BACKGROUND AND TECHNOLOGY

DEFINITIONS

- CENTRALIZED SOLUTIONS
  - Conventional gravity sewers to treatment and surface water discharge
- DECENTRALIZED SOLUTIONS
  - Onsite Systems
  - Cluster Systems
  - Mixed Systems

WHAT IS A "CENTRALIZED" SOLUTION?

- Sewage from each source is collected in large, deeply buried pipes that are laid at a specified grade to prevent solids from settling. The sewer must have regularly-spaced manholes and as many lift stations as necessary to move the sewage to a single treatment plant that discharges treated effluent to a receiving stream (NPDES permit).

PROS AND CONS

- PROS
  - Universally understood technologies
  - Well-suited for dense urban populations
- CONS

  Costly (capital and labor intensive)

  Generally serves entire town to spread cost

  Adds additional permit monitoring costs

  May stimulate unwanted growth and impacts

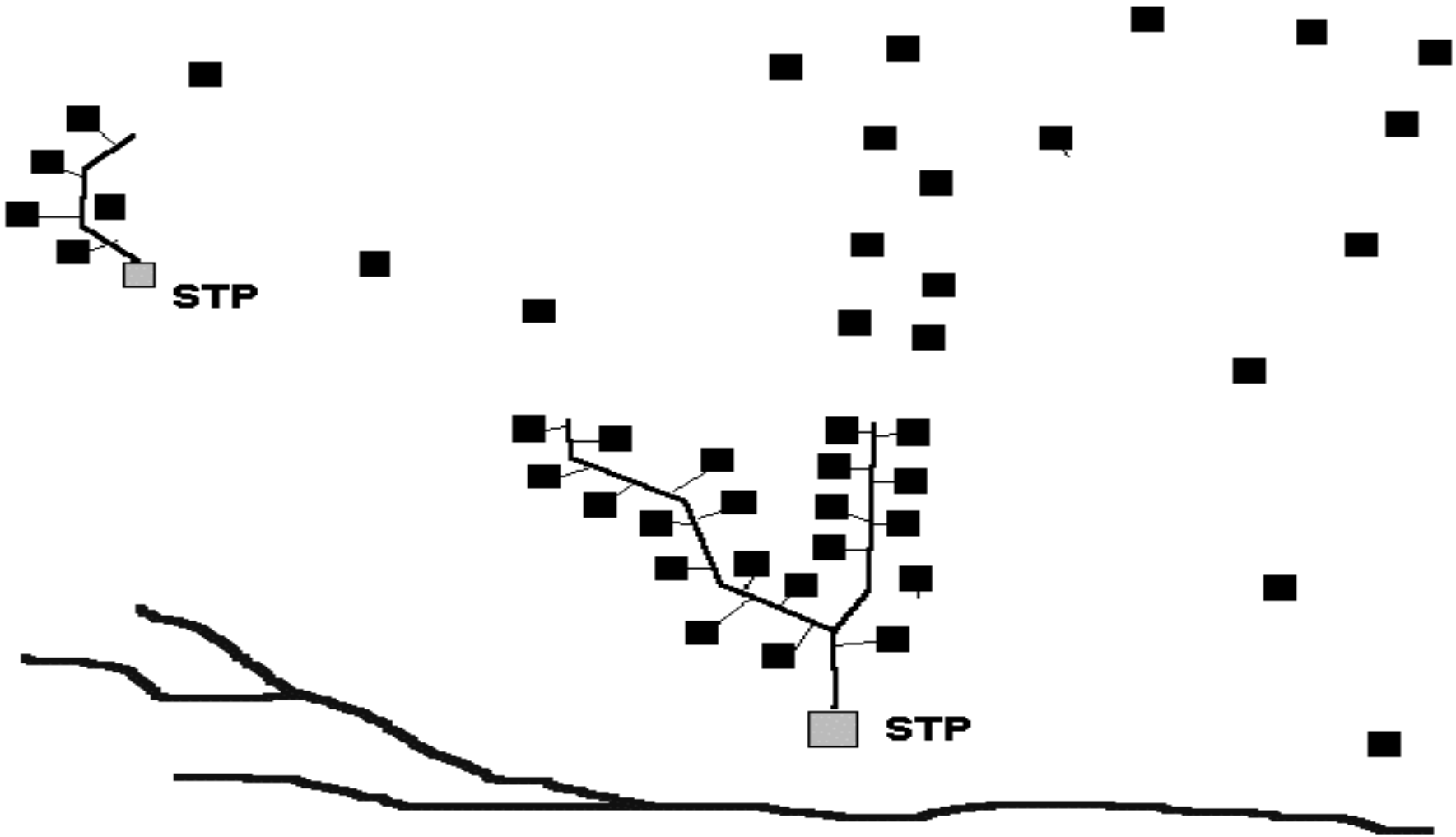
WHAT IS A "DECENTRALIZED" SOLUTION?

- Decentralized solutions treat and disperse wastewater as close as possible to its source, use the soil in preference to surface water discharge, and maximize reuse opportunities. They employ low-cost, low-maintenance infrasructure (e.g., onsite and cluster systems), require appropriate management, and disperse smaller volumes of treated sewage to the environment at multiple locations.

