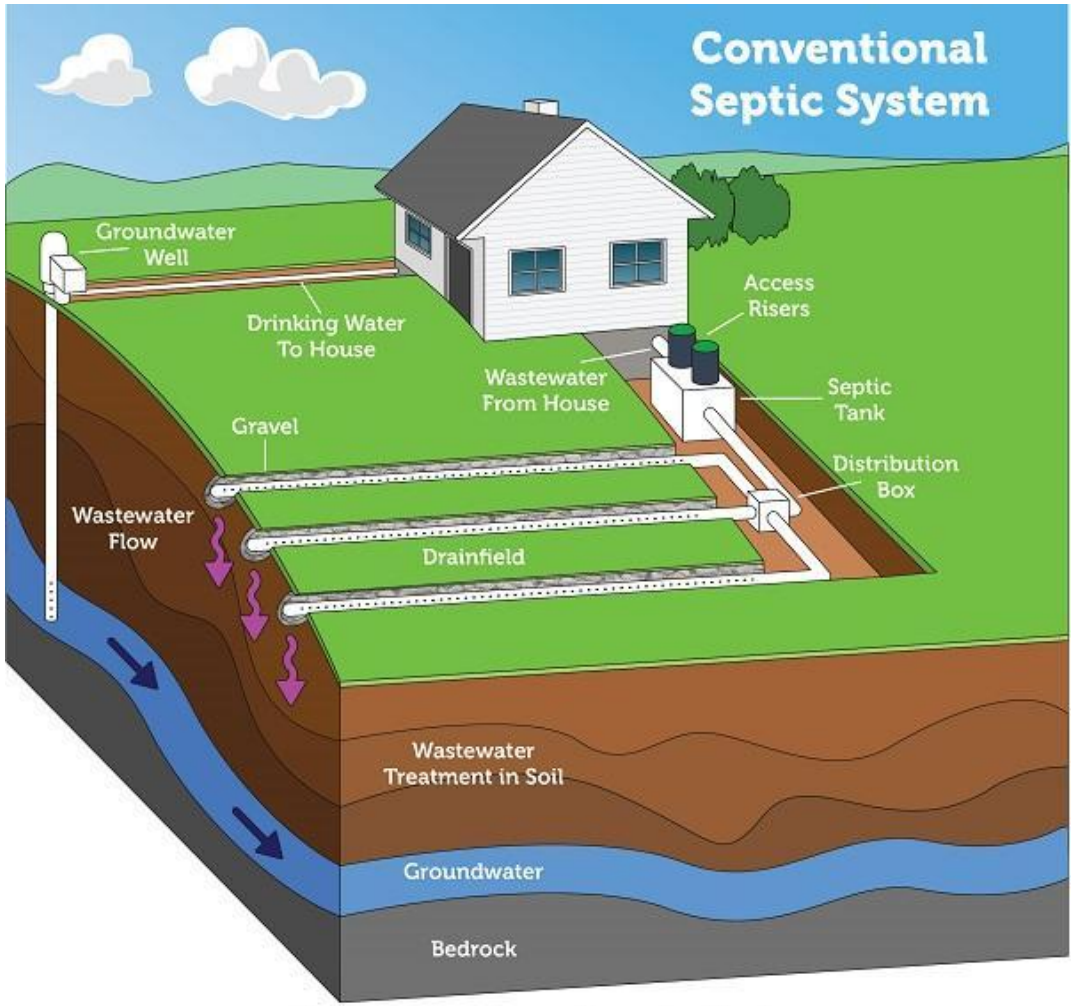
Footprint size is based on the expected flow amount and the soil evaluation (perc test)

- Effluent flows into the soil, the bacteria form a **biomat.**
- Provides nearly total removal of biodegradable organics, suspended solids, phosphorus, some heavy metals, and virus and fecal indicators.
- Nitrogen is the most significant wastewater parameter not readily removed by the soil within the footprint
- Inspection Ports may be installed to observe the liquid level in trenches, to monitor if there is ponding

RCAP Solutions

Conventional Septic System

- Gravity fed
- Septic tank
- D-box
- Drainfield
  - Require deep, usable soil
  - Not easily installed on steep slopes
- Typical residential water usage is 75-100 gallons per person per day.



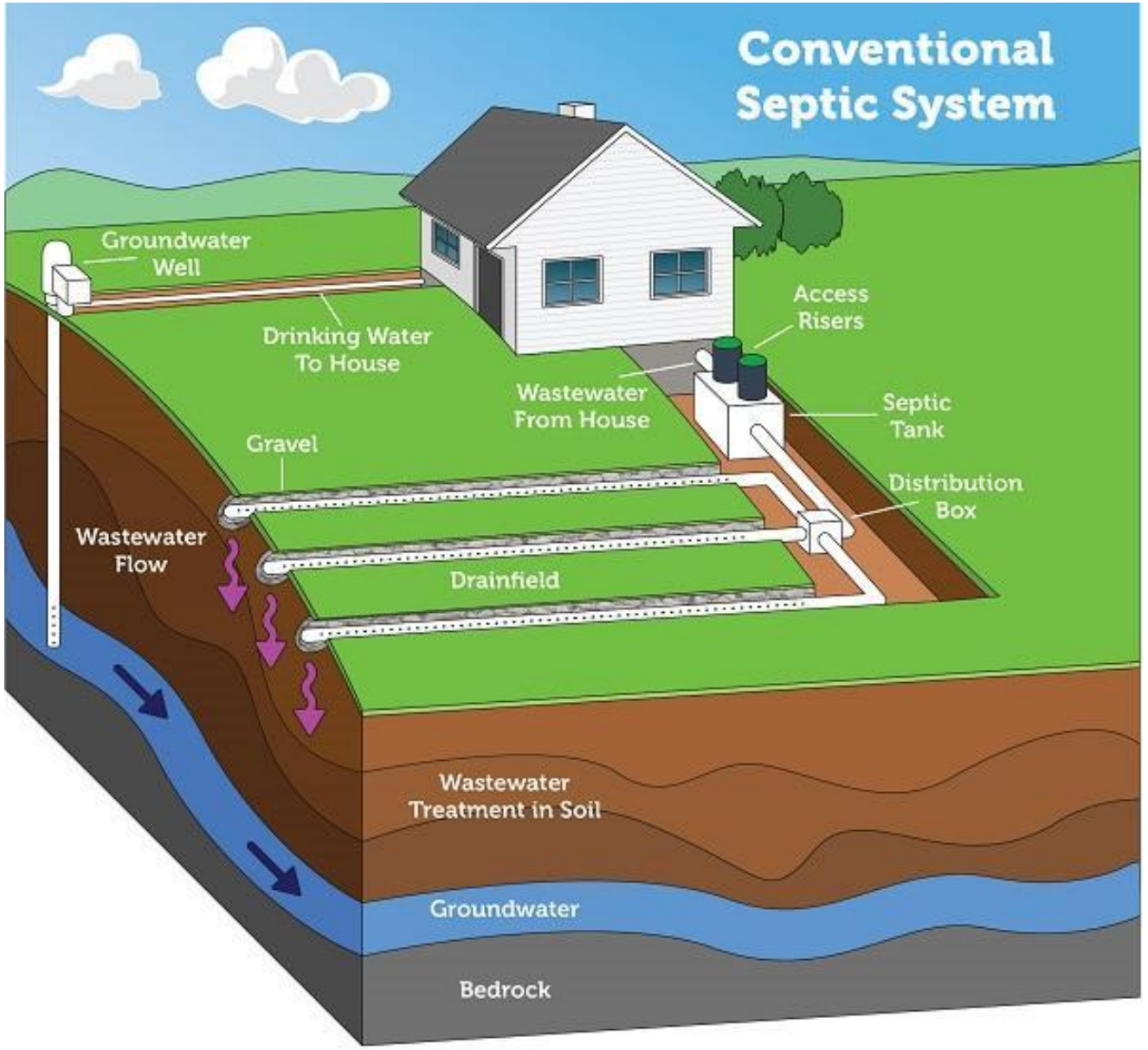
Please note: Septic systems vary. Diagram is not to scale.

Cluster Systems in the Field

RCAP Solutions

Trenches

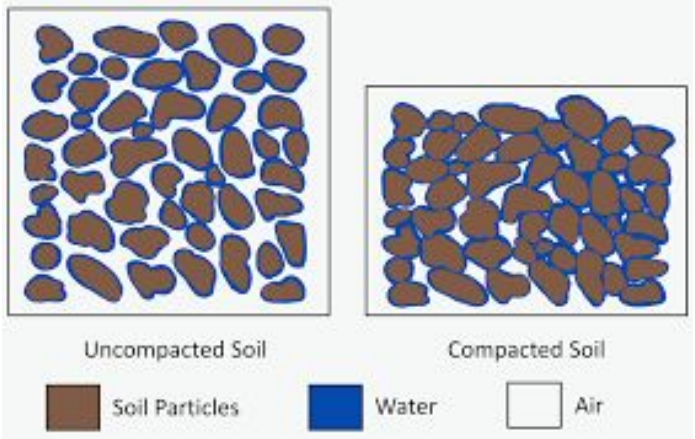
- Narrow stone-lined ditches
- Perforated pipes surrounded by stone and wrapped in geo fabric to prevent backfill from migrating
-
- Have more surface area to leach into soil (bottom and 2 sides)

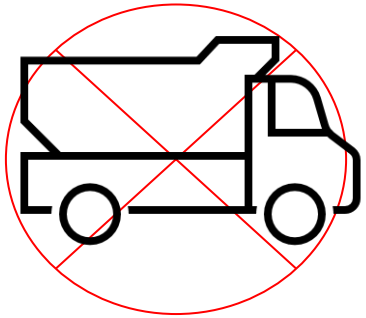


Please note: Septic systems vary. Diagram is not to scale.

