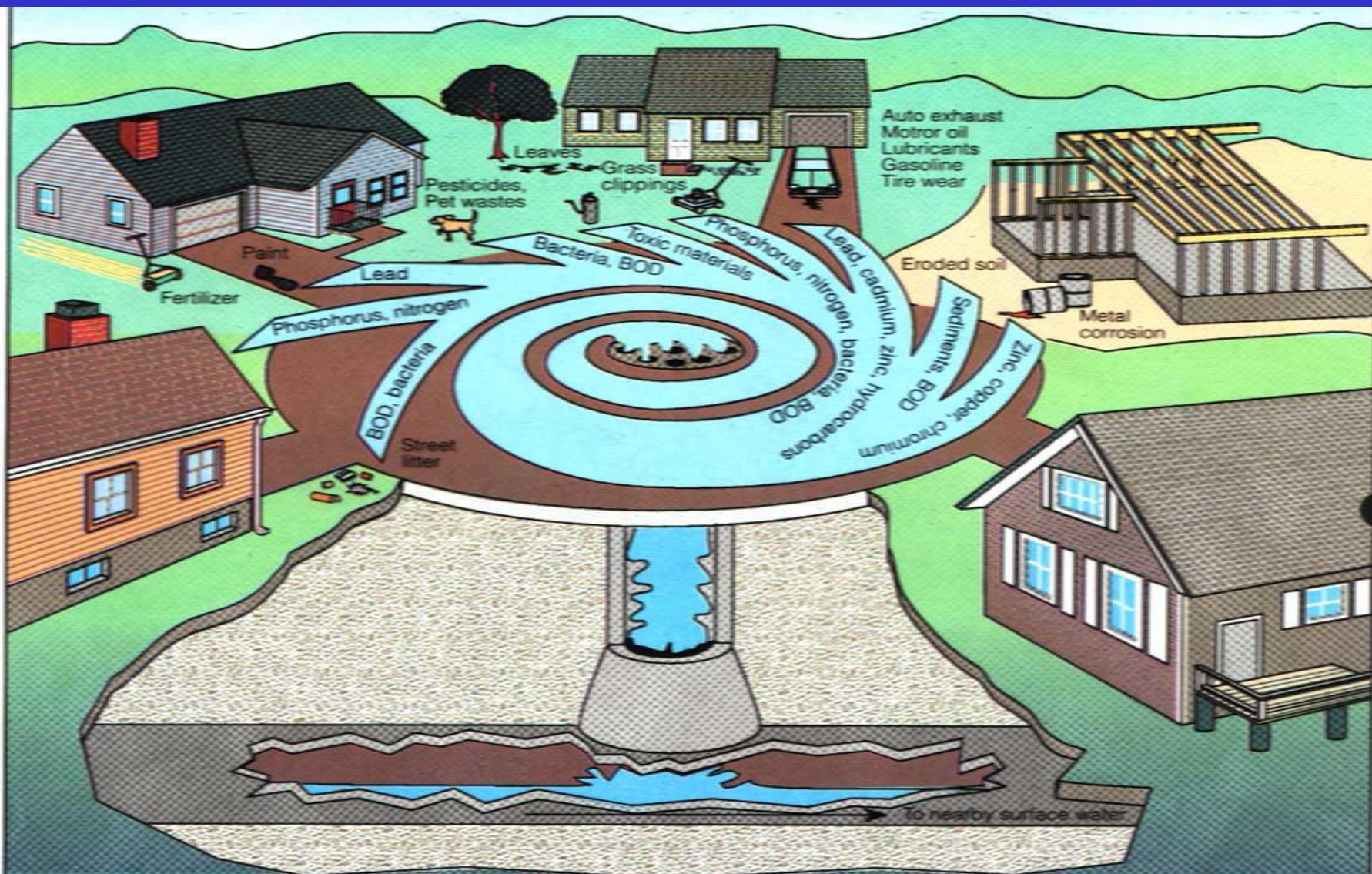


Water Purification and Wastewater Treatment



With thousands of storm-sewer inlets around town, stormwater is a major contributor to water pollution in urban areas. Although each storm-sewer inlet contributes only a small number of pollutants, when added together, pollution concentrations often exceed the limits established for industries and wastewater treatment plants. If the pollutants entering each of these inlets can be reduced, so will the pollution in area streams and bays.

