Solving Water Problems

College of Agricultural Sciences

MASTER WELL OWNER NETWORK

Pennsylvania's volunteer network for private water source protection.

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Penn State College of Agricultural Sciences research and extension programs are funded in part by Pennsylvania counties, the Commonwealth of Pennsylvania, and the U.S. Department of Agriculture.

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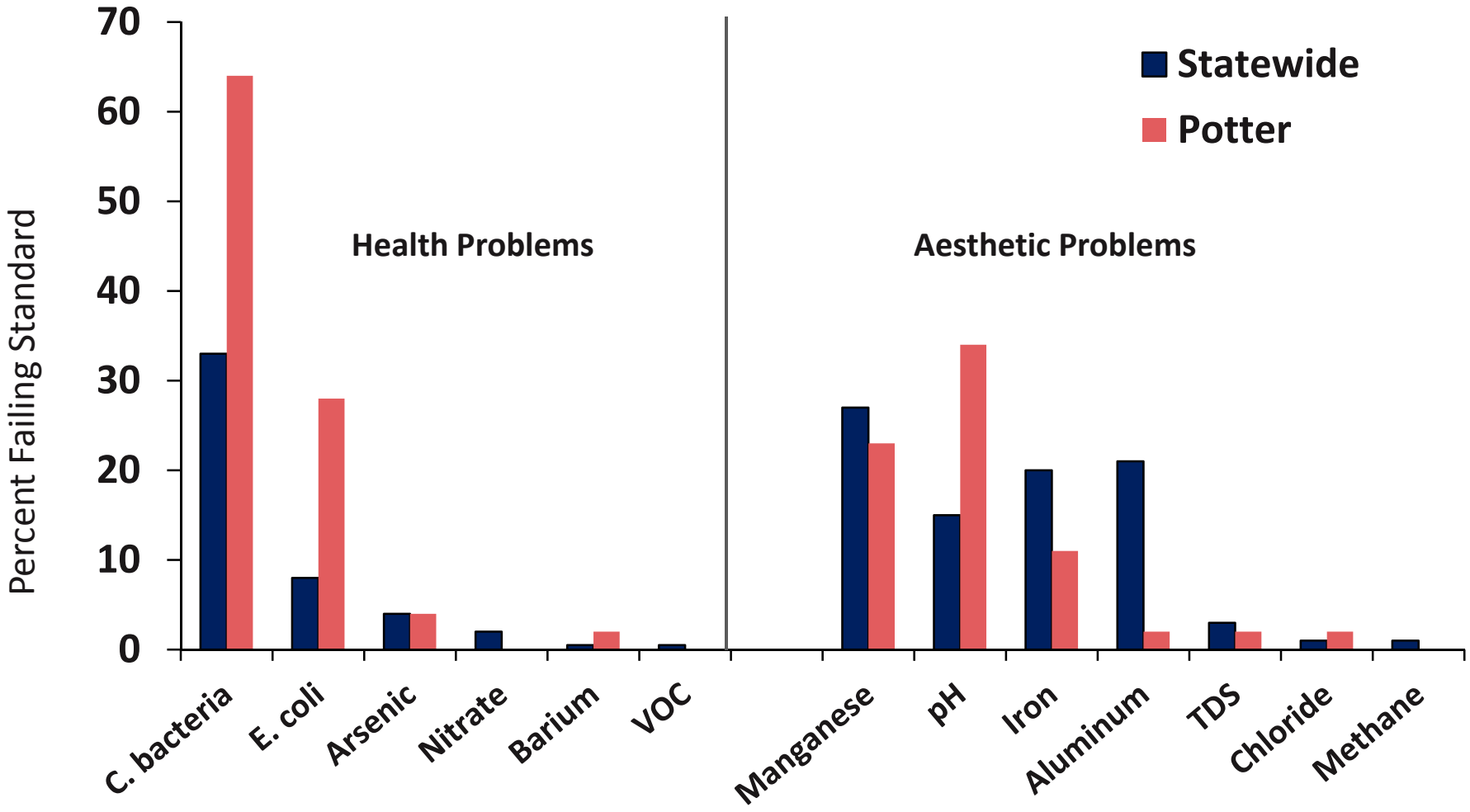
Why Solve Water Quality Problems?

- Private water wells and springs are not required to meet any drinking water standards
- Some pollutants can cause disease or illness
- Others cause stains, odors or tastes that make the water unappealing to use
- You can be held liable for illnesses to visitors to your home
- Most mortgage companies will require water to pass health-related standards before a home sale

Solving Water Quality Problems

- Base on independent lab results
- Explore all alternatives
  - New source, pollution control, maintenance/repairs, bottled water, treatment
- Match the pollutant with the correct process!
- May need more than one treatment in sequence
- 53% of PA private water systems have some treatment.
  - Most common: Sediment filters and softeners
  - About 10% unnecessary
- Maintenance is required
- Test water before and after treatment