Trenches in the Field

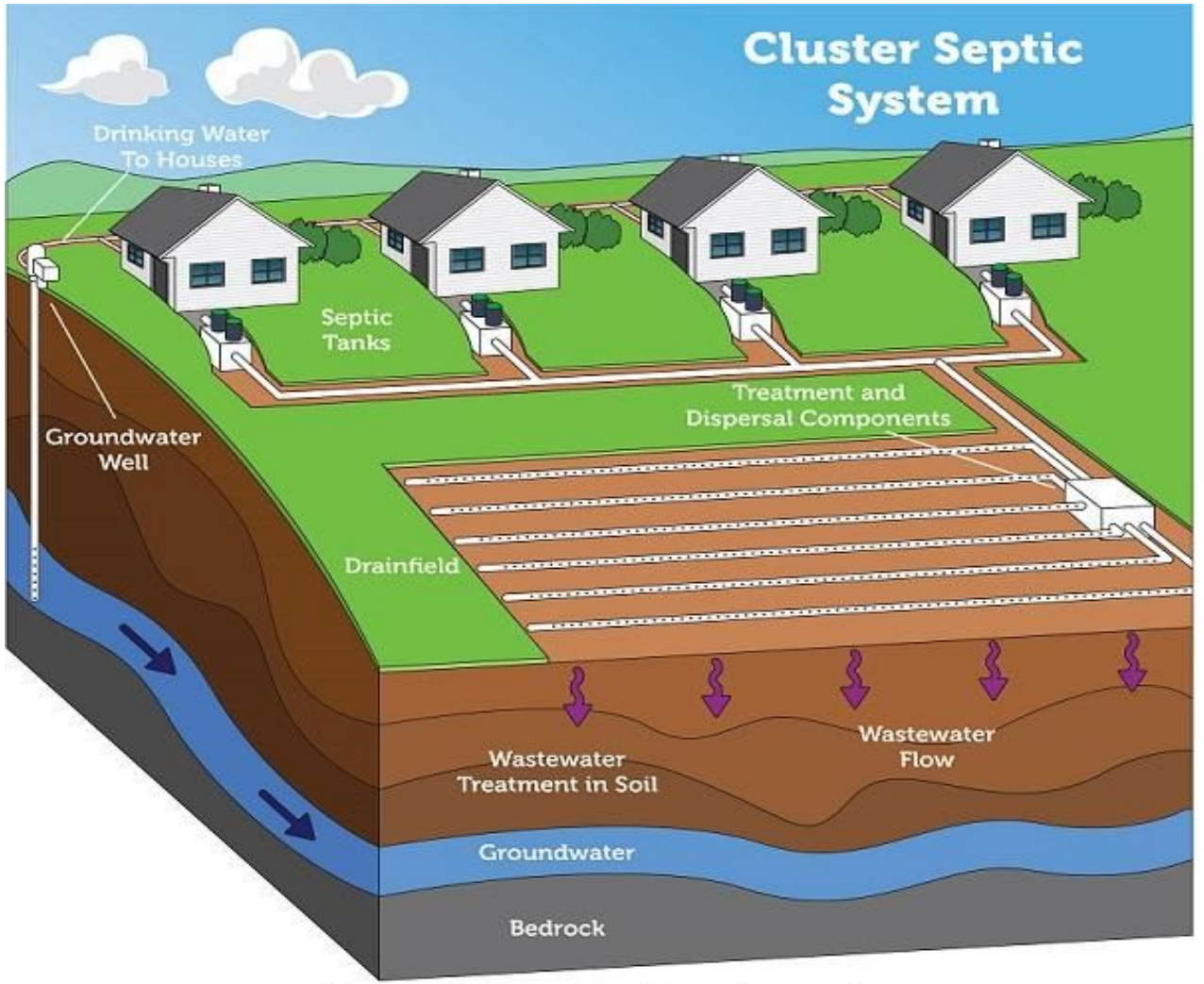
RCAP Solutions





Beds

- A single footprint/area that contain multiple lines of piping.
- Used for more permeable soils
- Must be careful during installation not to compact the soils



Please note: Septic systems vary. Diagram is not to scale.

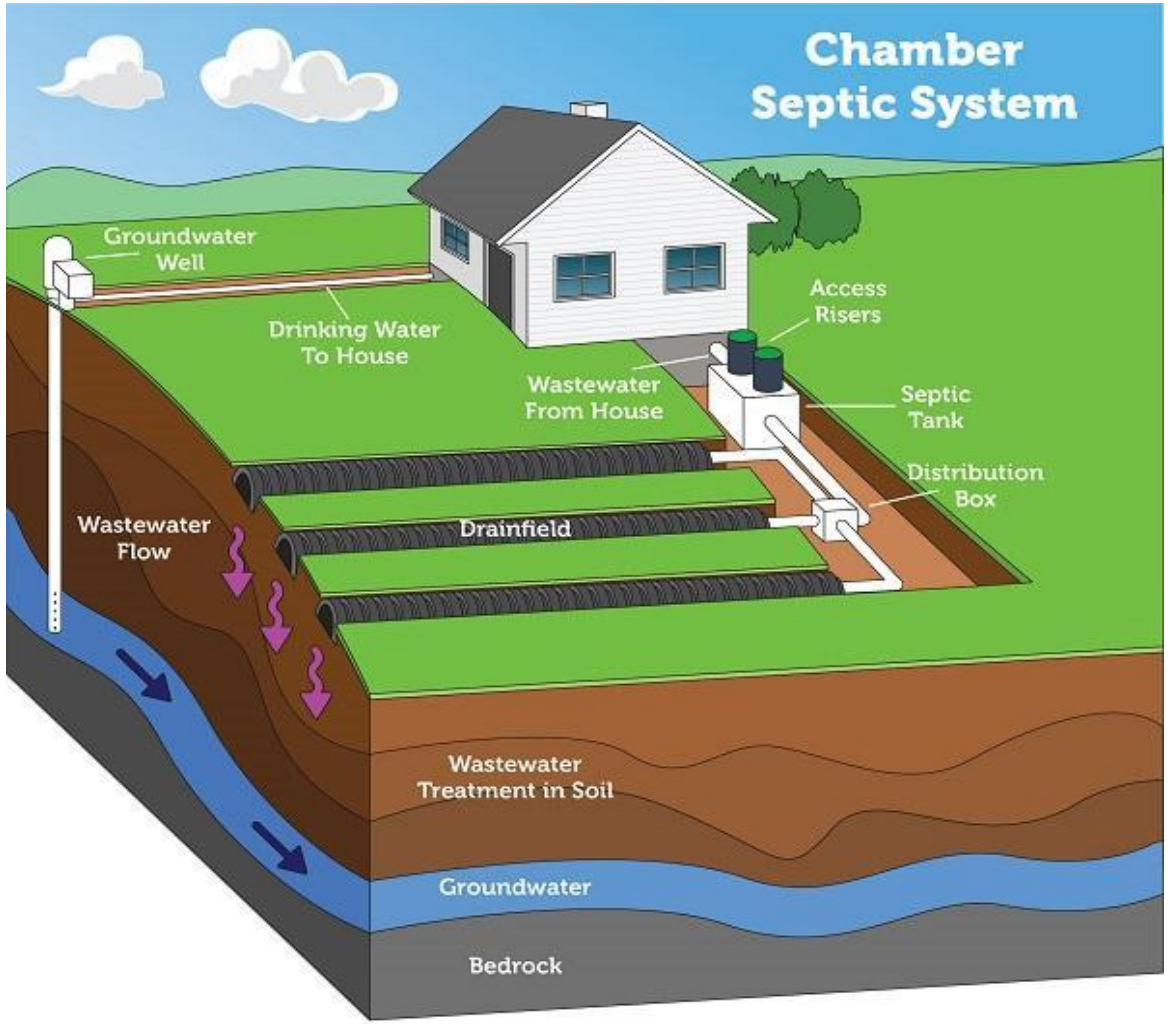
RCAP Solutions

Beds in the Field

RCAP Solutions

Chambers

- Open bottom, arch shaped HDPE segments or fabric-wrapped pipe, placed on the appropriate soil
- Light, fast and easy to install
- Installation does not compact soil
- Can provide more storage, and more time for proper infiltration
- Good for variable volumes
- No gravel needed
- Also used for stormwater



Please note: The ends of the chamber system lines are open for illustrative purposes only. In reality, and when properly installed, these lines are closed at the end. Septic systems vary. Diagram is not to scale.

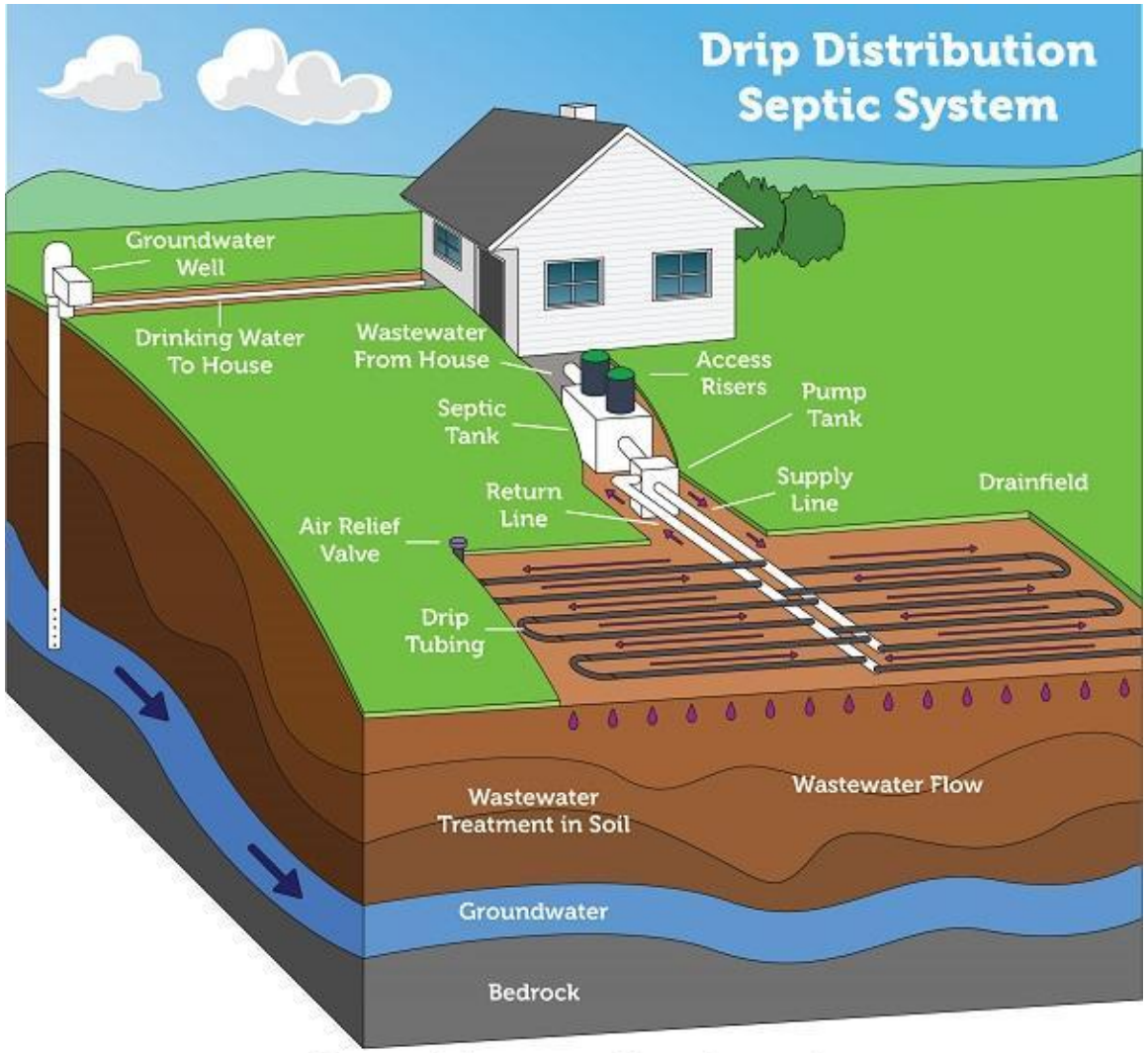
RCAP Solutions

Chambers in the Field

RCAP Solutions

Drip Distribution

- Pressurized system does require pumping.
- Releases small amounts or “drips” of wastewater effluent at regular intervals
- Maximizes the treatment of sewage and minimizes the risk of untreated wastewater quickly flowing through the soil
- Can be expensive to install and maintain
- Does not require as much hauled-in material. (uses native soil)
- Best suited for fast draining soils or near sensitive areas.