Water Purification

- Screening
- Chlorination, fluoridation
- Chemical application
 - Aluminum sulfate (“alum”)
 - Coagulation
 - Activated charcoal
 - Removes objectionable tastes and odors

Water Purification

- **Mixing Basins**

- Alum chemically reacts to form “floc”
 - Gelatinous particles
- Water in mixing basins is stirred
 - Promotes collisions between floc particles
- Floc particles grow in size
 - Entrain bacteria and sediment

Water Purification

- **Settling Basins**

- Flocculated material settles out and is piped to wastewater treatment plant

- **Sand Filters**

- Hydrated lime added to minimize corrosion
- Polishing operation

Water Purification

- Temporary storage in clear wells
- Filtered-water reservoir
 - Chlorination
 - Caustic soda to minimize corrosiveness of polished water
 - Gravity flow to pumping stations

Wastewater Treatment

- **Septic Tanks**
 - Bacteria in sewage degrade organic matter
 - Tank buried in ground to treat sewage from an individual home
 - Wastewater flows into tank

Septic Tank System

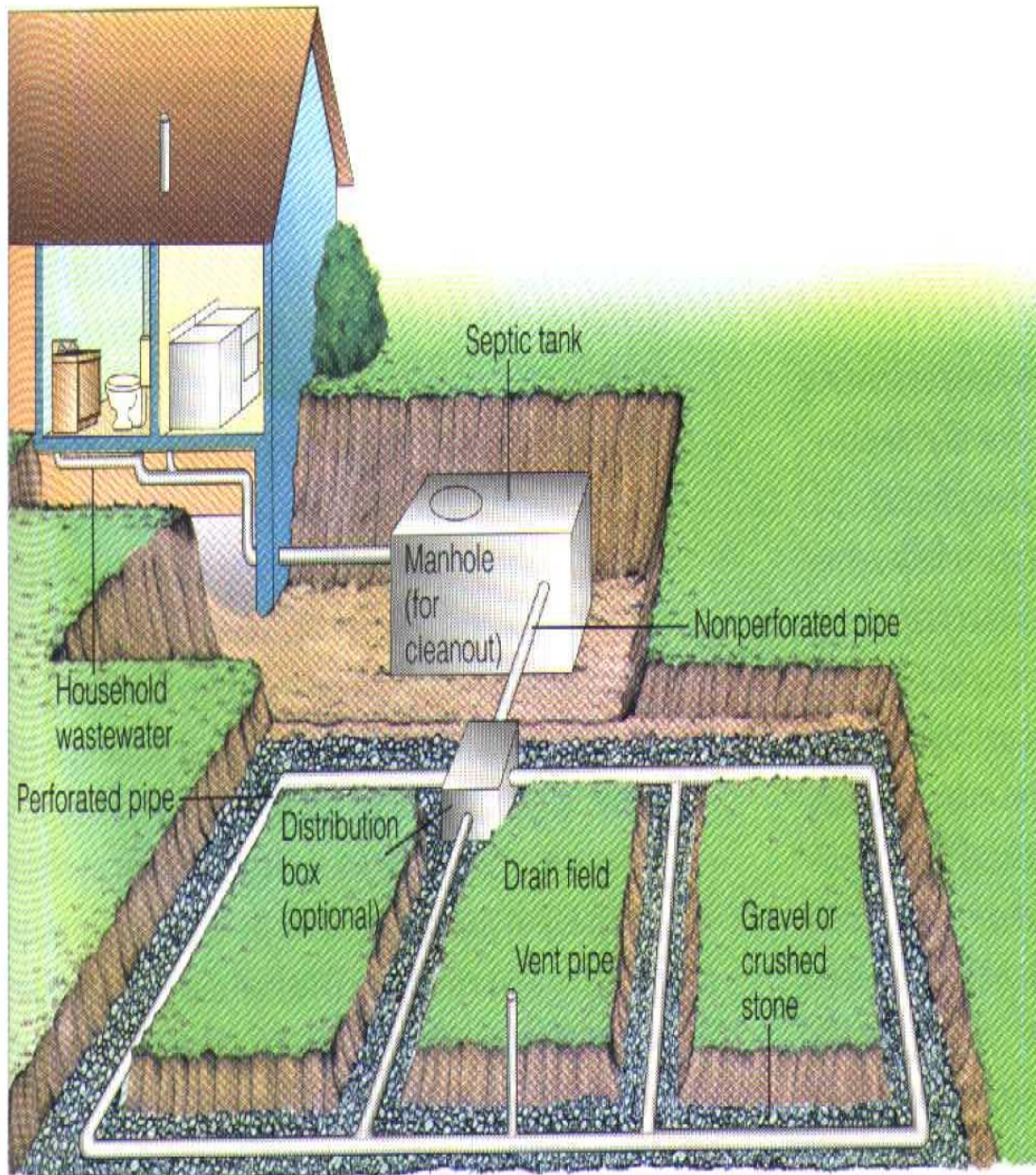


Figure 11-27 Septic tank system used for disposal of domestic sewage and wastewater in rural and suburban areas. This system traps greases and large solids and discharges the remaining wastes over a large drainage field. As these wastes percolate downward, the soil filters out some potential pollutants, and soil bacteria decompose biodegradable materials. To be effective, septic tank systems must be properly installed in soils with adequate drainage, not placed too close together or too near well sites, and pumped out when the settling tank becomes full.