Water Quality Problems in PA



Proper Well Construction

5 “sanitary” well cap

1 12” above ground

4 sloping ground

casing to bedrock

2

grout seal

3

bedrock

Only 20% of wells in PA
have sanitary construction

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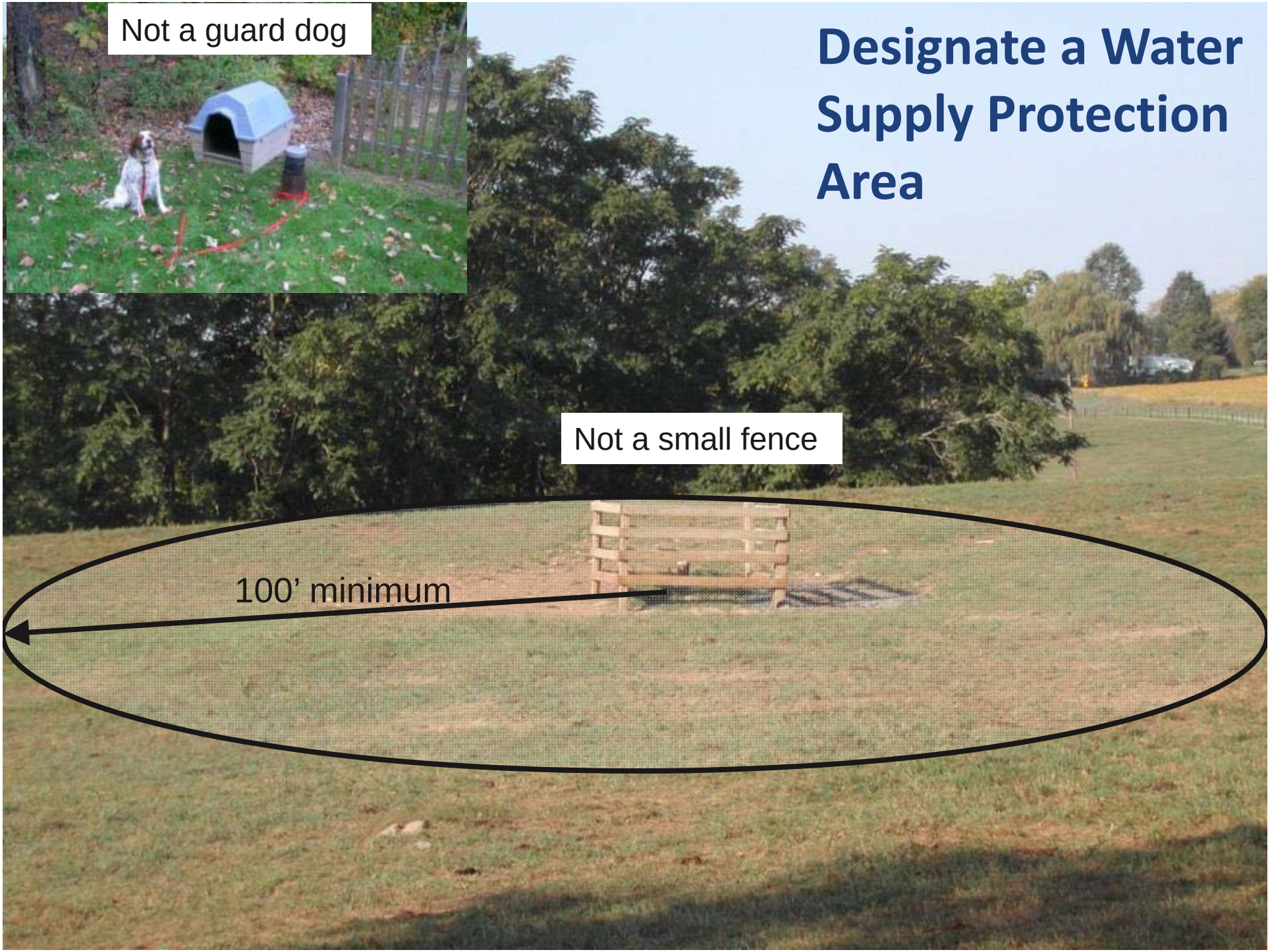
Designate a Water Supply Protection Area



Water Treatment

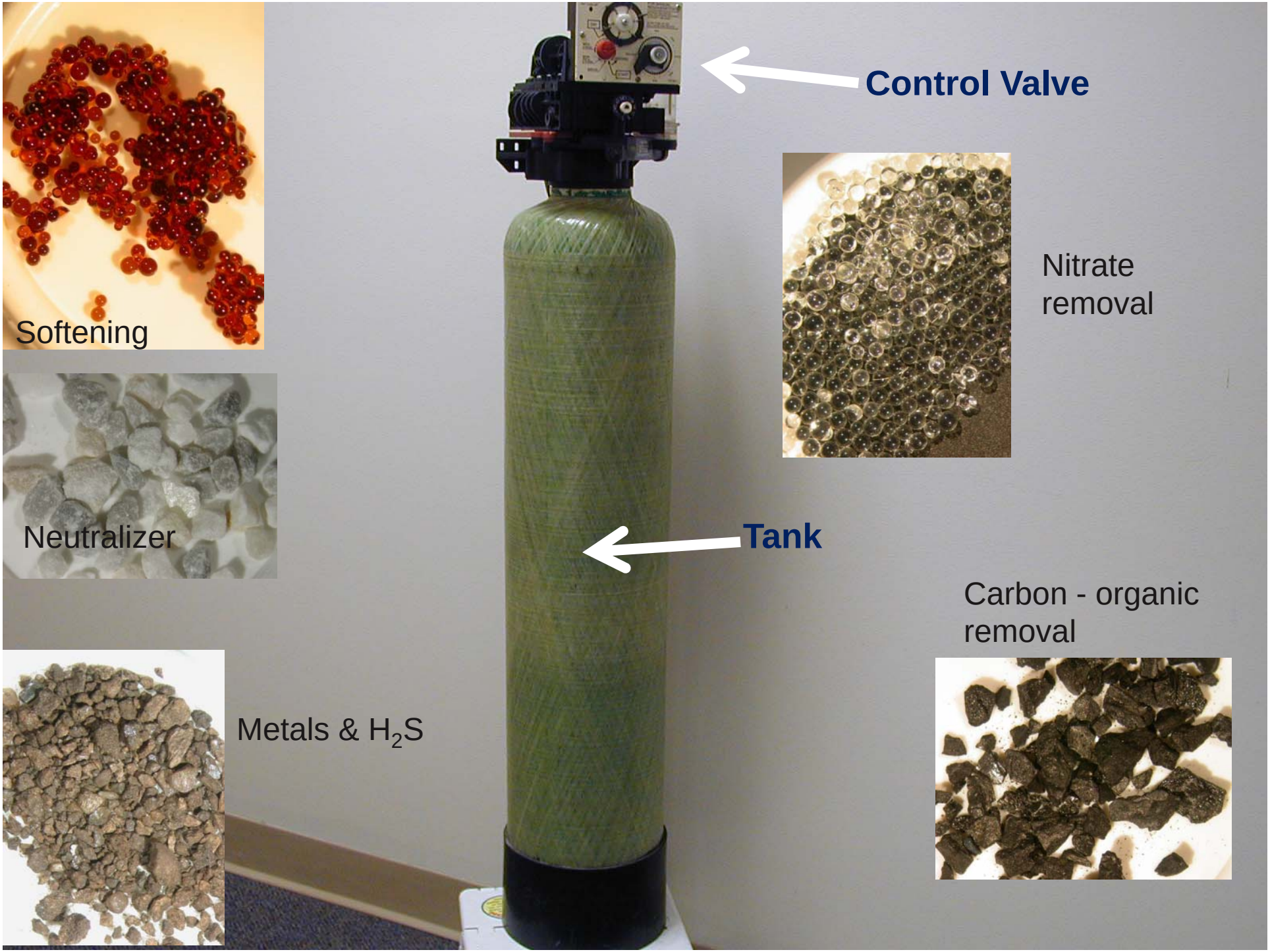
- Considerations
  - Health vs. aesthetic problem?