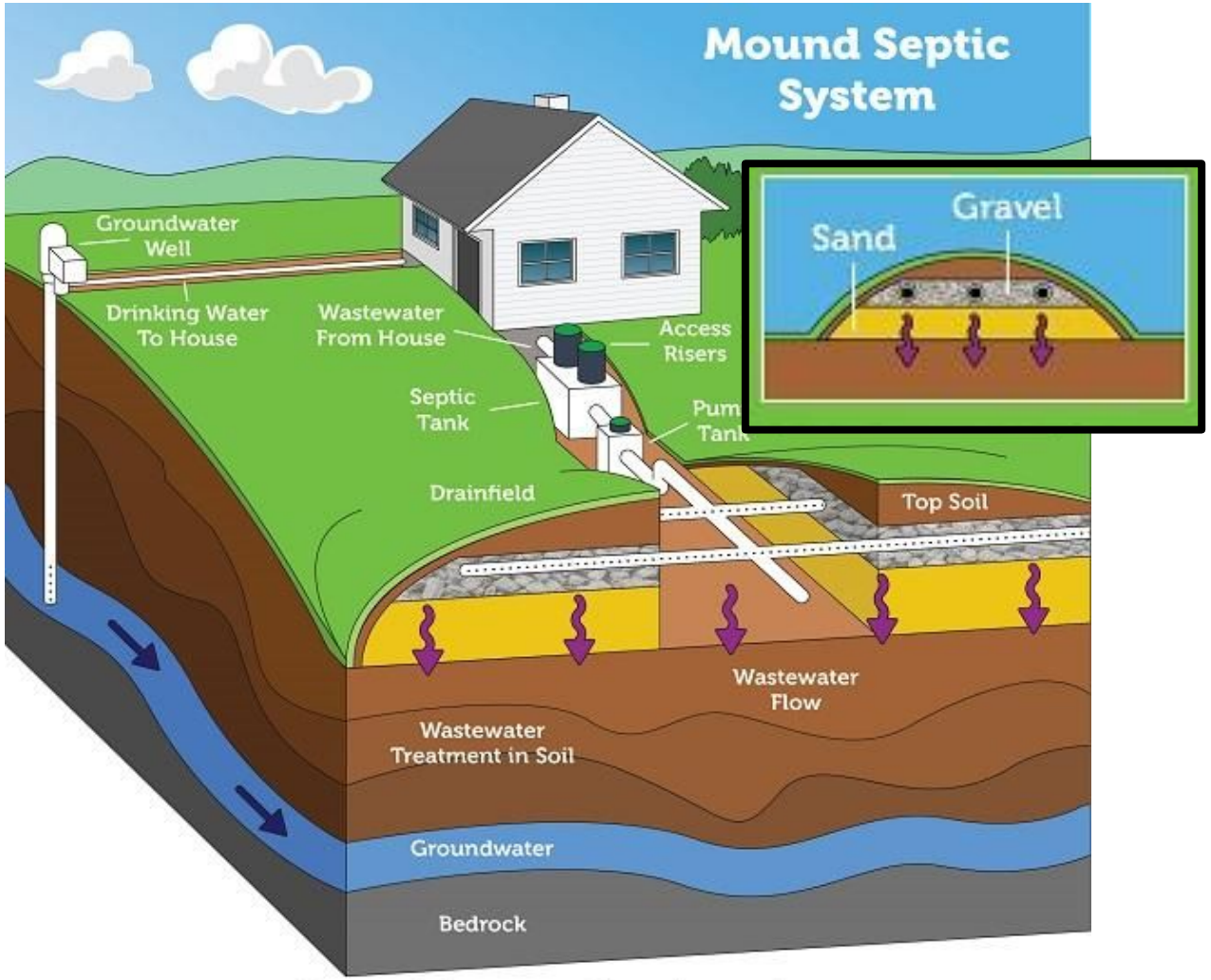
Please note: Septic systems vary. Diagram is not to scale.

RCAP Solutions

Drip Distribution in the Field

Mound

- Leaching bed elevated **above ground** with clean sand to provide ~3 ft of vertical separation to a saturated restrictive layer
- A pump may be required or can be fed by gravity depending on elevation requirements.
- Requires additional materials be hauled on site.
- Used to enhance existing soil treatment.



Please note: Septic systems vary. Diagram is not to scale.

RCAP Solutions

Mound systems in the field

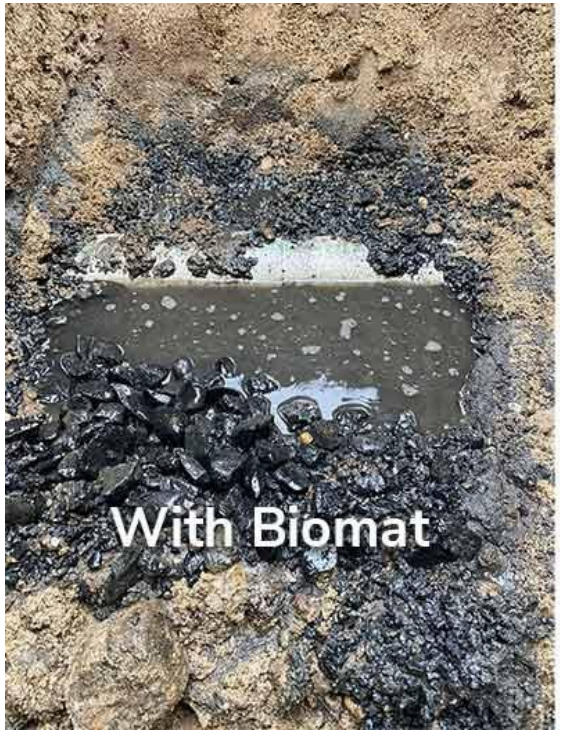
RCAP Solutions

BOD in the septic system

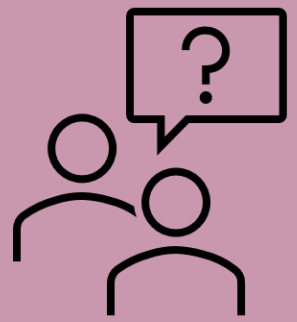
Septic tank –some BOD is removed by anaerobic (without dissolved oxygen) digestion

Leach field - BOD supports the growth of the microbial biomat (slimy layer of bacteria) which forms under the leach field.

- Too much BOD:
  - can lead to excessive growth of bacteria in the biomat
  - All available oxygen is consumed
  - The desirable aerobic bacteria die, anaerobic bacteria blooms (creates mucus like slime) which can quickly clog a leach field or cause it to function poorly
- Not enough BOD
  - less effective biomat forming under the leach field.

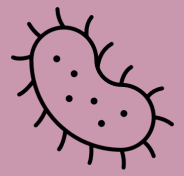


RCAP Solutions



Pick the correct component order:

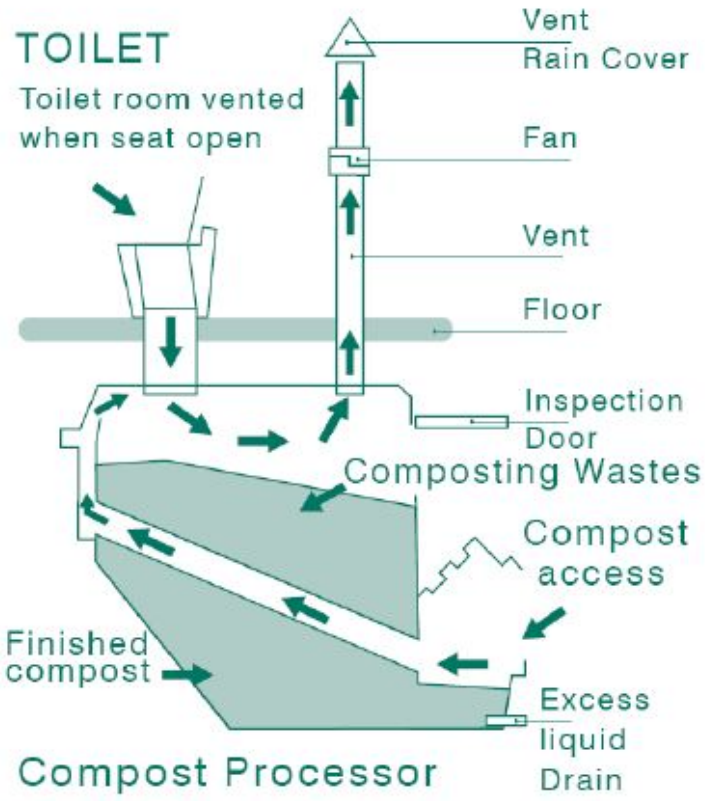
1. Septic tank, D-box, leachfield
2. Septic tank, mound, pump chamber
3. Septic tank, pump tank, drip dispersal
4. Pump chamber, septic tank, sand filter