CHARACTERISTICS OF DECENTRALIZED SOLUTIONS

- Area divided into sections by problems, drainage basins, and other common features
- Each area is evaluated and prioritized by relative risk to health and environment, and solutions to those problems
- Mixed solutions can include onsites, clusters, and centralized zones under a single management authority

DECENTRALIZED SOLUTION EXAMPLE



PROS AND CONS

- PROS
  - Generally less expensive than centralized
  - Less disruption during construction, continues aquifer recharge, simpler O/M and monitoring
  - Can phase solutions by addressing priority areas first
- CONS
  - Not taught in engineering schools
  - Regulatory and financing rules generally discourage applications
  - More complex rate structures may be necessary

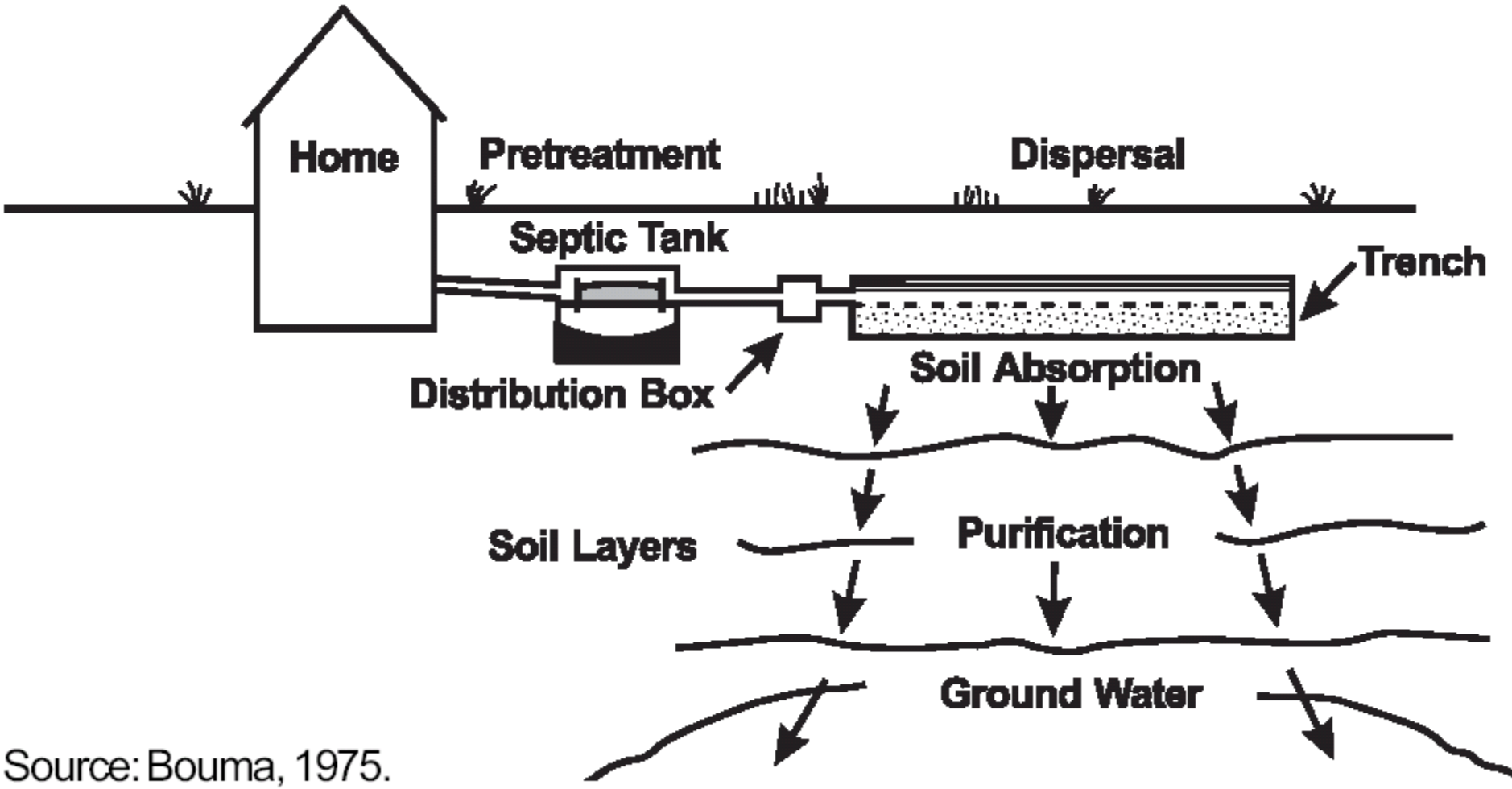
TRADITIONAL WASTEWATER SOLUTIONS

- ONSITE SEPTIC SYSTEMS
  - No management after prescriptive code design and cursory installation inspections (if site meets code requirements, it is assumed to perform until complaints from citizens)
- CENTRALIZED SEWER SYSTEMS
  - Continuing high-level management required to maintain performance and comply with NPDES permit (administration, O/M, monitoring)

RESULTS OF THIS PARADIGM

- Many small communities could not afford the centralized solution, and with problem septics homes had no or depressed value
- If a conventional system was built, the town often couldn’t afford to manage it, so unanticipated, unwanted growth was encouraged to pay for it, cancelling or delaying other needed investments

TRADITIONAL SEPTIC SYSTEMS



Source: Bouma, 1975.

MODERN CHANGES TO THAT PARADIGM

- Grants have become scarce
- Septic system contamination of ground water (source of 90% of US rural drinking water) now widely documented
- Smaller communities, shut out of grants because of size dependence for priority, cannot afford centralized solutions
- Properly managed new onsite and cluster technologies have reduced costs and increased capability of decentralized solutions
- Inclusion of decentralized solutions in the array of engineering solutions may reduce costs and permit more communities to be addressed by limited assistance funds