- Point of Entry (POE) – larger units, treat all water entering the home.
  - Mainly for aesthetic pollutants where all water needs treated or health-based pollutants which can enter the body through inhalation, absorption or drinking

- Point of Use (POU) – smaller units that treat water at one faucet
  - Mainly for health-based pollutants where exposure only occurs through drinking

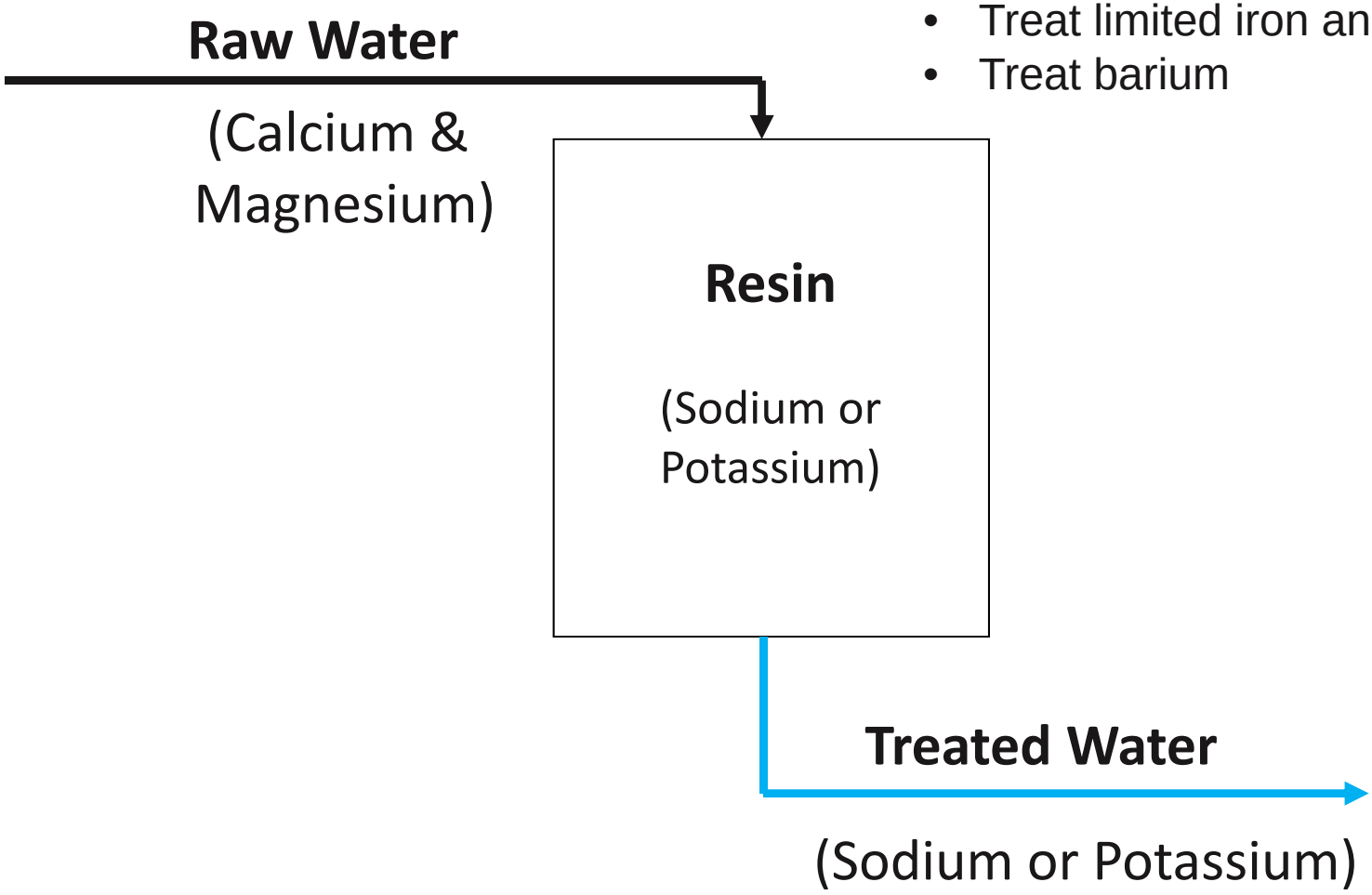
Point of Entry Treatment
Match the Pollutant to the Process