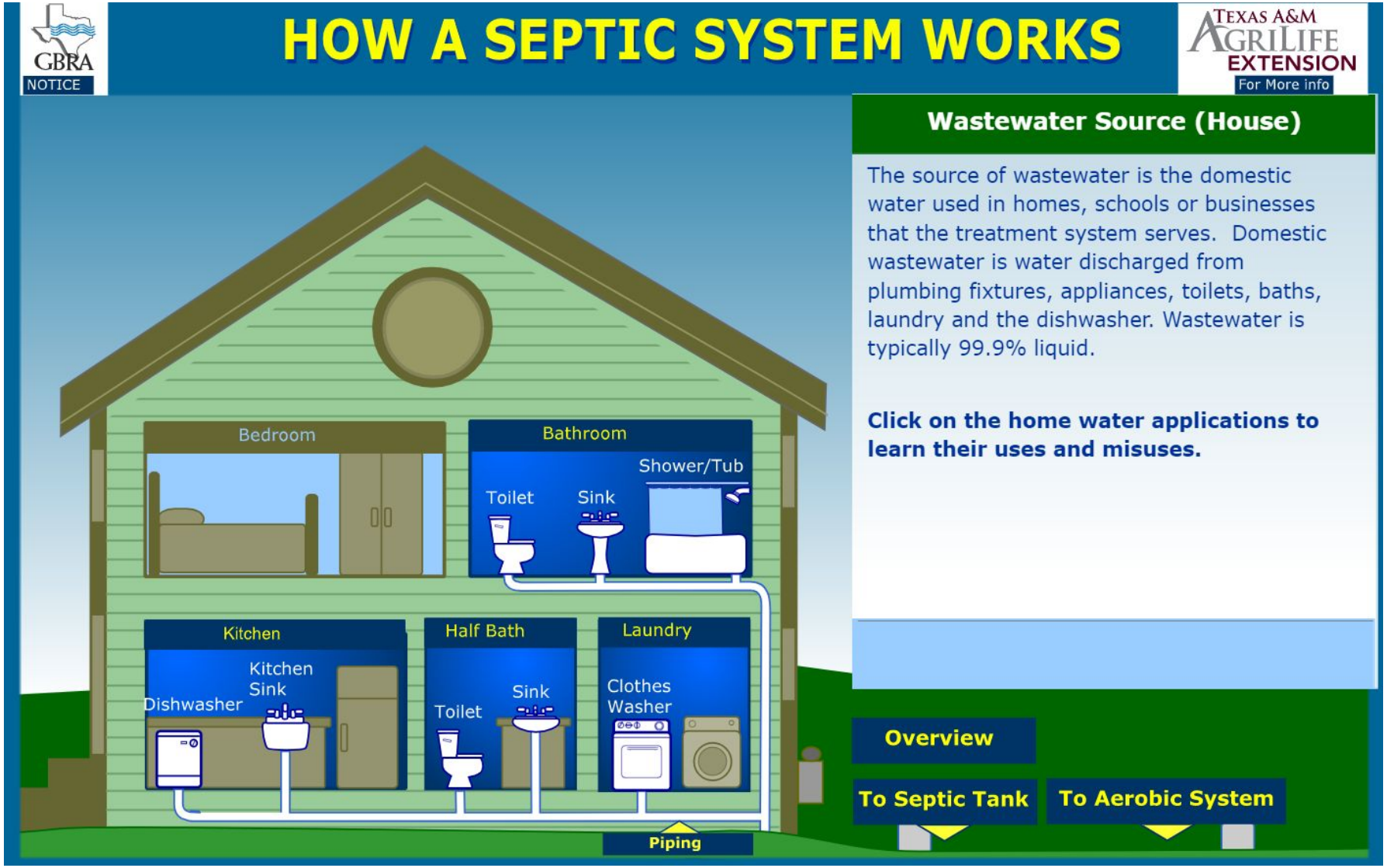
RCAP Solutions

Composting Toilets

- Not just a hole in the ground (pit toilet, outhouse)
- Use little to no water (30% of water usage is to flush)
- Use aerobic decomposition by adding carbon-rich absorbent material (sawdust, peat moss, straw)
- Bacteria consume and digest
- Some have fans and heaters
- “Compost” must be removed from the system at regular intervals



RCAP Solutions



https://www.gbra.org/presentations/septic/index.html

- Quick Tip Videos
- Brochures
- Posters
- Mailers
- SepticSmart for Tribal Communities
- SepticSmart Community Case Studies
- Webinars about Decentralized Wastewater Treatment

https://www.epa.gov/septic/septicsmart-education-materials

Questions?

Don’t forget to take your Post-Test!

Winnie the Poo

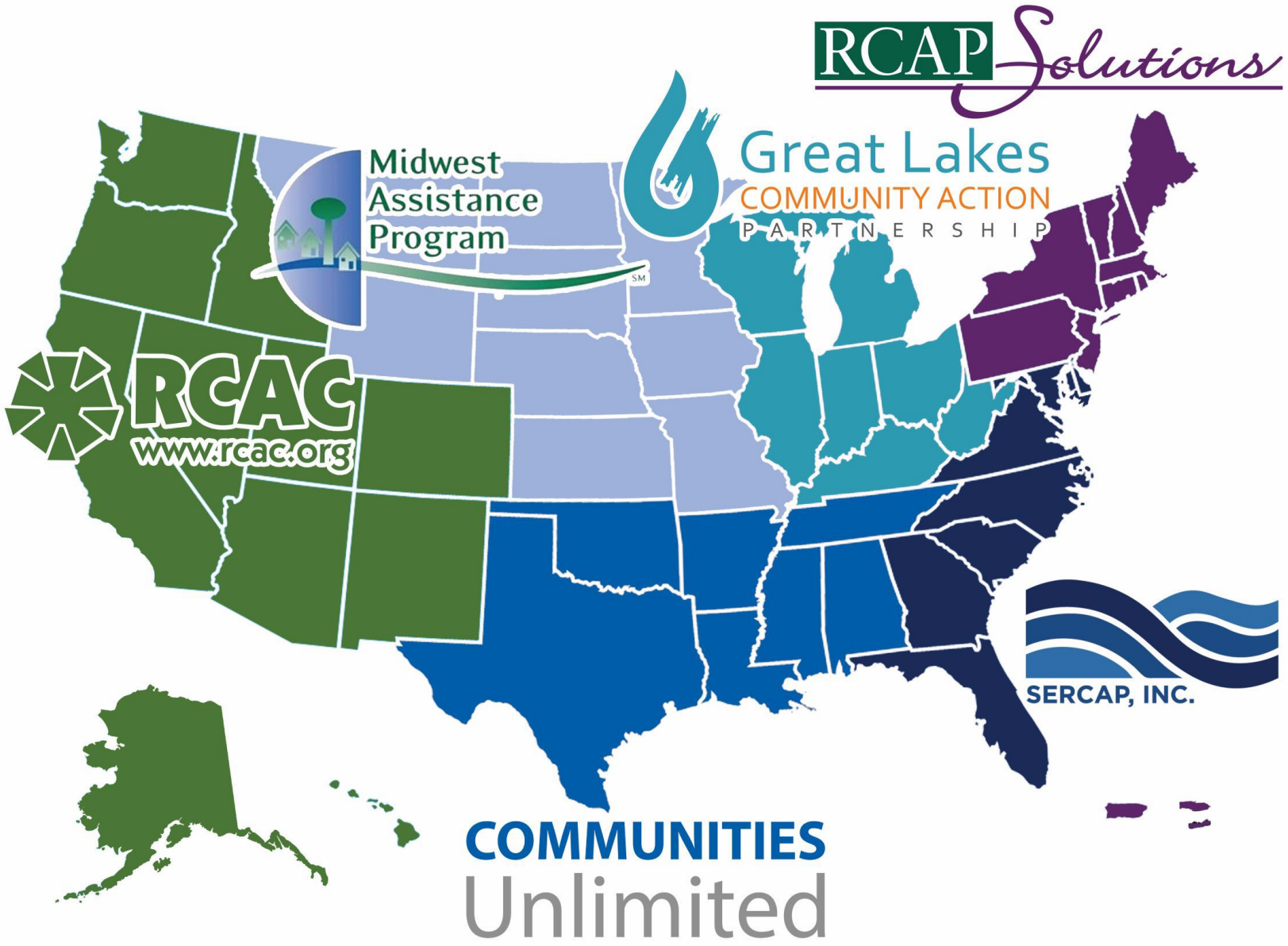
RCAP Solutions

Septic 101
Please complete your pre-test NOW

RCAP Solutions
Massachusetts

RCAP Solutions

Today's Presenters: RCAP Solutions

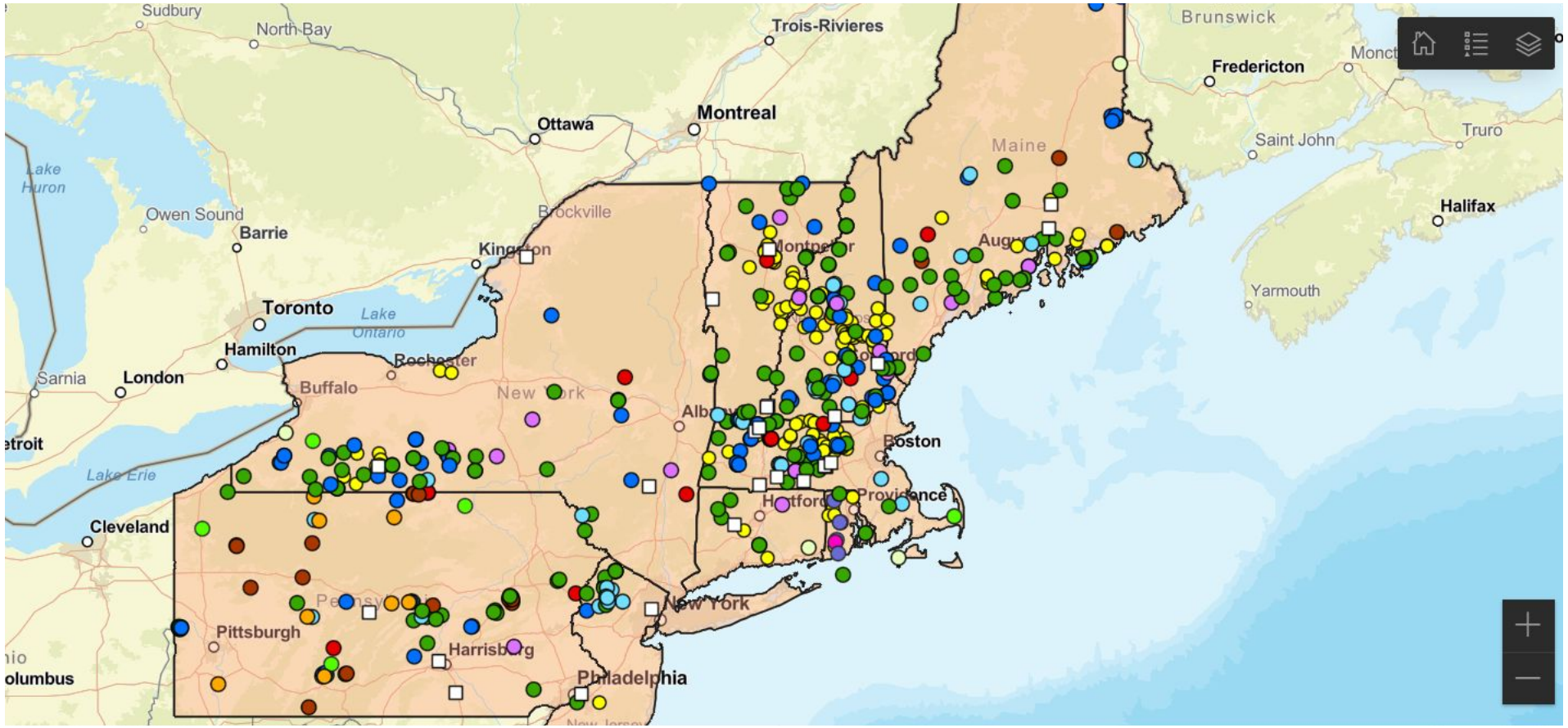


Rebekah Novak, E.I.T.
Water Compliance Specialist (MA)
rnovak@rcapsolutions.org

Andrew Evans
Environmental Technician
aevans@rcapsolutions.org

https://rcapnational.maps.arcgis.com/apps/webappviewer/index.html?id=61b5505cf4fb4026ac6cf1345321b1e8

RCAP Solutions Impact



RCAP Solutions

Acknowledgement

This project has been funded wholly or in part by the United States Environmental Protection Agency under an EPA Training and Technical Assistance for Small Drinking Water Systems to Achieve and Maintain Compliance.