WHAT ARE SOME OF THESE DECENTRALIZED TECHNOLOGIES

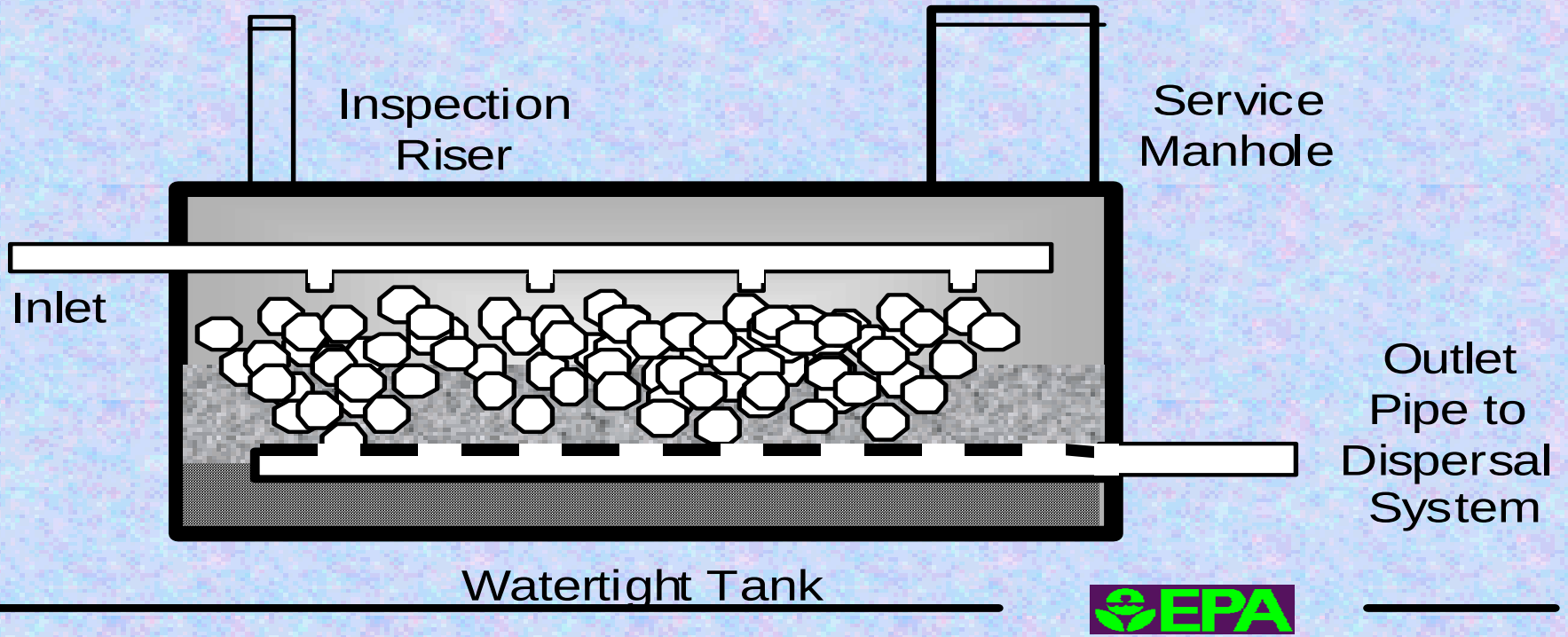
- BETTER ONSITE TREATMENT SYSTEMS
  - Media filters
  - Enhanced activated sludge designs
  - Constructed wetlands
- BETTER SOIL APPLICATION SYSTEMS
  - Pressure distribution
  - Drip distribution
- LOW-COST COLLECTION SYSTEMS
  - Effluent sewers
  - Vacuum and grinder pump sewers

BETTER PRETREATMENT CAPABILITY

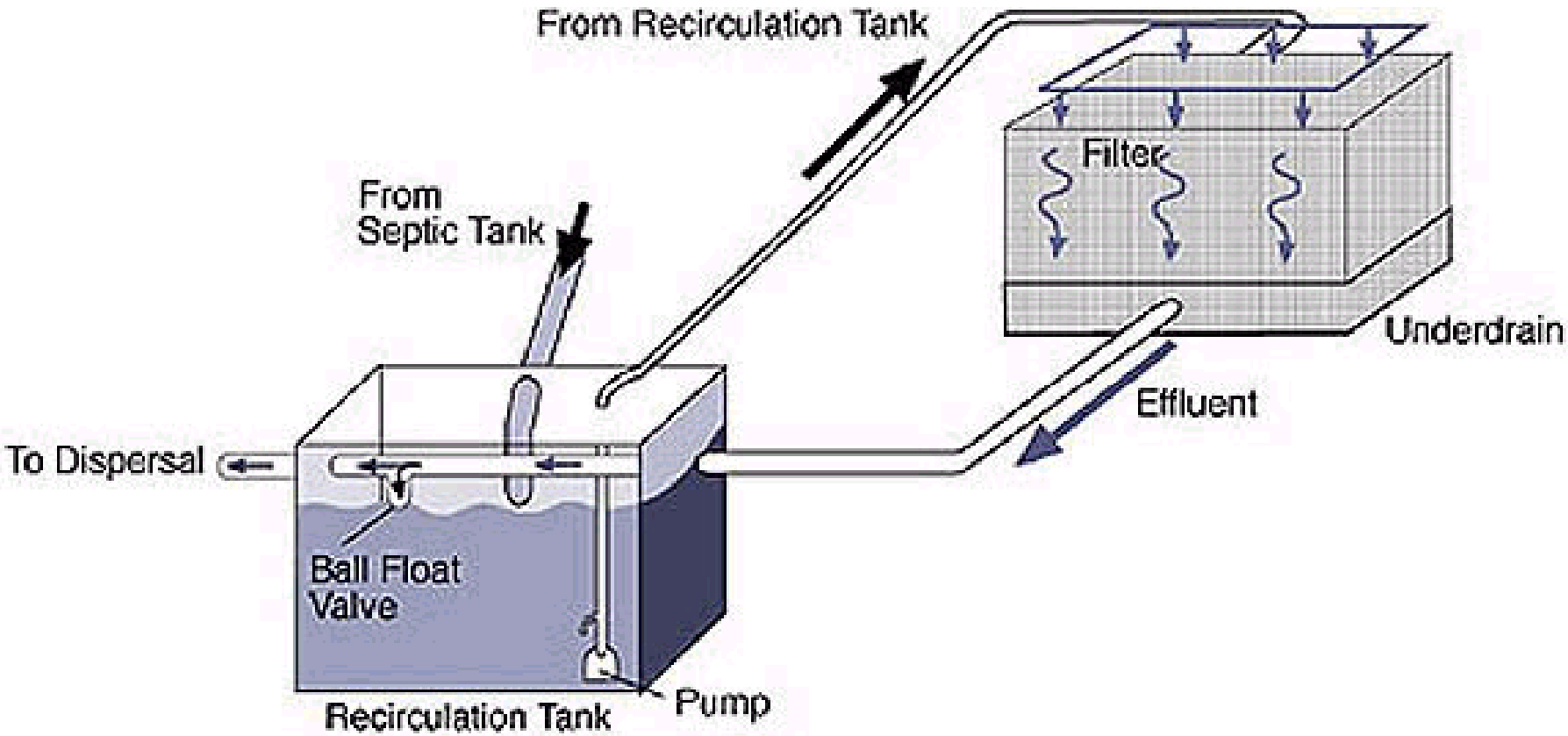
- Better treatment often permits smaller soil systems in many states
- Systems are available to produce lower concentrations of organics (BOD, COD), nutrients (nitrogen, phosphorus), and pathogens (bacteria, virus, and parasites)
- All require higher levels of management than traditional septic systems