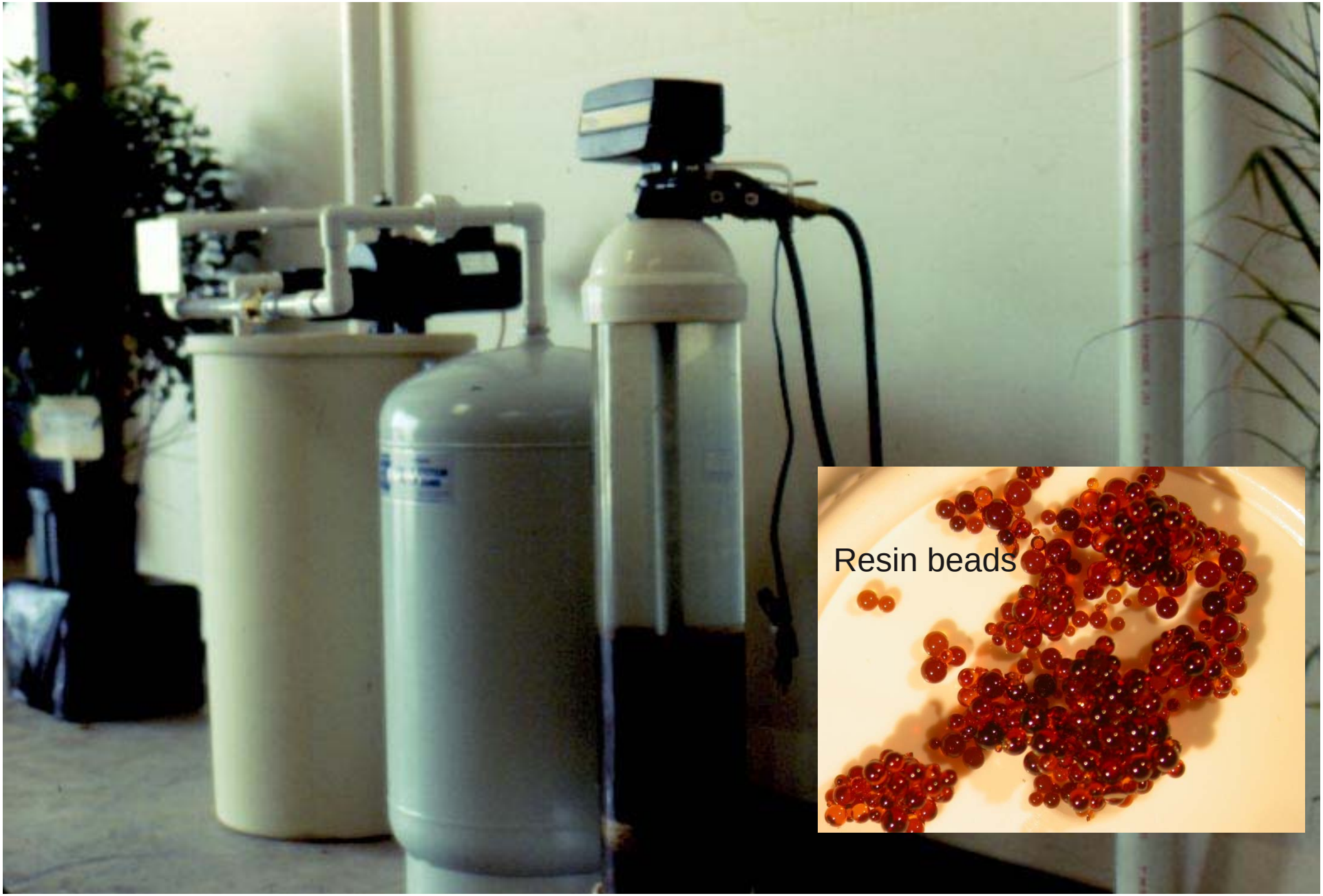
Process	Treats
UV light	Bacteria
Chlorine	Bacteria, iron, sulfur
Softener	Hardness, some iron
Carbon filter	VOC's, radon, sulfur
Sediment filter	Turbidity
Oxidizing filter	Iron, manganese, sulfur
Acid neutralizing filter	Low pH, corrosive water, lead, copper
Aeration	Methane, radon, gases


Softening
Neutralizer
Metals & H_2S
Control Valve
Tank
Nitrate removal
Carbon - organic removal