Wastewater Treatment

- **Septic Tanks**
 - Solid material (“sludge”) settles to bottom of tank
 - Cleaner water flows out of tank into ground through subsurface drains

Wastewater Treatment

- **Lagoons (Stabilization Ponds)**
 - 3-5' deep
 - Sunlight, algae, oxygen interact to clean wastewater

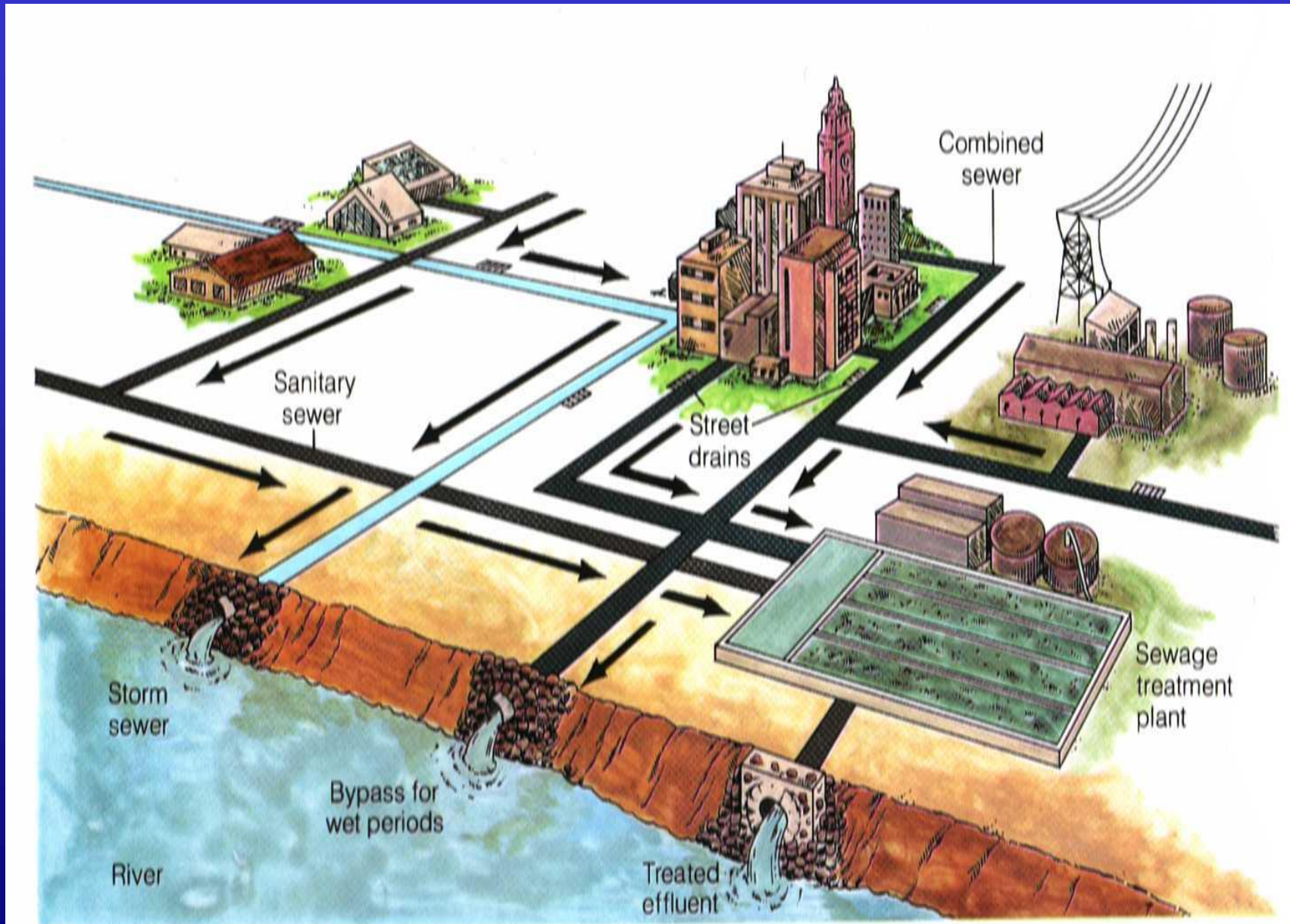
Wastewater Treatment

- **Conventional Sewage Treatment**
 - **Processes**
 - **Collection**
 - **Treatment**