SINGLE-PASS MEDIA FILTERS

Pretreatment - Near Secondary Level - Fixed Media, Residential

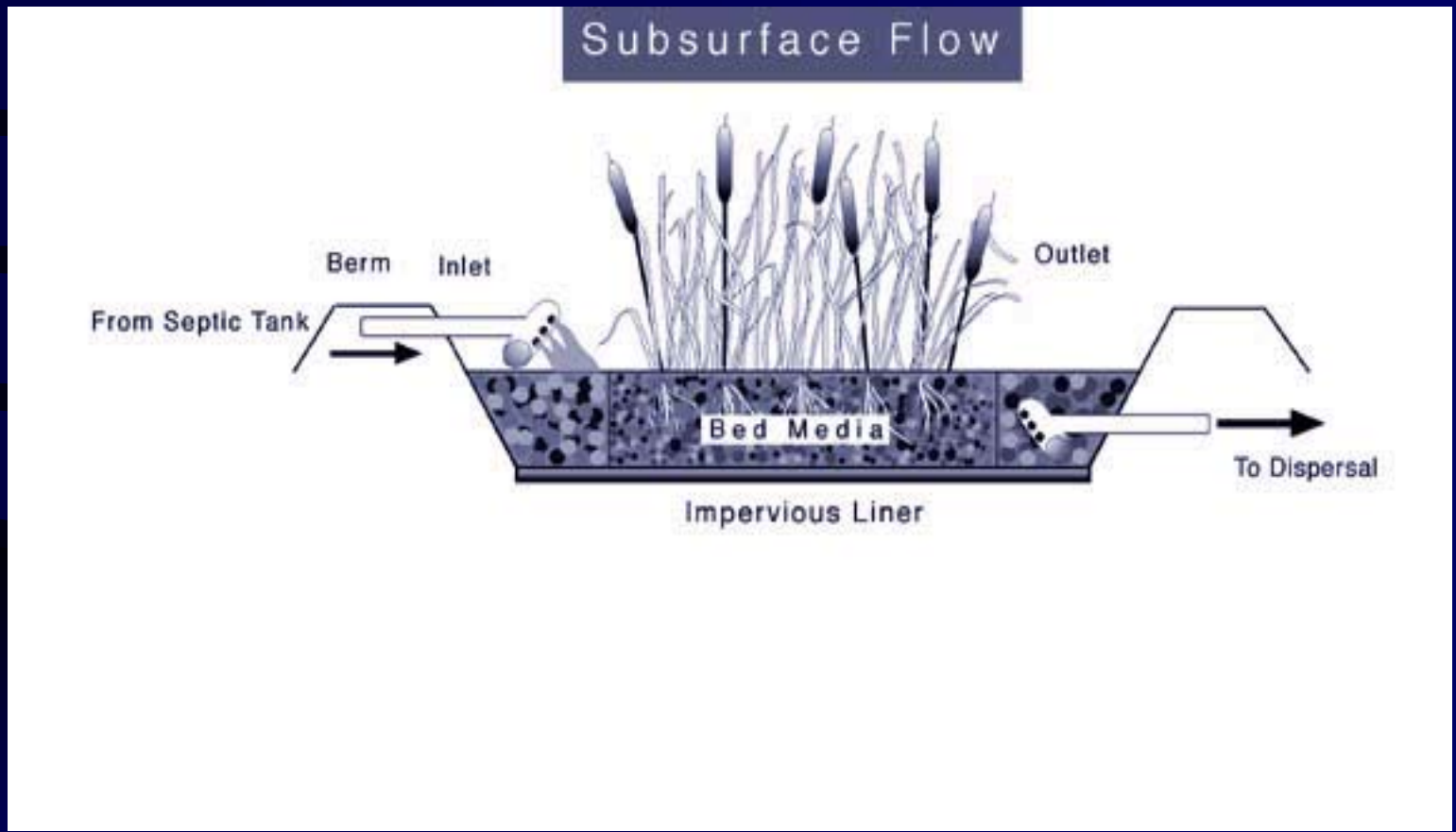


RECIRCULATING MEDIA FILTERS

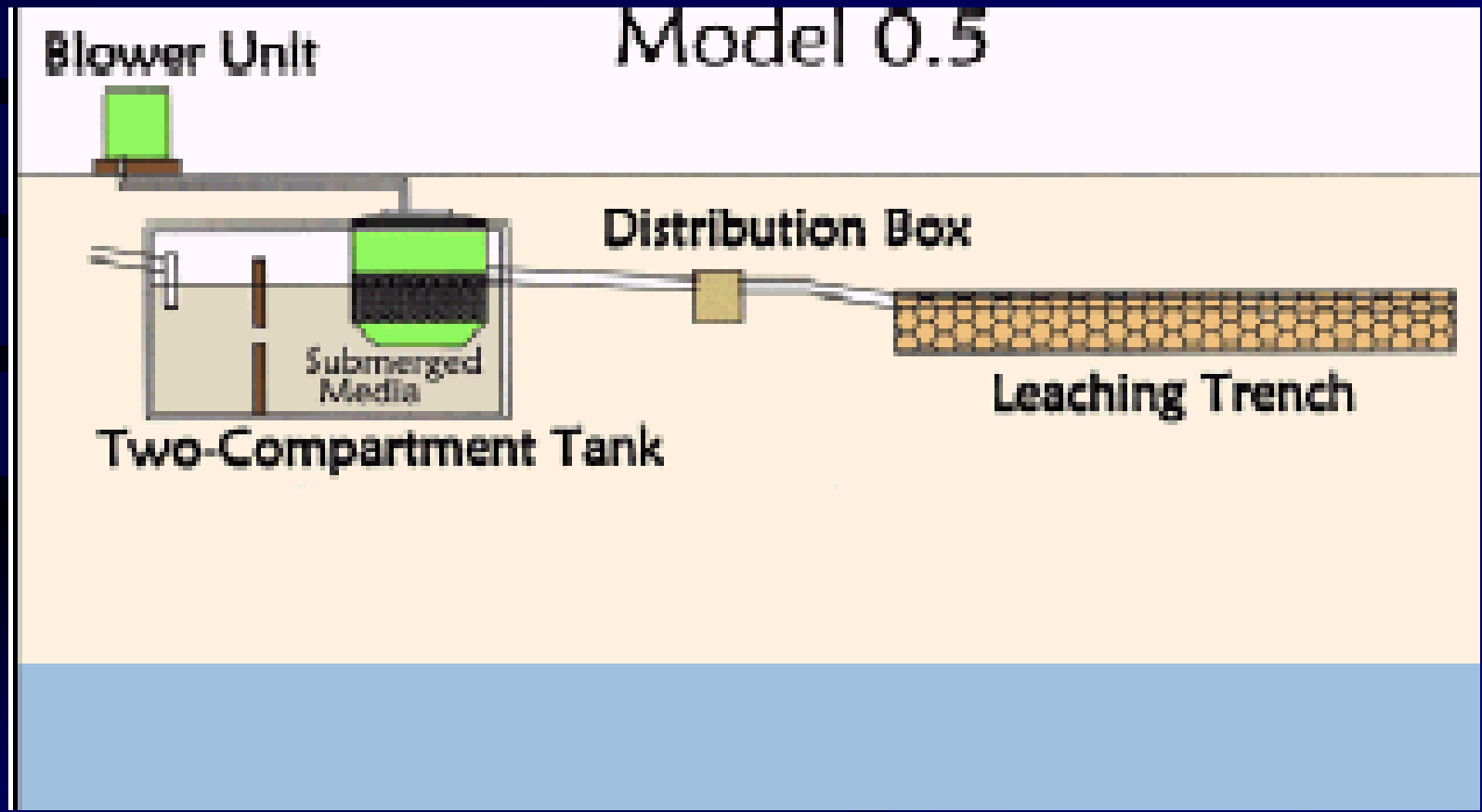


VEGETATED SUBMERGED BED

AKA: SUBSURFACE FLOW WETLAND



HIGH BIOMASS ACTIVATED SLUDGE

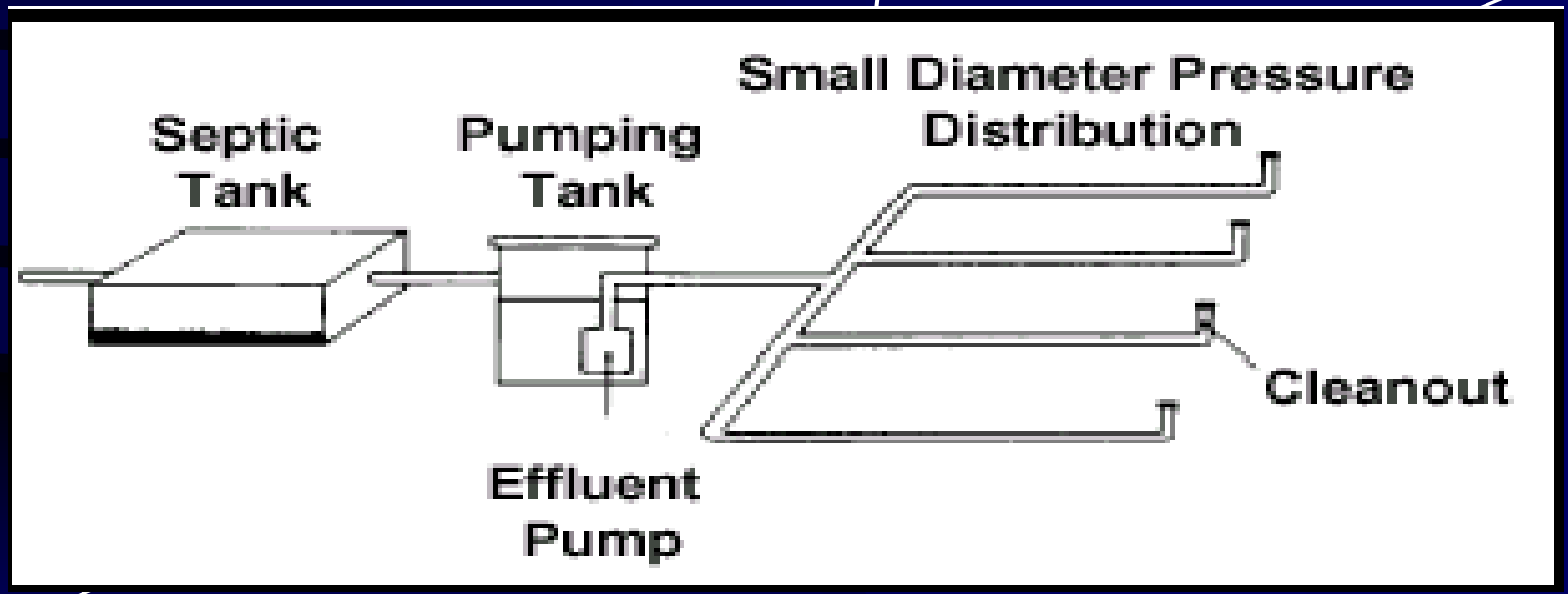


BETTER DISTRIBUTION