Water Softener

- Remove hardness
- Treat limited iron and manganese
- Treat barium



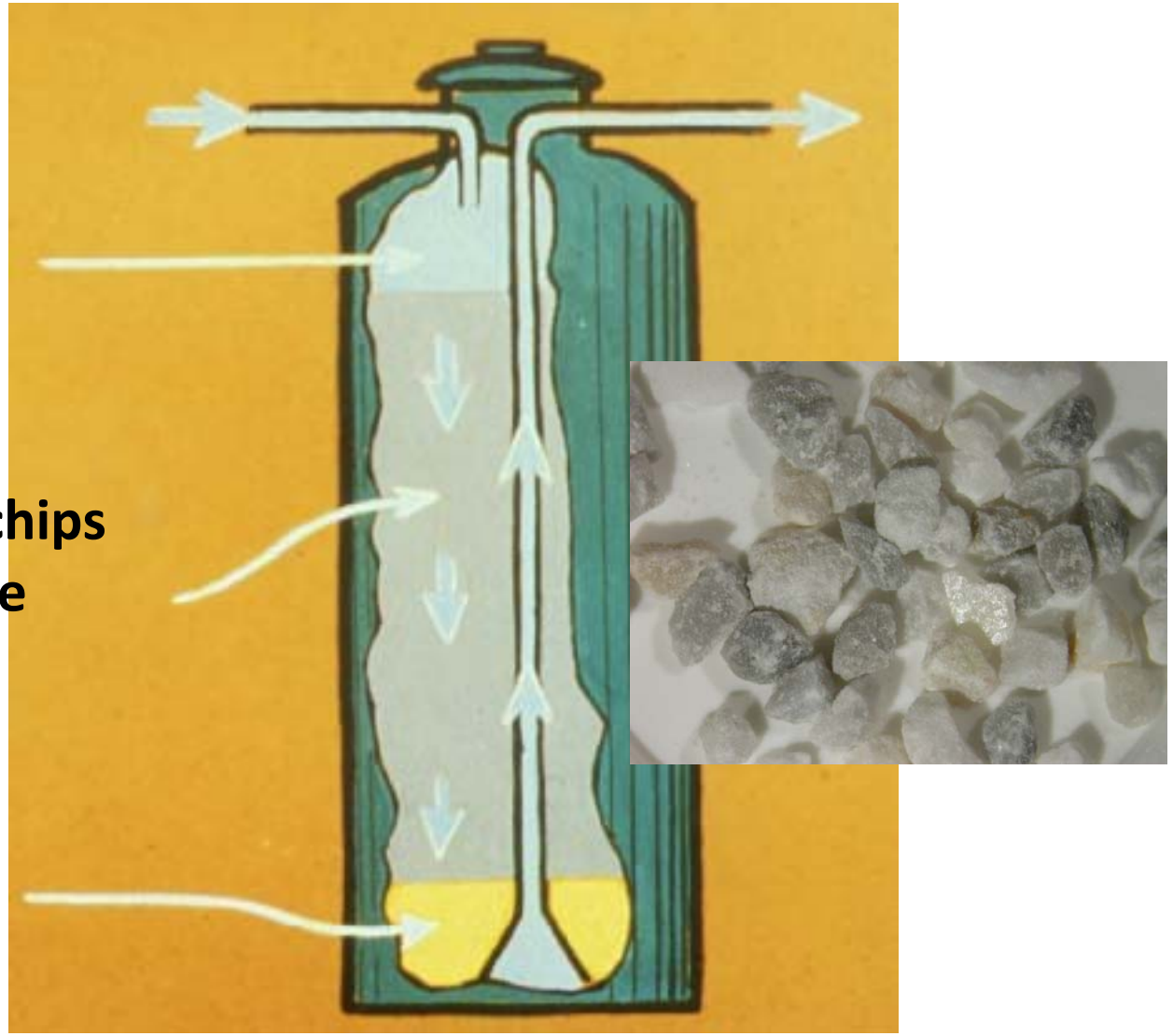

Resin beads

Low pH (Corrosive Water) Control

Water

Limestone chips or calcite

Gravel



Oxidizing Filters

- Oxidize and filter low to high concentrations of iron, manganese and hydrogen sulfide

- Options
  - Greensand
  - Antrasand (anthracite sand)
  - Zeolite

- pH of water must be at least 7.0
- Backwashing necessary to remove oxidize metals

Carbon Filtration

- Uses
  - Remove man-made organic chemicals
    - Volatile (solvents, etc.) , non-volatile (pesticides, etc.)
  - Remove miscellaneous tastes from water
  - Remove moderate radon gas and sulfur odor
- Performance
  - Water use, amount of pollutants, carbon quality, carbon size
- Maintenance
  - Carbon must be replaced routinely

Point of Use

Point of Entry

Sediment Filtration

- Necessary to remove sediment before other treatment devices
- Filter sizes vary – 5 micron, 20 micron, etc.
- Typical replacement frequency = 2-3 months
- Larger, multi-layer sand/gravel filters for bigger sediment problems

Shock Chlorination

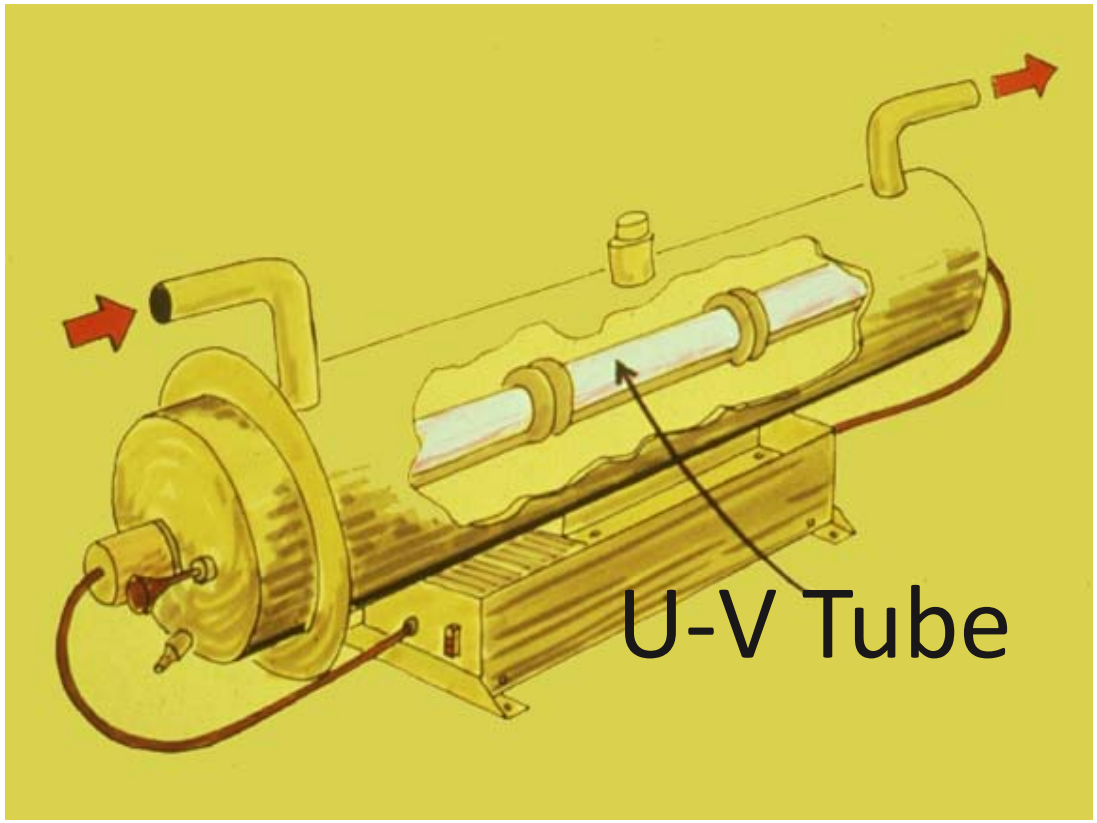
- Generally only works on wells with small numbers of coliform bacteria from one-time contamination incident
- Biofilms in the well can prevent chlorine from achieving a 100% kill
- No need to do this routinely!