The contents of this document do not necessarily reflect the views and policies of the Environmental Protection Agency, nor does the EPA endorse trade names or recommend the use of commercial products mentioned in this document.

For more information on this topic please visit: https://www.epa.gov/septic/septicsmart-homeowners

RCAP Solutions

Innovative & Alternative (I/A)

RCAP Solutions

Innovate/Alternative (I/A)

Chosen because of:

- site constraints
  - Area topography
  - Limited available space
  - Depth to groundwater
  - Less than ideal soil conditions
- Environmentally sensitive areas
  - Near a body of water or drinking water supply
  - *NITROGEN REDUCTION/REMOVAL
- Seasonal or intermittent use
- Enhanced Treatment Requirements

I/A System

- Adds a step between the septic tank and SAS.
- Expected to deliver higher quality effluent (lower BOD, nitrates, etc.), requiring less treatment from the final SAS component.
- This may allow the SAS to be downsized or require less vertical separation

- **Septic tank**
- **I/A components**
  - Control Panel (most)
    - Pumps
    - Level sensors
    - Programmable timers
    - Alarms
  - Enhanced treatment
- **Soil Absorption system (SAS)**

RCAP Solutions

Control Panel

- Analog or Motherboard/programmable Logic Controller (PLC)
- Alarms (Water level, parameters, time, power)
- **Pump** start/stop
- Programmable **timers**
  - precisely controls small pumping doses
  - Ideal when there is long periods of storage between discharges (churches, schools etc.)
  - Manual/off/automatic motor control operation
- **Telemetry**- dedicated phone line/internet connection
  - Monitors alarms, pump run time, water level, pump amperage etc.
  - Remote system adjustments: on/off pump run time, turn of alarm, pump override cycles, turn pump on and off

****Caution: ELECTRICAL HAZARD! Only licensed electricians should open, diagnose and repair any electrical system.**

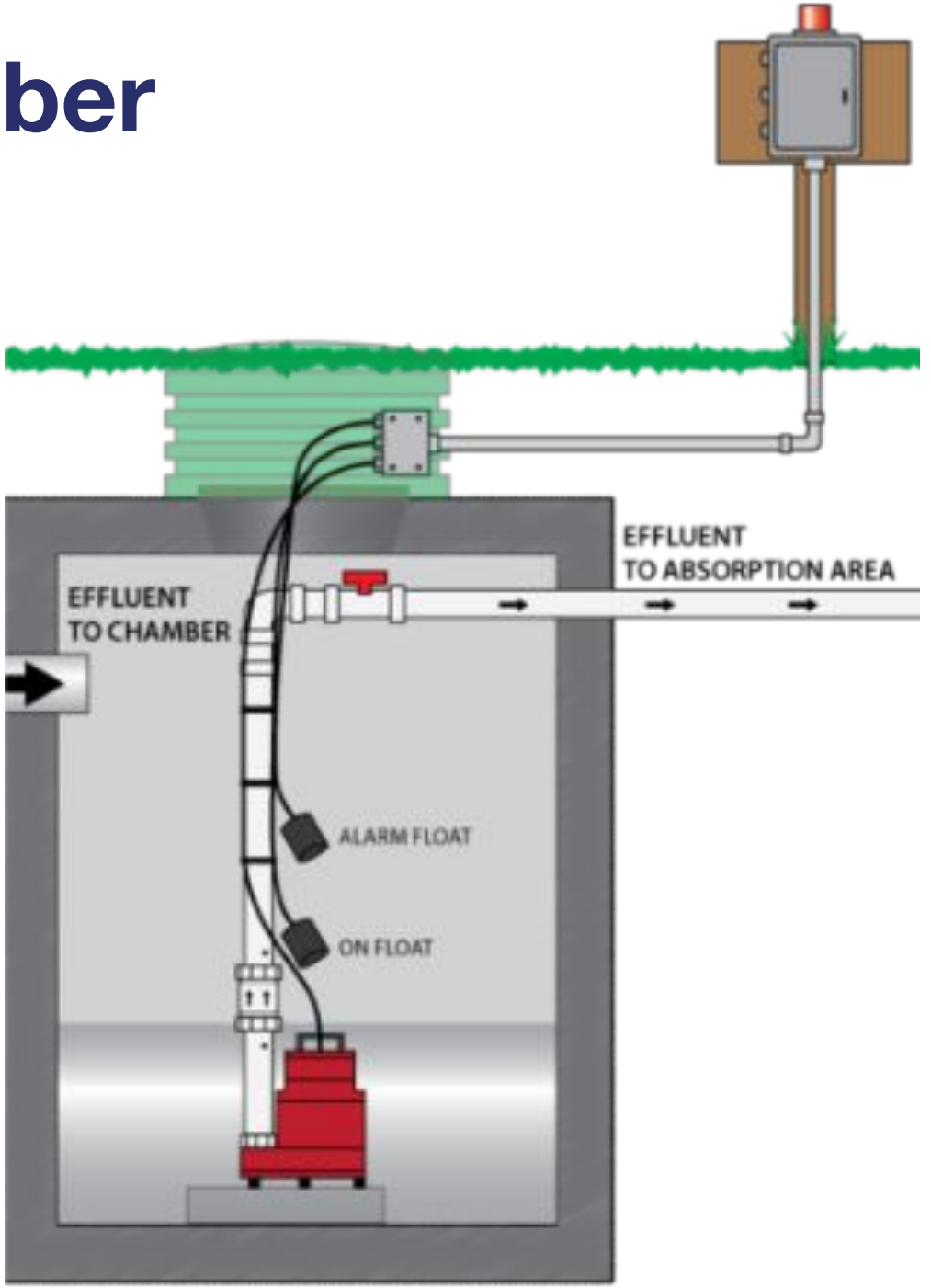
RCAP Solutions

Pump Chamber/Dosing Chamber

- Cannot discharge by gravity, intermittent discharge, recirculating sand filters, pressure distribution
- Timed, measured doses
- Emergency storage capacity = daily design flow
  - Don’t forget about drain-back volume

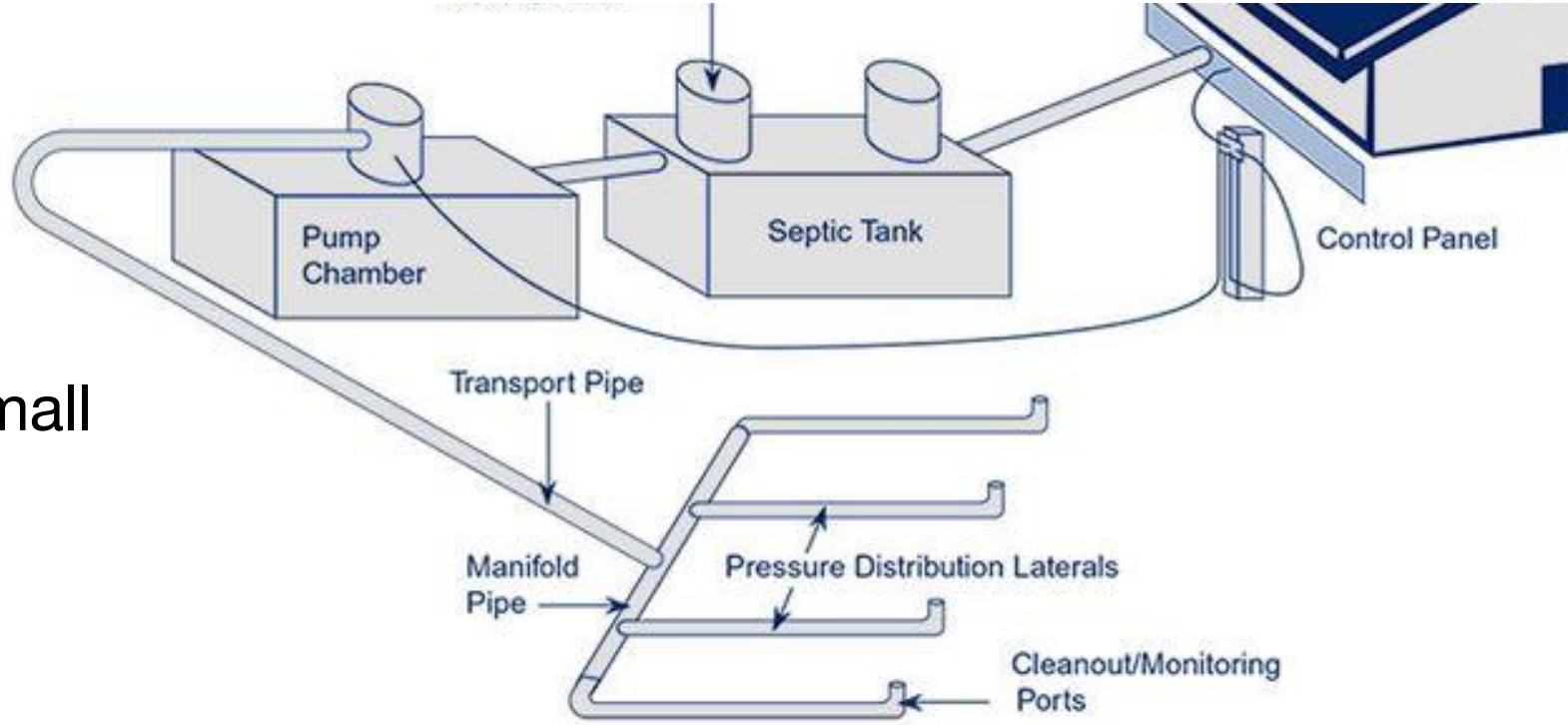
Components

- Chamber (~1,000 gallons)
- Splice box/electricity
  - Submersible effluent pump(s)
  - Float switches
- Weep hole for drain-back
- Effluent filter
- Access cover large enough to pull equipment out for service or repair