Wastewater Treatment

- **Conventional Sewage Treatment**
 - **Processes**
 - **Collection**
 - **Sewers**
 - **Combined**
 - **Separate**

Stormwater and Sanitary Sewer System



Wastewater Treatment

- **Conventional Sewage Treatment**
 - **Processes**
 - **Collection**
 - **Combined Sewers**
 - Carry stormwater and wastewater
 - **Separated Sewers**
 - Sanitary Sewers
 - Storm Sewers

Wastewater Treatment

- **Conventional Sewage Treatment**
 - **Processes**
 - **Collection**
 - Household sewer
 - Lateral sewer
 - Main sewers
 - Interceptors
 - Wastewater treatment plant

Wastewater Treatment

- **Conventional Sewage Treatment**
 - **Processes**
 - **Collection**
 - **High rainfall events**
 - **Some wastewater may be diverted to receiving streams**

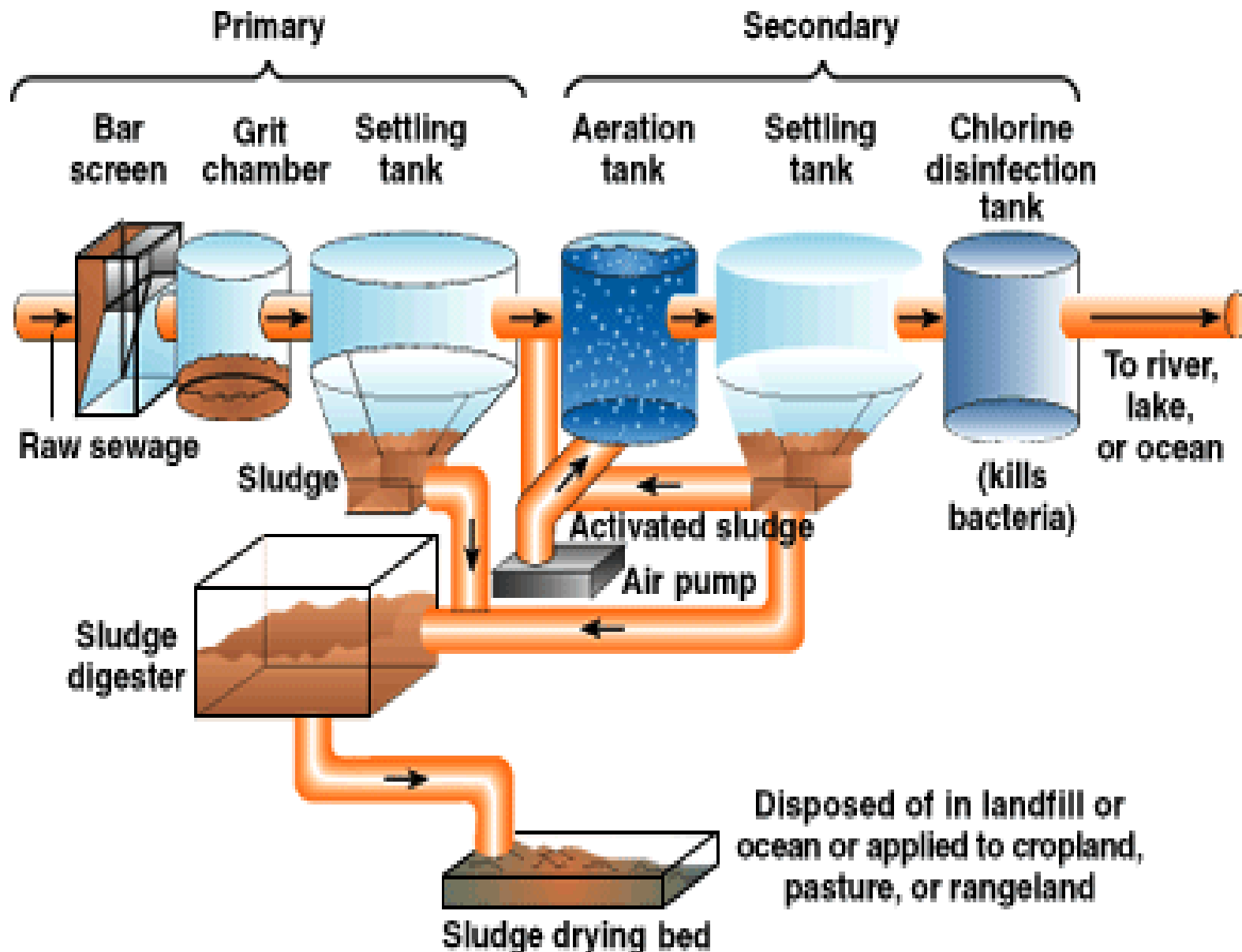
Wastewater Treatment

- **Conventional Sewage Treatment**
 - **Processes**
 - **Treatment**
 - **Function**
 - To speed up natural processes by which water purifies itself
 - DO is the key!