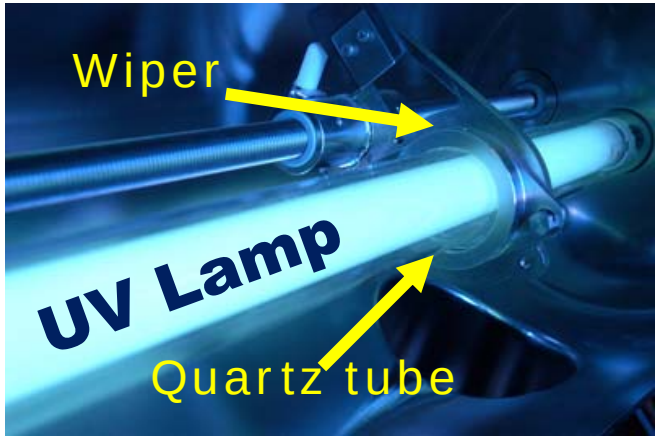
Table 5.2. Amount of household bleach required to disinfect a water well.

	Water diameter (inches)					
Water depth (feet)	6	8	10	24	32	36
10	1 c	1 c	2 c	3 qt	4 qt	6 qt
20	1 c	2 c	4 c	5 qt	8 qt	10 qt
30	2 c	4 c	3 pt			
40	1 pt	2 pt	4 pt			
60	2 pt	3 pt	6 pt			
80	2 pt	4 pt	7 pt			
100	3 pt	5 pt	4 qt			
150	5 pt	4 qt				

c = cup, pt = pint, qt = quart

Ultraviolet (UV) Sterilization

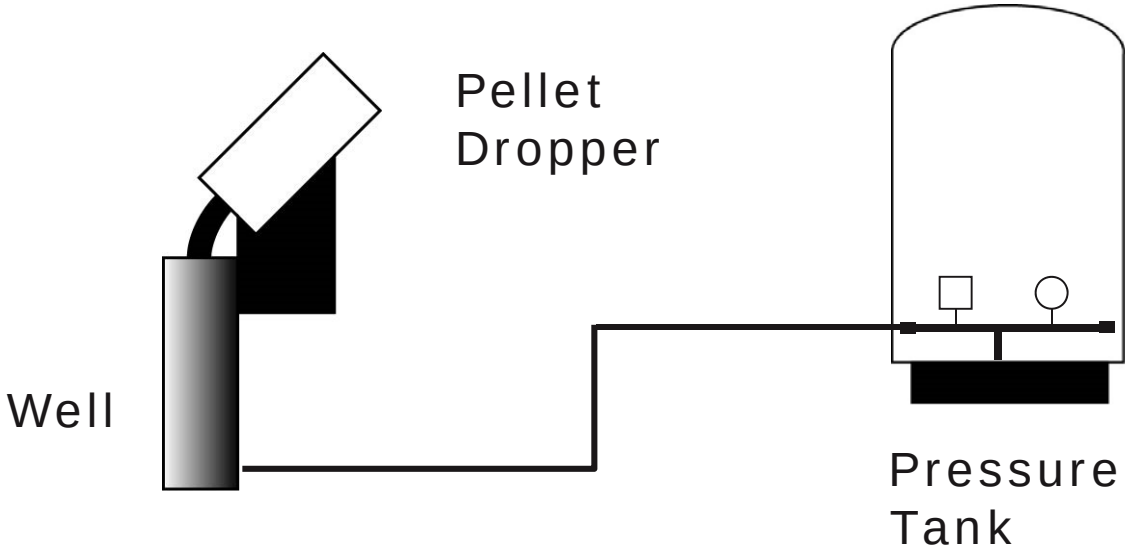




- Filter water before UV light
- Replace bulb annually

Iron Bacteria

- Filtration (large bacteria)
- Direct chlorination of well
- Drop tablets or solution down well casir



Radon Removal

- Point-of-Entry treatment!

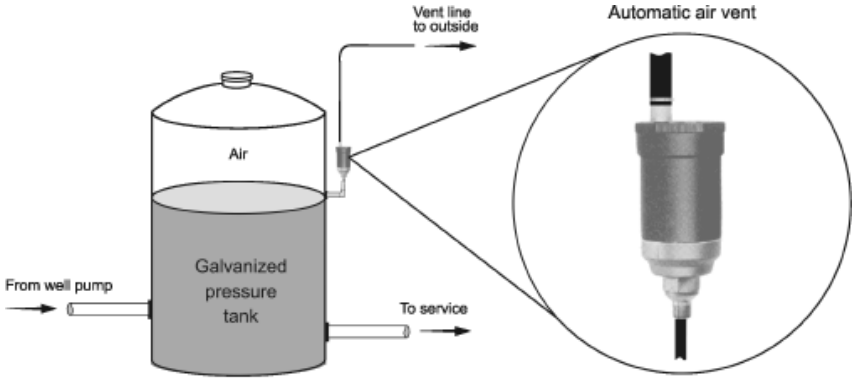
- Carbon Filtration
  - Radon decays in the filter
  - Gamma particles given off during decay
  - 82 to 99% removal
  - Sediment filter to increase GAC life?
  - Accumulates Pb 210 – 25 year+ life
  - Radioactive filter

- Aeration
  - More expensive
  - Preferred for water with > 25,000 pCi/L
  - Bubble or spray water to remove radon gas
  - Vent to outside!