Pump Systems

- **Pressure distribution**
  - Septic tank
  - Pump chamber
  - Manifold
  - Laterals/drain line with small orifices/holes
- **Drip distribution**
  - Septic tank
  - Pump chamber
  - Tubing with small orifices/perforations

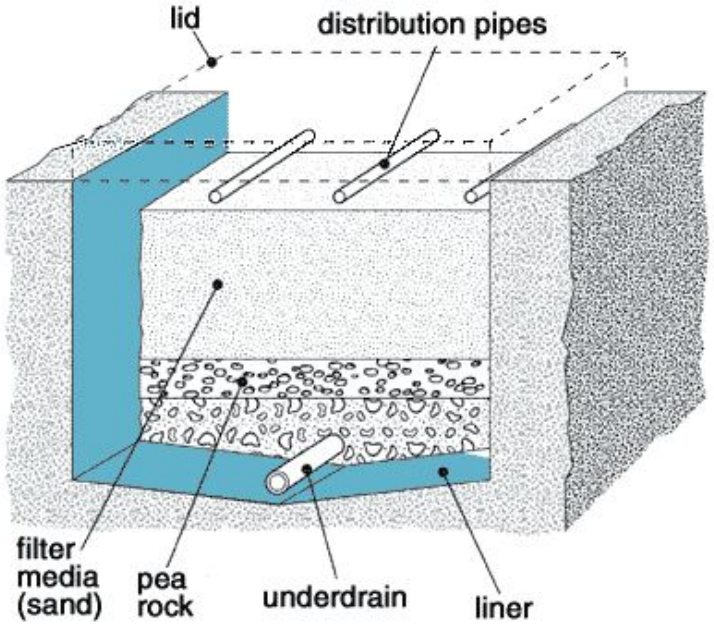


RCAP Solutions

Attached Culture

Trickling Filter/packed bed filter:

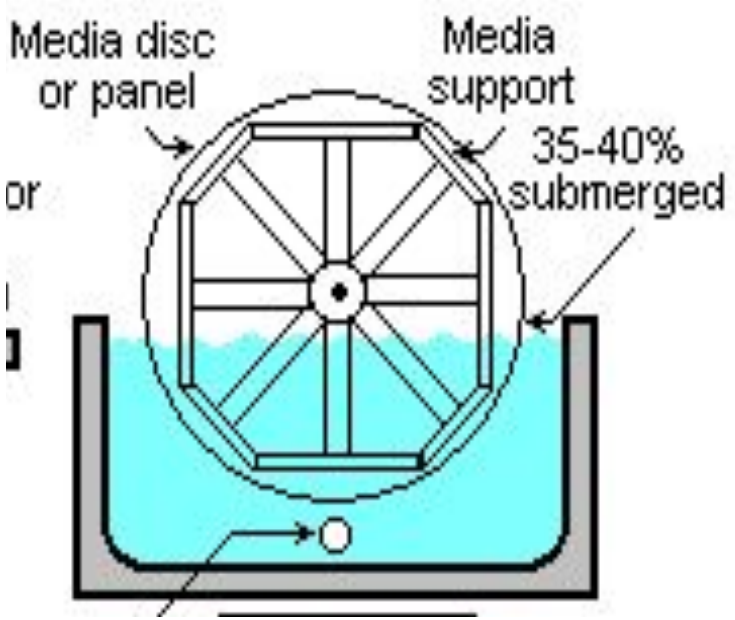
- Wastewater flows over fixed bed of media, where microbial films grows on the surface
  - Rocks, textile fabric, gravel, foam, peat moss, plastic
- Recirculates wastewater



- Open or covered
- Must be accessible for cleaning
- Treatment slows down in cold temperatures (may need insulation)
- Sensitive to pH
- Installed where subsurface construction is impossible
- Similar process and organisms as found in the natural bio-mat of leach field soils.
- Large footprint
- Small- medium sized systems

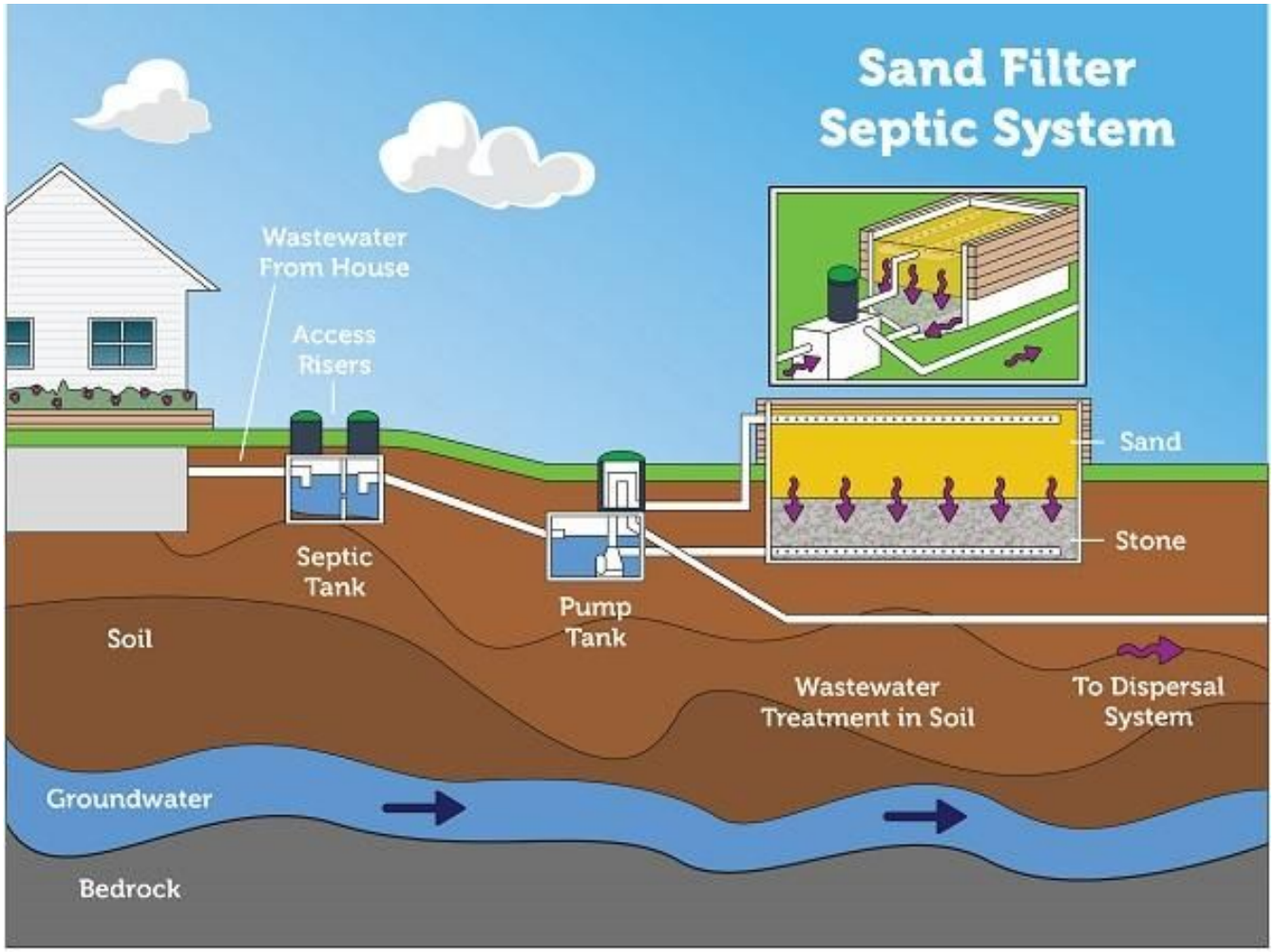
Rotating Biological Contactor (RBC)

- Media fixed on disks is rotated through the wastewater and then through the air



(Recirculating) Sand Filter

- Pumped doses to a perforated pipe into a layer of sand and stone
- Water is collected in an underdrain and is recycled, then sent to SAS
- Used where there is insufficient or sub par soil, high groundwater, limited space or is close to surface or well water (nutrient limits)
- Contains aerobic and anaerobic zones
- ~50% of nitrogen is removed