Wastewater Treatment

- **Conventional Sewage Treatment**
 - **Processes**
 - **Treatment**
 - **Processes**
 - **Primary**
 - **Secondary**
 - **Advanced**

The Wastewater Treatment Process



Wastewater Treatment

- **Conventional Sewage Treatment**
 - **Processes**
 - **Primary Treatment**
 - **Mechanical process**
 - Screening
 - Grinding
 - Grit Chamber (heavy particles - “grit”)
 - Sedimentation Tank (suspended solids - “sludge”)
 - Chlorination of effluent

Wastewater Treatment

- **Conventional Sewage Treatment**
 - **Processes**
 - **Secondary Treatment**
 - **Biological process**
 - Uses bacteria to removed ODW and lower BOD
 - **Types**
 - Trickling Filter
 - Activated Sludge

Wastewater Treatment

- Conventional Sewage Treatment

- Processes

- Secondary Treatment With Trickling Filters

- Effluent leaves sedimentation tank and flows through *trickling filters*

- Bed of stones 3-10' deep through which sewage passes
 - Bacteria gather on stones and multiply, consuming ODW
 - Cleaner water trickles through pipes at bottom of filter for additional treatment

Wastewater Treatment

- Conventional Sewage Treatment

- Processes

- Secondary Treatment With Activated Sludge

- Effluent leaves sedimentation tank and is pumped to an *aeration tank*
 - Effluent is mixed with air and sludge loaded with bacteria (“*activated sludge*”)
 - Sludge contacts with raw sewage, and bacteria in the sludge then decompose the raw sewage, lowering ODW and BOD

Wastewater Treatment

- Conventional Sewage Treatment

- Processes

- Secondary Treatment With Activated Sludge

- Activated sludge-sewage mixture is called *mixed liquor*
 - Mixed liquor leaves aeration tank and flows to another sedimentation tank where suspended solids settle out for reuse as activated sludge
 - Effluent is chlorinated
 - Activated sludge in sedimentation tank is reused

Wastewater Treatment

- **Conventional Sewage Treatment**

- **Processes**

- **Advanced (Tertiary) Wastewater Treatment**

- Physical and chemical processes that specific pollutants left in wastewater after primary and secondary treatment

- **Extremely costly!**

- It cost twice as much to build a tertiary treatment plant compared to a secondary treatment plant

Wastewater Treatment

- **Conventional Sewage Treatment**
 - **Processes**
 - **Advanced (Tertiary) Wastewater Treatment**
 - **Processes**
 - Bleaching to remove coloration
 - Disinfection to kill pathogens
 - Coagulation-sedimentation with alum
 - Adsorption using activated charcoal
 - Electrodialysis for salt removal

Wastewater Treatment

- **Conventional Sewage Treatment**
 - **Processes**
 - **Sludge Disposal**
 - Landfills
 - Incineration
 - Land application
 - Anaerobic digestion

Wastewater Treatment

- **Water Quality Protection**

- **Federal Laws**

- **Clean Water Act (1977)**
 - **Water Quality Act (1987)**
 - **U.S. Safe Drinking Water Act (1974)**

Wastewater Treatment

- **Water Quality Protection**
 - **Clean Water Act**
 - To restore and/or maintain the chemical, physical, and biological integrity of the nation's surface waters

Wastewater Treatment

- **Water Quality Protection**
 - **Safe Drinking Water Act**
 - Required USEPA to establish drinking water standards (“Maximum Contaminant Levels”) for any pollutant that MAY have adverse effects on human health
 - *No MCLs established for some SOC, radioactive materials, toxic metals, and pathogens*

Wastewater Treatment

- **Water Quality Protection**
 - **Natural Resources Defense Council Study**
 - Drinking water of > 50 million Americans exceeds one or more MCL standards
 - Most people have not been notified when their drinking water was contaminated
 - Contaminated drinking water is responsible for > 7 million illnesses and 1200 deaths per year

Wastewater Treatment

- **U.S. Water Quality Facts**
 - 44% of lakes, 37% rivers, 32% estuaries still unsafe for fishing, swimming, other recreational uses