Methane Treatment

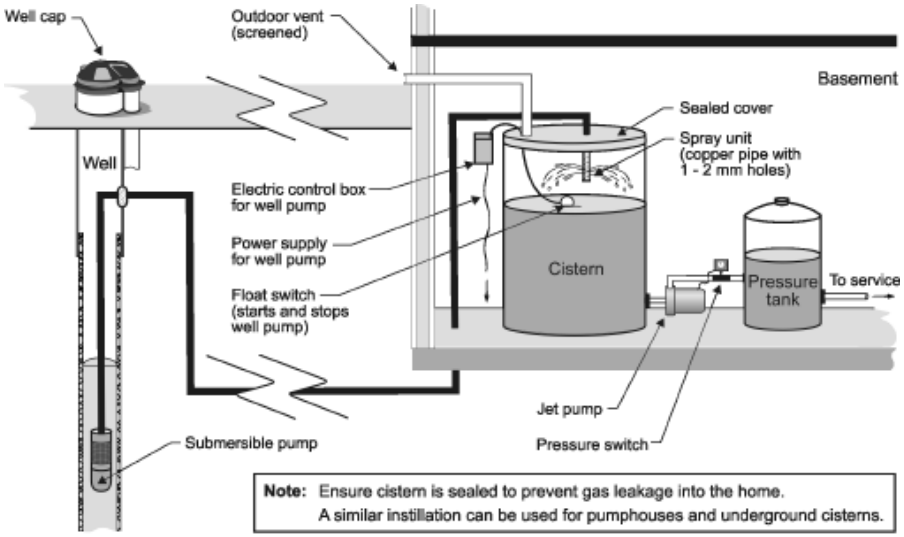
Vented Well Cap

Vented Pressure Tank



Note: Use a galvanized pressure tank without a diaphragm so that the excess gas can be vented from the tank. The figure shows a Braukmann EA122A automatic air vent however other similar vents can also be used.

Aeration

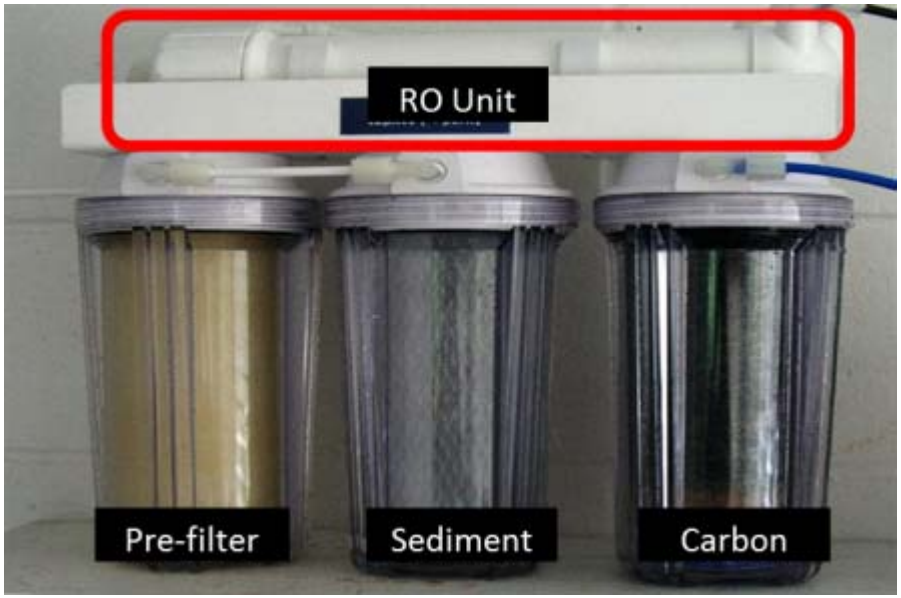


Note: Ensure cistern is sealed to prevent gas leakage into the home. A similar instillation can be used for pumphouses and underground cisterns.