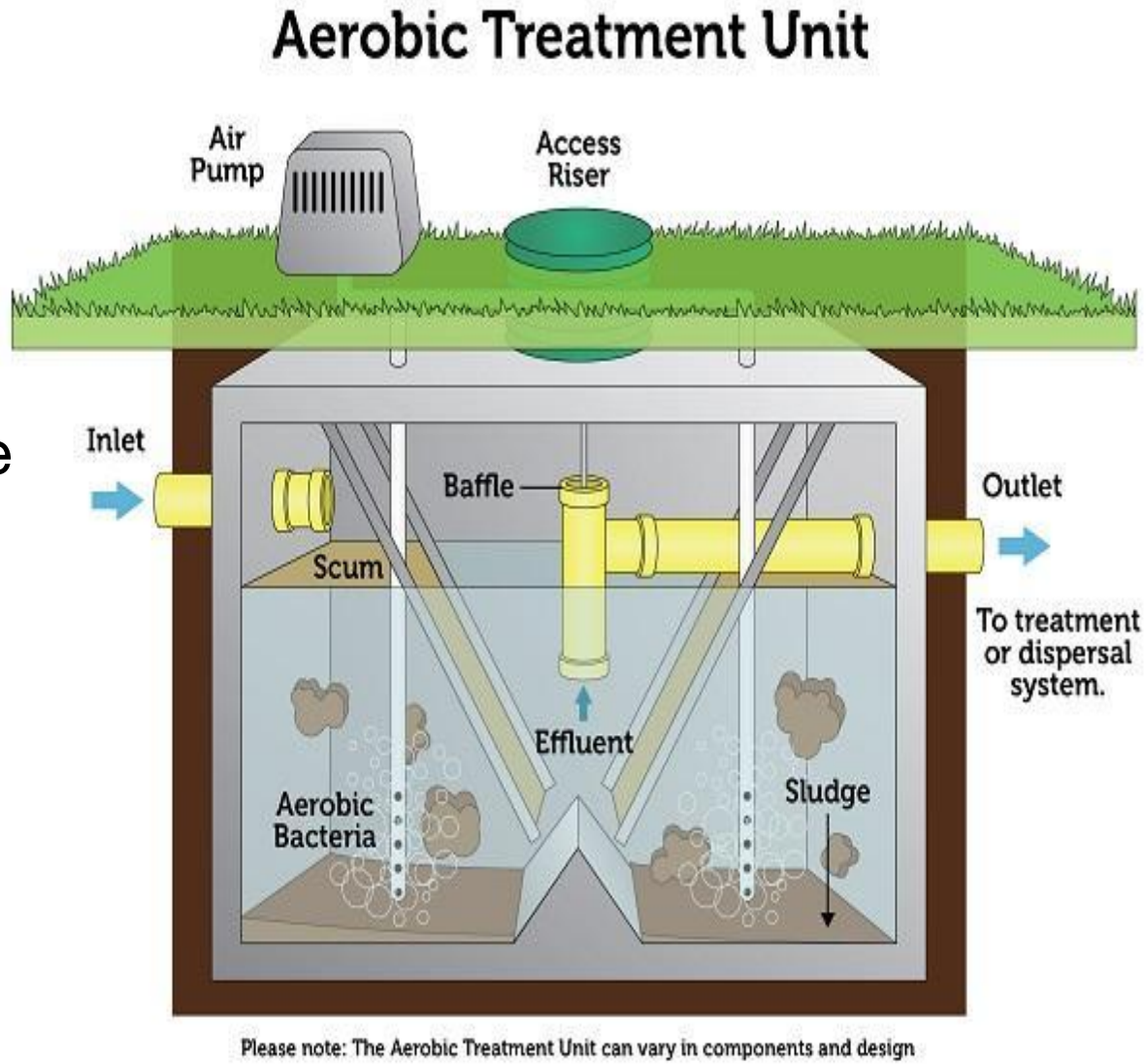


Please note: Septic systems vary. Diagram is not to scale.

Recirculating Sand Filters in the Field

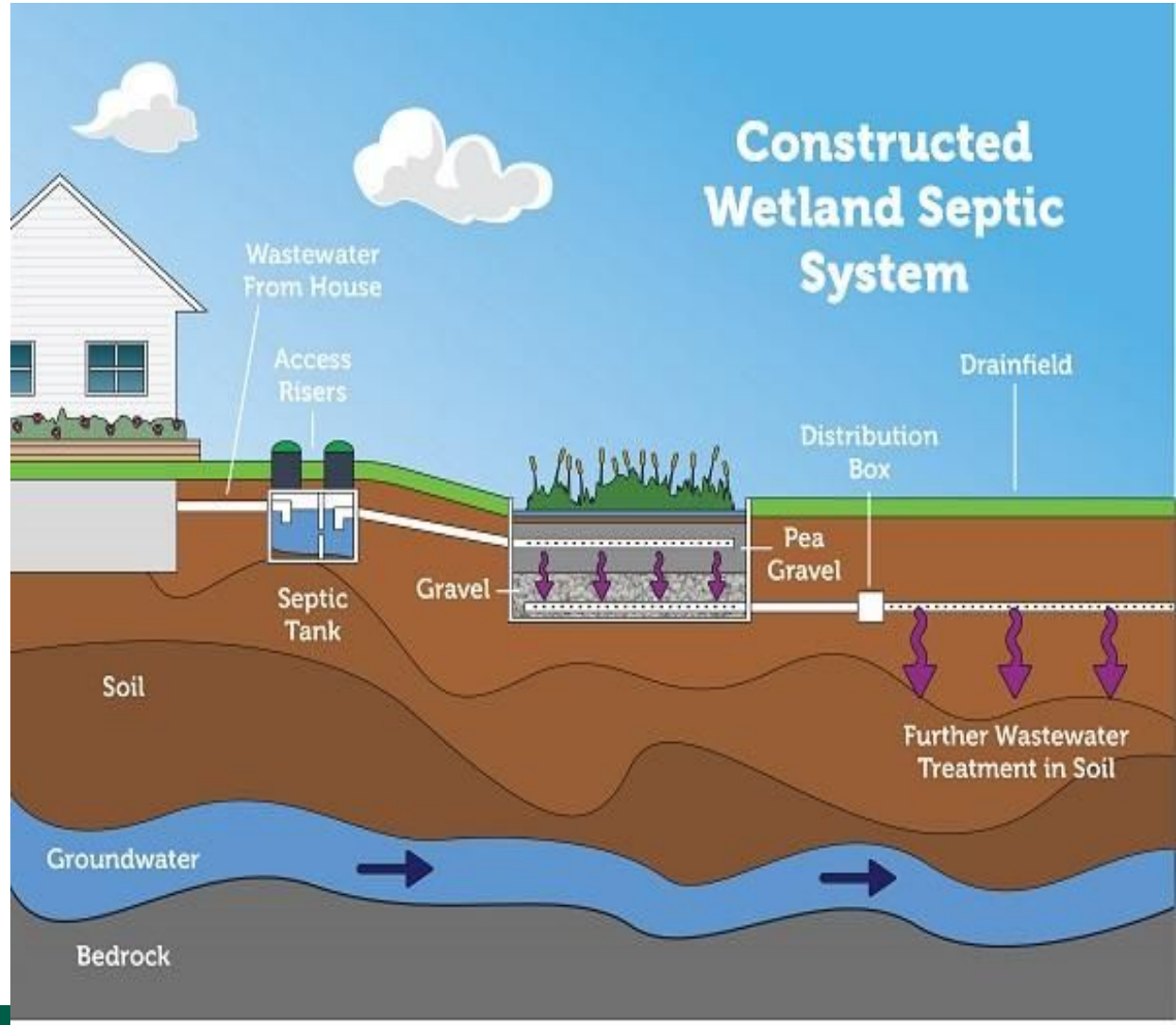
Suspended Growth (Activated Sludge)

- Aeration system
- Mixes wastewater
- Utilizes resident population of bacteria
- Periods where the mixing ceases and the solids are allowed to settle and excess solids can be removed.



Constructed Wetland/ Lagoon

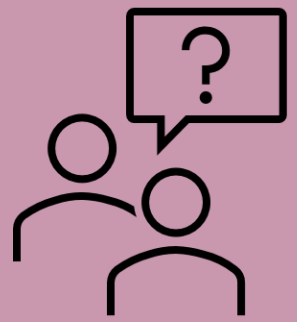
- microorganisms, media, and plants that provide treatment
- Can be gravity or pressure fed.
- Contains piping to provide even flow throughout
- Filled with graded gravel or media
- May flow into a SAS for further treatment
- Can be expensive to install and maintain
- Requires a significantly larger area
- Performance varies seasonally



Please note: Septic systems vary. Diagram is not to scale.

Constructed Wetlands in the Field

RCAP Solutions



Which of the following needs an I/A system the most?

1. Most of the site has high groundwater
2. The site owner does not want to cut down any trees
3. The homeowner has 8 children
4. The home is within 200’ of a lake

RCAP Solutions

Operation & Maintenance (O&M) and Proper Usage

RCAP Solutions

Operations, Maintenance & Proper Usage

RCAP Solutions

Self O&M (the resident)

Septic Tank

- Pump regularly
- Can sludge judge your own tank so you don't pump until needed (saves money)
- Pumped when the depth of the sludge and scum layer is equal to or more than 50% of the liquid level (by inspection)
- As the sludge level increases, wastewater spends less time in the tank (less time to settle)and solids may escape into the SAS
- Clean effluent filter (pumper or yourself)

Drainfield/SAS

- Maintain grounds above the field
- Grass cover is best within a 10' perimeter around/over the drainfield
- Remove trees or large brush – roots will find their way into pipes and covers
- Spread out major water discharge like laundry and showers

Pump chambers

- Check/clean floats, pump, alarms, Screens/filters, electrical/amp draw (indication pump issues) and pump run time (indicates pump issues)
- Lateral lines should be flushed.

Additives

- Not necessarily beneficial, can even be harmful -may break down solids too much, don't settle, bypass the effluent filer, and will end up in field (Septic system enzyme)
- NOT needed for system start-up, will NOT reduce pumping frequency

Unmaintained Leachfield Examples

RCAP Solutions

O&M Contract (multi-home, schools, etc)

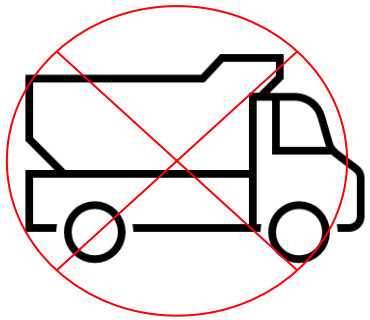
- Licensed Service Providers
- Absolutely necessary for some systems
  - Keeps system working efficiently, prevents costly repairs
  - Mechanical and electrical components cleaned and adjusted regularly
  - Routine servicing can detect problems you aren't aware of
  - Lateral lines may be flushed
  - Routine sludge judge to tell you when to pump (saves money)
  - Some systems require the contract to ensure warrantee
  - Some Boards of Health require the contract and paperwork submittal
  - Failure can be a public health threat (nearby drinking water supplies, flooded fields)
- Some systems require Licensed Installers
  - Monitoring (size dependent) – collect samples and send to lab
  - Warranty
  - Environmentally sensitive area? (more required monitoring)
  - Grease trap
  - Community by-laws set in place to protect the system

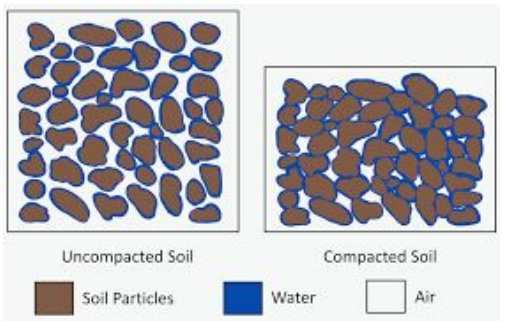
RCAP Solutions

DO NOT ALLOW

- The flushing of: Chemicals, paint/thinners, poisons, flushable wipes, cat litter, large amounts of FOG (fats oil & grease-kitchen or automotive), large amounts of disinfectants, sanitary napkins, tampons, and pharmaceuticals
- Habitual use of household drain cleaner/opener
- Vehicles/heavy equipment on drainfield, or stockpiled snow
- Water from roof drains, sump pumps or irrigation systems
- Garbage disposal connection
- Water softener backwash - can kill the good bacteria and void your warrantee

flush

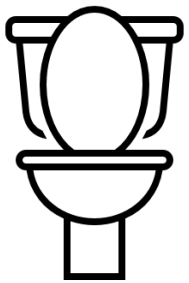


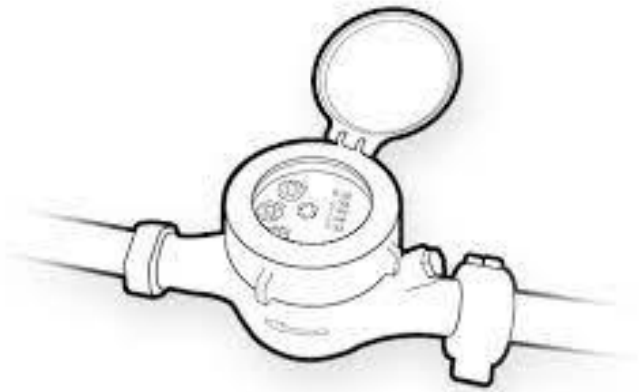


RCAP Solutions

Water Conservation

- Leaky faucets or toiles should not go unfixed – a leaking toiled can flood your system **(a leaky toilet can waste 200 gpd, that's 6,000 gallons per month!)**
- **Put dye in tank, see if it leaks to bowl**
- **Listen for a hissing noise at the tank or disturbance in the water either in the bowl or the tank, these can indicate a leak**
- **Utilize smart water meters**





RCAP Solutions

Grease Traps

- Sizing
- Maintaining
- Location: Where they are found/recommended?
- Restaurants
- Ghost kitchens
- Pumping frequency

RCAP Solutions

Vent

- What's the deal with the candy Cane? Everyone wants to know!