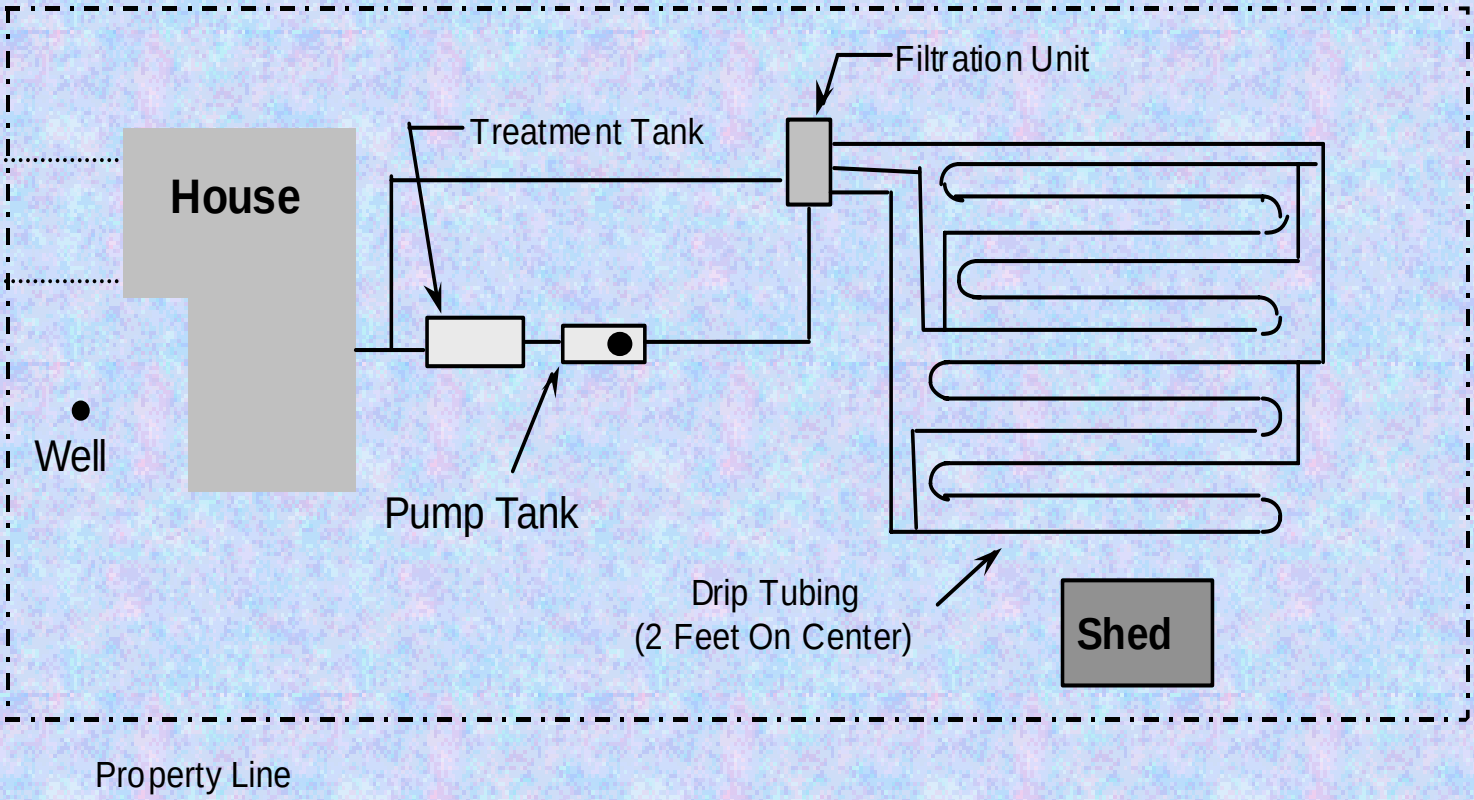
- Better distribution allows the entire soil infiltration area to be used, provides better oxygen diffusion for aerobic treatment by microbes, and increases the contact time between the wastewater and soils
- This type dose/rest application is required for larger (cluster) soil dispersal systems and most elevated onsite systems

BETTER DISTRIBUTION

PRESSURE DISTRIBUTION



Drip Dispersal



CLUSTER SYSTEMS

- Powerful tool to service problem areas or areas where lots are too small to accommodate conventional septic systems
- Permit significant reuse in the area close to the wastewater contributors
- Accommodates targeted solutions that address the main problem sources at an affordable cost