Point of Use Treatment

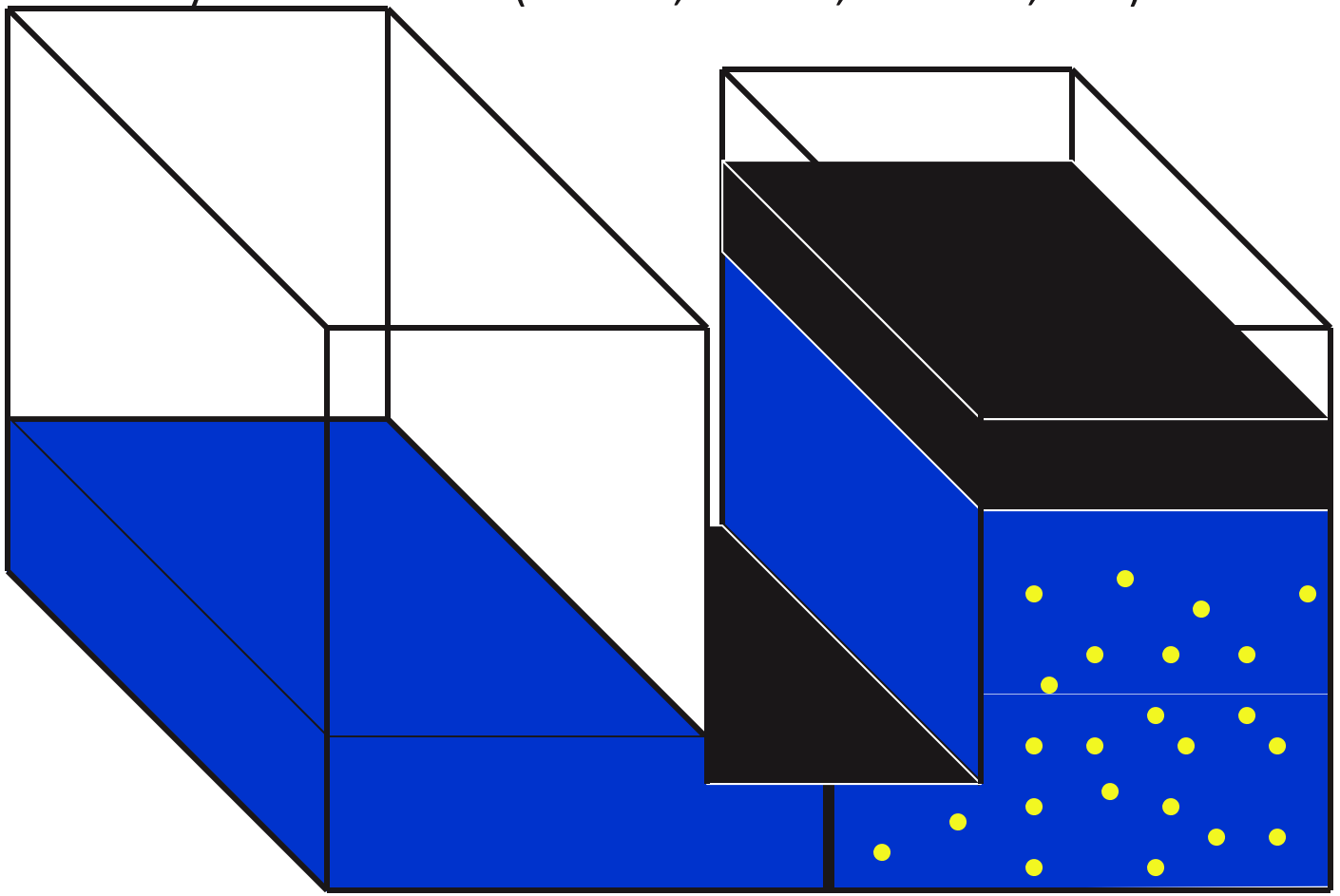
e.g., treat only kitchen tap

Process	Treats
Carbon filter	Chlorine, organics
Reverse Osmosis (RO)	Nitrate, arsenic, lead, chloride, sulfate, tds
Distillation	Same as RO



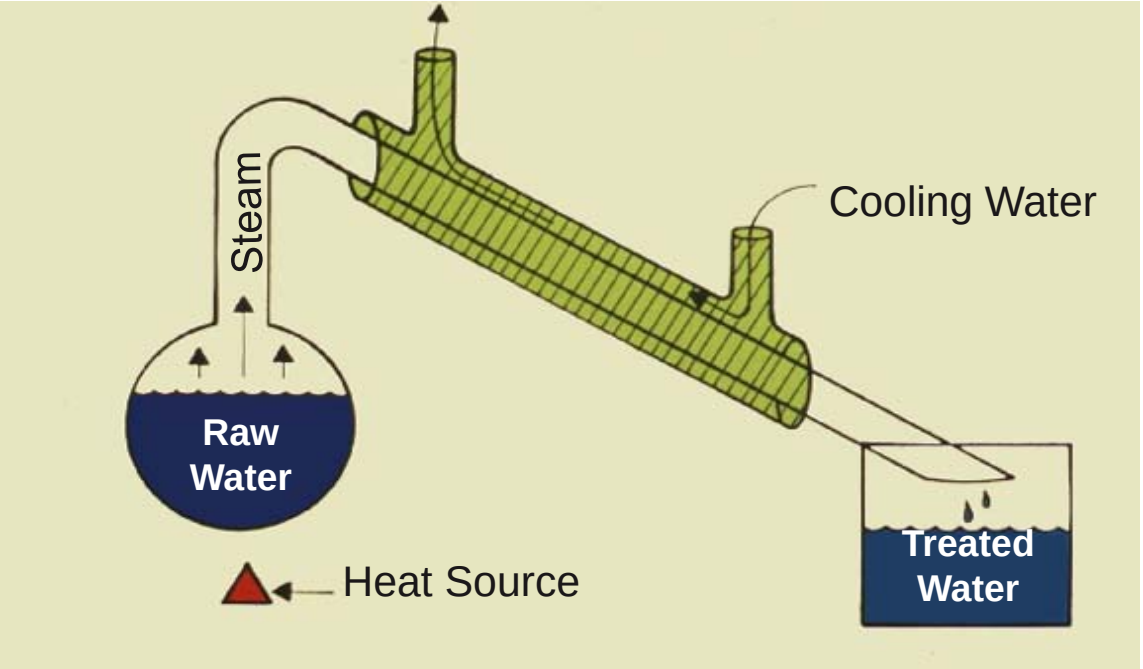
Reverse Osmosis

- Membrane (cellulose or acetate)
- Force water through membrane
- Removes many contaminants (arsenic, nitrate, chloride, etc.)



Distillation

- Treats many difficult problems (chloride, arsenic, high total dissolved solids)
- Heat water to boiling
- Condense vapor
- Ions left behind
- Energy intensive



Buy Water Treatment Devices Carefully

- Rely on independent lab results
- Check National Sanitation Foundation (www.nsf.org) for certifications
- Seek reputable companies, references
- Beware of hard sale techniques (scare tactics)
- Ask questions. If it sounds too good - it is!
- Ask about maintenance requirements (parts, chemicals, etc.)
- Get a detailed warranty in writing

Penn State Cooperative Extension Resources

http://extension.psu.edu/water