- There are both the INLET and OUTLET sides to vent. No smell should come out of this inlet vent. The system, septic tank, plumbing and roof vent/stack are all connected and because of

  A) the difference in elevation, air will flow out of the elevated end (stack) and

  B) because the biological processes create slight heat, and heat rises, it will follow the opposite flow of a gravity line, and up and out the roof vent/stack.

  *Make sure the vent has a screen. Make sure the vent isn't blocked

RCAP Solutions

Venting and Gasses

- Most common type of gas found in Decentralized systems is **H2S.**
- Hydrogen sulfide is a **colorless, flammable, and highly toxic gas**. It has a characteristic rotten-egg odor. Very Important to ventilate for personal safety but also the integrity of your system components. It is very corrosive.
- Other Highly toxic components of sewer gas include ammonia, methane, carbon dioxide, sulfur dioxide, and nitrous oxides among others.

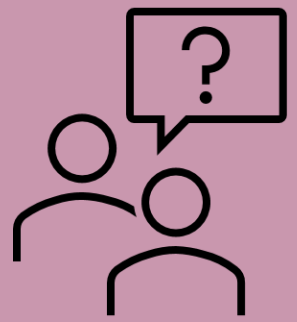
- **EXERCISE EXTREME CAUTION!!!**

RCAP Solutions

Sewer Pipe Materials

- PVC - white
- ABS - (black plastic)
- Cast Iron – rusty metal
- Orangeburg – black with layers
- Clay – orange

RCAP Solutions



What is the purpose of a sludge judge?

1. Measure the level of solids
2. To tell how good the sludge quality is
3. Water level in the leachfield
4. To settle disputes within the septic tank

RCAP Solutions

Failing Systems

- **Failing septic system – when wastewater is unable to seep into the ground**
    - Hydraulic overload
    - Improper disposal of Solids or grease
    - Tank full of solids and overflowing to drainfield, clogging it
    - High groundwater table flooding the drainfield
    - Leaking tanks, Broken pipes, tree roots, general damage
- Signs of a failing septic system
    - Sluggish drains or odor
    - Backups into the house
    - Squishy patches or ponding above drainfield
    - Lush grass above drainfield
- Different states have different regulatory agencies and programs.

RCAP Solutions

Signs that your septic tank is full

1. Overdue pumping
2. Standing water around the tank
3. Unpleasant odors
4. Gurgling pipework
5. Slow draining
6. Trouble flushing
7. Suspiciously lush lawn
8. Algal bloom in nearby ponds
9. High nitrate in nearby water wells
10. Backed up sewer lines

RCAP Solutions

TITLE “V” in MA

- What is a Title V inspection in MA?
- Title V refers to the section of the Massachusetts State Environmental Code that describes acceptable operating parameters for commercial septic systems.
- As of March 31, 1995, the state environmental code governing septic systems, commonly referred to as Title 5 regulations, **requires inspections of septic systems and cesspools prior to a home being sold or enlarged**. In most instances, systems that fail inspection must be repaired within 2 years.
- A Title V inspection involves **checking a septic system against these codes to ensure that the property is in compliance**.

RCAP Solutions

New Project Considerations

- Consultant
- Homeowner survey/newsletter development
- Meeting postings, publication and notice
- Educational materials
- Site evaluation data
- Soil scientists
- Attorney, consultant
- Engineers, Engineering report
  - Sanitary districts
  - Cooperative
  - Homeowner and lake associations

- Grant writer
- Creation of organization entity
- Purchase of land
- Applications, recording fees
- Responsible Management entity with the legal authority and administrative capabilities (organizational structure)
  - A legal and responsible entity is need to work on behalf of the community

RCAP Solutions

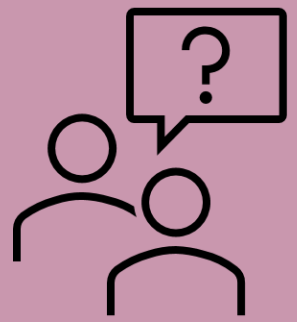
Design Considerations

- Ecological/Environmental Constraints
  - Temperature and precipitation
    - Large surface area systems need to take account for precipitation and seasonal patterns
  - Soil temp/depth of frost/snow cover
    - Depth of frost will influence depth and type of the system installed
  - Wildlife habitat
    - Soils affect the kind and amount of vegetation that is available to wildlife as food and cover
  - Native plant and animal species (protected species/critical habitat)
  - Area topography
    - Gravity or mechanical movement of wastewater
    - Amount of material needed to be dug out or added

- Population
  - Future population change - Quality and quantity of wastewater generated
  - Seasonal or year-round use (quick start up, matting etc.)
  - Density of population- current and future

- Proximity
  - Proximity to water/shoreline (targeted problem)
  - Proximity to drinking water wells (Wellhead Protection Area)
  - Proximity of homes to each other and treatment area
  - Land use
  - Parcel ownership and size
  - Local/Zoning ordinances
  - Neighbors – are others failing too?

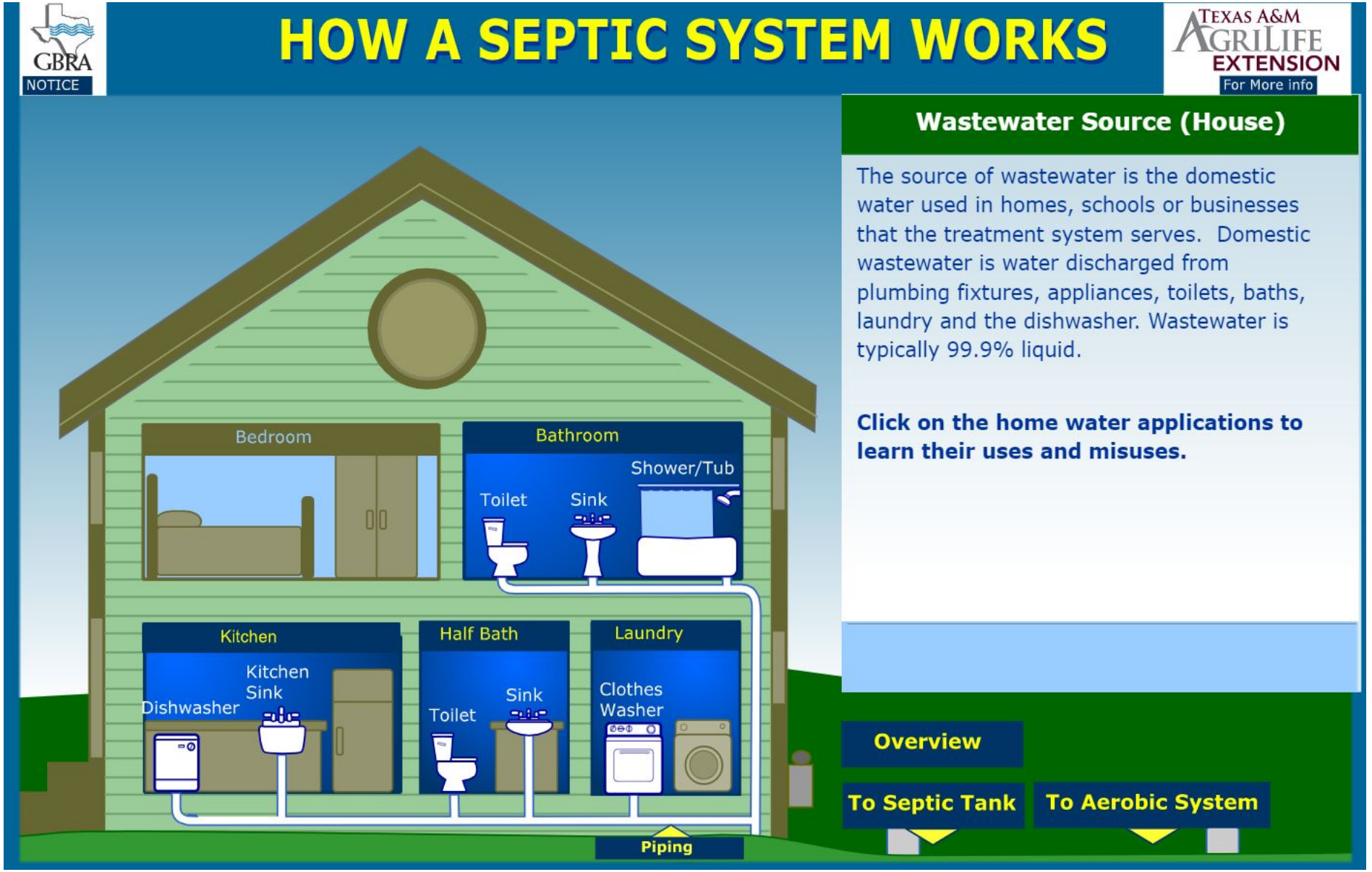
RCAP Solutions



What is the best way to prevent a system from failing?

1. Educate users on proper use
2. Hire an Operator
3. Do not use flushable wipes
4. Pump the tank every 6 months no matter what

RCAP Solutions



https://www.gbra.org/presentations/septic/index.html

- Quick Tip Videos
- Brochures
- Posters
- Mailers
- SepticSmart for Tribal Communities
- SepticSmart Community Case Studies
- Webinars about Decentralized Wastewater Treatment

https://www.epa.gov/septic/septicsmart-education-materials

"A lot of folks have been eating corn lately."

Don’t forget to take your Post-Test!

Questions?

RCAP Solutions