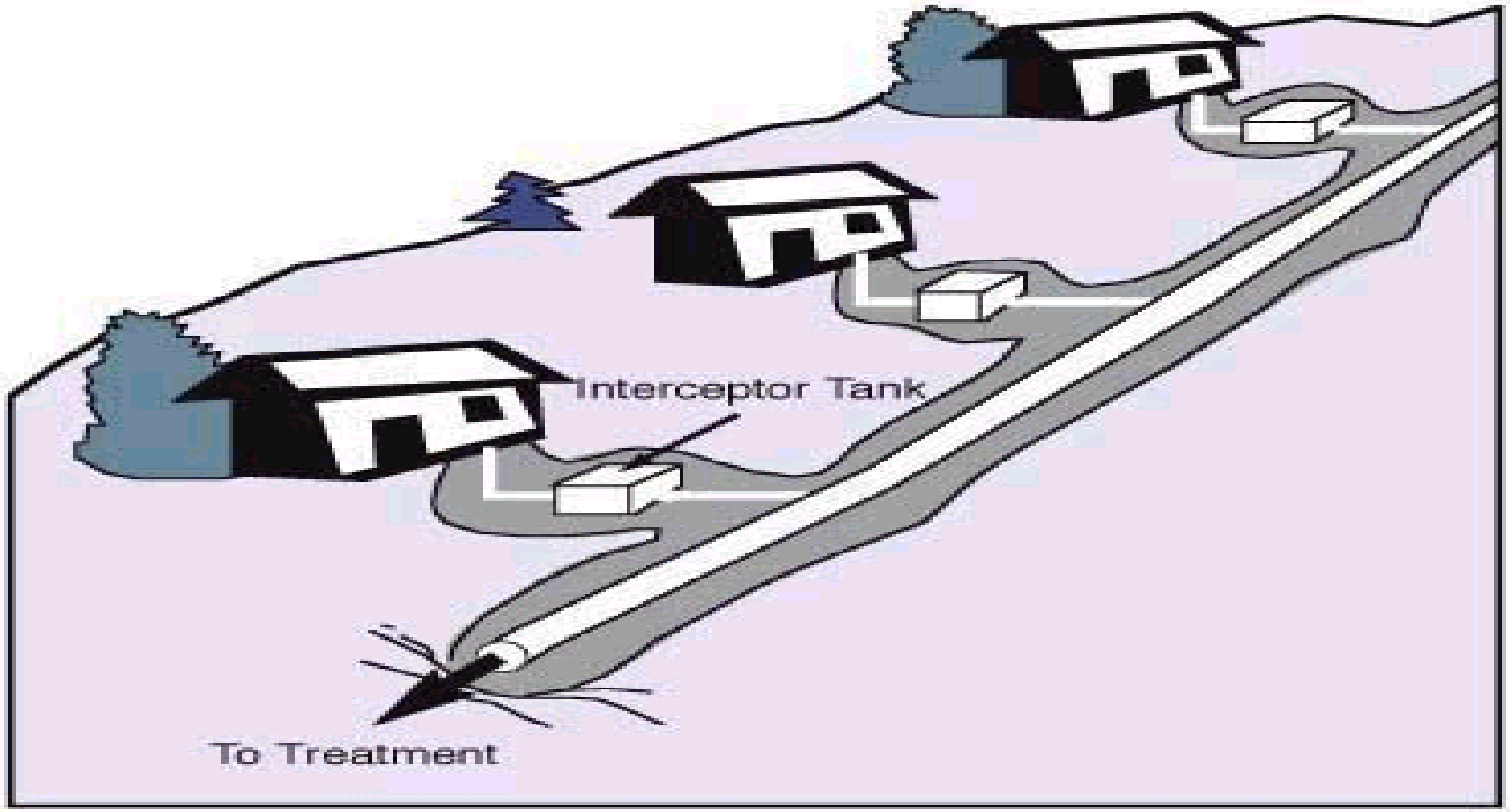
LOW-COST COLLECTION SYSTEMS

- These collection systems all consist of shallowly-buried plastic pipes, low-cost cleanouts instead of frequent/costly manholes, and a minimum number (if any) of lift stations
- They have 40 years of successful experience in the US and worldwide (less I/I, exfiltration, construction duration and disruption)
- Their management requirements are equal or lower than conventional gravity sewers (depends on number of lift stations)

EFFLUENT SEWERS

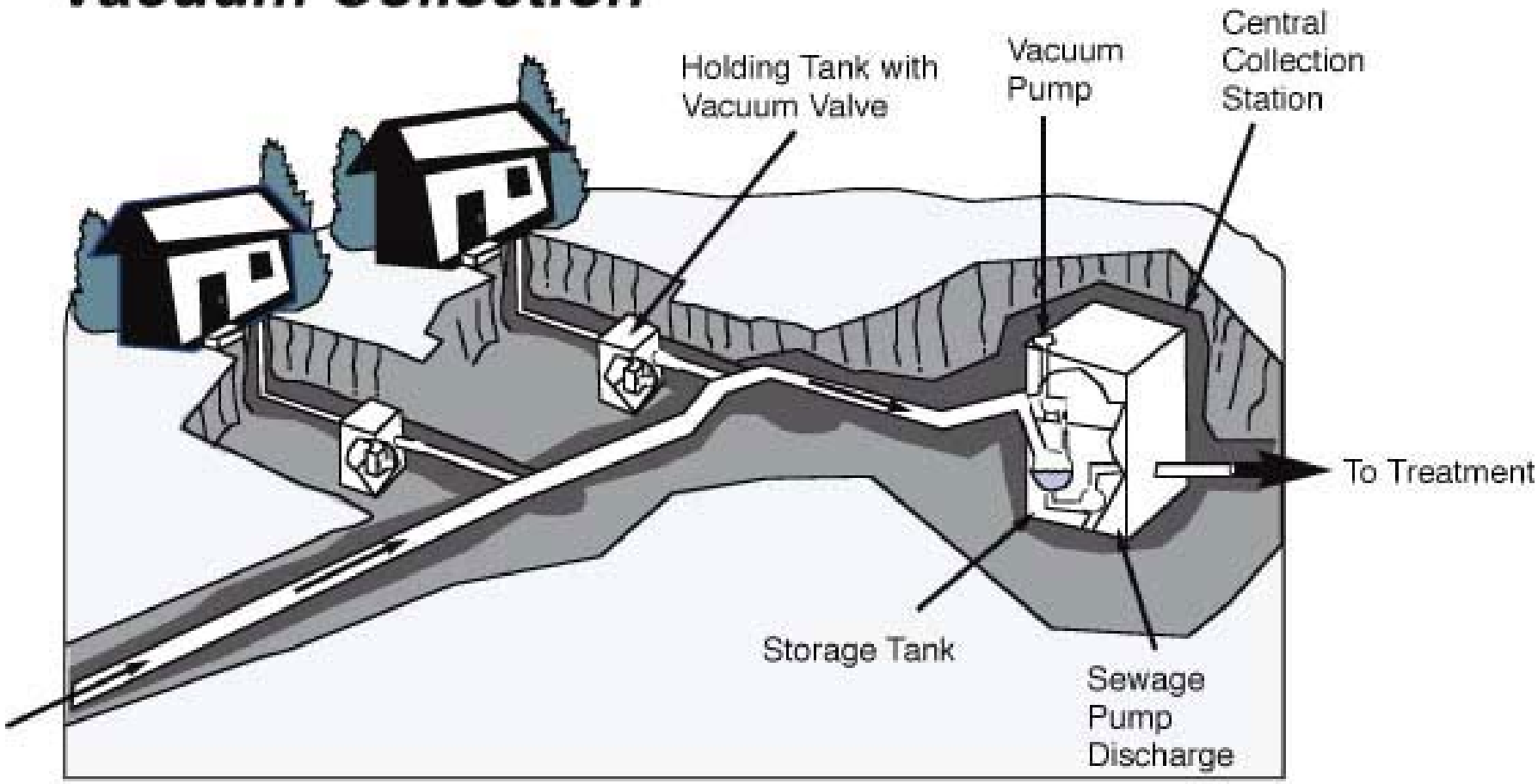
- Septic Tank Effluent Gravity (STEG) Sewers
  - "Small Diameter Gravity Sewers"
  - "Small-Bore Sewers"
- Septic Tank Effluent Pressure (STEP) Sewers

Small-diameter Collection



A **small-diameter collection system** is made up of interceptor tanks, service lines, and small-diameter collection mains. The interceptor tanks, similar to septic tanks and located upstream of each connection, remove grease and settleable solids from the raw wastewater. The settled wastewater is discharged from each tank first into the service laterals and then into the gravity collector mains. The mains transport the effluent to a treatment facility or connection with a conventional collection system. Other names for small-diameter collection systems include variable-grade effluent sewer (VGES), septic tank effluent gravity (STEG), and small bore collection.

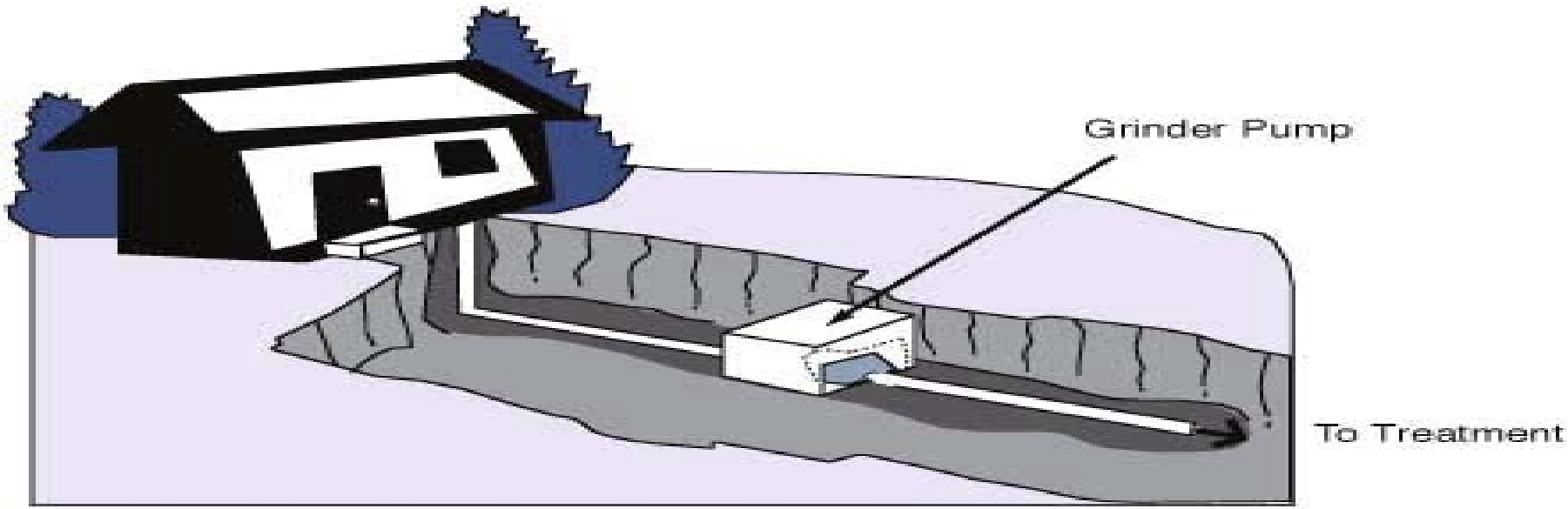
Vacuum Collection



A **vacuum collection system** is composed of holding tanks, collection mains, and a central collection station. Wastewater from each home flows by gravity to a holding tank. Generally, when 10-15 gallons of wastewater accumulate in the tank, a vacuum interface valve opens, allowing the wastewater to be drawn into the main pipe leading to the central collection station. When wastewater in the central collection station reaches a certain volume, it is transferred by pump to a treatment plant or conventional collection system.

GRINDER PUMP PRESSURE SYSTEM

Pressure Collection



Pressure collection is a small- diameter pressurized pipeline, buried below the frost line, following the land contour. Normally, either a grinder pump or septic tank effluent pump (STEP) is used to discharge the wastewater to the pressure main whereby it is conveyed to a central treatment facility. A grinder pump is a small pump located in a tank/vault outside the house that grinds the solids in the wastewater into a slurry and after a predetermined level has been reached in the tank ,then discharges the slurry to a pressure sewer. The STEP system uses a septic tank to remove the solids, grit, grease, etc., with the pump conveying the effluent to a centralized collection system.

WHAT DO THESE DECENTRALIZED TECHNOLOGIES HAVE IN COMMON?

- They all require management to assure proper operation….no more free ride
- The more complex onsite systems require at least 4 visits per year, less complex 1 to 2.
- The cluster systems of any significant size require oversight and management.
- Management can be public, private or a combination of both

CONCLUSIONS

- The traditional paradigm for smaller communities must be revised to include full consideration of decentralized approaches to solving wastewater problems
- However, it cannot be overstated that such solutions must have appropriate management arrangements, just as the conventional engineering solutions have